World Habitat Award 2001

Winner

Fukasawa Symbiotic Housing Complex

A Model Project
of
Rebuilding Public Housing Complex in Tokyo, Japan
for
"the Sustainable Future"

by

Kazuo Iwamura

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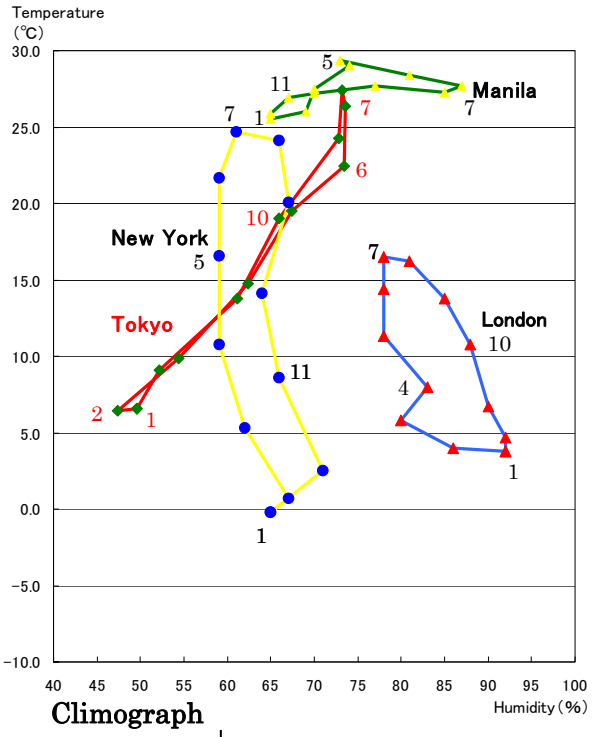
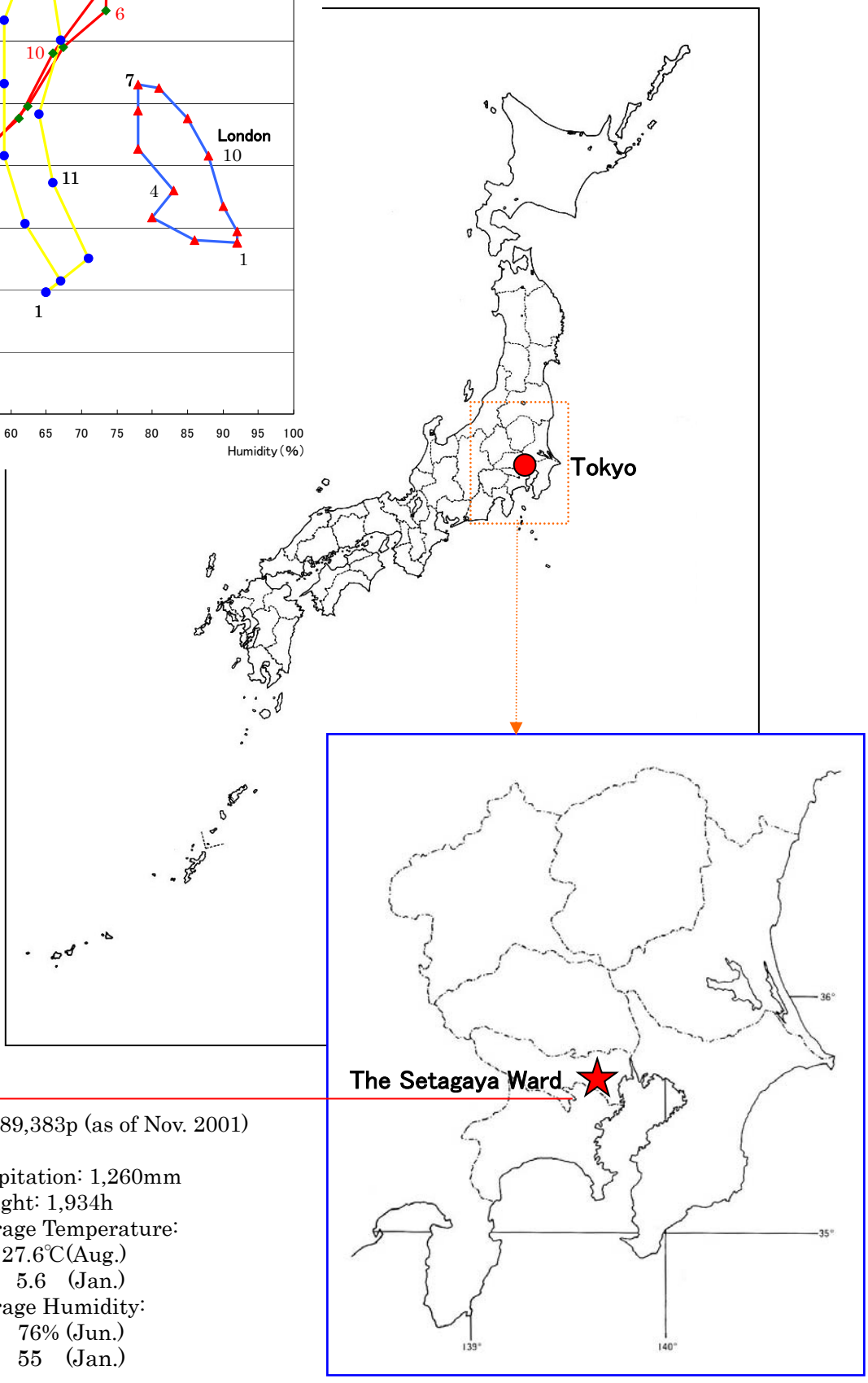


Climograph

JAPAN



■Population: 789,383p (as of Nov. 2001)
■Area: 58 k ㎡
■Annual Precipitation: 1,260mm
■Annual Daylight: 1,934h
■Monthly Average Temperature:
The Highest: 27.6℃(Aug.)
The Lowest : 5.6 (Jan.)
■Monthly Average Humidity:
The Highest: 76% (Jun.)
The Lowest : 55 (Jan.)

0. INTRODUCTION

Fukasawa Symbiotic Housing Complex[1]

A Model Project of Rebuilding Public Housing Complex, in Tokyo, JAPAN for the Sustainable Future

Prof. Kazuo Iwamura[2], Architect UIA/JIA, Tokyo, Japan

0.1 The Background

The Fukasawa Symbiotic Housing Complex rebuilding project was begun in December 1992, and was completed in March 1997. On a site of 7,388m, a complex of five apartment buildings, accommodating lease hold 70 dwelling units in all, replaced 39 municipally owned wooden detached houses. Built 1952 in Fukasawa, a residential district of Tokyo's Setagaya Ward, theses houses were part of the post-war housing supply drive, constructed and administered by the Tokyo Metropolitan Government. Forty years later, the administration of the site was passed to the Setagaya Ward, and the dilapidated houses were to be replaced with a ward-built, ward-owned housing complex.

Fig. 1: The designated site with original wooden public housing (April 1997)

1 *The client: Setagaya Ward, Tokyo, The architects: Ichiura Planning & Housing Consultants / IWAMURA Atelier Joint venture*

2 *Faculty of Urban Life Studies, Tokyo City University*

0.2 Movement of the Environmentally Symbiotic Housing

At around the same time, both the national and Ward administration were beginning to set their sights upon ecologically friendly urban planning. In 1990, a group of public and private-sector professionals joined forces under the banner of "Environmentally Symbiotic Housing (**"Symbiotic Housing"** hereinafter)", first functioning as a research body then as an organization for Symbiotic Housing promotion and realization (Since the very beginning, the author has been playing a major role as a technical consultant). Aided by a national and prefectural subsidiary scheme, this environmentally conscious approach to housing has been so far applied to over 70 projects throughout Japan.

In1992, the Ministry of Construction published housing guidelines based upon its R&D concerning the global environment, and the Setagaya Ward established its "Technical Design Guidelines for Environmentally Conscious Building". In the same year, the Fukasawa rebuilding project was designated an "Environmentally Symbiotic Model Housing Complex". As such, its goals are A) to help preserve the global environment, B) to exist in harmony with the local environment, and C) to provide a healthy residential environment with amenity.

Environmentally Symbiotic Housing

refers not just housing itself, but to the surrounding local environment. It is developed from the stand point of preserving the global environment by conserving energy and resources, while reducing waste at the same time. It's goal is to exist in harmony with both natural and man-made surroundings, as well as to provide residents with amenity-rich health life, thus encouraging them to participate in constriction process, and then taking care of the environment.

The following four themes(1-4) correspond to the three basic objectives(A-C) that must be realized to achieve Environmentally Symbiotic Housing :

A. Global Issue: Global Environmental Protection (Low Impact)

1.Energy Saving

2.More Effective Use of Natural Resources

B. Local Issue: Harmony with the Surrounding Environment (High Contact)

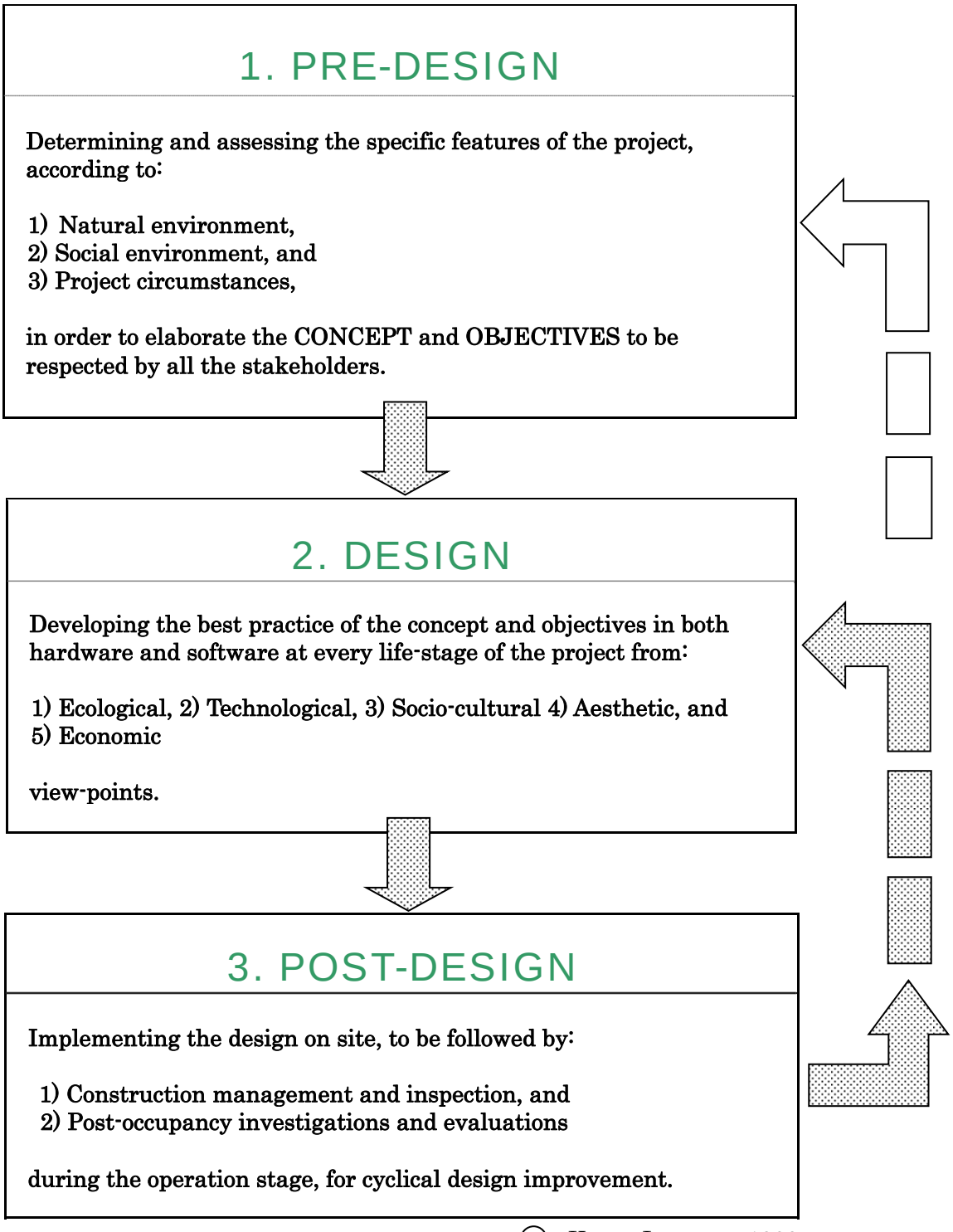
3.Compatibility and Harmony with the Local Environment

