

SUSTAINABLE COMMUNITY: Seeking Sustainable Potentials in an Urban Community in Kobe, Japan

by
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SUSTAINABLE COMMUNITY: Seeking Sustainable Potentials in an Urban Community in Kobe, Japan

by Masaki Furukawa

Submitted to the Department of Architecture on January 15, 1997 in partial fulfillment of the requirements for the degree of Master of Architecture.

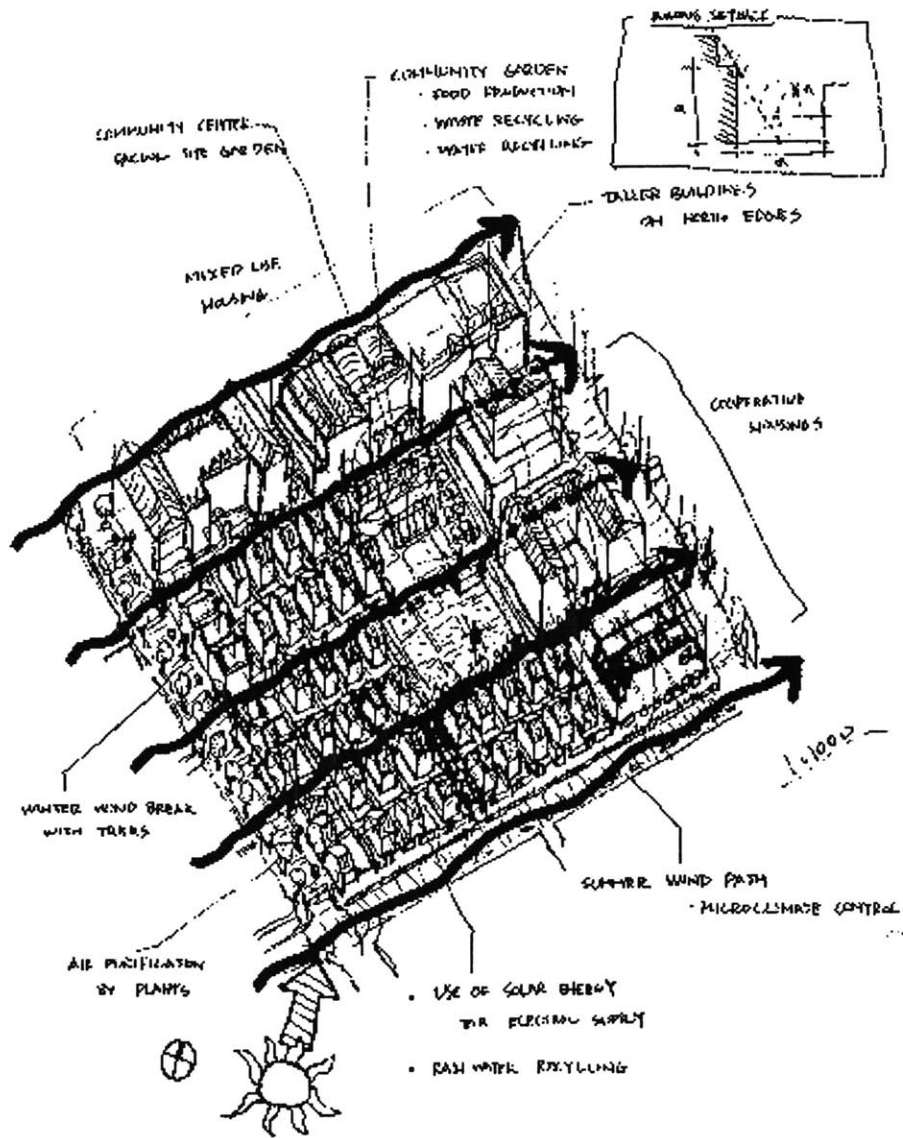
ABSTRACT

Sustainability was once inherent in many communities of the pre-modern society; however, it has been lost under the progress of the modern society through humankind's rationalized and short-term visions in pursuing more comfort and convenience in their life. Consequently, humankind is gradually heading toward destruction of not only their own systems, but also whole systems on the earth. In the context of the modern society, how can sustainability in communities be regained to promise the future of humankind, the earth, and the universe.

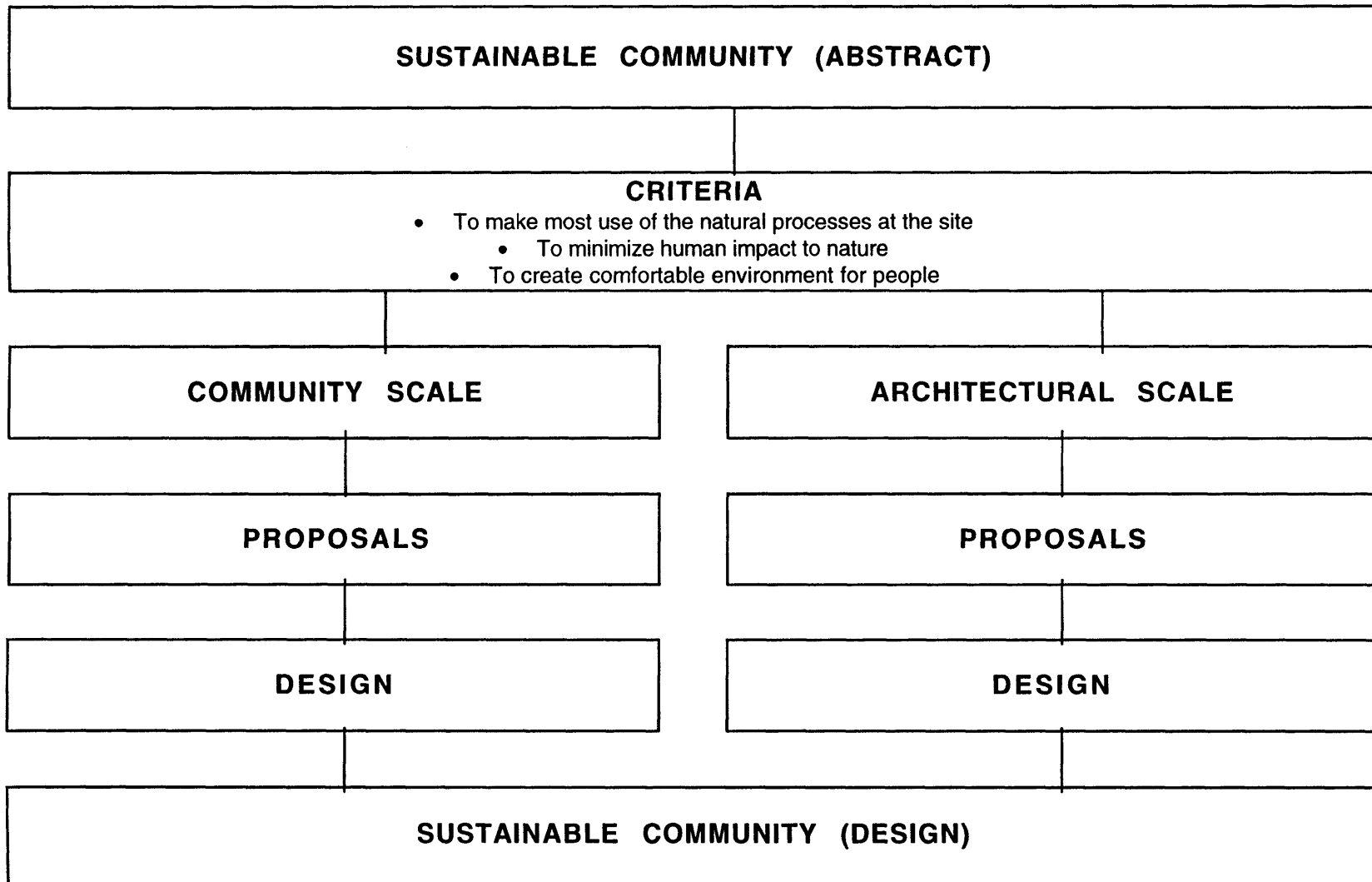
The intent of this thesis is to investigate the possible forms and systems of urban communities, whose compact forms and efficient social and physical systems have more potentials for sustainability than those of suburban types' do, while urban communities have been major consumers of energy and resources and major producers of various kinds of pollution and wastes. In order to explore this, the thesis seeks sustainable potentials in an urban inner-city community in Kobe, Japan and develops a sustainable community with proposals of systems and community design in the scale of urban design, a block, streets, and architecture. The site is located in Takatori-Higashi district in the city of Kobe where was totally devastated by the major earthquake in January, 1995 and where is needed to be restructured and reconstructed soon.

As the outcome of this exploration, this sustainable community will establish some possible answers to the question of how the communities for next generations should be and address possible issues of sustainable communities to be further explored and discussed.

Thesis Supervisor: Shun Kanda
Title: Senior Lecturer of Architecture



1. APPROACH



2. SITE BACKGROUND

Takatori-Higashi District

Takatori-Higashi district is located about 6 km west of downtown Kobe in Nagata ward.

Within 5-minute walking distance to the west, there is a rail way station, and 10-minute walking to the east, there is another station and a new commercial district.

Every block in the district consisted of narrow streets, so called "roji", and many old wooden row houses, so called "nagaya", built right after the World War II. It was a mixed used district with housing, commercial and light industrial buildings with a human scale quality.

However, in January 17, 1995, a major earthquake hit the region, and most of the area of the district was destroyed and burnt down by the fire.

Climate

The climate in Kobe is relatively mild and dry. Winter is mild with less precipitation, but summer is hot and humid. There is a rain season around June, and typhoon season is during autumn.

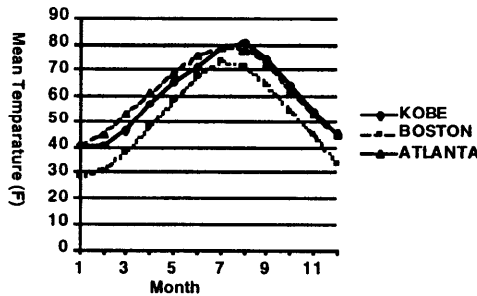


figure 2.1 Mean Temperature

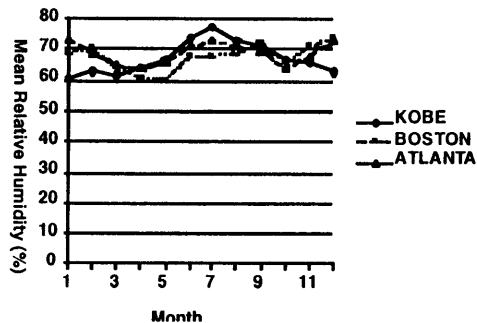


figure 2.2 Mean Relative Humidity

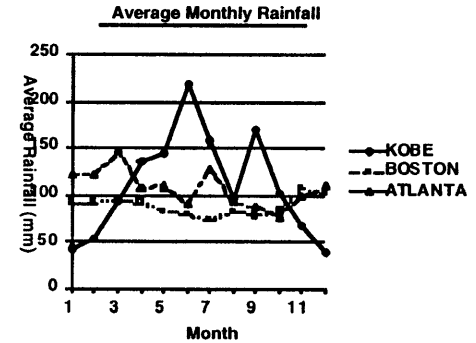


figure 2.3 Average Monthly Rainfall

3. CRITERIA

SUN

WIND

WATER

AIR QUALITY

WASTE

ENERGY

SUN

Sun governs radiation and temperature that are two of the most significant natural conditions which have an effect on heating and cooling requirement of buildings.

Effects of radiation and temperature on buildings should be controlled in the community scale before dealt with in the scale of buildings. Building configuration, surface materials and plants are the important elements to be considered.

Building Configuration

It is important to avoid placing taller building between sun and lower buildings and place highest buildings down sun from lowest buildings to minimize winter shading.

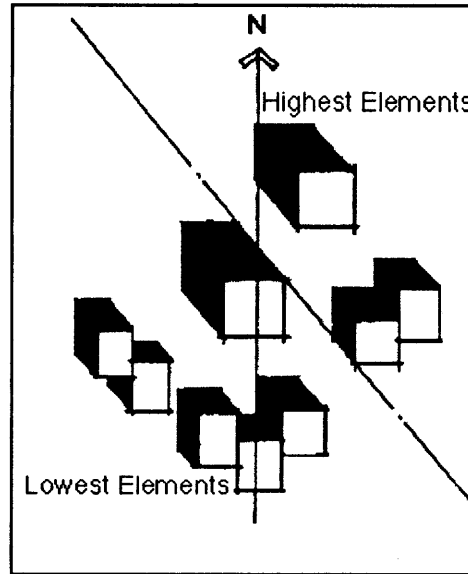


figure 3.1

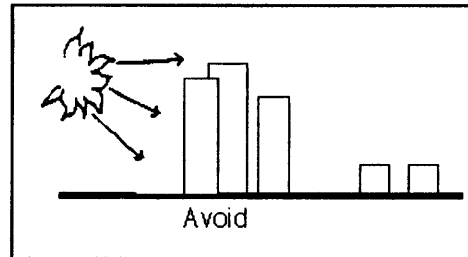


figure 3.2

Surface Material

- Paved surfaces like city streets store and conduct heat much faster than soil or vegetated surfaces.
- The different physical characteristics of the various surfaces exposed to radiation give a very contrasting temperature rise. (Graph)

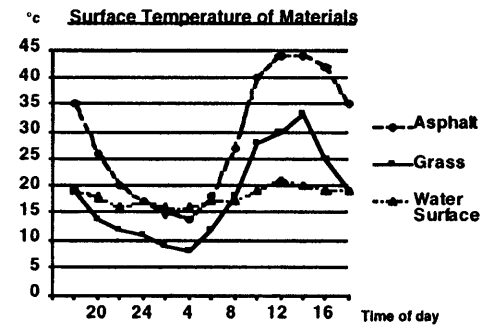


figure 3.3

- In addition, roofs, walls, and streets in the urban setting act as multiple reflectors. They absorb heat energy and reflect it back to other surfaces.

- Reduction of paved surfaces will reduce heat accumulation in the urban areas. Increase in the pervious surfaces will also reduce the temperature in the urban area. It is said permeable surfaces decrease the temperature on the streets by 3 degree C through evaporative cooling effect. (Group Raindrops p78)

Plants

- Plants have a significant role in the urban area to control radiation and temperature.
- The transpiration of water by plants helps to control and regulate humidity and temperature. A single large tree can transpire 450 liters (120 gallons) of water a day, and this is equivalent to 230,000 k calories of energy in evaporation.
- The mechanical equivalent to the tree transpiring 450 liters a day is five average room air-conditioners, each at 2500 k calories per hour, running 19 hours a day. (Hough p263)
- The air-conditioner only shifts heat from indoors to outdoors and also uses electric power. The heat is, therefore, still available to increase air temperature.

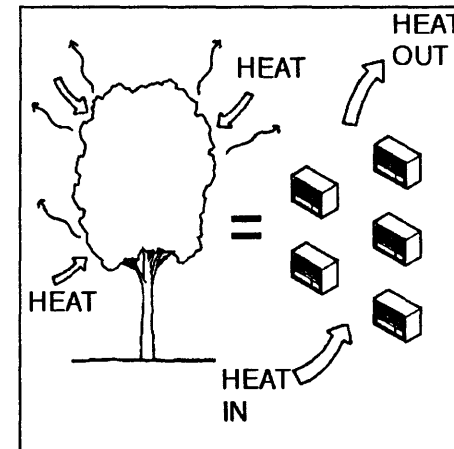


figure 3.4

- For example, in Davis, California, various studies have shown that neighborhoods with shaded narrow streets can be 6 degree C cooler and uses only one half the amount of electricity for air-conditioning than unshaded neighborhoods.

WIND

- Wind is one of the most significant natural conditions which have an effect on heating and cooling requirement of the structure. Wind affects temperatures, evaporation, the rate of moisture loss and transpiration from vegetation.
- There are two types of wind conditions to be considered in site design: cold winter wind and summer breeze.

Winter Wind

- The community and buildings have to be buffered against cold winter wind. Street direction, vegetation, and buildings can be used to buffer against winter wind.

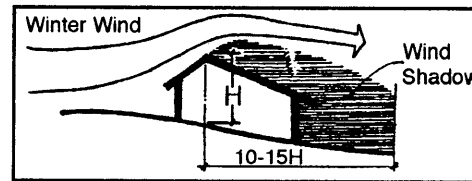


figure 3.5

- The preferred configuration is one with a strong vertical outline. The most effective windbreak configuration is an irregular one which is more effective in reducing eddying than a uniform one. Also, a mixture of species and sizes producing a rough upper surface is more effective in controlling wind.

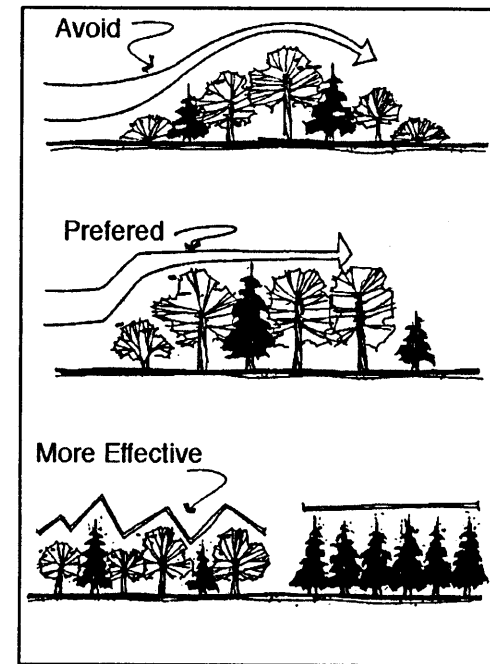


figure 3.6

Summer Breeze

- A sufficient air ventilation using summer breeze is an essential condition for maintaining the purity of the air and reducing heat accumulation within the community. Street direction and building configuration are the important conditions to be considered.

not like this

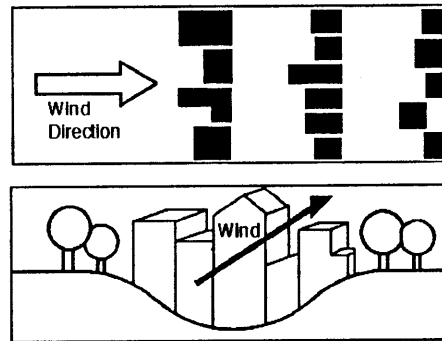


figure 3.7

but like this

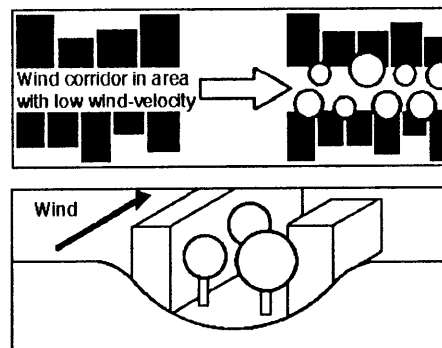


figure 3.8

WATER

- Japan has a great amount of precipitation through a year (average 1800 mm / m/year, which is twice as large as world average). Yet, it is very hard to make a use of this great amount of water since Japan has a mountainous landscape characteristic.

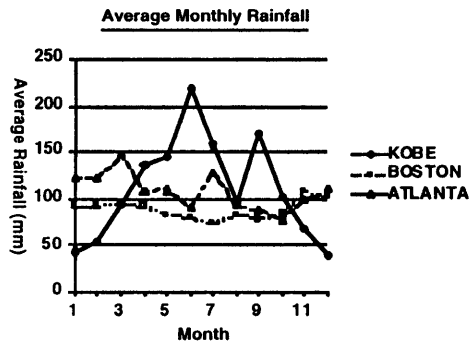


figure 3.9

- Urbanization creates a new hydrological environment. Asphalt and concrete replace the soil, buildings replace trees and the catchbasin and storm sewer replace the streams of the natural water shed. This situation sometimes produces problems like urban flood and dried underground water. It is important to make a urban hydrological condition as close as pre-urban one.

