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内部空間の居住性が外部空間での生活行動に与える影響について

EFFECTS OF THE INDOOR ENVIRONMENTAL PERFORMANCE ON THE LIVING BEHAVIOUR IN THE OUTDOORS AROUND HOUSE BUILDINGS

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Introduction

Hitherto, the research on the outdoor space around the house buildings has been carried out primarily in a field of the planology, not fully understood on the outdoor environmental performance different from indoor's (i.e., spaciousness, the earth surface covered with soil, lawn and trees, the fresh air, the sun, etc., and the environmental formation of air temperature, humidity, air current and radiation based on them), moreover, on the existence of the performance of supplementary interaction between the indoors and the outdoors. For that reason, the planological research was no more than analytical survey of how to use in the outdoor space for a few days a year. Consequently, it has not been referred to the human seasonal requirement of the thermal condition and to the outdoor behaviour resulting from the indoor thermal climate.

At present time, "ensuring six hours duration of sunshine on the winter solstice in a park" is only one standard for making a plan of the outdoor environment. So that, it is pointed out that many of all outdoor spaces are, seasonally and timely, unsuitable for using to stay in the view of thermal climate. The old, housewife and infants, who seem to live only in the indoors and in the surrounding outdoors for hours a day, require potentially the spaces where locally involving the thermal performance which is fit for their purposes of behaviour in the indoors, in the boundary space between the indoors and the outdoors or in the outdoor space around the house buildings. "Pool" where many people stay for hours is formed in the space where such the condition as just fit for human behavioural requirement is existing seasonally and timely by chance.

According to our observation on the behaviour through the year, enjoying the cool in summer or the sun-bath in winter is one of outdoor behaviours as a seasonal response to the indoor thermal condition. As to the thermal environments of these behaviour, the shady place with sensible air movement is selected for the former and the sunny place with little air movement for the latter. Still taking other social condition into consideration, it was observed that whether the direction of main opening is north, south, east or west, the difference of direction, make the difference of the appearance time of the inhabitants to the outdoors for enjoying the cool in summer or the sun-bath in winter.

Yet from these examples, it is obvious that the indoor living condition have influence upon the behaviour in the outdoor environment. To start from considering the indoors, the boundary and the outdoors as each one of the living spaces in the series of living spaces, it is necessary to investigate and analyze in detail about the environmental performance of the indoors and the outdoors which was formed in surroundings of multi storied, three-five storied and one or two story house buildings and about the behaviour as a response to such environments, and to qualify the supplementary interaction required for the outdoor space. It is important to throw a spotlight from the point of view upon the block plan of house buildings which is greatly concerned with formation of the indoor and outdoor thermal environments around house buildings, and seek after the magnification and diversification of the living space in the plan and the possibility of new development of its living performance.

Method of investigation

The content of this investigation can be divided into two parts, 1) and 2). As for the content of part 1), it is the study mainly on the effect of the indoor environ-

mental performance on living behaviour in outdoor environment around house buildings. But the environmental performance in the outdoors ought to have some effects on living behaviour in the indoors, so that the part 1) is regard to pursue the mutual supplementary interaction and to clarify the outdoor environment as the living space in the series of living spaces. The fields of the part 1) are the Morinomiya Estate No. 1 and No. 2, and method of investigation is monitor survey.

As for part 2), it is mainly the actual survey of the outdoor local thermal condition and the observation concerned with the living behaviour in the outdoors, and is to analyze the time and space distribution of living behaviour in relation to the local thermal conditions. There are many examples of observation on the indoor behavioral response to the indoor local thermal conditions, so that the responses are surveyed including in the content of part 1). The field of the part 2) is the Morinomiya Estate No. 2 that is one of the two estates above mentioned in the part 1).

Part 1) has been carried out by monitor survey through one year, and the monitors were invited under the following conditions.

(1) the monitor who do not remove from this estate during this survey.
(2) the monitor who has children, such as baby, infant, school child, etc.
(3) the monitor invited from the dwelling units on the lowest, highest, 2nd, 5th, 8th, 12th, 15th, 18th, and 22nd dwelling floor if it exist in the house building.
(4) when there are two kinds of dwelling units in respect of facing direction of main opening on the same floor, the monitors invited in the dwelling units of each facing direction.
(5) there are one dining-kitchen and two bed rooms in the dwelling unit of monitor.
(6) at least one of families of monitor stay in the dwelling unit in the daytime on weekdays.

The conditions on the monitor in the Estate No. 2 were not necessarily fullfiled, because its residents were different from those in the Estate No. 1 as it was constructed recently, the tenant rate was not so high, and the units in the Estate No. 2 were high rent units. The floor described in the condition (3) was also the floor of the dwelling unit where the room temperature was measured, and the choice of floor was due to our expectation that the differences in living consciousness might be caused by the difference in floor to some extent.

The outline of this estate objects and dwelling units of monitors are shown Table 1.

Part 2) was carried out as follows. The outdoor space was parceled out into 8 blocks in order to measure local thermal climate in the outdoor environments around house buildings. Each point was selected in each block and the local thermal climate in the block is represented by the measured values at the point. Following instruments were set up at every point: (1) Instrument screen was set up in which c-c thermo-couple was set in order to measure air temperature. (2) Anemometer of the three-cup type was set on the arm extending from lamppost in order to measure wind velocity and the sensor is at 2.0 meters high above the ground. (3) Pyrheliometer was set on the roof of the instrument screen to measure direct solar radiation on the horizontal surface, and the sensor is at 2.5 meters high above the ground. (4) Globe-thermometer was hung up to the cable between lamp-posts or to the same arm on which anemometer is set, and the sensor is at 3.0 to 5.0 meters high above the ground in order to measure the radiational temperature. It was tried to joint pyrheliometers, anemometers, thermo-couples in the globes and thermo-couples in the instrument screens at all points with one data-casette operation, but the c-c thermo-couples to measure air temperature and globe temperature were too long to measure accurate temperatures. Insulation transducers at the input power sources and two data casette operations were used to avoid these phenomena. By memomotional apparatus, made to order, in order to operate eight 8 m/m cameras (Fuji ZC1000) at the same time using one timer and by the cameras (Nikon FT) time and space distribution of human living behaviors in outdoor environments were surveyed. Four of all eight memomotional 8 m/m cameras were set up at veranda in the room No. 2415 in House Building No. 9 and two were set up at eastend and two at westend at two verandas facing south on 24th floor in the same house building. The pedestals were made in order to shelter 8 m/m cameras from wind and rain and to fix the camera angles for a long period. But for taking photographs to be able to analize human behaviors both in the sunny places and shady places, the successive deligent control of exposure was needed.

Results and Discussion

In September last summer, in 1979, we surveyed the problem of quality of the ventilative indoor space which greatly controlled the indoor living performance in summer, comparing feeling for living in air-conditioned state with those in ventilative state, and investigated the effect of indoor living performance on the human outdoor living behaviour. It was found that there were clear differences between the feelings in the two states. If the house buildings are gathering in the site, we cannot simply judge whether the indoor performance is ventilative or stuffy because of the occurence of the complex turbulent air flow, especially produced from the interactions among the house buildings. And the planning of the ventilative indoor space is depending on, not only a local main wind direction and that's time zone of wind direction in summer, but also the arrangement of the house buildings. The ventilative condition cannot be obtained unless it is planned from the begining concerning the arrangement of the house buildings.

So far, when one uses an air-cooler to keep off the heat in summer indoor space, there are many opposite factors against the psychological, physiological comfortableness of human body. Therefore many people don't welcomely live in air-conditioned state except when it is absolutely necessary at any cost. Recently we have entered upon what we call the age of saving energy, and from such a point of view, living in ventilative state to keep off the heat is going to be positively encouraged. However, our point of view is as follows; to explain the differences between comfortableness which the human body obtains in the air-conditioned state and ventilative state, that is, to make clear the differences of the total sensory qualities of human environments, and to make them reflect in the planning of the indoor, the outdoor and the boundary space (i.e., planning of the series of living spaces) in the future.