C. Residential Issue:A Healthy Residential Environment with Amenity (Health & Amenity)

4.Health and Amenity – Be Safe and Feel Safe

0.3 Cyclical Design Process of Symbiotic Housing

This model project has been implemented according to the cyclical design process of symbiotic housing, as shown below;



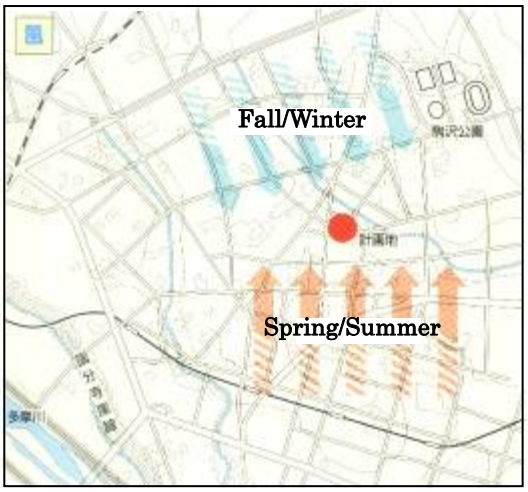
1.PRE-DESIGN

1.1 Analysis on the Site's Regional Contexts (● : The Site)

WATER

How storm water and ground water flow.

WIND



How seasonal prevailing winds blow.

GREEN

How to network the regional greenery

LIFE

How to network the ecological habitats

At the beginning of the Pre-Design Process, efforts were made in analyzing the regional context of the site to discover its potential resources and requirements. The above four figures represent most basic aspects for architectural and landscaping design; WATER, GREEN, WIND and LIFE, besides the ritual climatic conditions. According to such analysis, we came up with conclusions as follows:

1) Design form and layout of buildings not to disturb the water flows
2) Preserve the existing trees to keep and strengthen the regional green network
3) Design form and layout of buildings conforming to the seasonal winds
4) Design the landscape to embrace and network the regional ecological habitats

1.2 Original Situation of the Site

The site itself, though located in a highly urbanized area, flourished with trees, grasses and flowers, the rich greenery providing an agreeable home for the residents, as well as for diverse birds and insects. The original wooden houses were widely spaced, with unpaved path and garden in between them. This urban oasis had been carefully maintained by the longtime residents. They formed a self- regulating cleaning rotation, shared gardening duties, and planted a kitchen garden in the site's fertile soil. These residents had lived as neighbors for more than forty years, creating a warm, close-knit community. Both the greenery of the site, and the experiences and history of these now elderly residents were central considerations in the rebuilding process. The original residents participated actively in the planning stages. Most of them have returned to live in the new apartments, where they take leading roles in forming the new community of 70 households.

Fig.2-1 Very matured condition of former houses before the rebuilding (as of 1993)

Fig.2-2 Lifestyle of the residents reveals key aspects of rebuilding

1.3 Priority of the Rebuilding and the Concept

In the rebuilding, it was of course necessary to raise the standards of living on the site, and to guarantee an increase of its accommodation capacity. We envisioned, too, however, a Symbiotic Housing Complex that would enable the coming generations to inherit the rich environment of the Fukasawa site; one that would interact with and influence its surroundings. When the original buildings were demolished, reusable components were kept for the new. The trees earth, wells, and other treasures of the site were left untouched as much as possible. When it was necessary to remove the trees, they were preserved elsewhere during construction and replanted later. Soil displacement was kept to a minimum, with any excess soil reused elsewhere within the site. The buildings are situated so as not to disturb the underground water-flow, and water-permeable paving and rainwater systems return rainwater into the ground. Most of the flat roof surface is covered with greenery, and the two wind-powered generators circulate water around a brook and small pond.

Fig.3-1 Preserved trees, wells and fertile soil. as elements of memory, to be reused on site

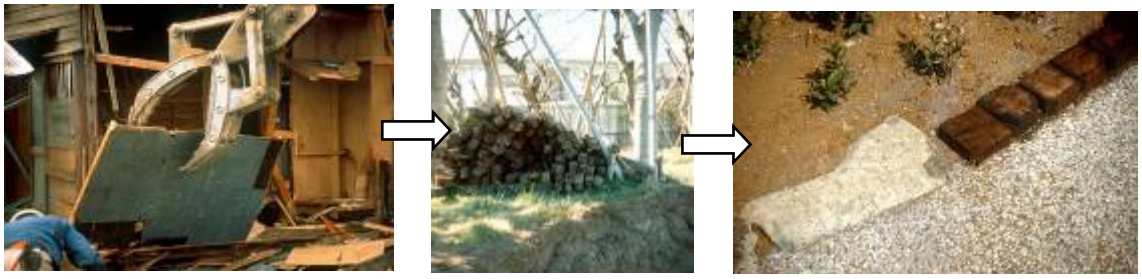


Fig.3-2 Timbers of the demolished houses, reused as landscape elements of memory

Fig.3-3 Roof tiles of the demolished houses, reborn as gardening design elements

Health and comfort were top priorities in the rebuilding. The new apartments are built with close considerations of sunlight and the winds, and incorporate various passive lighting, heating, and cooling methods. Each unit opens to at least two, often three or four directions, and the form of the complex itself was determined by the local wind patterns. The use of open alleys and light/wind voids are based on the traditional plan of the Japanese villages, enabling natural ventilation and aeration. The building materials, finishing materials, and facilities of the apartments were selected for their low impact upon the health of the residents and of the environment. Solar collectors provide warm water for the floor-heating system of the Ward's Day Home Center. Solar cells also power the outdoor lamps and a public clock.

These and other features have helped make the Fukasawa housing complex into a local focus for environmental education and awareness. Its footpaths are used by members of the neighborhood, who enjoy the site's greenery and the comfortable micro-climate. The ground floor of one of the apartments accommodates a day care service center to the elderly of the district.

As a whole, all the stakeholders came up with the concept to be shared as follows;

"Re-creation of the Fukasawa Biotope Garden"

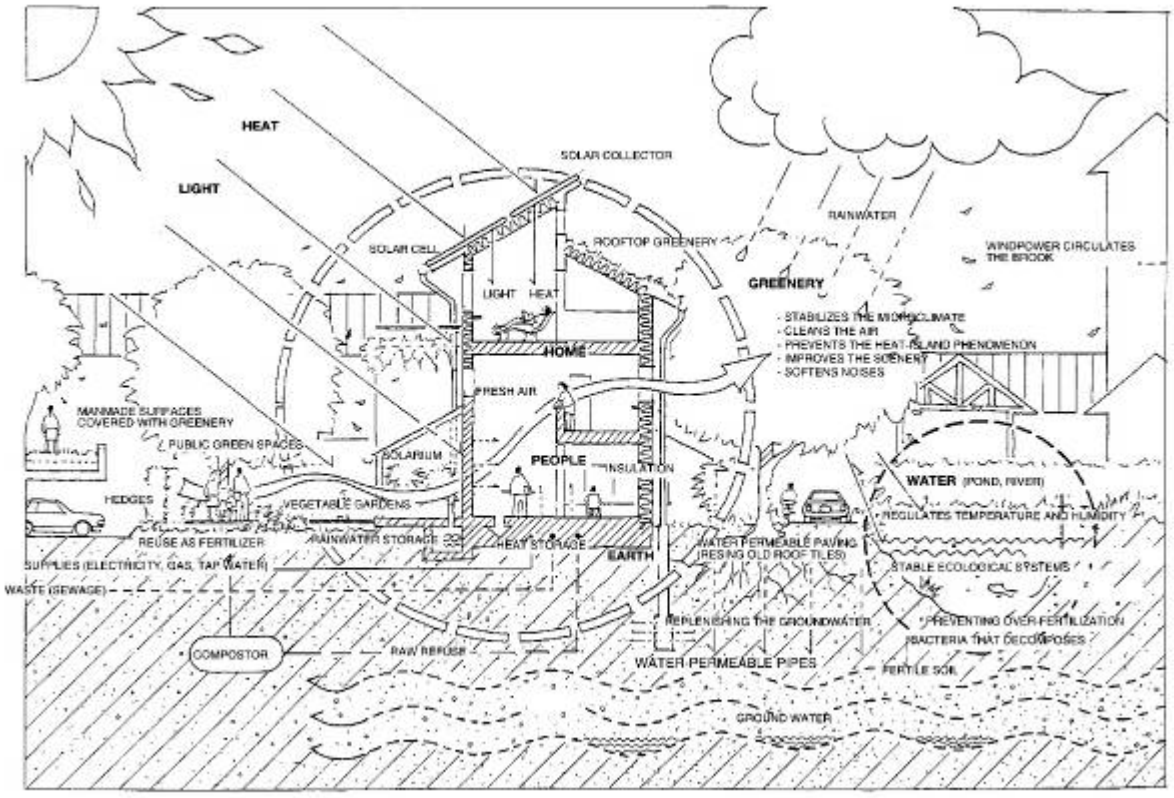


Fig.4 Holistic image of the Fukasawa Symbiotic Housing Complex as "Biotope Garden"

1.4 Social Aspects

The apartments themselves were planed to integrate a social mix, certain units custom-built for wheelchair users and others for single elderly residents. One unit is reserved for a "life support advisor" employed by the Ward to care for her elderly neighbors.

In the aftermath of the 1995 Great Hanshin Earthquake, the importance of this kind of daily cooperation and communication among neighbors was made very clear. This awareness has helped to shape the Fukasawa project. Spacious meeting rooms were incorporated into the plan, as were areas where children could play safely close to home.

As the Housing Complex approaches its fifth year, it has been developed into a close-knits community unusual in Tokyo's newer residential district. The Resident's Committee is active, its regular meetings providing a forum for discussion and problem-solving. The committee also organized cleaning, recycling, and gardening rotas, with a monthly Sunday morning being set aside for a communal cleaning effort. Much of the resident's involvement with each other is based upon their pride and enjoyment of their home's Environmentally Symbiotic aspects. Due to their involvement in the planning and running of the complex, there is a high level of environmental awareness among the residents.

Fig.5-1 Residents' meeting during the design process

Fig.5-2 Tea break during a communal cleaning

Fig.6-1 Residents' vegetable garden at the middle of former housing complex (Dec. 1992)

20 households of former residents were core members of the rebuilding project during the whole process. Frequent hearings, group interviews and meetings were held to learn from them and to discover the local resources.

