

single-family courtyard house /

Traditional Influence on the Contemporary

<i>Project Statement</i>	01
<i>Goals and Principles</i>	02
<i>Courtyard</i>	03
<i>Malqaf- wind tower</i>	11
<i>Mashrabiya- screen</i>	15
<i>Thermal mass</i>	17
<i>Materiality</i>	20
<i>Boundary</i>	22
<i>Climate</i>	24
<i>Program</i>	27
<i>Sites</i>	33
<i>Urban site</i>	38
<i>Suburban site</i>	60
<i>Detail</i>	83
<i>Precedents</i>	84
<i>References + Bibliography</i>	95

Table of Contents

Project Topic:

Contemporary single-family courtyard house.

Elevator Statement:

Reintroducing the courtyard concept in contemporary housing typology that addresses energy and human comfort in the surrounding environment.

Case Statement:

In older traditional Middle Eastern residences, the courtyard was the focal point of the house. It is an architectural form of major importance in traditional houses in hot, dry climates. Most, if not all, rooms of the house had a direct connection with the courtyard. Courtyards served privacy purposes where they decreased interior-exterior connections but increased interior-interior connections; they maximized interior relationships and openness while keeping the outside separate. They helped create an interior garden while respecting privacy values of the culture by having no exterior or street view from the courtyard itself. Not only were courtyards used as social family gathering spaces, they were also a source of air flow and thermal comfort to the residence. A fountain was usually located in the center of the courtyard as an artistic element as well as to control climate. Courtyards are convenient outdoor spaces that positively affect microclimate and indoor thermal conditions.

By studying older/traditional Middle Eastern courtyard houses and the advantages the courtyard brought to the living quality of the house, this project proposes a contemporary design that uses the benefits of the courtyard while catering for today's families. It also incorporates other traditional elements such as the screen to provide a breeze while obstructing the visual connection, and the wind tower which circulates the air and increases human comfort in the hot summer days. By reintroducing these elements through a study of dwellers' needs and their locale, the project will bring back the relationship between nature, architecture and inhabitant comfort, as well as create a strong relationship between inside and out.

Goal Statements and Guiding Principles:

Contemporary living in a redefined traditional Middle Eastern courtyard dwelling.

Traditional courtyard integrated within the contemporary house with appropriate local materials to provide a strong and viable courtyard home model

Human comfort due to the courtyard.

Energy use, human comfort and affordability catering for today's family needs.

Design tactics that address family ties and privacy through the balancing of collective family needs with individual privacy needs.

Promote natural systems and energy efficiency.

Decrease reliability on energy consuming mechanical systems and using the courtyard to provide seasonal and temporal comfort.

Design Response:

Reinterpret the exterior courtyard and integrate it with the house.

Modify special adjacencies for maximum use of courtyard.

Provide privacy and comfort through air, light and security.

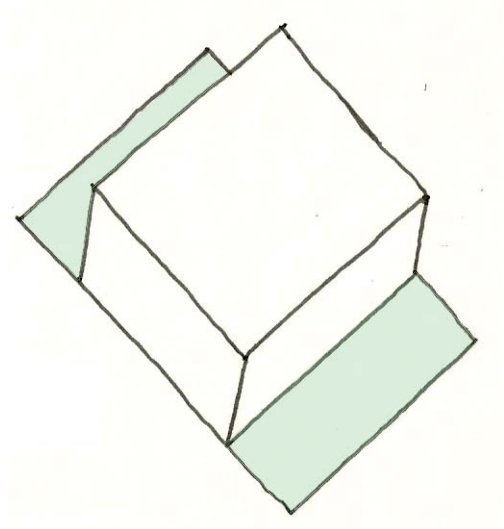
Maximize air quality and inhabitant comfort through the use of the courtyard and its components.

Use modern building techniques with traditional residential elements to create an affordable, energy efficient and durable home.

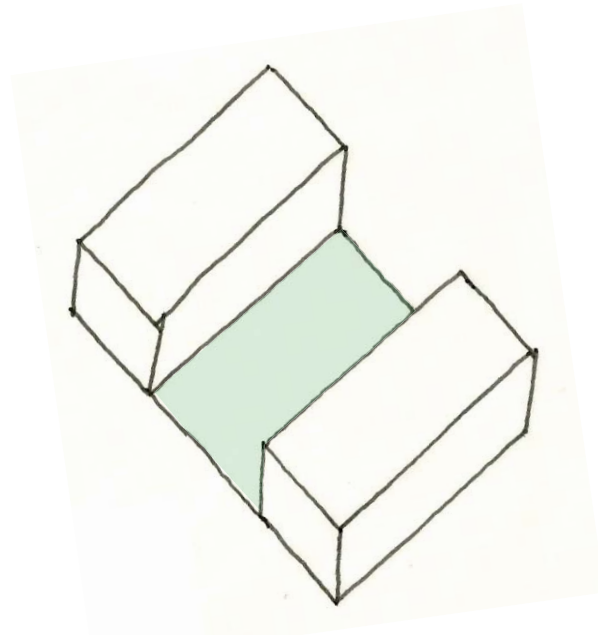


Nina Mahab
CENTRAL COURTYARD
ПРОЕКТ № 39 Studio Max
ПРОЕКТ И РЕШЕНИЕ В УРАУ
И НАЗНАЧЕНИЕ ИЛИ РИТМОНА

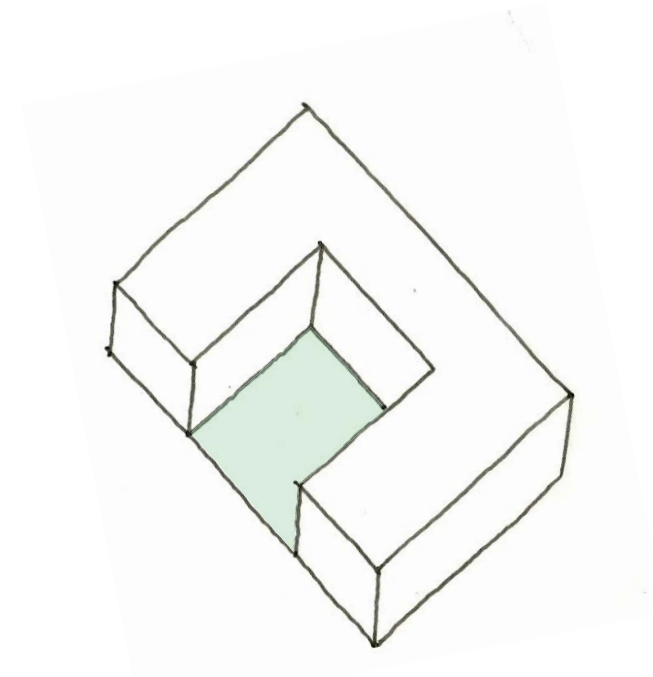
Courtyard: an enclosed court that is open to the sky. Thermal performance of a courtyard deals with heat exchange between the courtyard, the indoors and the outdoors.



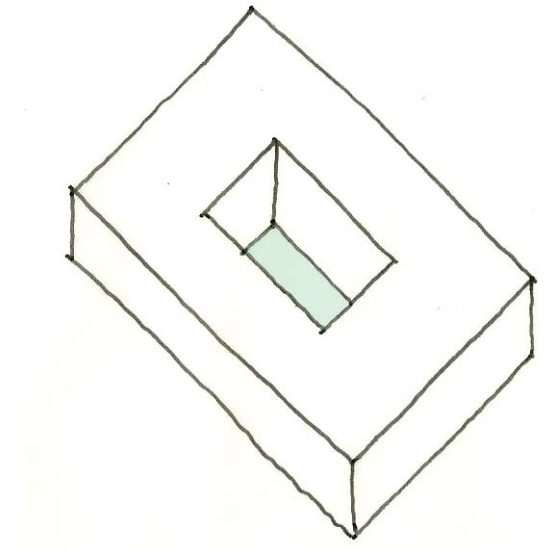
Central indoor living space with exterior open space on two or more sides.



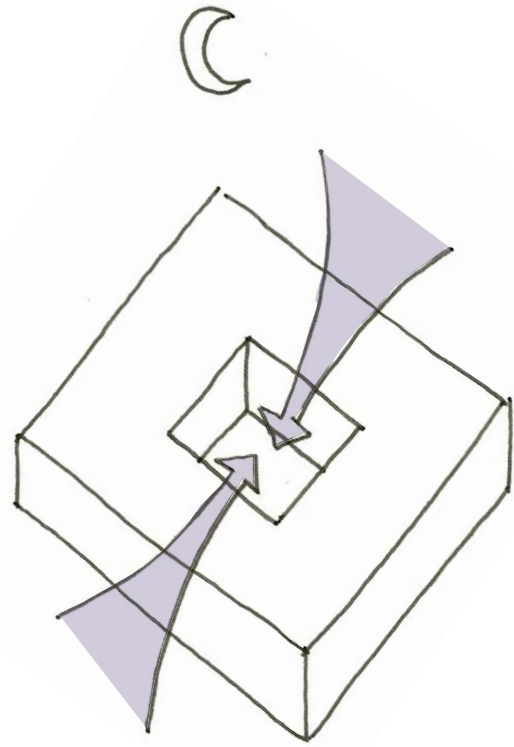
Courtyard cutting through house creating two strips of indoor living space with a central outdoor courtyard space.



Courtyard surrounded on three sides by interior living spaces.

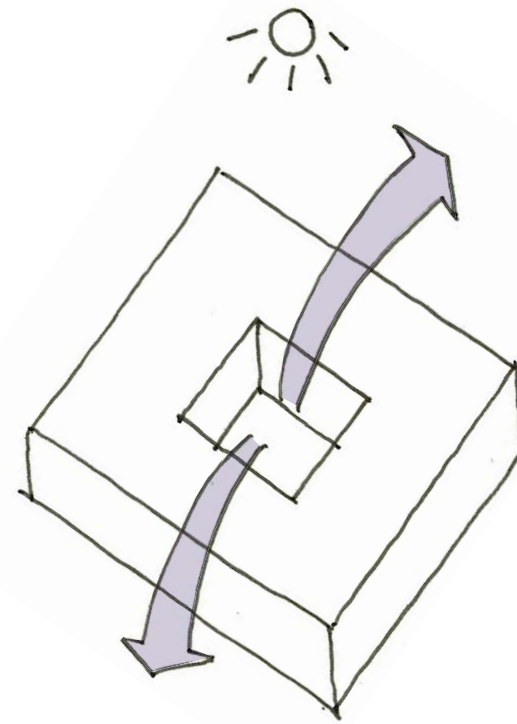


Courtyard surrounded on all sides by interior living spaces.



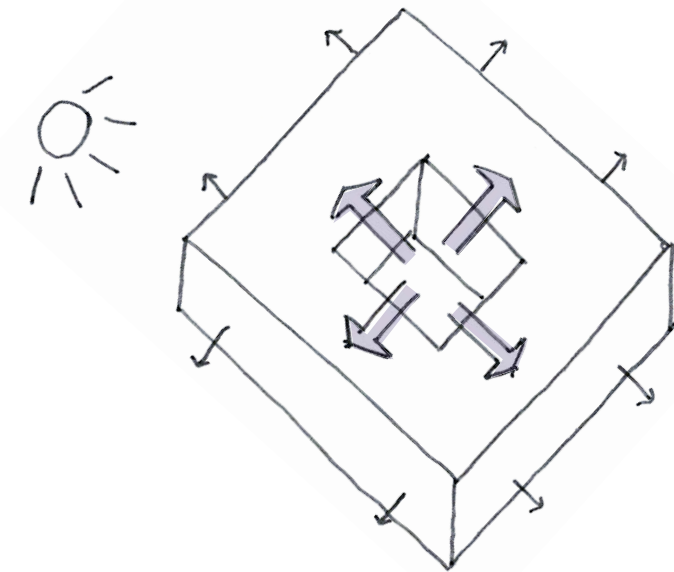
Phase 1

Cool night air descends into courtyard and fills surrounding rooms, walls, floors, roofs and ceiling which become cooled and remain so until the late afternoon. Once the sun is up, the courtyard loses heat by radiating it to the sky.



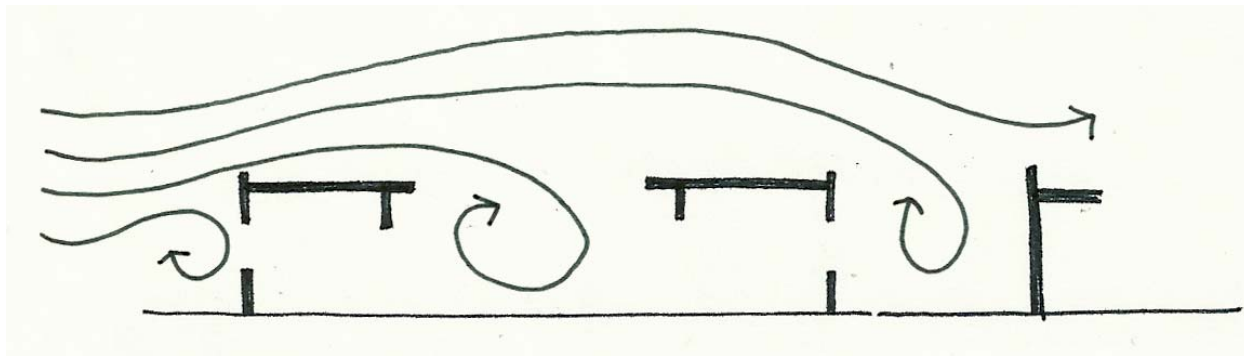
Phase 2

Once the sun strikes the courtyard directly around noon, the cool air starts to rise and leak out of rooms through convection. With the outdoor temperature rising, wall thickness and material prevent heat to penetrate through walls.

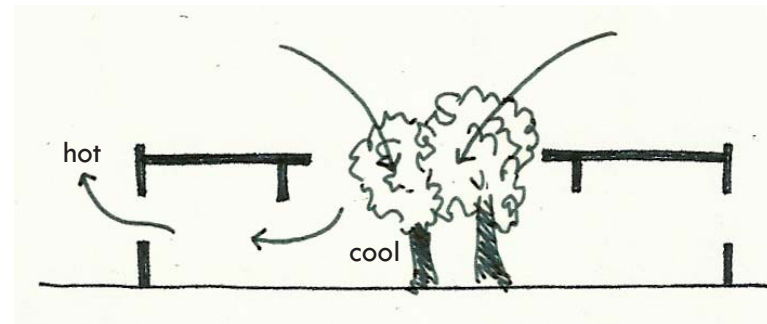


Phase 3

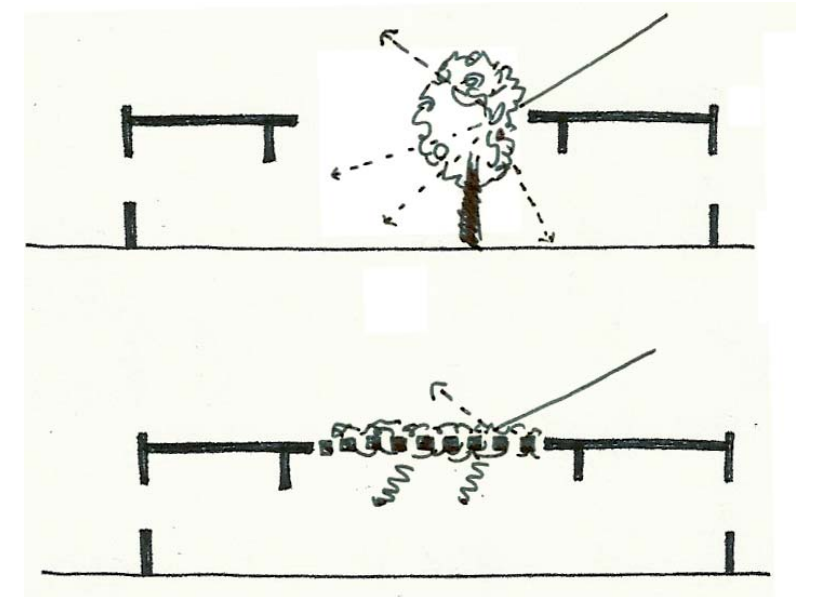
In the late afternoon, the courtyard floor and the interior of the house become warmer allowing for convection and heat exchange with the cool interior air.



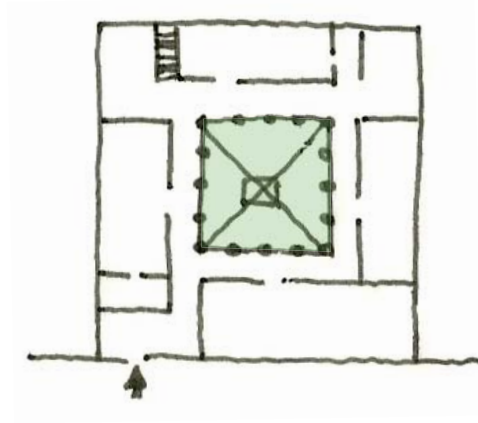
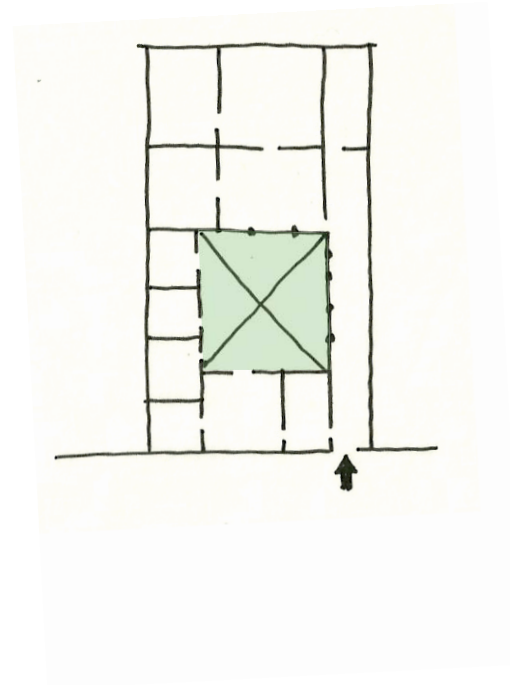
Orientation in regards to sun and wind



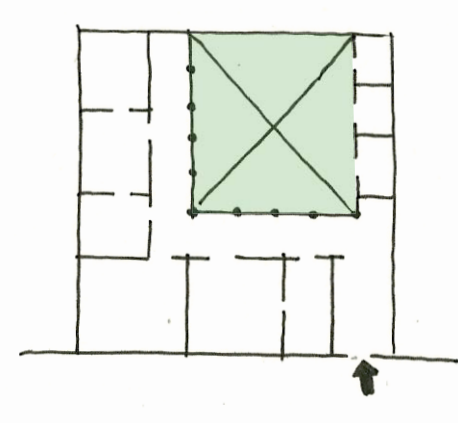
Ventilation through courtyard and the filtration of heat and sun through the use of vegetation



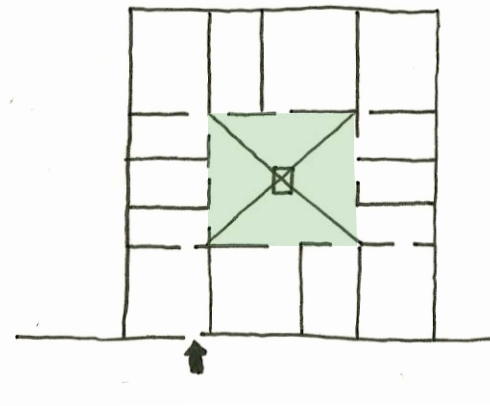
Using natural elements to create **shadow** in an open courtyard



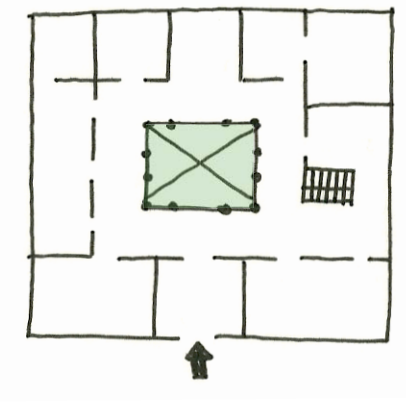
Morocco



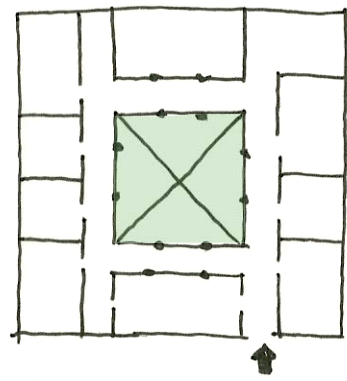
Colonial Latin America
(Venezuela)



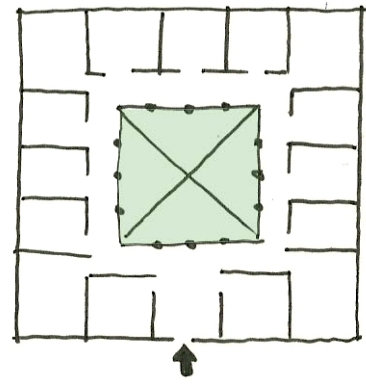
Ancient Egypt



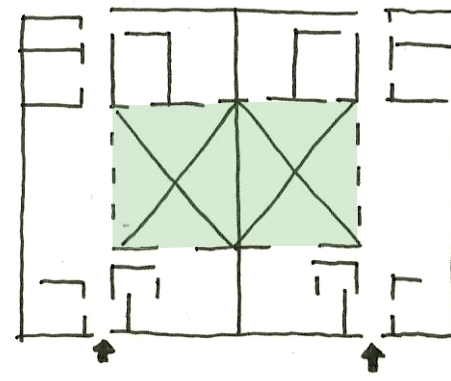
Hispanic



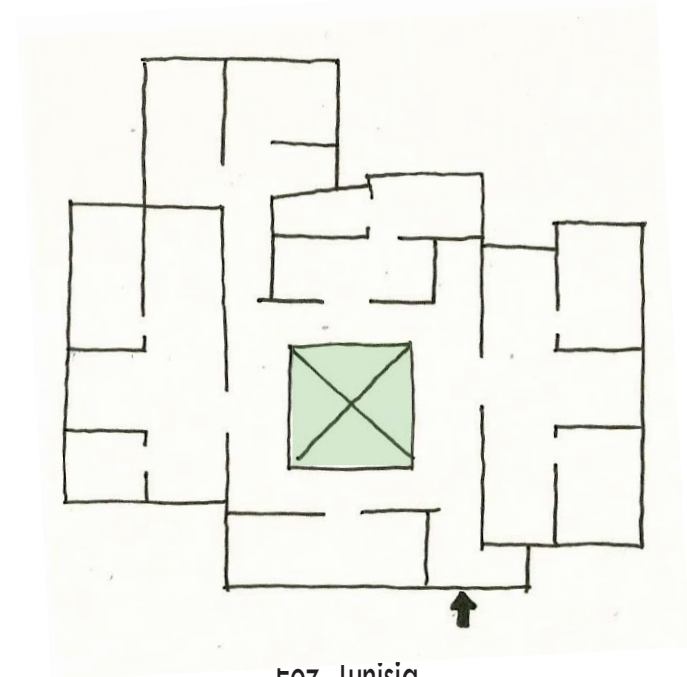
Iraq



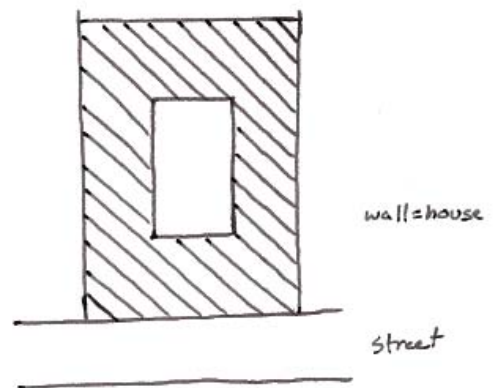
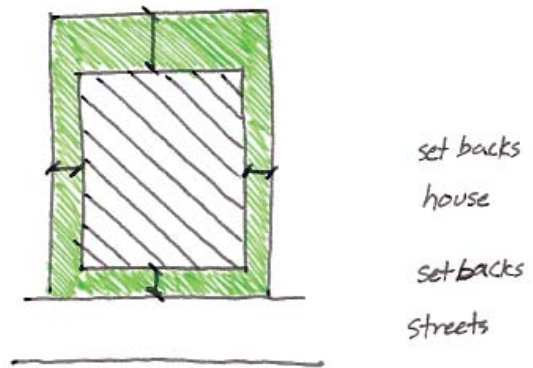
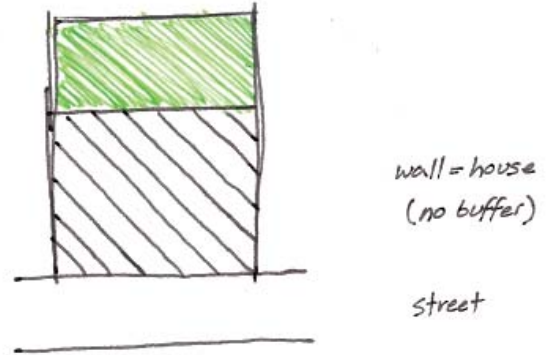
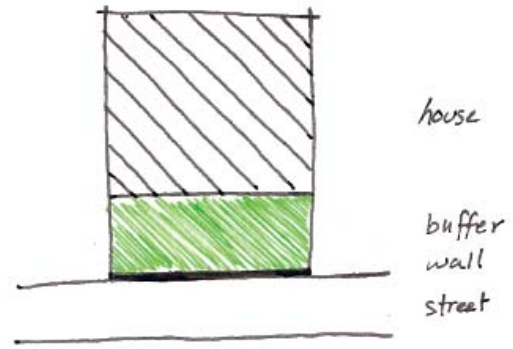
Syria

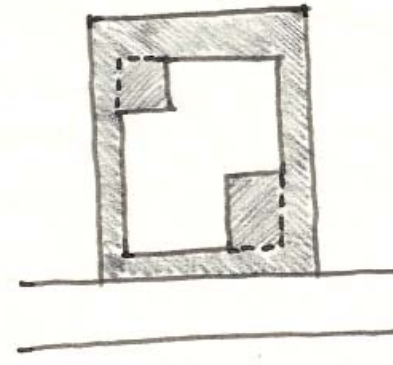
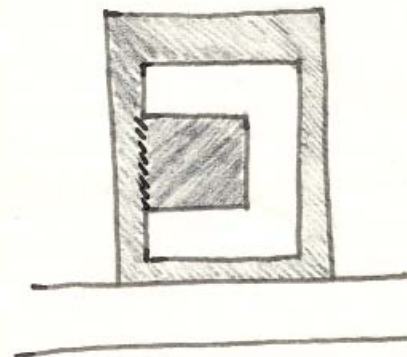
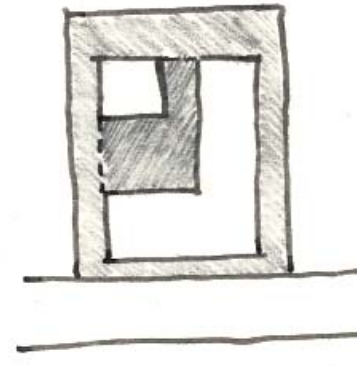
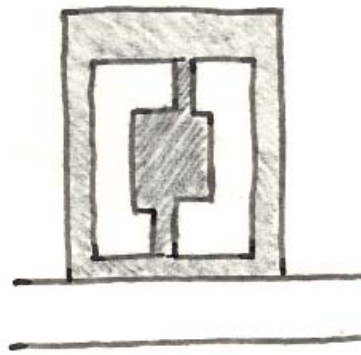
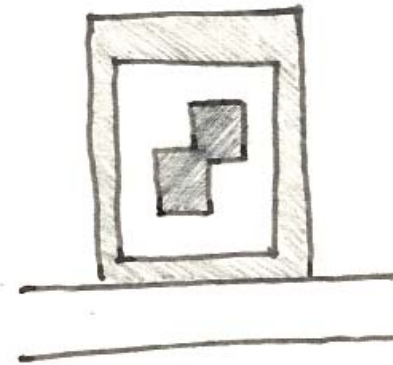
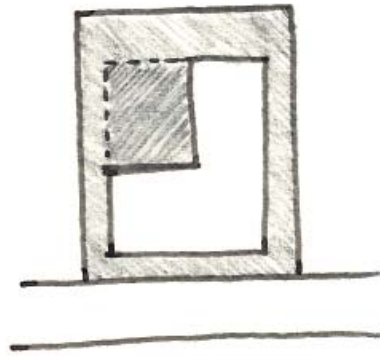
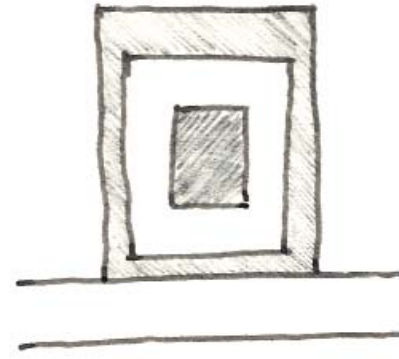
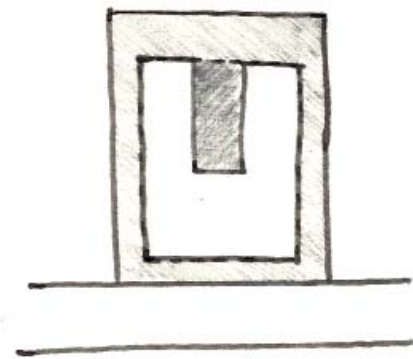


Plan of Chicago townhouses
Architect: Y.C. Wong, 1961



rez, lunisia



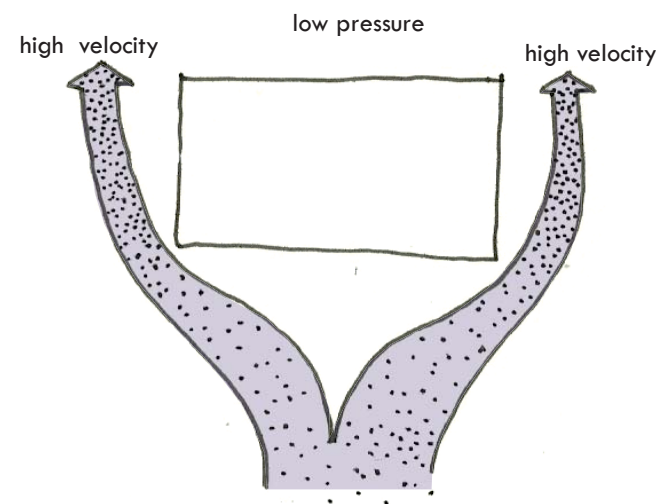




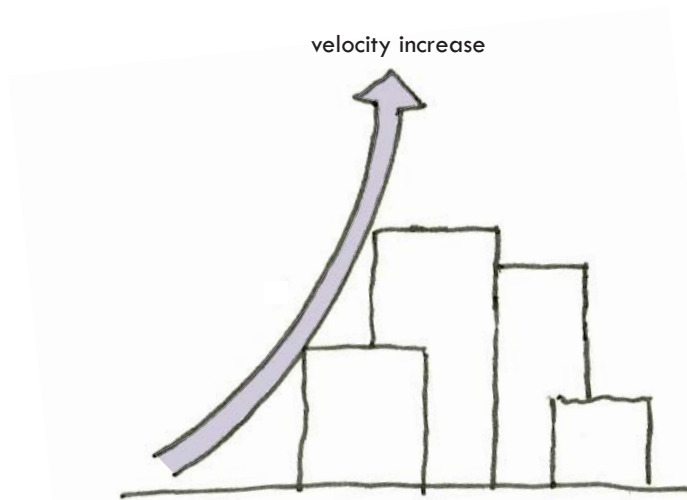
A courtyard is a horizontal aperture in which nature enters.



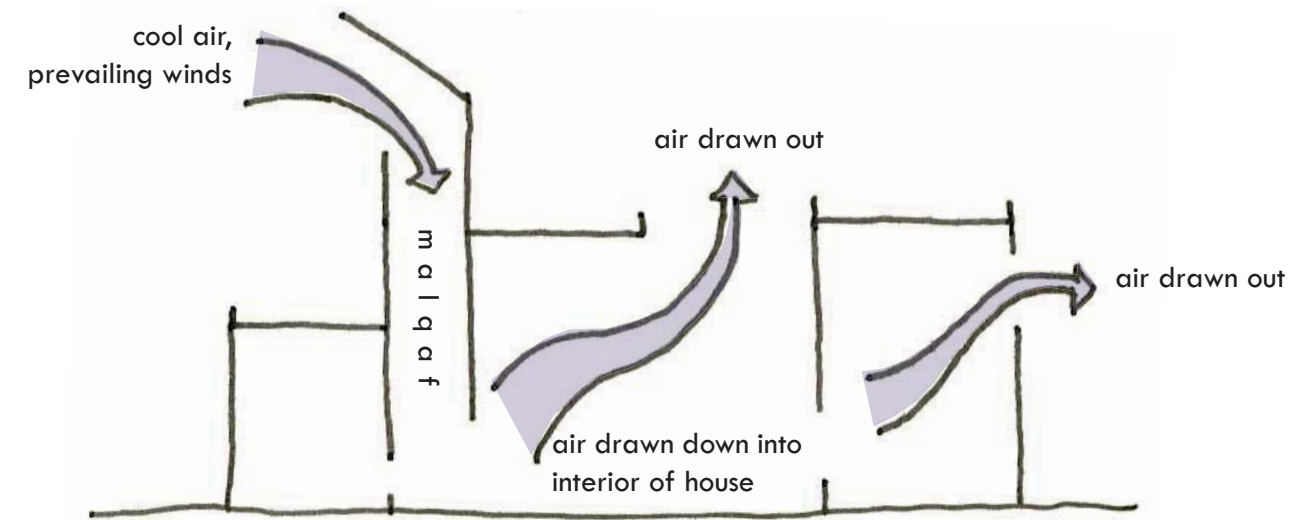
A shaft rising high above the building with uni or multi-directional openings facing the prevailing winds. It captures the wind from the top where it is cooler and stronger and channels it down into the interior of the building forcing it out through the openings. The malqaf can also act as a chimney where it sucks out the warm rising air out of the building and creates thermal comfort due to the air circulation and replacement.



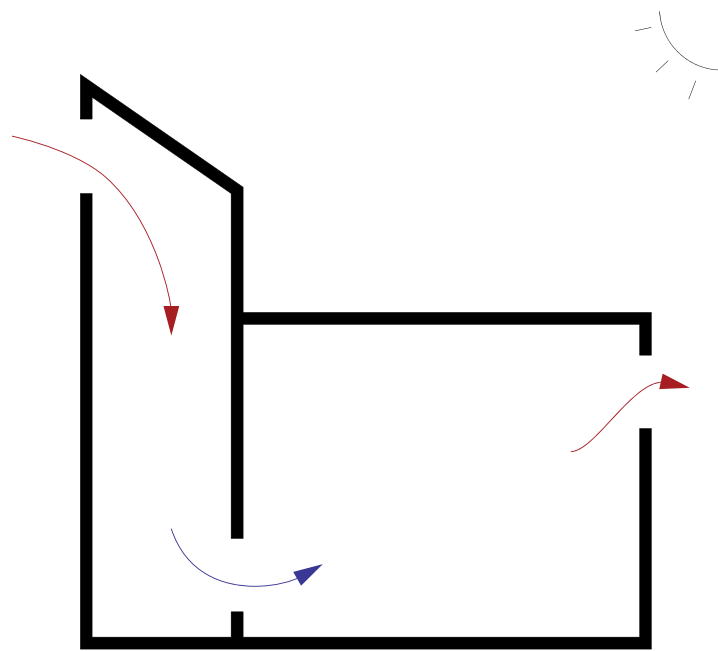
Plan



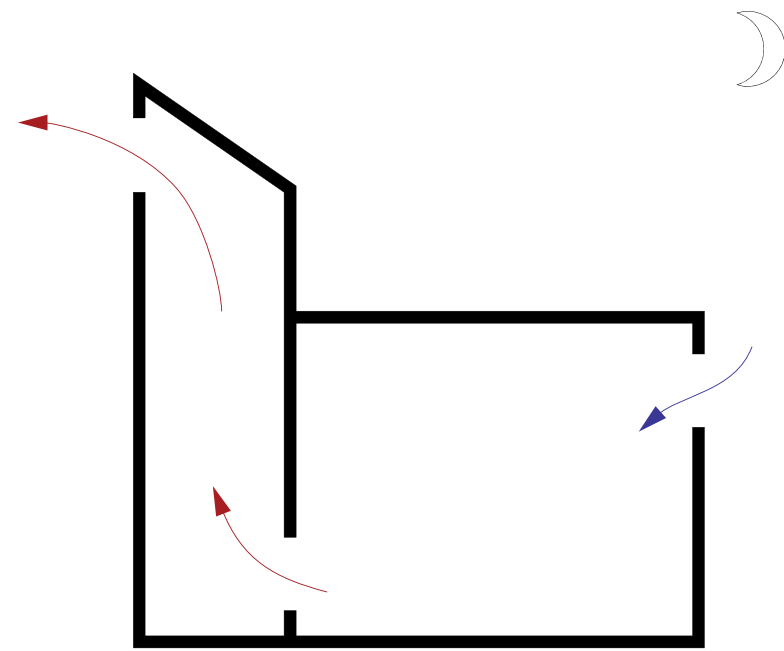
Elevation



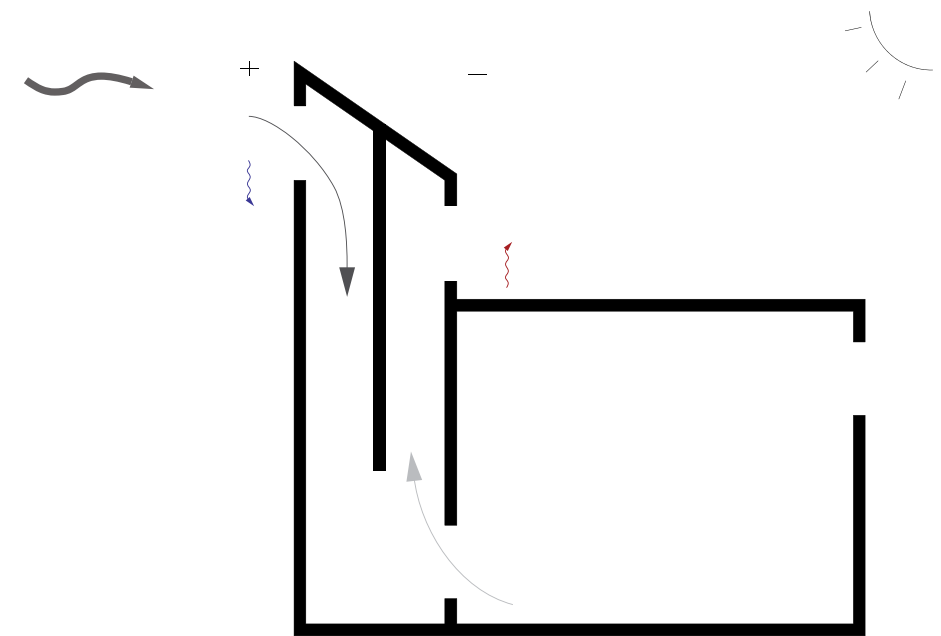
Section



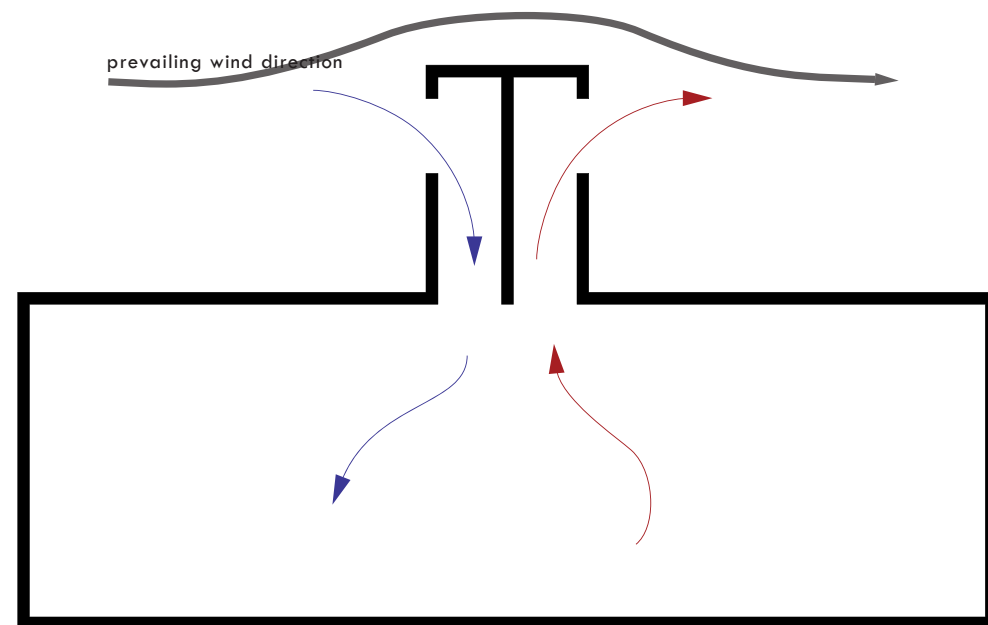
hot heavy air is cooled as it goes down the wind tower, cools the space, then raises at it gains heat and exits through the window



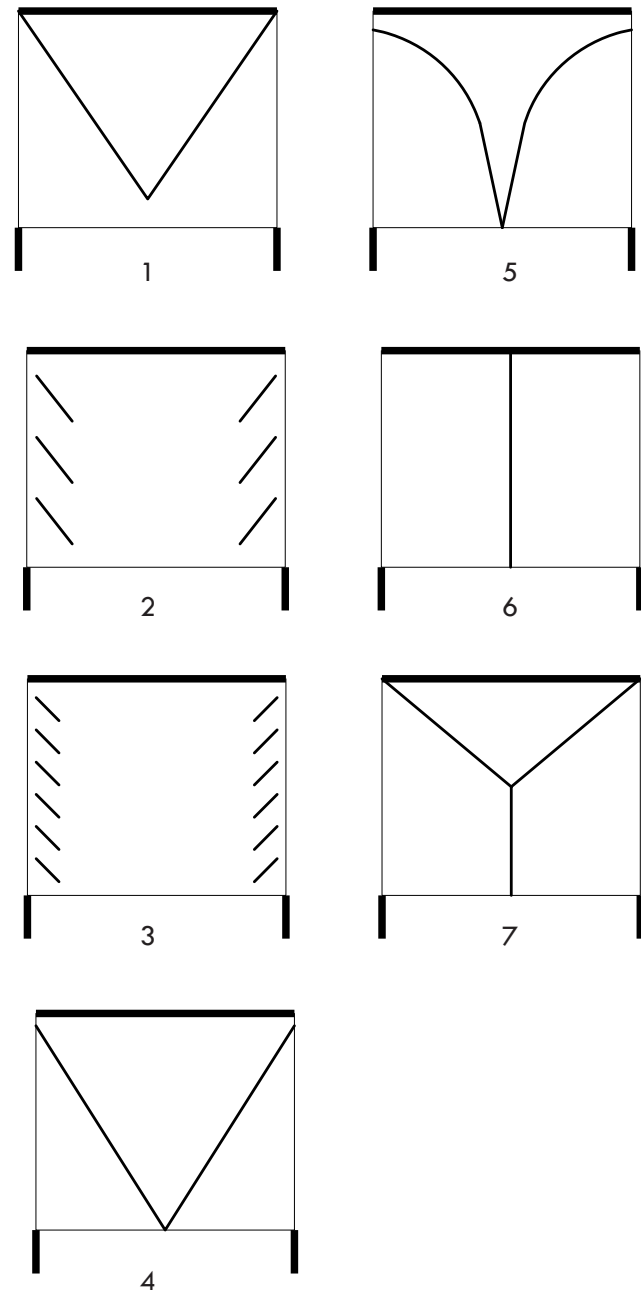
cool air enters through the window, cools the space then raises up the tower as it gains heat from the space



positive pressure and lower temperature are created at the wind side and negative pressure and higher temperature from the sun are created at the opposite side. venturi effect allows ventilation of the space through the wind tower



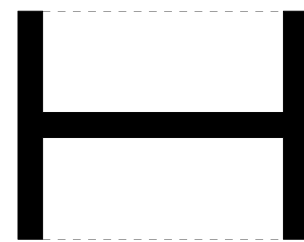
cool, fast moving air enters the tower, cools the space and is exhausted back up through the tower by the venturi effect