When the human environments revolve their qualities from the artificial and closed to the natural and opened, from the released to the strained, from the static to the dynamic, that is, when understrained man removes his living space asking for the change of the environmental condition, from the indoor to the outdoor, from the outdoor to the indoor, how each space should fill up mutually in their environmental performance? The above-mentioned theme, that is, supplementary interaction among the indoor, the outdoor and the boundary space is surveyed, focusing our concern on the multiple dwelling houses in the large city which have many problems on their indoor living performance. It is necessary to explain clearly the quantitative, qualitative meaning of the outdoor space.

As follows, we referred to Question-8 in Questionnaire in September 1979 that we carried out to investigate about the effect of ventilating and air-conditioning which controll greatly the indoor environmental performance on the outdoor appearance of inhabitants by monitor survey. Still more, the results were analyzed, and "Questionnaire C in winter with reference to outdoor appearance of inhabitants" were made on basis of the results of Questionnaire in September 1979.

The data for the items from Ques. 8-a to Ques. 8-b2 were classified and analyzed by facing directions of dwelling units. The data for the item from Ques. 8-b3 to Ques. 8-e were analyzed as follows. Firstly the persons are defined as those who depend on only living in ventilative state for keeping off the heat in summer, who answered (b-1イ)∩{(b-2イ)∪(b-2ロ)}. They are called Group A. Secondly the persons are defined as those who depended on only living in air-conditioned state for keeping off the heat in summer, who answered {(b-1ロ)∪(b-1ハ)}∩(b-2ハ)∪(b-2ニ). They called Group B. The numbers of persons in Group A and in Group B are (37 persons, 58 persons) in 144. (b-1イ)∩{(b-2ハ)∪(b-2ニ) are 21 persons, who answered in the Question that "depend on ventilating", moreover "use it considerably" or "almost keep on using it all day". (b-1ロ)∩(b-2ロ) are 19 persons, in other words, persons who answered that "depend sometimes on it" and "don't use it except absolutely necessary". The number of the rest in 144 persons is 9, having all the other combinations. The numbers of panelists classified by facing directions of main openings in Group A are (4, 7, 26, 37) in order of (South, East, West, Total), likewise the numbers of panelists in Group B are (3, 32, 23, 58). Of all the panelists the numbers of persons living in the units facing South, East, West and its Total is 19, 65, 70 and 144, representatively.

In Osaka in summer, as shown Table 3, the prevailing winds blow mainly from the directions within WSW and S in the daytime. Therefore in Question 8-a, the percentages of persons in the rooms facing west and south, to each number of all panelists in the rooms facing each direction, who answer "it is ventilative", are higher than that in the rooms facing east, and they are (70%,

63%, 21%) in order of (West, South, East), representatively. There are no person in the rooms facing west and south, but 18% to all in the room facing east, who answer "it is stuffy", and as high as 47%, to all in the room facing east, who answer "it is sometimes ventilative according to the wind direction".

To Question 8-b3, that "when do you go out to ask for coolness?", in both Group A and Group B, the percentages of persons who answer "when the room is exposed direct to the sun" in the rooms facing west in each Group, to each all in the rooms facing west in each Group, are higher than those in the rooms facing east, and they are ((27%, 30%), (0%, 13%)) in order of ((West in Group A, West in Group B), (East in Group A, East in Group B)) representatively. The percentages of persons, who answer "when the room is stuffy" or "after sunset", to all in the rooms facing east in each Group, in the rooms facing east in each Group are higher than those in the rooms facing west. They are ((29%, 41%), (27%, 4%)) in order of ((East in Group A, East in Group B), (West in Group A, West in Group B)) representatively, with respect to the answer "when the room is stuffy", likewise ((14%, 19%), (0%, 9%)) representatively with respect to the answer "after sunset". On the whole, it is found that the persons in the room facing west ask for coolness to the outdoors "when the indoors is exposed direct to the sun" and those in the room facing east "when it is stuffy". In conclusion, the percentage of persons, to all of Group B, who ask for coolness to the outdoors is higher than that of Group A, (60%, 43%) in order of (Group B, Group A) representatively.

The survey in winter was carried out by using Questionnaire C from the middle to the end of Feb. 1980. The nurmerals which are written after each item in following Questionnaire C are the numbers of the panelists for each item and the nurmerals which are written in ( ) show the percentages of the numbers of panelists for each item to total. We marked ◎ on the highest rate of panelists and ○ on the high rate.

The result was obtained from this Questionnaire C that a peak time zone of the outdoor appearance of persons who live in the rooms facing east came into view in the forenoon and that a peak time zone of appearance of persons in the room facing west both in the forenoon and in the afternoon. There was no extreme peak time zone of the appearance of persons in the rooms facing south all day long. (Fig. 3)

Next, the time lengths of outdoor stay of inhabitants were surveyed by intervals of 30 minutes for the both estates. There were an overwhelming number of persons who were staying outdoor for an hour. There was any difference in the lengths of outdoor stay with facing directions. (Fig. 4)

On the strength of these data, the model on the outdoor appearance of persons who live in the rooms facing west and east was examined. Fig. 5 is the model of the behaviour of the persons who ask for a different environmental condition from indoor to outdoor, from outdoor to indoor, as it was cleared by Questionnaire C and by man-watching.

Above mentioned, the result was discussed that how the thermal dwelling performance affected on the appearance to the outdoor space around house buildings. Next, the relation between the appearance of inhabitants to the outdoors and the sensory thermal climates in the Morinomiya Estate No. 2 is discussed.

The Morinomiya Estate No. 2 was divided into 8 blocks as shown in Fig. 6 with the thick solid line. Direct solar radiation, air Temp., globe Temp., and wind velocity were measured at one point in each block. It was examined to express the outdoor thermal sensory climate with WBGT, one of the indices in sensory thermal climate, and to seek for upper limit of human appearance of WBGT in summer. One appears in the outdoor spaces as his selectional behaviour based on his physiological response to the indoor thermal environments. If the globe is in the shady part in a block, and the remainder of a block is sunny, and if in the reverse case, the WBGT calculated with one representative globe Temp. in each block cannot cover the sensory thermal climate in whole block. Therefore, it is very rare that the WBGT correspond to the total appearance of persons in the block as shown in Fig. 8. Under such boundary defined, the relation between the WBGT and the appearance persons which correspond to the part in the block is shown in Fig. 9, and according to Fig. 9, upper limit of human appearance in WBGT is 31.4°C. But we did not check the lengths of stay at the upper limit in WBGT. Hourly variation in WBGT in Block 3 and in Block 6 are shown in Fig. 10.

Next, the wind situation in summer in Osaka is written in Fig. 7, Table 2, and Table 3. The wind strongly blow mainly from NNE and direction within SSE and WSW in Block 3 and mainly from NNE and

the direction within SW and W in Block 6. In Osaka, the wind blow mainly from direction within WSW and S in summer daytime, so these two blocks (3 and 6) are the breezy open space in daytime. Therefore, when there are shady place in these two blocks, there the appearance of many persons can be seen. According to our survey and observation in outdoor space, in shady part of Block 3, persons mainly from the rooms facing east appear till 10:30 a.m. and in shady part of Block 6, persons mainly from the rooms facing west begin appearing from 2:30 p.m. We are successing calculations of the indice ITC by Dr. Givoni in place of WBGT.

WBGT can be obtained from the next formula, when the globe Temp., wet-bulb Temp., and dry-bulb Temp. are tg[°C], twb[°C], tdb[°C],

$$WBGT = 0.7\,twb + 0.2\,tg + 0.1\,tdb$$

above formula is in the case that the wet-bulb is exposed to the sun. In the case when the wet-bulb is not exposed to the sun, WBGT can be obtained from

$$WBGT = 0.7\,twb + 0.3\,tg.$$

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Appendix

QUESTIONNAIRE IN SEPTEMBER 1979.