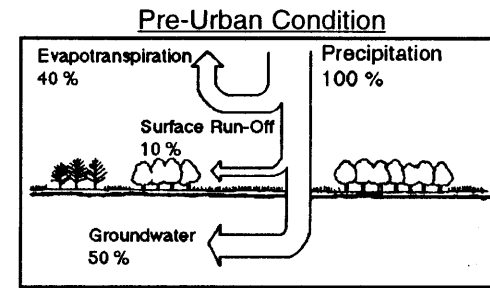


figure 3.10

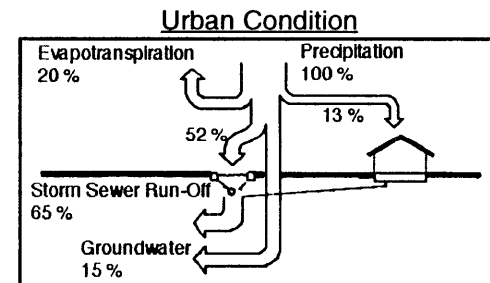


figure 3.11

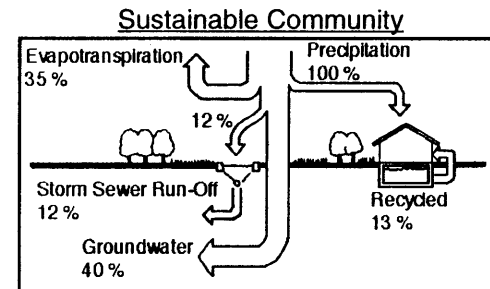


figure 3.12

- In Kobe, more than a half of water is provided from out of city sources even though the city receive a great amount of precipitation.

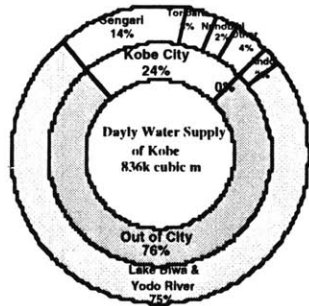


figure 3.13

- Within daily usage of water, about half of it can be covered by recycled gray water or rain water.

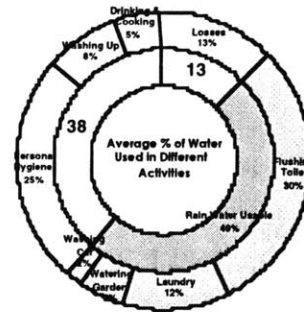


figure 3.14

AIR QUALITY

- Air quality in urban setting is a very important issue.
- The site has two major arterials and a elevated express way very near-by, and pollution by automobile exhaustion is serious issue.
- Leaves of trees can take up or absorb pollutants such as carbon dioxide, nitrogen dioxide, ozone, and sulfur dioxide to significant levels.
- Urban vegetation can also mitigate ozone pollution by lowering city temperatures and directly absorbing the gas.
- Some vegetation also collects heavy metals in soil.
- For example, a Douglas fir with a diameter of 38 cm can remove 19.7 kg of sulfur dioxide per year without injury from an atmospheric concentration of 0.25 p.p.m. (Hough p265)

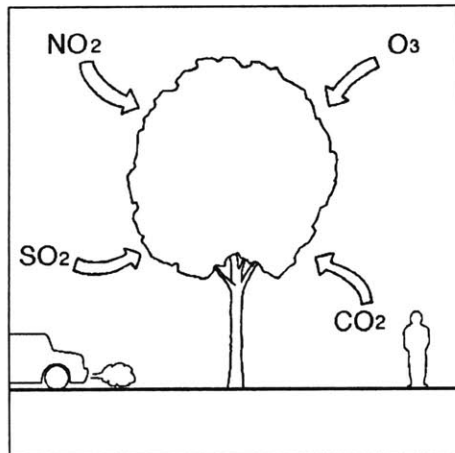


figure 3.15

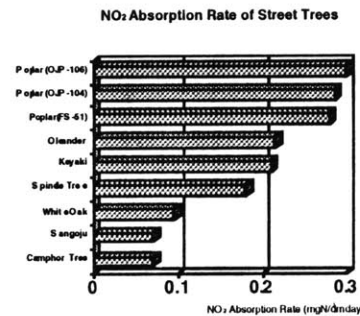


figure 3.16

WASTE

- Every year, the amount of waste disposal increases and the area of landfill site decreases instead. However, most of wastes including organic waste are renewable. Solid wastes like metal and plastic can be recycled, and organic gas and natural fertilizer can be produce from organic waste. In this manner, only tiny portion of waste is actually wasted.

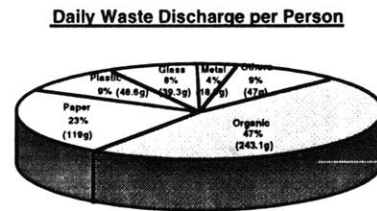


figure 3.17

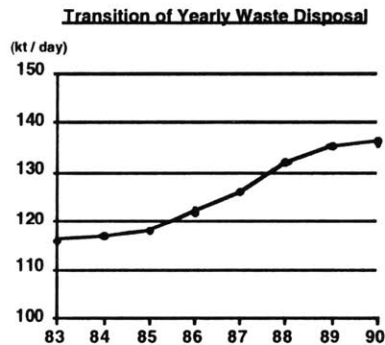


figure 3.18

ENERGY

- A hierarchical system of energy infrastructure is less efficient in terms of energy loss and distribution cost. It is also fragile to the natural disasters like earthquake and typhoon. So a self-sufficient system is a considerable feature for a new type of communities.
- Use of renewable energy, such as solar energy and bio-gas is also key to sustainability since it has low impact on the environment and it is limitless.
- Energy efficiency and less use of energy within the communities are also important.

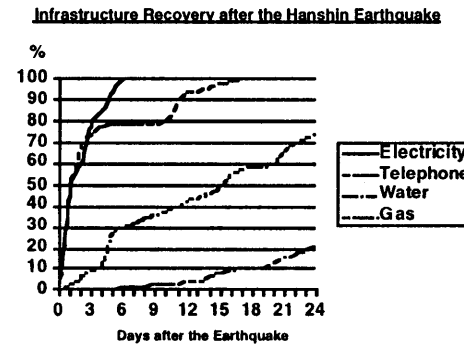


figure 3.19

4. COMMUNITY DESIGN

Proposed Site

Community Design Proposals

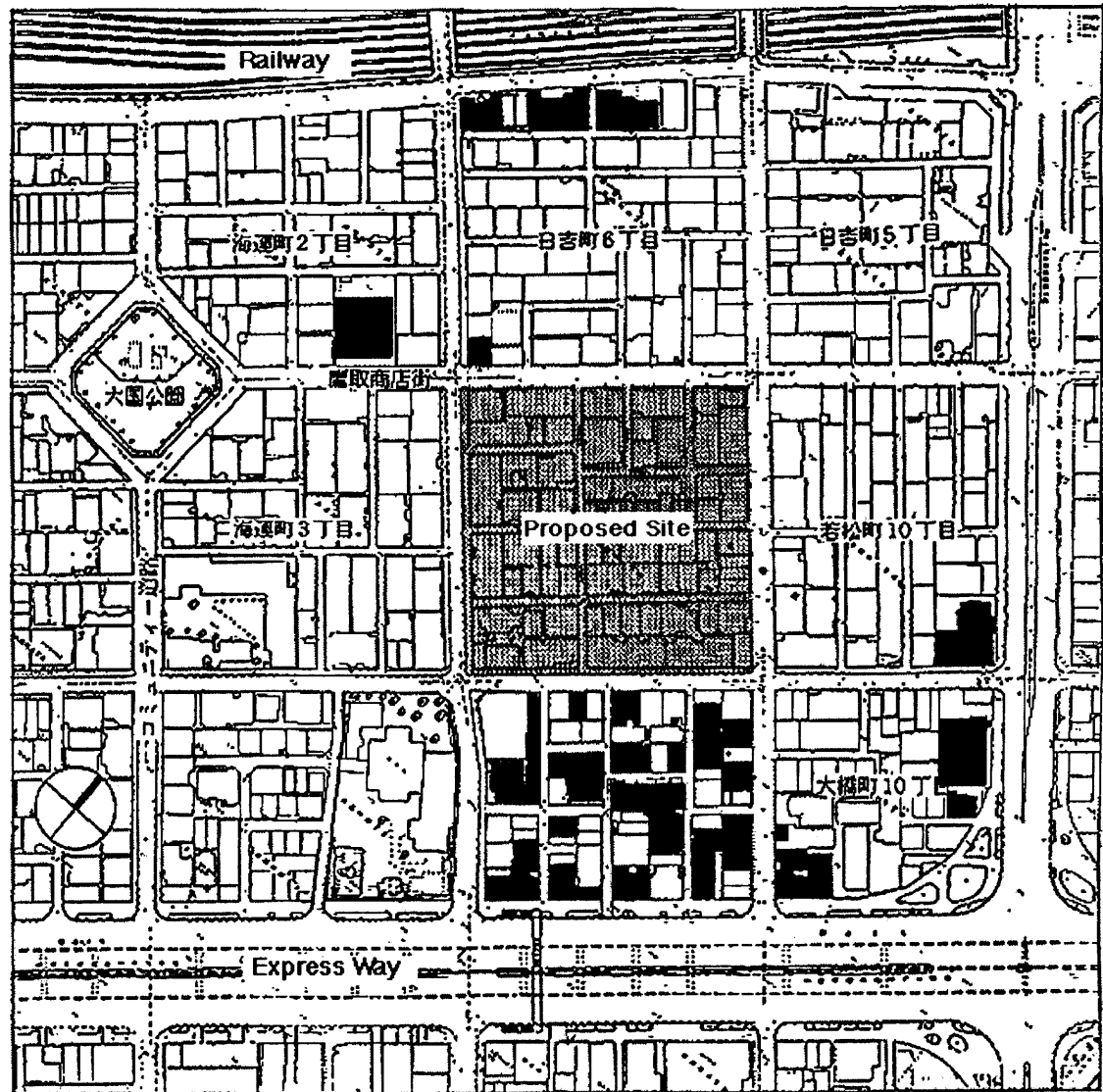
Community Design

PROPOSED SITE

One block (Wakamatsu-cho 11 chome community) in Takatori-Higashi District

Area 1 ha (2.5 acres)
104m x 104m
(345ft x 345ft)

Population 100 households
250 people



COMMUNITY DESIGN PROPOSALS

Sun & Buildings

Summer Breeze Paths

Winter Wind Buffer

Street Plants

Solar Energy

Green Pavement & Roofing

Organic Waste Recycling

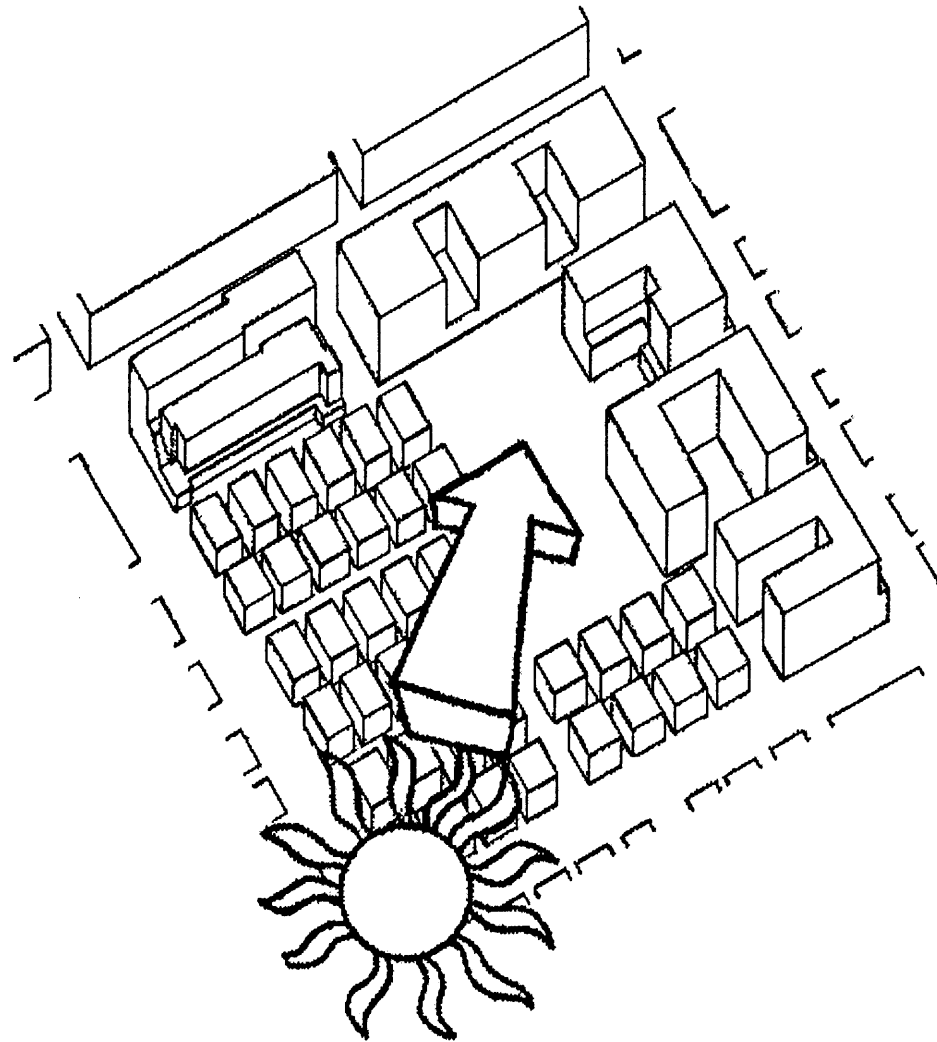
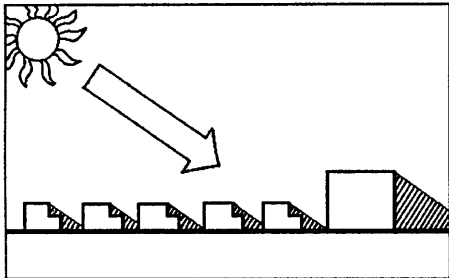
Rain Water Recycling & Recharging

Community Center & Open Space

Streets

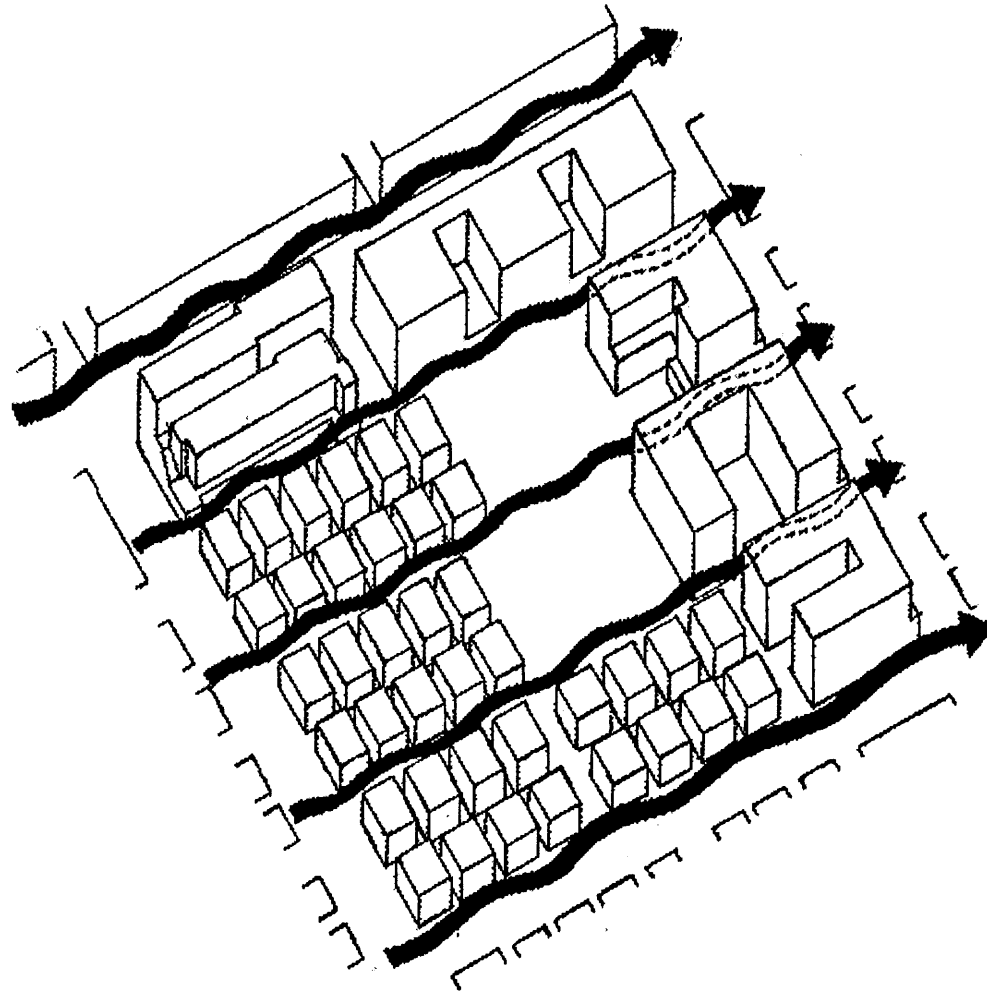
SUN & BUILDINGS

- Taller buildings (max. 4 story-high) are located on the northwest and northeast edges of the community to make most use of solar energy within the community.
- Building set-back requirement is necessary to allow more natural light onto streets as well as adjacent buildings.
- Maximum use of grass roof and vegetation on vertical surfaces will minimize heat-up of buildings by solar radiation.



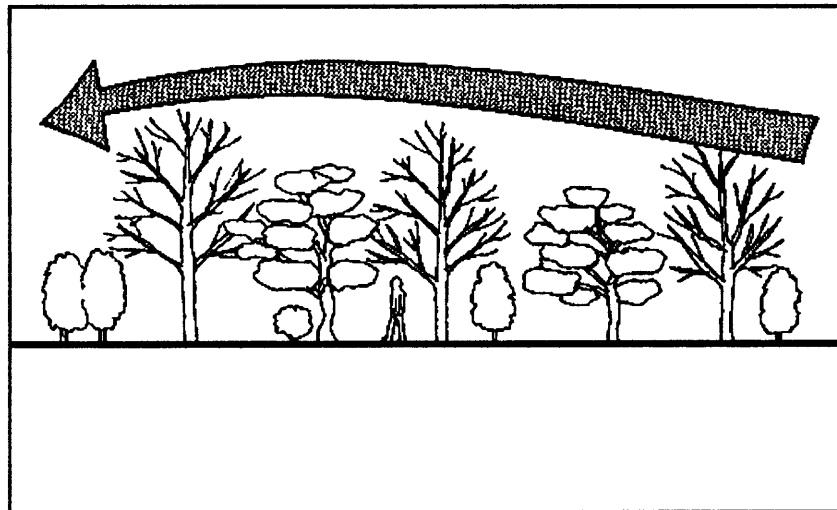
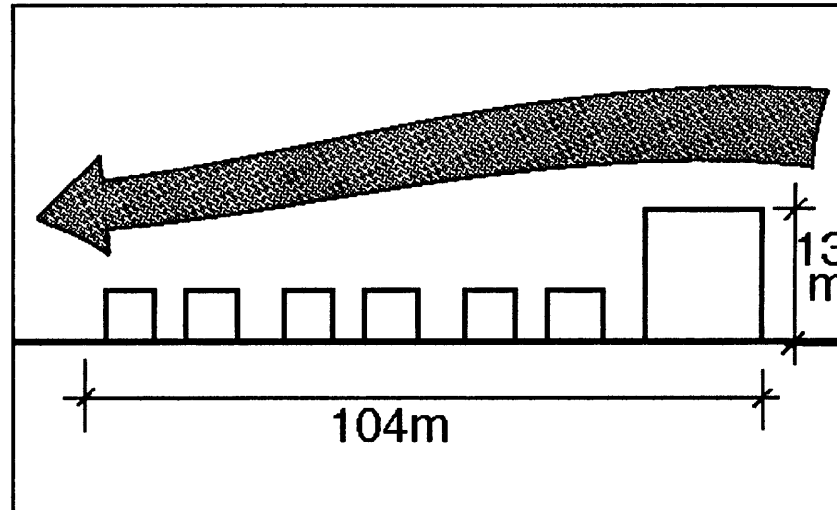
SUMMER BREEZE PATH

- Most of the streets in the community are oriented along the direction of the summer breeze (which is from the southwest to northeast).
- Summer breeze paths should be kept as open as possible to allow maximum air movement.
- Sufficient air ventilation through the community is an essential condition for maintaining the purity of the air and reducing the heat island effect.
- The water stream on one of the summer breeze paths makes air temperature down through evaporative cooling effect together with the summer breeze.