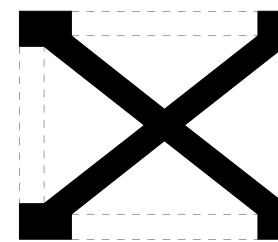
section/ malqaf configurations



one-faced, uni-directional

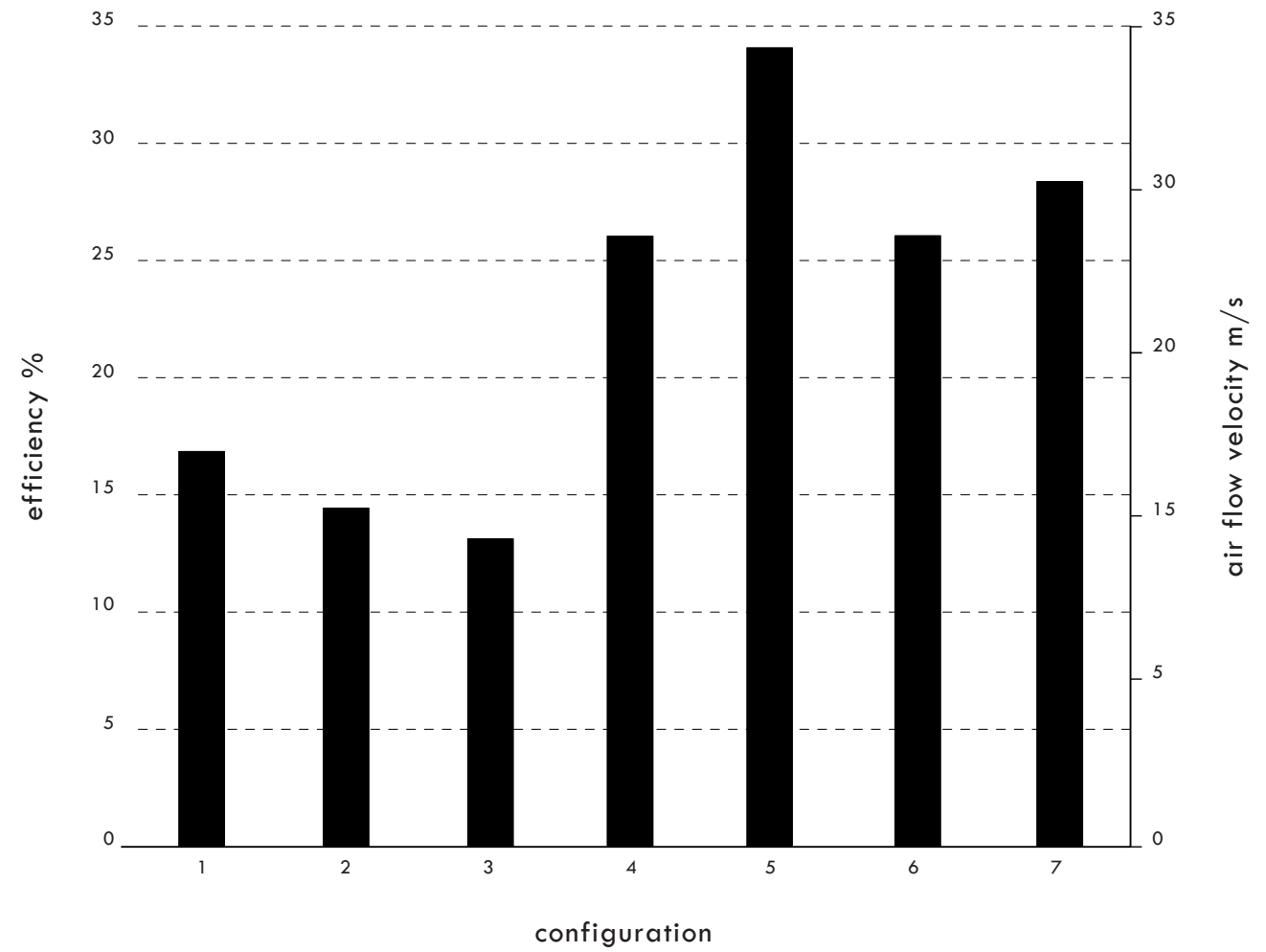


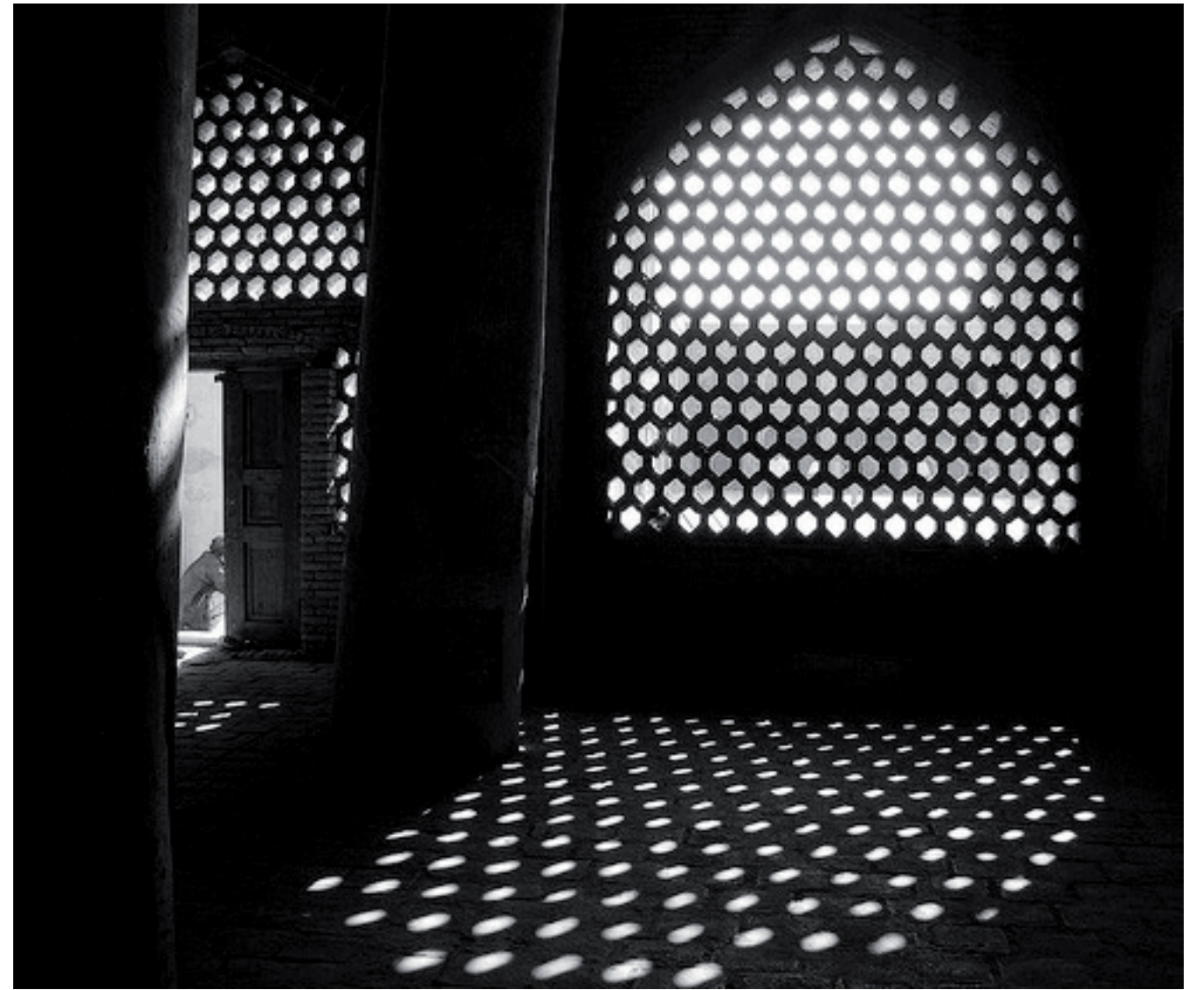
two-faced, dual-directional



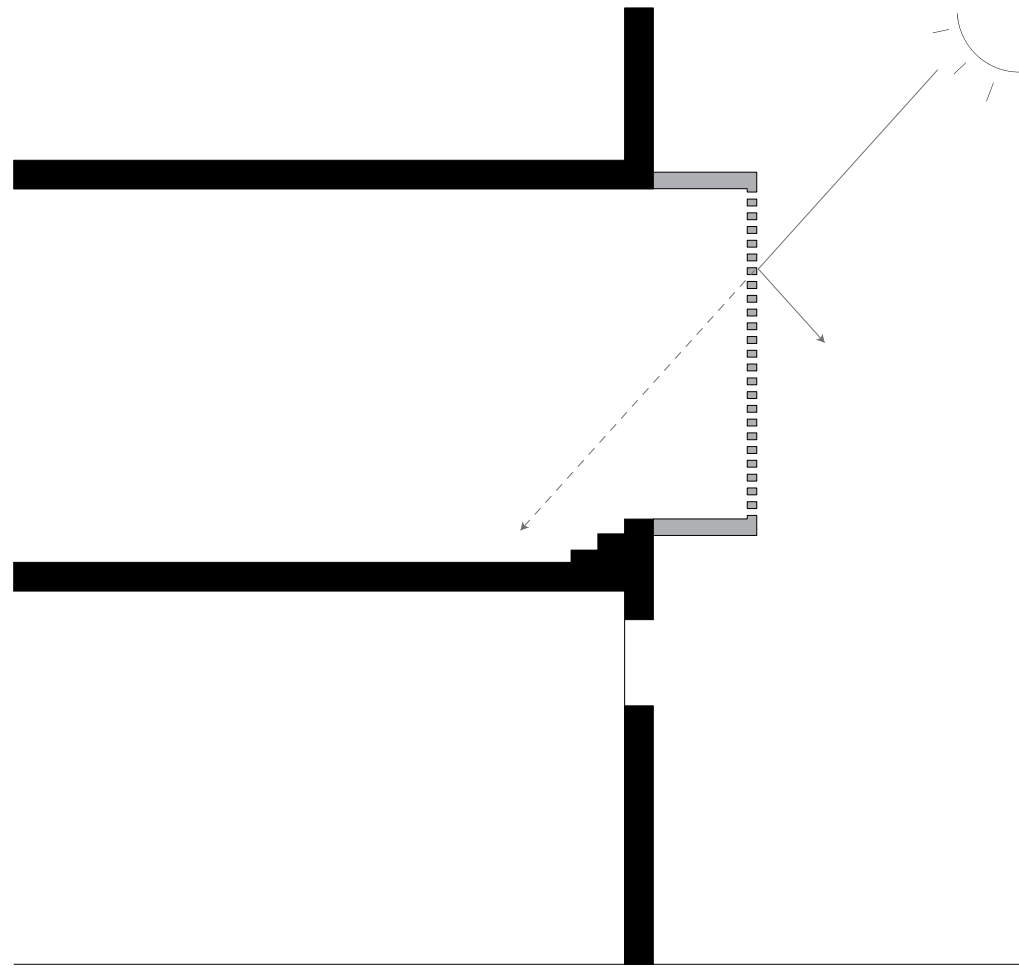
multi-faced, multi-directional

plan/ malqaf openings

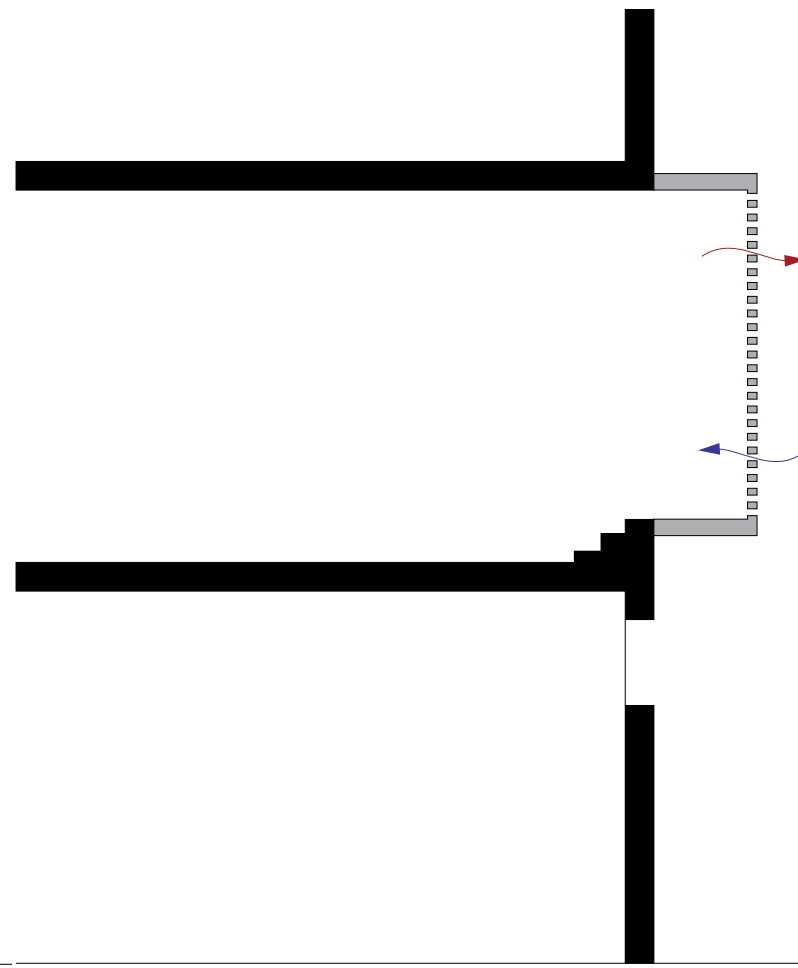




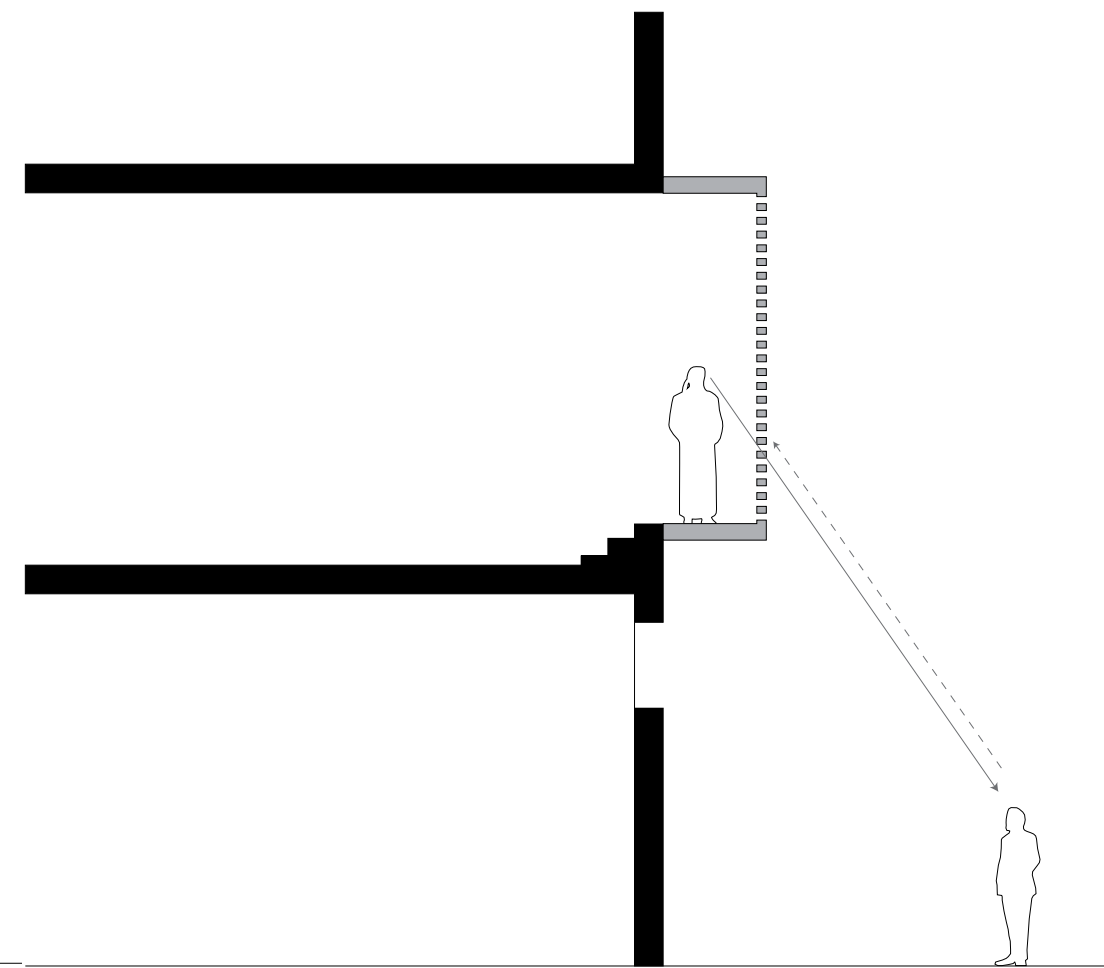
A mashrabiya controls the passage of light, controls the air flow, reduces the temperature of the air current and ensures privacy.



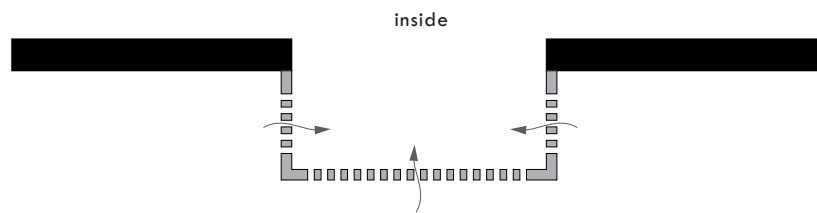
section/ the screen blocks the direct sun beams but allows for light to enter through the openings



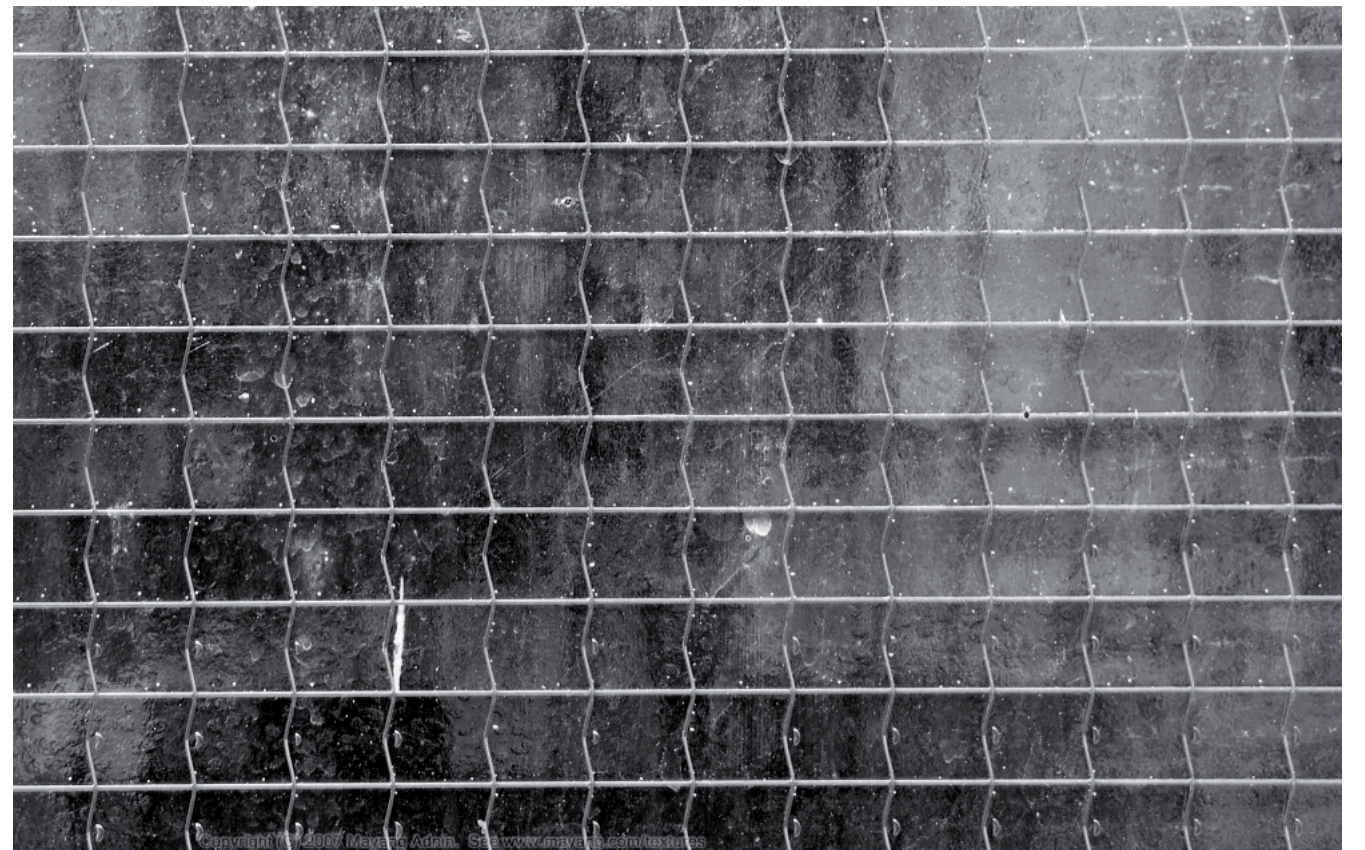
section/ the opening allows for air to flow: cooler outside air enters as the heated interior air exits

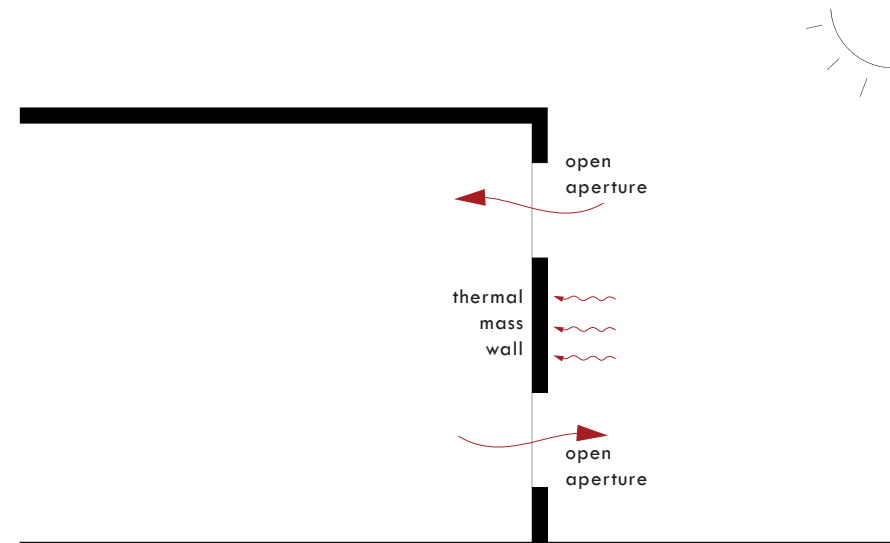


section/ the screen creates privacy from the exterior, yet allows for an interior-exterior visual connection

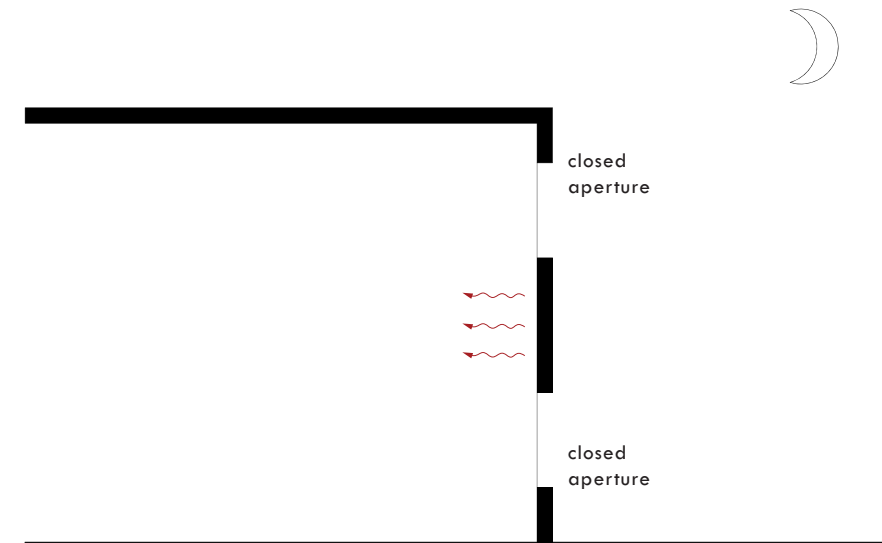


plan/ the screen is placed at a projecting oriel window to catch air flowing from three sides and parallel draughts

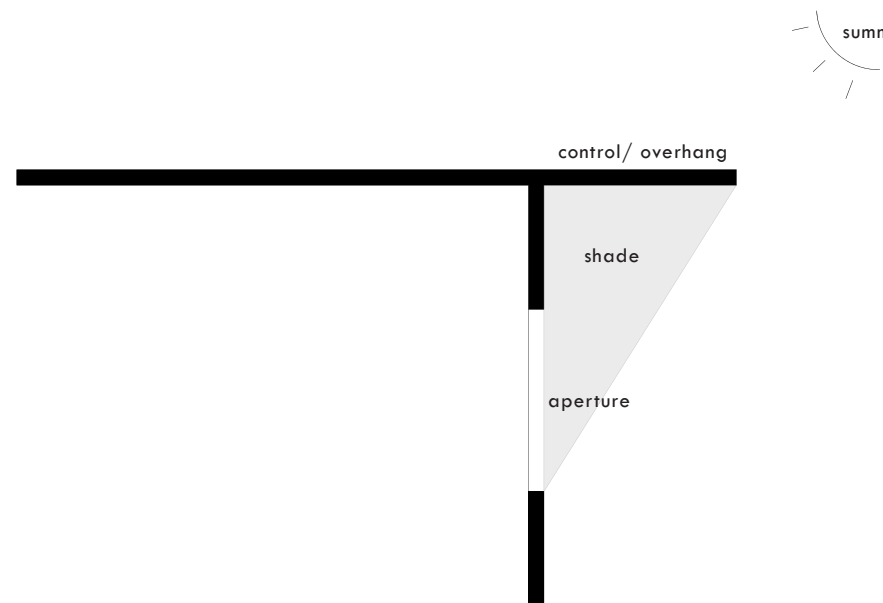




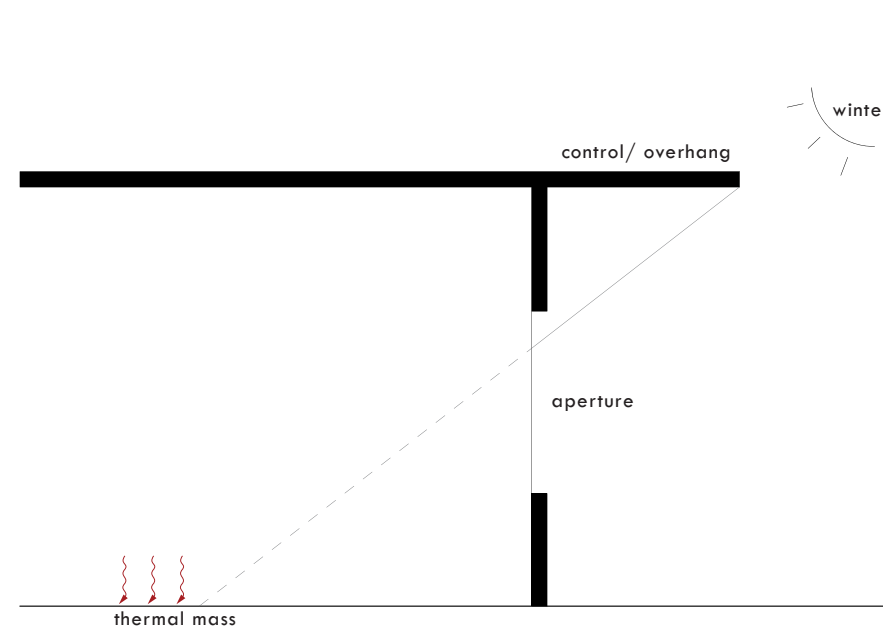
absorption of heat by thermal mass wall during the day



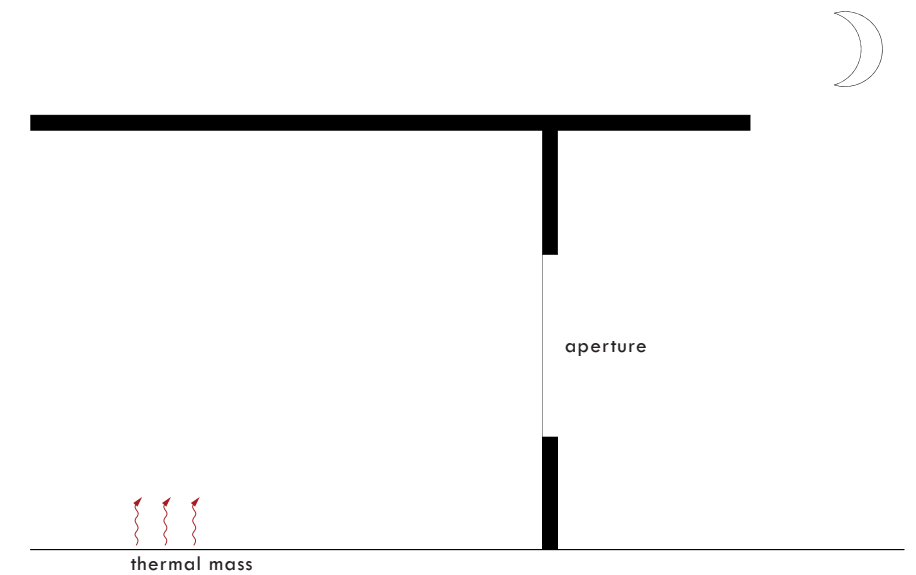
release of heat by thermal mass wall at night



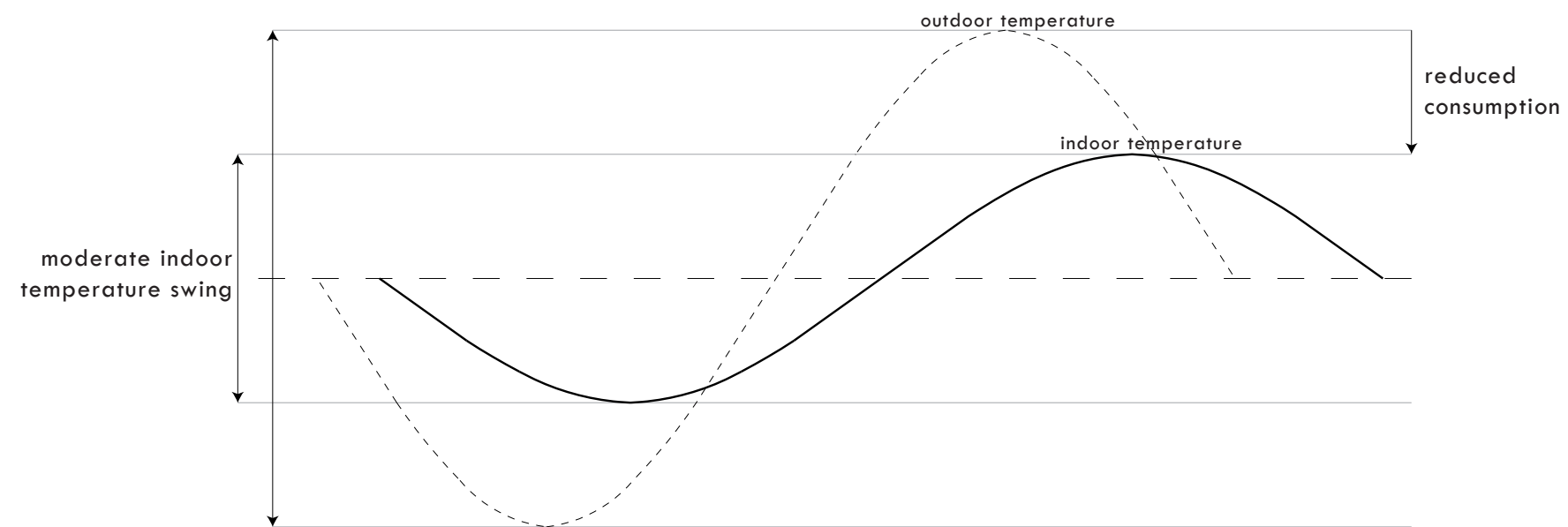
overhang to control direct sun exposure of summer sun angle



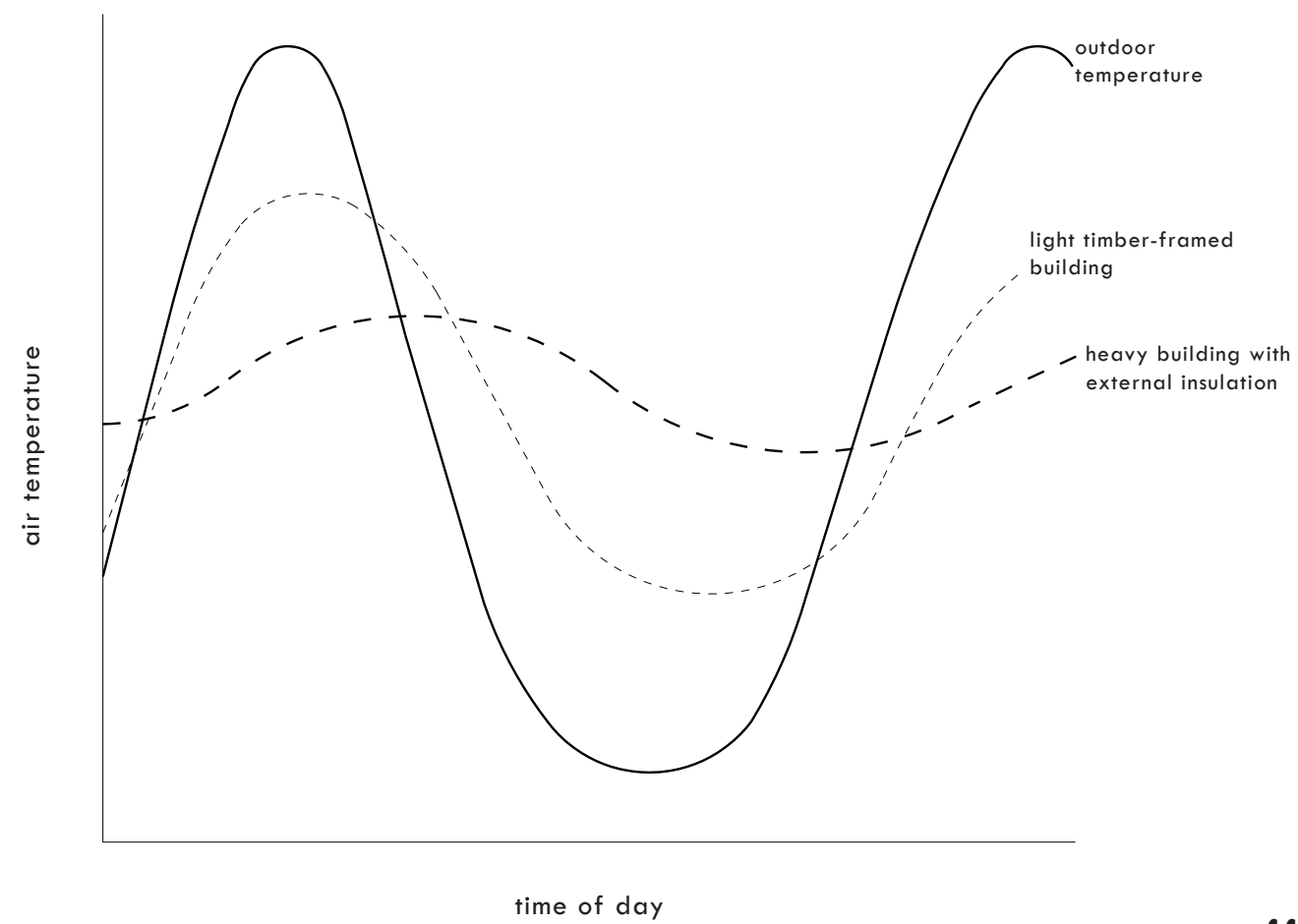
heat absorbed by thermal mass slab exposed to winter sun angle during the day



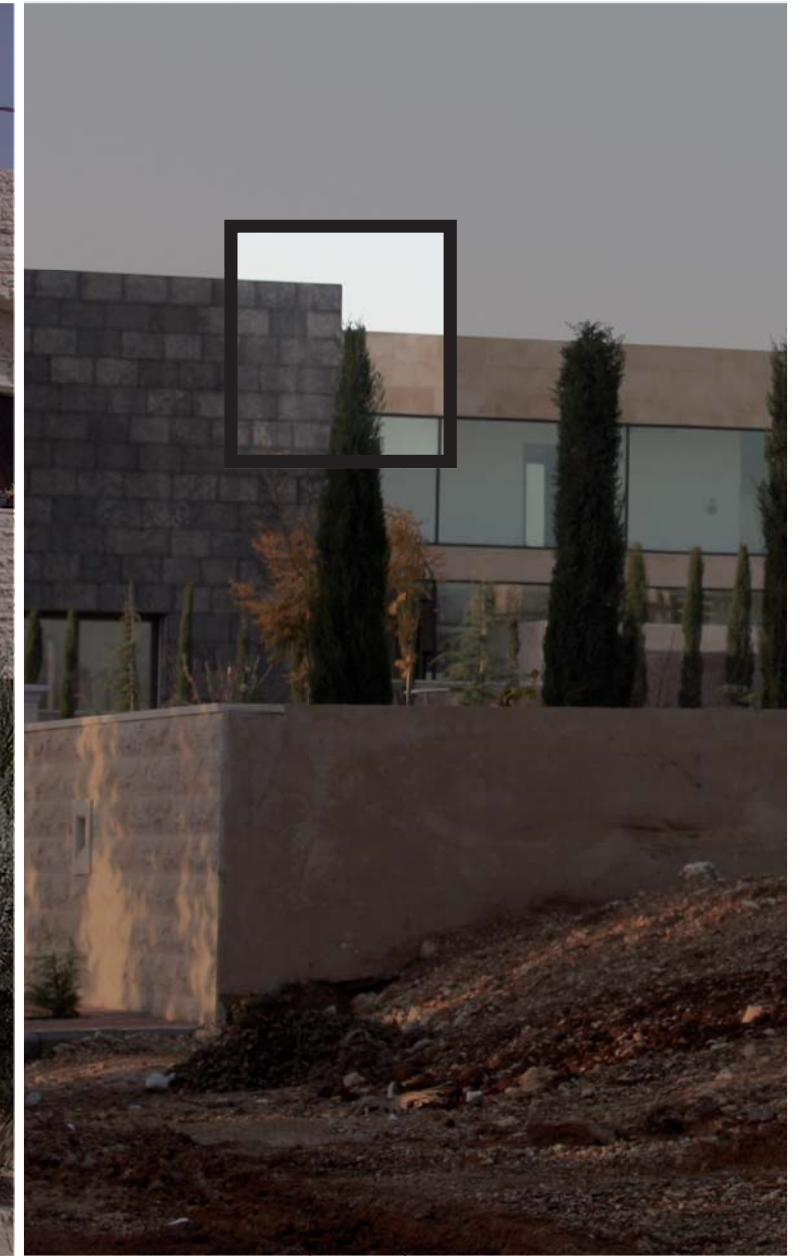
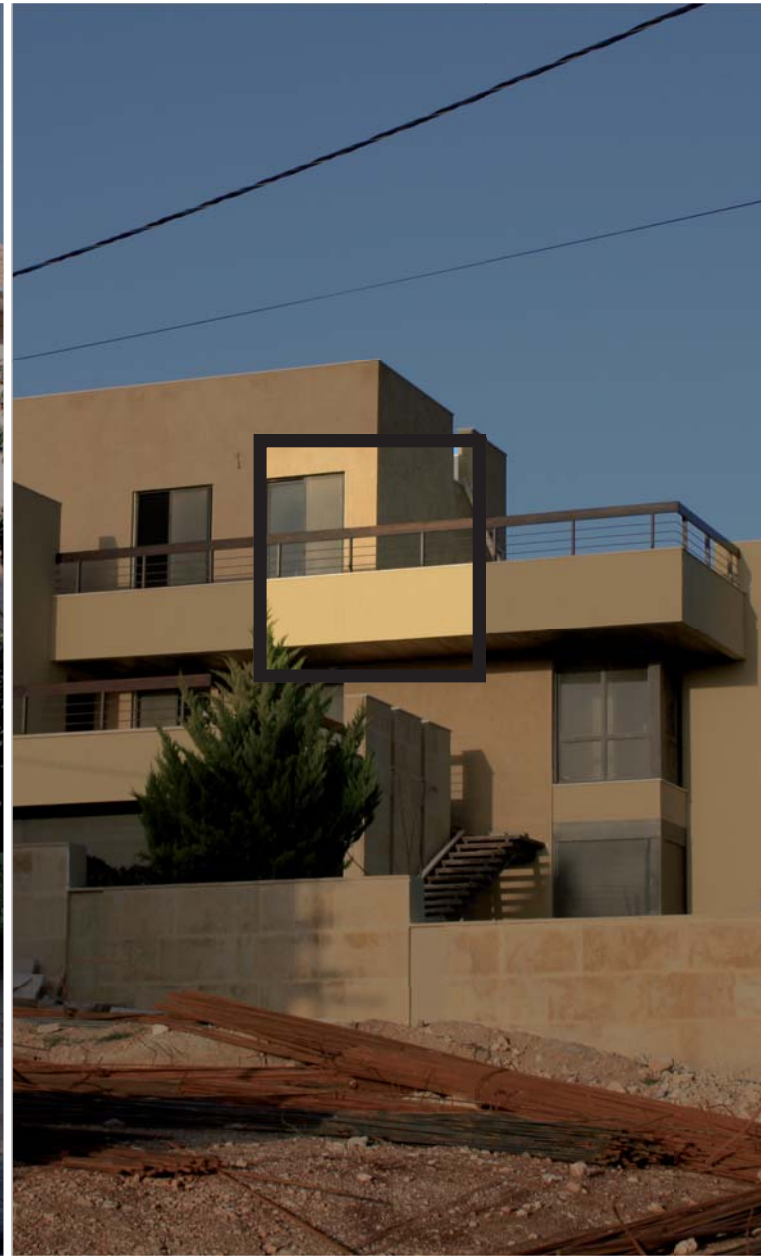
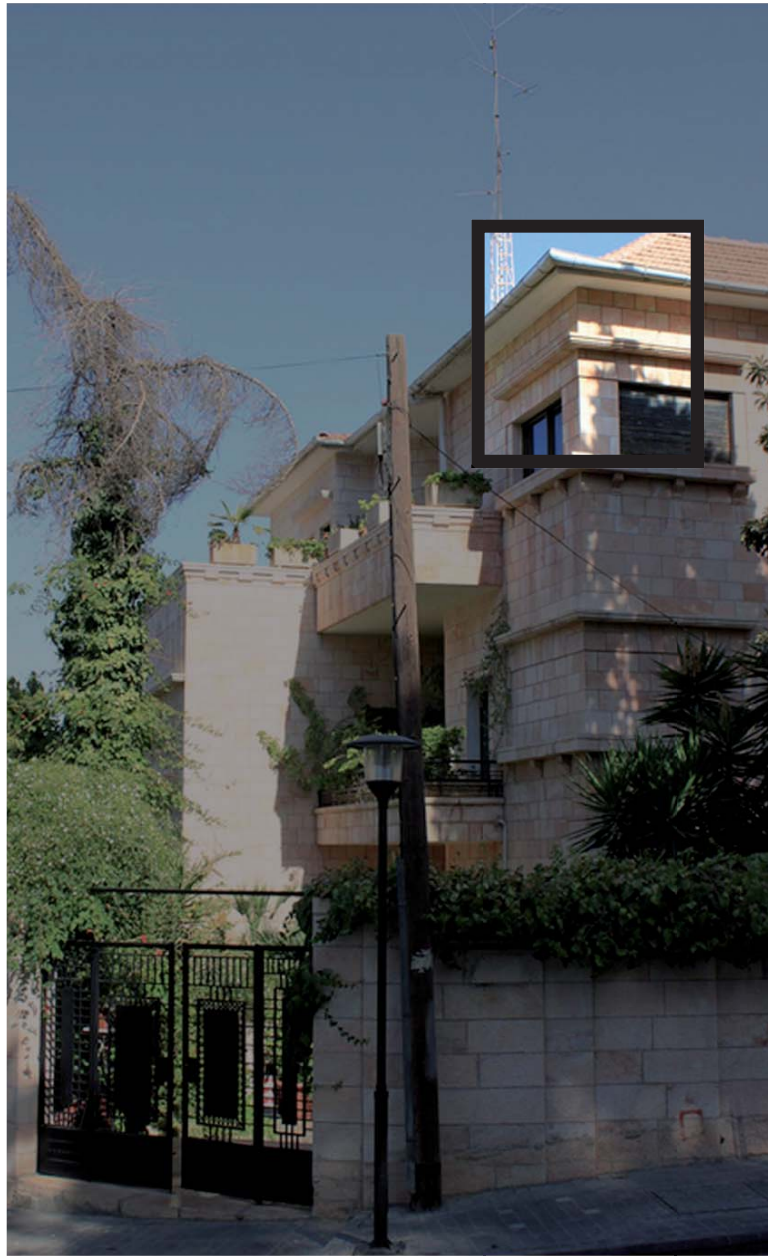
heat release of thermal mass to the space during the night



thermal mass effects on building envelope



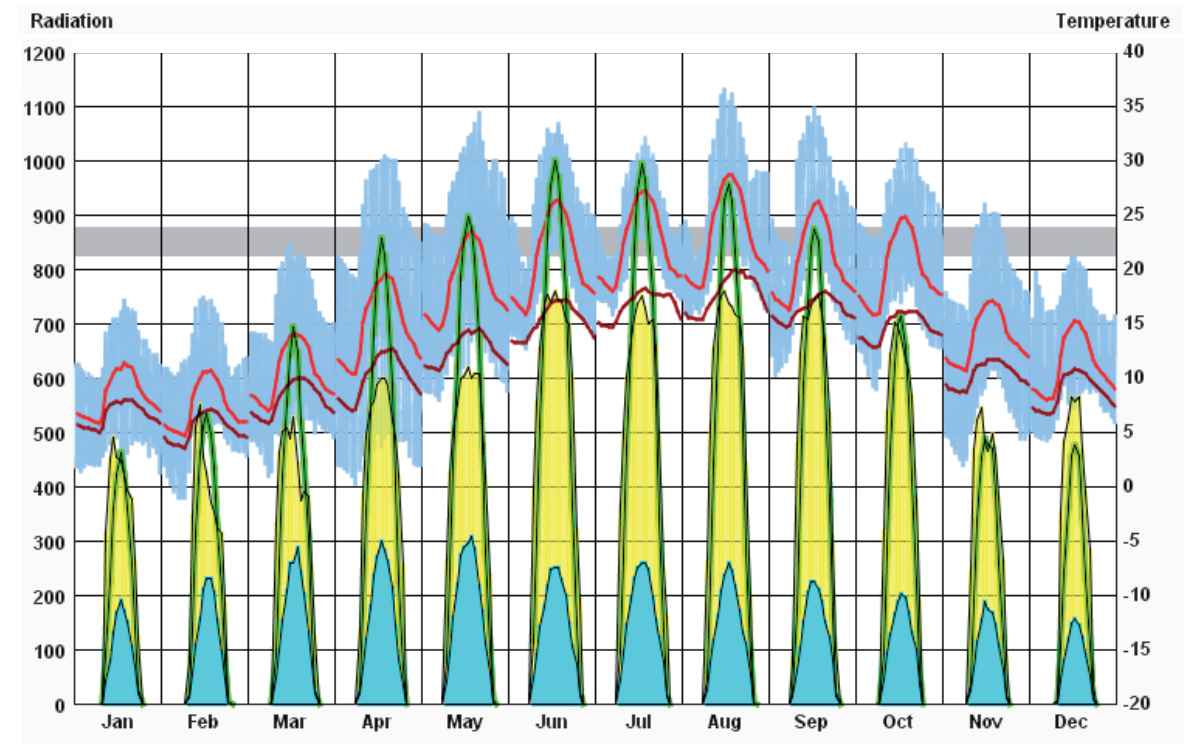
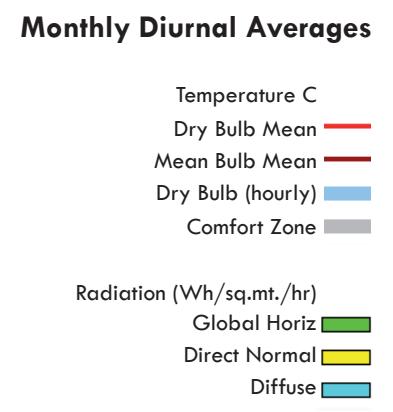
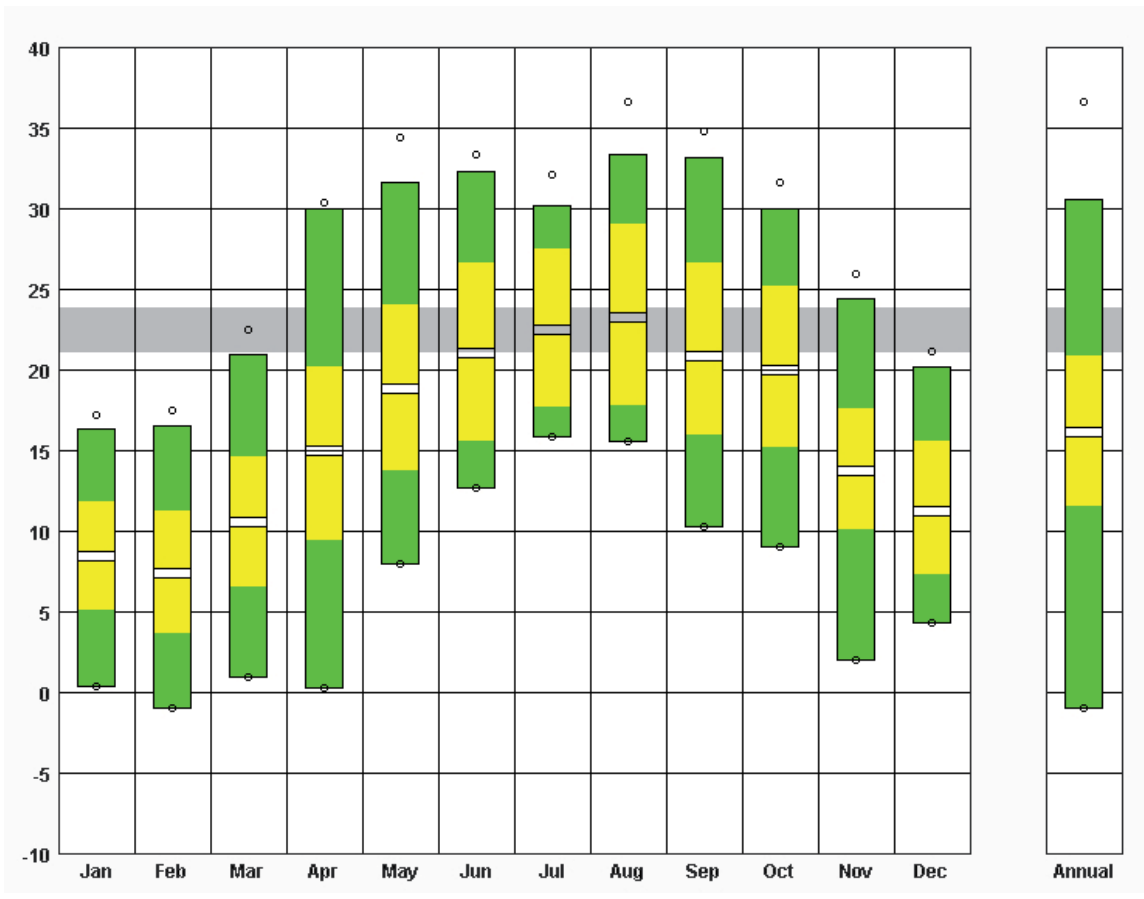
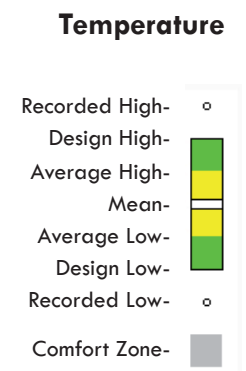