QUESTION 8. HOW DO YOU KEEP OFF THE INDOOR HEAT IN SUMMER?

Please mark ○ on one suitable item from Question 8-a to Question 8-b2 and on every suitable item from Question 8-b3 to Question 8-e.

a. How about indoor ventilative condition when the entrance is opened?

	S 19 persons	E 65 persons	W 70 persons
イ. It is ventilative.	12 (63%)	13 (21%)	48 (70%)
ロ. It is stuffy.	0 (0%)	11 (18%)	0 (0%)
ハ. It is sometimes ventilative according to the wind direction.	7 (37%)	29 (47%)	20 (29%)
ニ. It is ventilative when the opposite entrance across the passage is opened.	0 (0%)	12 (19%)	2 (3%)

persons (%)

b. How do you keep off the indoor heat in summer?

1. On ventilative condition?

	S 18 persons	E 59 persons	W 69 persons
イ. I depend on it.	9 (50%)	15 (25%)	36 (52%)
ロ. I depend sometimes on it.	8 (44%)	23 (39%)	30 (44%)
ハ. I don't depend on it.	1 (6%)	21 (36%)	3 (4%)

2. On using air-cooler?

	19 persons	60 persons	69 persons
イ. I don't use it at all.	4 (21%)	4 (7%)	8 (12%)
ロ. I don't use it except absolutely necessary.	6 (32%)	16 (27%)	28 (41%)
ハ. I use it considerably.	9 (47%)	29 (48%)	29 (42%)
ニ. I almost keep on using it all day.	0 (0%)	11 (18%)	4 (6%)

persons (%)

3. When do you go out to ask for coolness?

	Group A (%)				Group B (%)			
	S	E	W	T	S	E	W	T
イ. When the room is exposed direct to the sun.	0	0	27	19	0	13	30	18
ロ. When the room is stuffy.	0	29	27	24	67	41	4	28
ハ. After sunset.	0	14	0	3	33	19	9	16
ニ. I don't go out so much. ホ. I don't go out at all.	100	57	50	57	0	34	52	40

c. What do you think about using air-cooler?

	Group A (%)				Group B (%)			
	S	E	W	T	S	E	W	T
イ. It is not good for health.	100	100	81	86	33	28	13	22
ロ. It is comfortable if not over cooled.	0	14	23	19	67	53	65	59
ハ. It is better not to use the air-cooler for household and saving energy if possible.	25	57	42	43	0	19	17	17
ニ. It is impossible to keep off the indoor heat without using air-cooler.	0	0	0	0	33	63	22	45

e. We ask you about the feeling for living in air conditioned state and that for living in ventilative state.

1. What do you think about the feeling for living in ventilative state?

	Group A (%)				Group B (%)			
	S	E	W	T	S	E	W	T
イ. I feel comfortable as the wind evaporate the sweat.	0	43	50	43	33	44	30	40
ロ. I feel released as the wind stimulates the skin.	25	43	38	38	0	28	26	26
ハ. I feel harmonious and spacious as it is ventilative.	50	29	27	30	0	19	30	22
ニ. I feel cool when a wind-bell rings.	0	43	8	16	0	6	9	7
ホ. The opening left open, there are some problems on the prevention of crimes and guarding the the privacy.	0	57	50	46	100	63	65	66
ヘ. There are some contact with the nature, such as smell of wood, chirping of insects, breezing air, and etc.	0	14	15	14	0	6	13	9
ト. The others. ( )	0	0	0	0	0	3	4	3

2. What do you think about the feeling for living in air conditioned state?

	Group A (%)				Group B (%)			
	S	E	W	T	S	E	W	T
イ. I can gain an adequate coolness easily at any time.	0	43	38	35	67	59	52	57
ロ. I feel dry and comfortable as it removes the humidity.	50	43	50	49	67	47	65	55
ハ. There are some problems for health as it doesn't cause perspiration.	0	29	23	22	33	28	43	35
ニ. I feel air oppressive.	0	29	15	16	33	6	9	9
ホ. I feel the room narrow, closed and artificial as the opening is closed.	0	29	30	24	33	28	22	26
ヘ. I feel my articulations fast.	0	14	0	3	33	16	0	10
ト. Its noise annoies me.	0	14	8	8	33	16	9	14
チ. I become dull of coolness if I keep on using for a long time.	0	0	12	8	33	34	0	21
リ. The others. ( )	0	0	0	0	0	0	0	0

For the items from Ques. 8-a to Ques. 8-b2, the nurmerals written after each item and the nurmerals in ( ) after those, by facing direction of the dwelling unit, show the numbers of panelists for each item and the percentages of those to the total numbers of panelists by facing direction representatively.

For the items from Ques. 8-b3 to Ques. 8-e2, the nurmerals in each Group written after each item show the percentages of the numbers of panelists to the total numbers of panelists by facing direction of the dwelling unit in each Group.

QUESTIONNAIRE C

A. WHEN DO YOU ASK FOR GOING OUTDOORS THIS SEASON?

Please mark ○ on every suitable item, and fill ( ) with definite words.

a. How about the weather when you go outdoors? 130 persons*

1. It is clear. 125 (96%)◎
2. It is cloudy. 2 (2%)
3. It is snowy. 5 (4%)
4. It is rainy. 0 (0%)
5. It is windy. 1 (1%)
6. It is breezy. 45 (35%)○
7. And others. 17 (13%)

b. How about the condition of the room when you go outdoors? 119 persons*

1. It is cold. 10 (8%)
2. It is warm. 48 (40%)◎
3. It is hot. 19 (16%)
4. It is cool. 2 (2%)
5. It is dark. 25 (21%)○
6. It is light. 25 (21%)○
7. It is dazzling. 4 (3%)
8. It is ventilative. 6 (5%)
9. It is stuffy. 18 (15%)
10. And others. 16 (13%)

c. How about your situation and feeling at that time? 129 persons*
   1. I just finished the household matters. 95 (74%)◎
   2. I was tired of my work. 6 (5%)
   3. I was tired with my work. 10 (8%)
   4. I was absent-minded. 12 (9%)
   5. I became weary. 18 (14%)
   6. I was sick for persons. 7 (5%)
   7. The child ask for going outdoors. 64 (50%)○
   8. Somehow. 14 (11%)
   9. And others. 13 (10%)

d. For what purpose do you go outdoors? 131 persons*
   1. In order to divert myself. 69 (53%)◎
   2. In order to expose the child to the air. 45 (34%)
   3. In order to attend on the child and let the child play. 54 (41%)○
   4. In order to chatter with the neighbors. 25 (19%)
   5. In order to take a walk and light exercise. 35 (27%)
   6. In order to come in contact with the nature. 10 (8%)
   7. In order to ask for the open outdoor space. 59 (45%)○
   8. In order to expose myself to the air and enjoy the released feeling. 29 (16%)
   9. And others. 21 (16%)

e. Where do you stay outdoors? 127 persons*
   1. Sunny place. 112 (88%)◎
   2. Shady place. 0 (0%)
   3. Breezy and cool place. 6 (5%)
   4. Stuffy place. 51 (40%)○
   5. The place where the play facilities are. 16 (13%)
   6. The place where the open ground is. 29 (23%)
   7. And others. 16 (13%)

f. What did you wear at that time? 128 persons*
   1. Always the same as in the room. 17 (13%)
   2. I wore sometimes ( ). 105 (82%)◎
   3. I wore ( ) only when it blew hard. 45 (35%)○
   4. The same as in the room when the sun shined. 18 (14%)
   5. And others. 13 (10%)

g. When do you go outdoors this season? Please write the area and the time zone of stay on Estate Facility Figure on next page as the example.