WINTER WIND BUFFER

- Taller buildings on the northwest edge work as a wind buffer against severe cold winter wind from the northwest and create “wind shadow” within the community.
- Vegetation, especially evergreen plants on the streets along the direction of winter wind works as wind buffers and create a more comfortable environment for pedestrians.



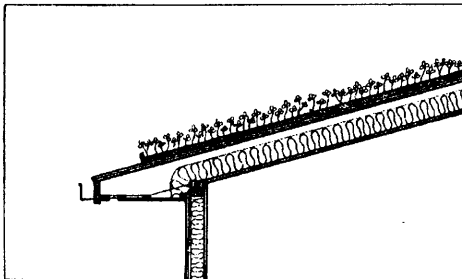
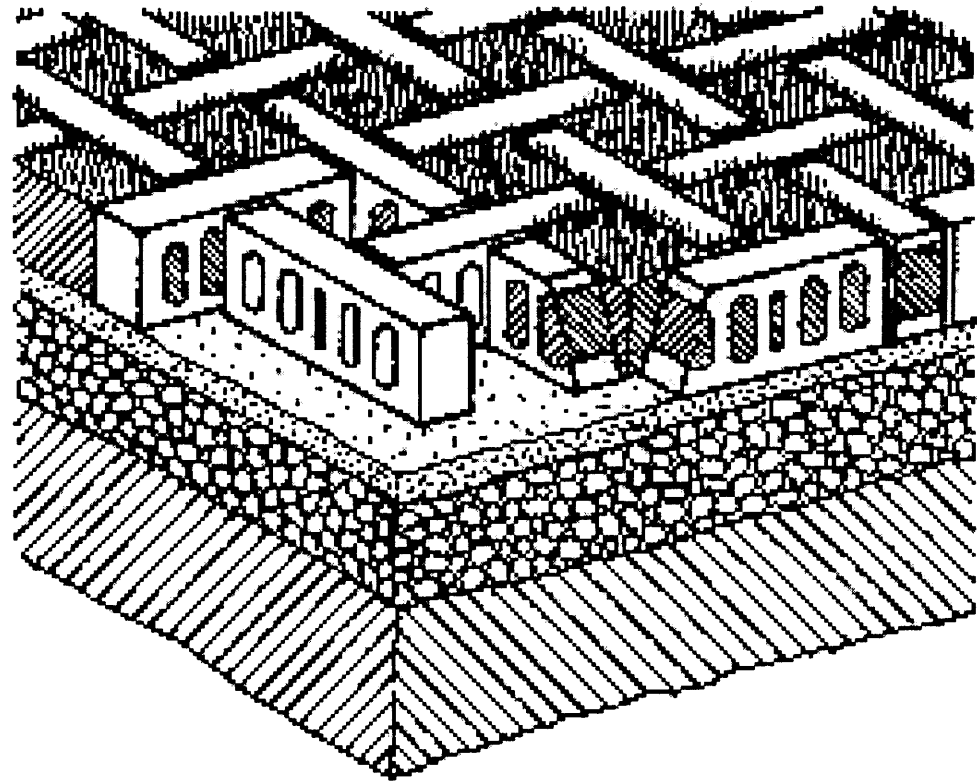
STREET PLANTS

- Most of the plants in the community are native to this region for less maintenance and more perseverance toward diseases.
- The priority in plant selection is based on the plants with high air purification ability, such as:
 - Poplar
 - White oak
 - Spindle tree
 - Cherry tree
 - Ginko
- Plants in the community significantly contribute to the reduction of air temperature.
- Mixed species of plants are planted against pest and disease problems.

PLANT LIST		
	Max. Height	
Street Trees		
Poplar	20 m (65 ft)	High Air Purifying
White Oak	9 m (30 ft)	High Air Purifying
Ginko	20 m (65 ft)	High Air Purifying
Zelkova	20 m (65 ft)	
Japanese Maple	20 m (65 ft)	
Cherry Tree	6 m (20 ft)	Air Purifying
Japanese Pine	6 m (20 ft)	Winter Wind Buffering
Willow	6 m (20 ft)	Air Pollution Indicating
Fruit Trees		
Japanese Persimmon	9 m (30 ft)	Fruit Bearing
Tangerine Tree	6 m (20 ft)	Fruit Bearing
Apple Tree	4.5 m (15 ft)	Fruit Bearing
Chestnut Tree	10 m (32 ft)	Fruit Bearing
Shrubs		
Spindle Tree	2 m (7 ft)	High Air Purifying
Blue Japanese Oak	2 m (7 ft)	
Azalea	1 m (3 ft)	
Box Tree	1 m (3 ft)	
Groundcovers		
Clover		
Chinese Milk Vetch		
Silver Grass	1.5 m (5 ft)	
Cluster Amaryllis	0.6 m (2 ft)	
Cosmos	0.6 m (2 ft)	
Rape Blossoms	0.6 m (2 ft)	

GREEN PAVEMENT & ROOFING

- The green pavement reduces surface temperature of streets as well as air temperature.
- The green pavement has high permeability and recharges storm water into the ground. Consequently, it will reduce urban flood.
- The green roofing reduces heat reflection and surface temperature on the roof, and it lowers air temperature around the buildings as well as inside.
- The green roof also works as a filter for rain water and air.



ORGANIC WASTE RECYCLING

- Solid organic waste and human organic waste as well as yard organic waste are collected by the vacuum system within the community.

Water Use 1.13 liters
 (1 quart)
 /flush

Pipe Diameter 63 mm
 (2.5 in)

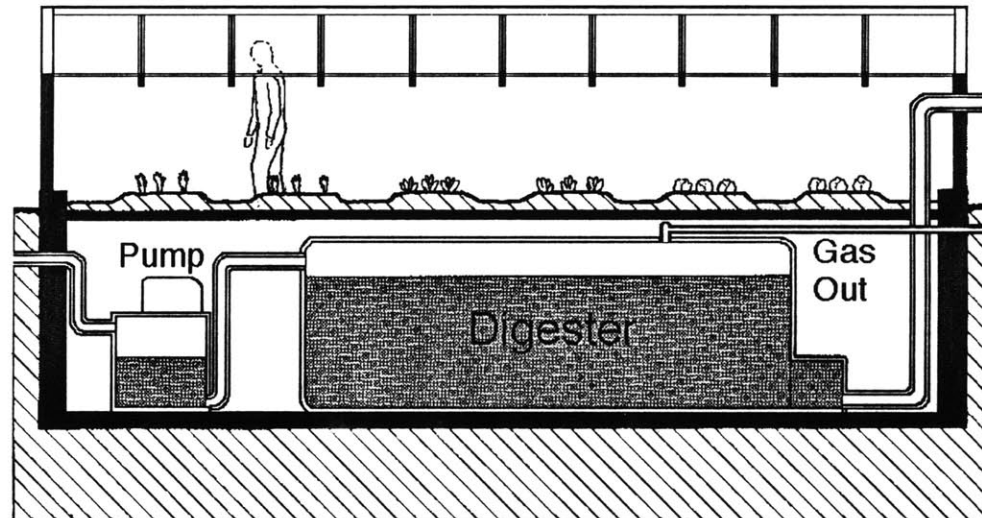
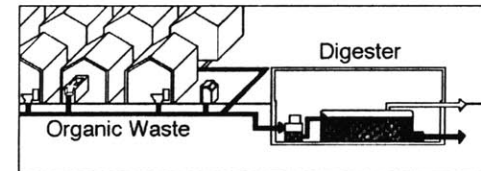
Pressure -0.5
 atmosphere

Max. Transportable Range
Horizontal 192 m
 (640 ft)
Vertical 5 m (16 ft)

- Organic waste is sent to the methane gas producing digesters located in the community open space
- Two cylindrical horizontal continuous feeding digesters are used to produce methane gas.

Diameter 1.8 m (6 ft)
Length 5.4 m
 (17.7 ft)
Volume 13.7 m³
 (500 ft³)
Capacity 45.4 kg
 (100 lb)
 of Volatile
 Solid/day

Production 60 m³
 (1800 ft³) of
 methane gas
 /day



RAIN WATER RECYCLING & RECHARGING

- The community utilizes recycled rain water for household use, community garden watering, street stream, and fire hydrant.

Total Collectable Area
6000 m²

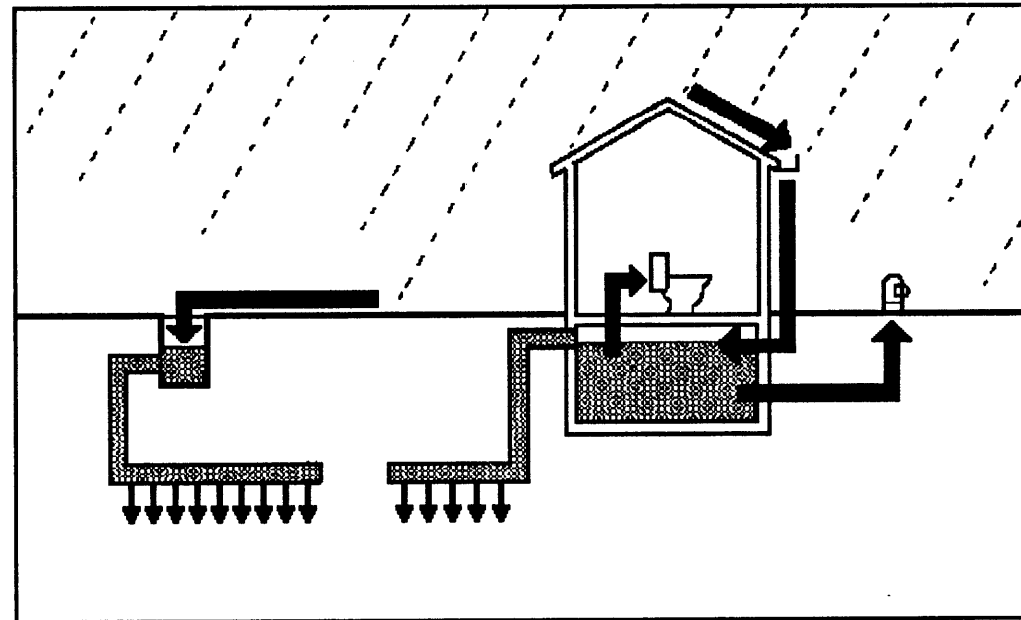
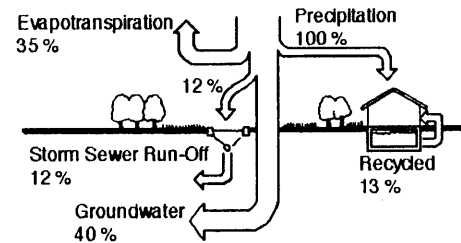
Average Precipitation
1315.5 mm/year

Recyclable Rain Water
7893 m³/year

- Every building in the community is required to have the rain water recycling system.

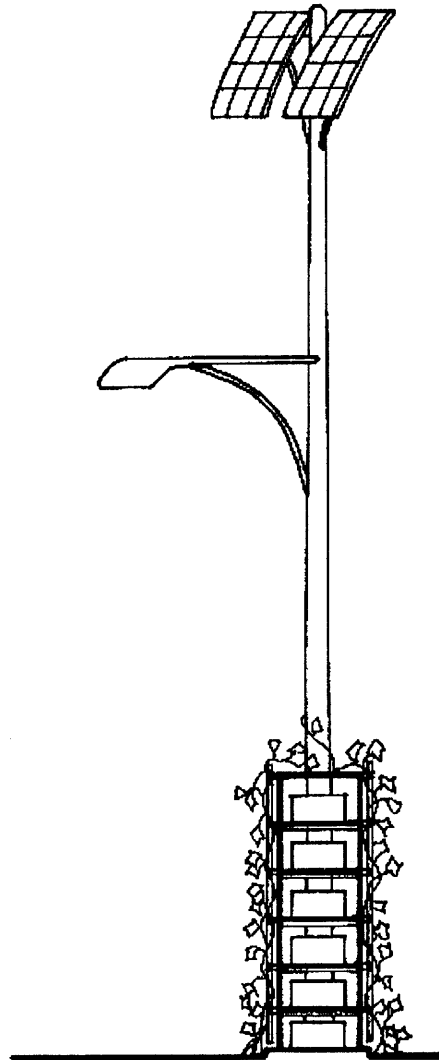
Min. Cistern Capacity
Roof Area x C (0.1)

- Over-flowed water from the cisterns and streets is recharged into ground through recharging pipes.



SOLAR ENERGY

- Solar generated electricity is used for all public facilities and systems such as street lights, the community center, and a vacuum waste collection system.
- Street lights in the community are a self-sufficient type, which is integrated with photovoltaic panels and a battery. Photovoltaic cells produce electricity during the day time, and generated electricity is stored in the battery. The street light uses electricity from the battery to light up during the night time.
- All buildings in the community have photovoltaic cell units to produce, at least, electricity needed in case of electricity shut-down.



COMMUNITY CENTER & OPEN SPACE

- The community center is located on the ground floor of one of the mixed-use building, which faces 1150 m² (0.3 acre) of a community open space.
- The program for the community open space is as follows:
 1. amphitheater
 2. organic waste recycling facility/ green house
 3. Methane gas tank/ fertilizer storage
 4. orchard
 5. grape trellis
 6. community garden
 7. storm water wetland.
- The community center as well as the open space support various kinds of activities related to sustainability and community issues, such as recycling workshops, lectures, conference, and so on.

Community Garden

- 576 m² of community garden is located in the community open space in the middle of the block.
- Recycled rain water is used for watering, and organic fertilizer recycled from community's organic waste is used to fertilize vegetables.
- Grapes are harvested on the trellises over the streets and in front of the community center.

STREETS

- In this community, streets are not merely circulation for vehicles, but useful open space. Vehicle speed is controlled by a characteristic of pavement and street plants so that all people can be safely on the streets.
- There are four types of streets in the community:
Commercial Street
Winter Wind Buffering Street
Summer Breeze Street
Roji
and each street has different kinds of characteristics.

COMMUNITY DESIGN

Community Site Plan

Roji Street Plan

NW-SE Street Plan & Sections

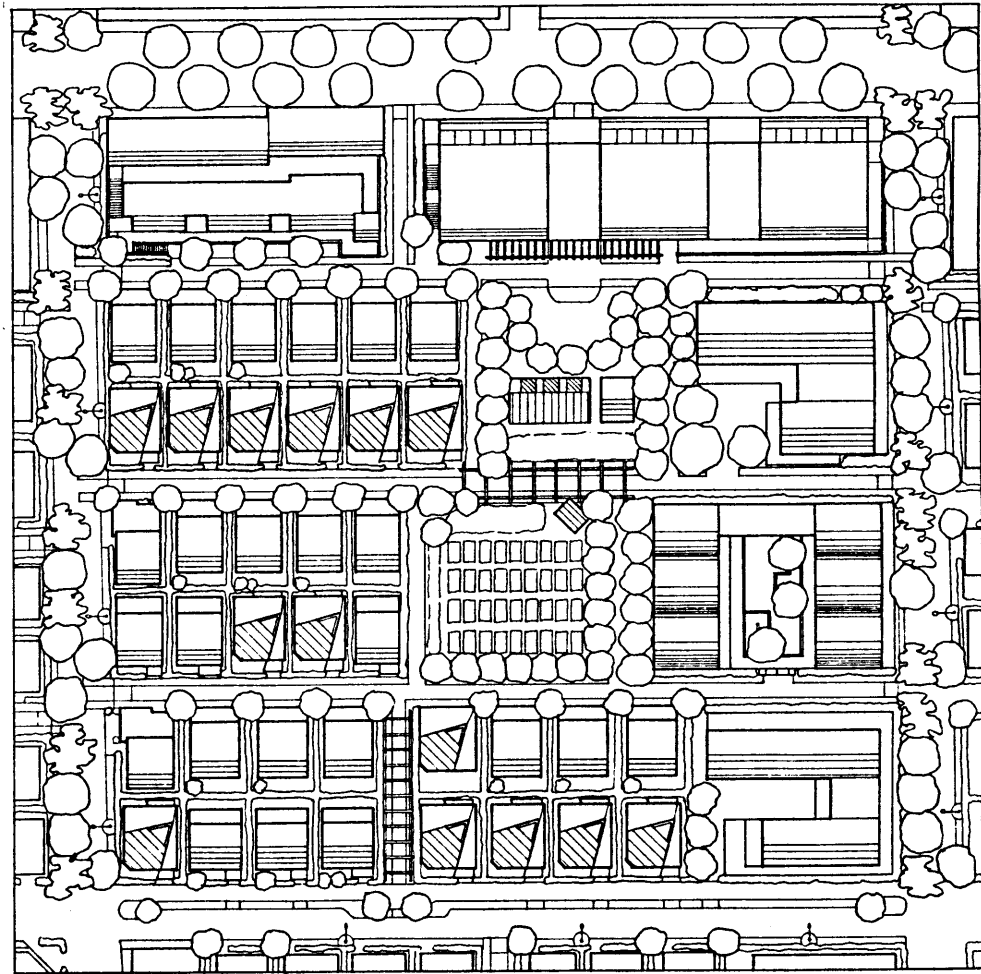
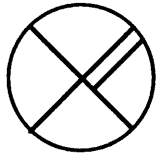
SW-NE Street Plan & Section

