

The Analysis on the Emotional Evaluation Methods of Environmental Design Elements Using the Eye Mark Recorder and the Repertory Grid Method

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ABSTRACT

This paper is an inquiry into the human sensibility on view from high-rise housing in a viewpoint of architectural environment design that pay attention to multi-family high-rise housing which is becomes a trend in recent years. And this paper is the fundamental approach for applying this result to later architectural environmental plan of multi-family high-rise housing. In this paper, we used repertory grid method as a cognitive psychological way of analysis and eye mark recorder measurement experiments as a physiological way of examination. In the conclusions, examined human sensibilities on views-focused on the analysis result of eye mark recorder measurement experiments through repertory grid method that are carried on the main subject-and described problems after this and possibilities in the same time.

Keywords: Emotional Evaluation, Environment Factor, Repertory Grid Method, Eye Mark Recorder.

1. INTRODUCTION

Many environmental changes have occurred in the content and quality of super high-rise buildings which have recently been built mainly in city centers [1]. Since such changes in various environmental aspects have significant effects on the lifestyles, comfort levels and living environments of people living in such urban areas, it is becoming necessary to place greater importance on the study focused on human sensibility at environmental design [2], [3]. But according to the study on the research tendency of sensibility study in space study by A. Jung and Y. Oh, most of the previous studies on focus on human sensibility tended to analyze by qualitative method with space-oriented or designer-oriented aspect, such as the analysis of sensible concept within architectural space or the one of sensible intention of designer [4]. While human sensibility has been studied in various manners and forms, there are few studies on human sensibility with environmental perspective. Since so-called the evaluation based on human sensibility is an essential precondition for discriminating the good from the bad, human sensibility have to be considered as the most basic and important analytical axis for current environments.

This paper presents a method for evaluating environmental design elements from the viewpoint of human sensibility, with a focus on the influence of environments on humans and a human-centered concept. It thus examines the sensibility aspects of environmental elements and tries different combinations to find effective evaluation methods for such elements [5].

The preparatory examinations and experiments were carried out before substantial interviews and measurement experiments. To be concrete, the preparatory examinations and experiments were executed on the basis of groping for repertory grid method and eye mark recorder measurement experiment that was chosen as ways to research and various patterns of experiments. And the interviews were executed that are founded on repertory grid method. This is an attempt to extract key words that are related with sensibility like human beings' feelings, emotions, conditions and demands on multi-family high-rise housing, and we collected the facts that are related with architecture, environment, designs among the contents of interviews. So we executed physiological examinations of respondents' five kinds of results from psychological method of analysis on multi-family high-rise housing that are extracted from the second paragraph. As the data of examinations, we used pictures that would represent the environment of multi-family housing that are drawn up the key words from the facts of architecture, environment and designs. At the eye mark recorder measurement experiment, we showed the pictures that are made for the subjects and tried to read the quantitative analysis of recorded data in the aspect.

2. PRELIMINARY EXPERIMENT

In this paper, we executed the preparatory experiments formulate as effective methods of research and analysis through compounding the two patterns, those are, the judgments from the pictures and based on experience, of forms. As a result, it was found out that the form based on experience can get more objective expression and responses.

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2.1 Purpose of the preliminary experiment

A preliminary experiment was conducted to examine combinations of emotional evaluation methods, as an attempt to find specific methods effective for studying environmental elements from the viewpoint of sensibility ergonomics.

2.2 Method of the preliminary experiment

2.2.1 Experiment method

The experiment method consisted of the repertory grid method from the aspect of cognitive psychology and the eye-mark recorder test from a physiological viewpoint.

The repertory grid method is a method for identifying the cognitive structure, to understand what humans perceive and what kind of judgments they make based on such perceptions. The repertory grid method is a method of making structure of evaluating items that are based on respondents' languages of themselves and the reasons of that response and then grasp the whole aspects through the interviews that are made from the basis of comparative evaluation to that reasons' forms. By this method, we can induce the evaluating items on multi-family high-rise housing environment and key words on the respondents' sensibility as well. In the interview, several targets of evaluation were presented to the subjects to find their preferences, and the reasons for targets with different preference levels classified using the laddering technique. Laddering consists of ladder-ups, which are questions to identify the fundamental psychological states of the subjects, and ladder-downs, which are questions to determine specific conditions of the subjects [6]. This method makes it possible to efficiently reveal the general cognitive structure of subjects [7].