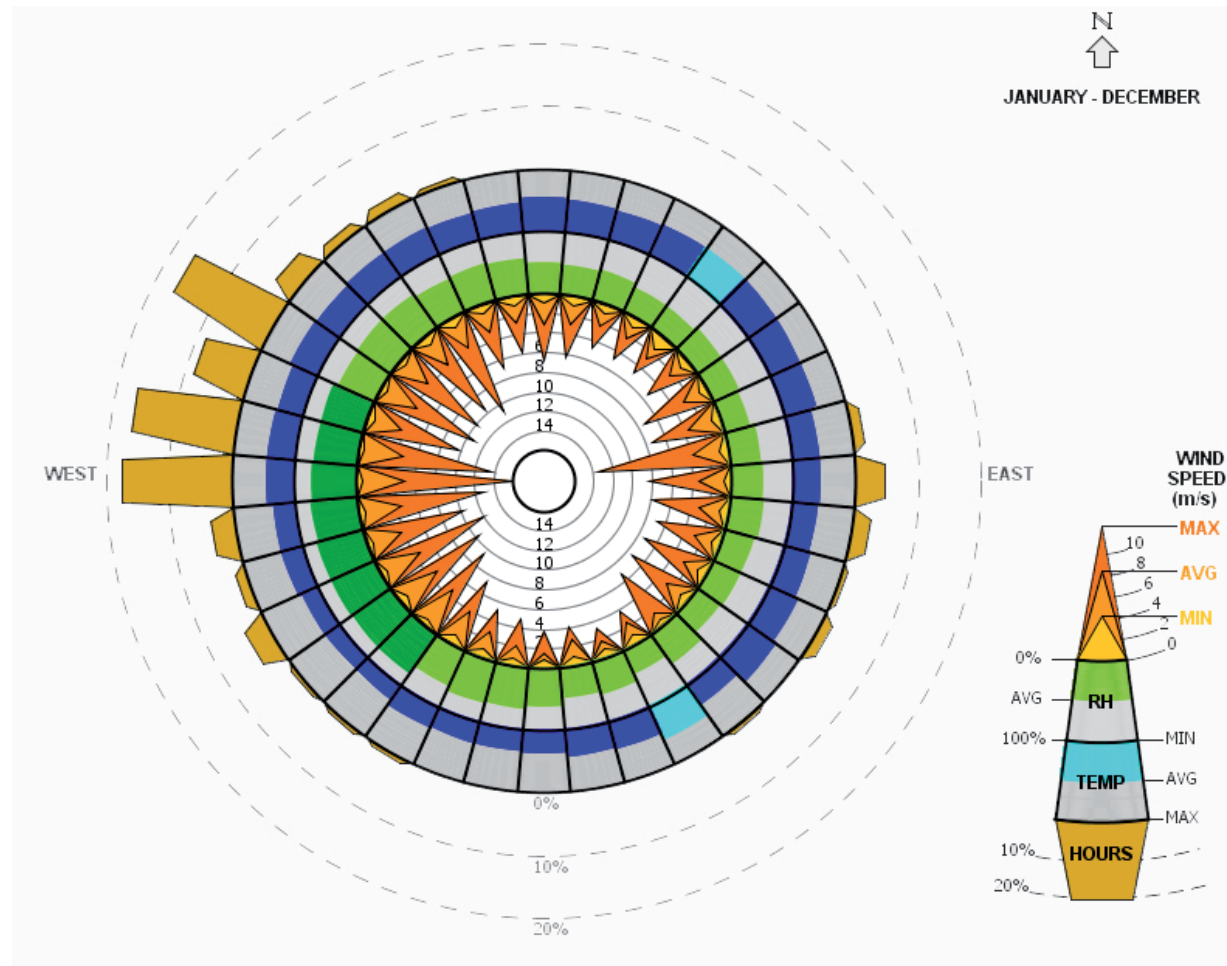




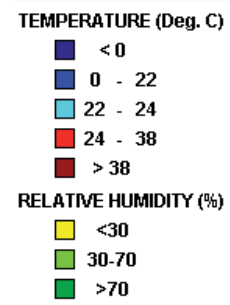




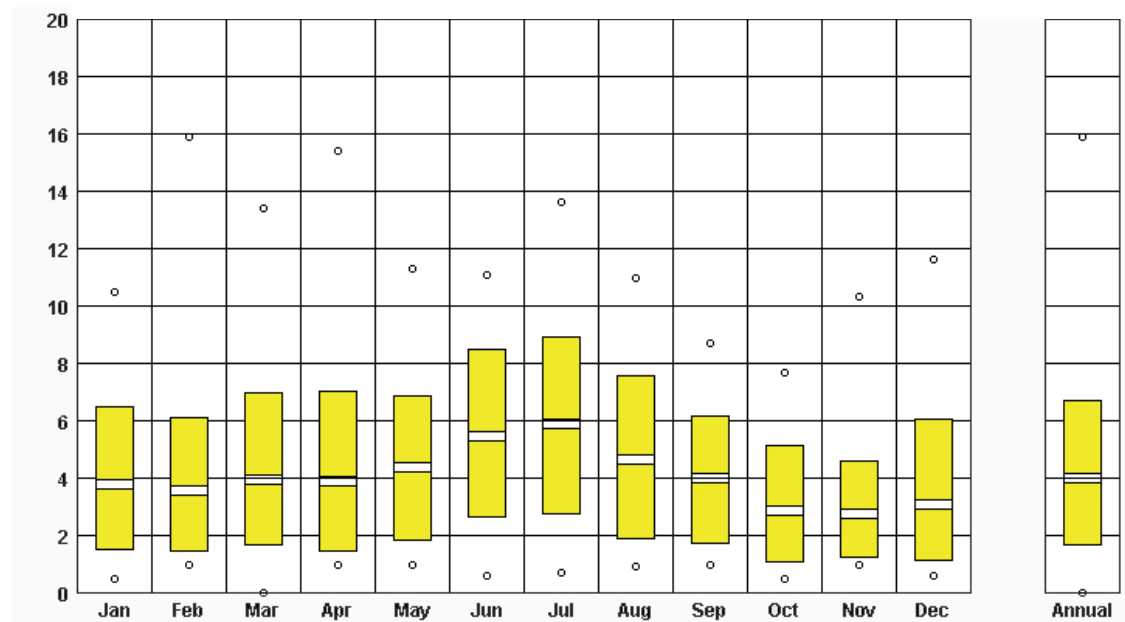
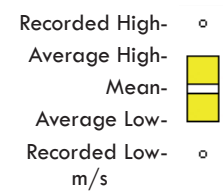




Wind Wheel

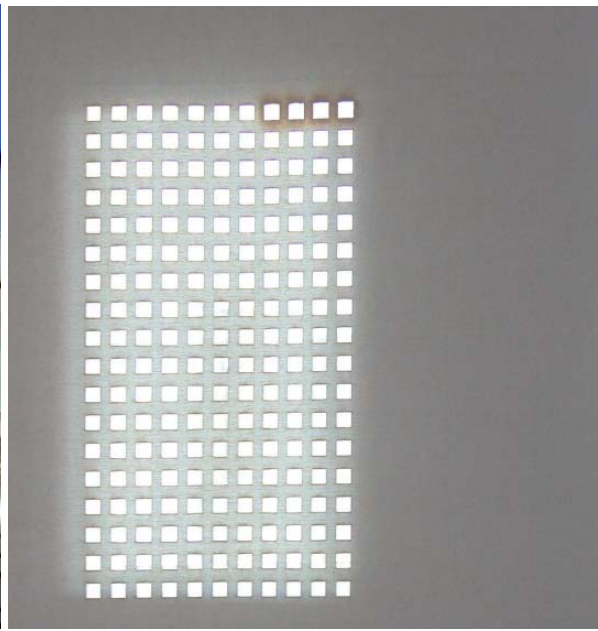
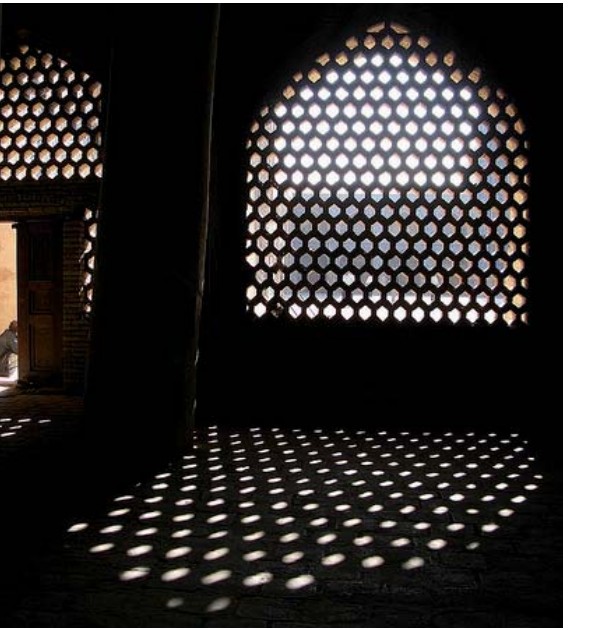


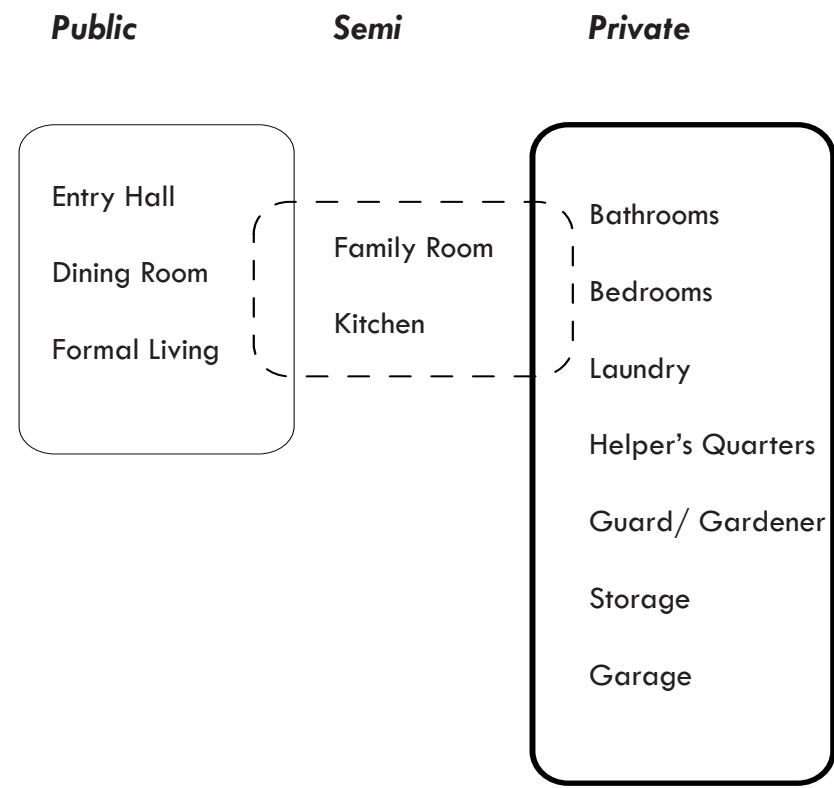
Wind Velocity range



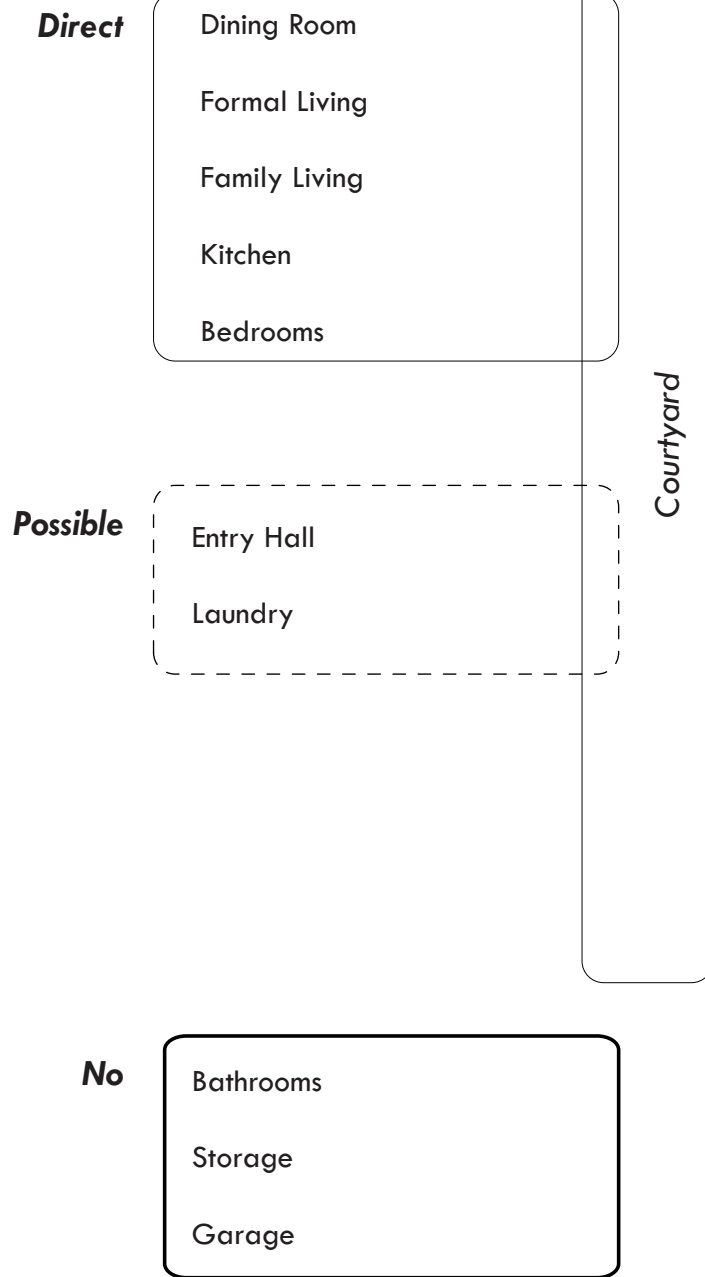
Space	Dimensions (m) *	Quantity	Number of Occupants
Bathroom	2 x 3	2-5	1-2
Bedroom	4 x 4	2-5	1-2
Dining	3 x 5	1	up to 16
Entry hall	2 x 3	1	N/A
Family living	6 x 6	1-2	up to 8
Formal living	8 x 8	1-2	up to 25
Garage	5 x 7	1-2	2 cars
Guest washroom	1.5 x 2	1	1
Kitchen	5 x 6	1	2-3
Laundry	3 x 3	1	1

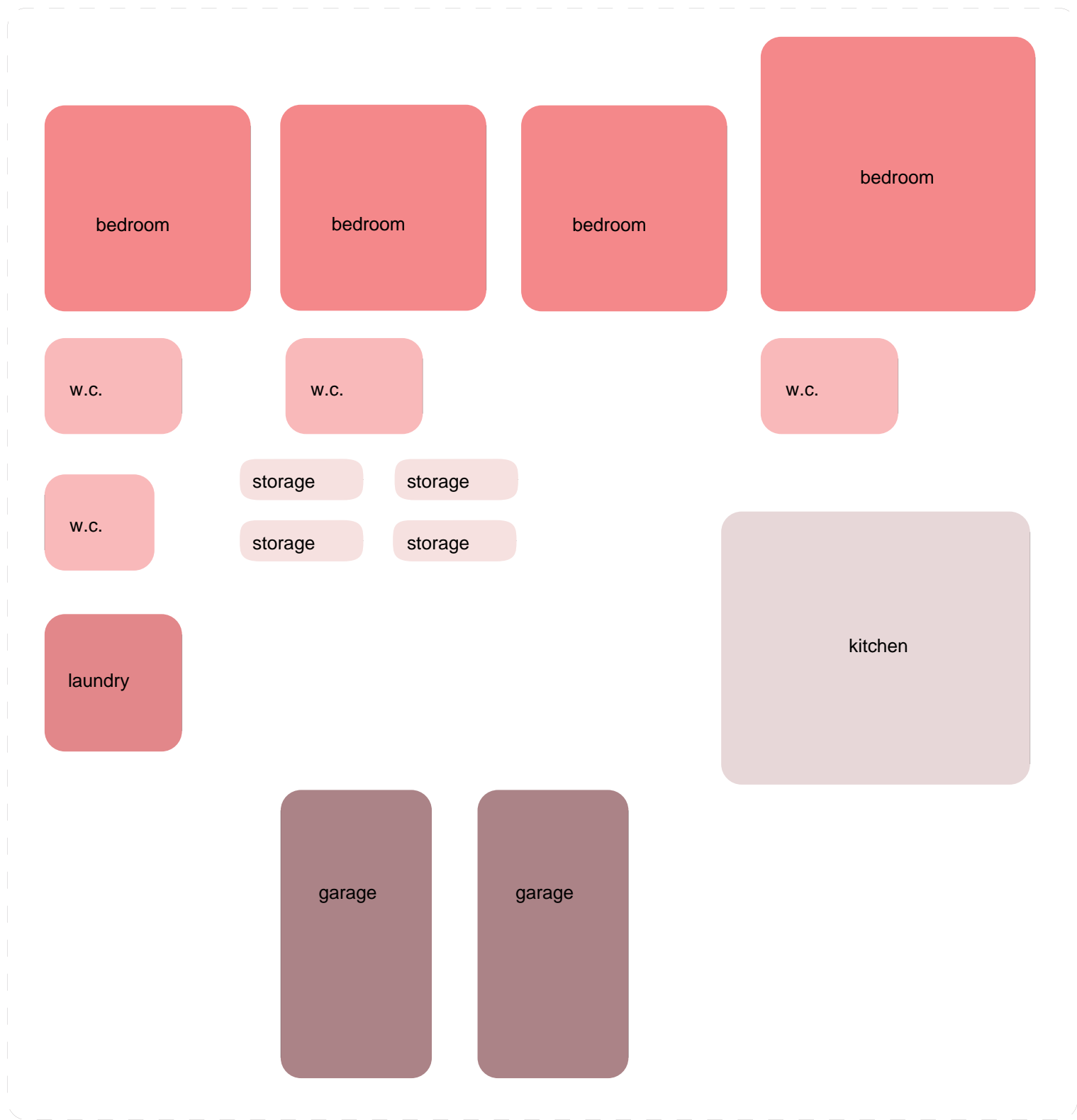
* Average typical middle-class area requirements of a residence



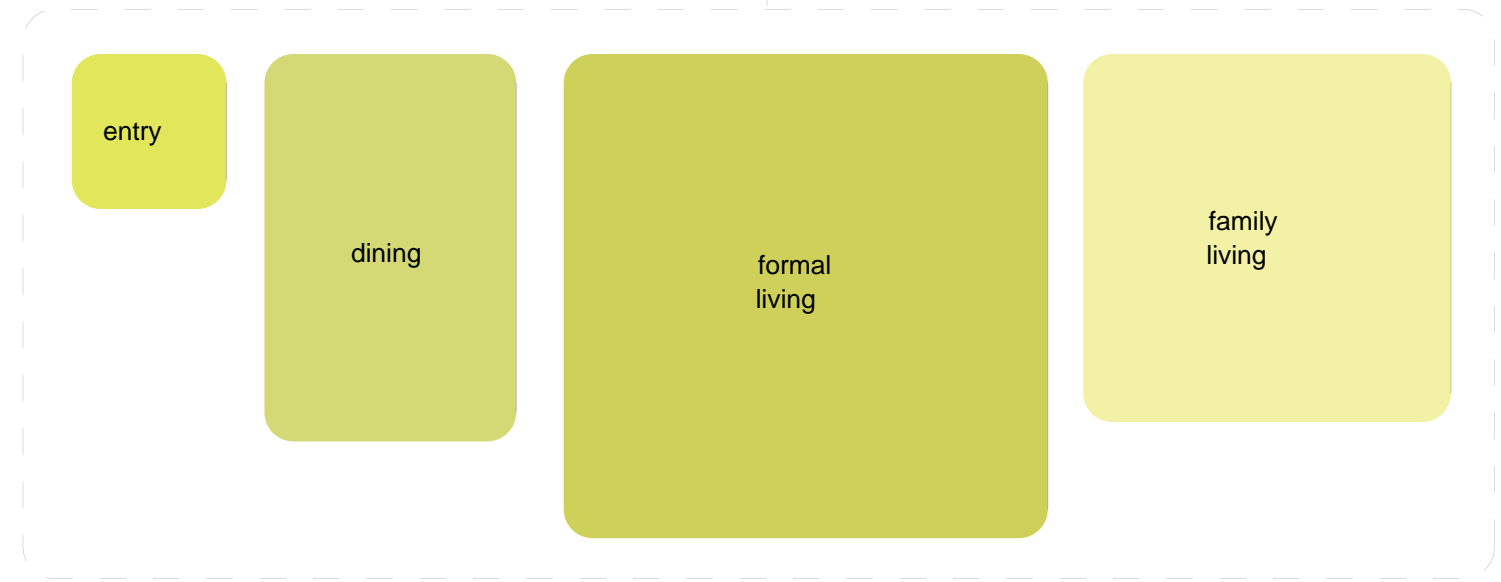


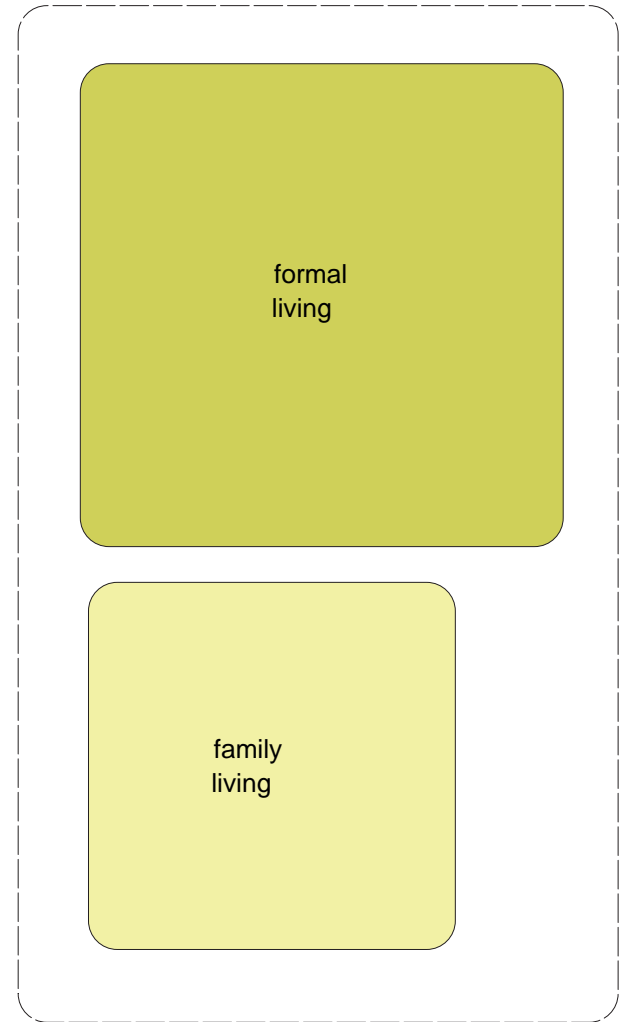
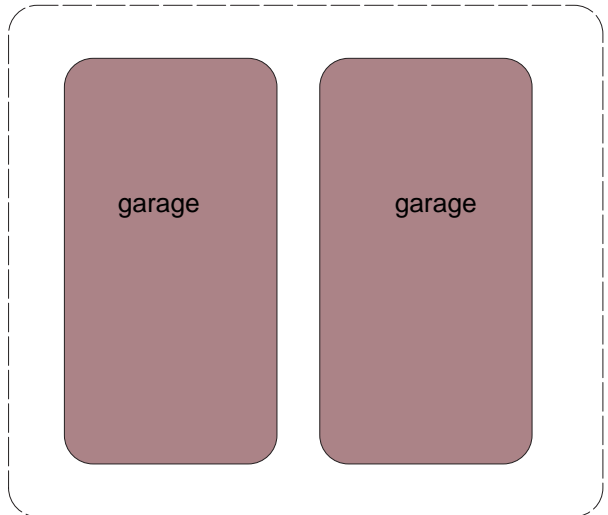
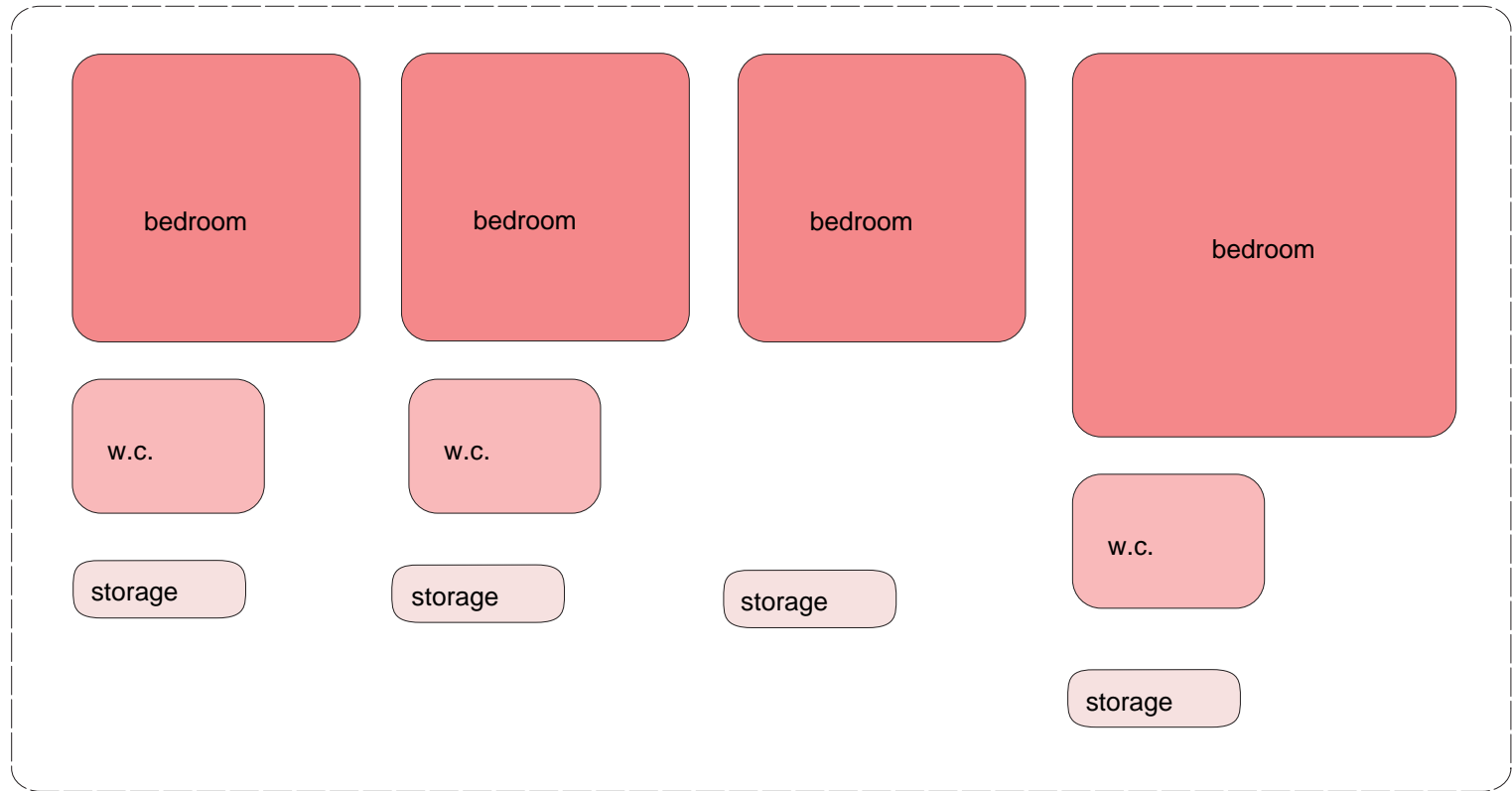
Connection to courtyard

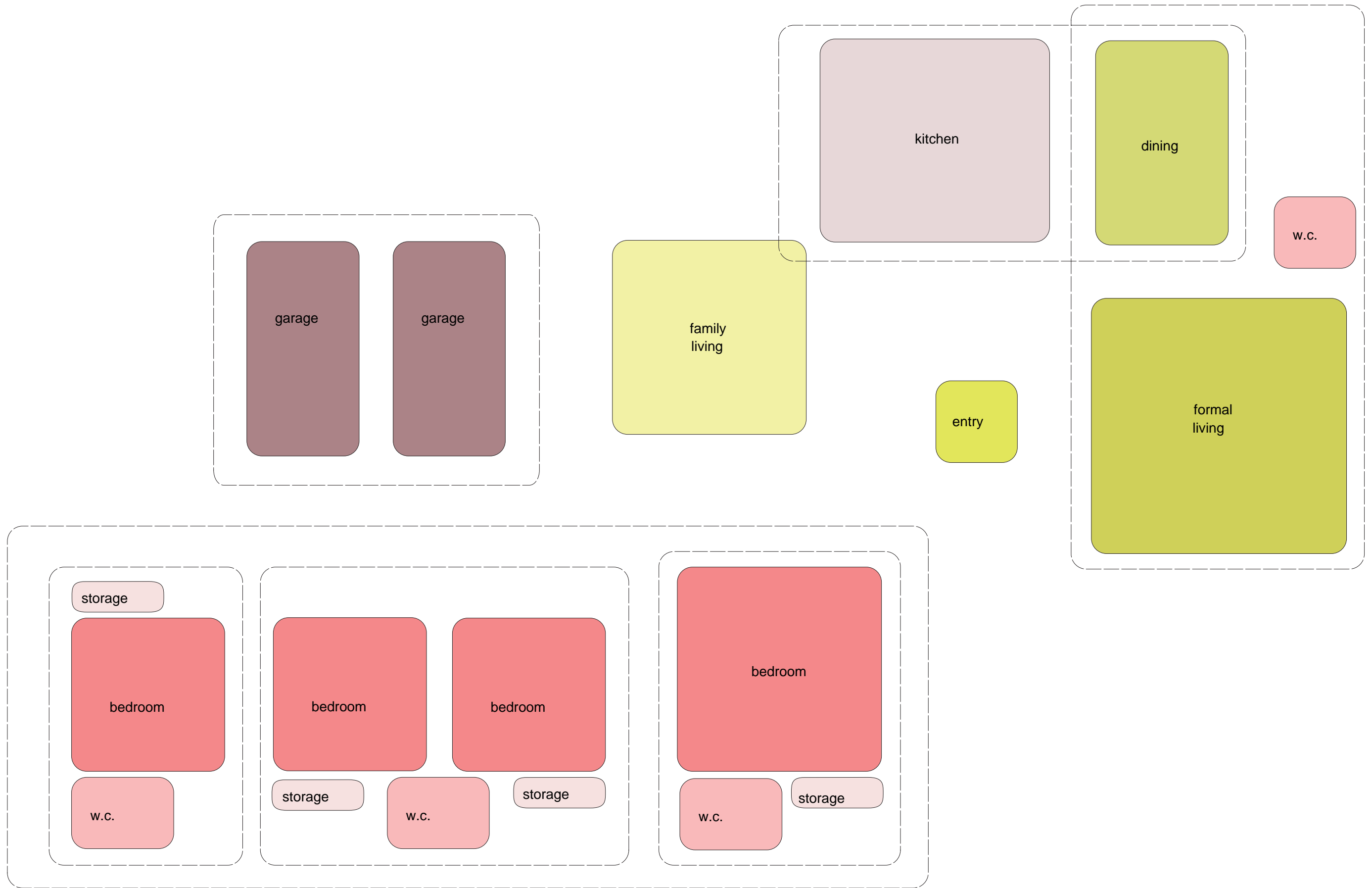


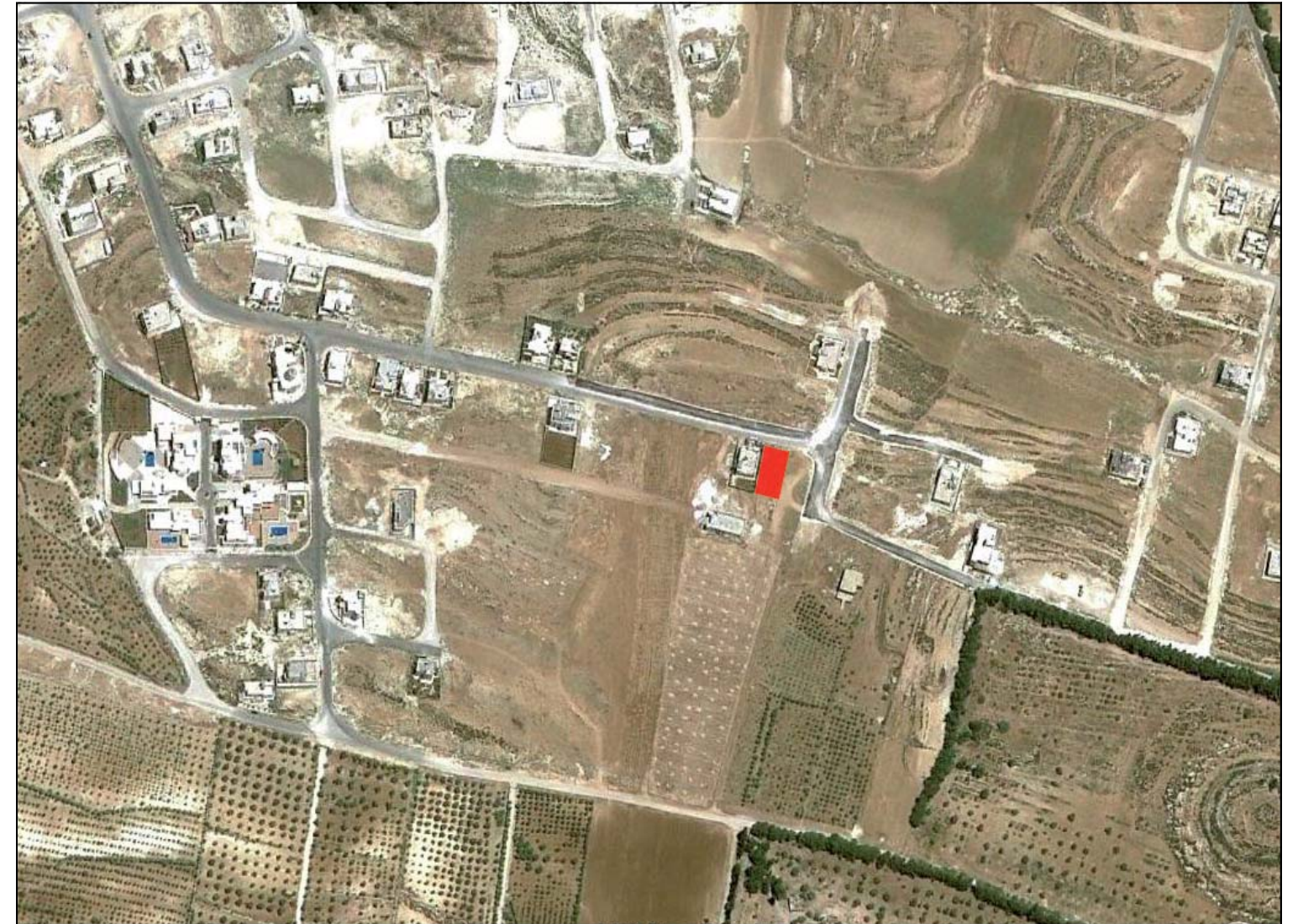
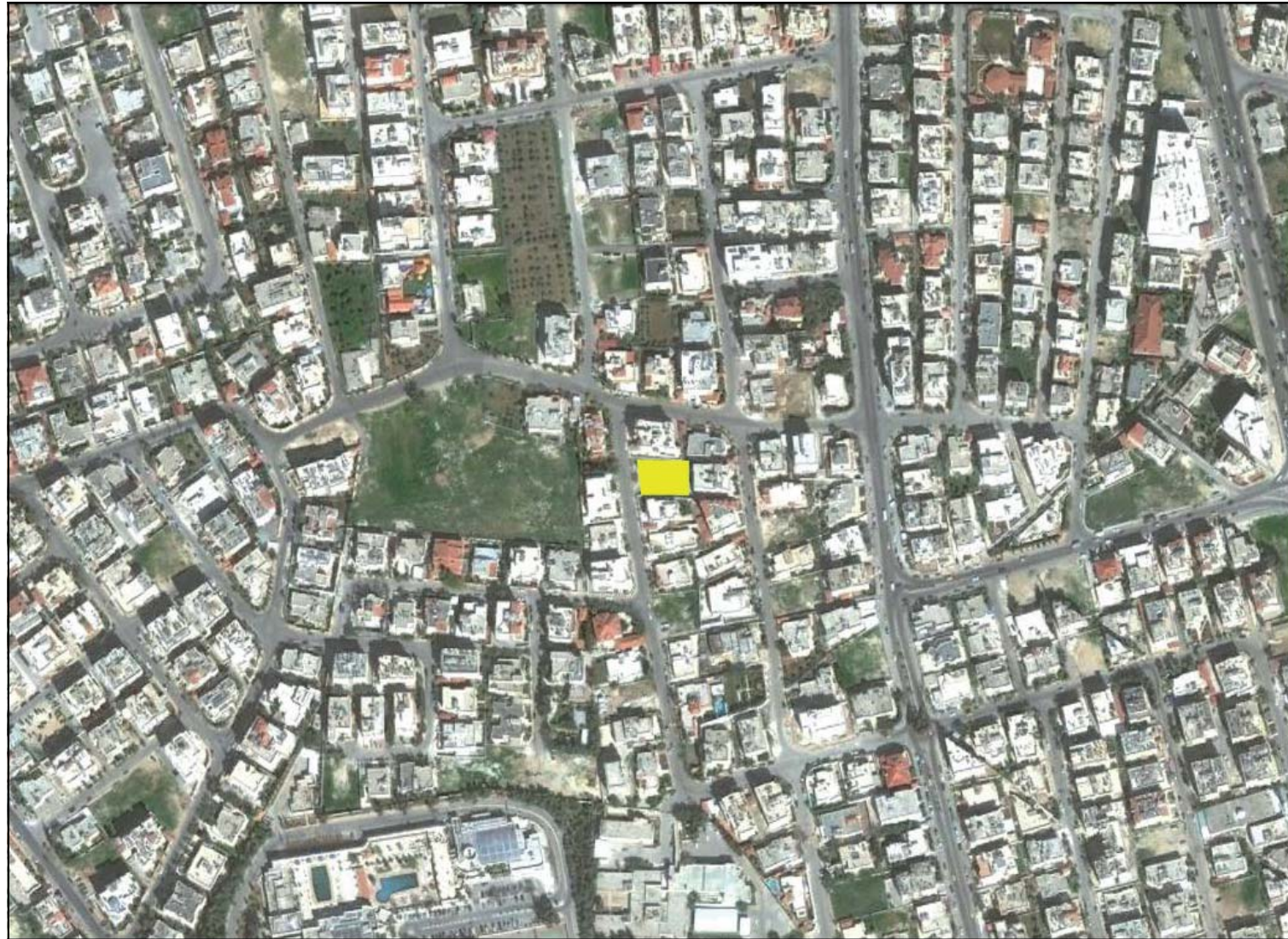