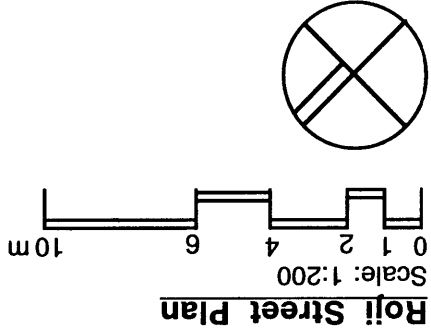
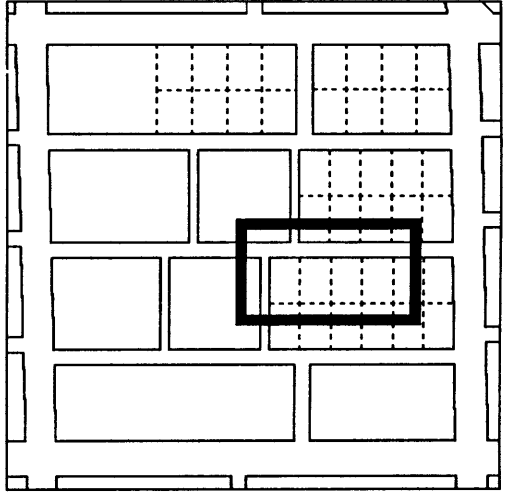
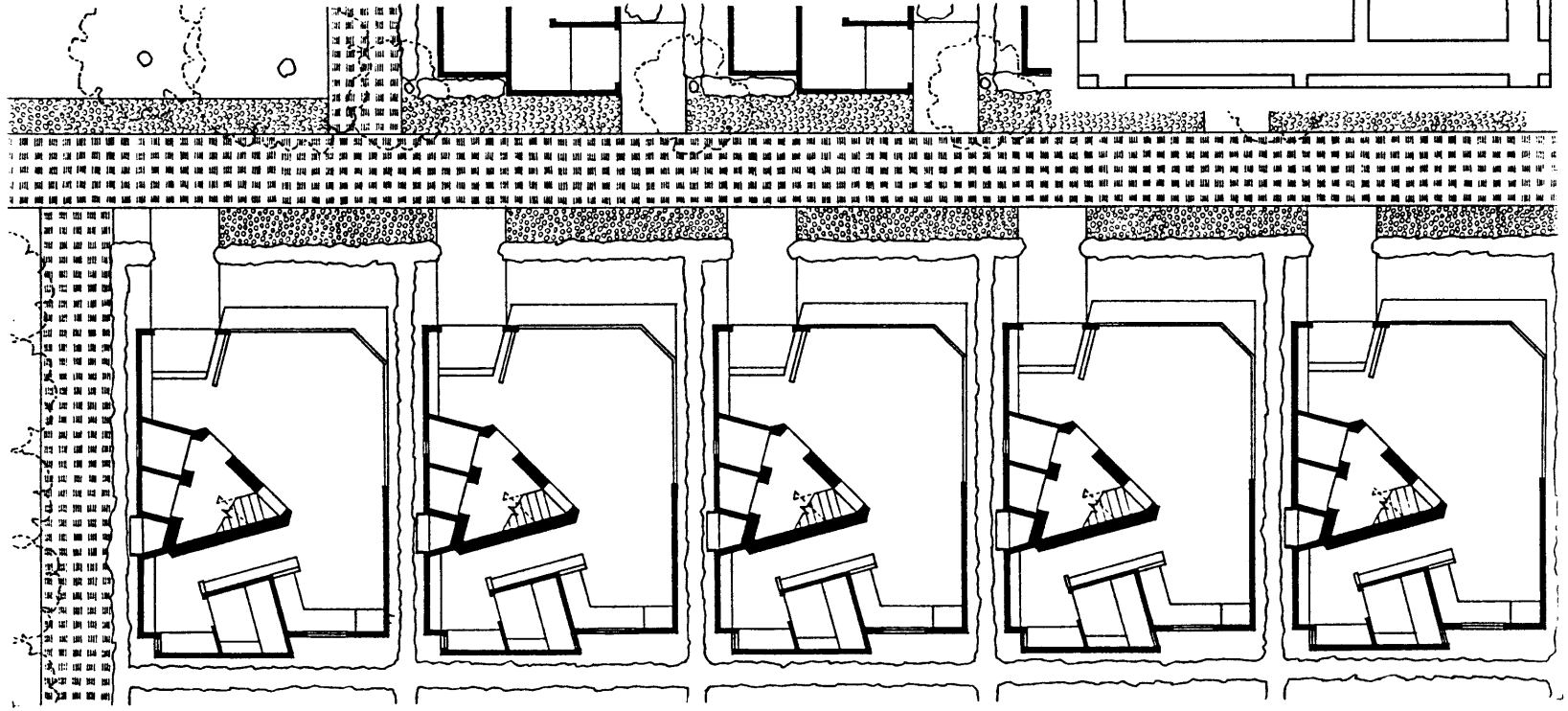
Community Sections

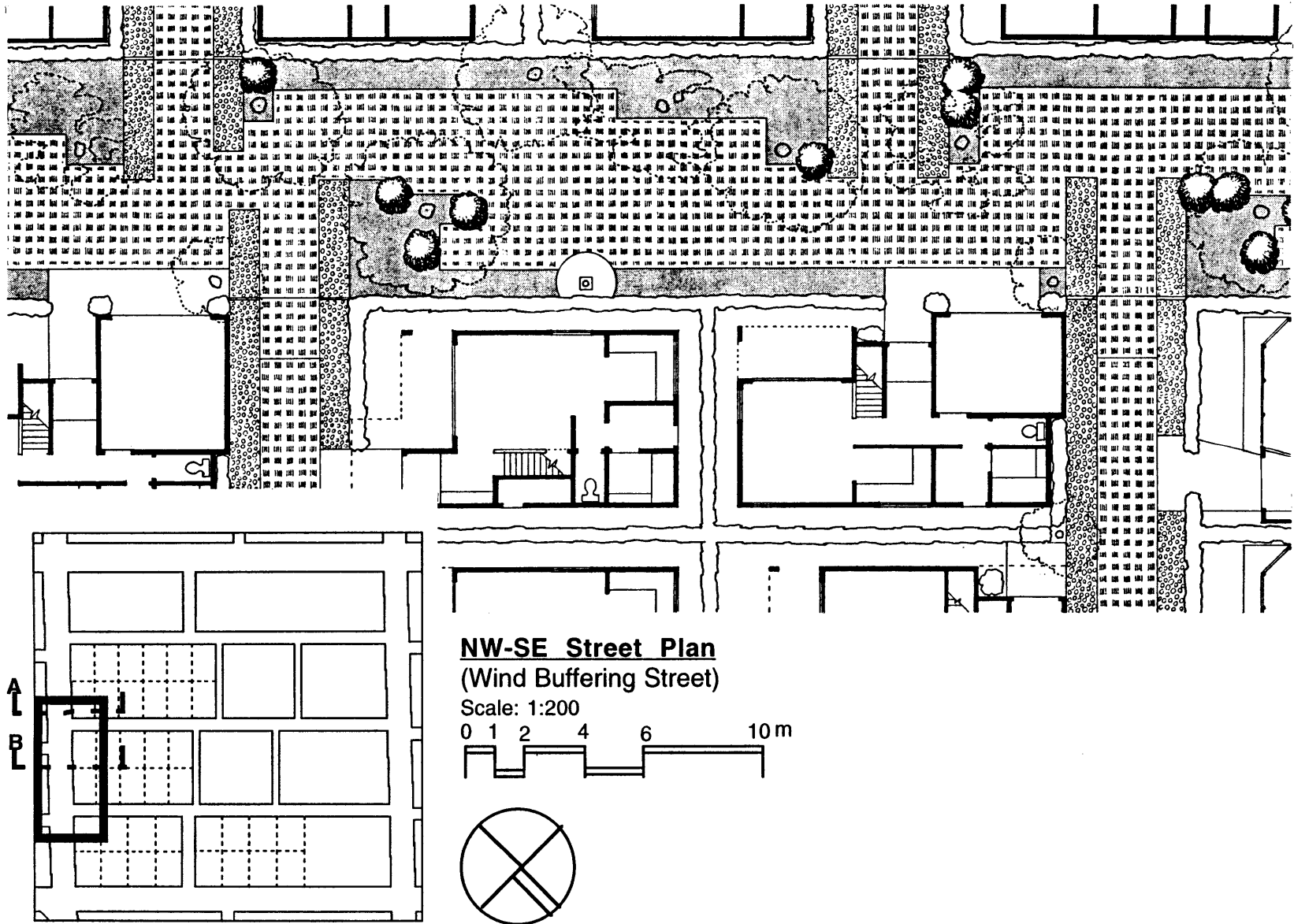
Community Site Plan

Scale: 1:1000

0 10 20 40 60 m

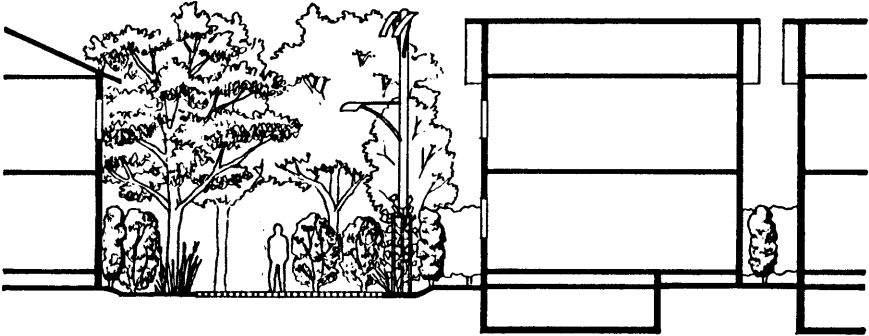
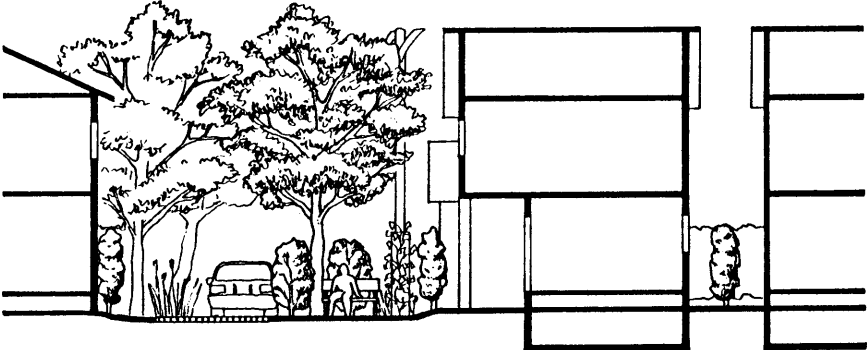
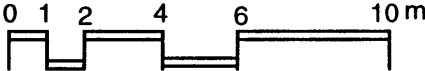






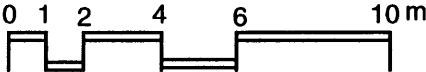
NW-SE Street Section A

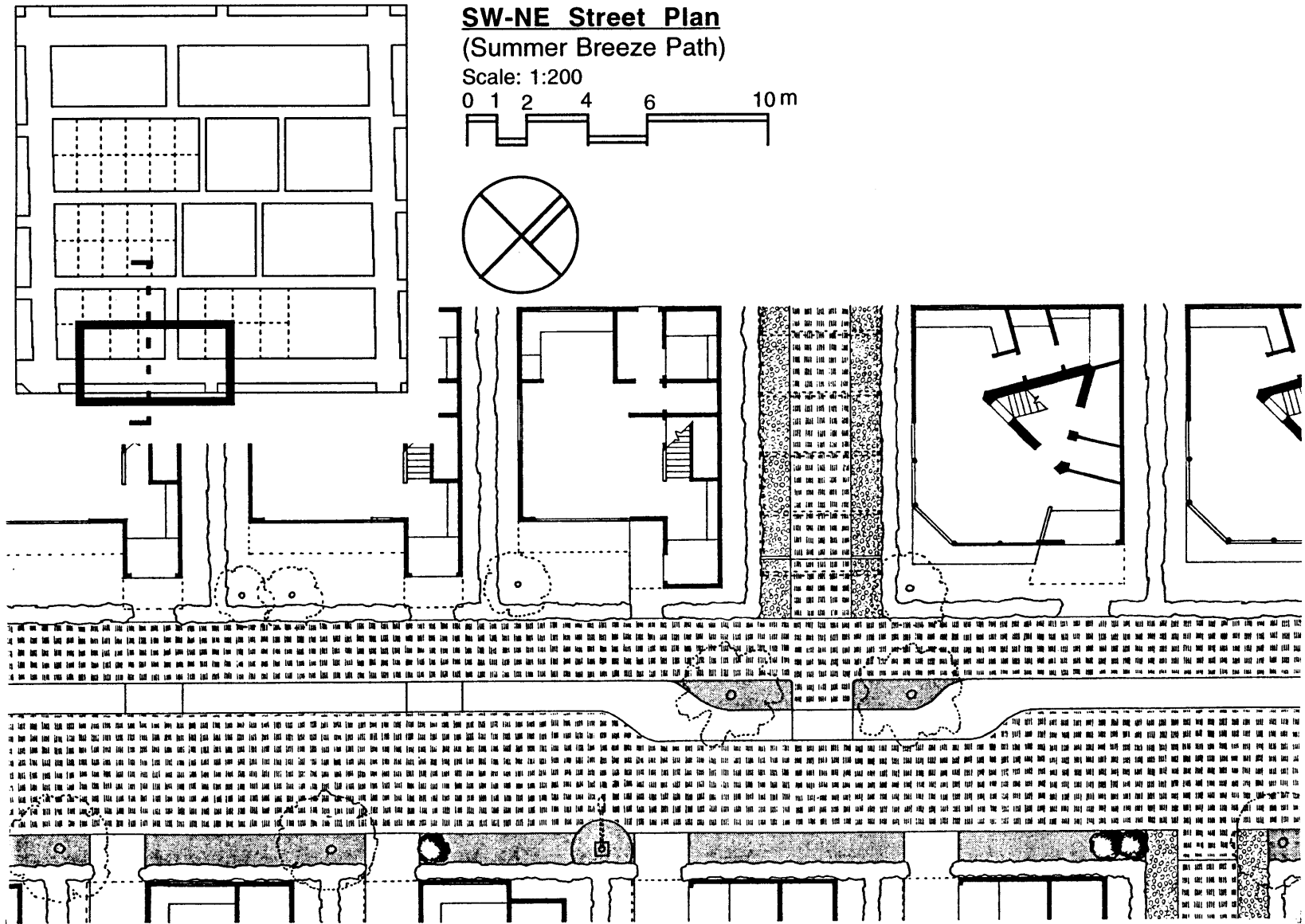
Scale: 1:200



NW-SE Street Section B

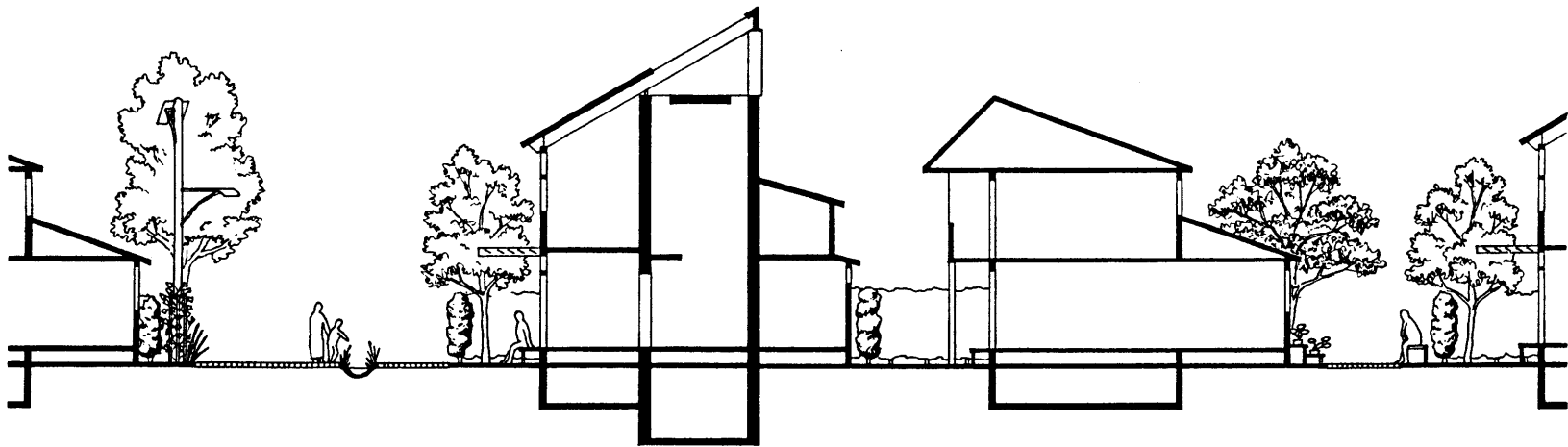
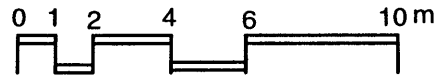
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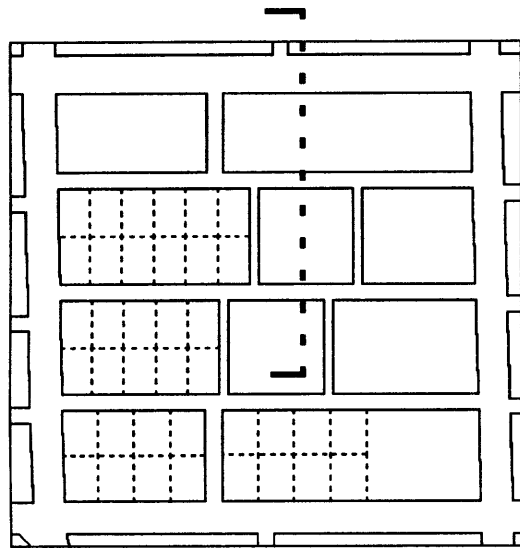




SW-NE Street Section

Scale: 1:200



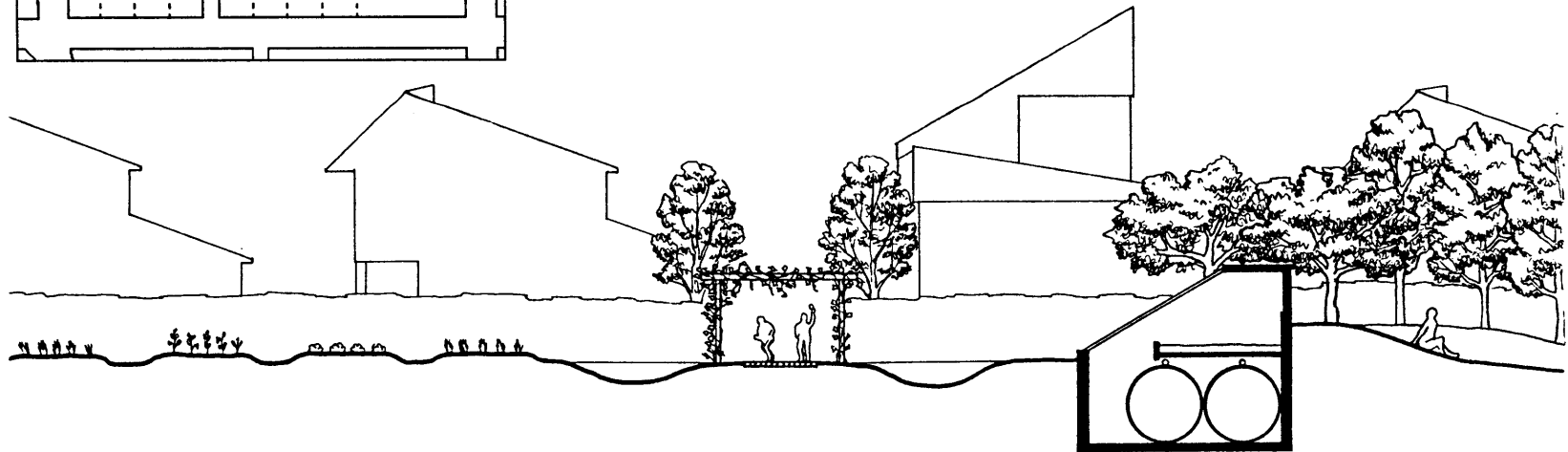
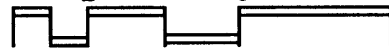