Fig.6-2 Eventual harvest in the former vegetable garden

Fig.6-3 Informal communication between residents and the author (right)

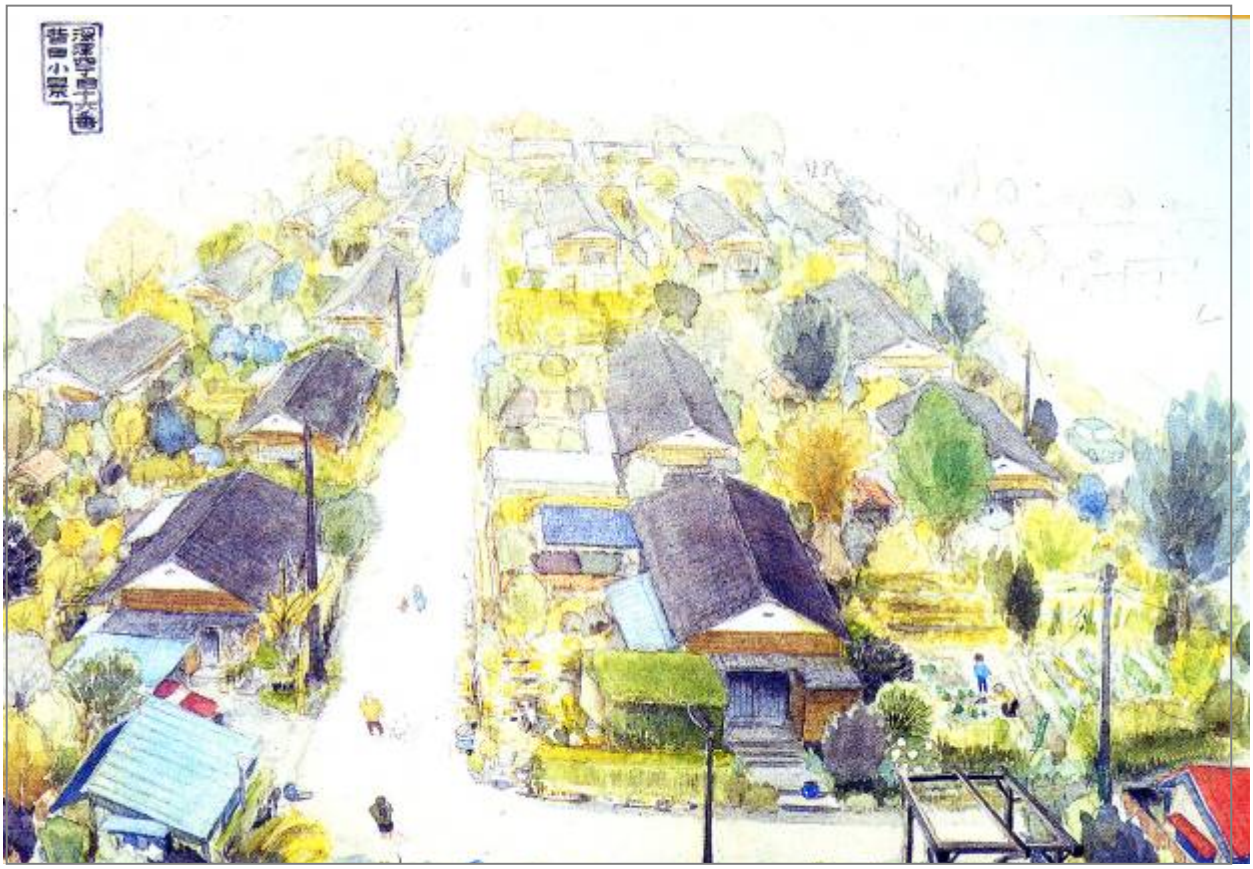


Fig.7 A beautiful memory of old Fukasawa Housing Complex, painted by a former resident

2. DESIGN

2.1 Site Plan

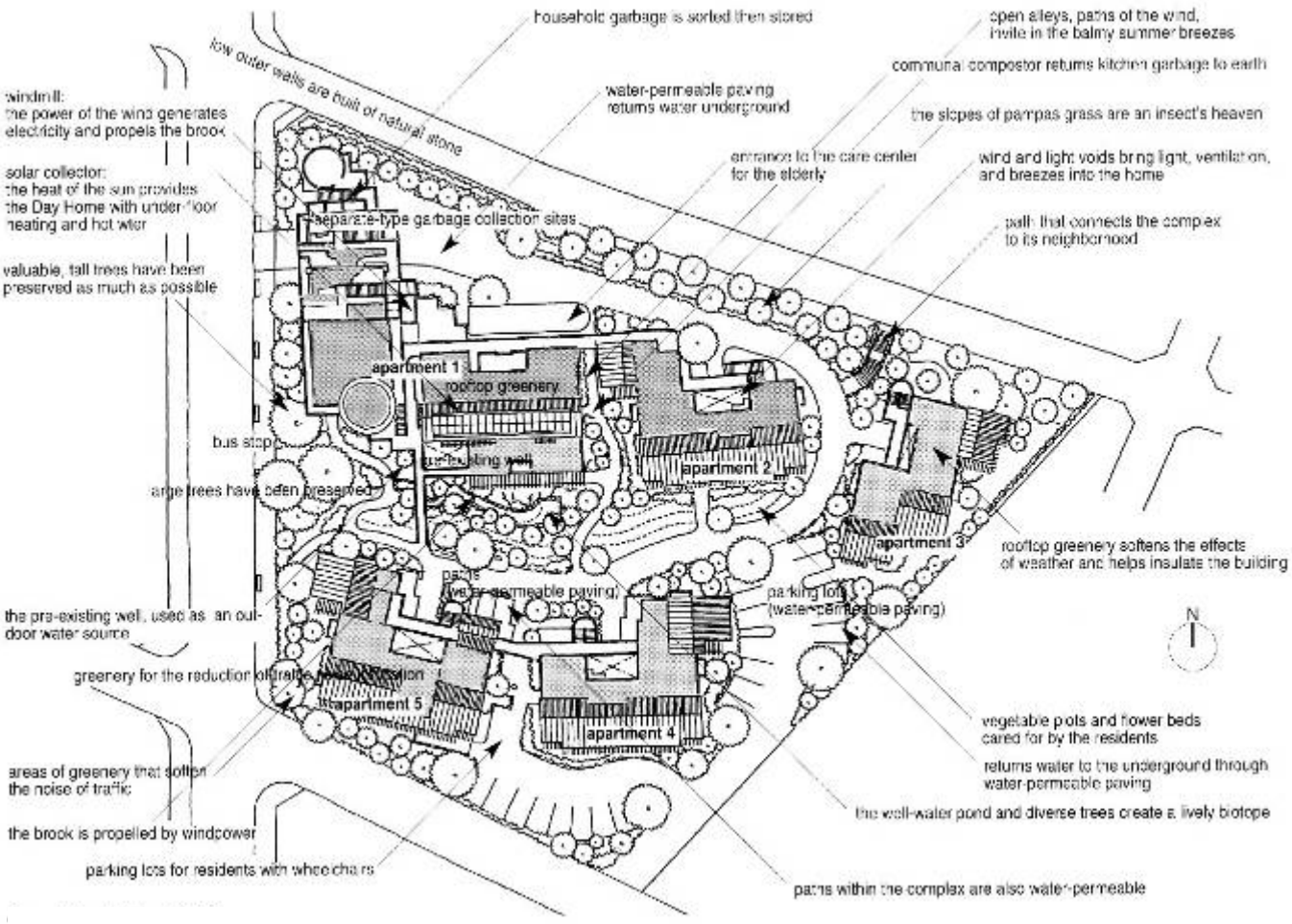


Fig.8-1 Complete Site plan

Fig.8-2 "Roofscape" of the complex

Fig.8-3 Bus stop under the preserved trees

Fig.9 Court integrated with “Biotope Garden” on the left

2.2 Biotope Garden

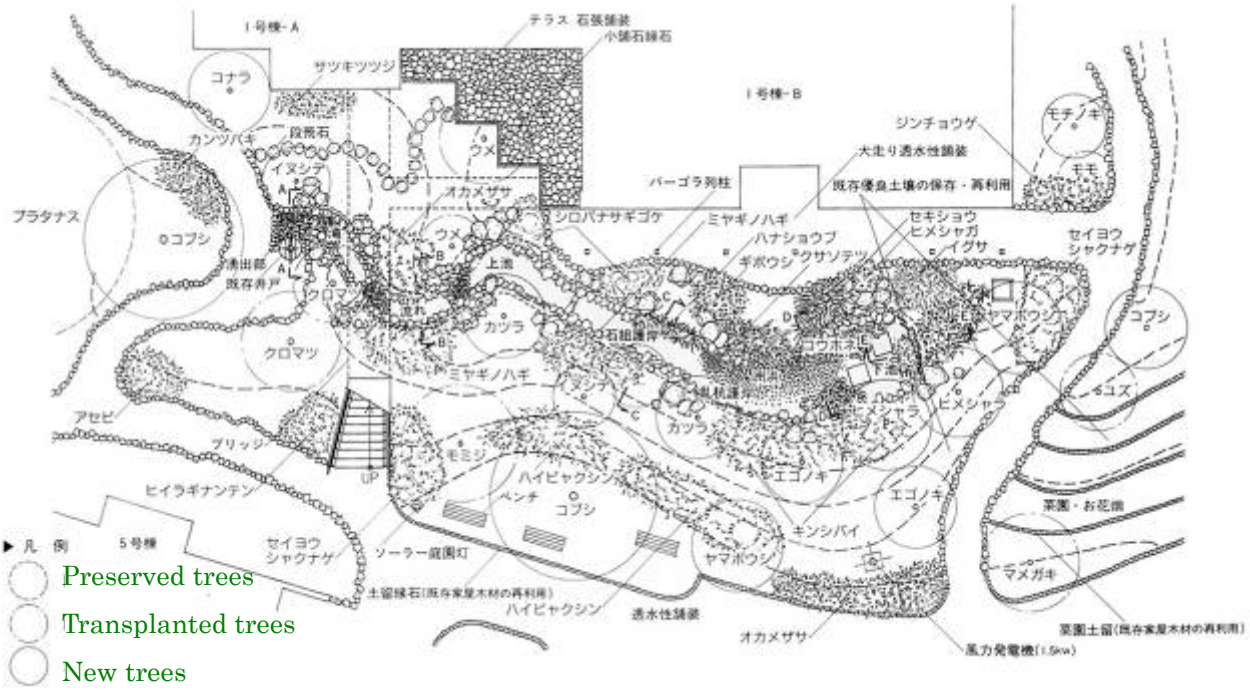
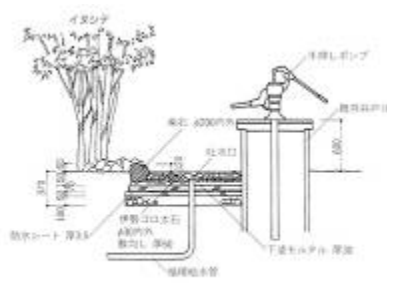
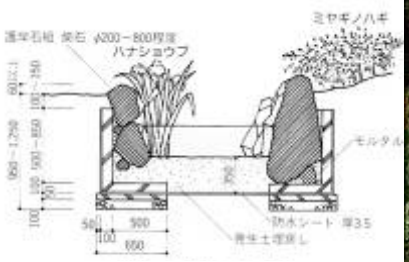


Fig. 10-1 Landscape design of the Biotope Garden at the heart of complex



Diversity



Porous

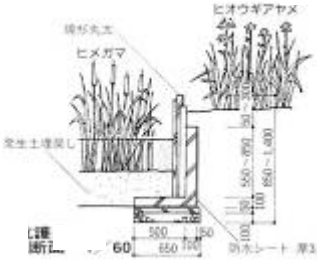


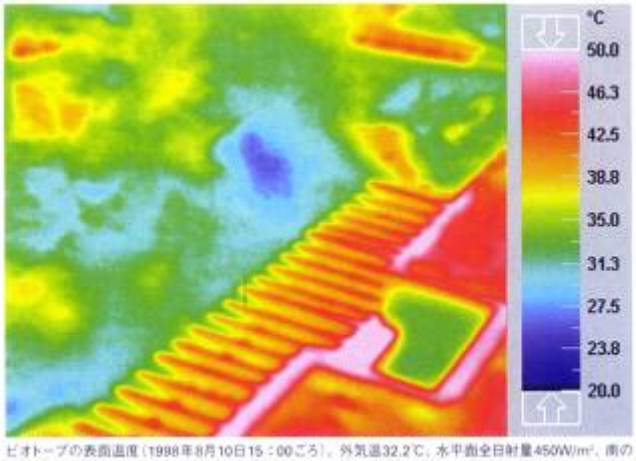
Fig.10-2 Biotope Garden in summer, 1999

Fig.11-1 “Biotope Garden” shortly after the completion (April 1997)

The Biotope Garden is protected topographcally and accomodates a variety of plants, birds and insects. The water from the preserved well is circulated by the windcharger behind, when wind blows.