private vs. public









■ suburban site
■ urban site



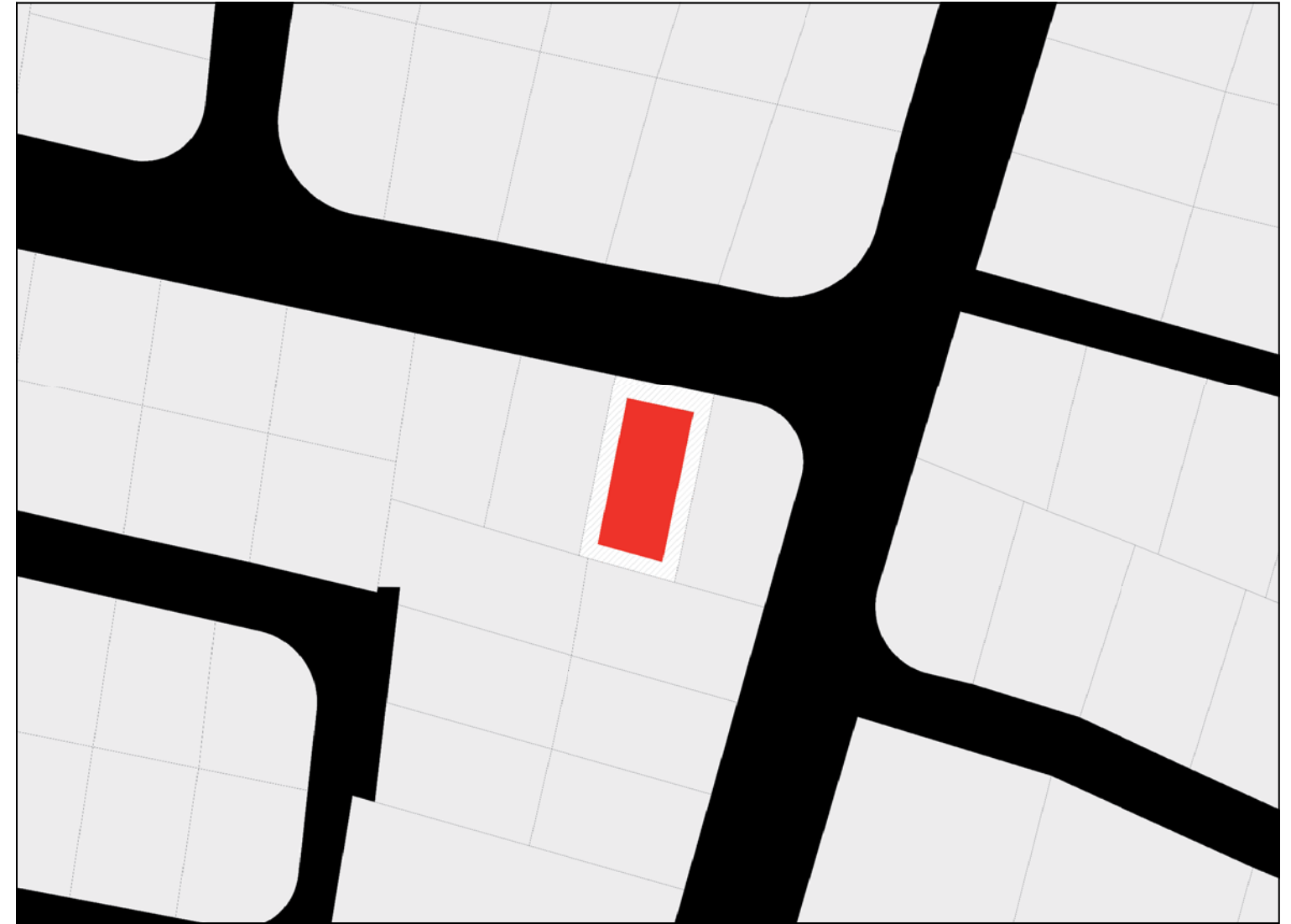


- streets
- vacant lots
- built up lots
- suburban site
- urban site

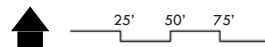


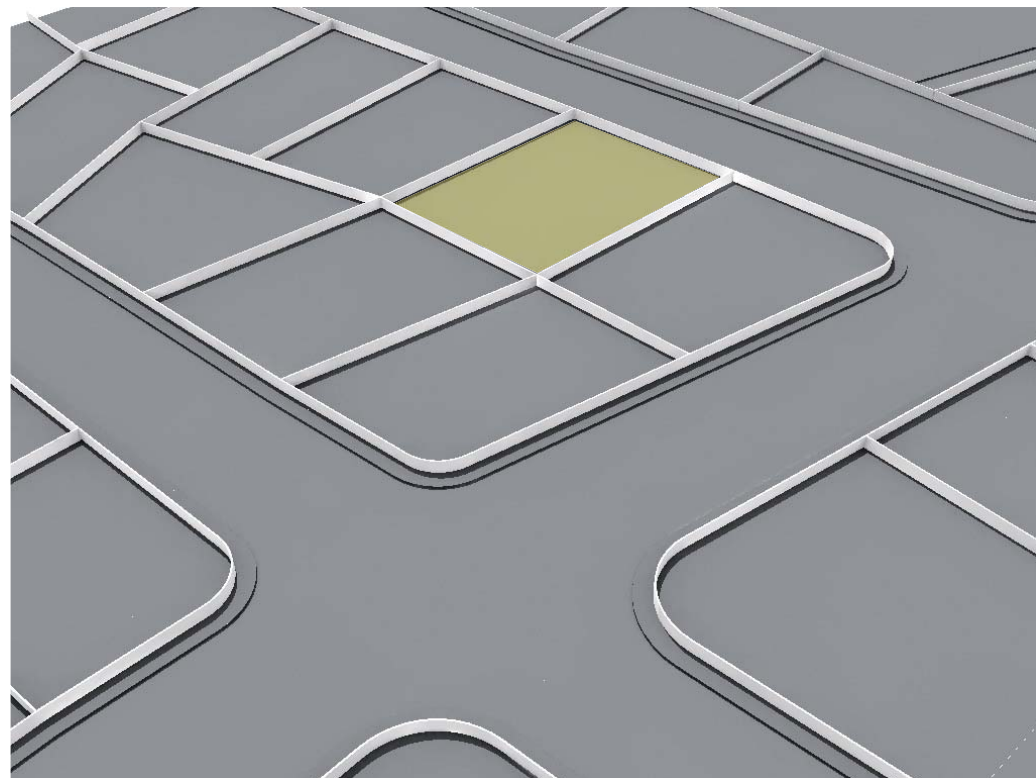


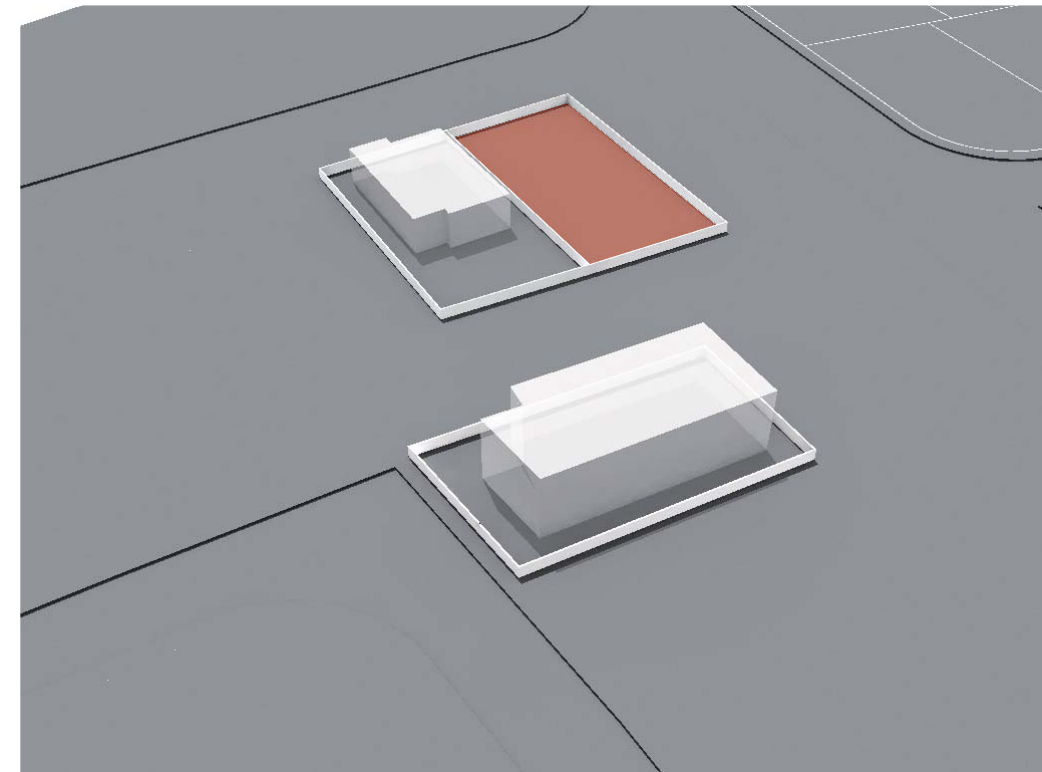
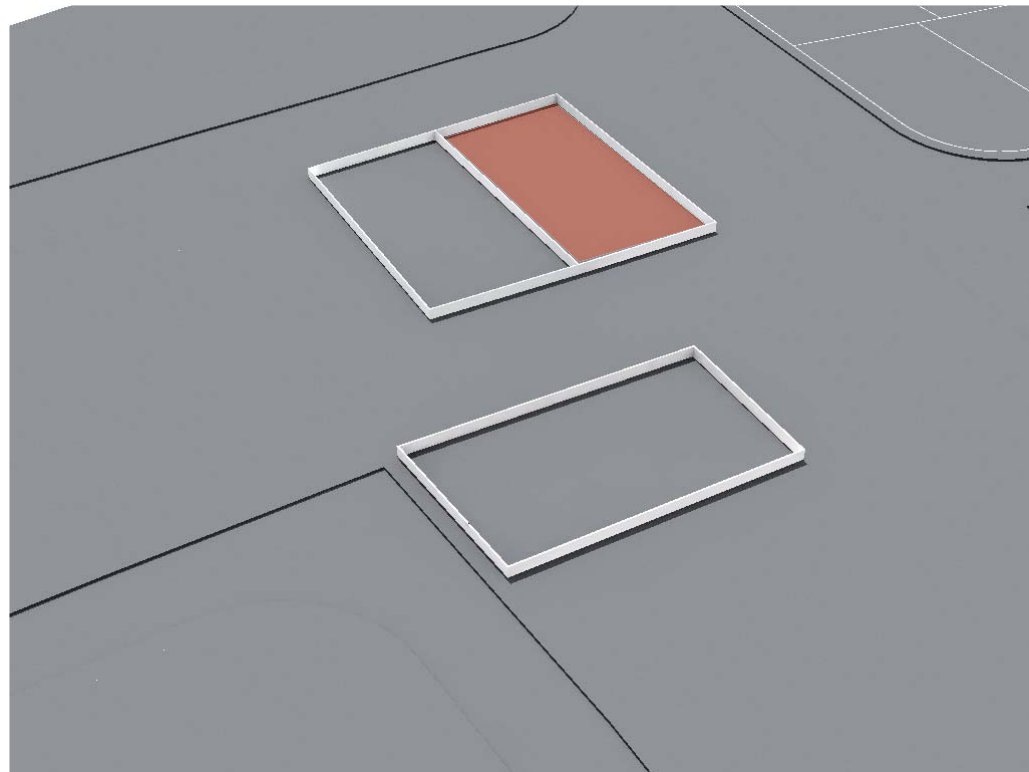
urban sit
category:
 residential B
 minimum lot area of 8750 ft²
setbacks:
 front: 13'
 side: 13'
 back: 20'
lot dimensions:
 118' x 82'
lot area:
 9690 ft²

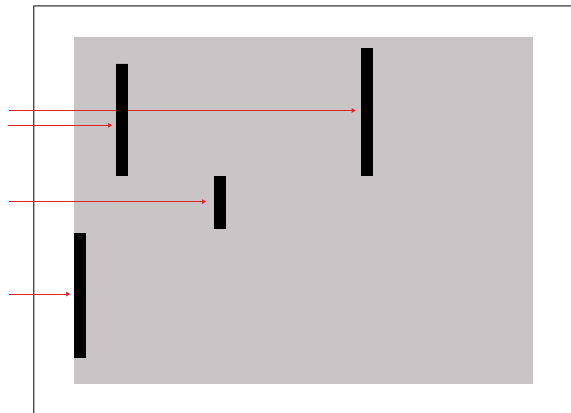


suburban site
category:
 residential C
 minimum lot area of 5380 ft²
setbacks:
 front: 10'
 side: 10'
 back: 13'
lot dimensions:
 118' x 61'
lot area:
 7170 ft²

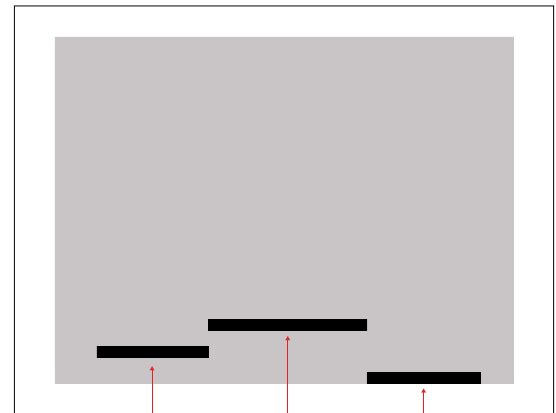




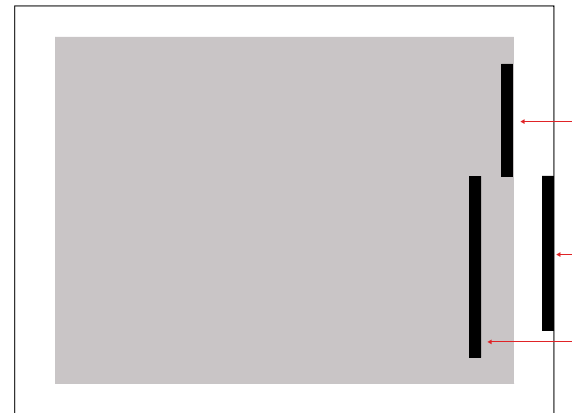




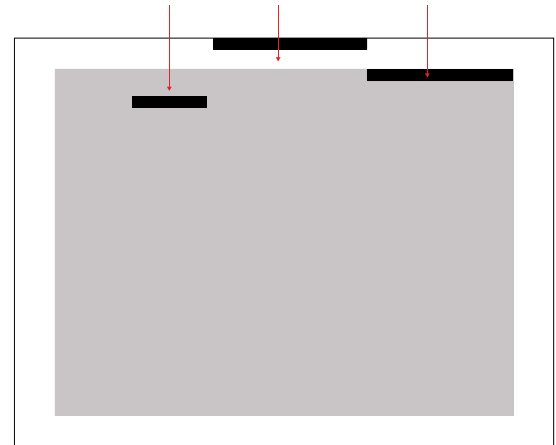
W- facing street + winds



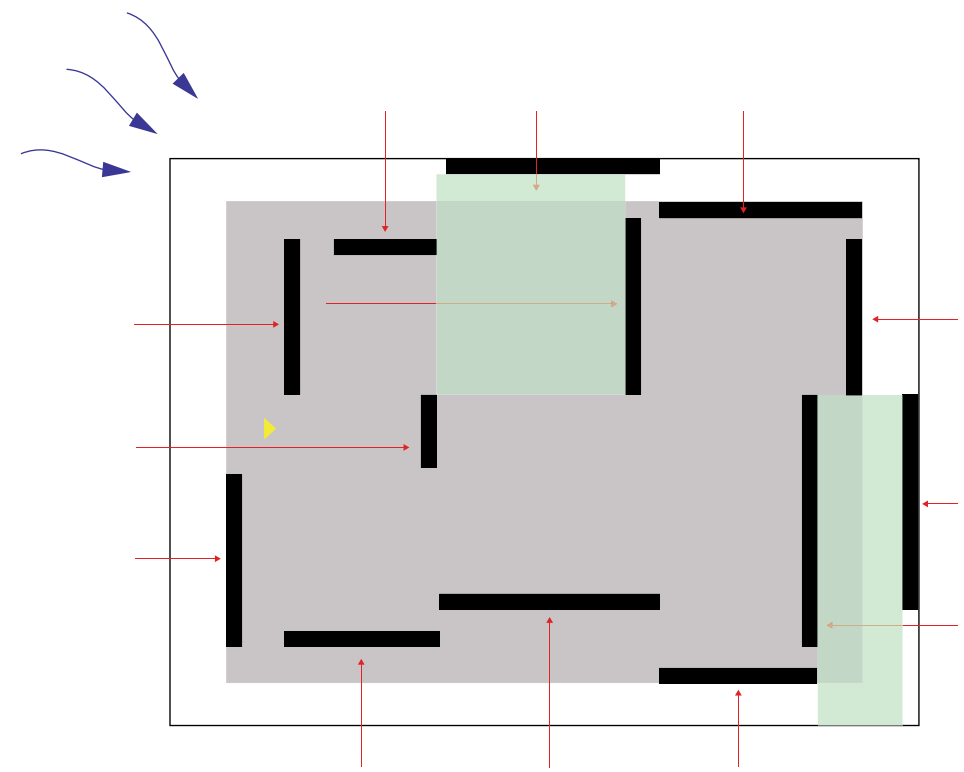
S- facing neighbor

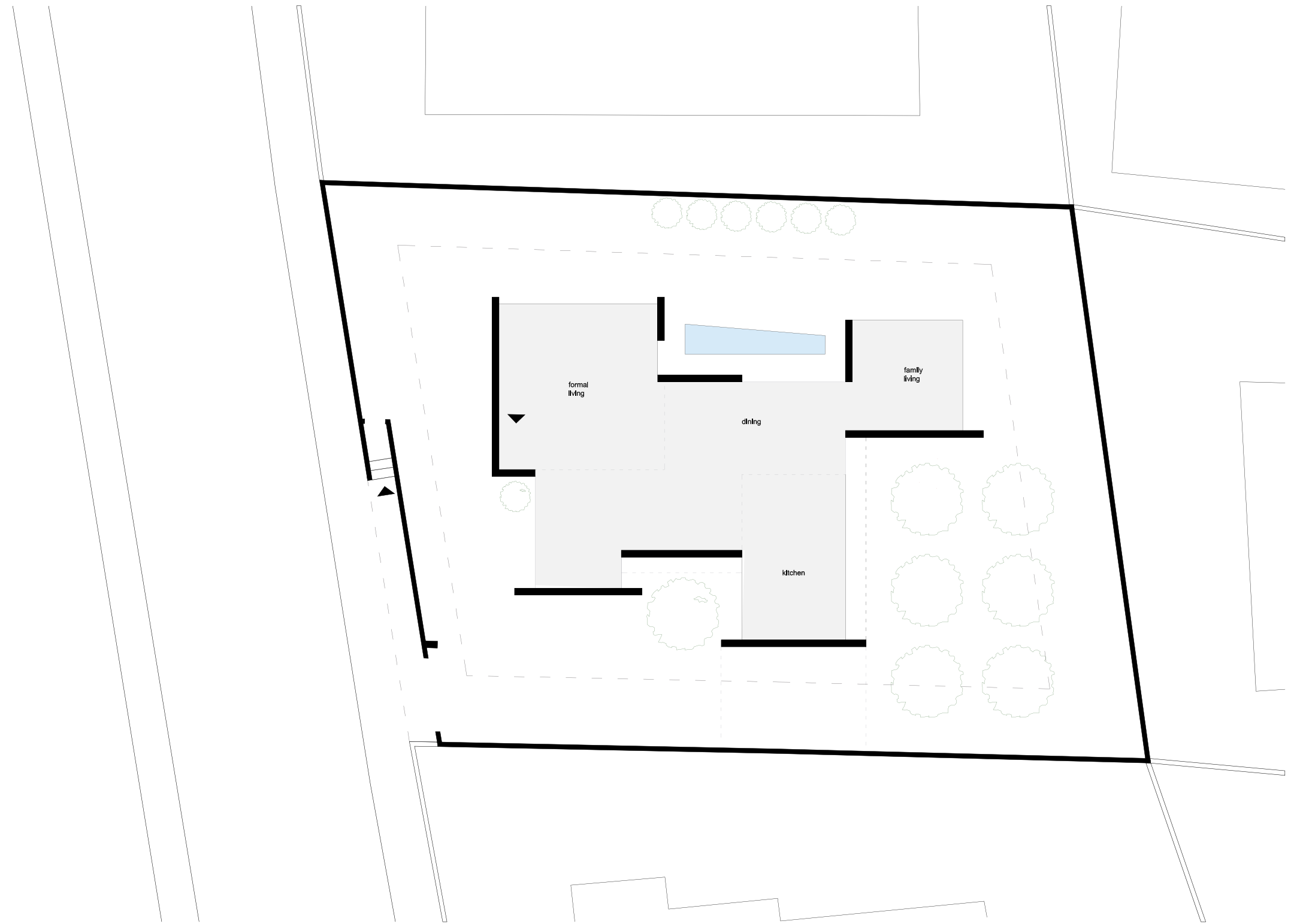


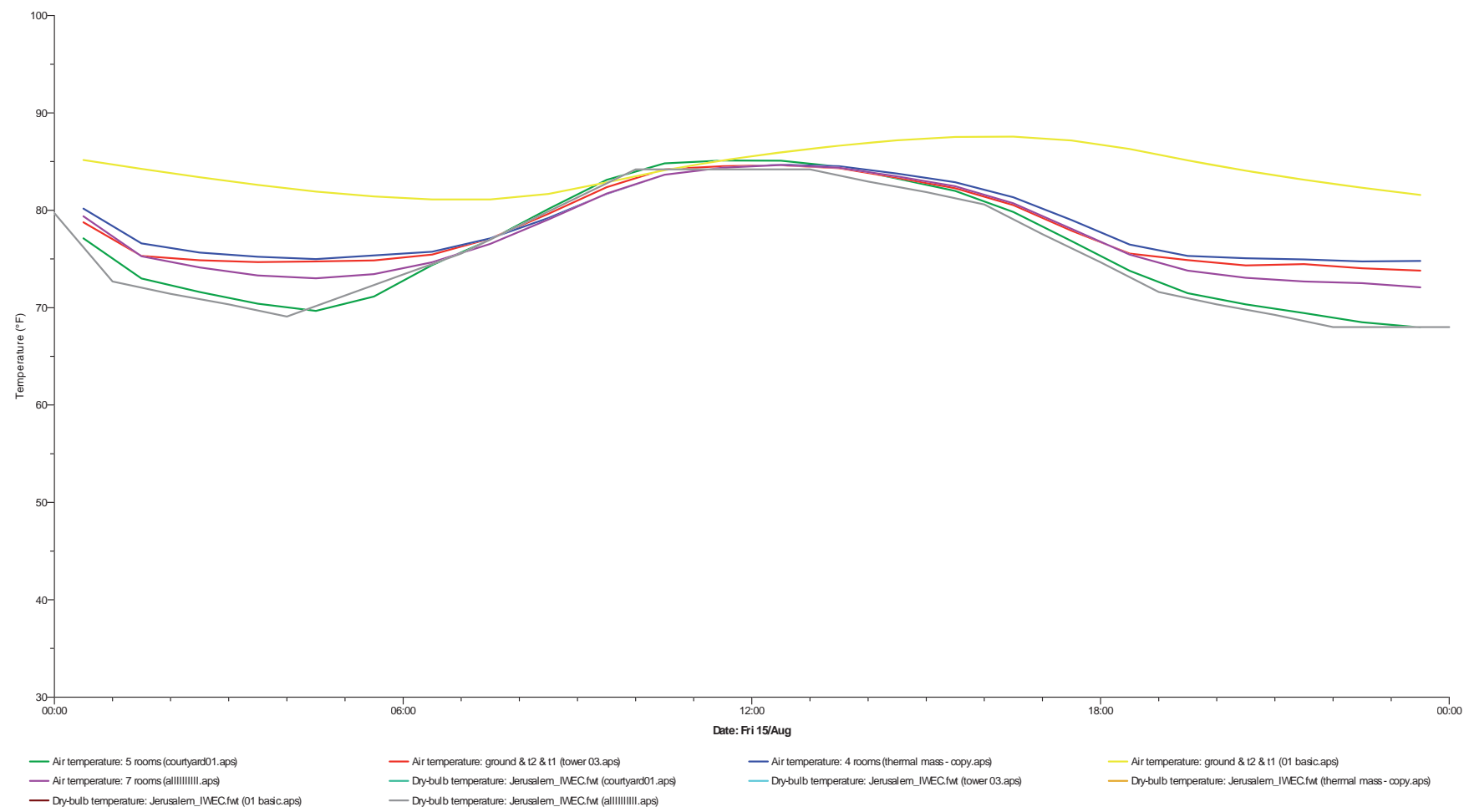
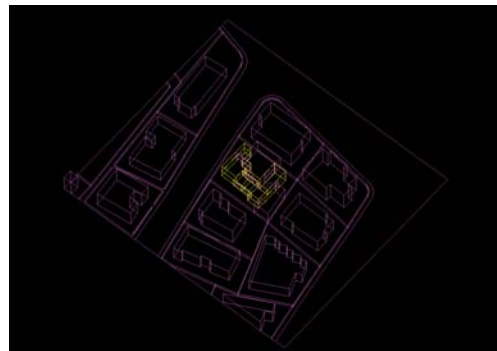
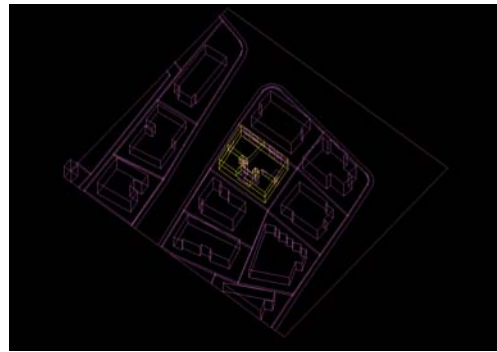
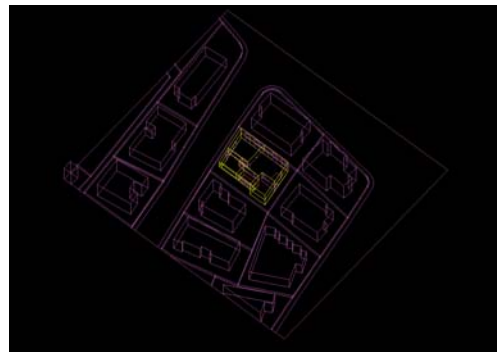
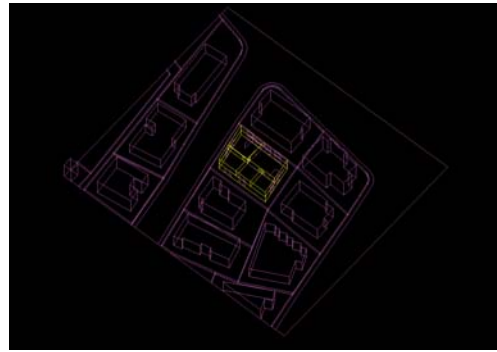
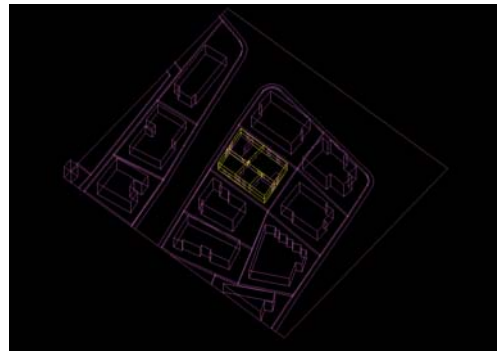
E- facing neighbor



N- facing neighbor + winds

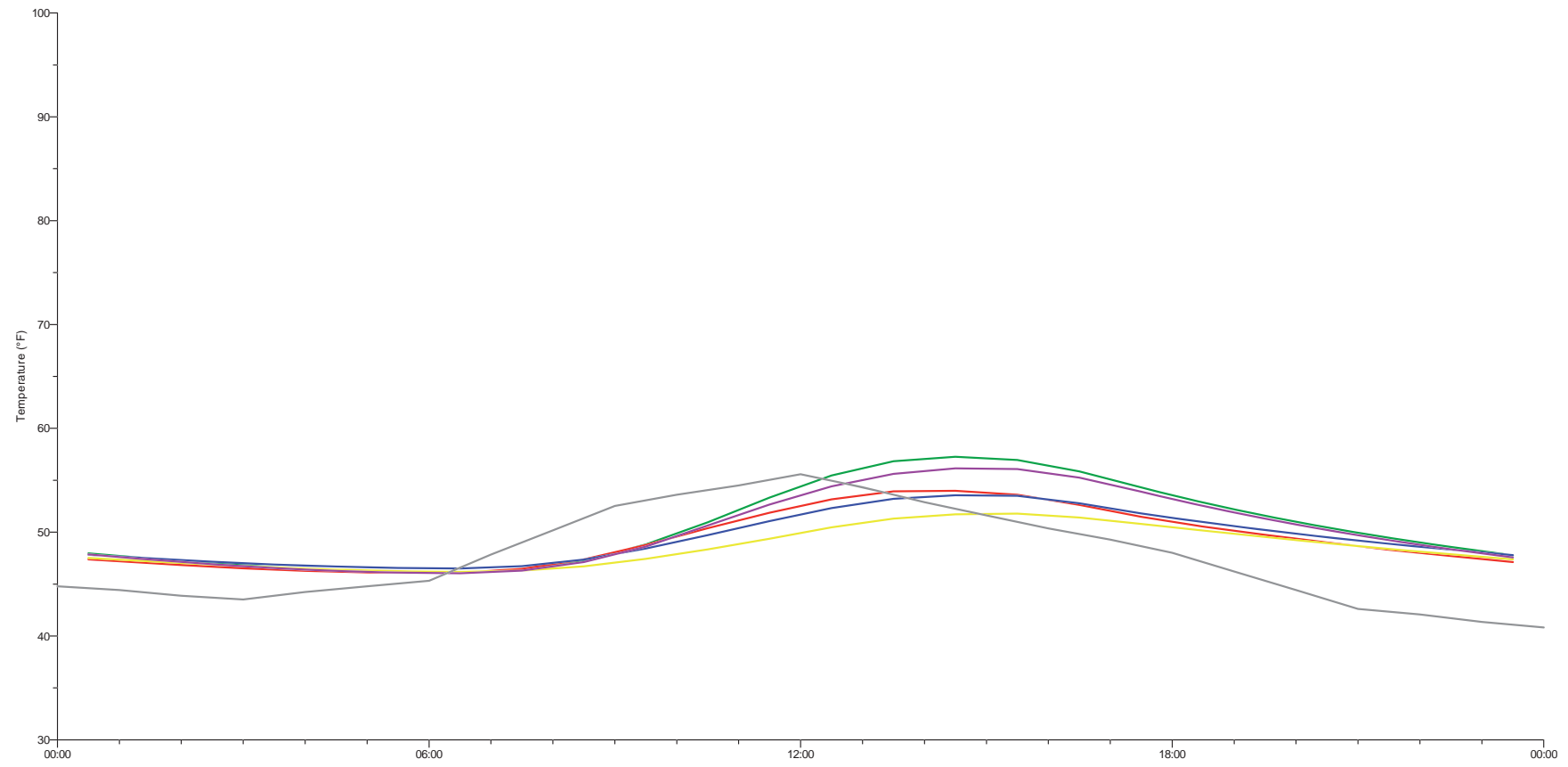
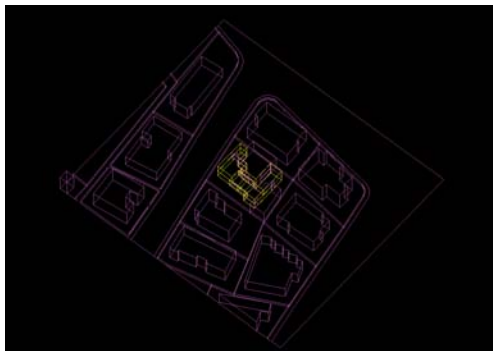
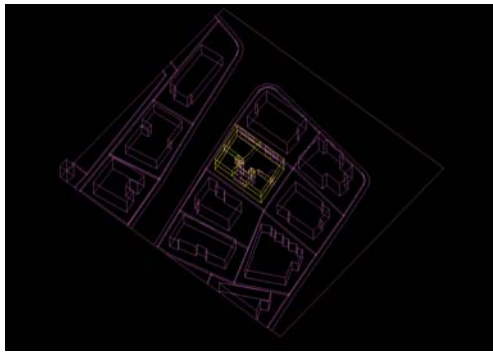
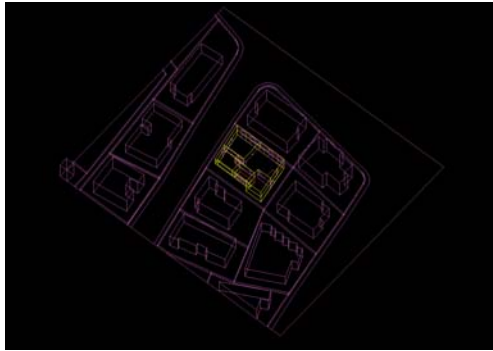
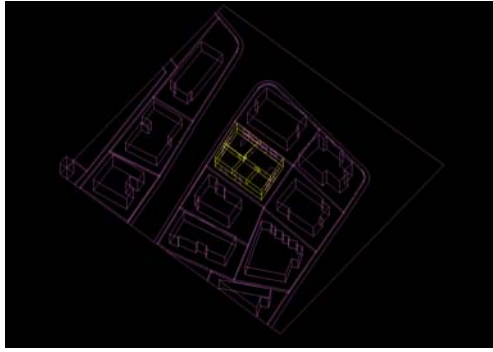
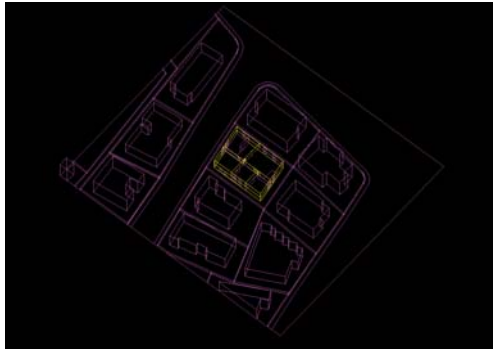






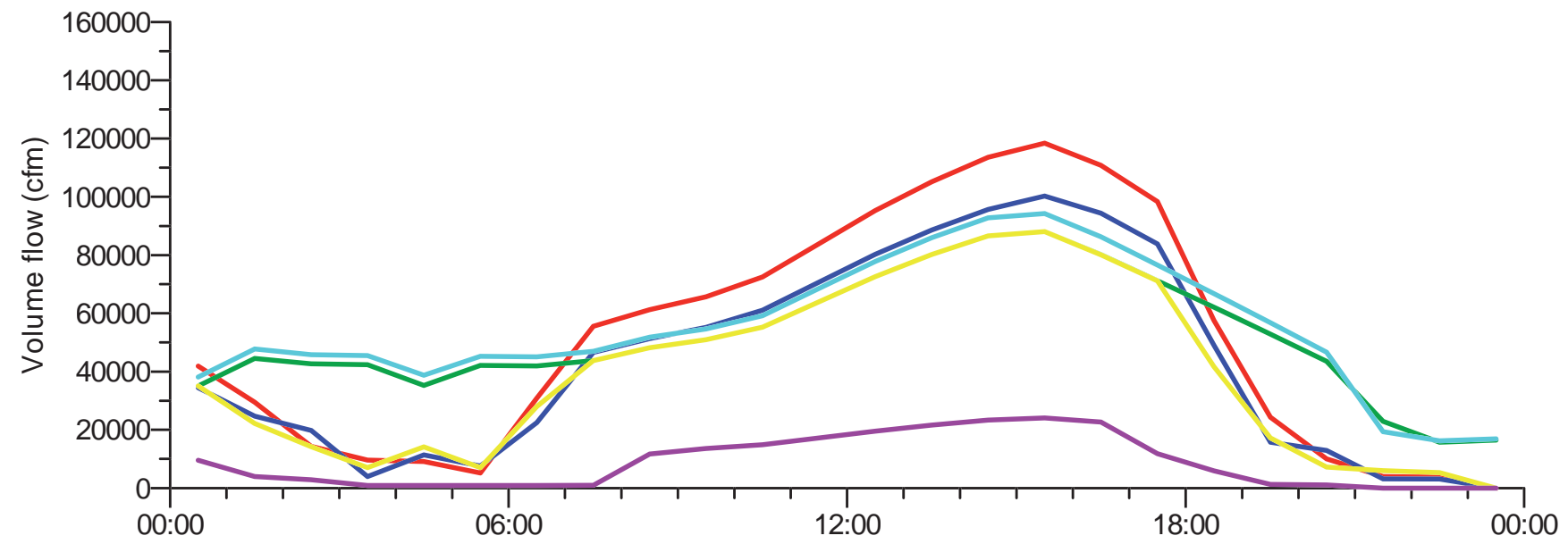
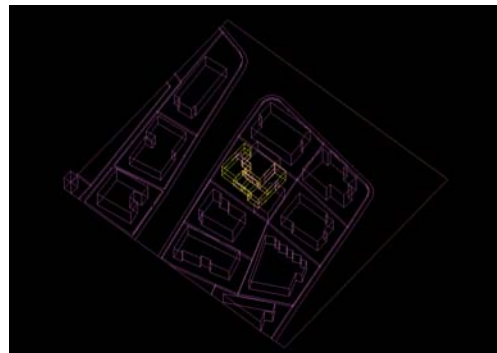
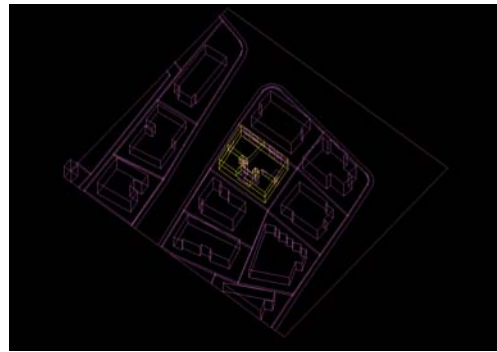
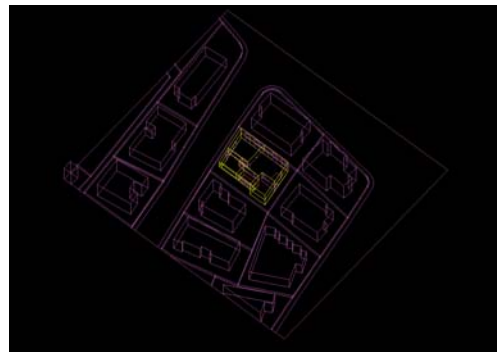
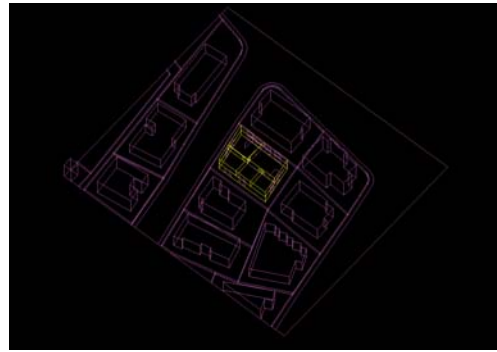
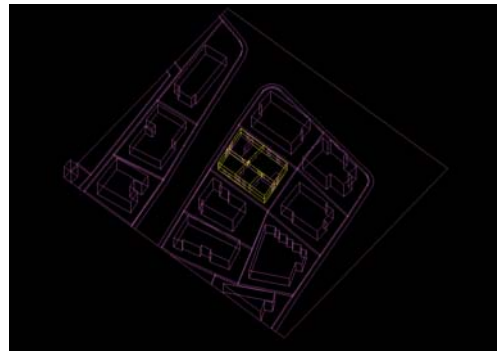
AUGUST 15

- Dry-bulb temperature: Jordan
- Air temperature in basic
- Air temperature with shading + thermal mass
- Air temperature with wind tower
- Air temperature with courtyard
- Air temperature with trees
- Air temperature of final design



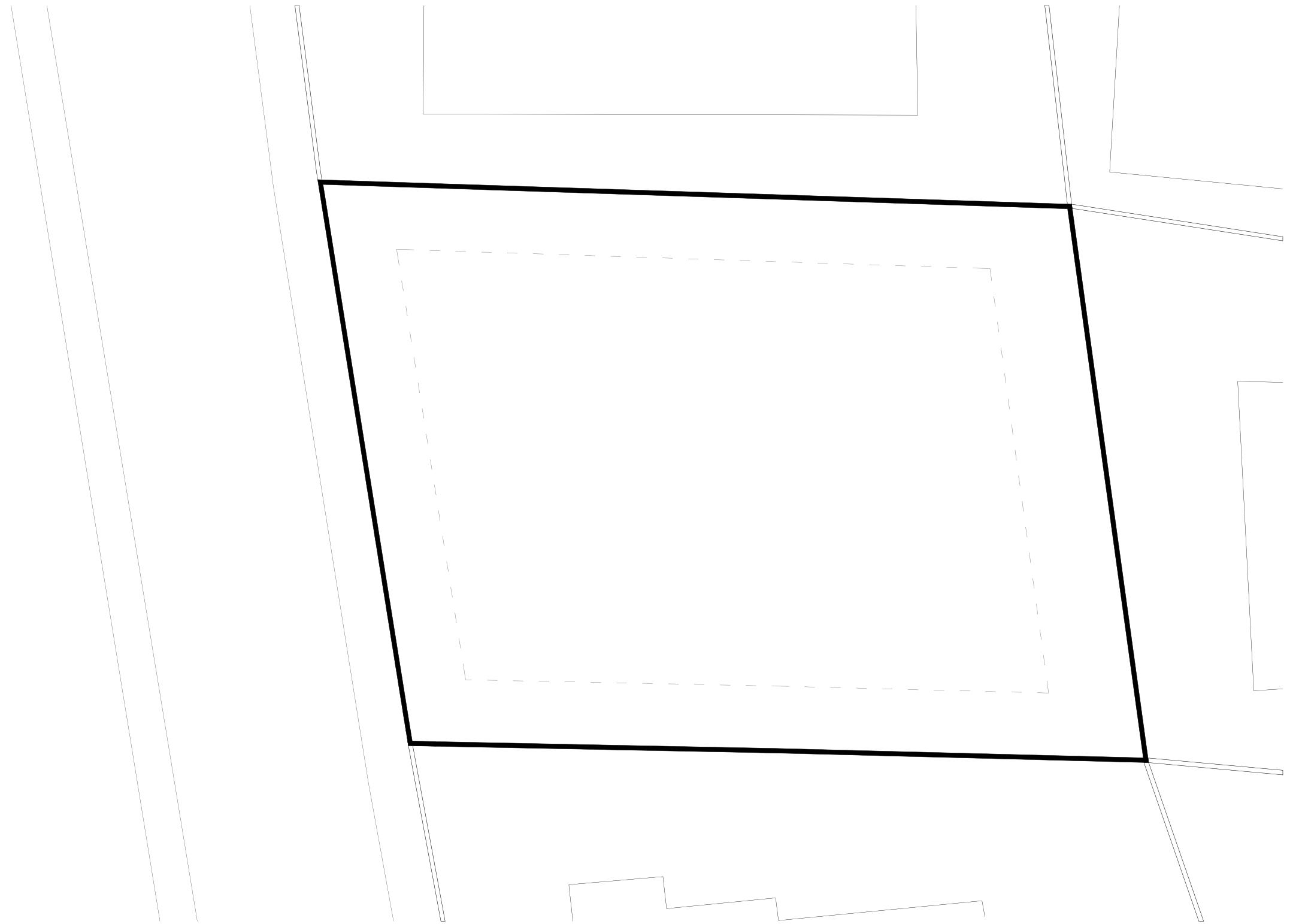
JANUARY 15

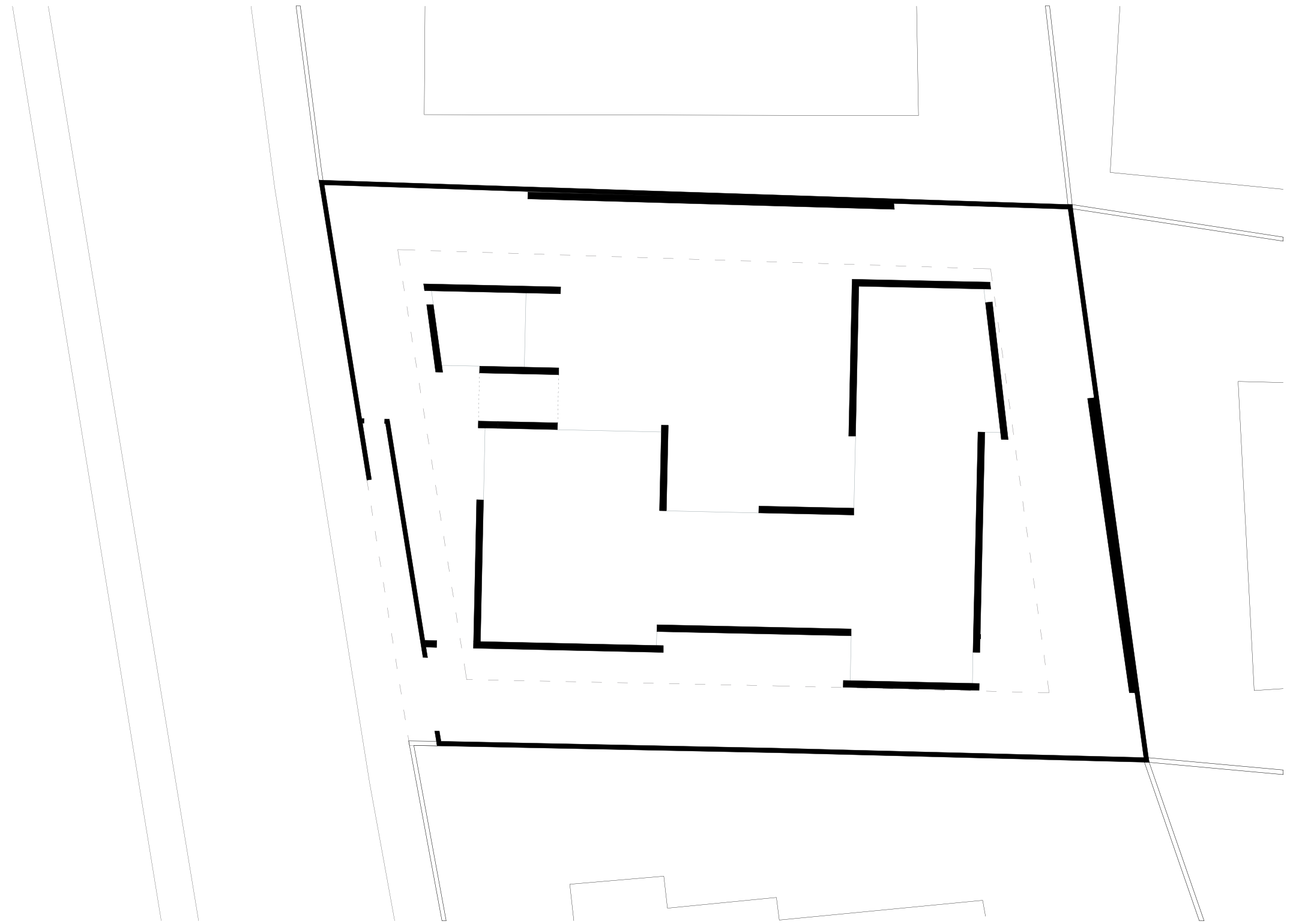
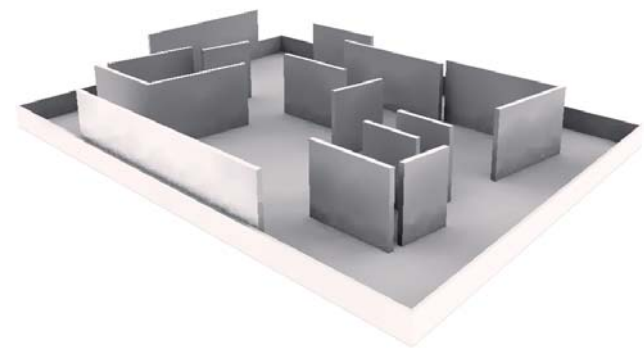
- Dry-bulb temperature: Jordan
- Air temperature in basic
- Air temperature with shading + thermal mass
- Air temperature with wind tower
- Air temperature with courtyard
- Air temperature with trees
- Air temperature of final design