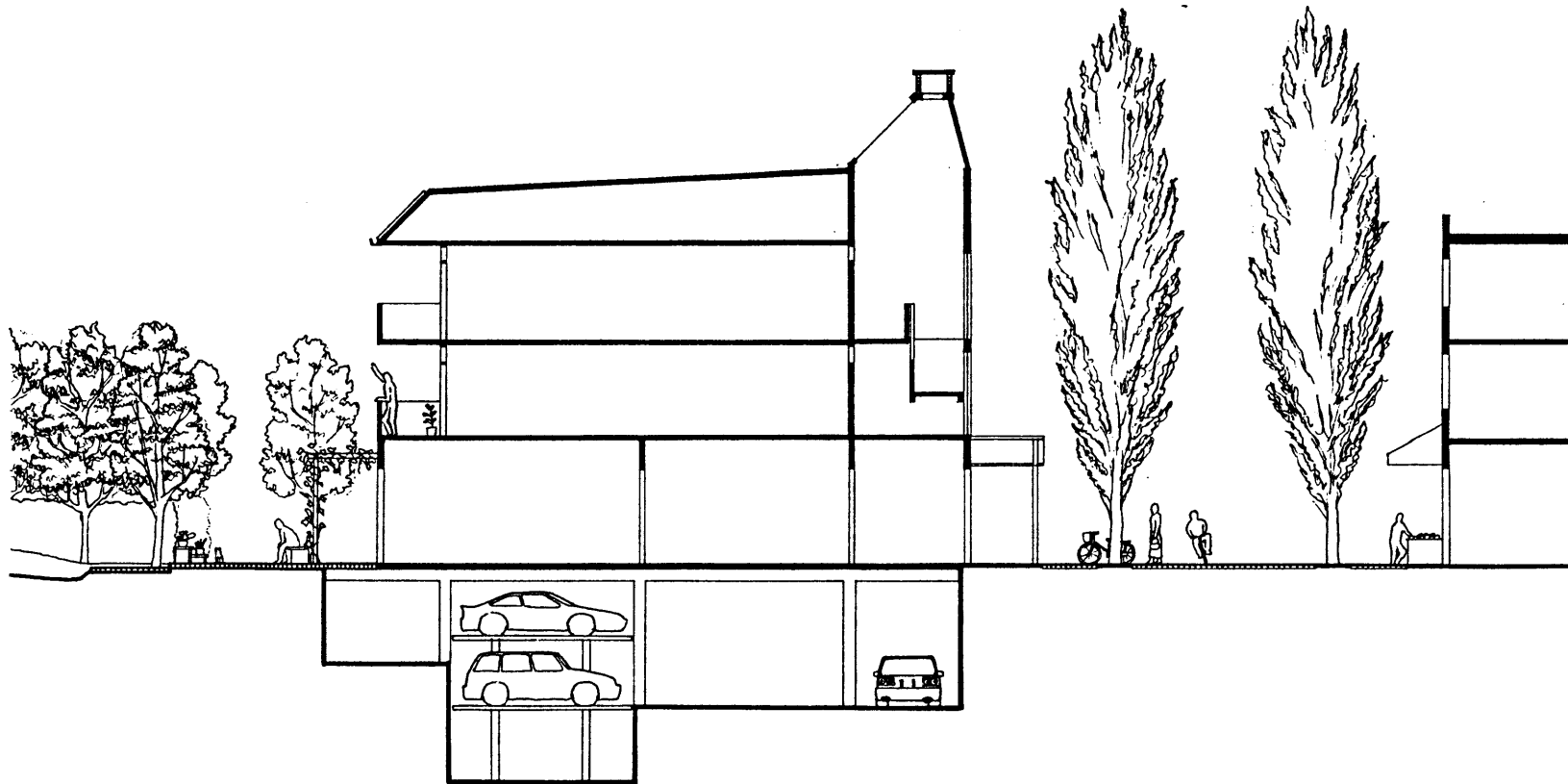
COMMUNITY SECTION A

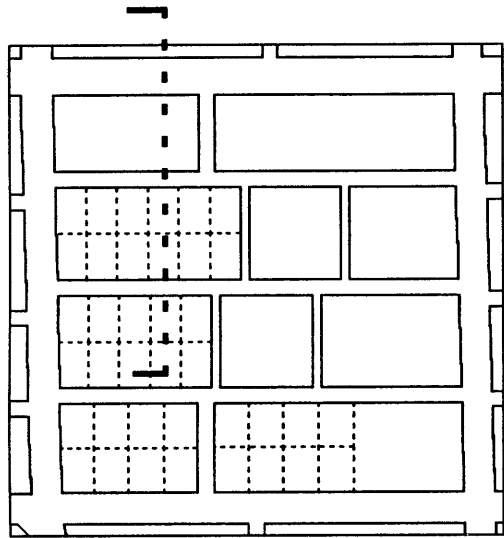
(Community Open Space)

Scale: 1:200

0 1 2 4 6 10 m

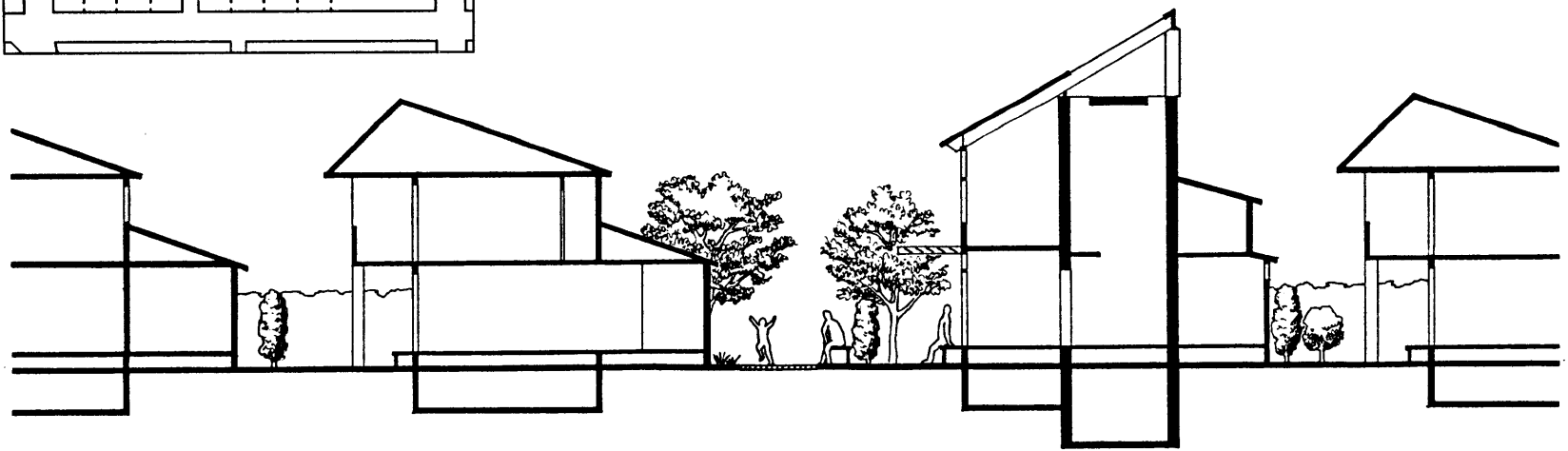
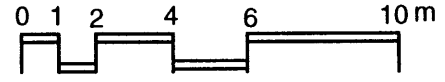


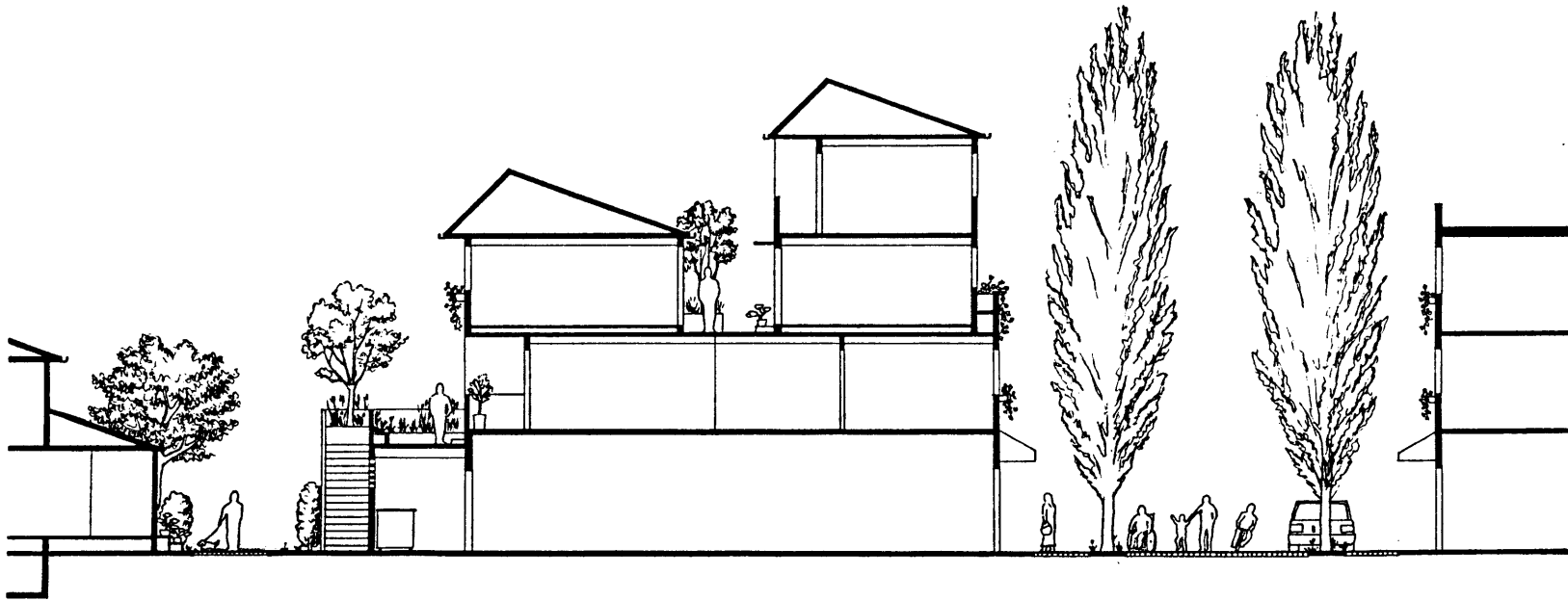




COMMUNITY SECTION B

Scale: 1:200





5. PROTO-TYPE HOUSING

Program

Proto-Type Housing Proposal

Proto-Type Housing Design

PROGRAM

Lot Area 99 m²
 (9 m x 11 m)

1st Floor (67 m²)

Living Room

Kitchen

Bathroom

Toilet

Mechanical Room

2nd Floor (49 m²)

2 Bedrooms

Toilet

Mechanical Room

PROTO-TYPE HOUSING PROPOSAL

Spatial Organization

Structure

Passive Cooling & Ventilation

Solar Collector & Heating

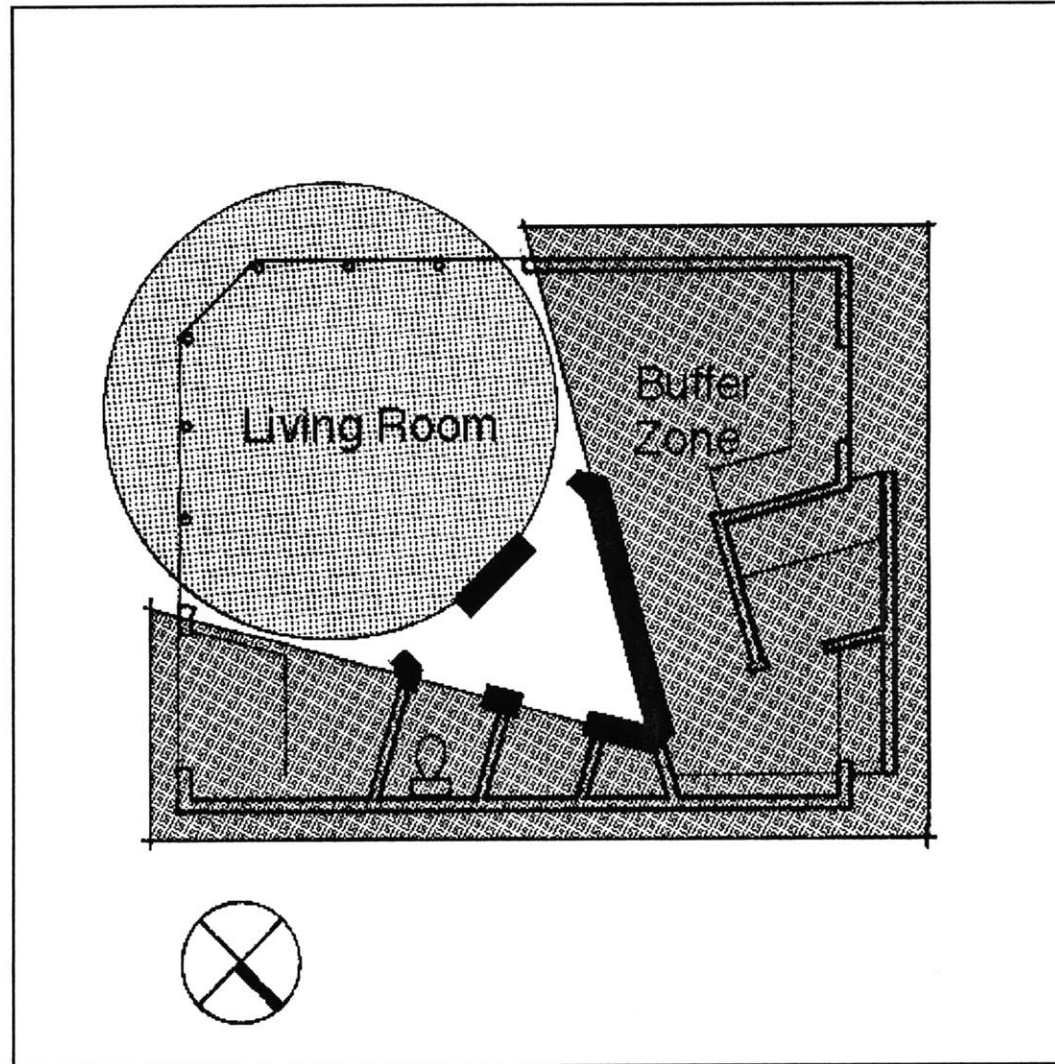
Photovoltaic Roofing

Rain Water Recycling

Organic Waste Disposal System

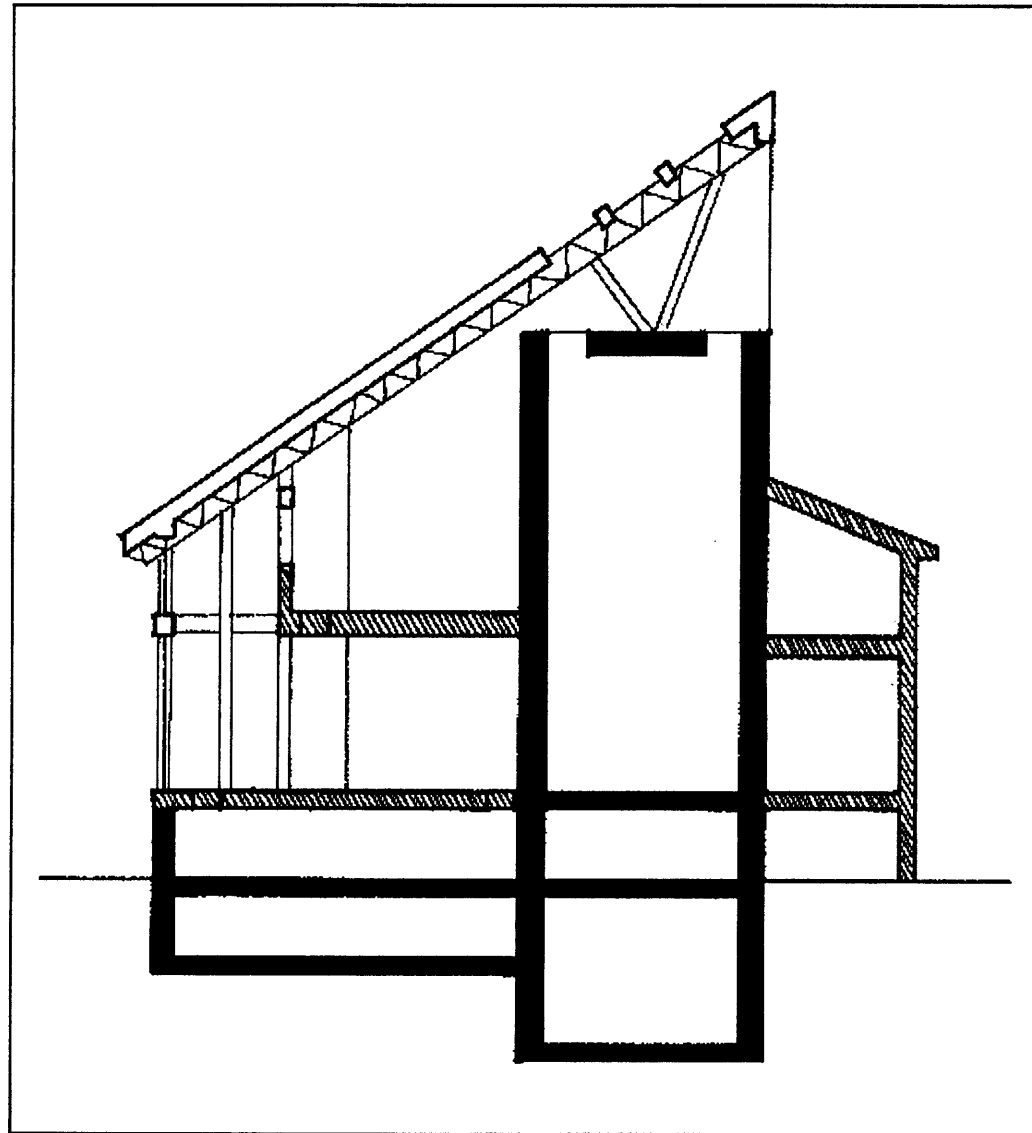
SPATIAL ORGANIZATION

- Space is organized around concrete core, which works as vertical circulation, structural, and cooling/ventilation core.
- The buffer zone is located on the north side against heat loss. (which is heat producing or enclosed space such as a kitchen, bathroom, toilet, mechanical room)
- The living room faces the south with lighter structure, especially toward the southeast. (Most of the windows are concentrated on the south side)
- Interior space is kept as open as possible for allowing natural ventilation in summer.