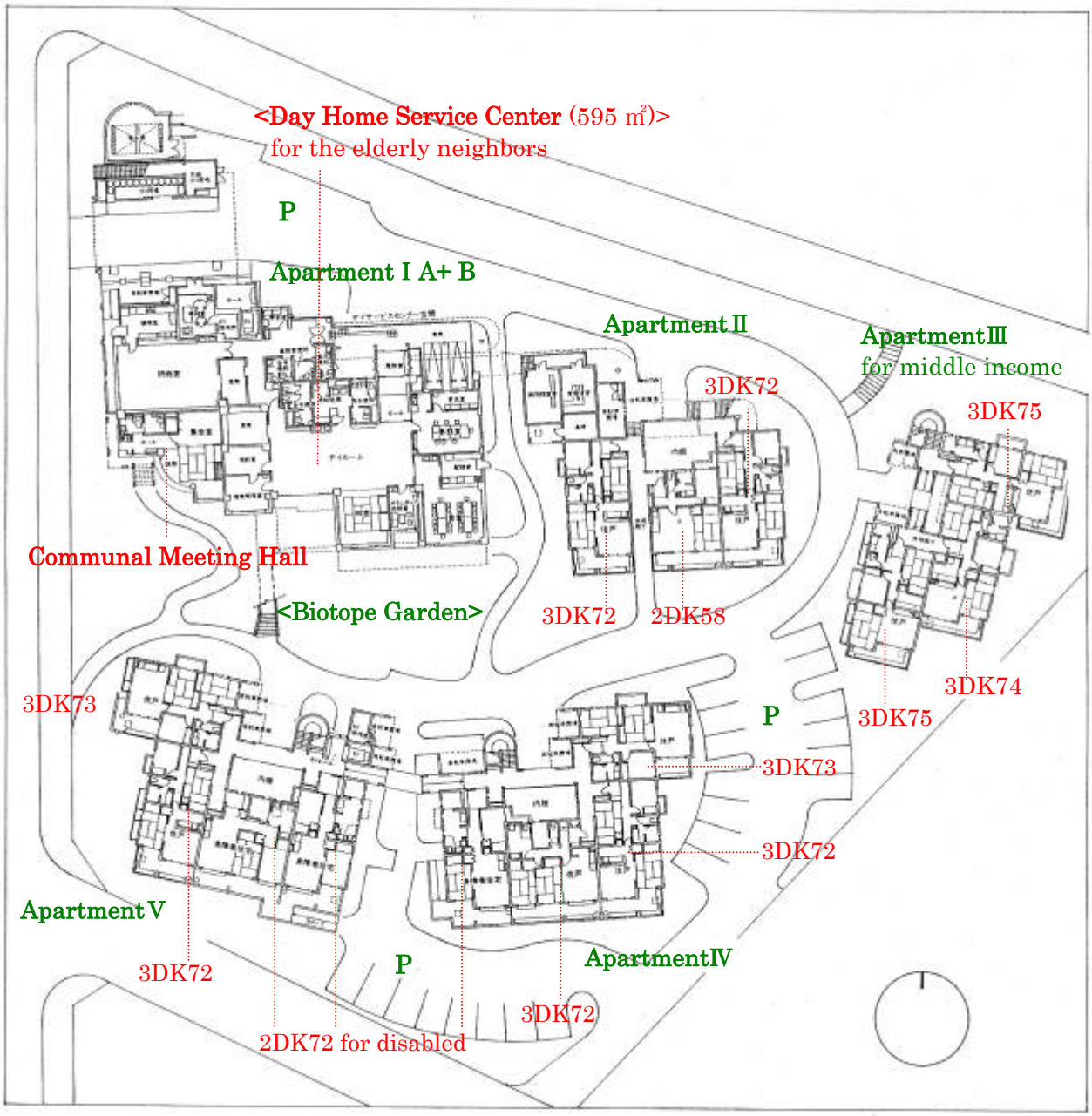
Fig.11-2 “Biotope Garden”, producing cool air in mid-summer within the complex

ビオトープにある豊かな植栽や池



ビオトープの表面温度（1998年8月10日15：00ごろ）。外気温32.2℃，水平面全日射量450W/m²，南の風2.0m/s。表面温度が30℃以下の部分も見られる

2.3 Layout of Apartments and Related Facilities



F Fig.12 Layout plan of apartments at the ground level

LEGEND

3DK72 : 3Bed Rooms + Dining & Living + Kitchen = 72 ㎡ (Net Floor Area)
P : Car Parking

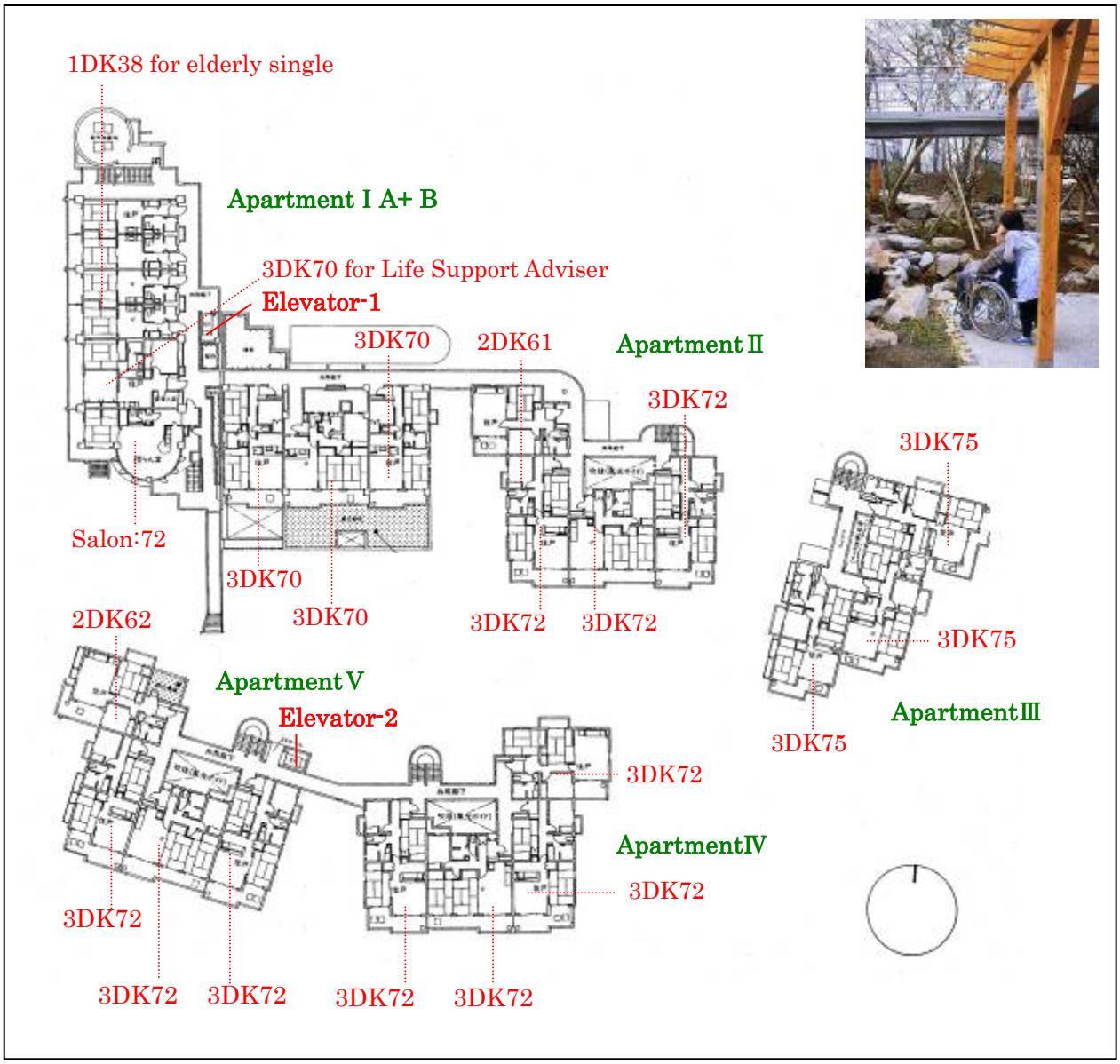


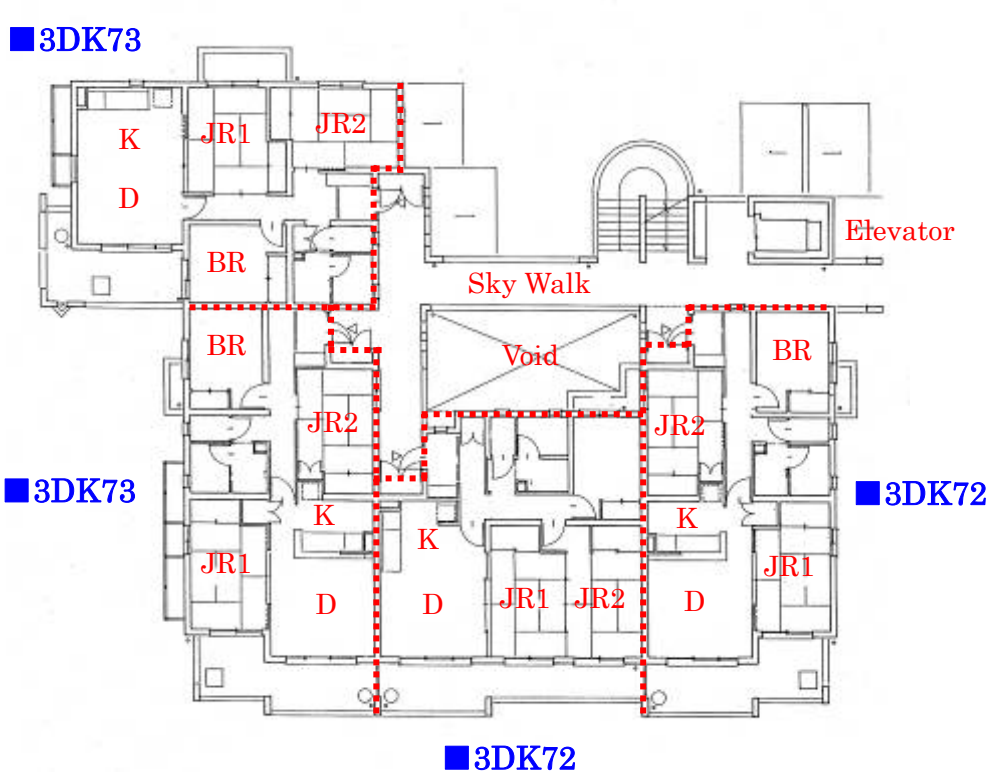
Fig.13 Layout Plan of apartments at the upper floor

Fig.14-1 Wind passage between ApartmentIV & V

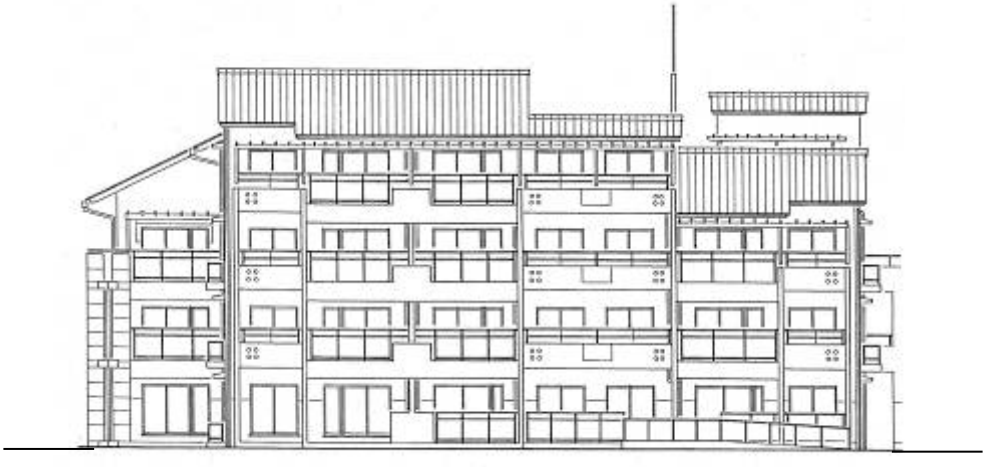
Fig.14-2 Northern elevation of ApartmentIV & V