SUMMER

- External ventilation in basic
- External ventilation with shading
- External ventilation with wind tower
- External ventilation with courtyard
- External ventilation with trees
- External ventilation of final design







Almond tree- ornamental
Flowers in early spring
Leafy year round
Grows up to 15-30 ft high



Lemon tree- fruit + shade
Flowers from summer to autumn
Evergreen
Grows up to 40 ft high



Olive tree- fruit + shade
Olives harvested in early winter
Evergreen
Grows up to 25-50 ft high

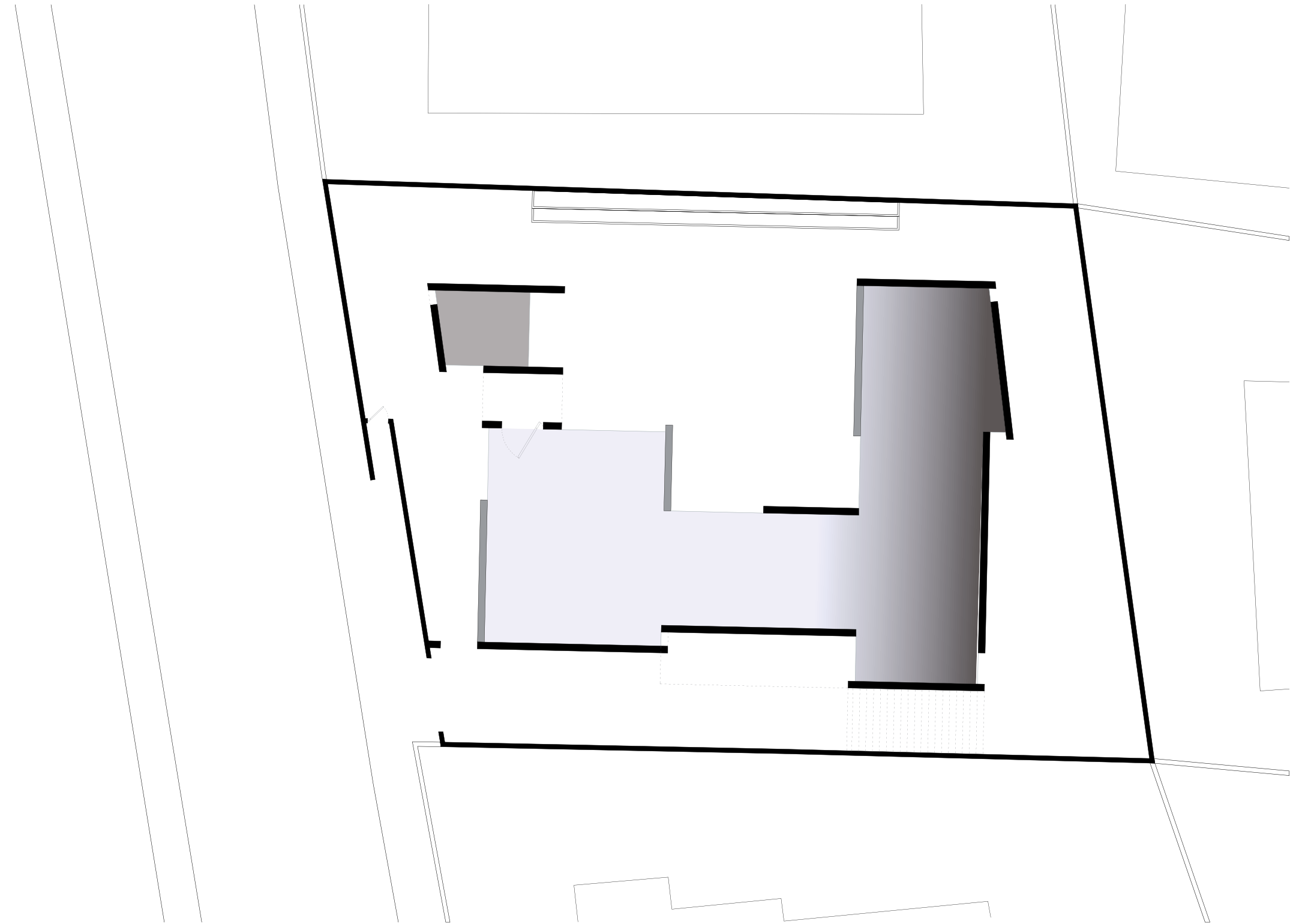


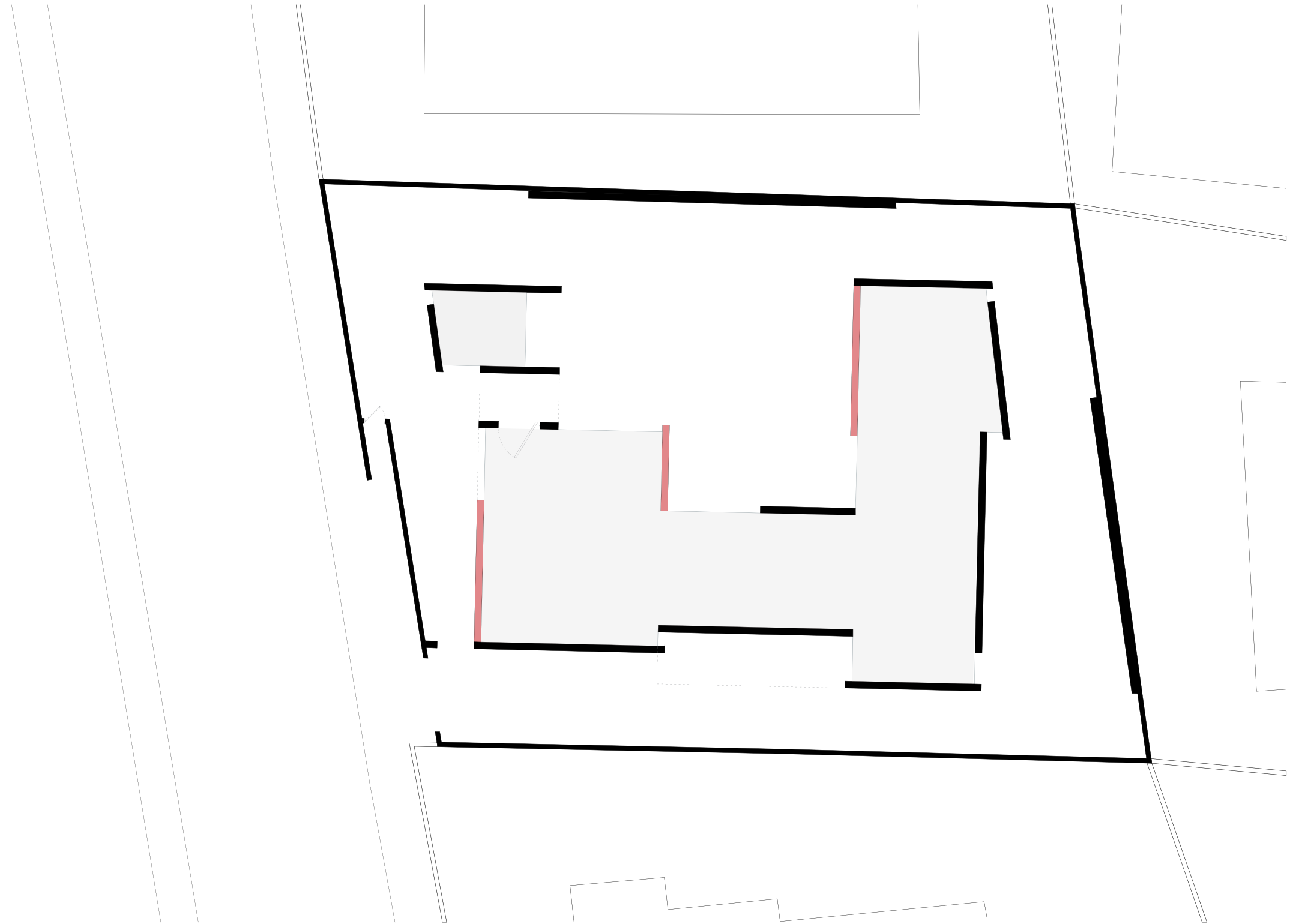
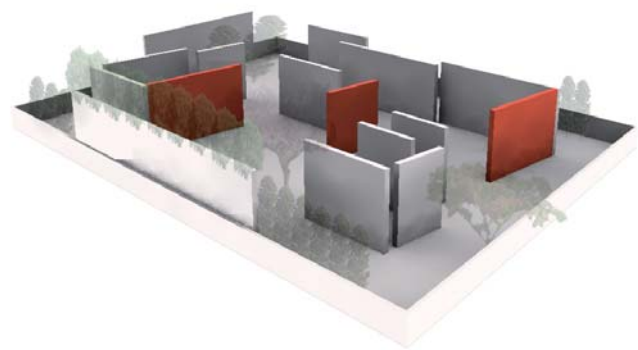
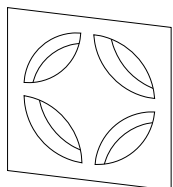
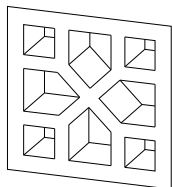
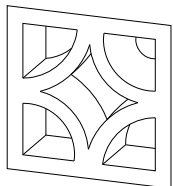
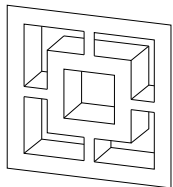
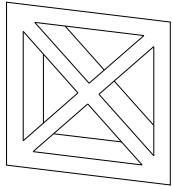
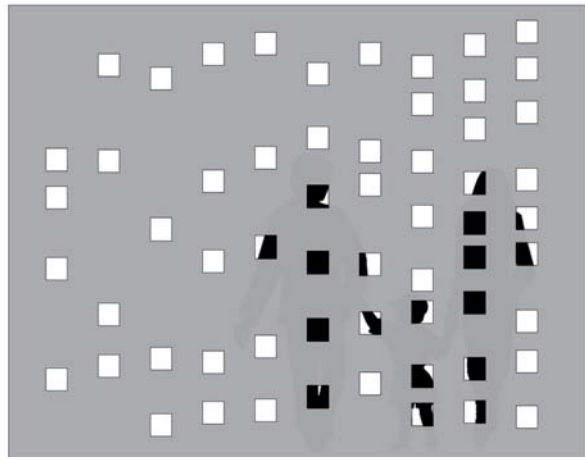
Weeping willow tree- shade
Flowers from early spring
Seasonal change of color
Grows up to 65-80 ft high

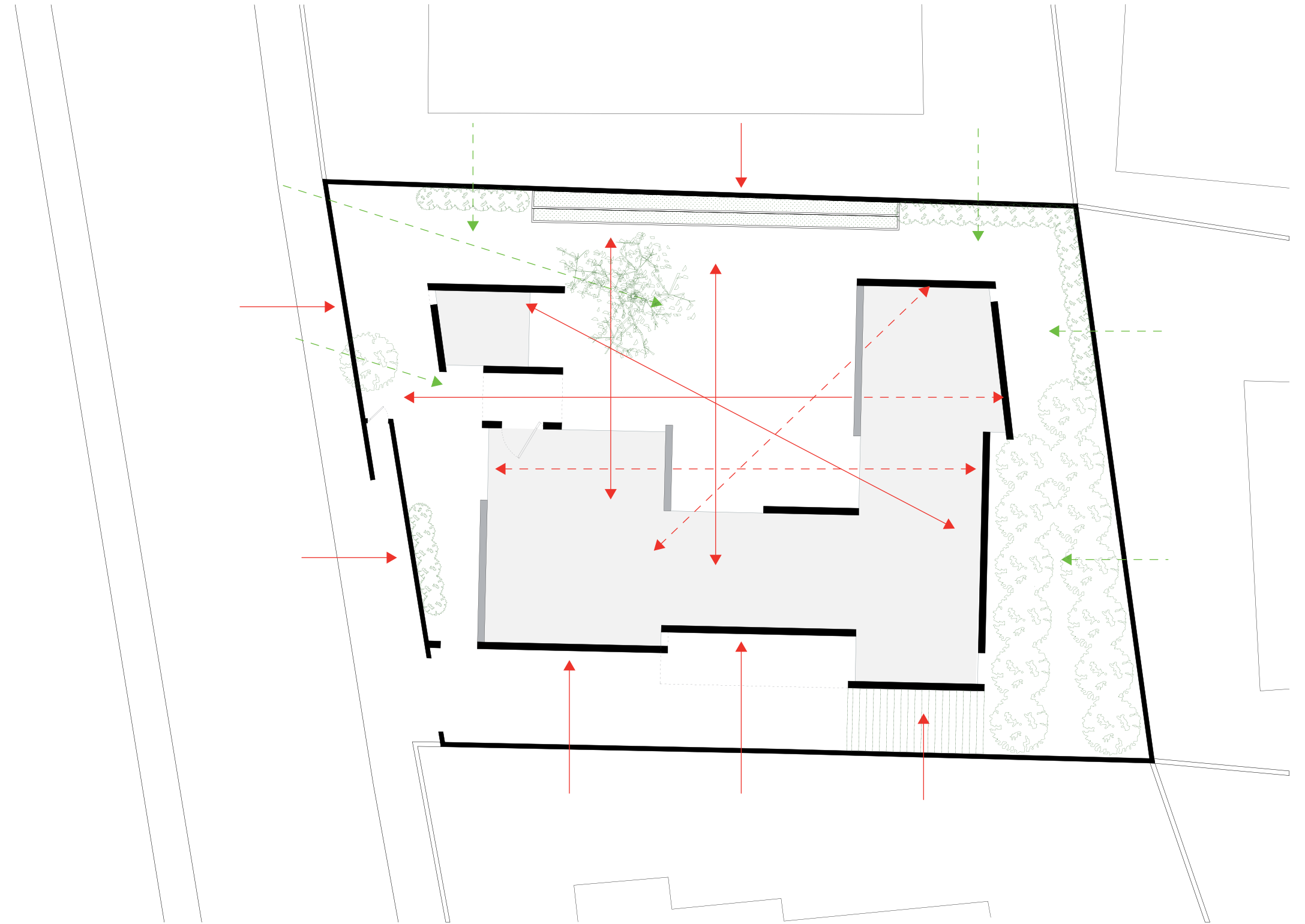


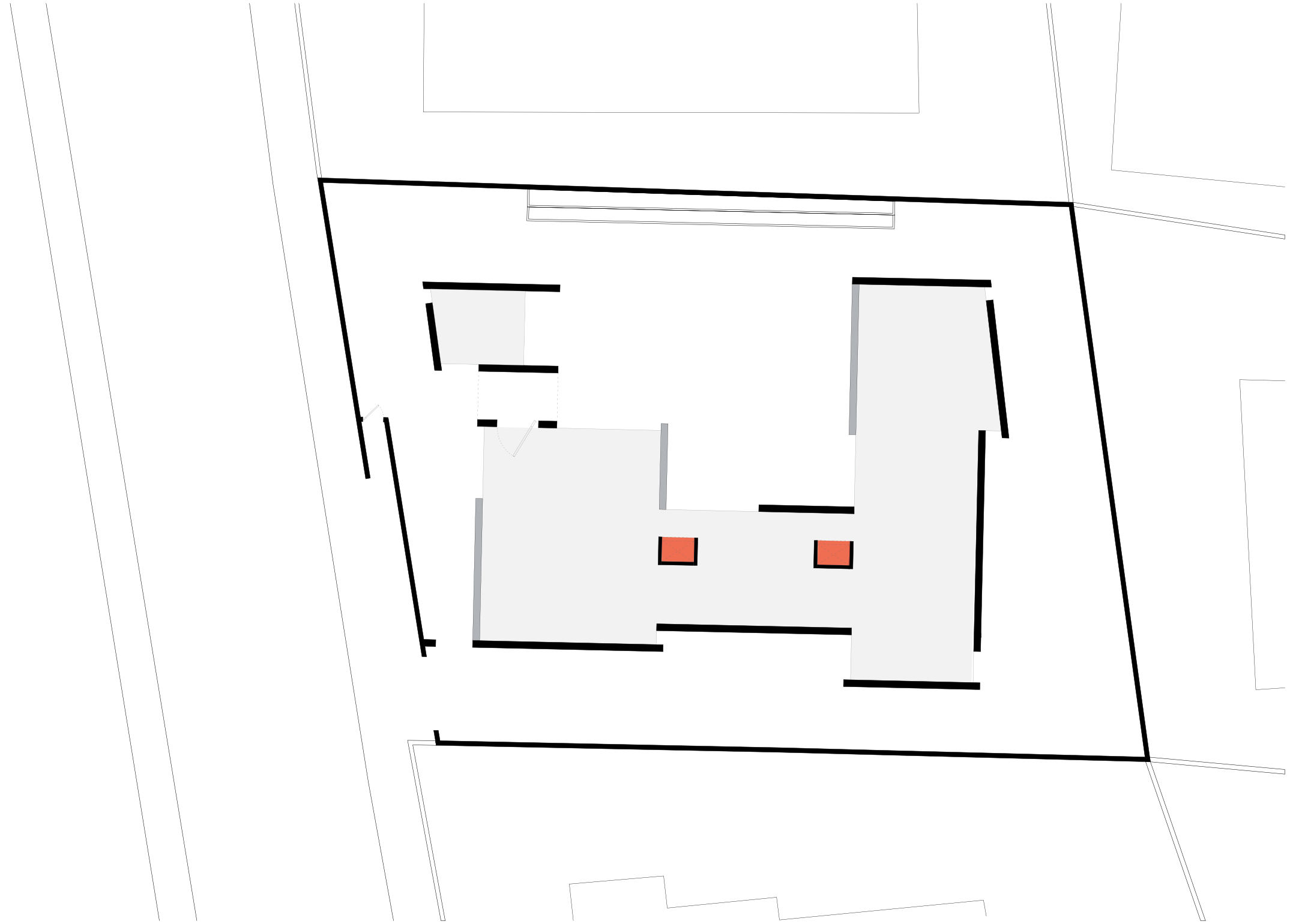
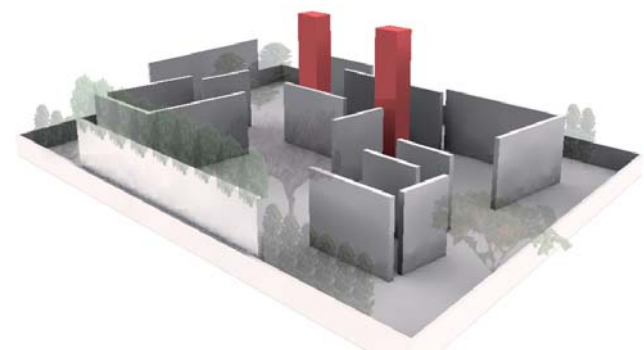
Cypress tree- shade + wall
Evergreen
Grows up to 100 ft high

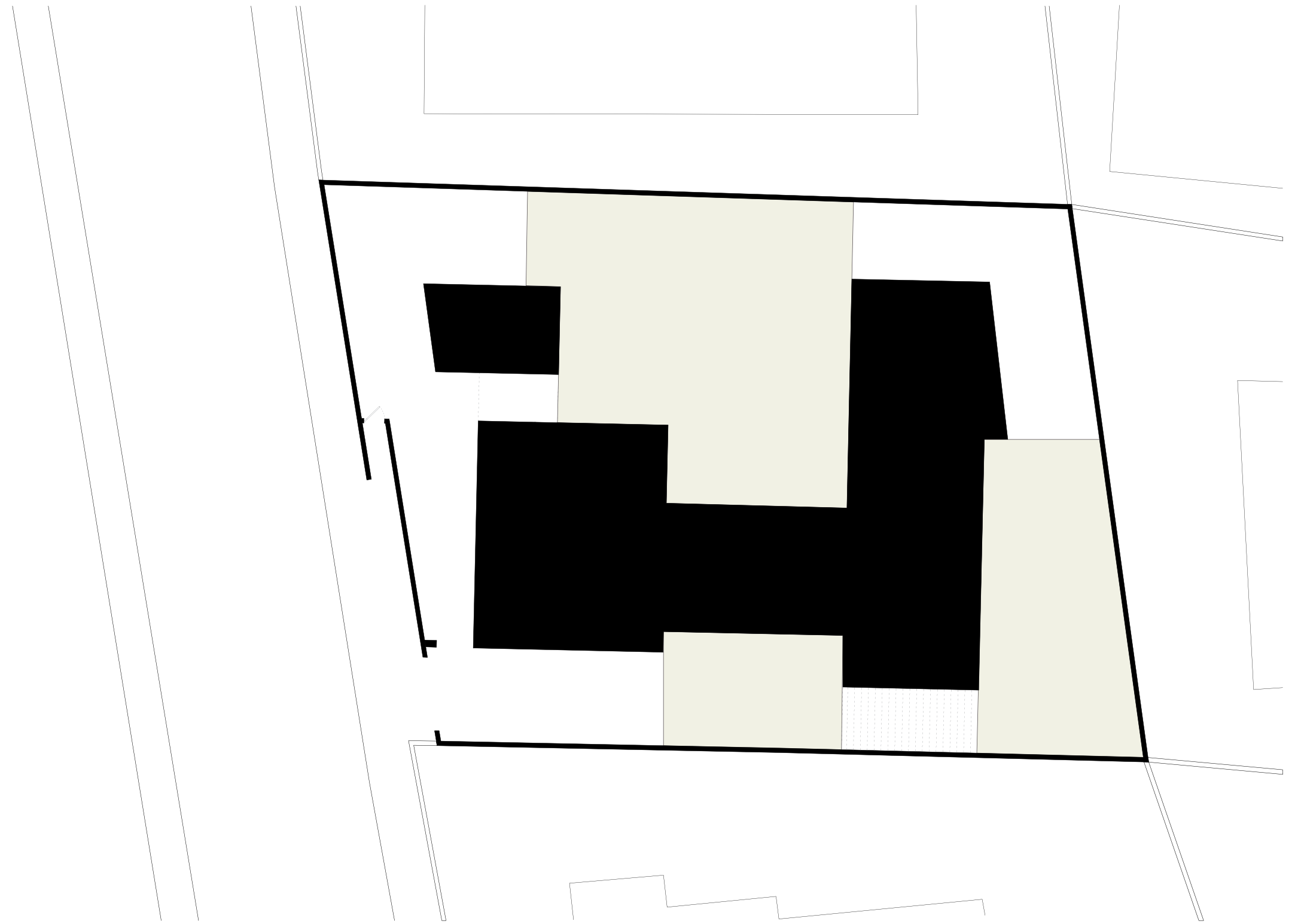


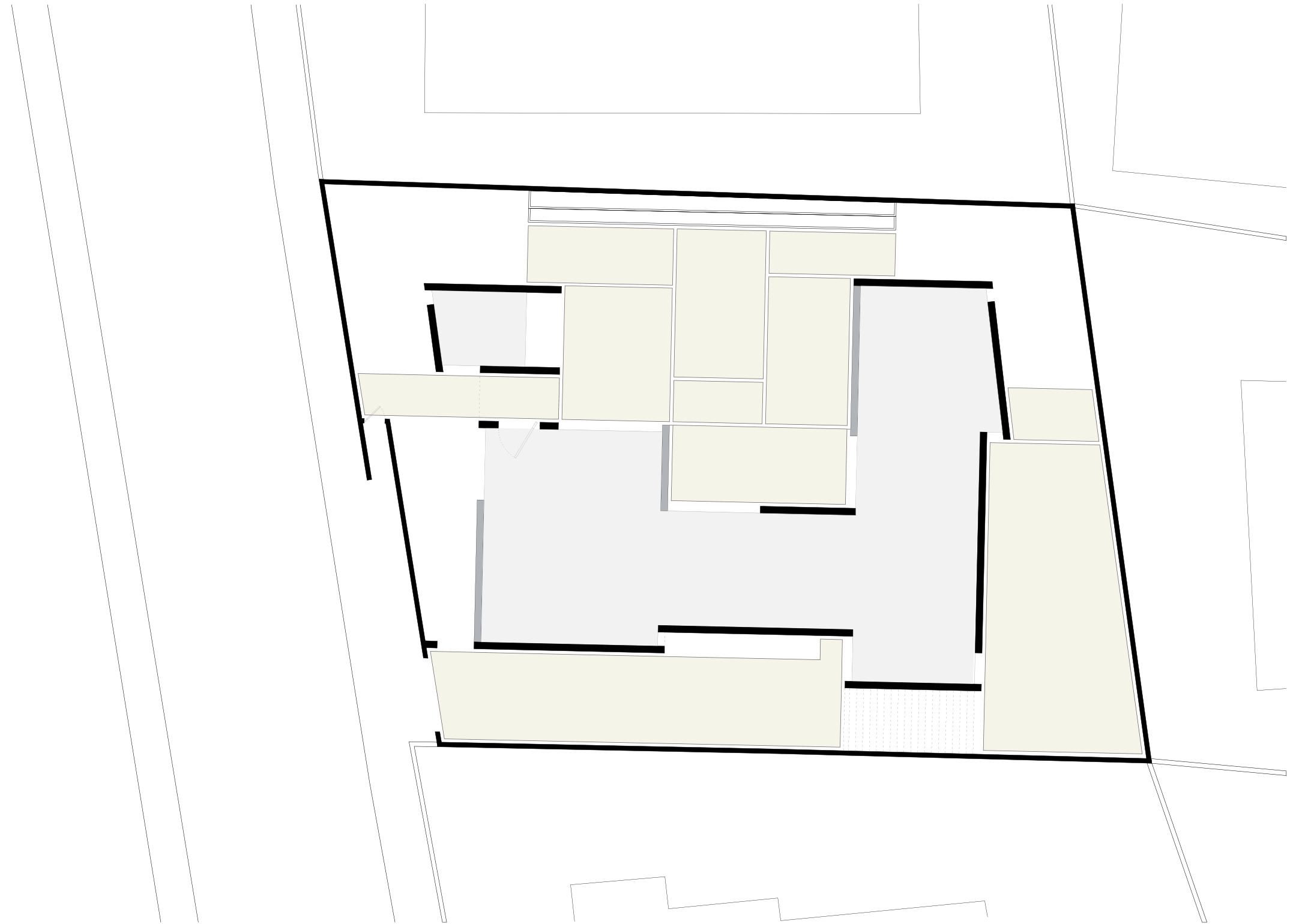
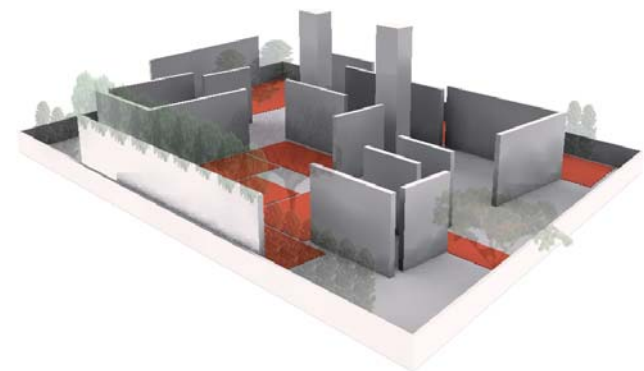


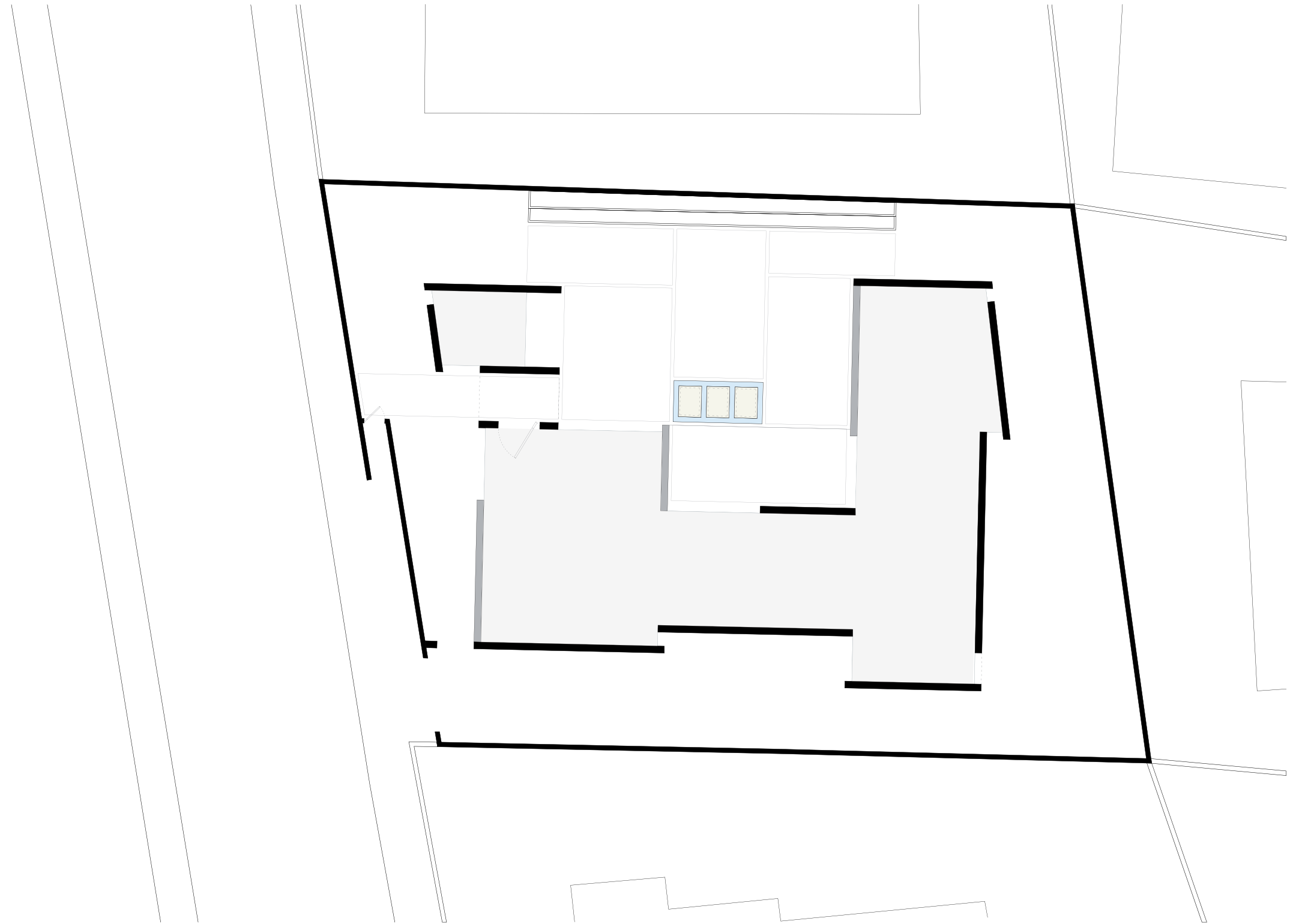
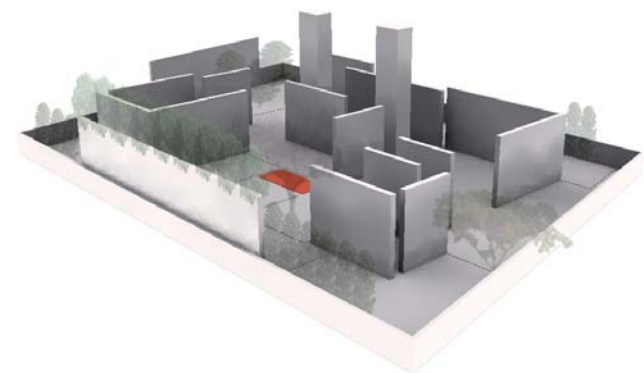


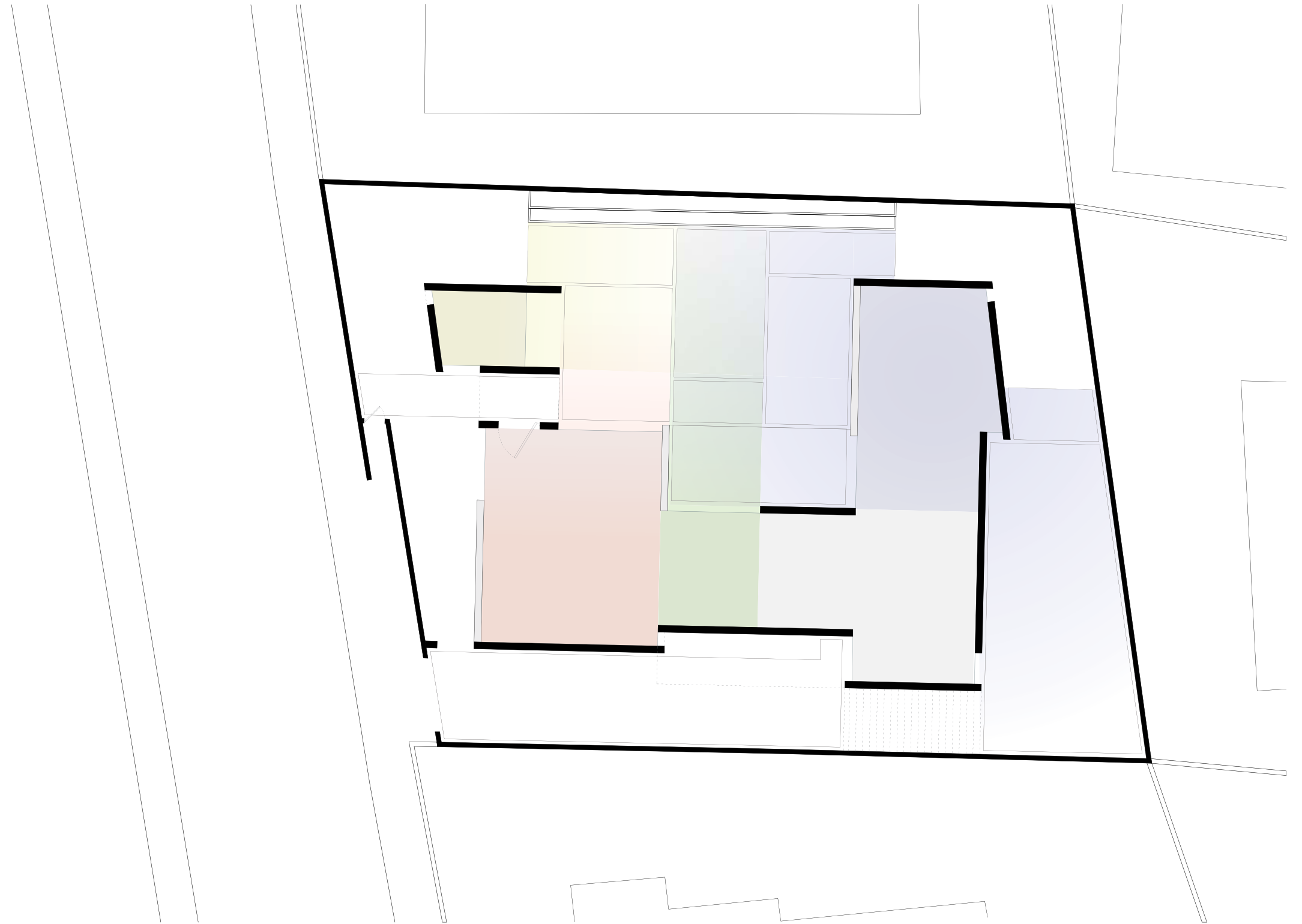


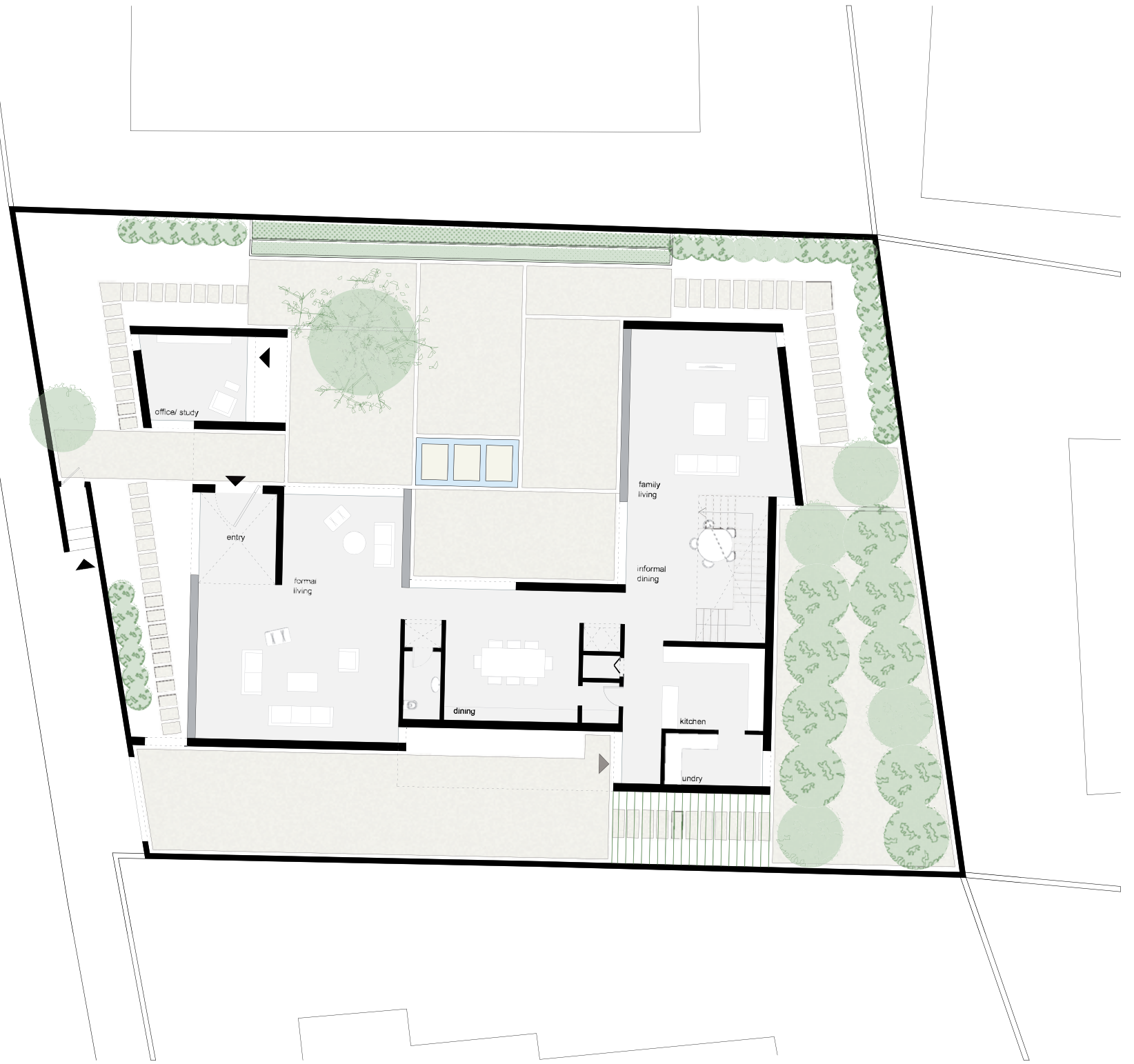
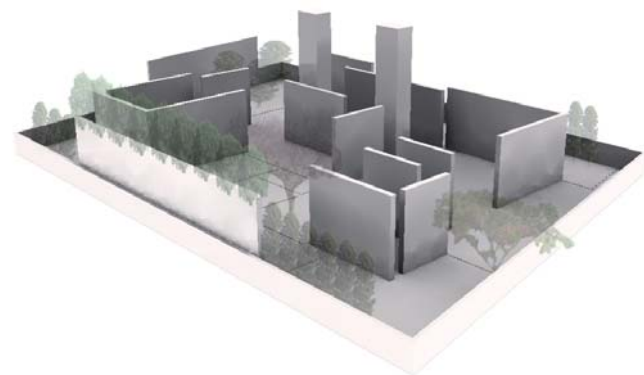