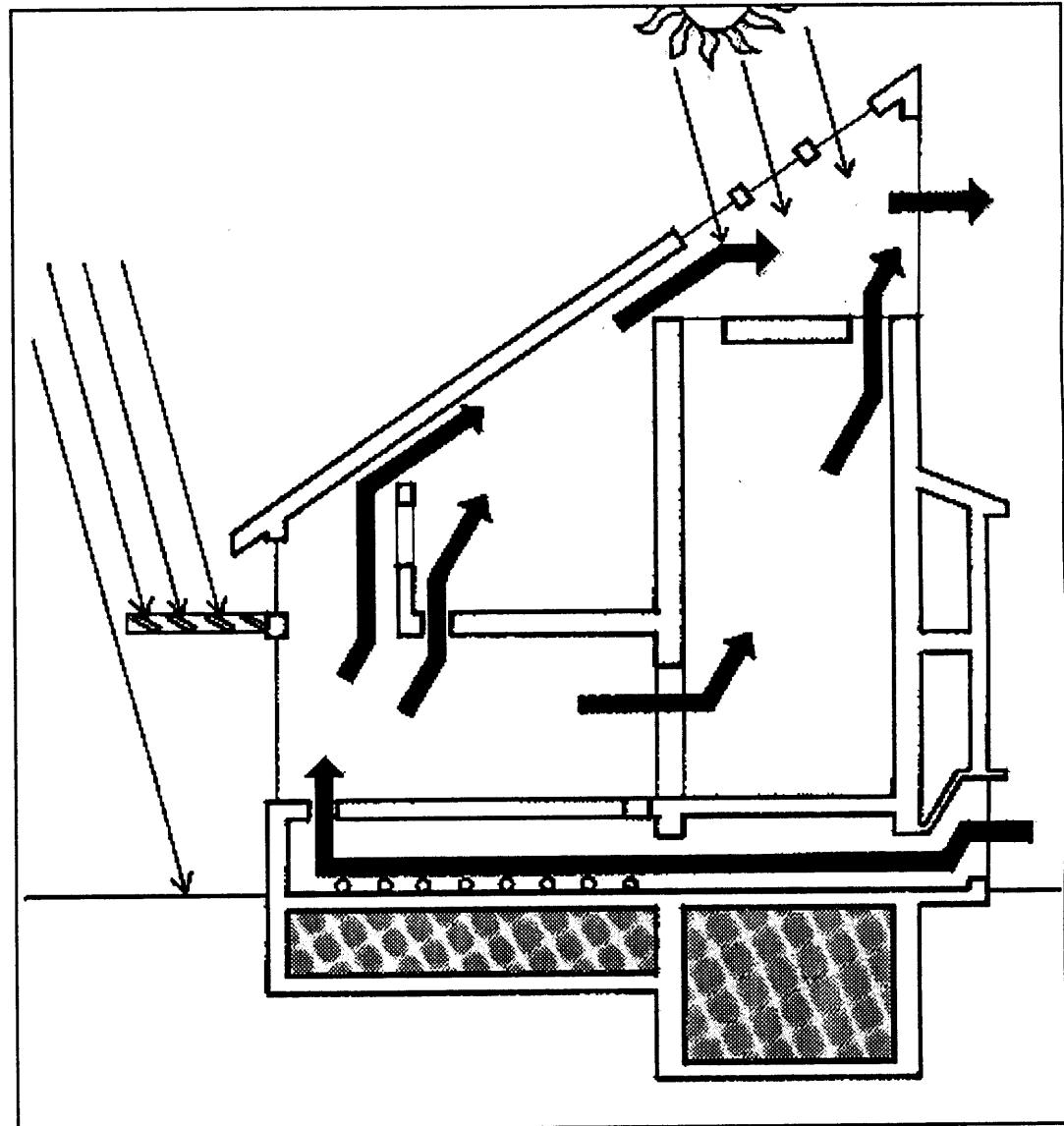
STRUCTURE

- Most of the structure consists of wood construction. Wood has high structural strength per unit weight, and strength and lightness is necessary against earthquake force.
- Wood is an organically grown, renewable, and biodegradable material; therefore, it is an environmentally friendly material.
- Post and beam construction with trussed roof structure is used on the south side (for the light and open space). These wood columns and beams are glulam members made out of recycled wood and non-toxic glue.
- Wood light frame construction is used on the north side (for the buffer zone).
- The concrete core stabilizes wooden building structure against large forces such as an earthquake or typhoon gust.



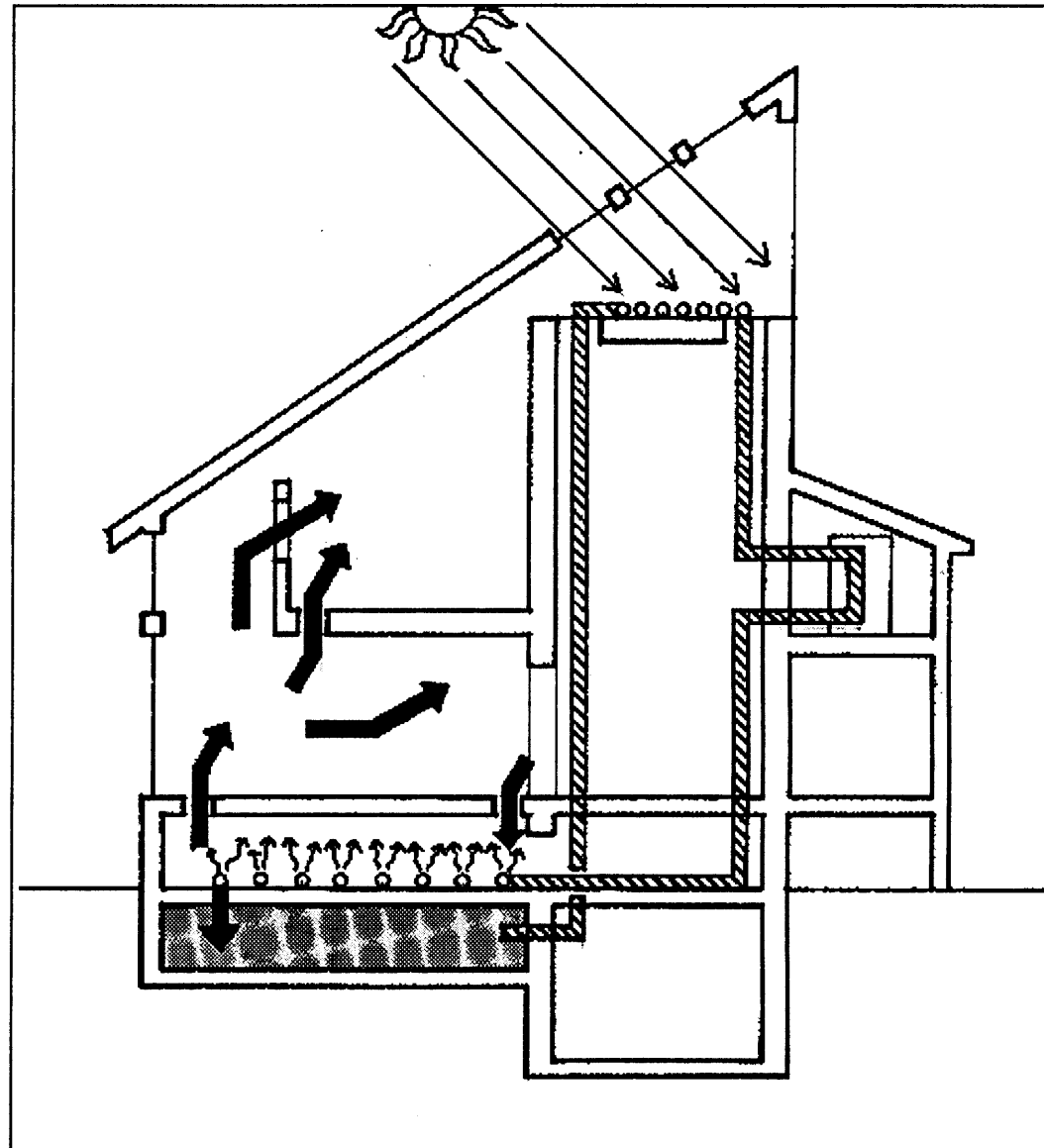
PASSIVE COOLING & VENTILATION

- Stack effect (chimney effect) takes up and exhausts interior warm air out at the top of concrete core.
- Fresh and cool air is supplied from the shaded north side of the building without any mechanical means.
- Supplied air is further cooled down in the crawling space by water radiation pipes and water cistern below, then dispersed into the interior.
- Heat absorbed by concrete at the top of the concrete core facilitates stack effect even during night.
- Passive cooling contributes to reduction of heat island effect.



SOLAR COLLECTOR & HEATING

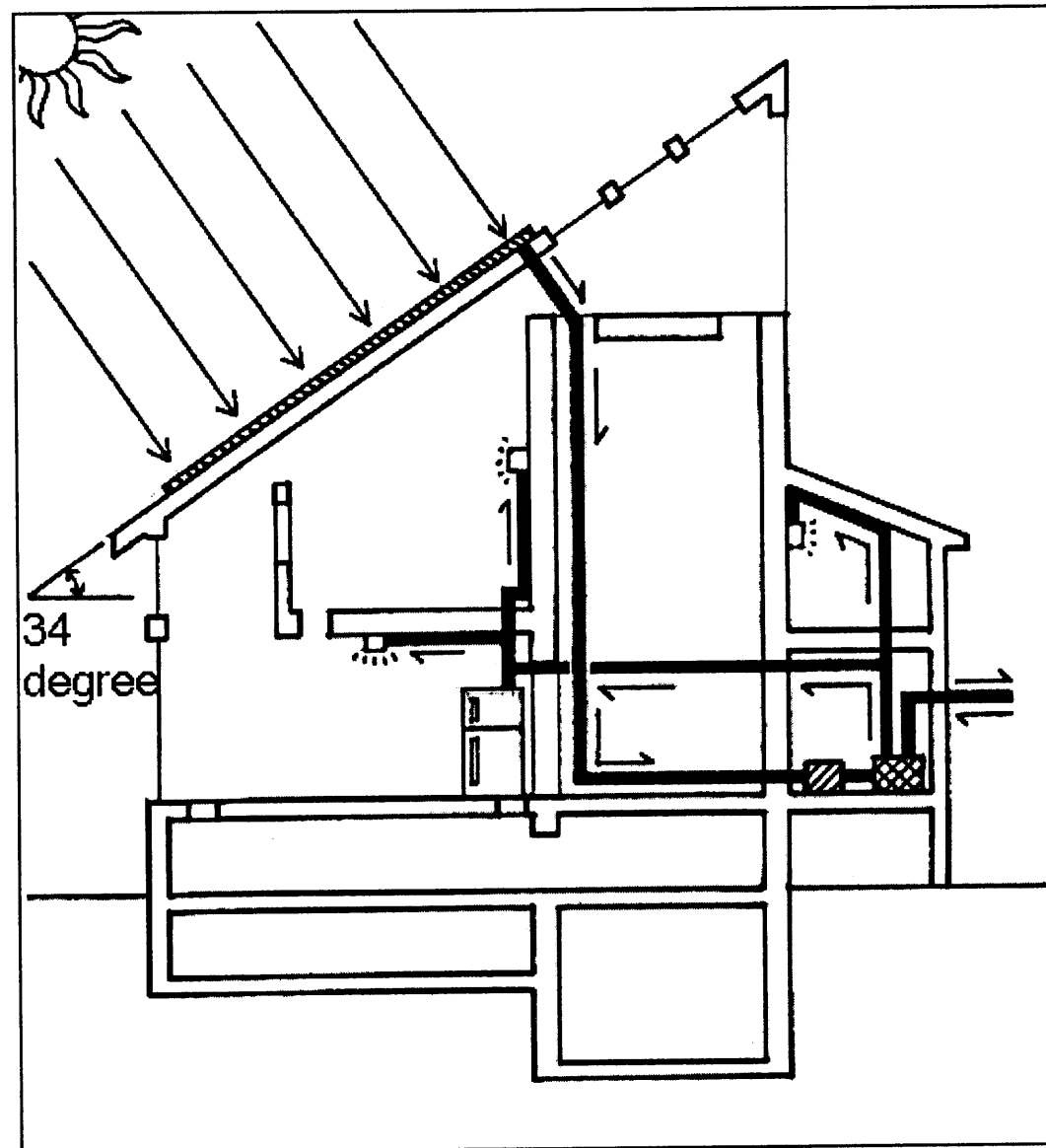
- The evacuate tube solar collector collects solar energy and heats up water running through pipes.
- Recycled rain water in the cistern below the building is used as a liquid medium for the solar collector.
- Water is sent from the cistern to the collector, heat exchanger, radiation pipe in the crawling space, and then back to the cistern. The cistern holds heated water and works as heat storage as well as insulation.
- The heat exchanger exchanges heat in the liquid medium to water and makes hot water for domestic use.
- The radiation pipe warms up the air in the crawling space and then the air is supplied into the interior space.
- The system is backed-up by a boiler for extreme conditions.



PHOTOVOLTAIC ROOFING

- Photovoltaic cells are installed on the south facing roof with the slope angle of 34 degree (which is same as the latitude)
- Photovoltaic cells cover all electricity needs within the building during a day.
- Sufficient electricity is stored in a battery or sold to a electricity company.
- Insufficient electricity is covered by the battery or electricity from a electricity company.
- The photovoltaic system is able to supply electricity in case of emergency such as electricity shut-down by natural disturbances.
- Technical Requirements

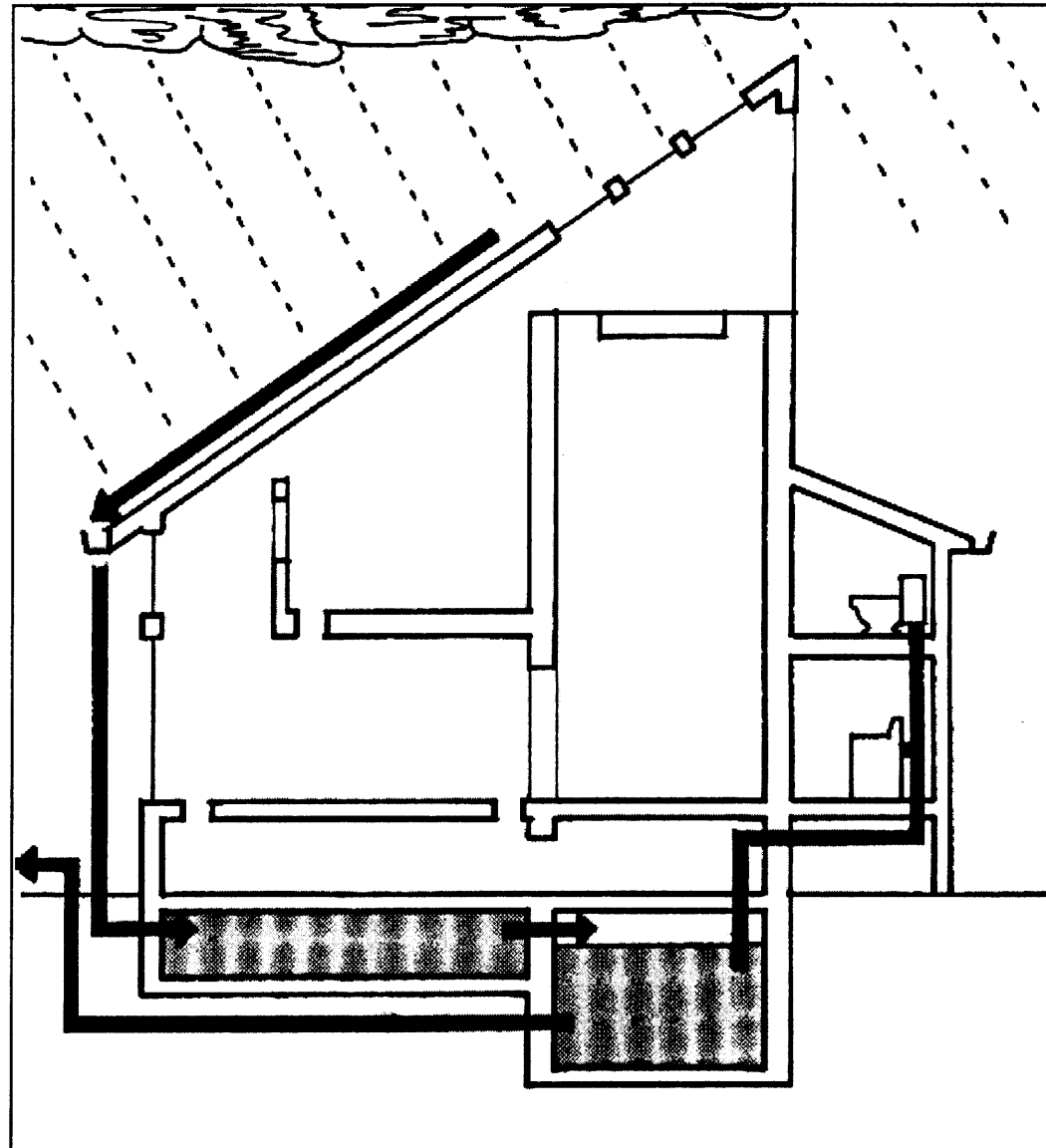
Installed Capacity	3000 Watt
Installed Roof Area	27 m ²
Annual Production	2700 kWh



RAIN WATER RECYCLING

- Precipitation fallen onto the roof is purified through the filter and stored in the cisterns below the building.
- The first cistern is always kept full and works as heat storage.
- The second cistern receives over-flow water from the first cistern. Water in this cistern is used for toilet flushing, laundry, plant watering, and so on (not as potable water).
- Water in the second cistern is also connected to the fire hydrant and used in case of emergency, especially during water shortage.
- Cisterns Capacity

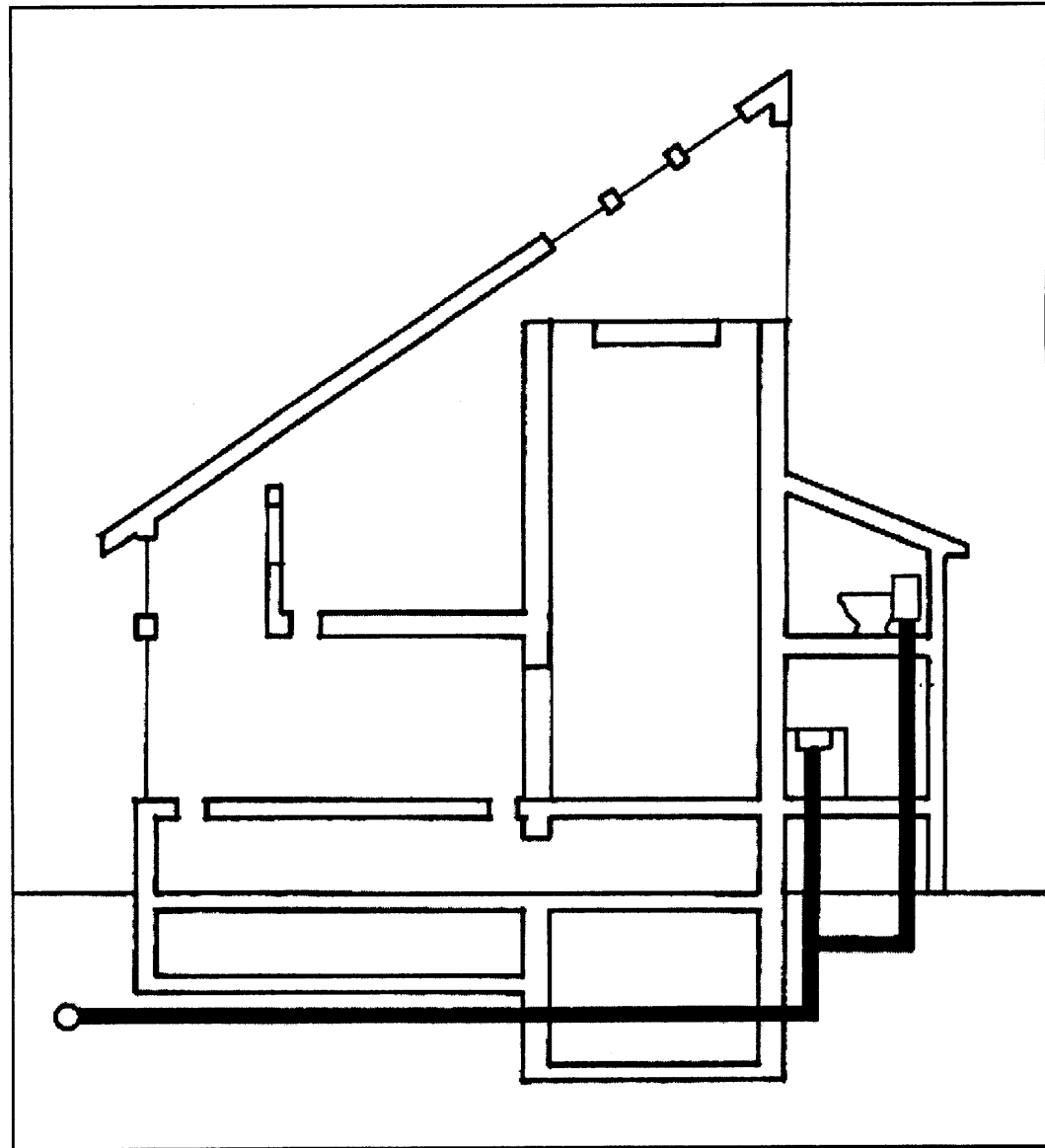
Collection Area	73.5m ²
First Cistern	8.9 m ³
Second Cistern	7.4 m ³