2.4 More Details of Apartment

Fig.15 Plan and elevation of Apartment V



■Typical Plan



■South Elevation

(D: Dining & Living, K: Kitchen, JR: Japanese Rm., BR: Bed Room)

1) Major Architectural Solutions for Passive Environmental Control

Fig.16-1 Elevator Tower

Fig.16-2 “Sky Walk”, leading to the entrances

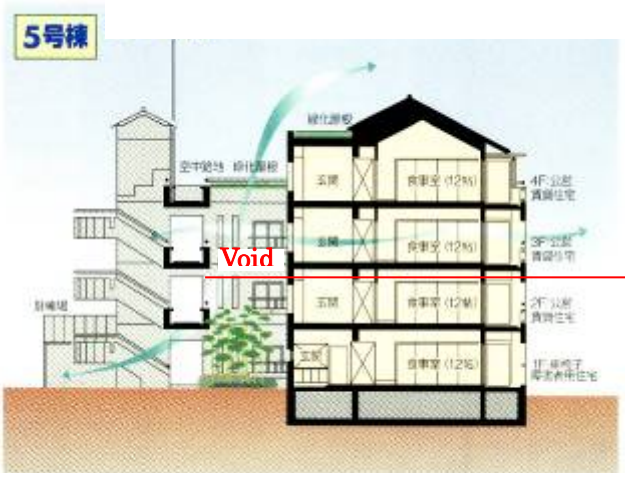
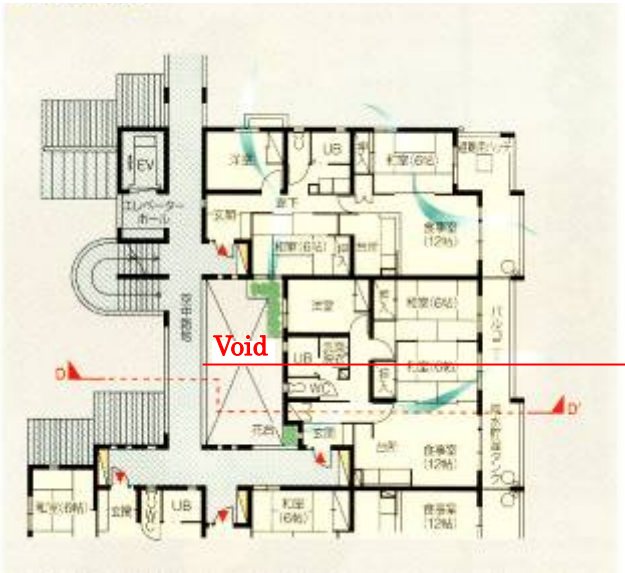


Fig.16-3 Typical plan & section of Apartment V

Fig.16-4 “Void” for day-lighting & natural ventilation



2) Niche Garden

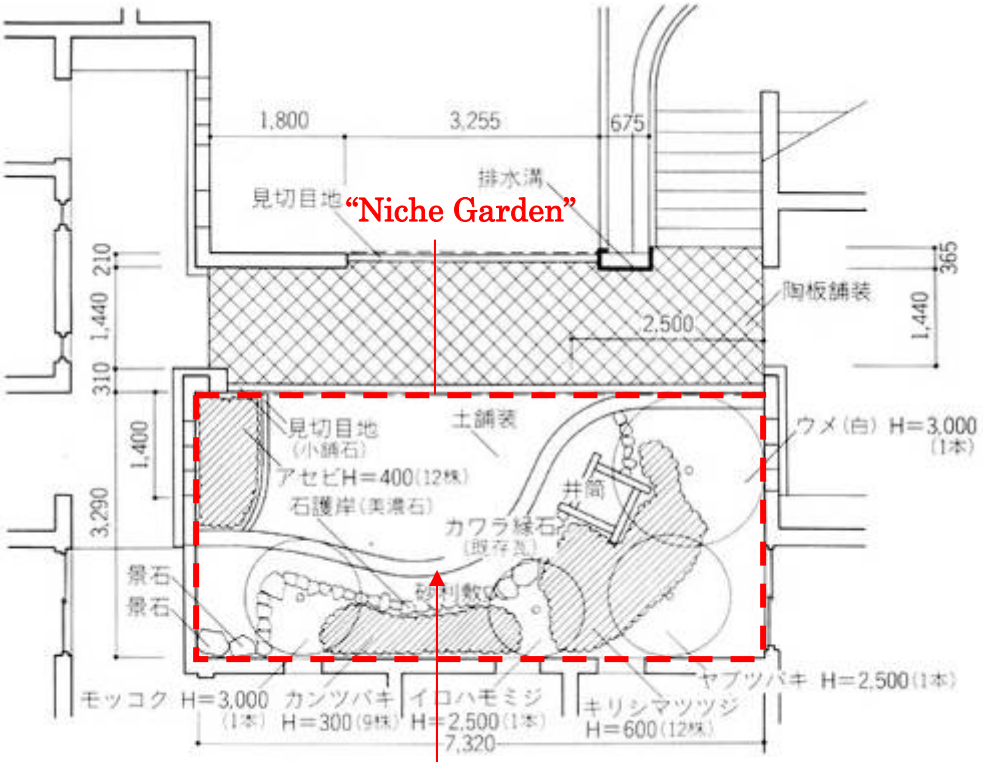
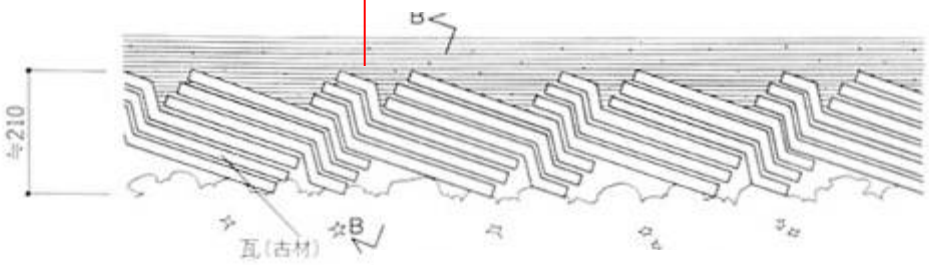
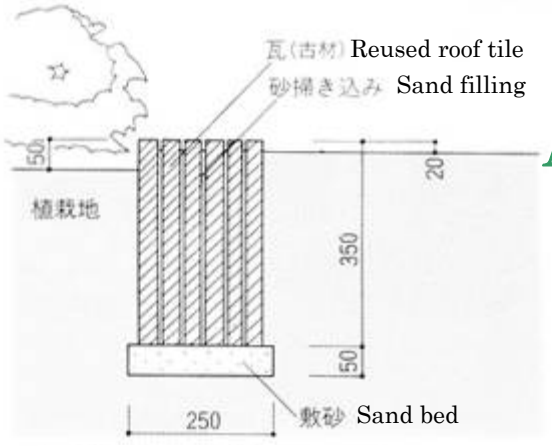


Fig.17 Details of "Niche Garden" at the bottom of "Void"

Reused Roof Tiles for Gardening



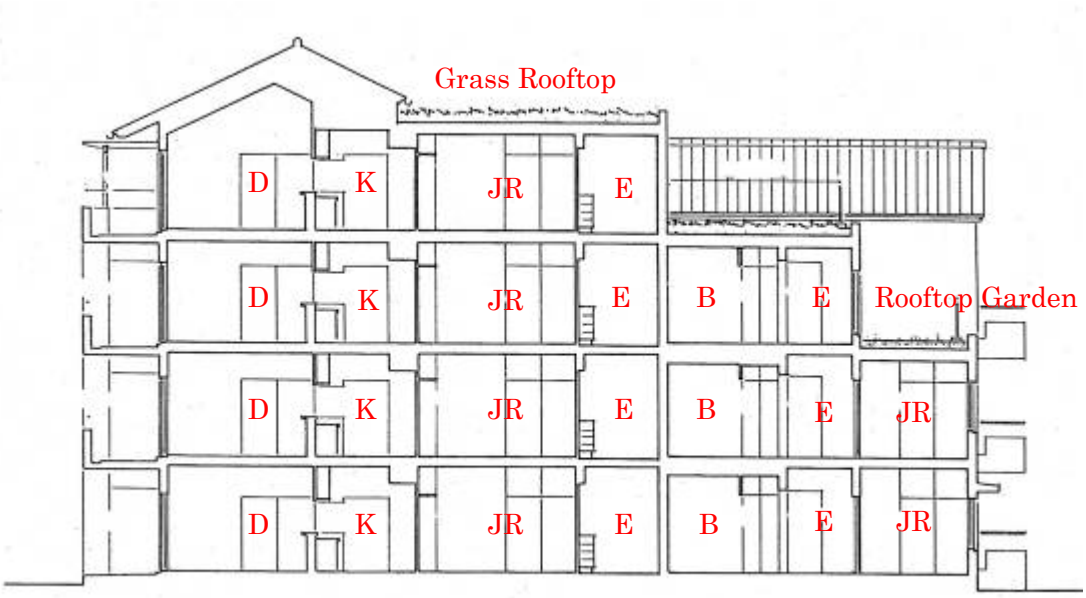


Memory

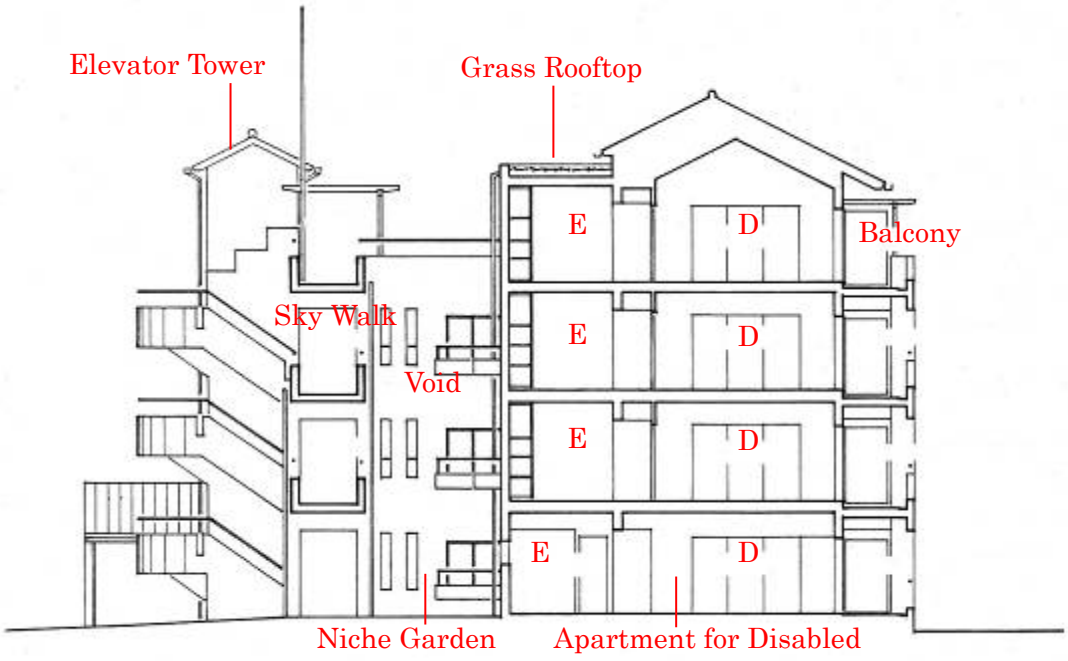
Fig.18 South elevation through a circle opening of bicycle garage