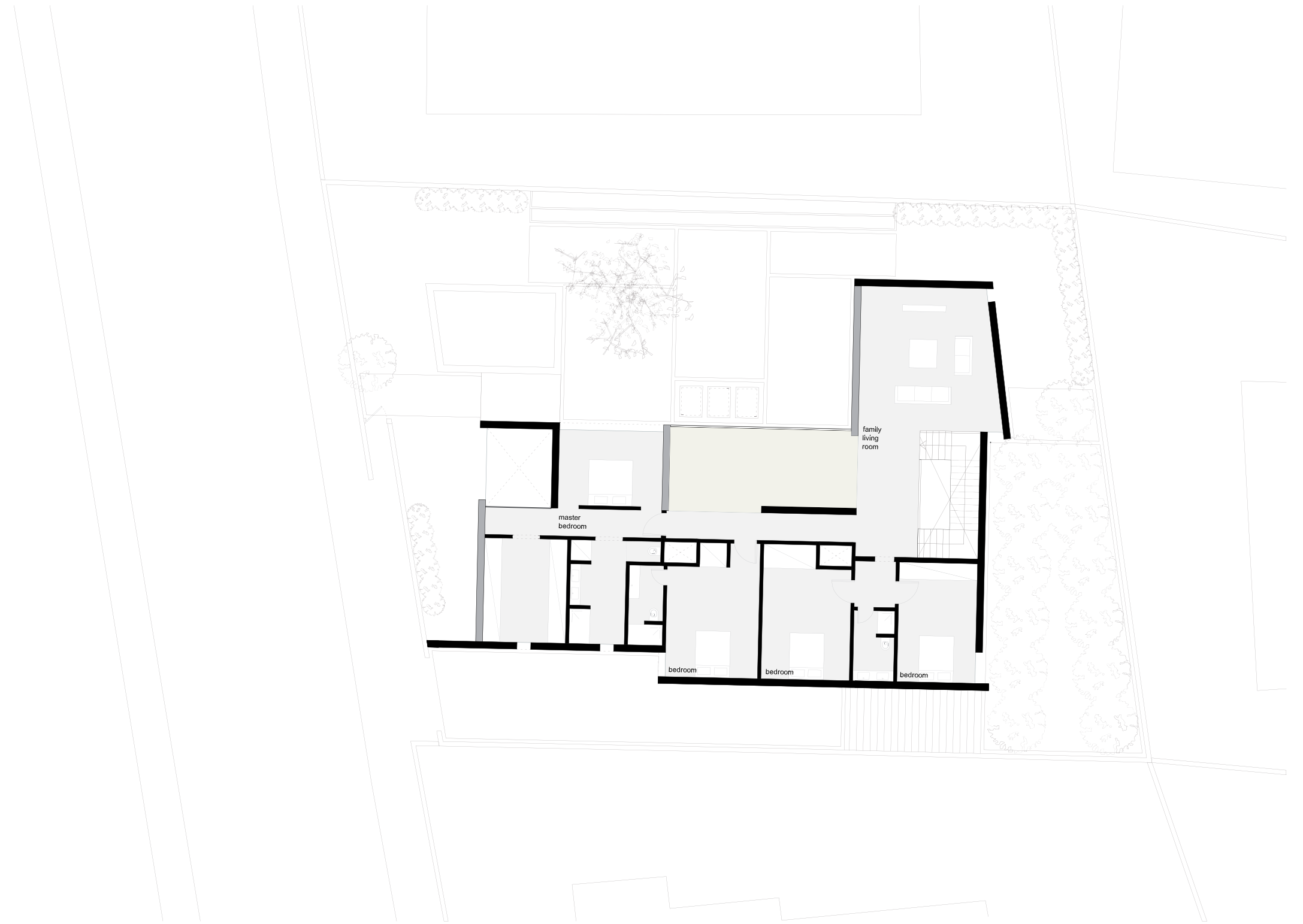








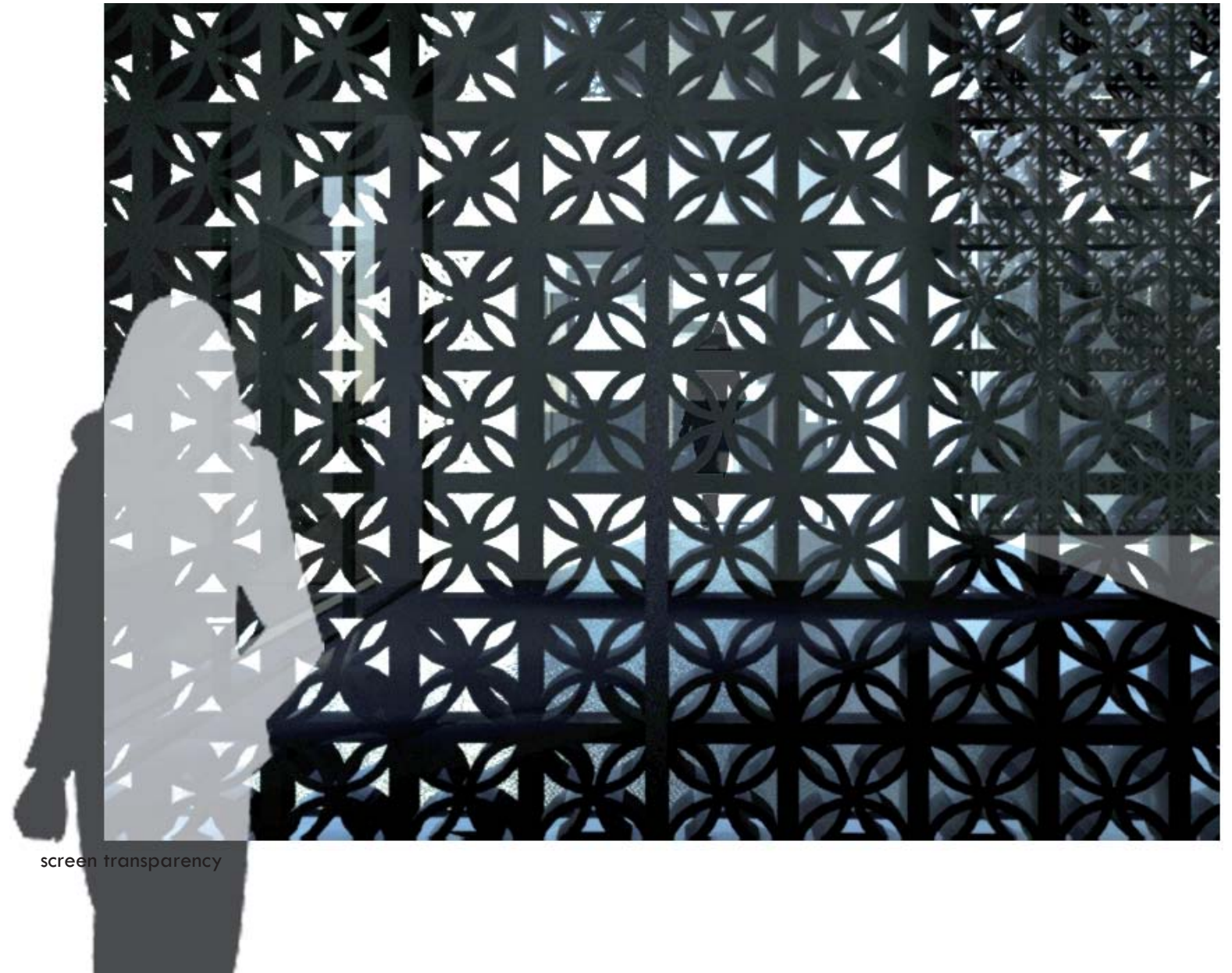








overall view



screen transparency



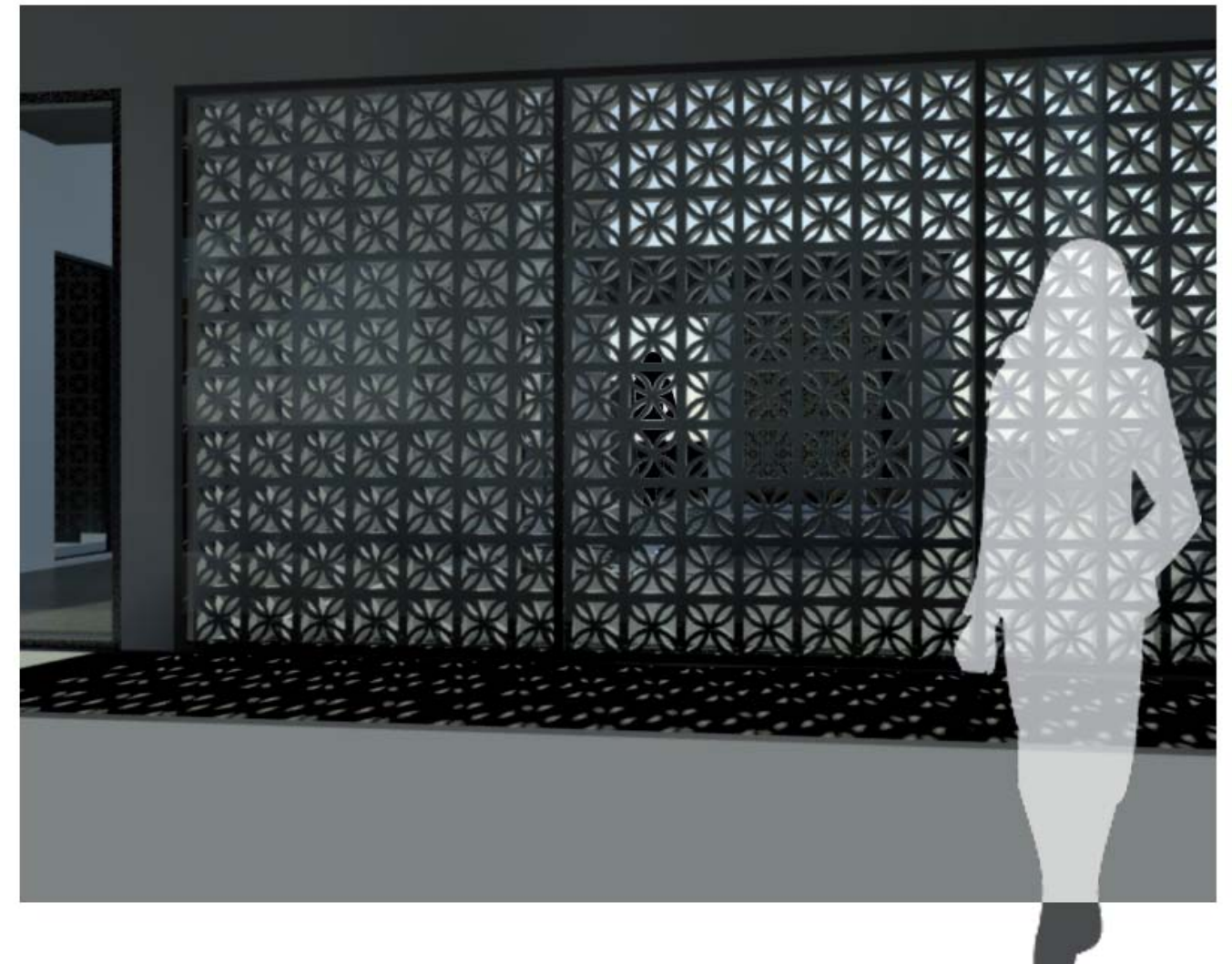
courtyard sun exposure during the day



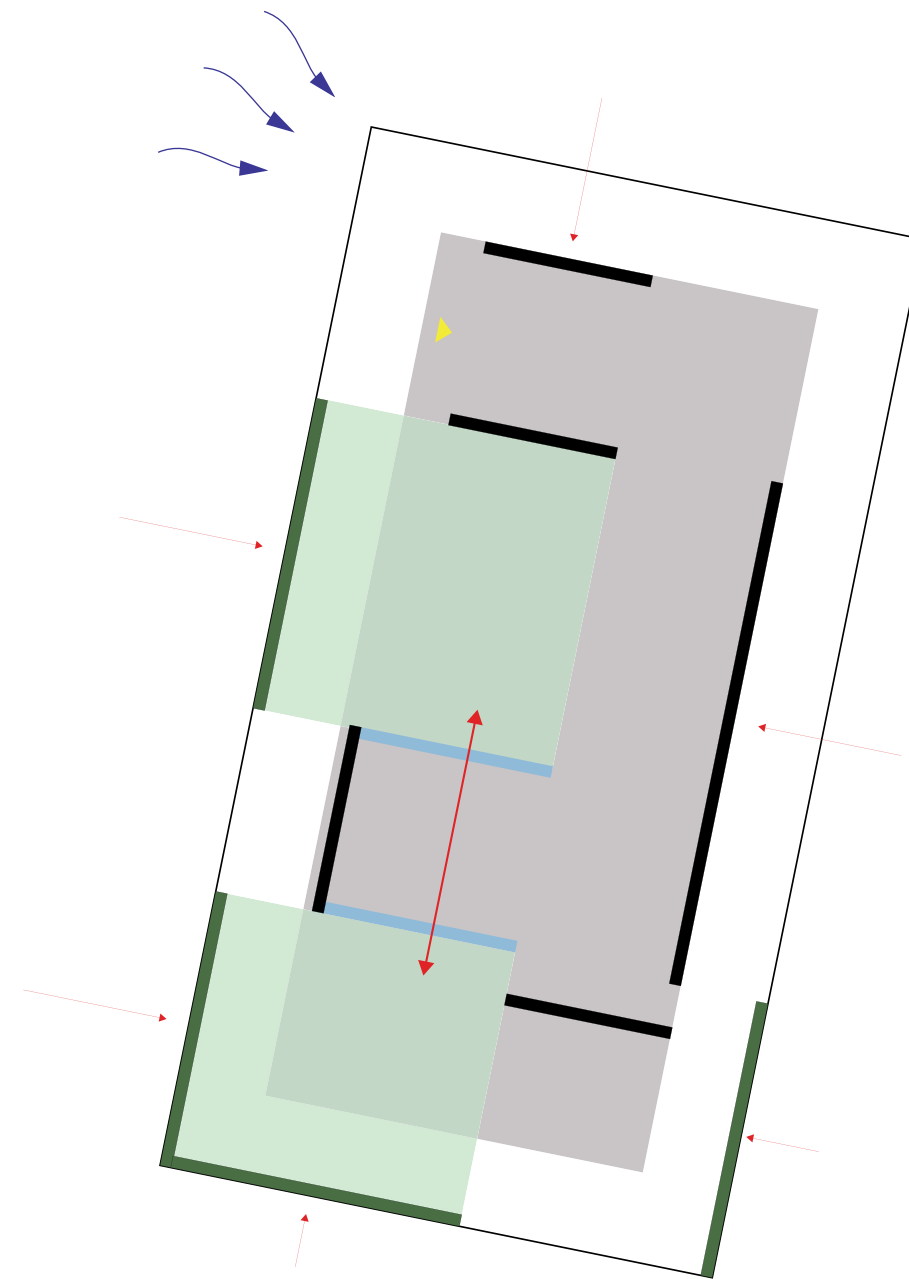
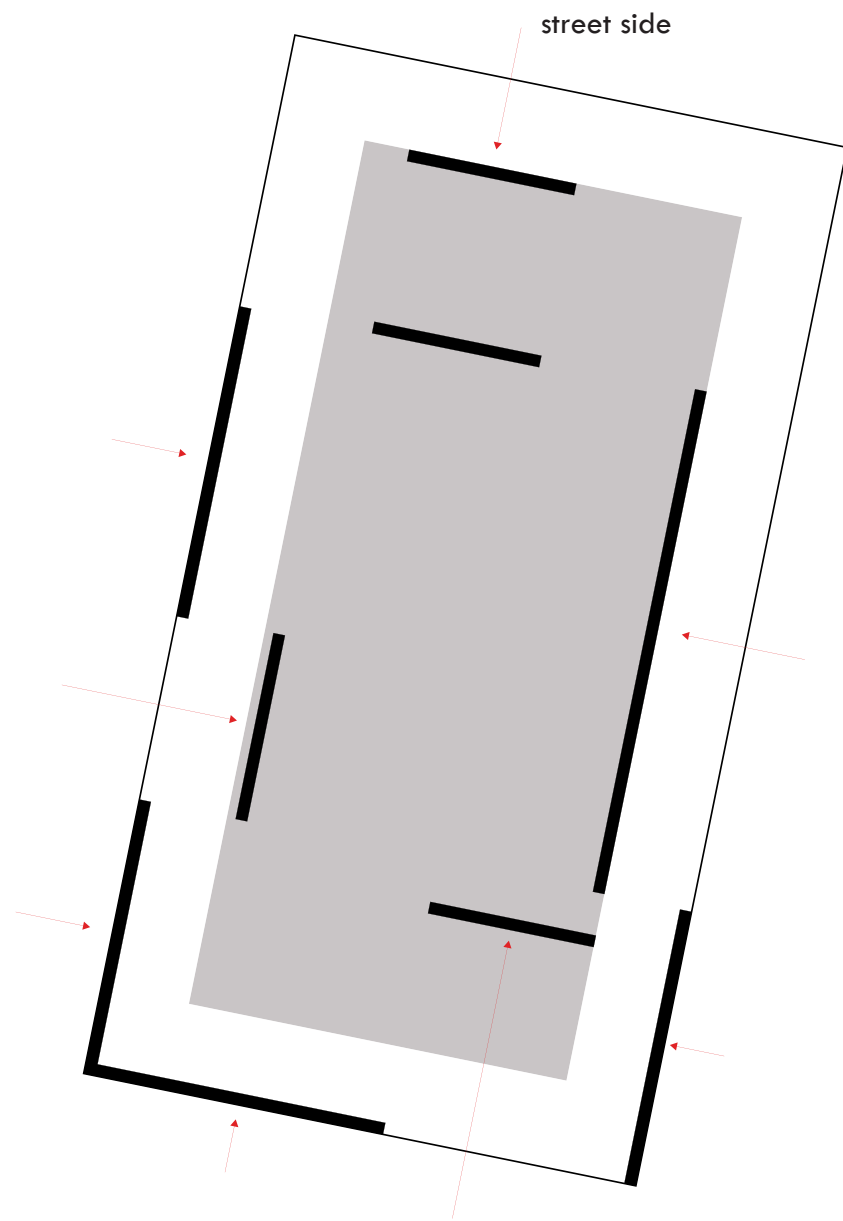
courtyard at night

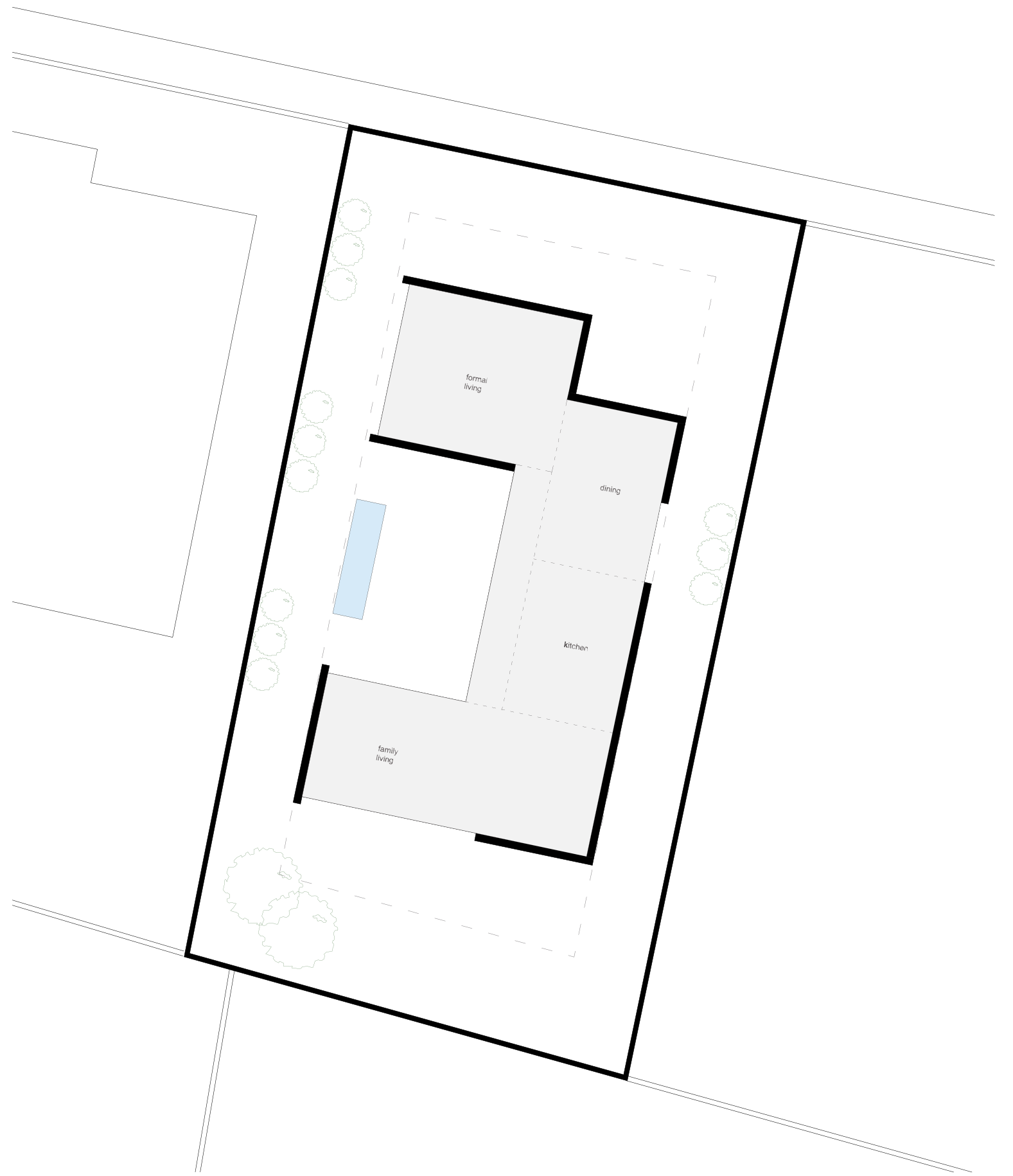


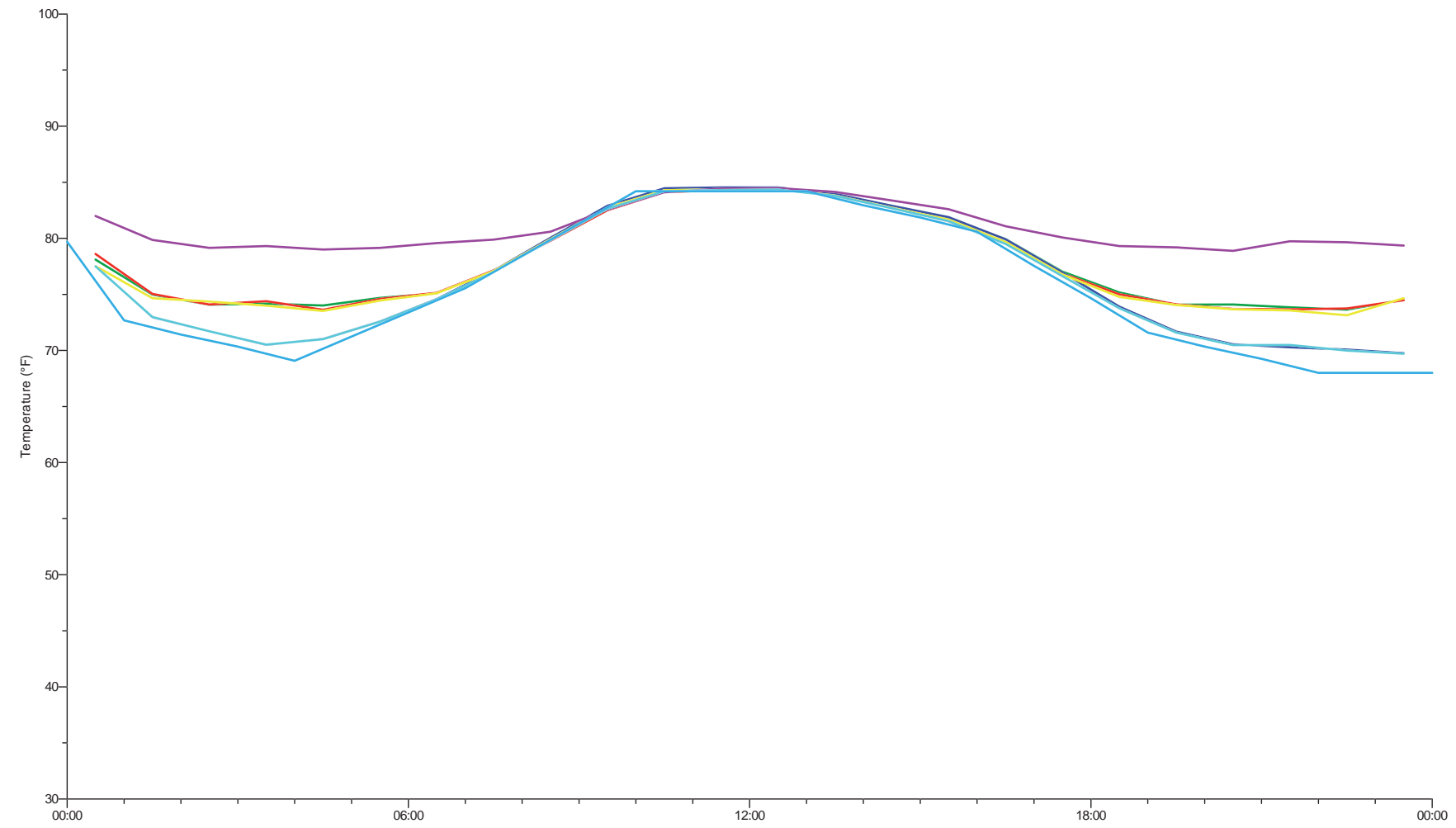
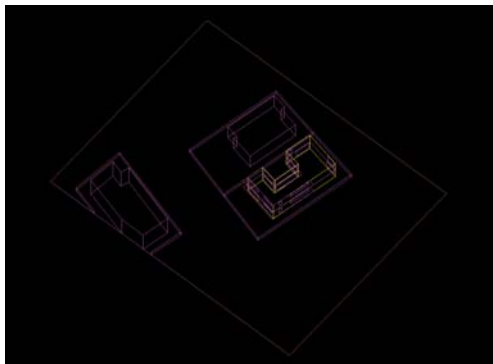
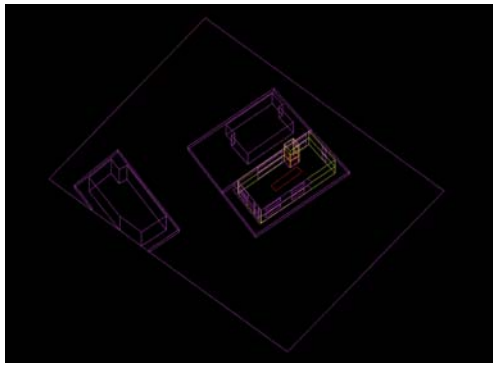
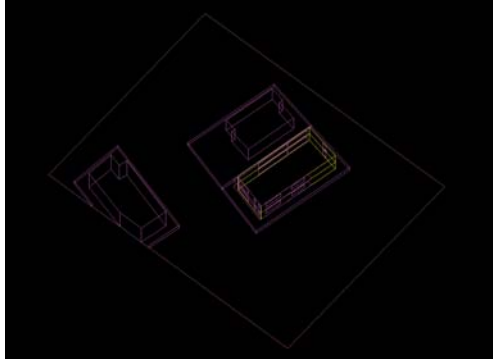
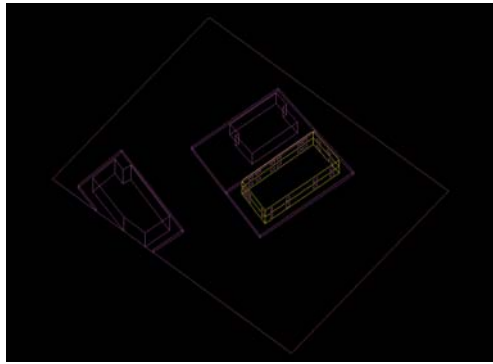
view through entrance



family living space transparency

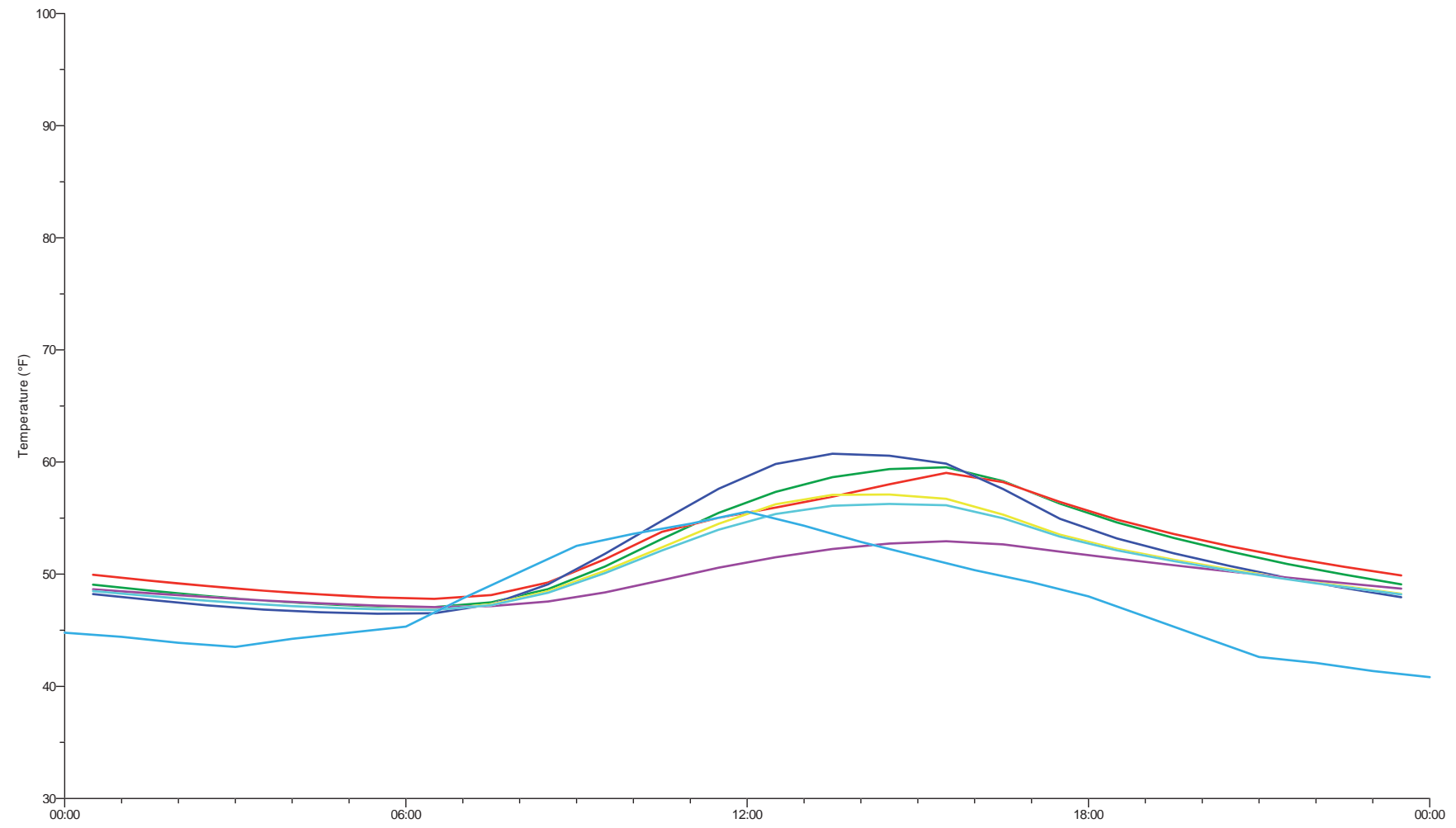
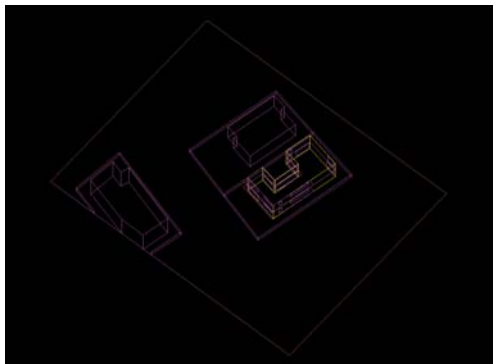
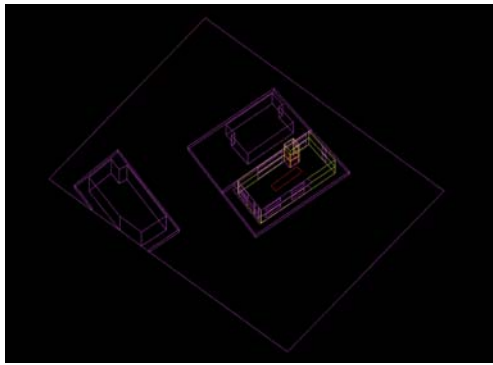
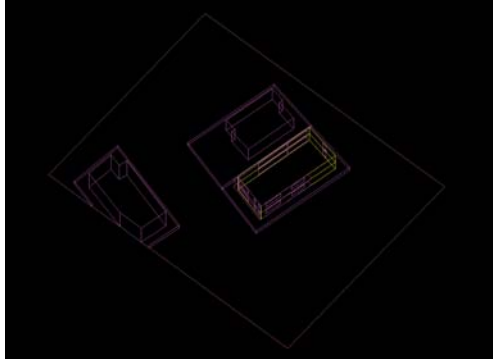
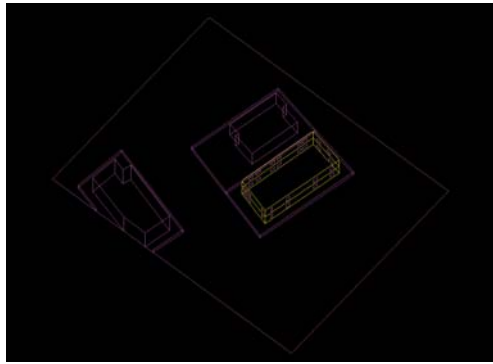






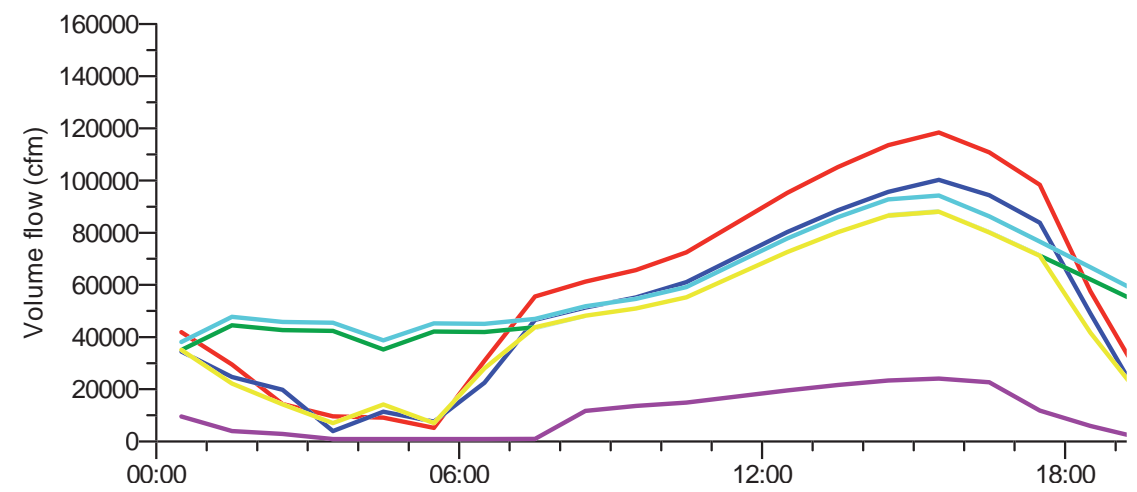
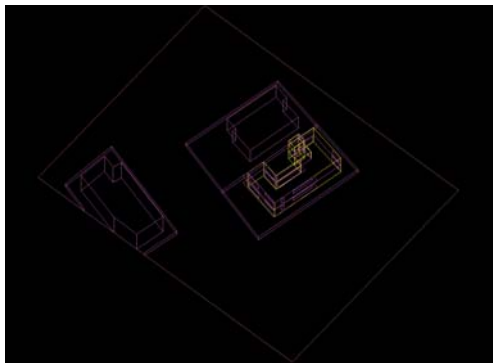
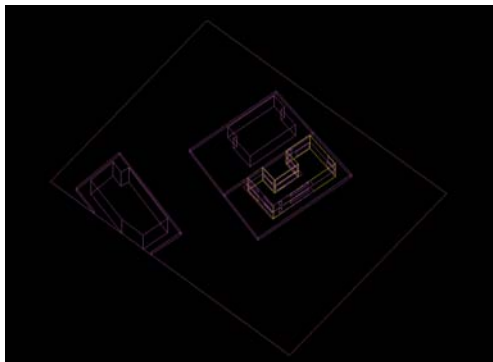
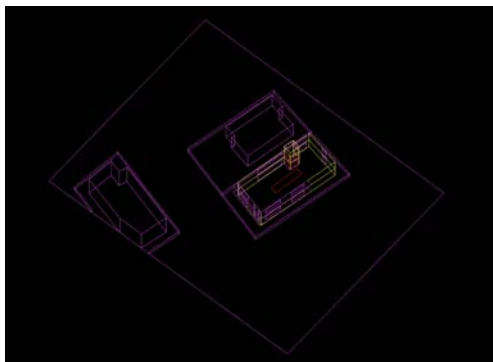
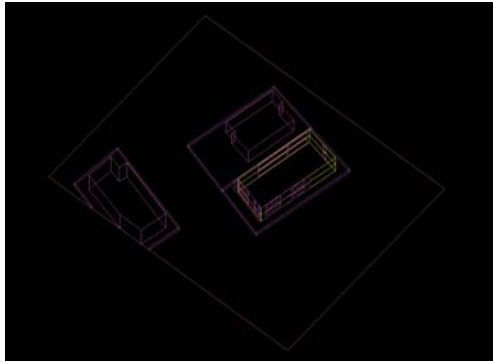
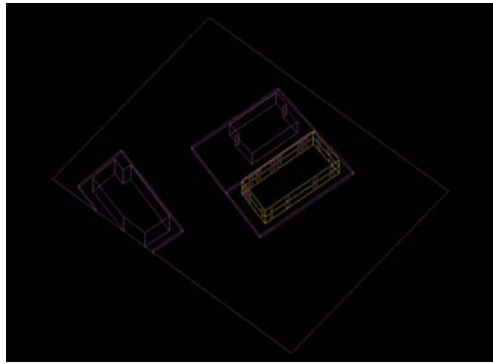
AUGUST 15

- Dry-bulb temperature: Jordan
- Air temperature in basic
- Air temperature with shading
- Air temperature with wind tower
- Air temperature with courtyard
- Air temperature with trees
- Air temperature of final design



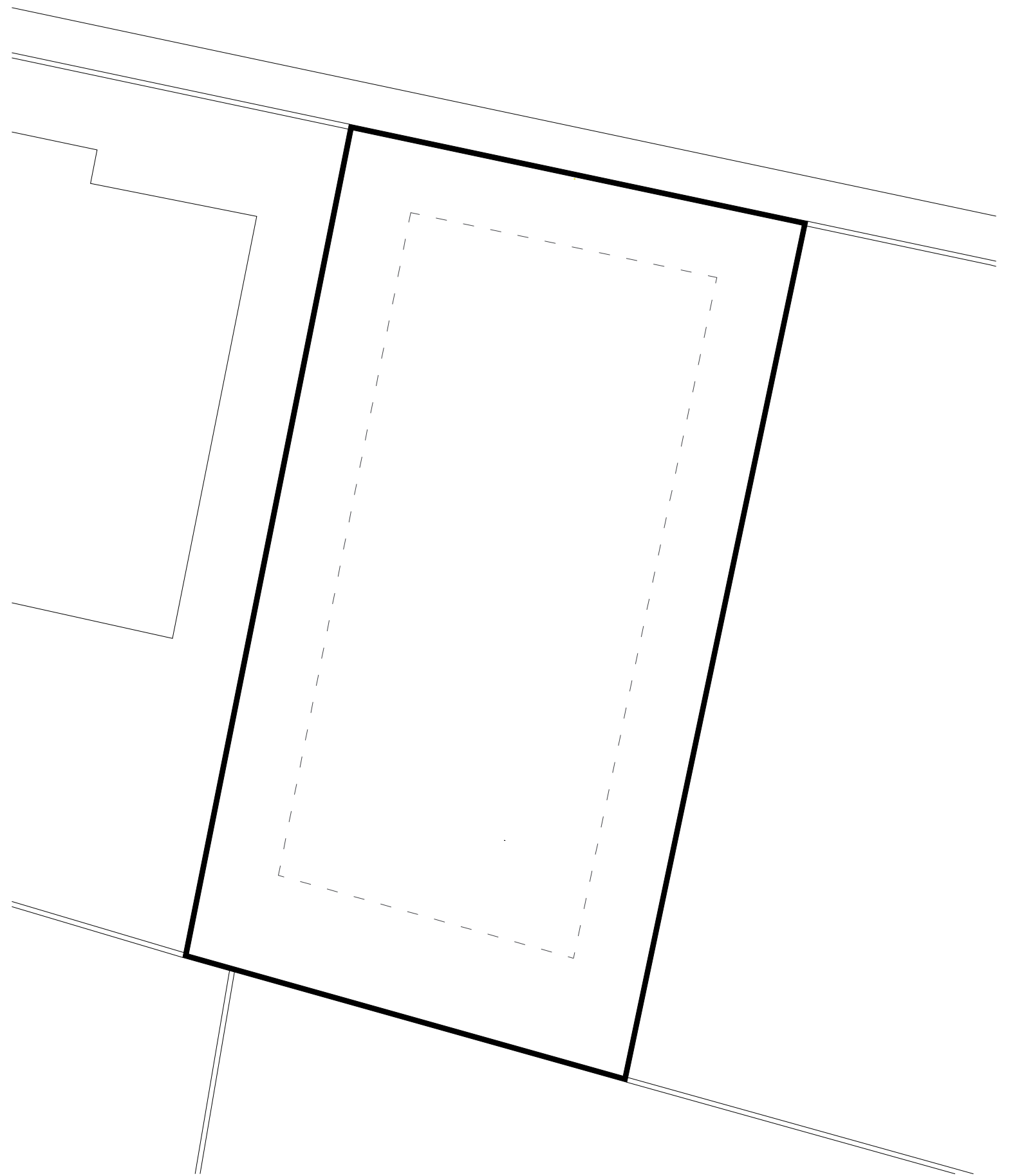
JANUARY 15

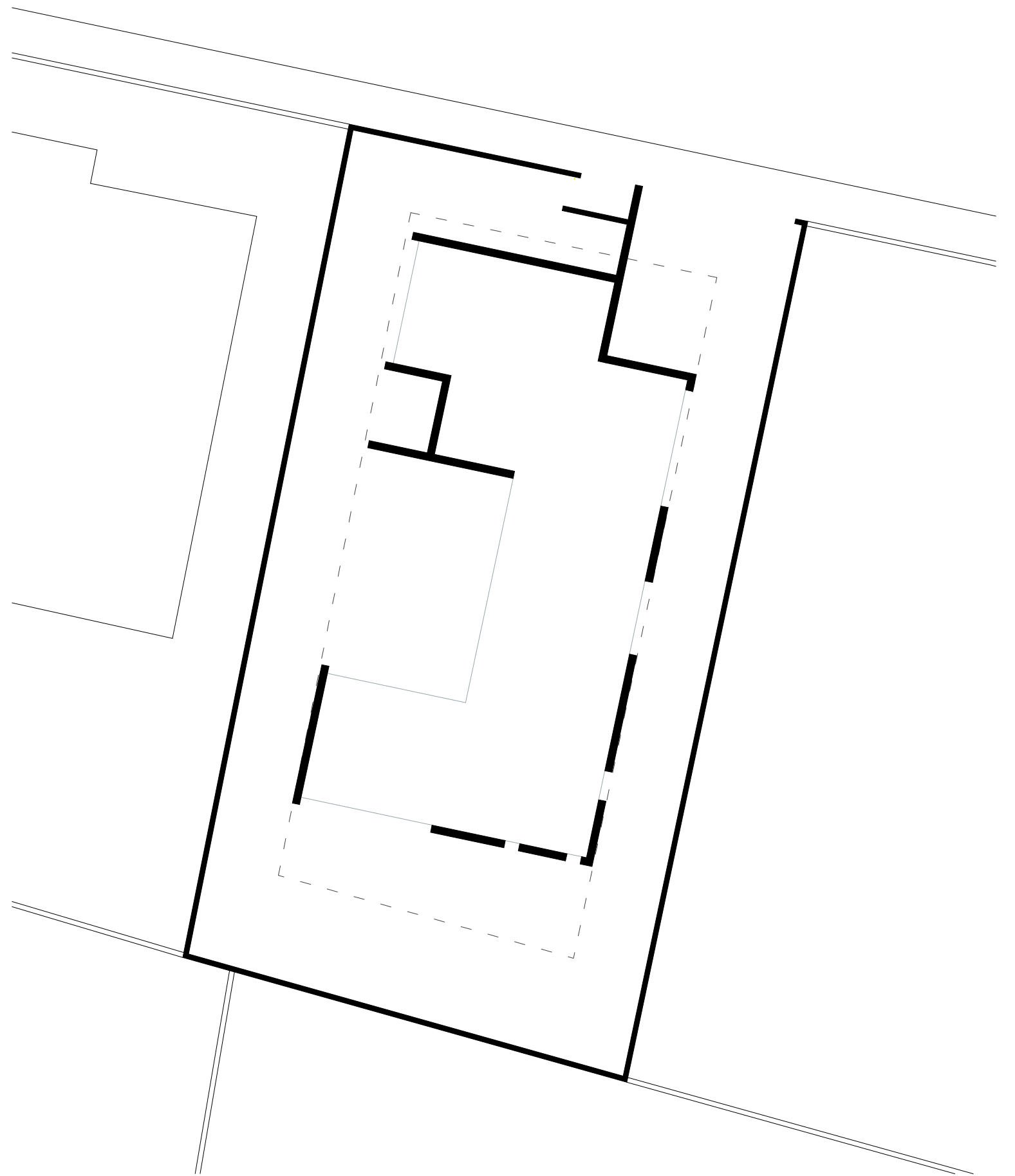
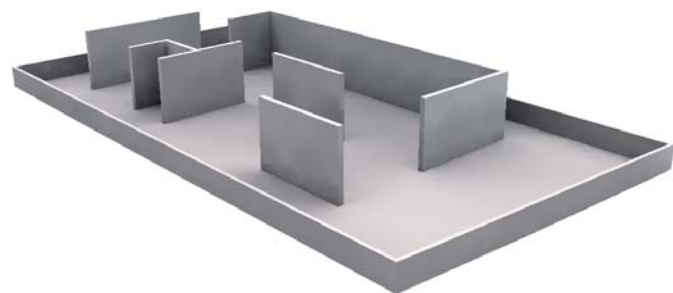
- Dry-bulb temperature: Jordan
- Air temperature in basic
- Air temperature with shading
- Air temperature with wind tower
- Air temperature with courtyard
- Air temperature with trees
- Air temperature of final design

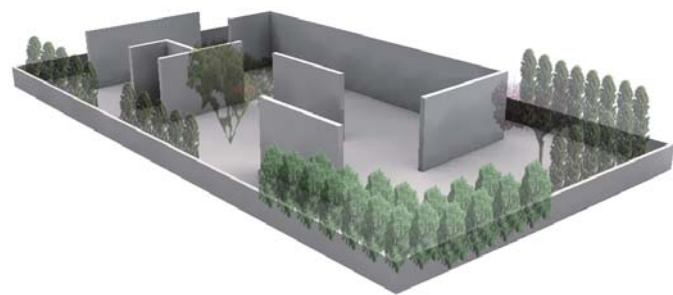


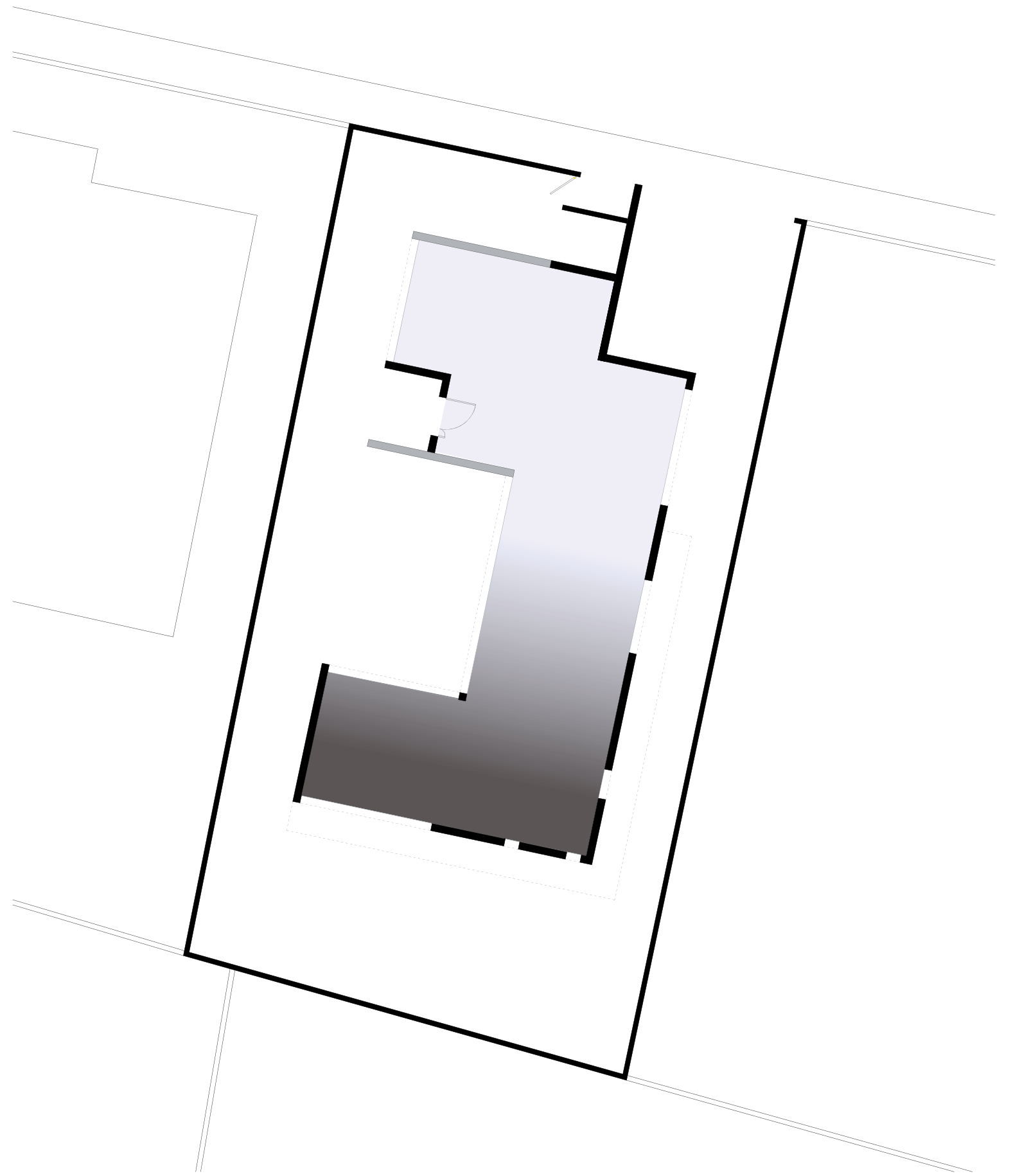
SUMMER

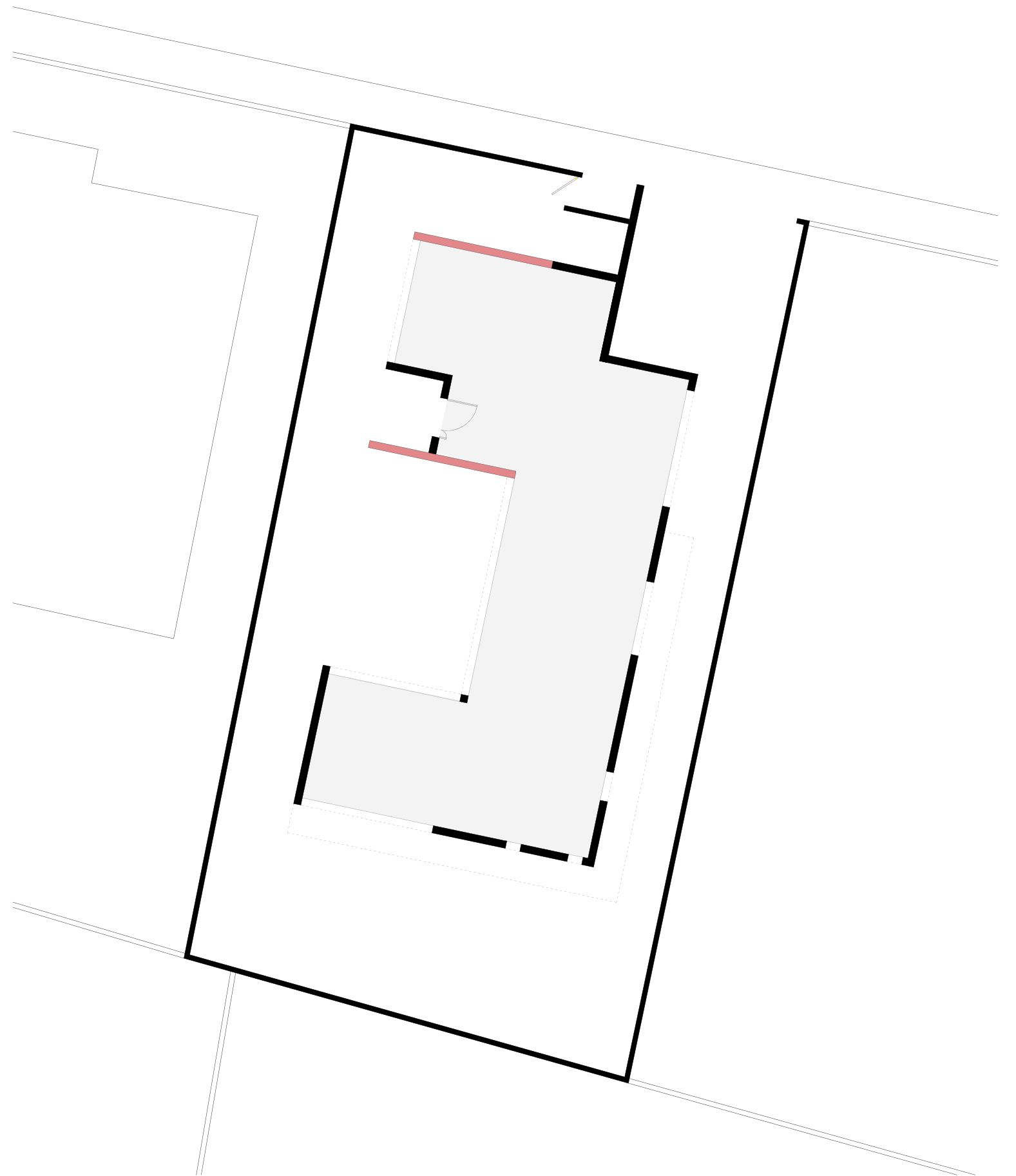
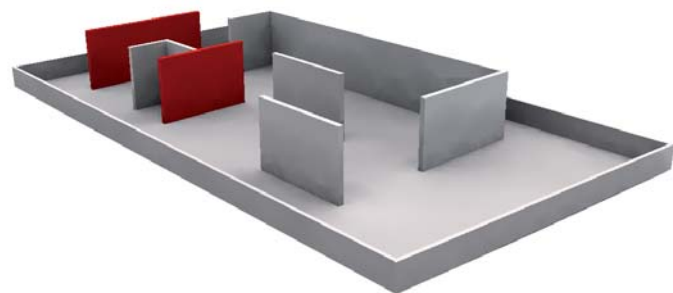
- External ventilation in basic
- External ventilation with shading
- External ventilation with wind tower
- External ventilation with courtyard
- External ventilation with trees
- External ventilation of final design