ORGANIC WASTE DISPOSAL SYSTEM

- Kitchen organic waste and human organic waste from toilets are carried through the vacuum collection system.
- The vacuum collection system saves up about 80 percent of flushing water used in the water-borne system (about 47.5 liters or 12.5 gallons of water per person per day)
- Requirements

Water	13 liters (1 quart) /flush
Pressure	-0.5 atmosphere



PROTO-TYPE HOUSING DESIGN

First Floor Plan

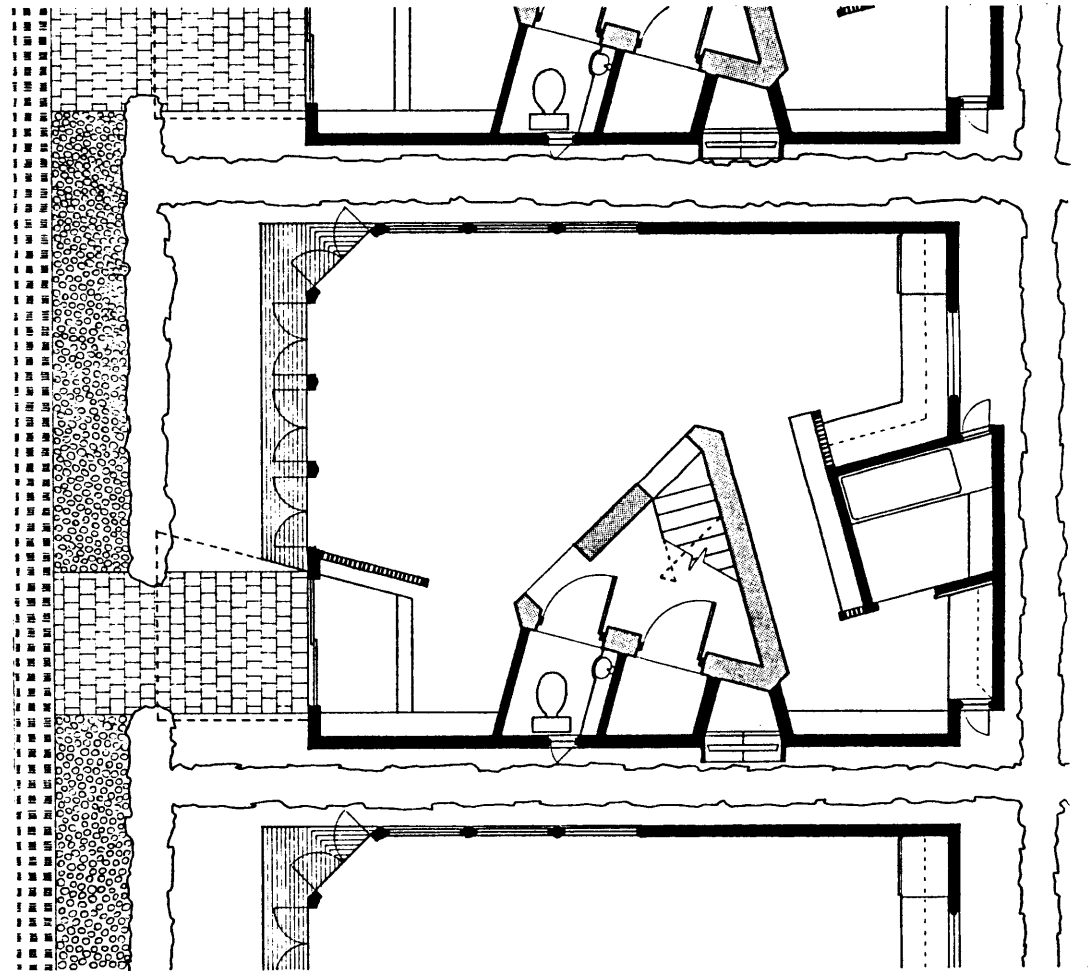
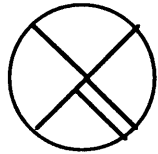
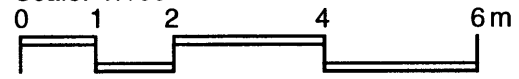
Second Floor Plan

Sections

Details

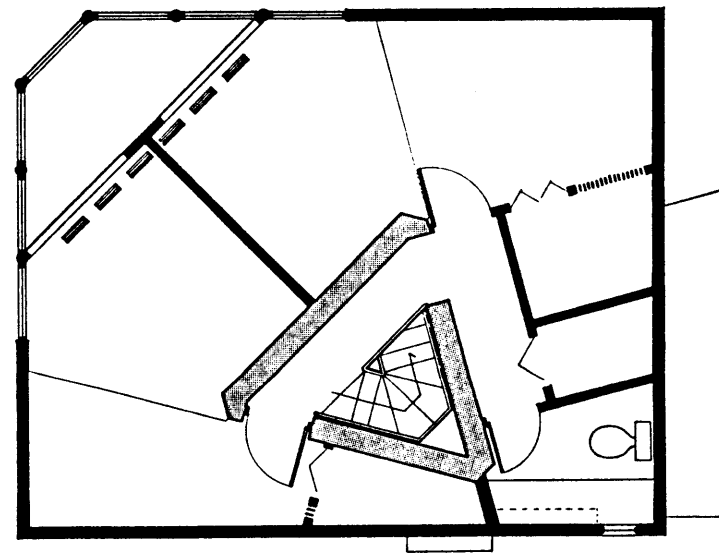
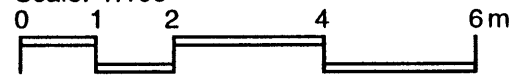
First Floor Plan

Scale: 1:100



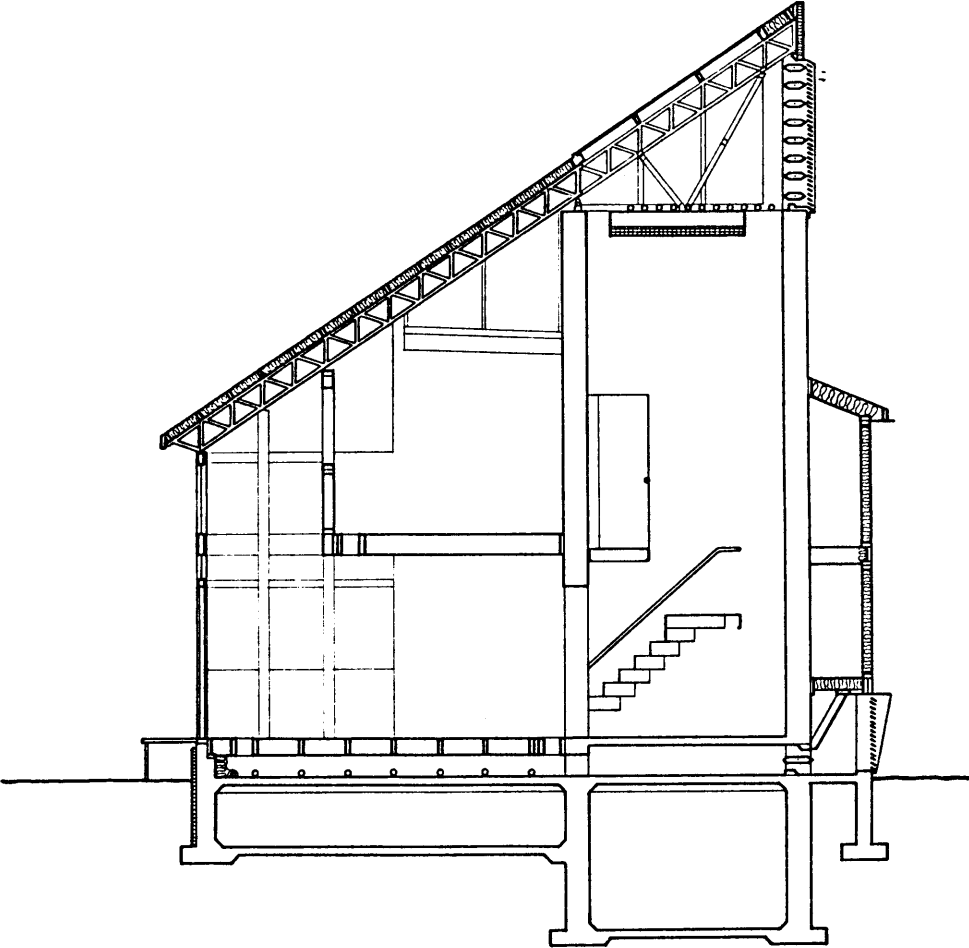
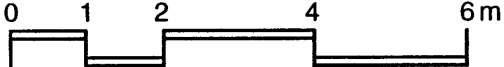
Second Floor Plan

Scale: 1:100



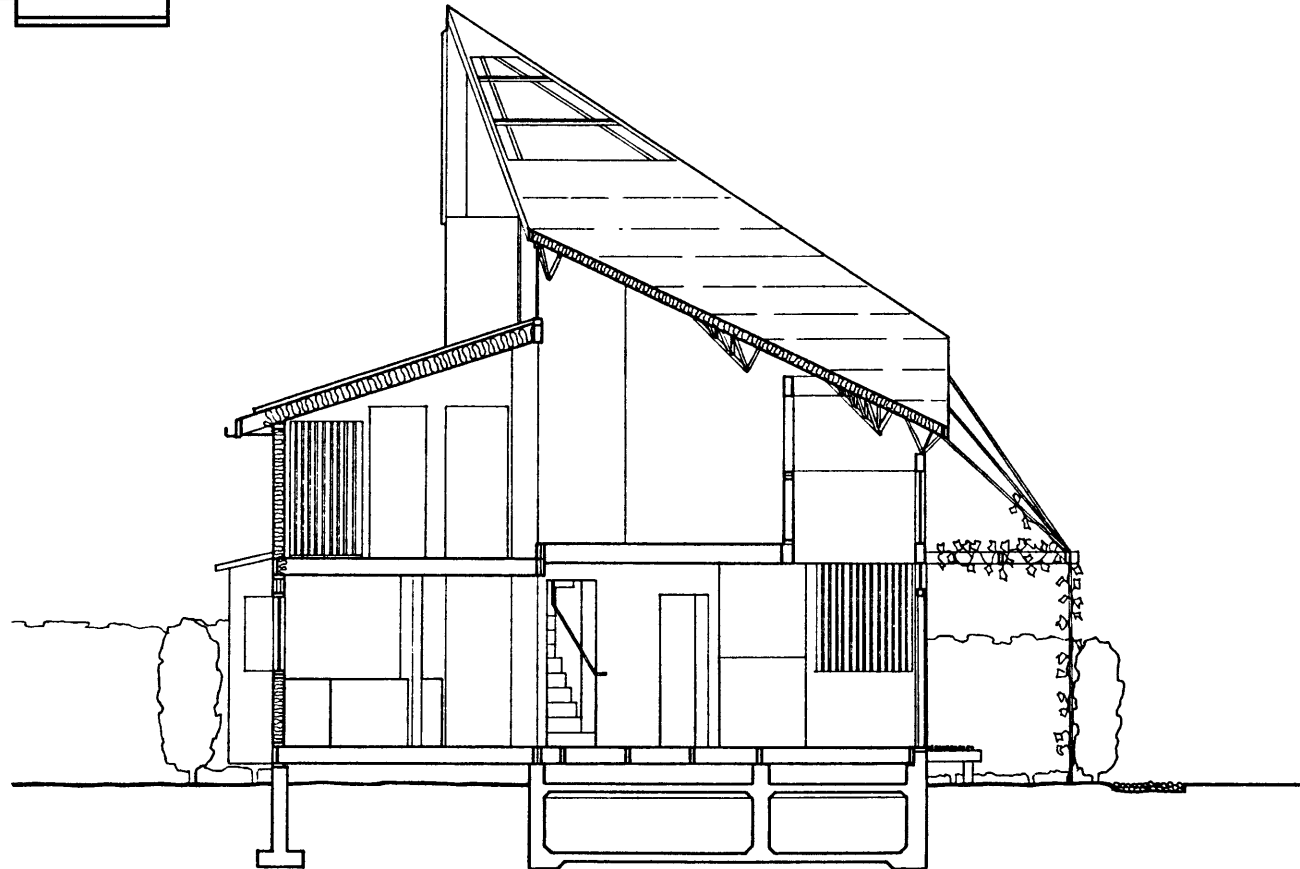
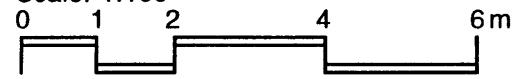
Section A

Scale: 1:100



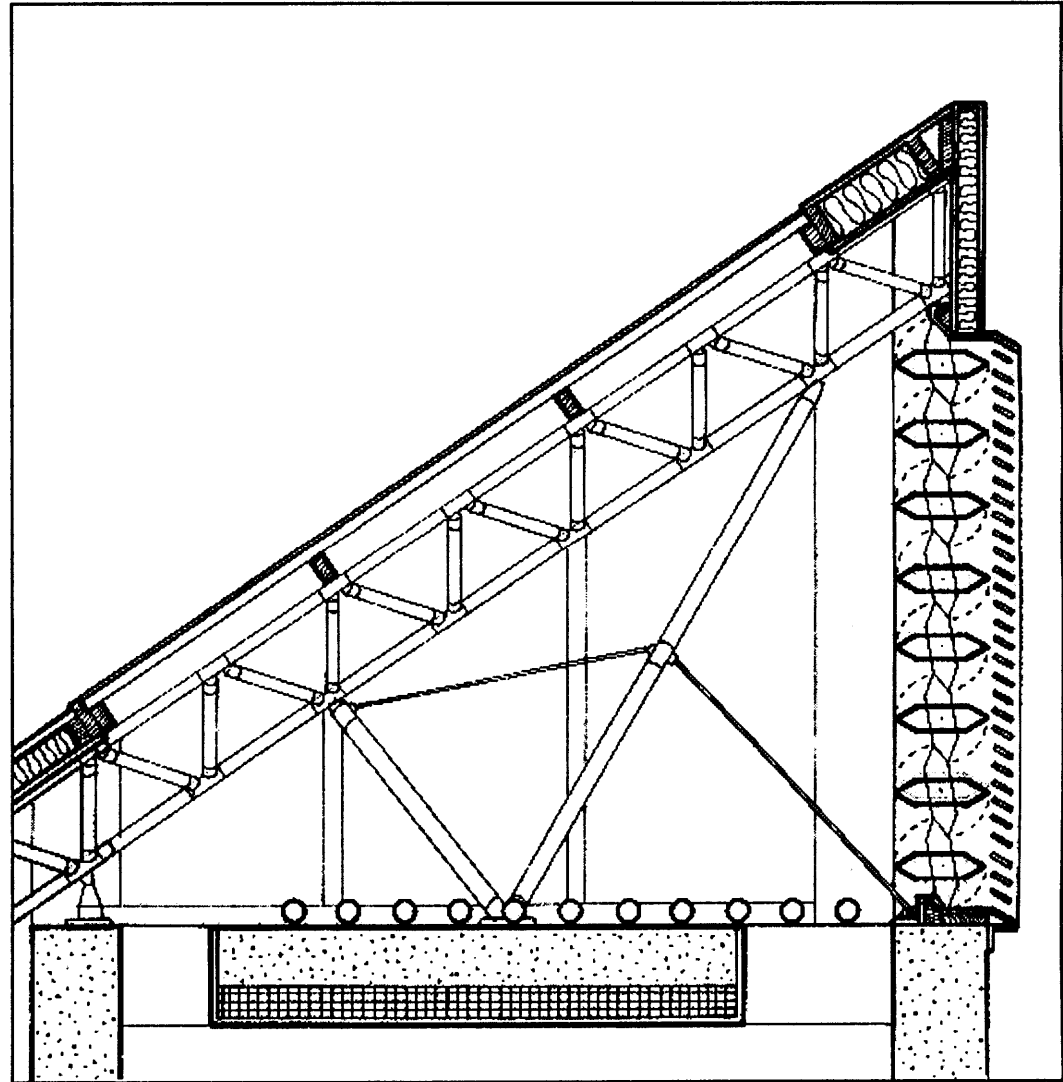
Section B

Scale: 1:100



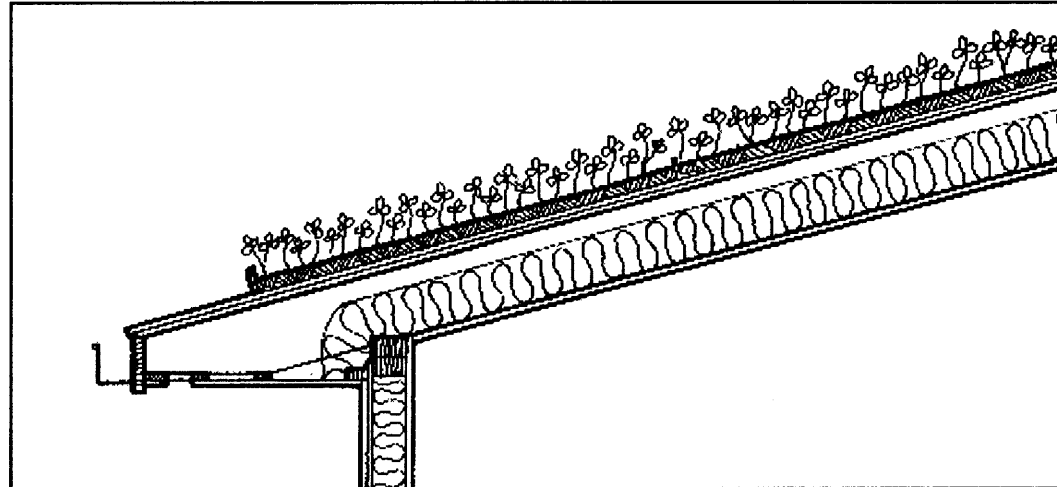
Heat Chimney Detail

Scale: 1:25



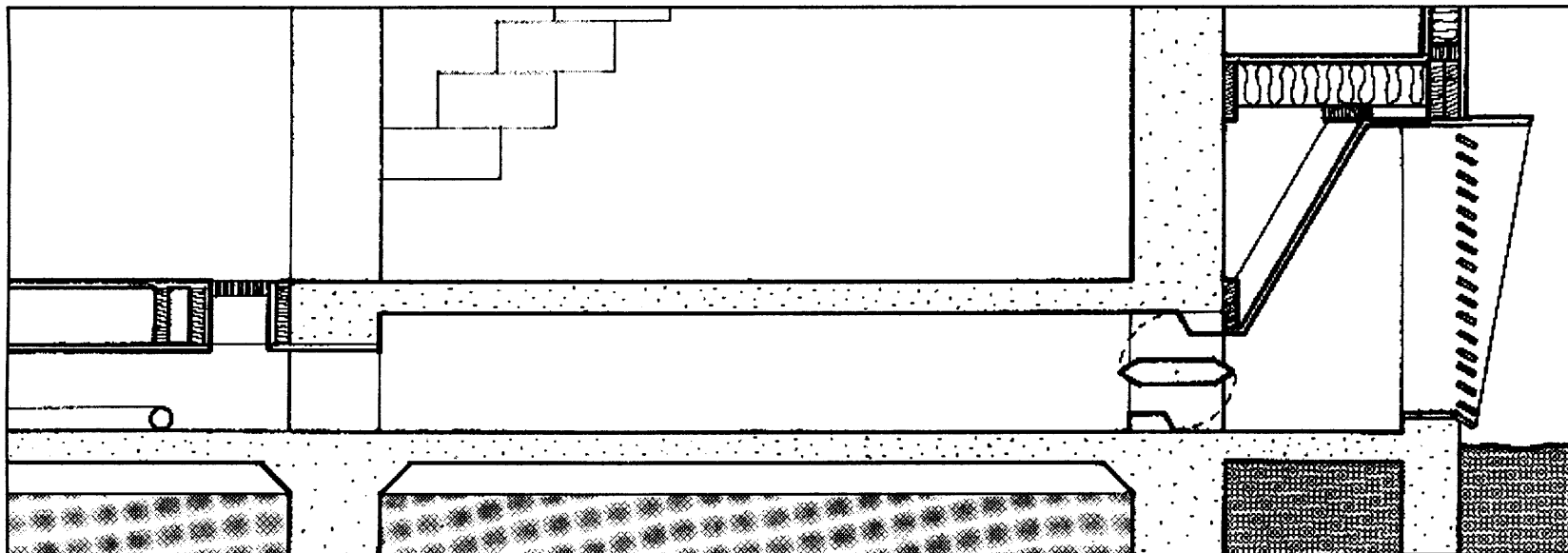
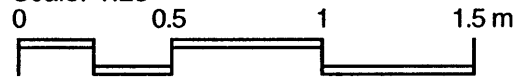
Green Roof Detail

Scale: 1:25



Air Intake Detail

Scale: 1:25



CONCLUSION

Through the process of the thesis, a sustainable community was developed from the community design to a proto-type housing design based on the criteria established from sustainable potentials found in the proposed site. First of all, criteria were set considering how to make most use of the natural processes at the proposed site, how to minimize human impact to nature, and how to create comfortable environment for people. Then the community and proto-type housing design were developed utilizing both natural processes and technology.