The nurmerals which are written after each item are the numbers of the panelists for each item and the nurmerals which are written in ( ) show the percentages of the numbers of panelists for each item to total panelists. We marked ◎ on the highest rate of panelists and ○ on the high rate. * shows total numbers of panelists for each question.

Table 1 The summary of housing estates and monitor dwelling units in the object of monitor investigation

The Summary of the Estates					
Name of Estate	No. of Build.	Structure	Total Floors	Total Dwelling Units on the Standard Floor	Total Dwelling Units
Estate No.1	Build. No.1	SRC	11	16	172
	Build. No.2	SRC	11	14	150
	Build. No.3	SRC	11	18	189
	Build. No.4	SRC	14	19	245
	Build. No.5	SRC	14	19	245
Total	5 Build.s				1001
Estate No.2	Build. No.6	SRC	15	64	896
	Build. No.7	SRC	15	16	224
	Build. No.8	SRC	8	12	84
	Build. No.9	SRC	25	24	530
Total	4 Build.s				1734

The Summary of The Moniter Dwelling Units						
Name of Estate	No. of Build.	Direction of the main opening				Type of Plan
		South	East	West	Total	
Estate No.1	Build. No.1	9	—	—	9	3K, 3DK
	Build. No.2	10	—	—	10	2LK, 3DK
	Build. No.3	—	8	8	16	2DK
	Build. No.4	—	8	8	16	2DK
	Build. No.5	—	8	8	16	2DK
Total	5 Build.s	19	24	24	67	
Estate No.2	Build. No.6	—	18	20	38	2DK, 3K
	Build. No.7	—	3	5	8	2DK
	Build. No.8	—	4	5	9	2DK, 2LDK
	Build. No.9	—	13	15	28	2DK, 3DK
Total	4 Build.s	—	38	45	83	

Notes: No heating and cooling equipments in the Estate No. 1.
Zone heating and hot water supply system in the Estate No. 2 but no cooling equipment.
3DK : 3 bed rooms and 1 dining and kitchen.
2DK : 2 bed rooms and 1 dining and kitchen.
3K : 3 bed rooms and 1 kitchen.
2LK : 2 bed rooms and 1 living and kitchen.
2LDK : 2 bed rooms and 1 living, dining and kitchen.

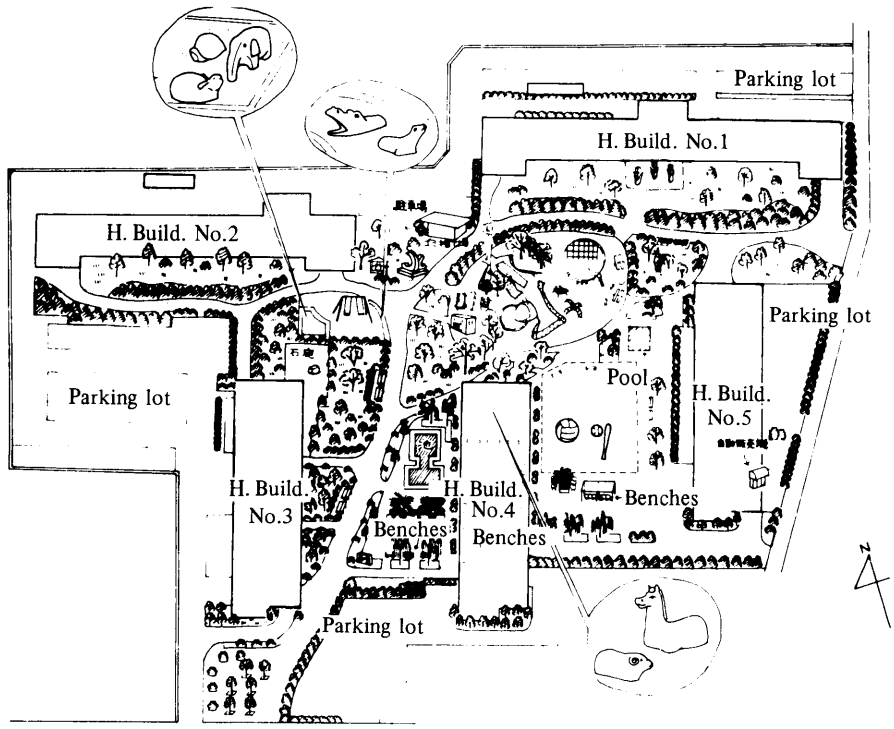

Fig. 1 Plot plan of house building in Morinomiya Estate No. 1

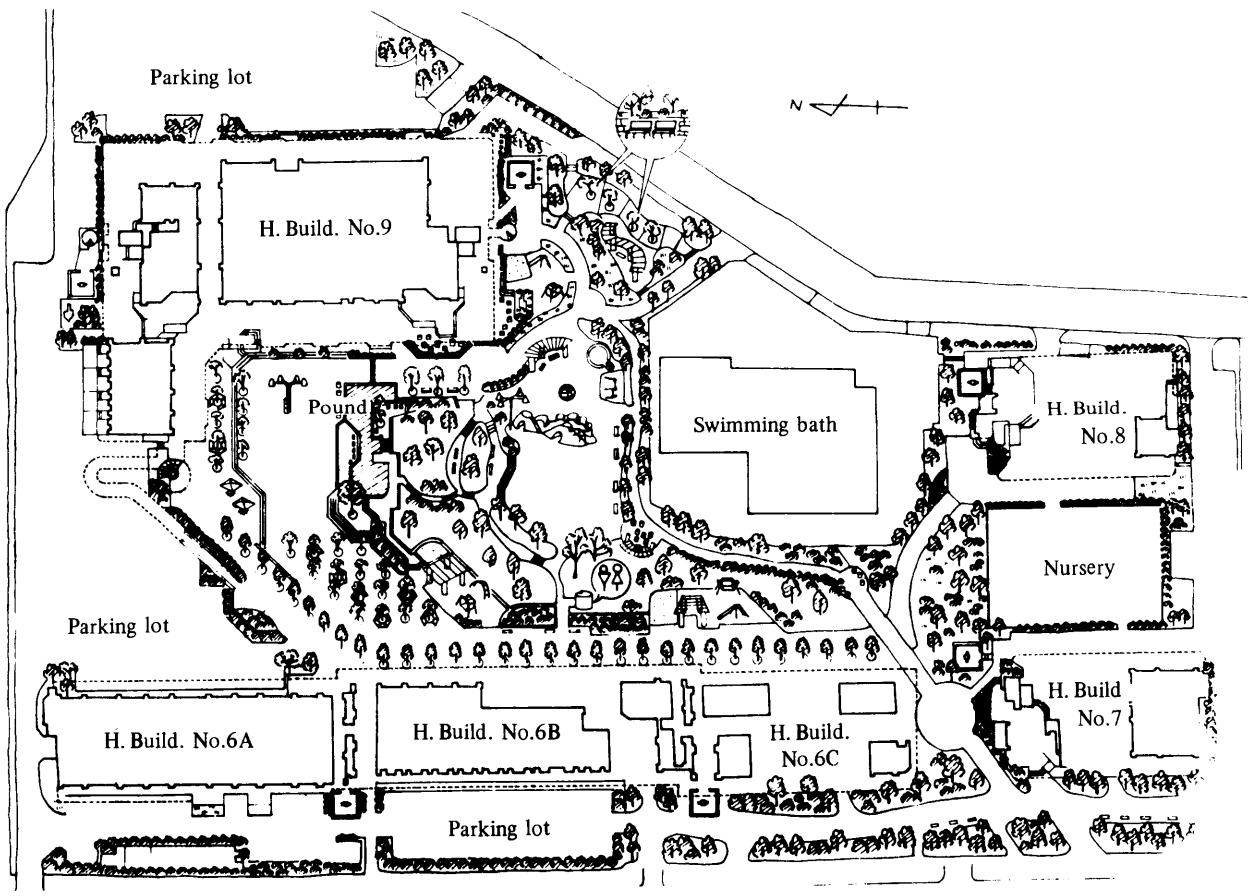

Fig. 2 Plot plan of house building in Morinomiya Estate No. 2

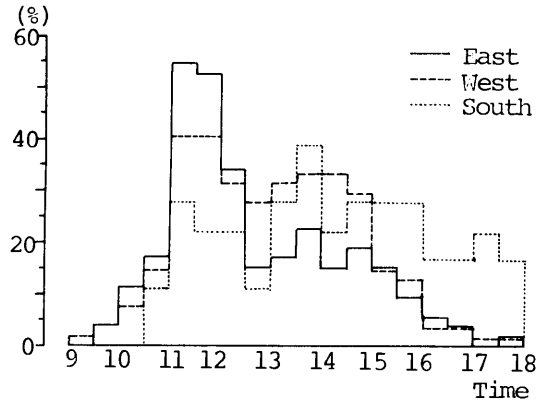

Fig. 3 The time zone of outdoor stay of inhabitants by facing direction of dwelling unit.