3) Sectional Details

Fig.19 Sections of Apartment V



■East-West Section



■North-South Section

(D: Dining & Living, K: Kitchen, JR: Japanese Rm., B: Bath Rm., E: Entrance)

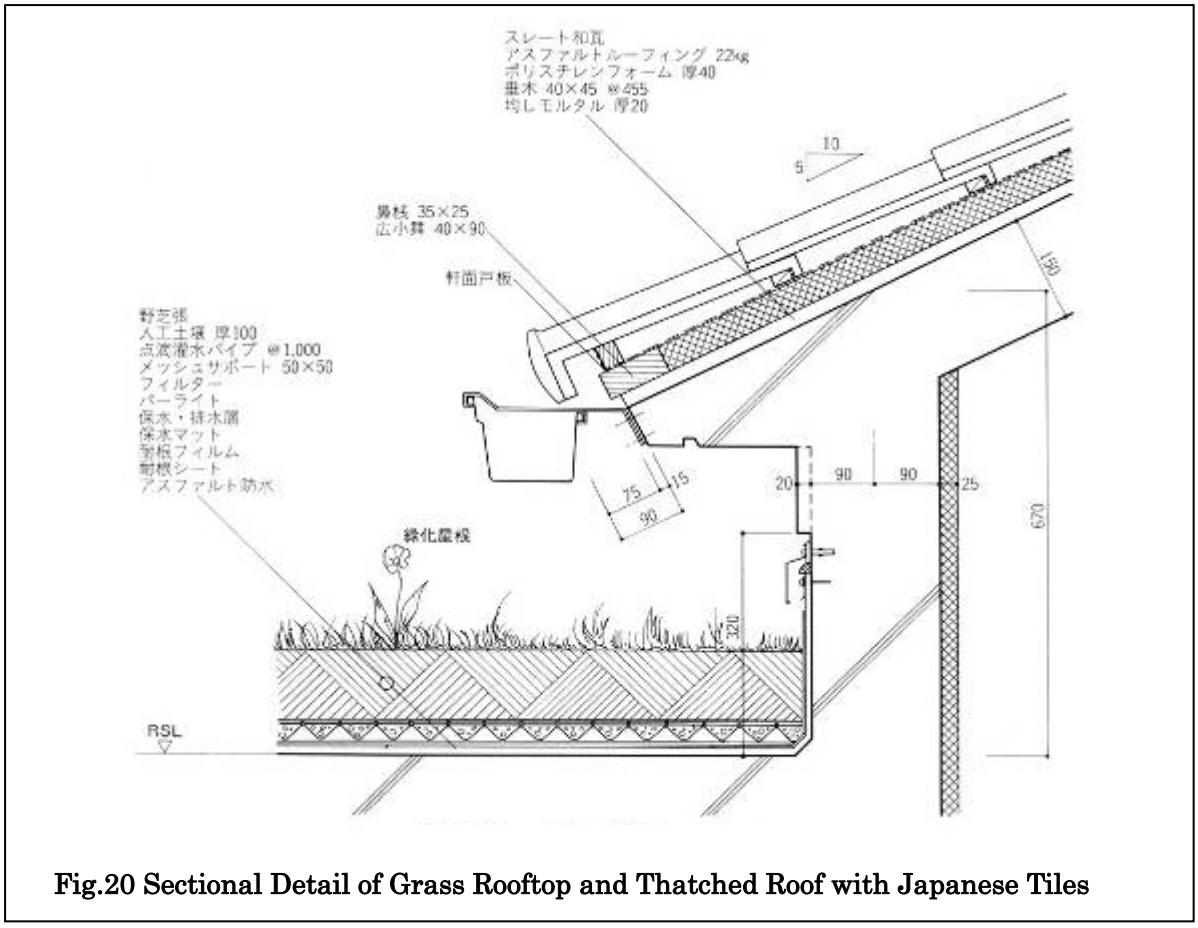


Fig.20 Sectional Detail of Grass Rooftop and Thatched Roof with Japanese Tiles

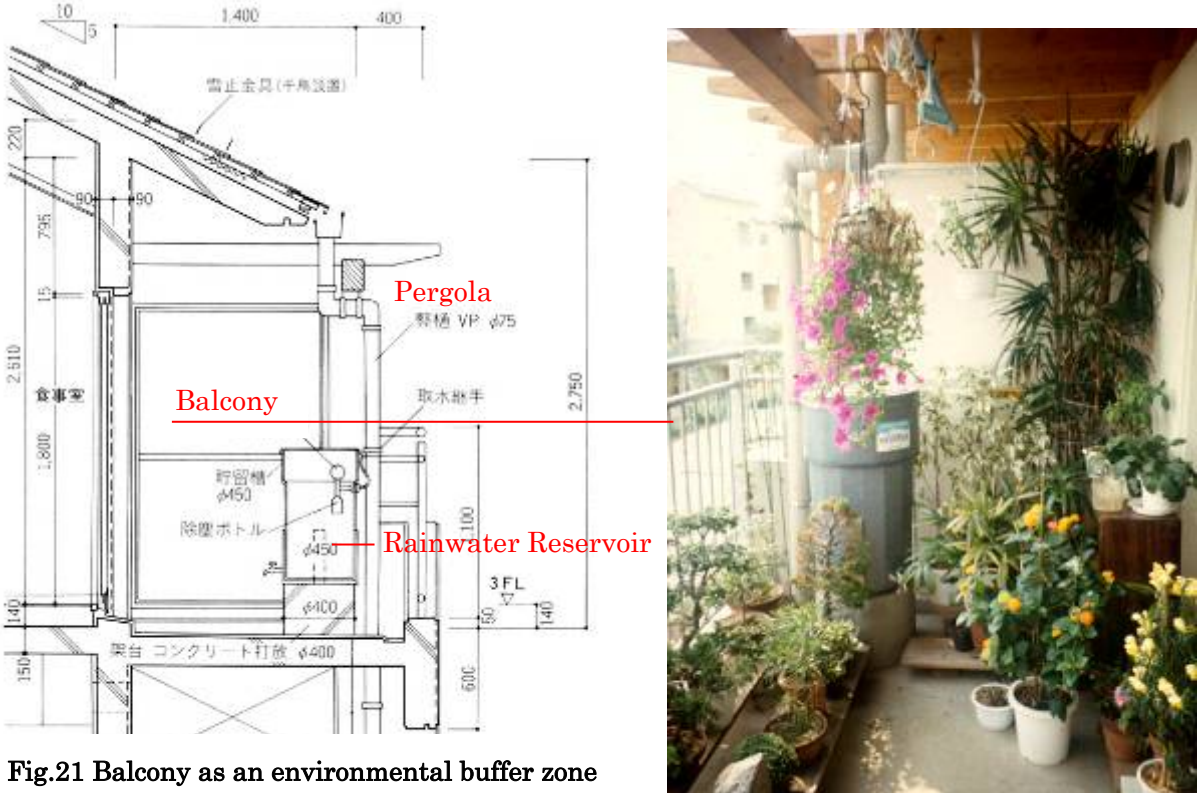
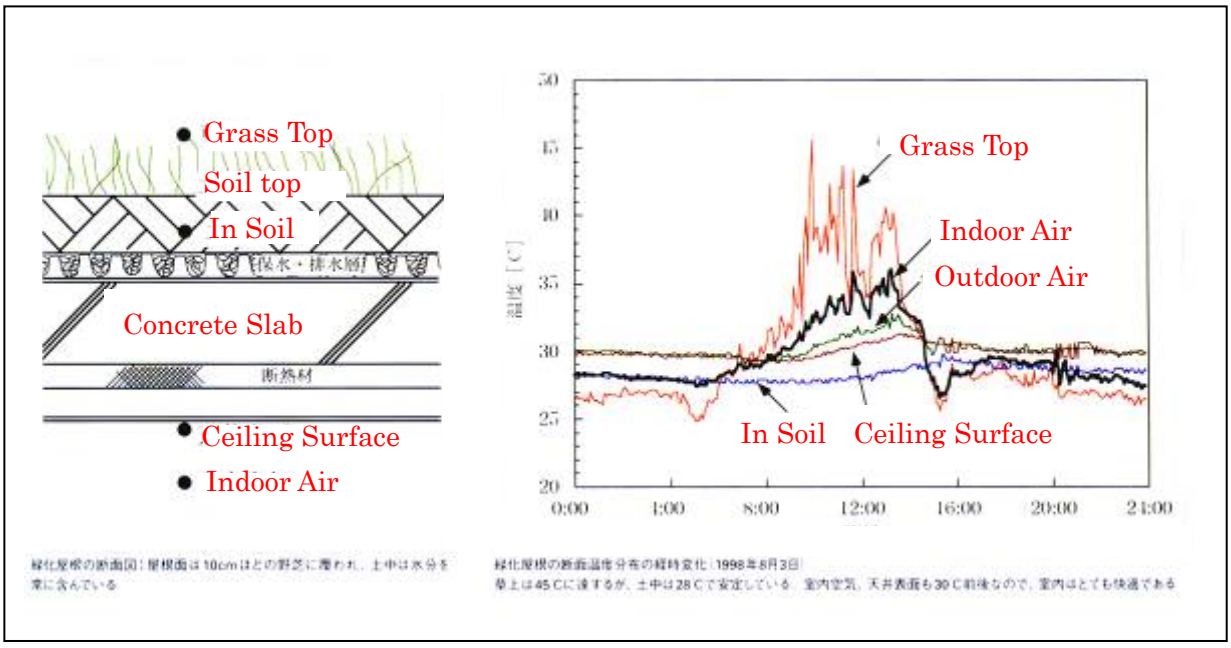


Fig.21 Balcony as an environmental buffer zone

4) Rooftop Greening

Fig.22 North side of ApartmentIV, characterized by grass rooftop and the "Sky Walk"

Rooftop greening was one of the most outstanding characters of this project. Major objectives were to contribute to regional green networking and to improve the urban thermal condition.



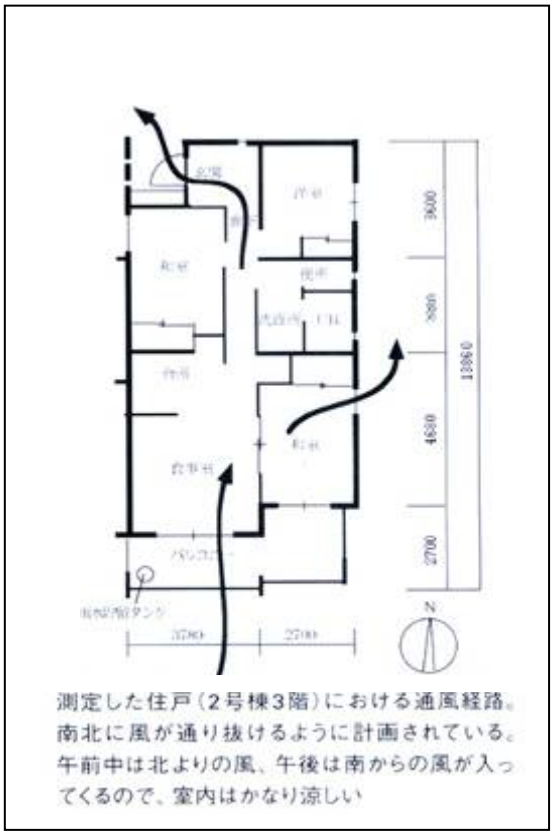
Fig,23 Thermal effect of "Rooftop Greening" (Aug.1998)

5) Natural Drafting & Ventilation

Passive design methods to improve the indoor environment require the residents' understanding of the idea and their willingness to apply their lifestyle, enjoying the natural circumstances.

Our post occupancy investigation (see P33) shows that 40% of the panelists first open the windows when it is hot in summer, before using any other equipment such as air-conditioner. This reveals that the buffer zones between indoor and outdoor help reduce thermal impacts, and that the natural drafting and ventilation in housing units are quite successful. .