The eye mark recorder measurement experiment is a physiological way of examination on evaluating items that are made by the repertory grid method, so we can analysis the physiological judgment like the point of a staring gaze and time to forms of fixed quantities of numerical value data. An eye-mark recorder is a device which is supposed to be effective for precisely grasping complex eye movements and other physiological information and indicating such information as quantitative data. It is used for the analysis and research of human behavior and psychology [8], [9].

2.2.2 Experiment materials

As preliminary experiment materials, random photos of the lower, middle and upper levels of buildings, bridges, trains and other artificial elements and the sky, in addition to other elements, were used (since the photos and other materials were not ready at the time of the preliminary experiment, photos of common environments were used within a predictable range). The photos were projected on a screen in the A0 size for five seconds each in a random order, using a slide projector.

2.2.3 Experimental apparatus

Personal computer of Window XP, projector, screen, T.K.K 2920 free view eye mark recorder, the eye movement statistics program II was used for analysis (Fig. 1), [10].

2.2.4 Subjects

Six male and female graduate students with corrected eyesight of 0.8 or higher participated in the experiment.

2.2.5 Procedure

Two patterns of interviews were conducted depending on which one of the prepared photos was shown, followed by an

eye-mark recorder experiment under the above-mentioned experiment environment. The subjects were interviewed individually, listened to the prepared questions one after another and wrote the answers on cards. The answer cards were sorted out and data sheets were prepared as individual interview charts. After that, the results of the preliminary experiment using an eye-mark recorder were analyzed using the eye movement analysis program II to examine a variety of analyzable items based on the program [11].

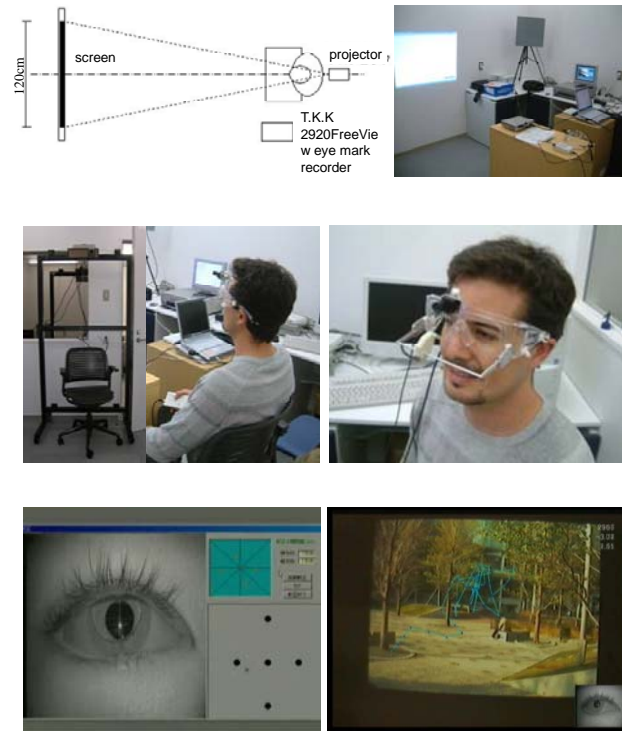


Fig. 1. Test setting of eye mark recorder

2.3 Preliminary experiment results

As a result of the interviews in the preliminary experiment, it was confirmed that the subjects were less likely to be influenced by external information and images when photos were not shown to them. It is minimized limits by information from outer sources and images and so on, because respondents make answers that depend on absolute standards of evaluation and judgment of themselves that are founded on their experiences until now.

However, the photos used were prepared randomly and did not represent the images of the subjects themselves. It was also necessary in this experiment to use photo materials, for which the subjects could feel more sympathy, rather than those reflecting their experiences and opinions. It is thus considered necessary in this experiment to prepare photo materials based on keywords obtained from the interview results, as well as to increase the number of subjects [12].

Then, out of the data obtained by the eye-mark recorder experiment, it will become possible to use the locus, gaze duration and position diagrams for a physiological examination of this experiment. (Fig. 2)