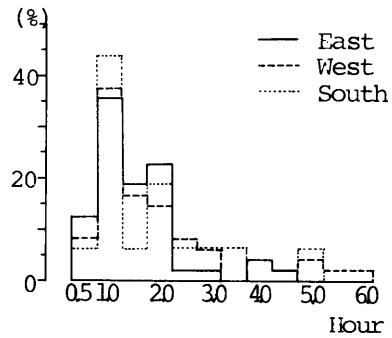

Fig. 4 The time length of outdoor stay of inhabitants by facing direction of dwelling unit.

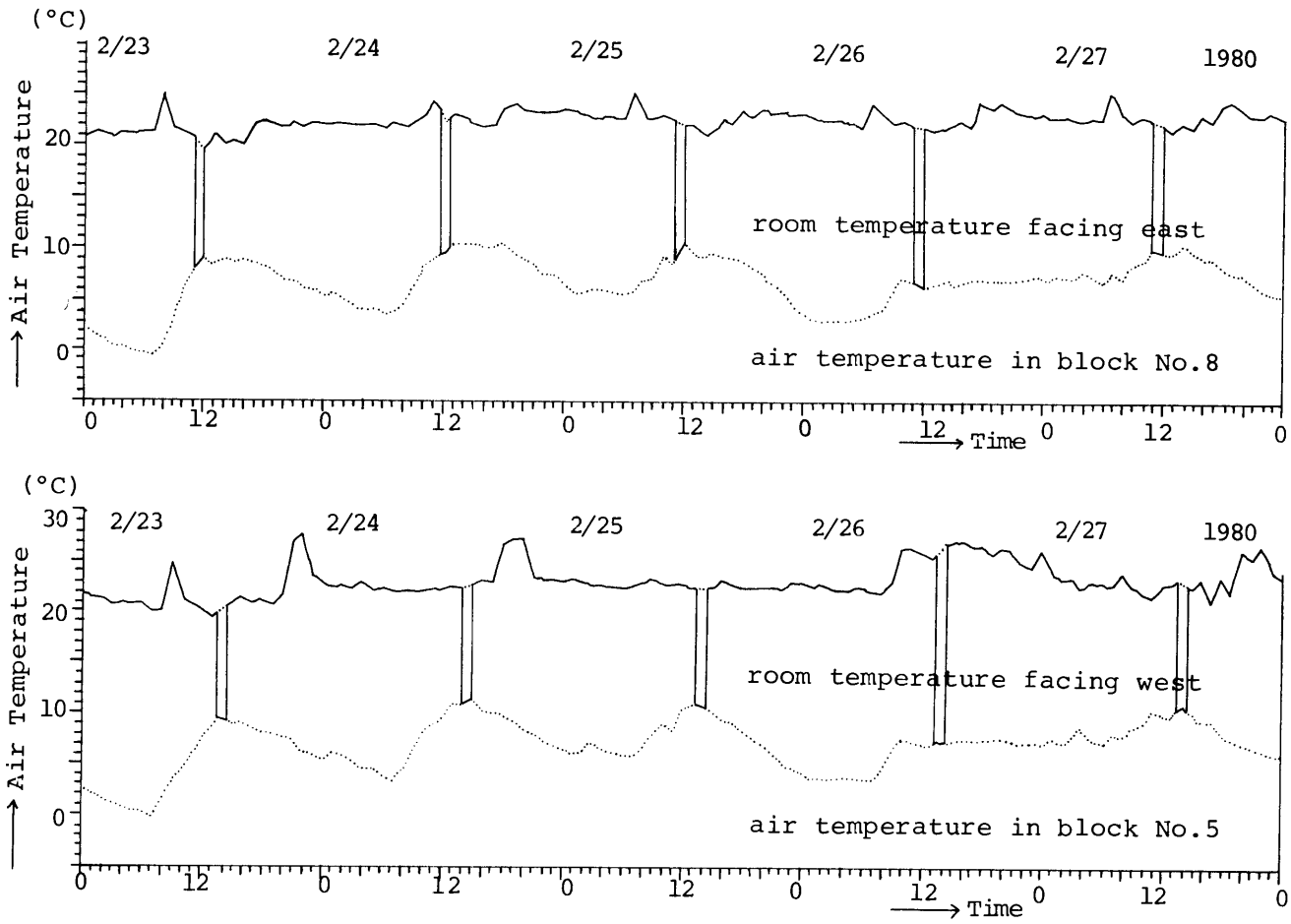

Fig. 5
The model of the inhabitants of the outdoor appearance as a response to the indoor environments in the Morino-miya Estate No. 2 during 23/2 - 27/2 in 1980.

Upper is the model of the persons who live in the rooms facing east and go out in the Block 8, and lower is the model of those who live in the rooms facing west and go out in Block 5. Those who live in the rooms facing east come into view in the forenoon (11:00 a.m. - 12:00 a.m. on weekdays, 11:30 a.m. - 00:30 p.m. on Sunday) and those who live in the rooms facing west come into view in the afternoon (1:30 p.m. - 2:30 p.m. on weedkays, 2:00 p.m. - 3:00 p.m. on Sunday). The 24th Feb., 1980 is Sunday.
This model is made by man-watching and monitor survey.