Fig.24-2 Living & dining towards balcony



測定した住戸（2号棟3階）における通風経路。
南北に風が通り抜けるように計画されている。
午前中は北よりの風、午後は南からの風が入ってくるので、室内はかなり涼しい

Fig.24-1 Natural cross ventilation passages

2.5 Environmentally Symbiotic Building Elements

As a model project of the Symbiotic Housing Complex, a series of techniques and building elements have been applied to meet the major goals of sustainable building, providing better quality of life, and at the same time reducing the environmental impact as much as possible. Within the limited cost framework of public housing, the following elements and items have been carefully selected among others:

1) Energy Saving

- -Adequate thermal insulation of the buildings
- -Effective daylight control by eaves, pergolas, greenery etc.
- -Selection of energy saving equipment systems and appliances

2) More Effective Use of Natural Resources

- -Solar collector(57.42 ㎡) for floor heating(100 ㎡) and warm water supply within the Day Home Service Center (Warm water tank capacity: 1.5m^3) <Fig.25-7>
- -Solar cells for garden foot lighting (5sets), street lighting (5sets) and a street clock <Fig.25-8, 25-9>
- -Wind power generators (1.5kw×2) for circulation of water in brook.<Fig.25-7>
- -Groundwater use through the 4 preserved wells within the complex <Fig.25-3>.
- -Rainwater reservoir (60m^3) in the building foundation for toilet flushing (Day Home Service Center), and Rainwater tanks(100l) in each balcony for watering the green.
- -Water saving equipment (toilets) and faucet
- -Least soil removal from the site and reuse of the existing cover soil for gardening
- -Metal mesh forming for foundation work, to reduce the amount of plywood forming
- -Supportive system for sorting and storing wastes and garbage

3) Compatibility and Harmony with the local Environment

- -Permeable pavement for all the streets and parking lots in the complex <Fig.25-6>
- -Preservation of 17 tall trees and replacement of 160 trees <Fig.25-1>
- -Greening all the flat rooftops and the walls facing west <Fig.22, 25-2, 25-4, 25-5>
- -Preservation of grass banks from ecological and town-scaping viewpoints
- -Creation of the Biotope Garden at the heart of complex <Fig.10, 11>
- -Providing intermediate rich buffer spaces between indoor and outdoor <Fig.16, 21>

4) Health and Amenity

- -A variety of the basic passive design of housing for residents' health
- -Symbolic reuse of timbers and roof tiles of demolished houses for memory <Fig.3>
- -Thorough consideration for the elderly and the disabled <Fig.25-6>
- -Selection of eco-materials and improvement of Indoor Air Quality
- -Semi-public facilities for supporting the community activities

Fig.25-1 Preserved trees

Fig.25-2 Rooftop garden

Fig.25-3 Preserved well

Fig.25-4 Wall greening

Fig.25-5 Priv. rooftop garden

Fig.25-6 Universal design

Fig.25-7 Solar collector & W.G.

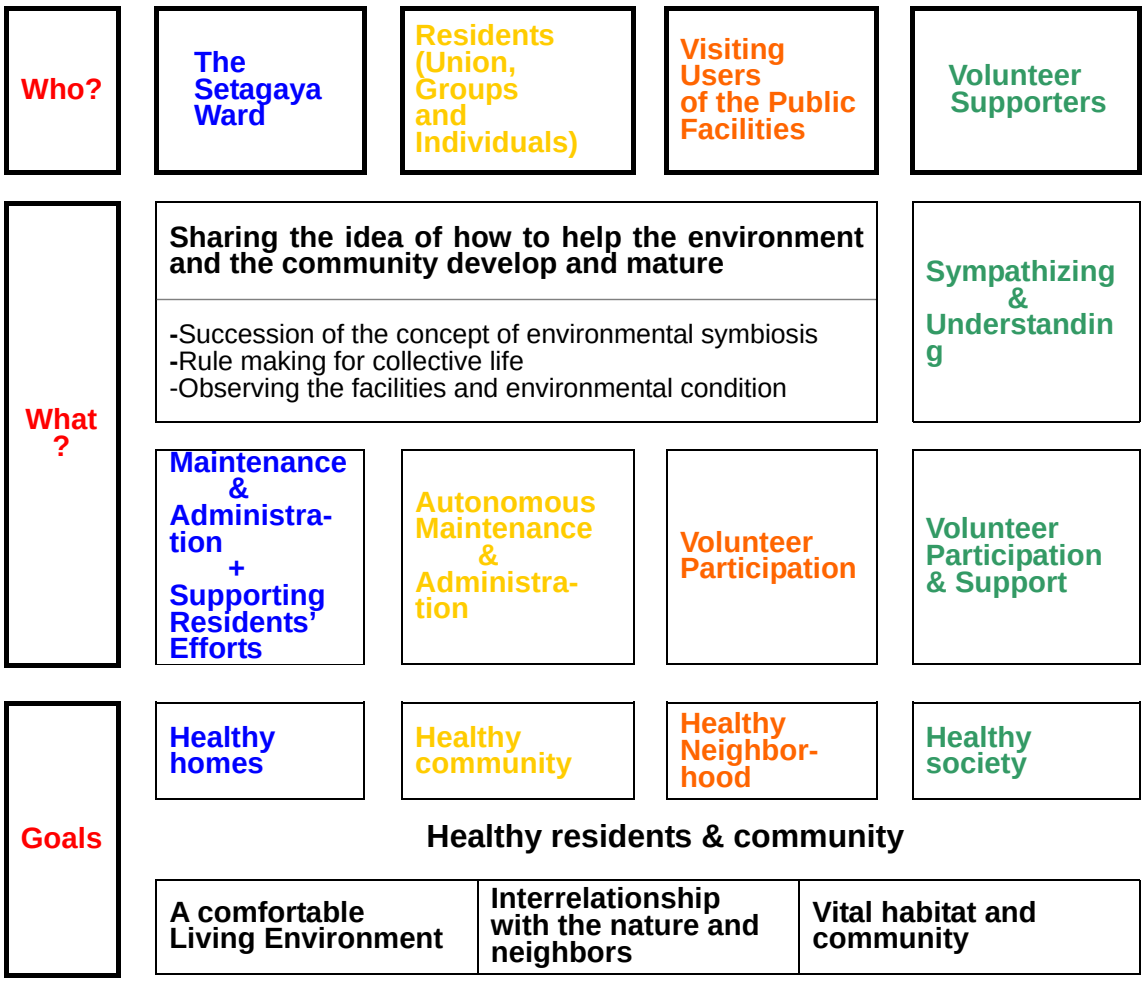
Fig.25-8 Solar-powered clock

Fig.25-9 Solar-powered footlight

2.6 Post Occupancy Operation and Administration

Assigned by the Ward, at the end of the Design Process, we have also elaborated operational scheme for post occupancy, examining possible forms of organization and regulations, as well as the share of expenses for the maintenance. The final scheme was made on the basis of residents' participation into major maintenance activities. The following chart illustrates a comprehensive structure for the maintenance and administration of Fukasawa Symbiotic Housing Complex, associated with the goals and methods to be shared by the stakeholders including the Ward, the residents, visiting users of the public facilities and volunteer supporters. Based upon such preoccupations, a close-knit community has been developed in between, and the very high level of maintenance shows the visitors an outstanding willingness of the residents' autonomous activities re-creating an environmentally symbiotic atmosphere.

Fig.26 Comprehensive image of the roles for maintenance and administration of the housing complex, to be shared by the stakeholders



3. POST-DESIGN

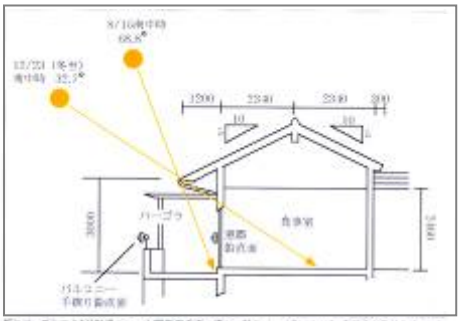
3.1 Post Occupancy Investigations

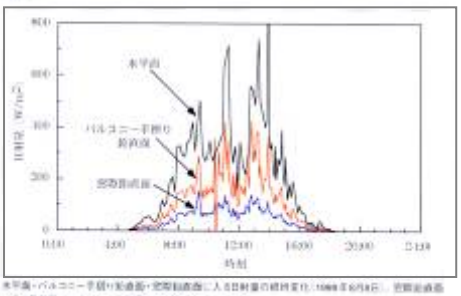
As a governmental pilot project, the Fukasawa complex has attached attention and debate nationally. Its successes, problems, and development over time will help to share the future of sustainable public housing in Japan.

We, as collaborative architects, continue to give efforts in elaborating the post occupancy evaluations, both scientific and sociological, in order to discover and improve problems between design and the reality. This is an essential way how we learn a lot more about housing design, and improve our knowledge and skills for the next.

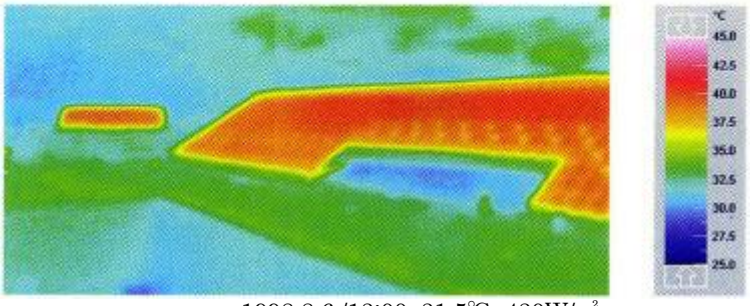
3.2 Thermal Conditions (Aug.1998)

Fig.27-1 Sun control effect of eaves and pergola above the balcony





1998.8.6 /10:00, 30.6℃, 240W/㎡

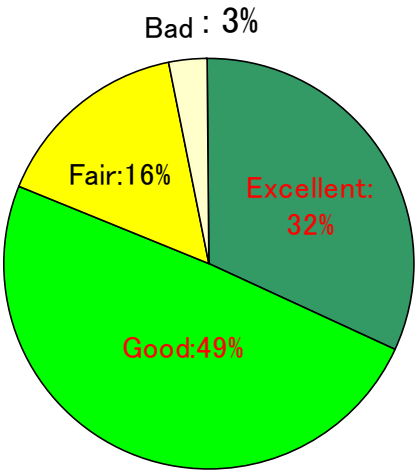


1998.8.6 /13:00, 31.5℃, 430W/㎡

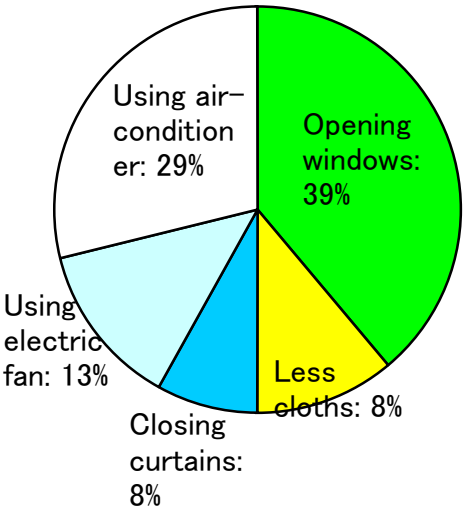
Fig.27-2 Thermal effect of rooftop greenery
(Surface temperature of the grass rooftop turned out to be 7℃ lower than that of roof tiles at sunny mid-summer daytime.

These post-occupancy investigations was made in cooperation with Prof. Masanori Shukuya and his students, Musashi Institute of Technology.