However, it seems that the physical aspect of sustainability was more focused in this thesis. Ideally, all of the aspects of sustainability, not only physical one, but also social and cultural ones as well as economical one should be considered in the process of developing a sustainable community. Regarding the cultural aspect, the thesis is based on my thought that the existing community already has strong cultural characteristics and how I can create physical environment which will sustain these existing characteristics. Therefore, this thought was somehow reflected in the design, but was not fully discussed in the thesis.

Talking about other aspects of sustainability, it might involve more complex processes to deal with all of the aspects, and it is too broad to deal within the thesis. However, it is really necessary to consider all of the aspects of sustainability in order to develop a sustainable community in the real world. It will not be made possible merely by architects or urban planners, but it will require the participation of various kinds of professional and non-professional people. The issue of sustainability or a sustainable community is a topic that has to be explored and discussed more and further in the society, and the role of architects and urban planners is, I believe, to remind people about the issue of sustainability and guide them to solve the issue. I hope my thesis will take one tiny step in this process and remind some people, including architecture students, about the importance of considering sustainability within the design process.

RELATED PRECEDENTS

The Ahwahnee Principles

Village Homes

Next 21

AHWAHNEE PRINCIPLES

The Ahwahnee Principles was established by six architects, Peter Calthope, Michael Corbett, Andres Duany, Elizabeth Plater-Zyberk, Stefanos Polyzoides, and Elizabeth Moule, in a conference held at the Ahwahnee Hotel in Yosemite National Park in 1991. It states principles that have to be followed in designing communities with less dependence on automobiles, more concern on ecosystem, and stronger identity which these six architects advocate. The Ahwahnee Principles consists of four sections, preamble, community principles, regional principles, and implementation strategies.

Preamble

Existing patterns of urban and suburban development seriously impair our quality of life. The symptoms are: more congestion and air pollution resulting from our increased dependence on automobiles, the loss of precious open space, the need for costly improvements to roads and public services, the inequitable distribution of economic resources, and the loss of a sense of community. By drawing upon the best from the past and present, we can plan communities that will more successfully serve the needs of those who live and work within them. Such planning should adhere to certain fundamental principles.

Community Principles:

1. All planning should be in the form of complete and integrated communities containing housing, shops, work places, schools, parks and civic facilities essential to the daily life of the residents.
2. Community size should be designed so that housing, jobs, daily needs and other activities are within easy walking distance of each other.
3. As many activities as possible should be located within easy walking distance of transit stops.
4. A community should contain a diversity of housing types to enable citizens from a wide range of economic levels and age groups to live within its boundaries.

5. Businesses within the community should provide a range of job types for community's residents.
6. The location and character of the community should be consistent with large transit network.
7. The community should have a center focus that combines commercial, civic, cultural and recreational uses.
8. The community should contain an ample supply of specialized open space in the form of squares, greens and parks whose frequent use is encouraged through placement and design.
9. Public design should be designed to encourage the attention and presence of people at all hours of the day and night.
10. Each community or cluster of communities should have a well defined edge, such as agricultural greenbelts or wildlife corridors, permanently protected from development.
11. Streets, pedestrian paths and bike paths should contribute to a system of fully-connected and interesting routes to all destinations. Their design should encourage pedestrian and bicycle use by being small and spatially defined by buildings, trees and lighting; and by discouraging high speed traffic.
12. Wherever possible, the natural terrain, drainage, and vegetation of the community should be preserved with superior examples contained within parks or greenbelts.
13. The community design should help conserve resources and minimize waste.
14. Communities should provide for the efficient use of water through the use of natural drainage, drought tolerant landscaping and recycling.
15. The street orientation, the placement of buildings and the use of shading should contribute to the energy efficiency of the community.

Regional Principles:

1. The regional land use planning structure should be integrated within a larger transportation network built around transit rather than freeways.
2. Regions should be bounded by and provide a continuous system of greenbelt/wildlife corridors to be determined by natural conditions.
3. Regional institutions and services (government, stadiums, museums, etc.) should be located in the urban core.
4. Materials and methods of construction should be specific to the region, exhibiting continuity of history and culture and compatibility with the climate to encourage the development of local character and community identity.

Implementation Strategy:

1. The general plan should be updated to incorporate the above principles.
2. Rather than allowing developer-initiated, piecemeal development, local governments should take charge of the planning process. General plans should designate where new growth, infill or redevelopment will be allowed to occur.
3. Prior to any development, a specific plan should be prepared based on the planning principles. With the adoption of specific plans, complying projects could proceed with minimal delay.
4. Plans should be developed through an open process and participants in the process should be provided visual

models of all planning proposals.

VILLAGE HOMES

Village Homes is a new town community in Davis, California, which was designed by Michael Corbett and built in 1981. It is a small town of sixty acres with 240 residential buildings that implemented coexistence of ecosystem and human's comfortable life.

The main goal of the Village Homes is the creation of the ecologically sustainable community. The characteristics unique to the Village Homes are:

- Edible landscape
(On site food production)
- Natural storm water drainage
Use of solar energy
- Streets shaded with
vegetation
- Undulating streets
- Pedestrian & bike paths
- Large public space

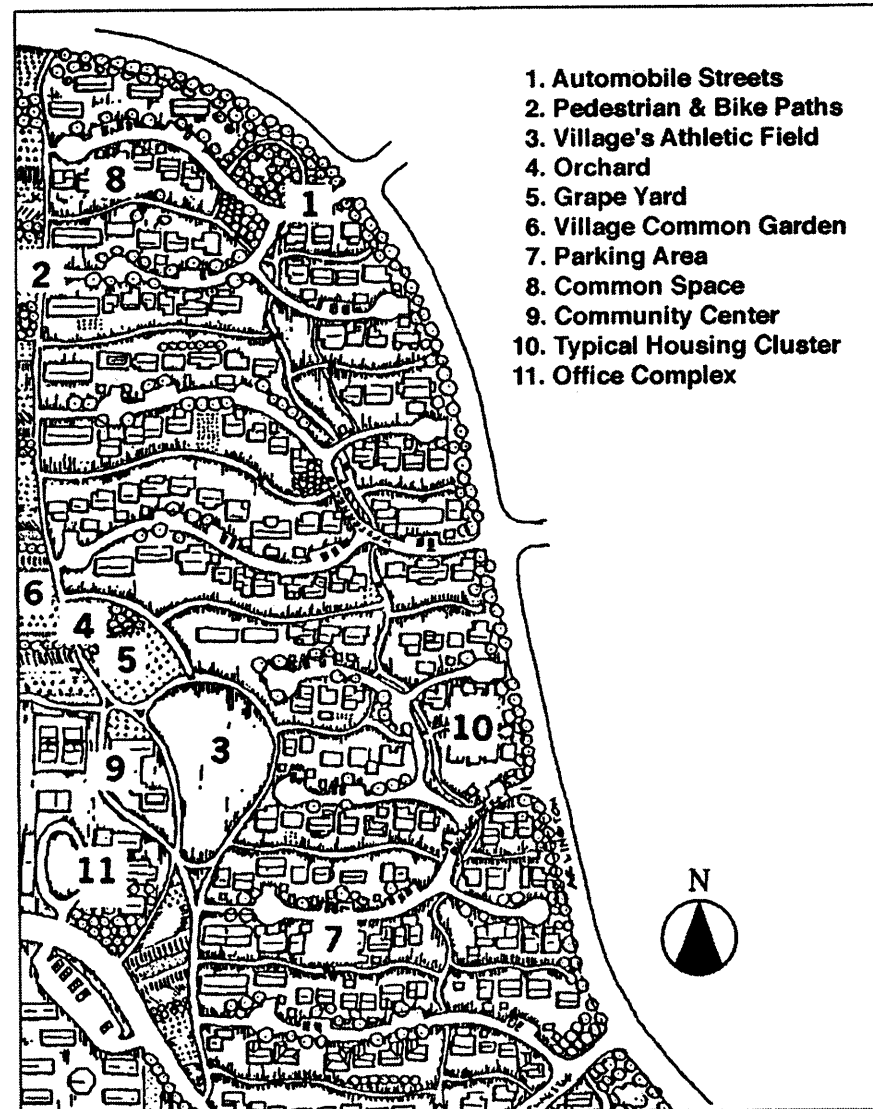


figure A (Village Homes Site Map)

figure B (Community Center)

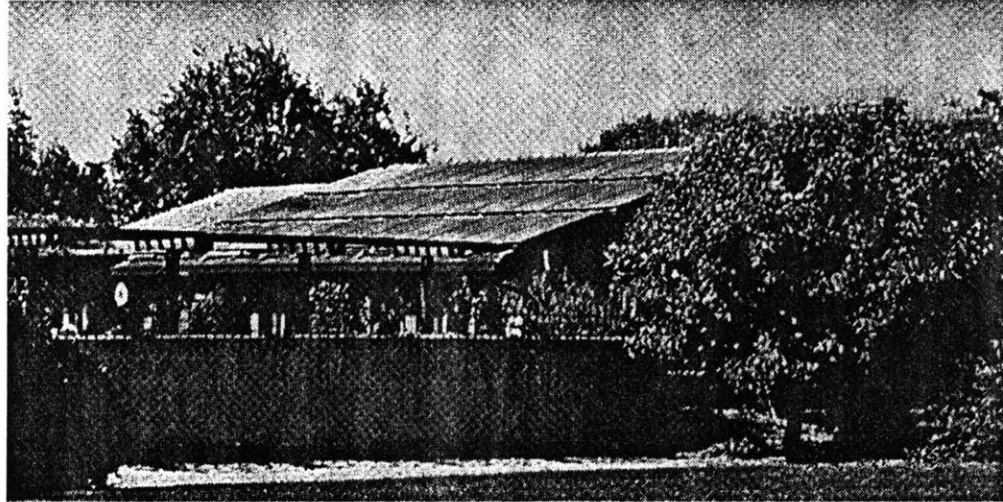


figure C (Pedestrian & Bike Paths)



Next 21

NEXT21 is an experimental housing designed by a committee for the Osaka Gas NEXT21 project, which is located in Osaka City, Japan. The committee of this project consists of six working groups: Architecture and Structure, Housing Design and Supply System, Energy and Infrastructure, Life Style, Site Development and Management, and Environment. The main objective of this project is to consider possible ways of housing for future to be through experiments in the aspects mentioned above. Currently, eighteen families live in this experimental housing as monitors, and housing experiments have been being made since 1994 for five years. The characteristics unique to NEXT 21 are:

- Ecological garden
- On site organic waste treatment
- Gray water recycling
- Photovoltaic cell units
- Co-generation system

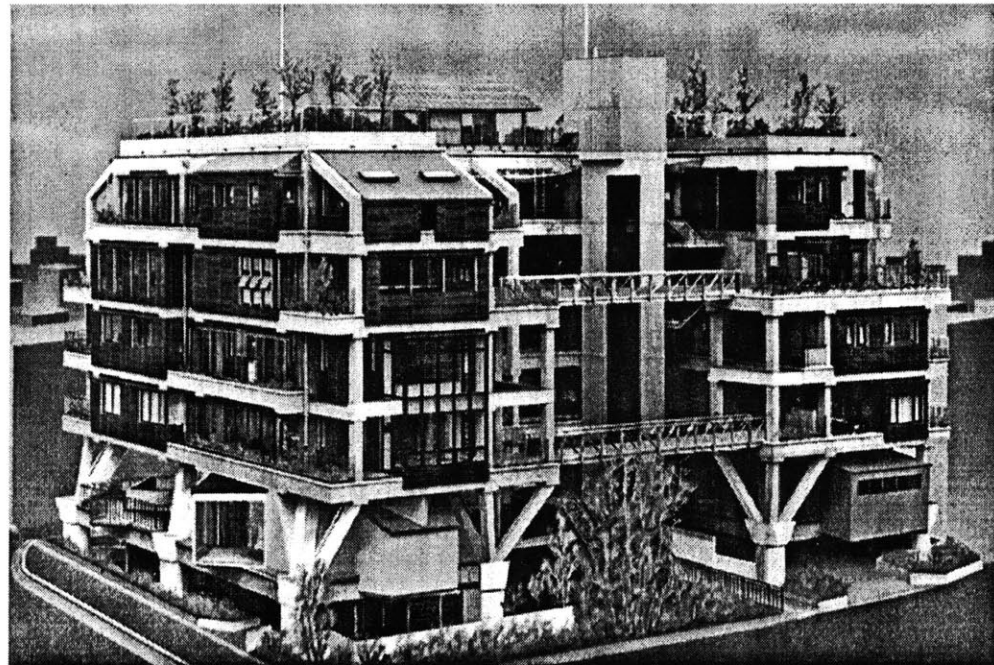


figure D (NEXT 21)

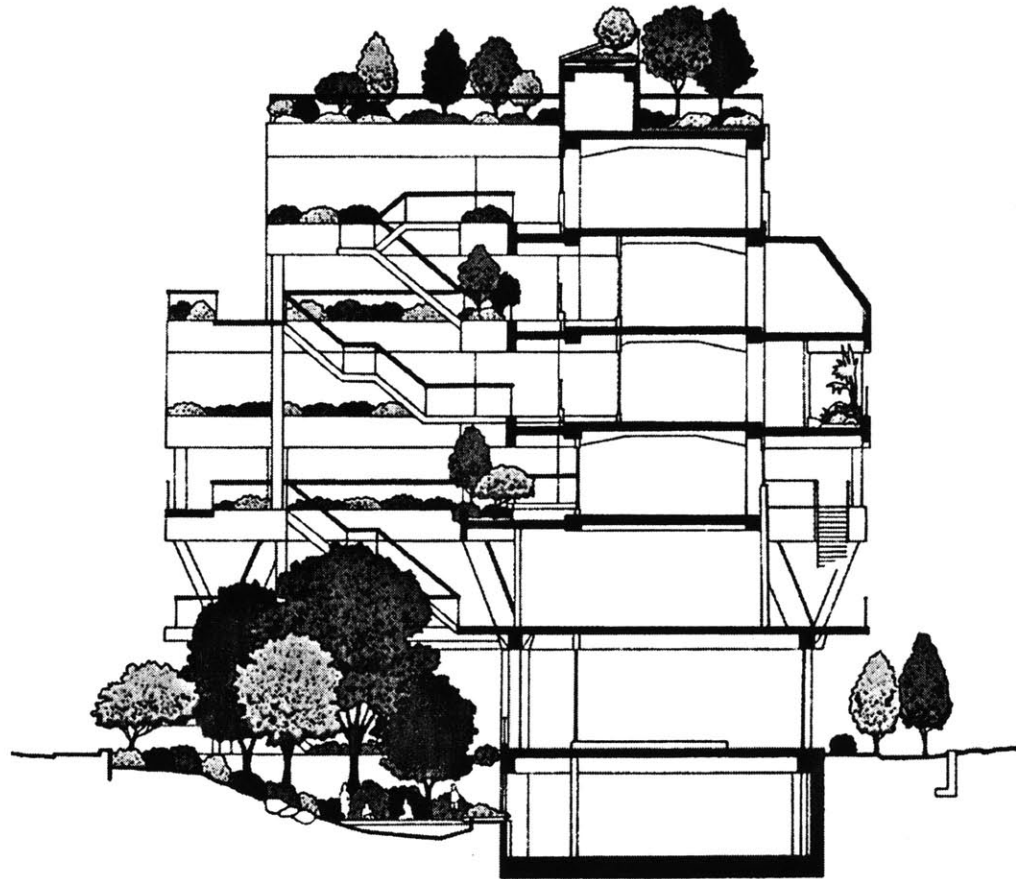


figure E (NEXT 21 Section)

RELATED PRECEDENTS

CREDITS

figure	2.1	Japan National Astronomical Observatory. <i>Science Almanac</i> , p.199.
	2.2	Ibid., p.207.
	2.3	Ibid., p.209.
	3.1	Robinette. <i>Energy Efficient Site Design</i> , p.90.
	3.2	Ibid.
	3.3	Hough. <i>Cities and Natural Process</i> , p.248.
	3.5	Robinette. <i>Energy Efficient Site Design</i> , p.92.
	3.6	Ibid., p.66.
	3.7	“Climate Data Book” Working-Group. <i>Applied Climatology</i> , p25.
	3.8	Ibid.
	3.9	Japan National Astronomical Observatory. <i>Science Almanac</i> , p.209.
	3.11	Hough. <i>Cities and Natural Process</i> , p.40.
	3.12	Ibid.
	3.14	Harland. <i>Eco-Renovation</i> , p.144.
	3.16	Funase. <i>Chikyuni Yasashiku Ikiru Houho</i> , p.116.
	3.17	Osaka Gas. <i>NEXT21</i> .
	3.18	Ibid.
	3.19	Ohno. <i>Toshigata Saigaini Manabu Shimin Kougaku</i> , p.76.
	A	Kawamura. <i>Sustainable Communities</i> , p.55.
	B	Ibid., p.60.
	C	Ibid., p.61.
	D	Osaka Gas. <i>NEXT21</i> .
	E	Ibid.

All of the other figures and illustrations that are not listed above were done by the author.

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