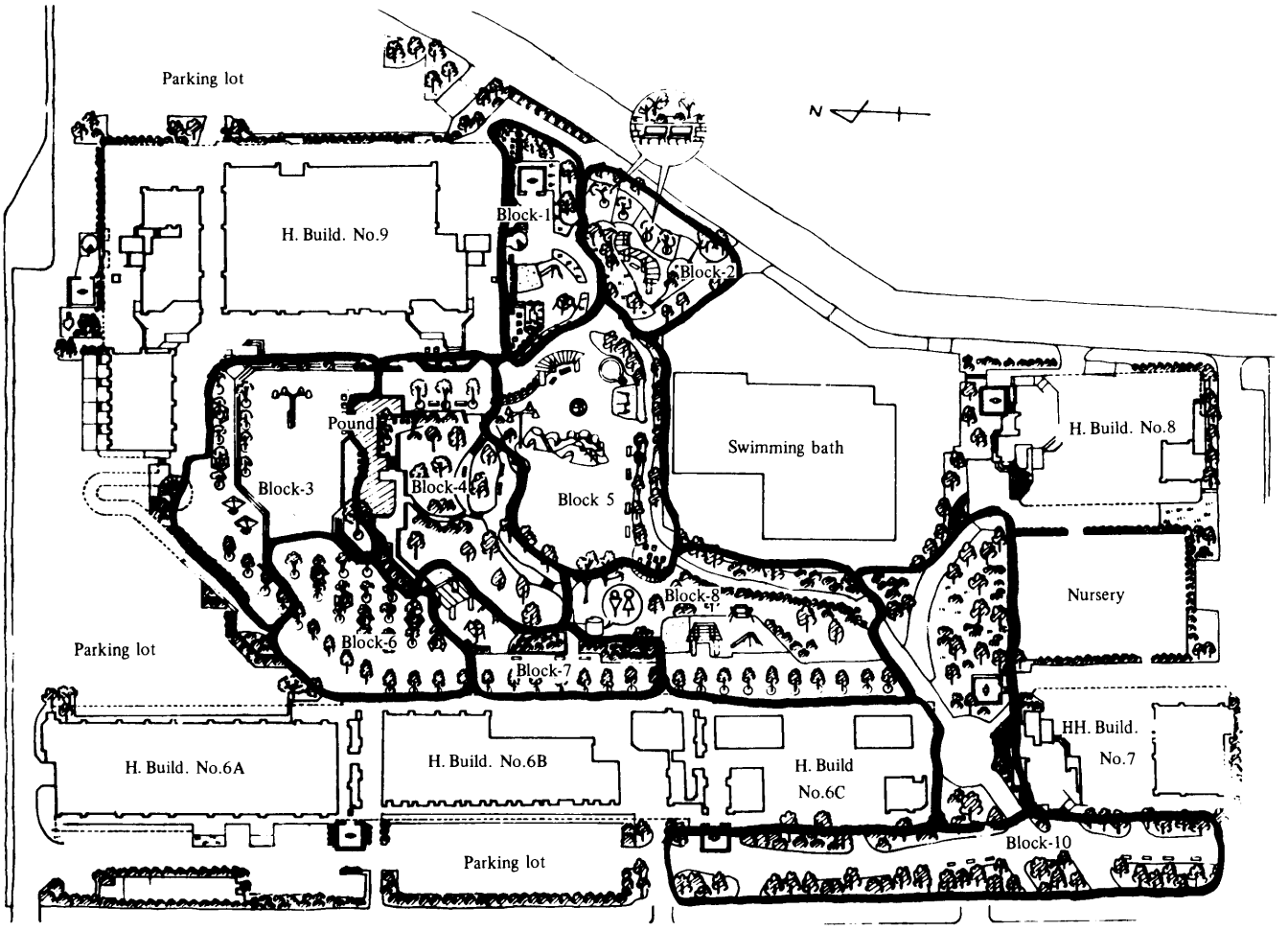

Fig. 6 Figure of blocking in the Morinomiya Estate No. 2

Table 2 The hourly wind direction measured on the roof of house Build. No.6 in Aug. 1979 During 2/8 – 8/8

Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Day 2/8	SW	SW	SW	SW	W	SW	SSW	SSW	SSW	SW	SSW	SW	SSW	SSW	SW	SW	WSW	SW	W	WSW	WSW	SW	SW	WSW
3/8	S	SE	N	SE	ESE	SSE	WSW	S	S	S	WSW	S	SW	SSW	SSW	SSW	SSW	SW	N	NNE	NNE	NNW	N	N
4/8	NNE	W	N	N	N	SSE	S	WSW	SSW	SW	SW	SSW	SSW	SW	SSW	WSW	SW	S	SSW	SSW	SW	S	SSW	WSW
5/8	SSW	SSW	S	S	SSW	SW	SW	SW	SSW	SW	SW	WSW	SW	WSW	SW	SW	SW	SW	SW	SW	SSW	WSW	SW	SW
6/8	SSW	SW	SSW	S	SE	N	ESE	SSW	WSW	SSW	SSW	SW	SW	SW	SW	SW	SSW	SSW	SW	SW	SSW	SSW	S	WSW
7/8	SSW	SSW	SSW	SSW	SSW	SW	SSW	SW	SSW	SW	WSW	SW	SW	WSW	SW	SSW	NNE	N	NNW	NNE	NNE	NNE	NNE	N
8/8	NNE	N	NNE	N	NNE	N	N	NNE	NNE	N	N	NNE	N	N	W	WSW	WSW	NNE	N	NNE	NNE	NNE	NNE	NNE
***	SSW 3	SSW2	SSW 2	S 2	SSW 2	SW 3	SSW 2	SSW 2	SSW 4	SW 4	SSW 2	SW 3	SW 4	SSW 2	SW 4	SW 3	SSW 2	SW 3	SW 2	NNE 3	NNE 3	NNE 2	SW 2	WSW3
	NNE2	SW 2	N 2	N 2	SE 1	SSE2	S 1	SW 2	S 1	SSW1	SW 2	SSW 1	SSW2	SW 2	SSW2	SSW 2	SW 2	SSW 1	N 1	SW 2	SSW 2	NNW1	NNE2	N 2
	SW 1	SE 1	NNE1	SSW1	ESE 1	N 2	SW 1	S 1	WSW1	S 1	WSW2	S 1	N 1	WSW2	W 1	WSW2	WSW2	S 1	SSW 1	SSW 1	SW 1	S 1	SSW 1	SW 1
	S 1	W 1	S 1	SW 1	W 1		WSW1	WSW1	NNE 1	N 1	N 1	WSW1		N 1			NNE 1	N 1	NNW1	WSW1	WSW1	SSW 1	S 1	NNE 1
		N 1	SW 1		N 1		ESE 1	NNE 1				NNE 1						NNE1	W 1			WSW1	N 1	
					NNE1		N 1															SW 1		