3.3 Some results of the questionnaire investigation (Aug.1998, 38 answers)

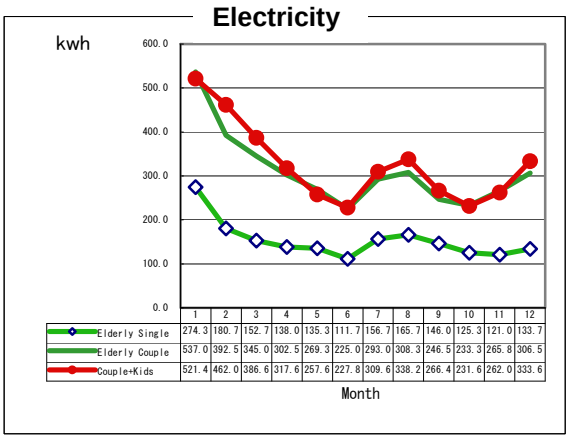


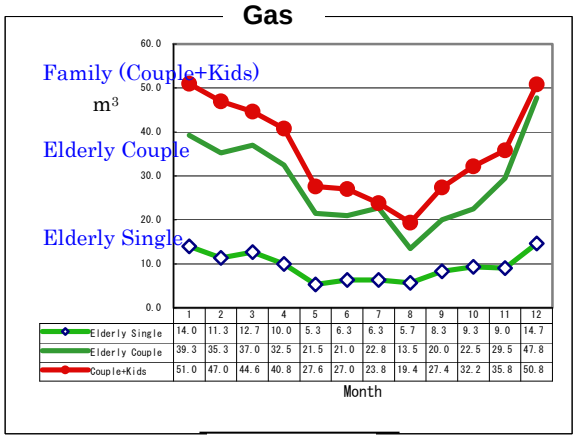
Graph 1. General feeling of residents in terms of satisfaction



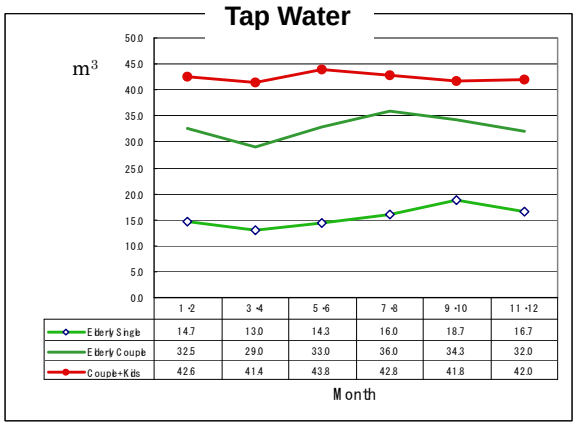
Graph 2. How to live against hotness in summer

3.4 Energy and resource consumption according to the type of household (as of Sep.1997～Aug.1998)

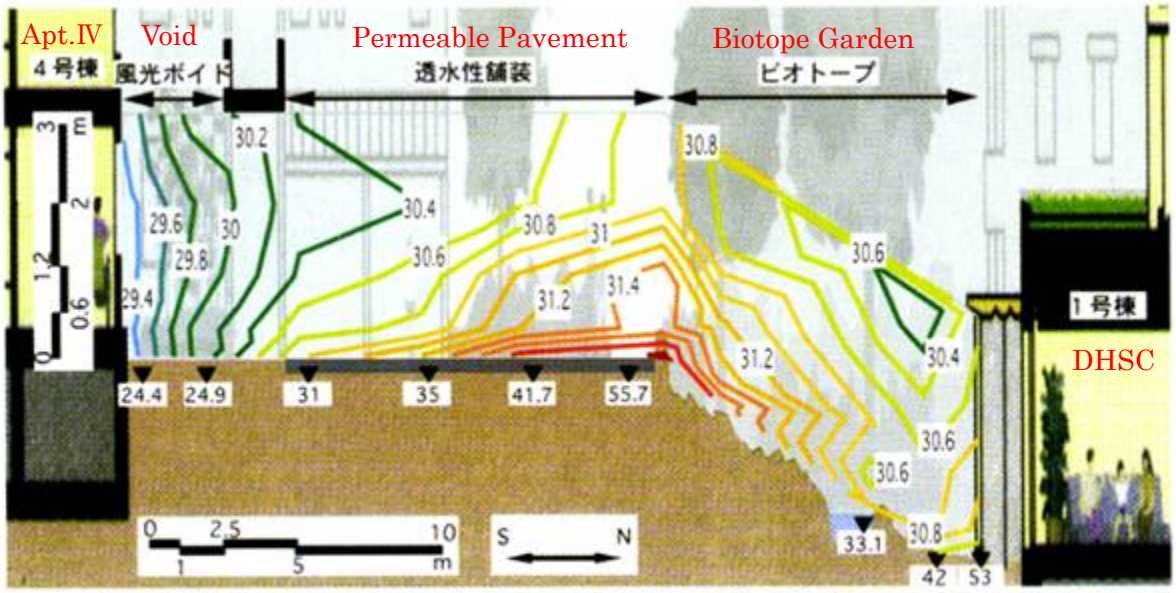




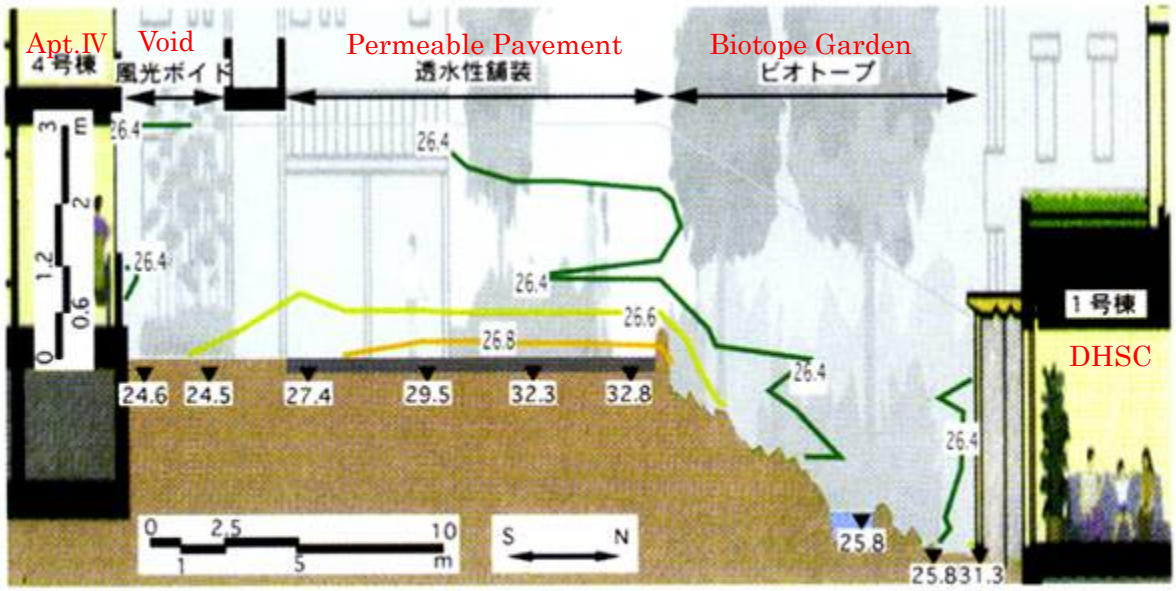
According to the investigation on energy and resource consumption, the family households living in the complex consume 30% less energy in average than the similar households in the central area of Tokyo. This tendency is much clearer in the energy consumption (gas+ electricity) for heating and cooling, which is 1/2～1/9 of the similar household in Tokyo.



3.5 Outdoor Thermal Conditions during a day in summer (Aug. 10th, 1998)



15：45ごろの空気温度と表面温度の分布（1998年8月10日）。日向の舗装面は最高55.7℃に達しているが、ビオトープ・風光ボイド付近の空気は冷えている (At around 15:45)



18：20ごろの空気温度と表面温度の分布（1998年8月10日）。中庭全体の空気温度は、26～27℃ほどに落ちついてくる。上下図とも、図中の数字は表面温度、▼印の下の数字は地表面温度を表す（上下とも作図：荒嶽慎） (At around 18:25)

Intensive researches were made to evaluate the thermal effects of exterior design, including the permeable pavement, biotopes and flower fields. The above results show that the ground surface condition may contribute to improve the micro-climate around buildings, and that the design of buffer zones between interior and exterior is a key issue to create environmentally symbiotic housing.

4. APPENDIX

4.1 Architectural Summary

■**Name:** Setagaya-Ku Fukasawa Symbiotic Housing

■**Completion:** March 1997

■**Address:** Fukasawa 17-4, Setagaya-Ku, Tokyo, Japan

■**Building Regulations:**

Exclusively residential of low-rise /10m（partially medium-rise), Category Ⅰ

Special height control, Category Ⅰ（partially Ⅱ） & off-site shadow control

Fire protection, Category Ⅱ

■**Site Area:** 7,388.08 ㎡

■**Total Floor Surface Areas:**

Ward-built and owned housing:	5,536.86 ㎡
Day Home for the elderly:	594.54
Meeting hall:	69.07
Total:	6,200.47 ㎡

■**Housing Units:**

Ward-owned housing (including 3 units for the disabled): for low-income	43 units
Ward-owned housing for the elderly:	17
Ward-owned housing for middle-income residents	10
Total	70 unit

■**Associated Facilities:**

Day Home Service Center for the Elderly

Communal meeting hall

Public open areas (Children's Playground, Biotope Garden, flower fields, etc.)

Parking lots (25lots, of which 3 are for visitors to the public facilities, and 3 for disabled)

■**Project's Procedure**

Preliminary Planning:	Dec.1992 ~ Mar. 1993
Preliminary Design:	Oct.1993 ~ Mar. 1994
Final Design:	Oct.1994 ~ Mar. 1995
Construction:	Sep.1995 ~ Mar. 1997

■**Total Construction Cost**

2,023,000,000 Yen (1000Yen = 7.0£, as of March 1995)

■**Planning and Design:**

Setagaya Ward +

Ichiura Planning & Housing Consultants / IWAMURA Atelier Joint Venture

4.2 Financial Aspects

All the post-war public housing in Japan has been built and totally financed by public sectors, such as the state government, prefecture and local administration, according to the public housing law. This project was no exception. The Setagaya Ward, as the project developer, received total amount of subsidy, ca 900,000,000 yen, from the Ministry of Construction and the Metropolitan Government of Tokyo. This subsidy included additional aids for being a model project of Symbiotic Housing and universal design for the elderly and disabled. The table below show the details of the whole construction cost.

Table 1 Construction Cost and Subsidies **×1,000Yen (=7.0£, as of Mar.1995)**

		Zone I		Zone II	Total
		Public Facilities	Public Housing	Public Housing	
1.Earth Works					33,000
2.Building construction	Buildings	779,000		544,000	1,323,000
		208,000	571,000		
	Equipment	297,000		142,000	440,000
		150,000	147,000		
	Subtotal	**1,076,000**		**686,000**	**1,762,000**
		358,000	**718,000**		
3.Exterior construction	Gardening				161,000
	Equipment				67,000
	Subtotal				**228,000**
4.Grand total					**2,023,000**
5.Subsidies					**ca 900,000**

1) **"Public Facilities"** include the Ward's day home service center and communal meeting hall
2) **"Gardening"** includes the construction of streets, stone walls, planting, pond and brook, and fire protection water reservoirs(40t+100t)
3) **"Exterior Equipment"** includes the construction of outdoor electrical equipment, such as solar collector, wind generators, solar-powered lightings etc.
4) Surplus expense for the environmentally symbiotic components and equipment, such as roof top green system, rainwater reservoirs, wind generators, solar panels, solar-powered lightings etc., amounted to ca 80,000,000Yen, which was 4% of the total construction cost.
5) Design fees: ①Preliminary Planning/13,000,000+②Preliminary Design/27,600,000 + ③Final Design/47,700,000+④Construction Supervising/45,000,000 = 133,300,000Yen

4.3 Acknowledgement

This project was commissioned by Setagaya Ward, and planned, designed and supervised on site by Ichiura Planning & Housing Consultants / IWAMURA Atelier Joint Venture. This paper has been elaborated and compiled, by the author, on the basis of knowledge given all through this design process, in cooperation with the residents, Setagaya Ward, Faculty of Environmental & Information Studies of Musashi Institute of Technology and many others. We would like to express our deep gratitude to all of them for the wonderful collaboration.