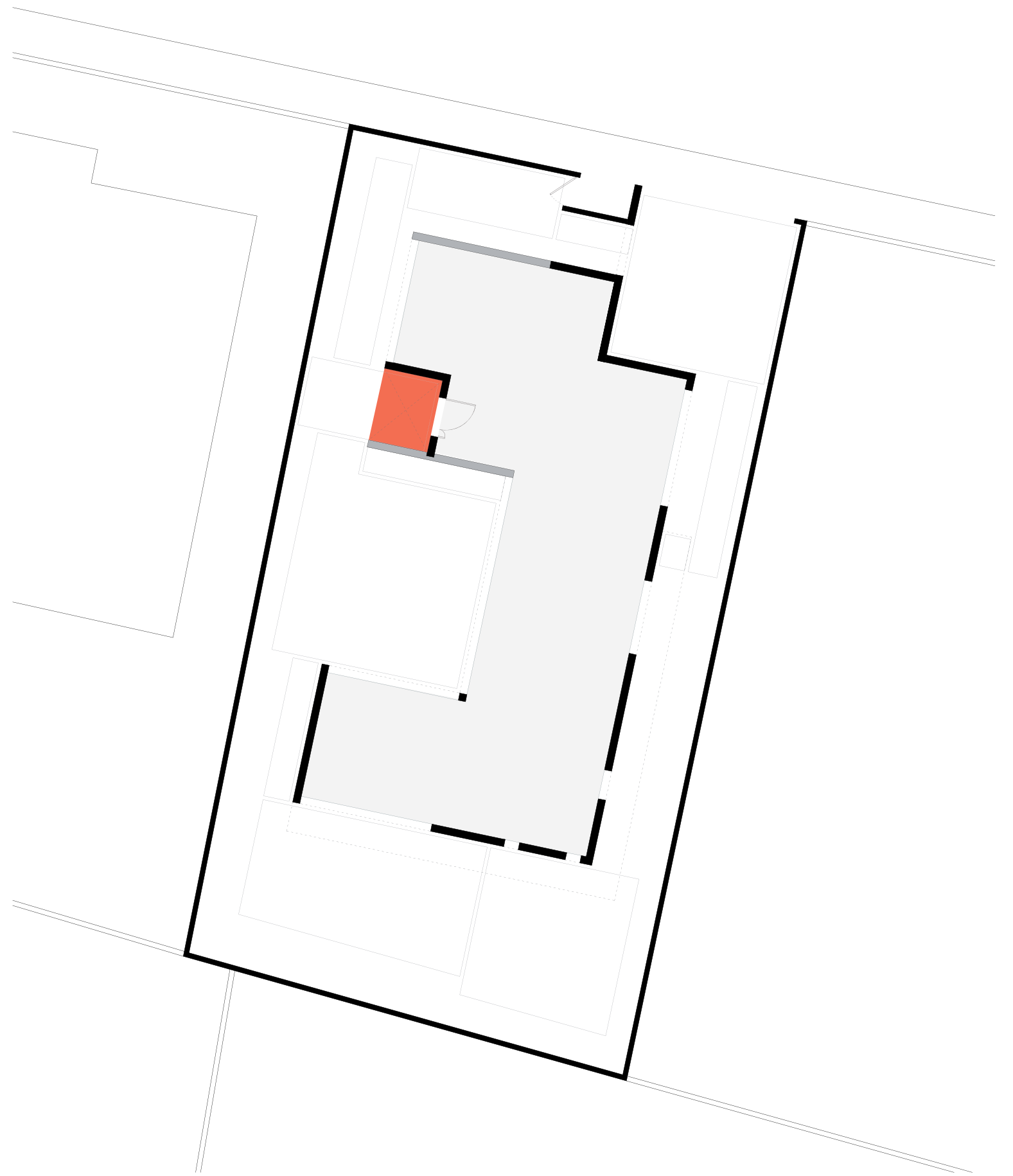
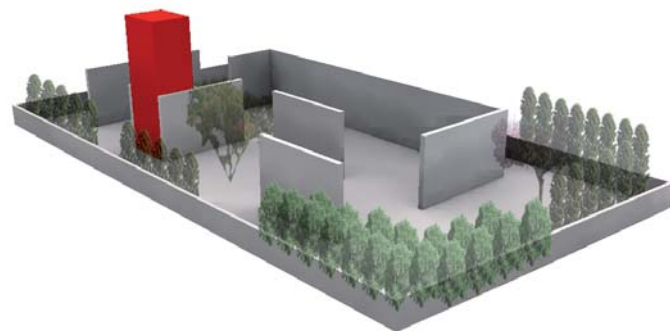


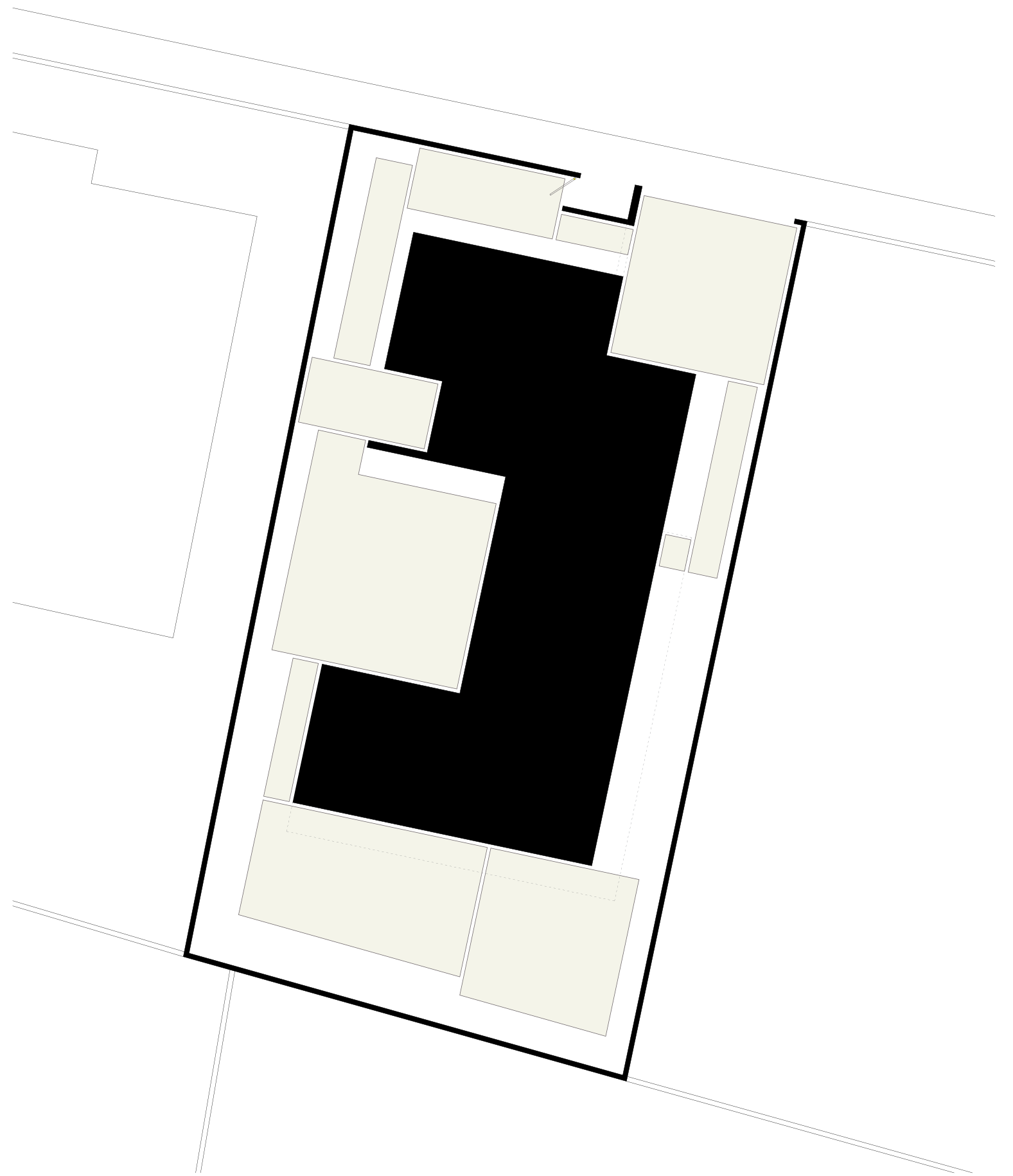


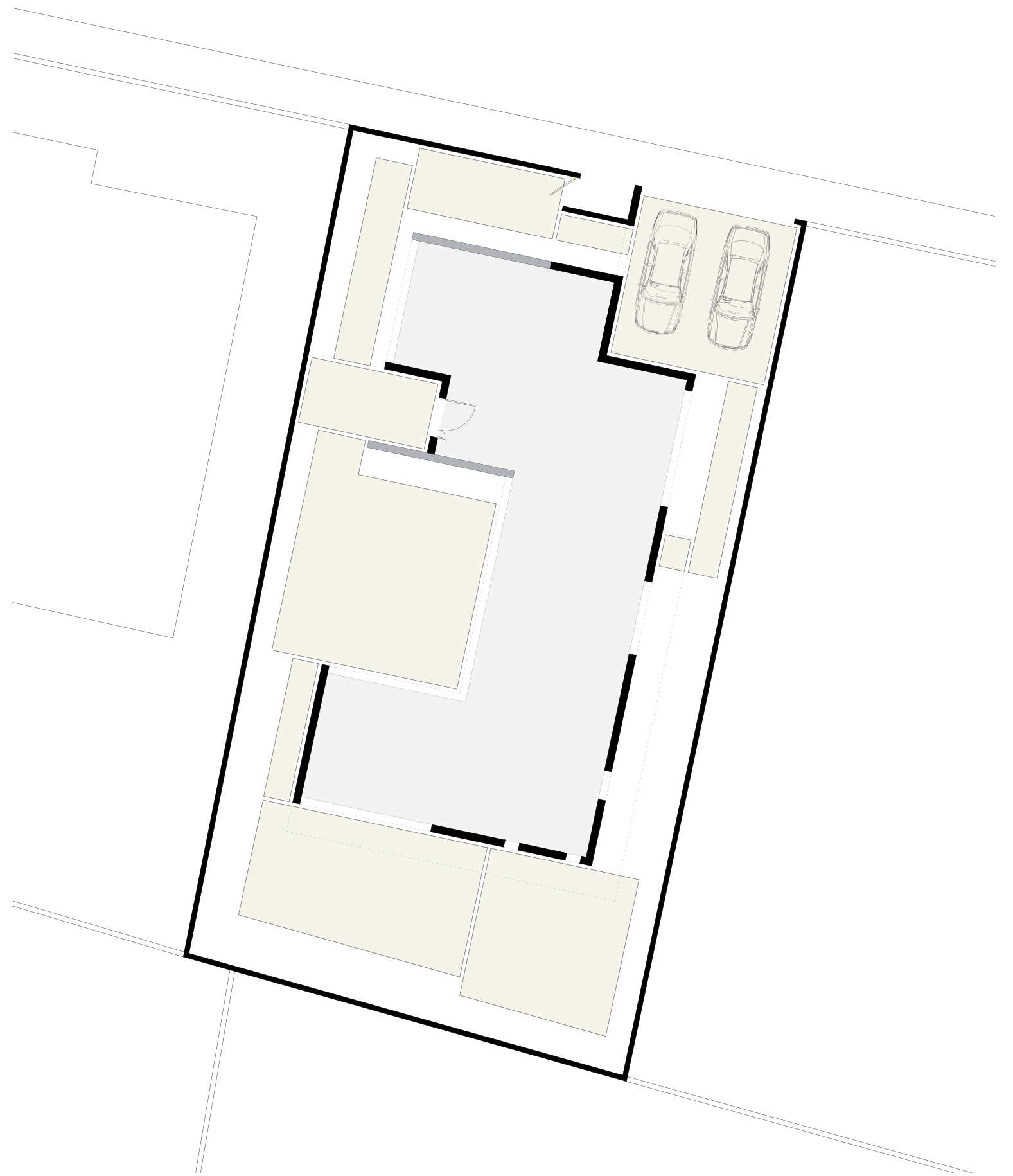
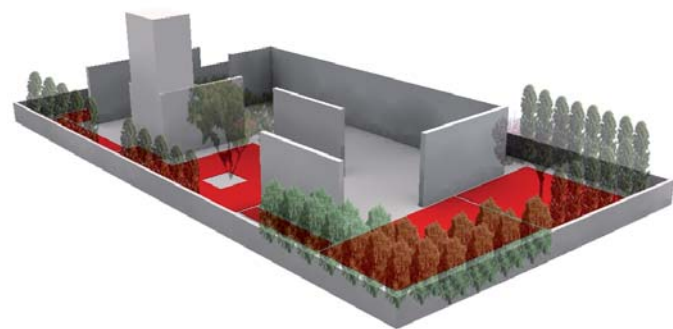


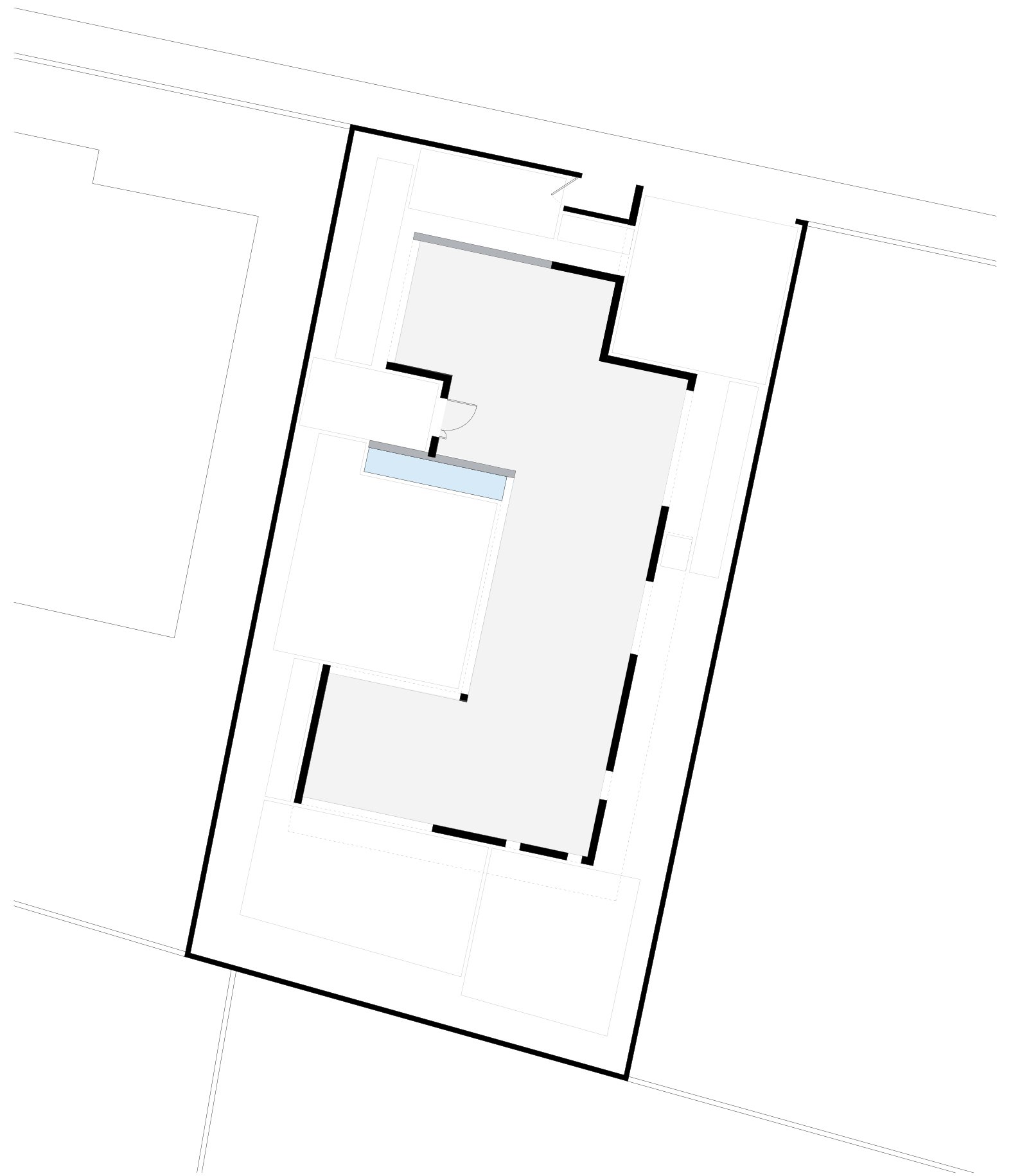
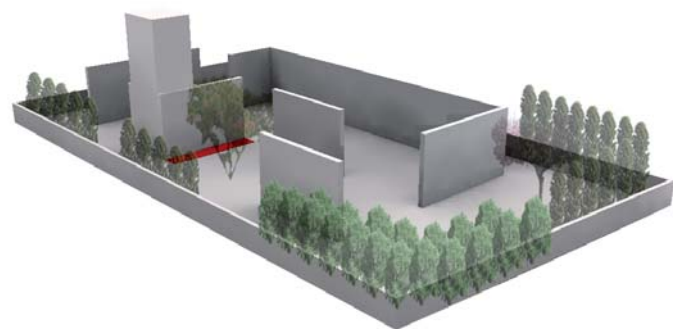
views: in, out, through / Suburban site 70

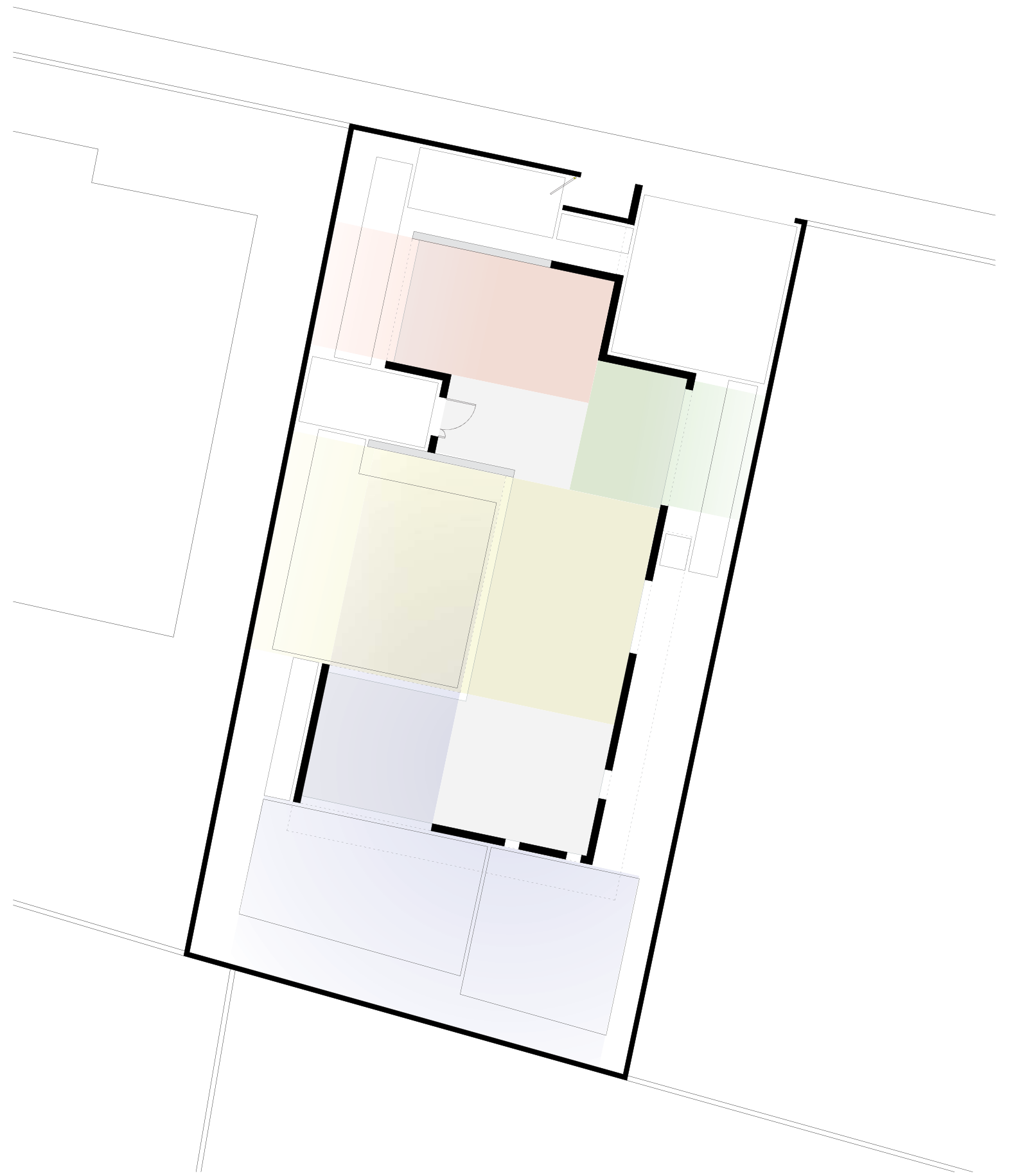


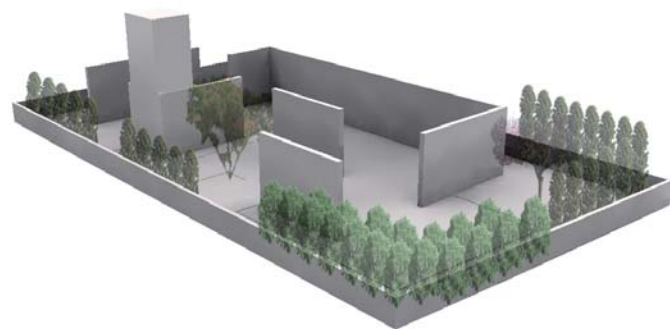






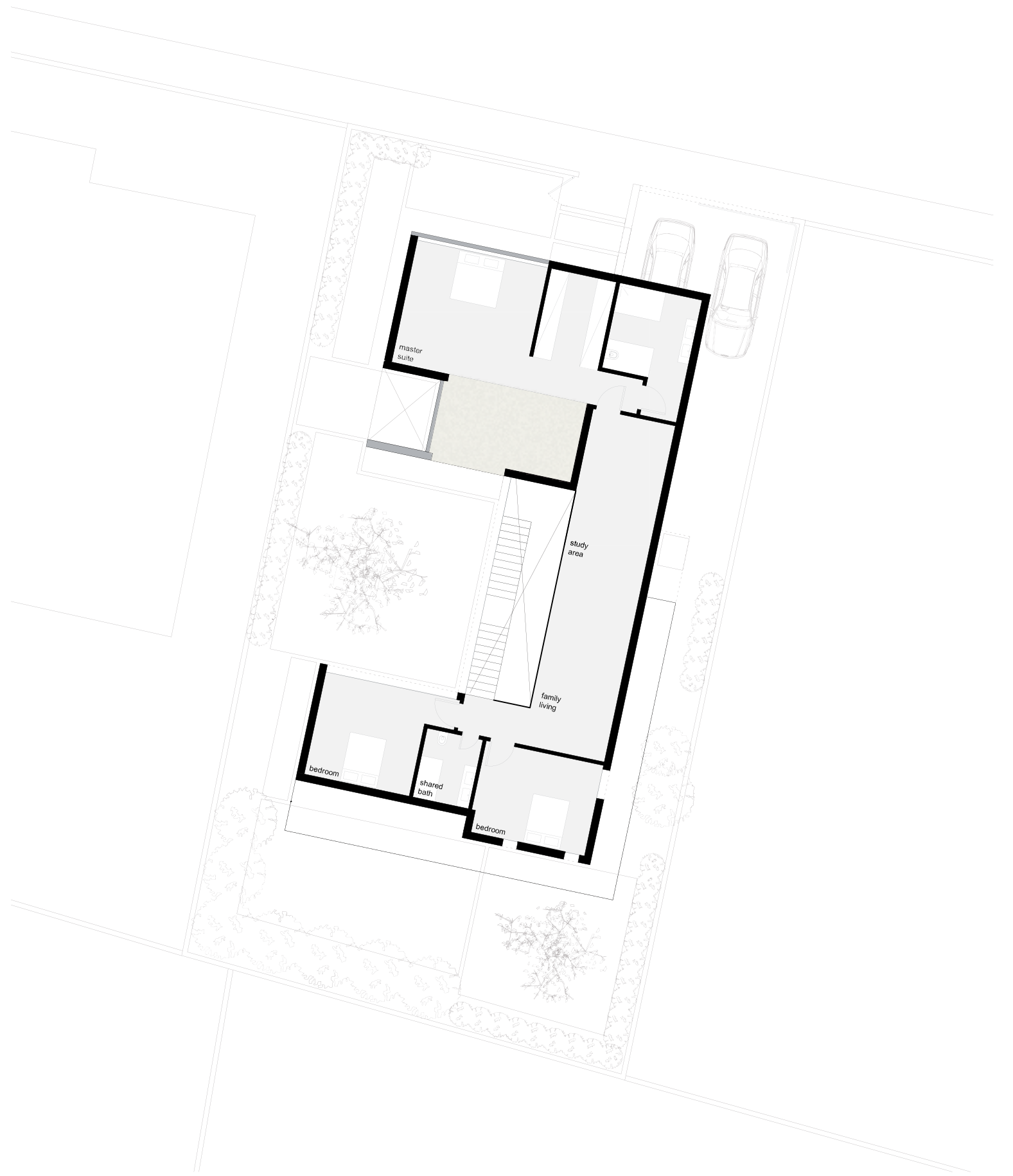






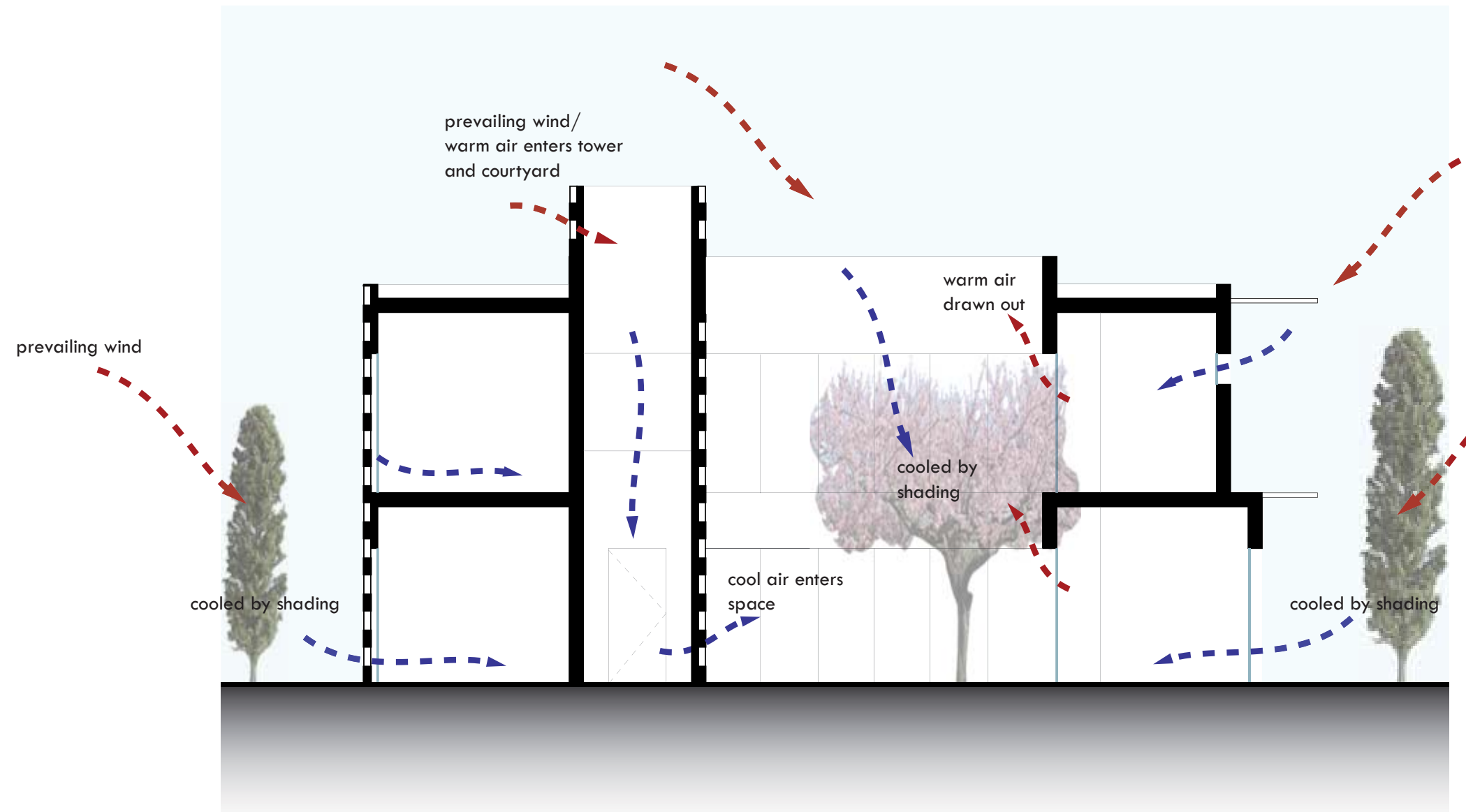
proposed typology- ground floor / Suburban site 76