*** Hourly numbers of occurrence times by wind direction

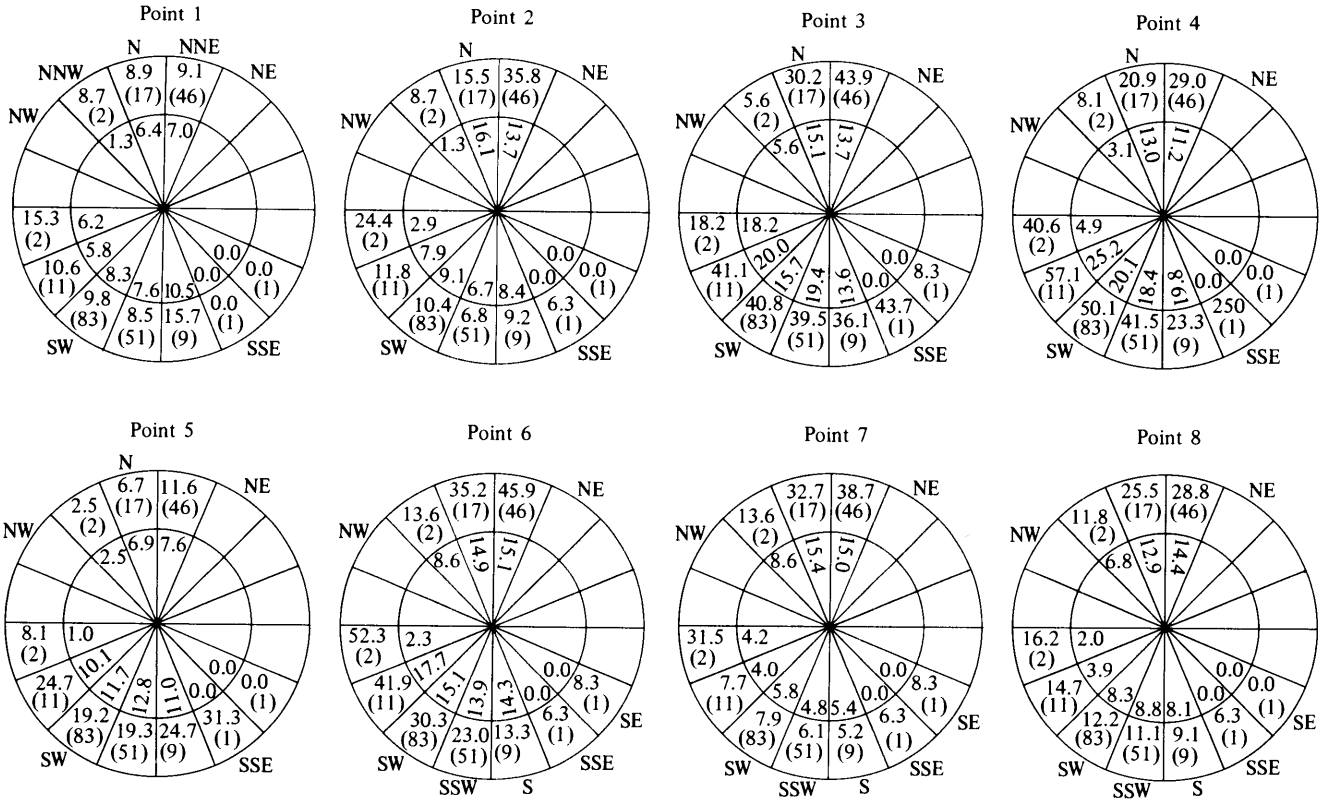

Fig. 7

The mean values of the percentages of wind velocity by wind direction in each block to that measured on the roof of house Build. No.6A. These are the cases that the wind velocity on the roof are above 2.0 m/sec, and within the period of 4/8 8:00 a.m. - 10/8 11:00 a.m. in 1979.

Here, the wind velocity is the mean velocity during ten minutes. The figures in outer circle, in ( ) in outer circle and in inner circle show the mean values of percentages, the numbers of data and the standard deviations, representatively.

Table 3

The percentages of the numbers of occurrence times by wind direction to the total numbers of the data of wind above 2.0m/sec measured on the roof with in the period.

N	NNE	NE	ENE
7.6	20.6	0.0	0.0
E	ESE	SE	SSE
0.0	0.0	0.4	0.4
S	SSW	SW	WSW
4.0	22.9	37.2	4.9
W	WNW	NW	NNW
0.9	0.0	0.0	0.9

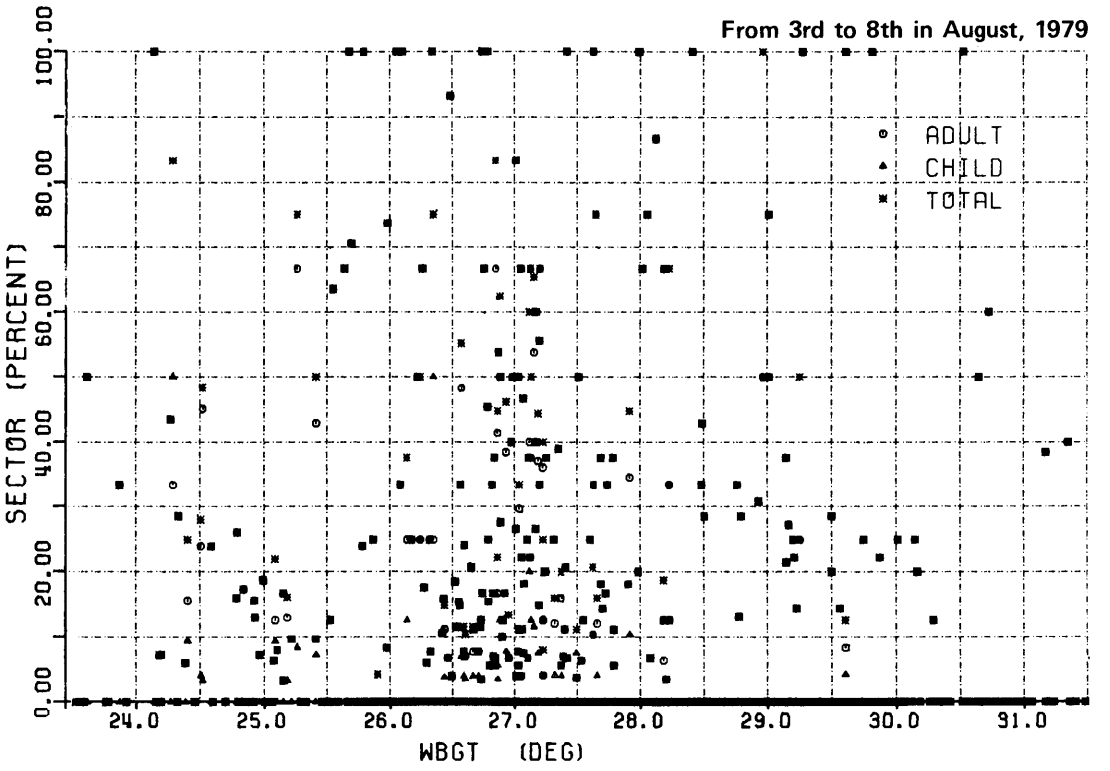

Fig. 8 The WBGT and the percentages of appearance persons in the part of block where the WBGT can be obtained to the total appearance persons in whole block.

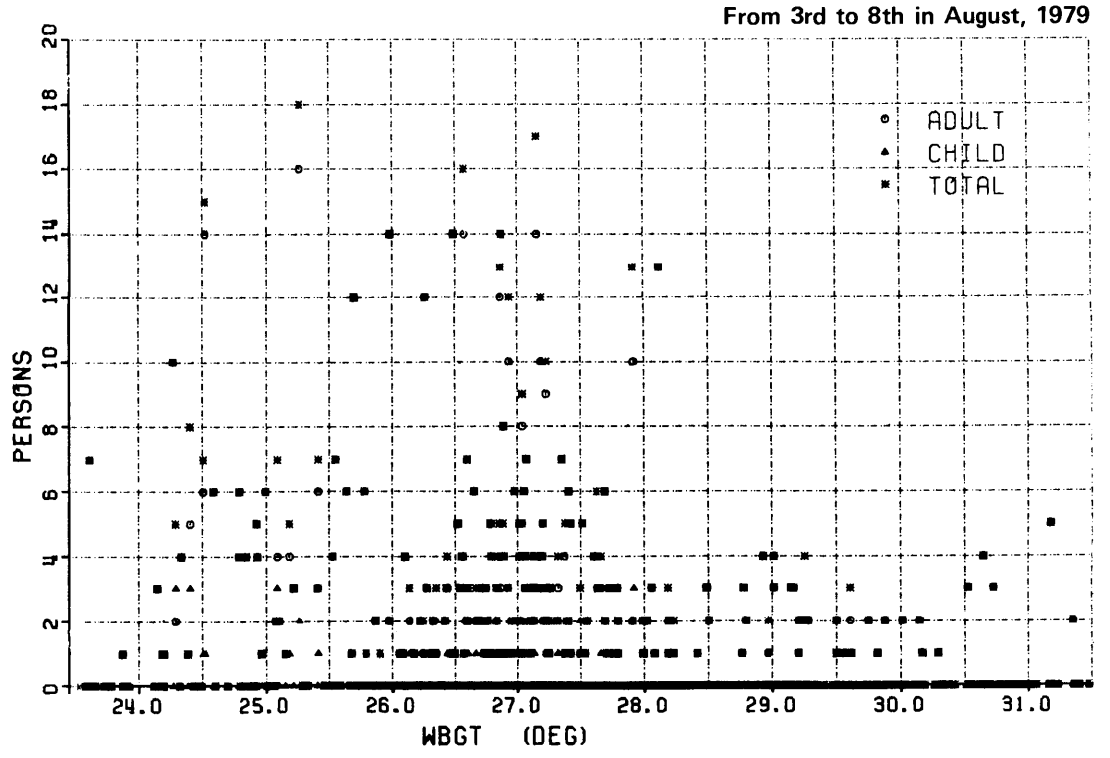

Fig. 9 The WBGT and the numbers of appearance persons in the part where the WBGT can be obtained in the block.

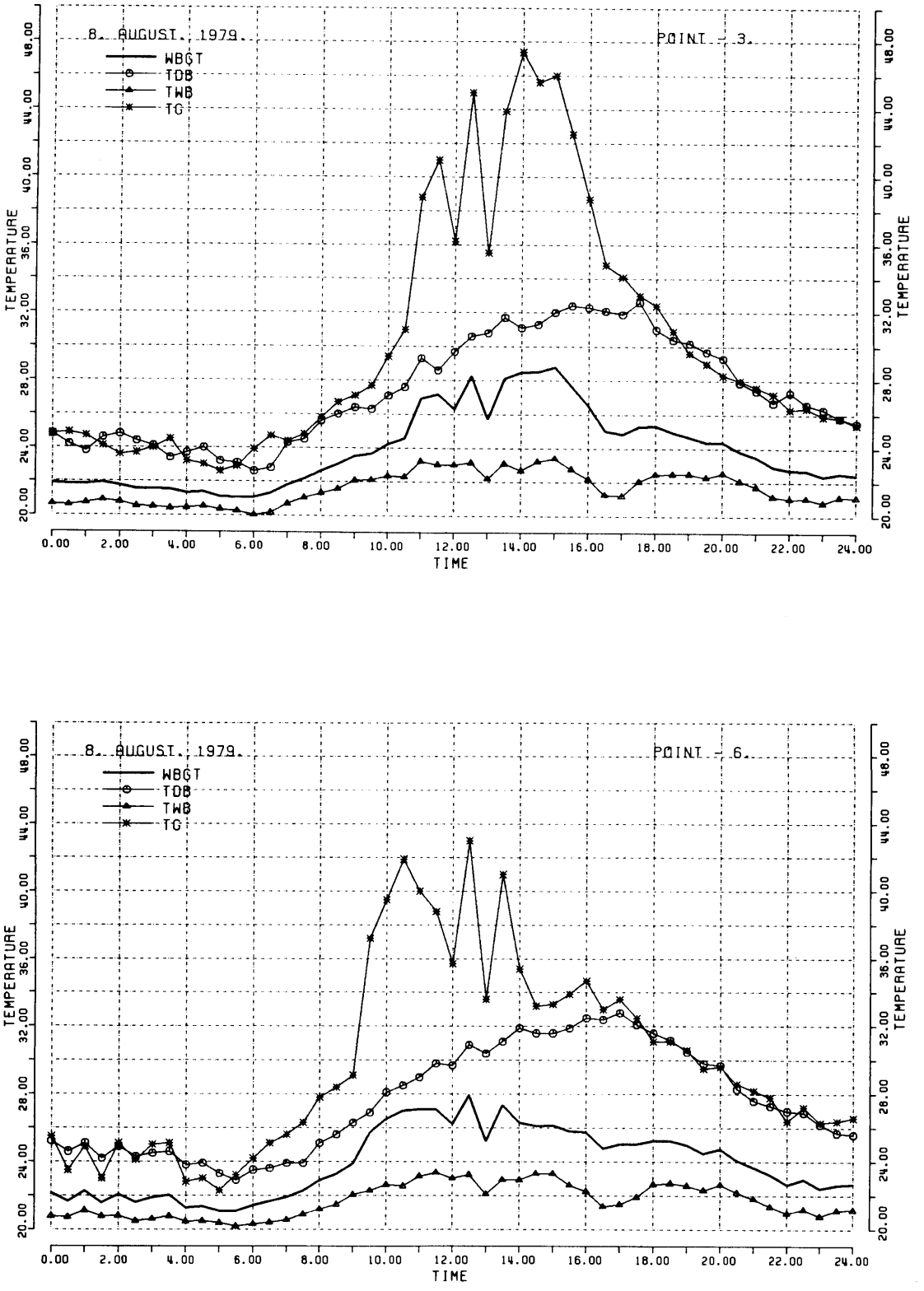

Fig. 10 Hourly variation of the WBGT in Block 3 and in Block 6 in 8/8, 1979.

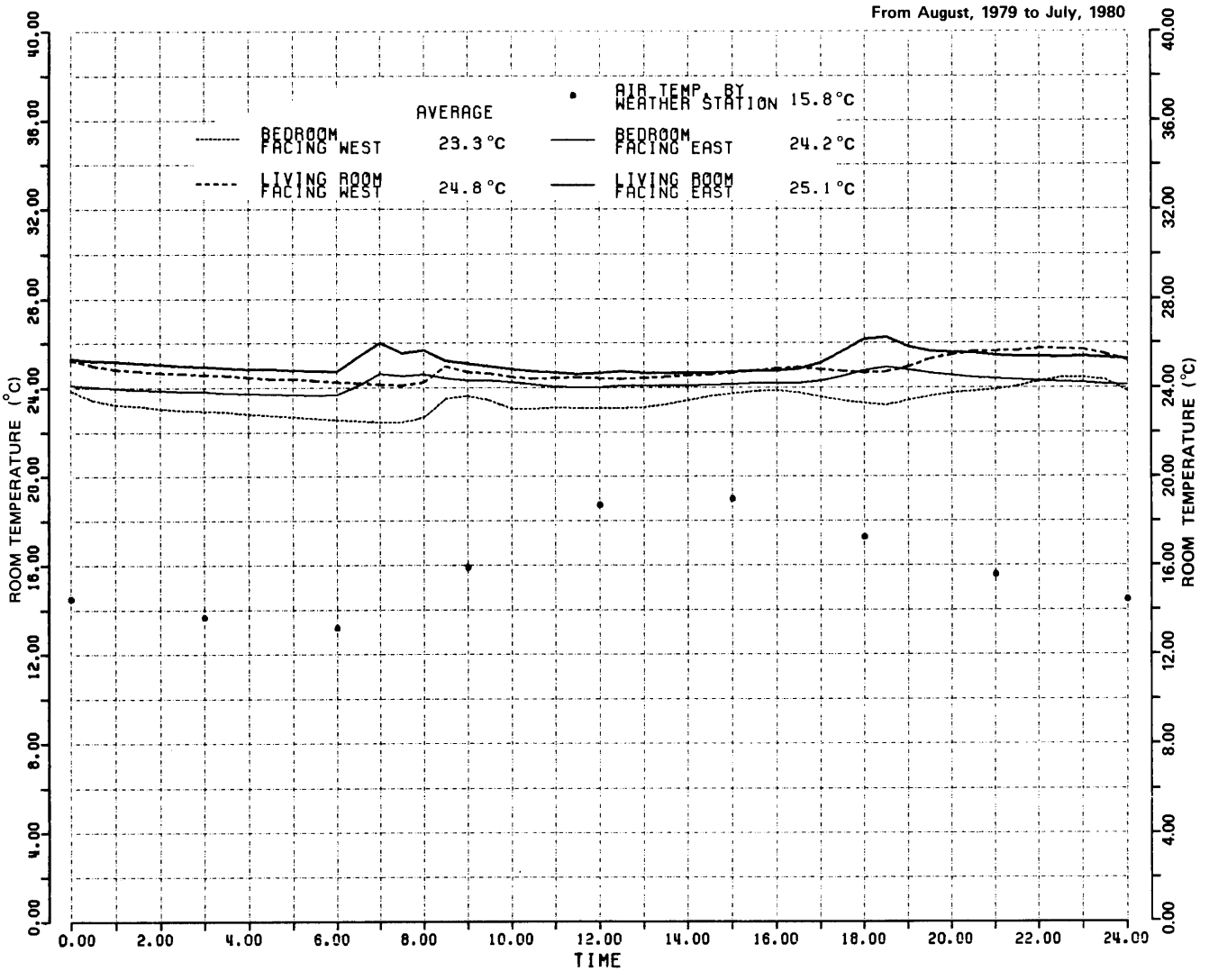

Fig. 11 Hourly average of room temperatures in the rooms facing east and facing west through the year from August, 1979 to July, 1980

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