proposed typology- second floor / Suburban site 17



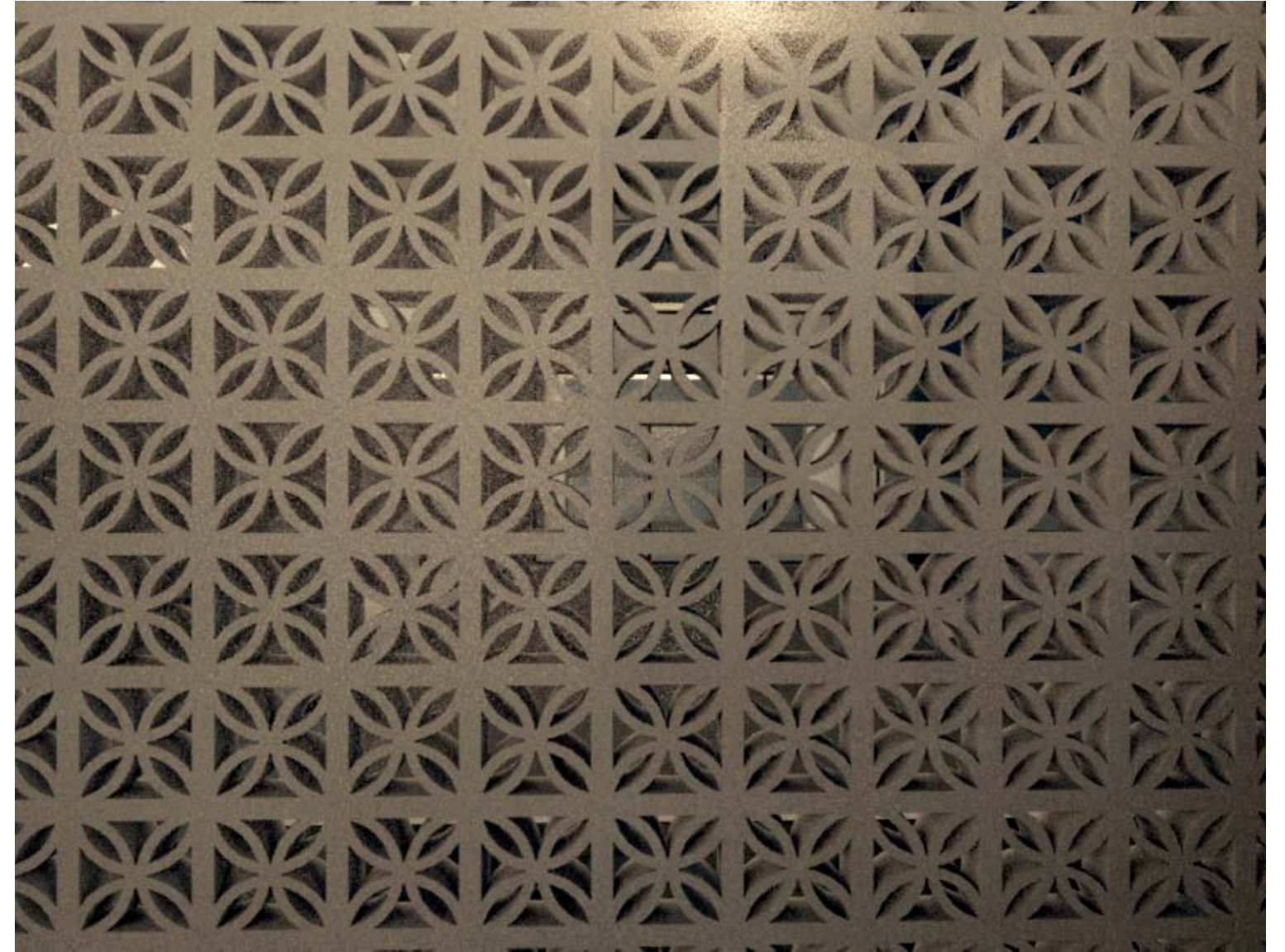


suburban proposal section showing air flow

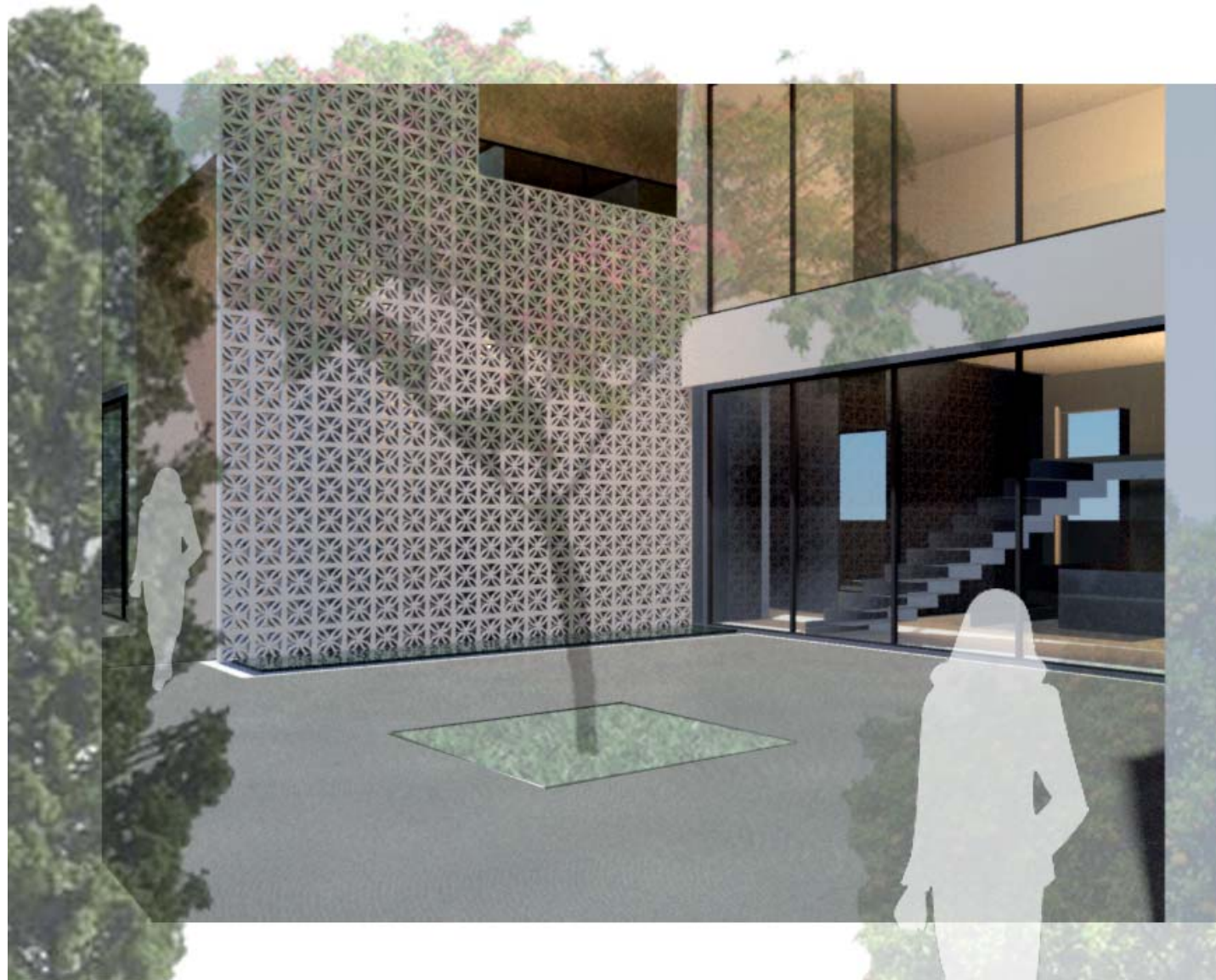




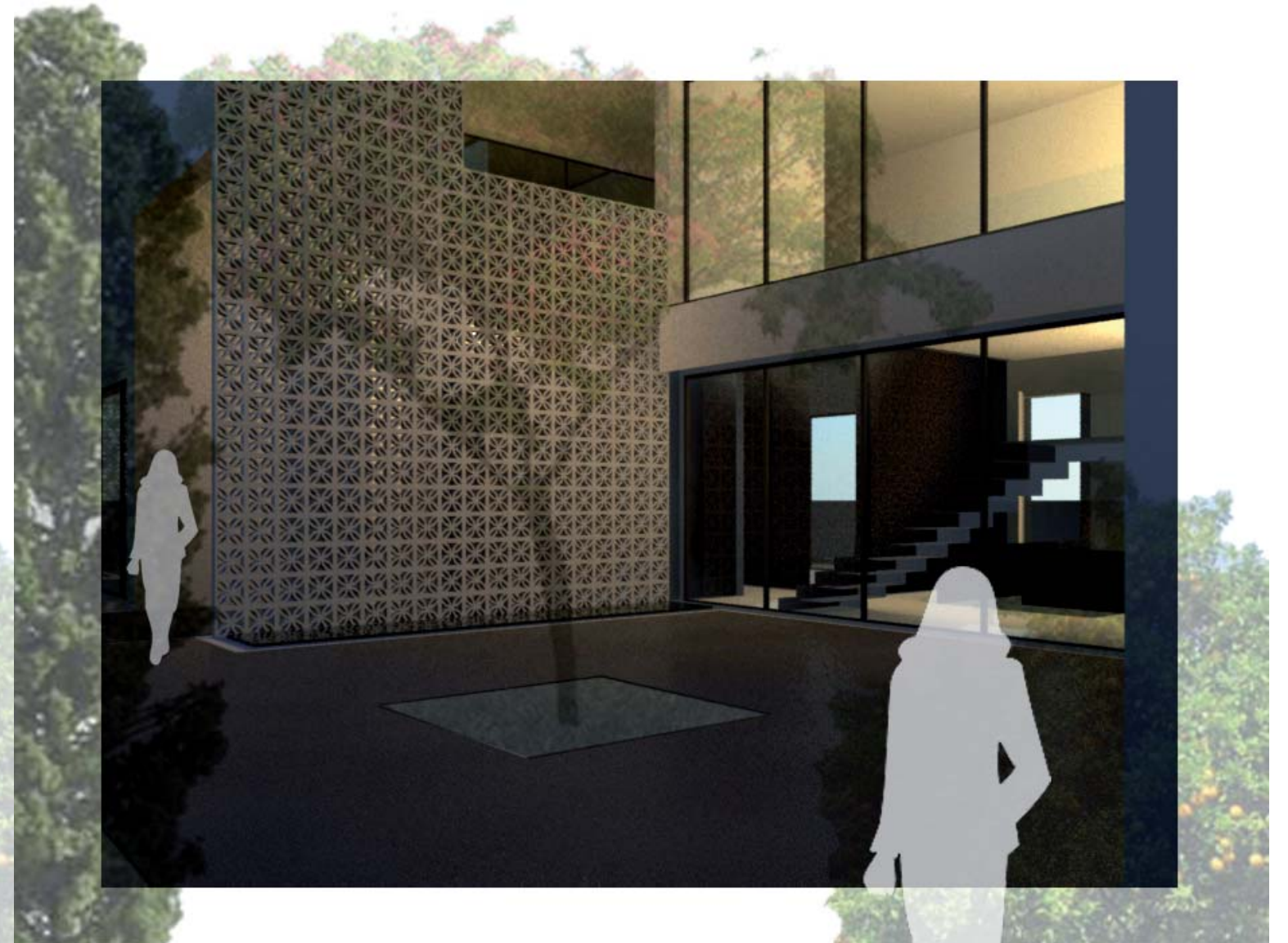
overall view



screen transparency



view of the courtyard at noon



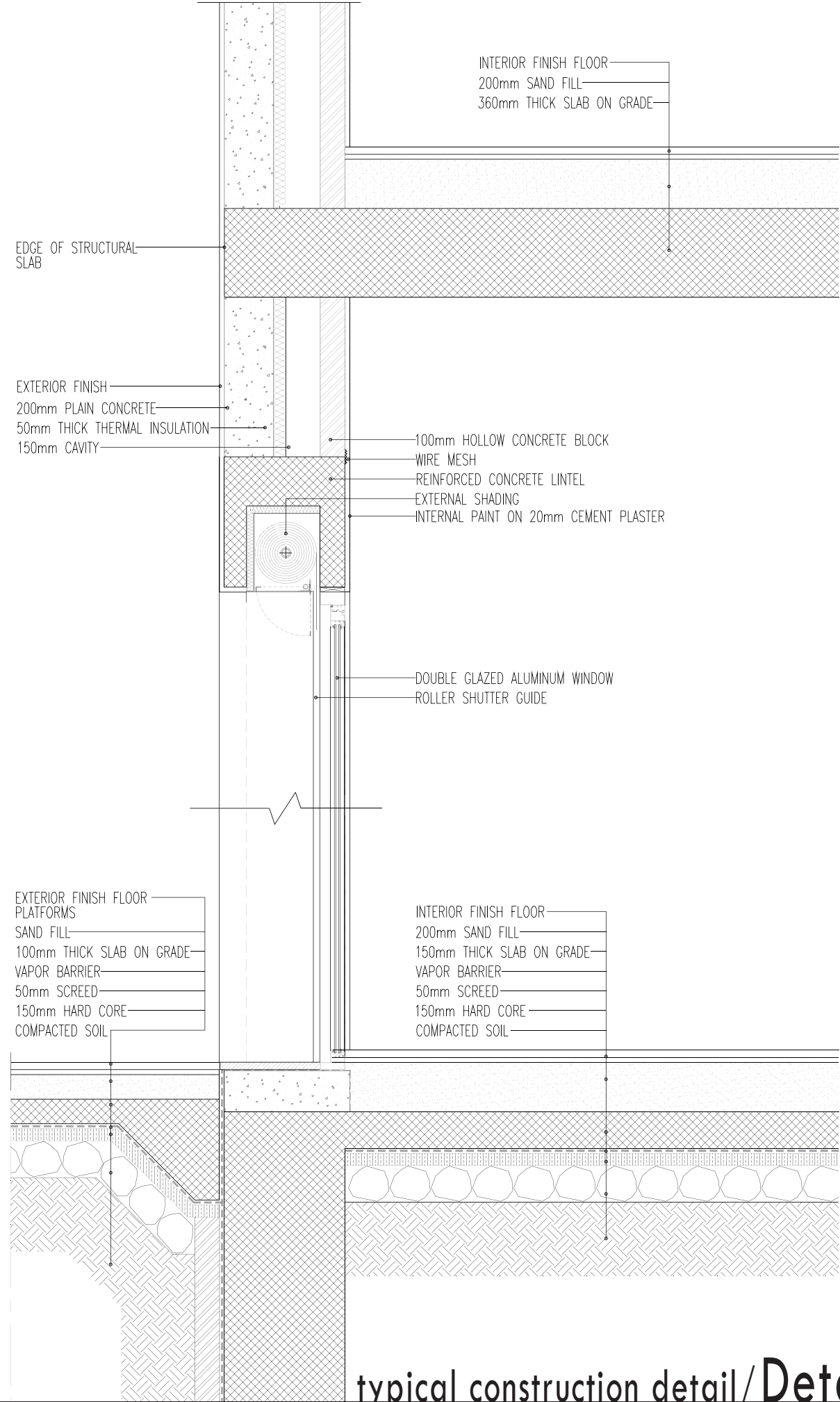
screen transparency



view through entrance



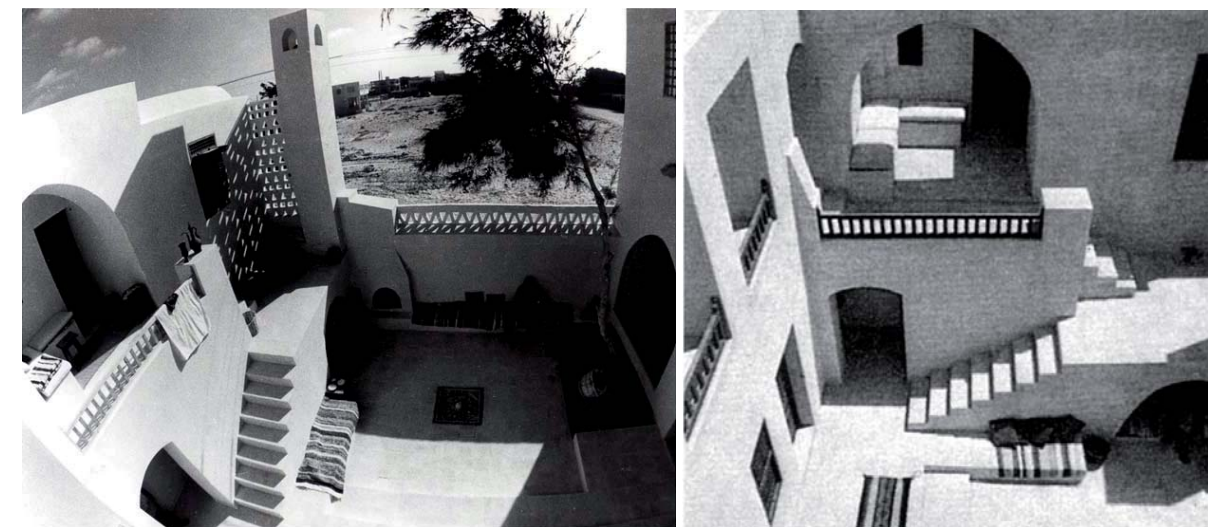
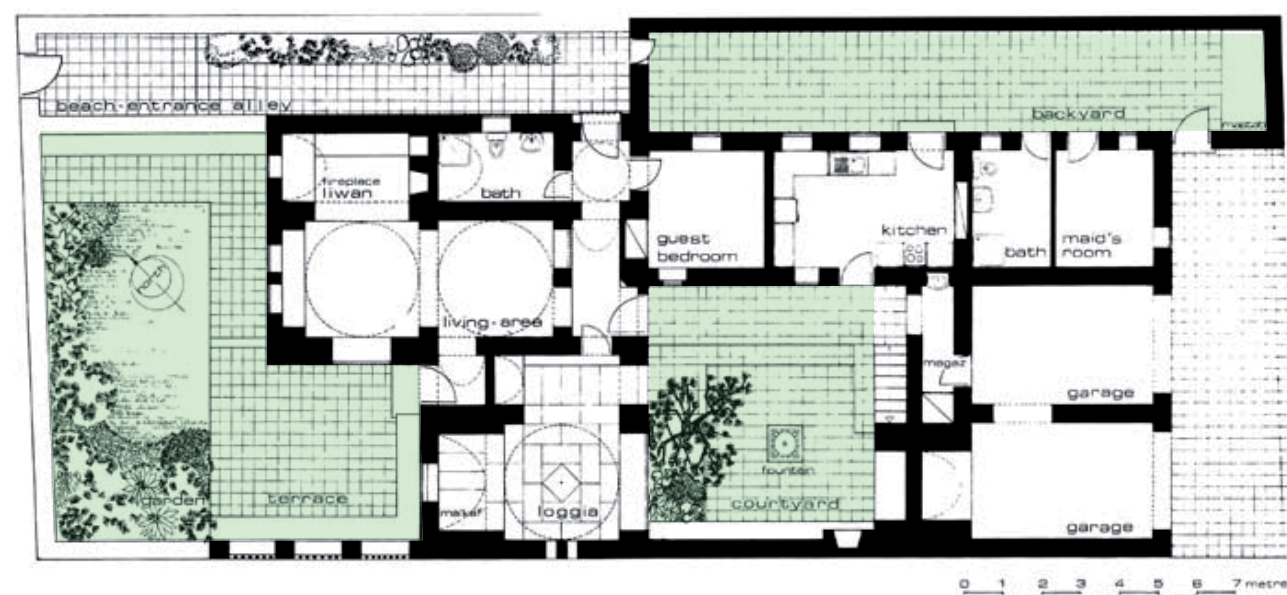
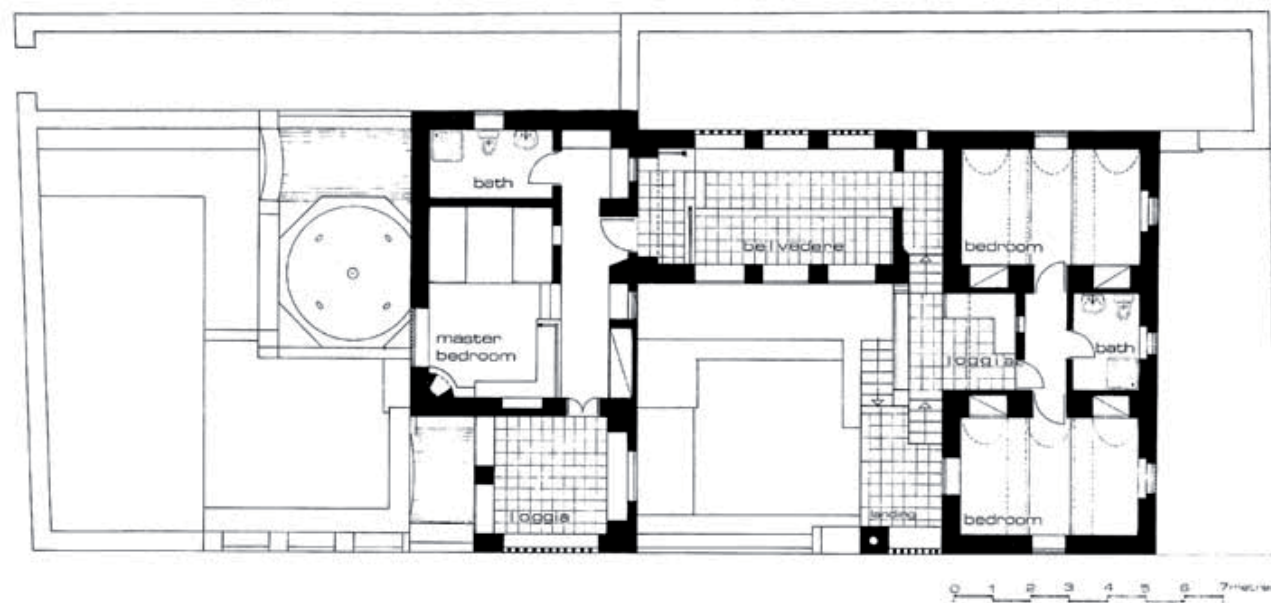
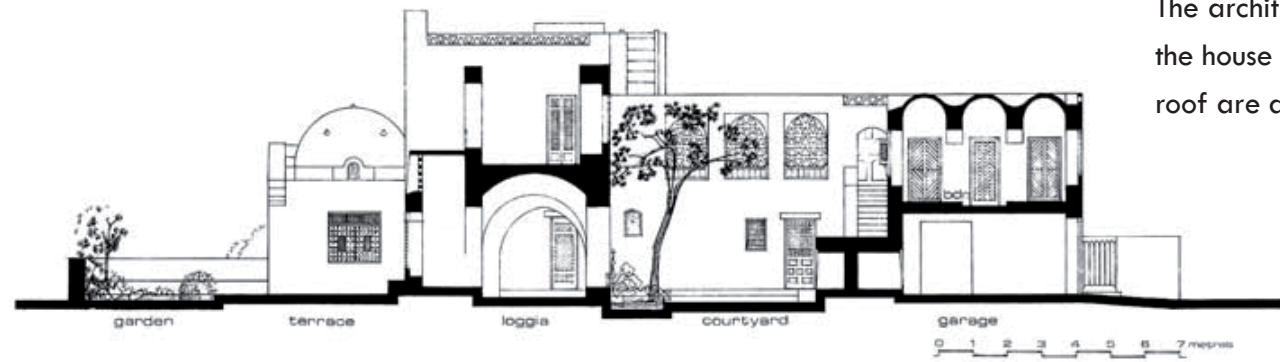
family living space transparency into courtyard



typical construction detail/Detail 83

Halawa House. Agamy, Egypt 1975
Abdelwahed El-Wakil

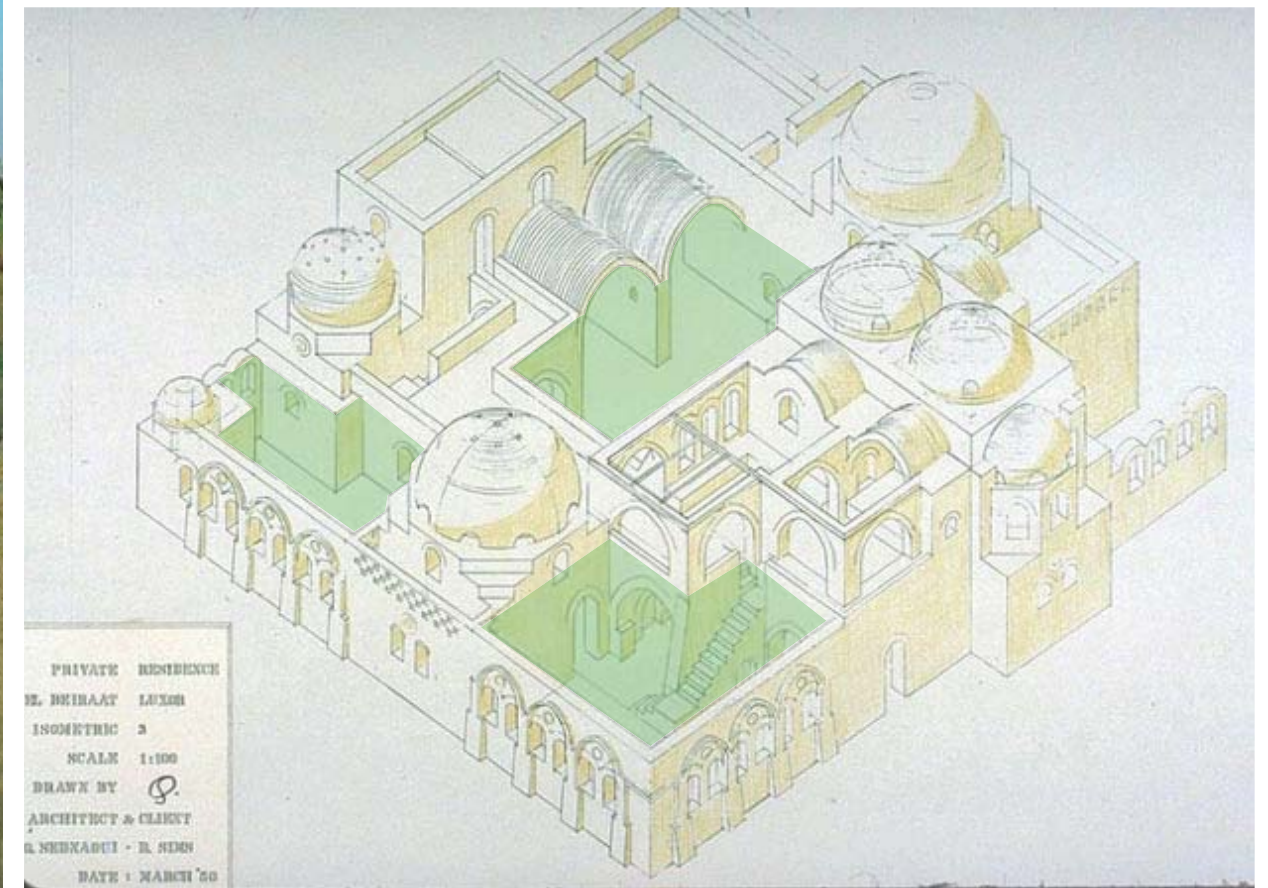
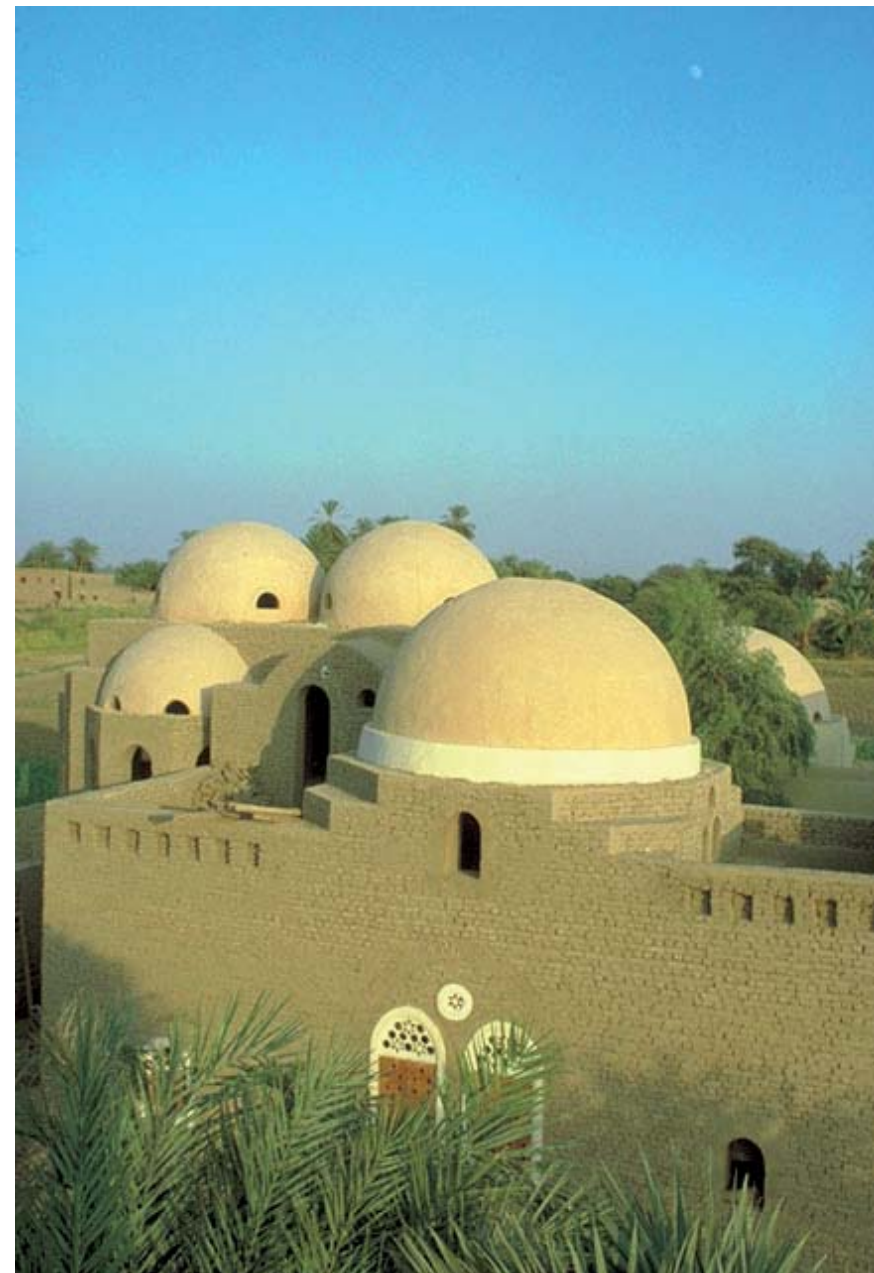
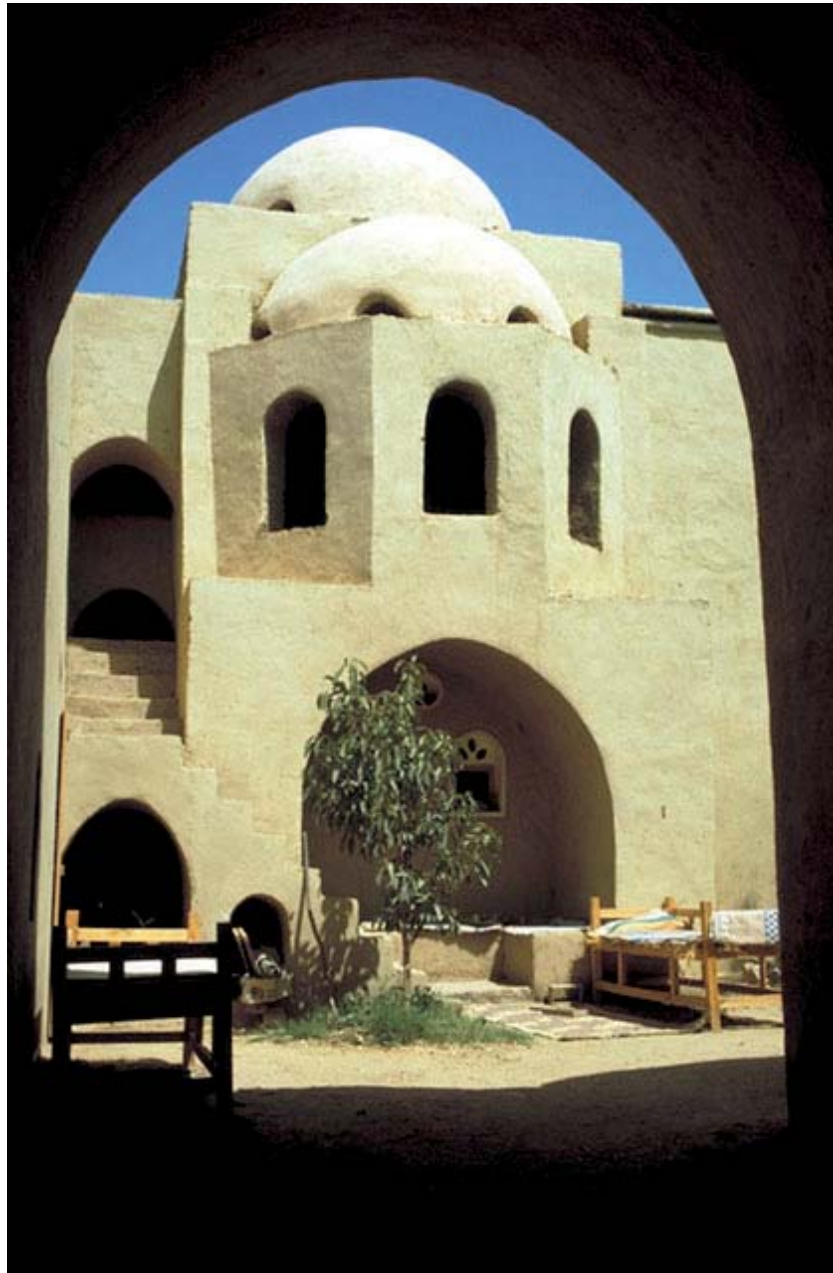
The architect has drawn upon traditional Islamic or Egyptian prototypes for the design of this house. In addition to the courtyard and its fountain, the house has a loggia, a wind catch, alcoves, masonry benches and a belvedere. The house works very well in Egypt's hot climate. The walls and roof are designed to provide insulation, sunlight filters through mashrabiyyas, and the courtyard draws fresh sea air down through the wind catch.



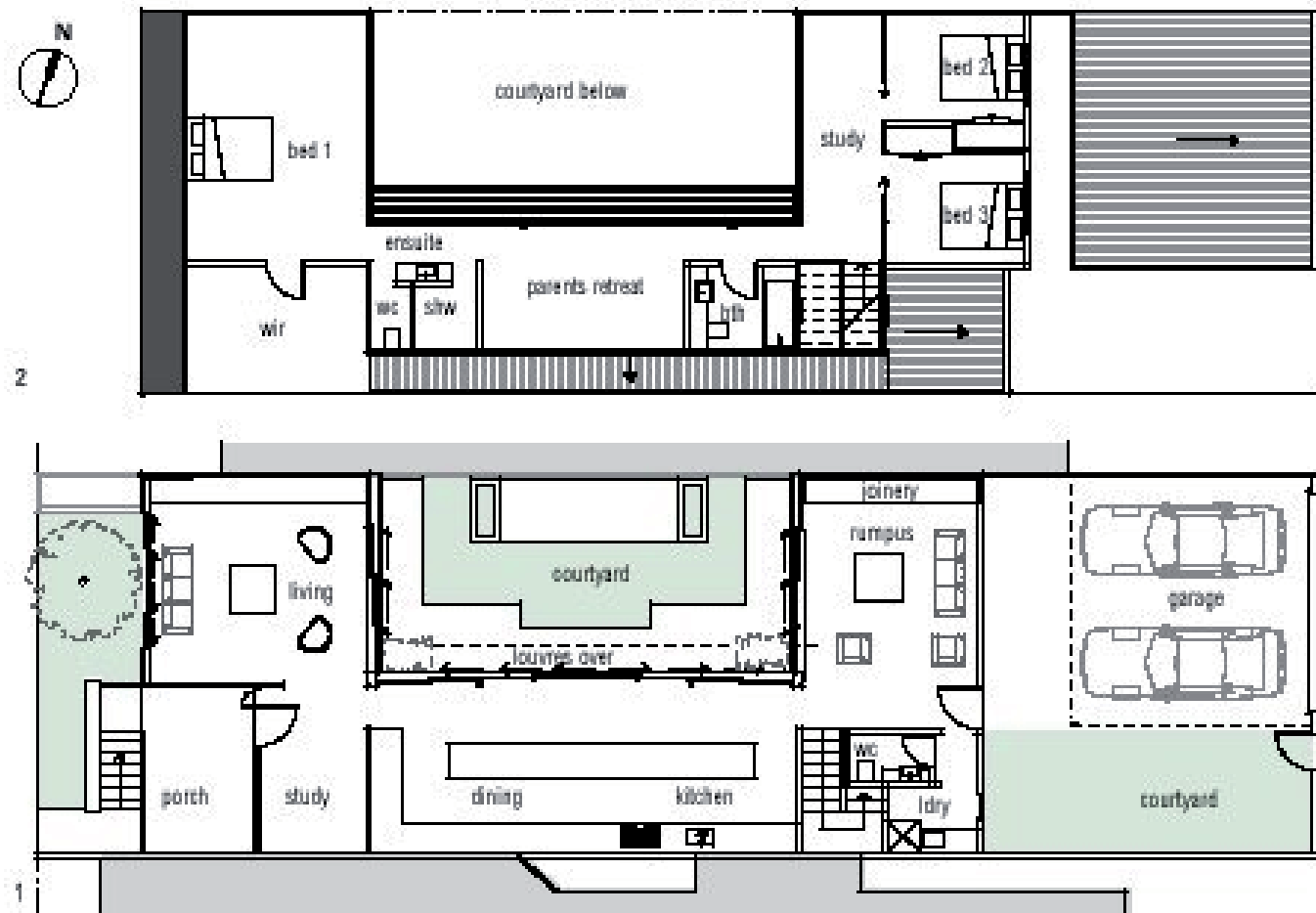
Sims and Sednaoui Residence. Luxor, Egypt 1980

Sims and Sednaoui Architects inspired by Hassan Fathi

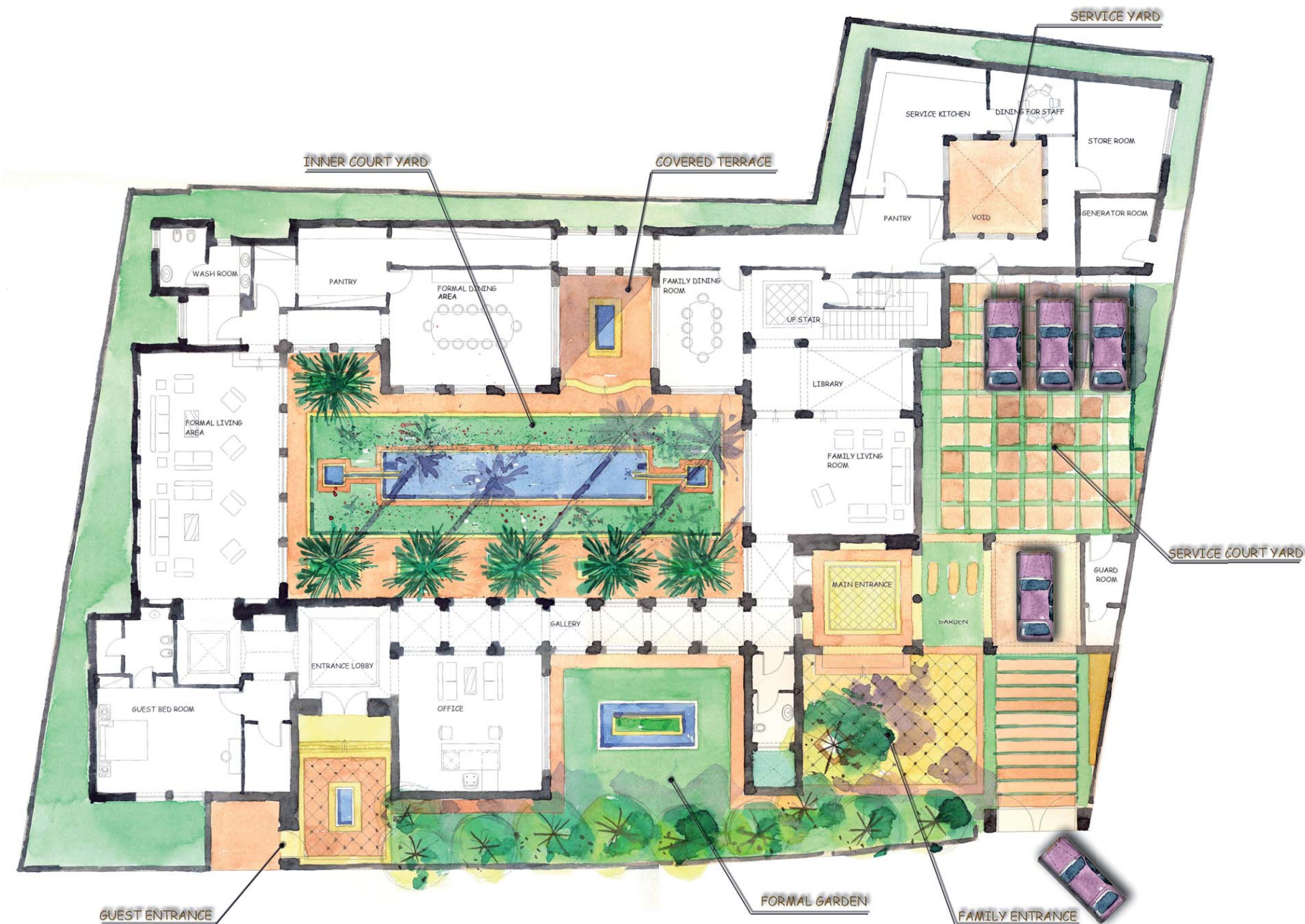
An indigenous courtyard house with a square base located on the west bank of the Nile River across the city of Luxor in Egypt. The large, private house is designed for the part-time use of the architect-clients and embodies the architectural concepts upon which they hope to develop their practice. The making of the residence was an experiment in building. By investigating a mode of rural construction traditional to Egypt, the architects intended to become familiar with existing conventions in mud brick technology. Using Hassan Fathy's work as a point of departure, they intended to explore the technology's potential with the intention of applying their experience to subsequent projects.



This house has a central courtyard, which faces north for winter sunshine, and gives great privacy to the occupants. Every room faces onto the courtyard and thus gets good light and ventilation. The house is exceptionally well insulated and has very high thermal mass with concrete floors on both levels and all internal walls in Hebel block to maximise passive heating. The house provides both high environmental performance and good internal amenity and privacy on very small land areas.



A house centered around a courtyard with water features as its focal point. A gallery space, Iwan, separates the main entrance from the courtyard for privacy reasons. Also an exterior formal garden creates a continuity between both green spaces. Sleeping quarters are located on the upper floor and they all overlook the courtyard.



The Horn House. Los Angeles, California. 2007

Tom Robertson of Ripple Design

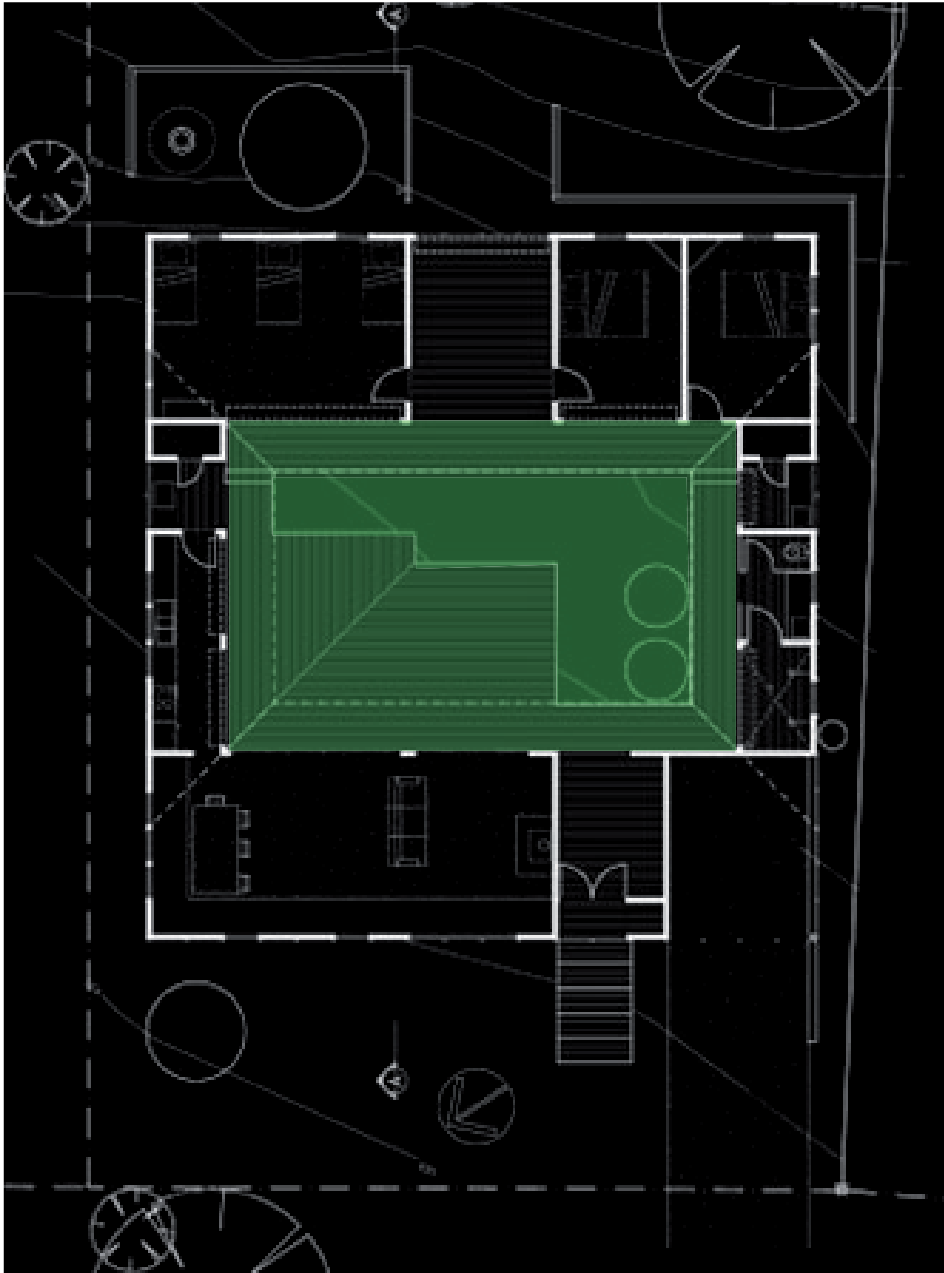
3 bedrooms, 2,800 sq.ft.

A green sustainable design featuring dramatic indoor-outdoor living spaces with a huge courtyard.



Idyllic Interior Courtyard. Seal Rocks, Australia 2009
Blue Bourne Architects

This coastal cottage home was designed around an inner garden and deck – ideal for outdoor entertaining – and is bordered by glass walls that flood the house with natural light while minimizing exterior glazing, for privacy. Sliding glass doors allow for indoor-outdoor living – a must in this idyllic warm-weather environment. This vacation house is finished with minimalist interiors – simple materials that fit in with the context of this fishing village. The cottage’s rustic style comes via CFC-clad walls, polished particleboard floors and locally sourced wood for the decks.



San Pablo Residence. San Juan, Puerto Rico. 2009
URBANA Architects.

Client's request: "...a structure that would evoke the clarity of mid-century Puertorrican modernism, with the charm and climatic responsiveness of their courtyarded, Moorish-styled, Old San Juan loft."

"The project became one of reconsidering the 'Spanish courtyard house' typology, itself an offspring of the Islamic influence on southern Spanish architecture, and an emblematic model of some of the early, native urbanización [development] projects in Puerto Rico.

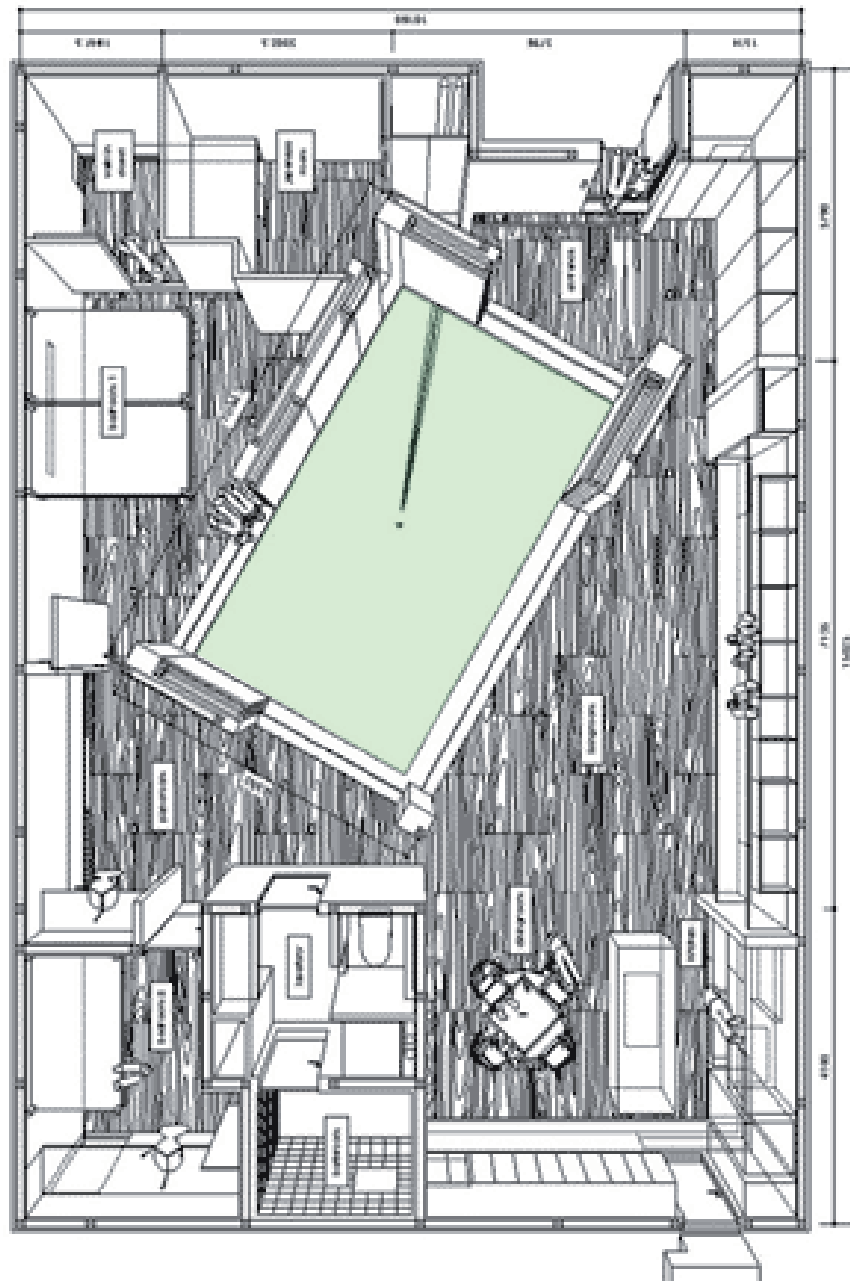


F White House. Kishawa, Japan. 2009

Takuro Yamamoto

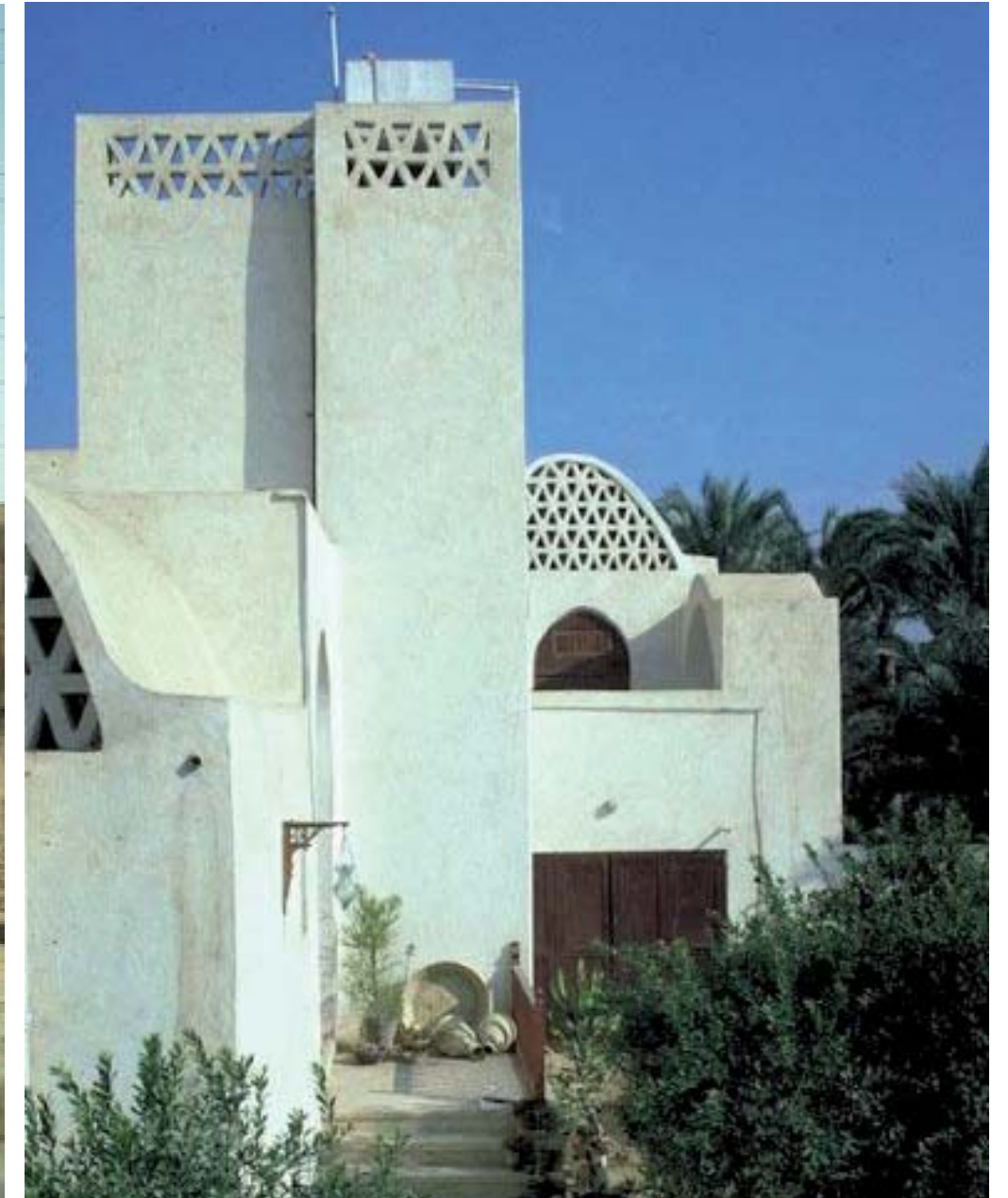
1 bedroom, 1315 sq.ft.

This one storey house is centered around a rectangular courtyard that has been rotated at an oblique angle which becomes the center point that divides the interior to smaller space.



L: The house of an Afghani family in Peshawar, North-West Pakistan. The living quarters are surrounded by a thick, high wall and are entered through a single door seen on the left of the picture.

R: Akil Sami Residence in Dahshur, Egypt by Architect Hassan Fathi. This image shows minimum openings towards to the street.



L: Imam Square inner courtyard, in Esfahan, Iran showing water feature at the center of the courtyard.
R: The communal courtyard of the Umayyad Mosque in Damascus, Syria showing a central courtyard with 'iwān' on all sides.



L: Interior courtyard of the Talisman Hotel in Damascus, Syria. Once an old palace built in a quiet side street has now been restored in the most authentic tradition of an Arab house.

R: Residence Andalous in Sousse, Tunisia by Architect Serge Santelli. The architect tried to achieve a contemporary expression of the structural principles that govern traditional Arabo-Islamic architecture. The regularity and simplicity of interior courtyards surrounded by porticoes similar to those in Tunisian fondouks; gardens treated architecturally; iwans, pools, fountains, and pergolas are the elements which were an essential part of the spatial design of the whole.



References

- 1 housedesignnews.com, 2 exinteriordesign.com, 3 archdaily.com, 4 modern-homes.net, 5 archdaily.com, p.04
6 juvandsign.com, 7 bp.blogspot.com, 8 exinteriordesign.com, 9 greatfi.com, 10 archinspire.com
- Ragette, Friedrich; Reynolds, , John p.09
<http://www.akdn.org/architecture> p.13
<http://www.archnet.org> p.14
<http://www.architecture01.com> p.15
images courtesy of the architect p.16
<http://www.thehornhouse.com> p.17
<http://www.trendir.com> p.18
<http://www.urbana-arquitectura.com> p.19
<http://www3.ocn.ne.jp> p.20
<http://www.mylearning.org>, <http://www.archnet.org> p.21
<http://www.travel-pictures-gallery.com>, <http://www.archnet.org> p.22
<http://www.talismanhotels.com>, <http://www.akdn.org/architecture> p.23

Bibliography

Books

- Edwards, Brian; Magda Sibley; Mohammad Hakmi; Peter Land. Courtyard Housing: Past, Present and Future. 2005
Crafti, Stephen. Courtyards for Modern Living: Contemporary Outdoor Spaces. 2008
Fathy, Hassan. Natural Energy and Vernacular Architecture. 1986
Pfeifer, Gunter. Courtyard Houses, A Housing Typology. 2003
Rabbat, Nasser O. The Courtyard House. 2010
Ragette, Friedrich. Traditional Domestic Architecture of the Arab Region. 2003
Reynolds, John. Courtyards: Aesthetic, Social, and Thermal Delight. 2001
Steele, James. The Architecture of Rasem Badran. 2005
Ackerknecht, Gut. Climate Responsive Building: Appropriate Building Construction in Tropical and Subtropical Region. 2002
Precedents + Case studies through the process

Websites

see references

Magazines + Journals

- Dwell Magazine. July 2010
Pearlmutter, Erell, Etzion, Mier, Di; Refining the use of evaporation in an experimental down-draft cool tower. The Center for Desert Architecture and Urban Planning, Israel.