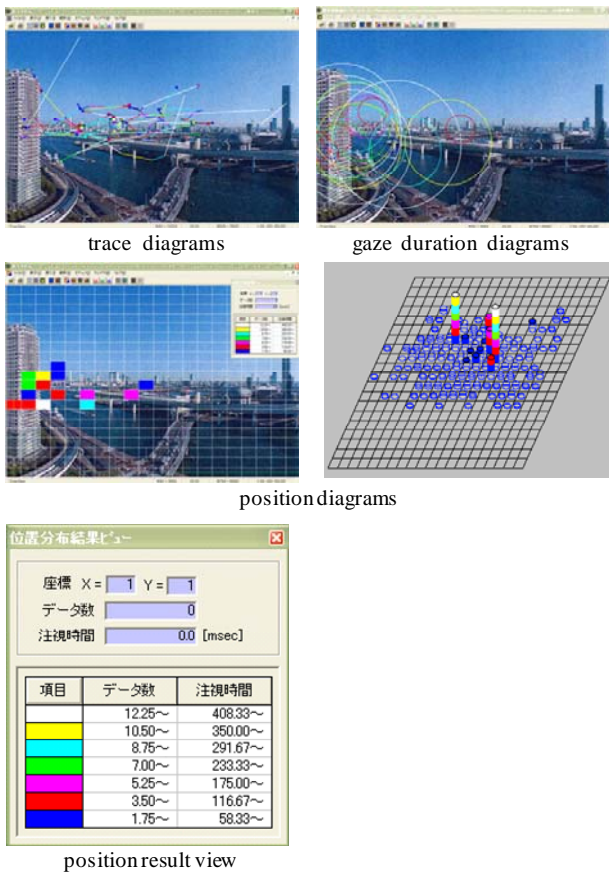


Fig. 2. Measurement data of eye mark recorder

3. AN ATTEMPT TO EVALUATE THE ENVIRONMENTAL DESIGN ELEMENT USING THIS EXPERIMENT

On the basis of the facts that are obtained from preparatory experiments and eye-mark recorder experiment, the interviews were executed using repertory grid method to 20 subjects.

3.1 Purpose of the experiment

In this experiment, interviews were conducted based on the results of the preliminary experiment without showing photos to the subjects. Environment-related keywords obtained from the interviews were examined by the eye-mark recorder experiment for the purpose of confirming the validity of the different combinations of evaluation methods.

3.2 Experiment method

3.2.1 Experiment method

An eye-mark recorder experiment was used in combination with an interview using the repertory grid method.

3.2.2 Experiment materials

The answers of the subjects obtained in the interviews were converted into individual data and were compiled into a general network [13], (Fig. 3). Based on the general network chart, the data could be classified into five evaluation item groups

concerning landscape, convenience, social value, comfort, structure and security. Of these groups, the subjects showed the highest interest in the landscape group, which was used in this paper to extract the keywords for the evaluation of human sensibility to environments. The subjects evaluated the landscape based on the sizes and quantities of natural elements, such as humans, greenery and the sky, and artificial elements, such as buildings, cars and lighting (Fig. 4). Based on these environmental element keywords, 20 photos were used as experiment materials (Fig. 5). Photos were projected for 8 seconds each in a random order, under the conditions similar to those of the preliminary experiment.

3.2.3 Subjects

The participants of this experiment were 7 male and 13 female subjects with corrected eyesight of 0.8 or higher. Of the total of 20, the number of subjects in their 20's, 30's, 40's and 50's were 4, 6, 6 and 4, respectively.

3.2.4 Procedure

First, interviews were conducted without showing photos to the subjects and environment-related elements were sorted using the repertory grid method. Based on the keywords then obtained, photos to be used for the experiment were prepared. After that, an eye-mark recorder experiment was conducted using the prepared photos. Visual targets, gaze frequency, gaze duration and other data were recorded.

3.3 Experiment results

The physiological data were extracted, such as position, number and duration of gazes from the experiments of 20 subjects.

Table 1. Measurement data graph of subject M

category	angle Y [deg]	angle X [deg]	pupil route X [dot]	pupil route Y [dot]	transport speed [deg/sec]	gaze time [msec]	movement [Y/N]
X	1.23	-0.53	60	54	0	0	N
X	1.26	-0.5	60	54	1.06	33.3	N
X	1.26	-0.49	60	54	0.35	66.6	N
X	1.32	-0.44	61	55	2.34	99.9	N
X	0.49	-1.3	61	59	35.95	0	N
X	-0.35	-2.15	61	59	35.95	0	N
X	-3.04	-4.29	63	59	103.18	0	N
X	-4.84	-5.52	63	59	65.05	0	N
X	-6.63	-6.74	63	59	65.05	0	N
X	-6.63	-6.71	63	59	0.77	33.3	N
X	-6.65	-6.76	64	60	1.6	66.6	N
X	-6.66	-6.81	64	60	1.6	99.9	N
X	-6.66	-6.82	63	59	0.25	133.2	N
X	-6.64	-6.78	63	59	1.33	166.5	N

Table 2. The gaze proportion of the each group's environmental facts

environment factor	gaze proportion(%)					mean	median	std error
	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5			
buildings	58.7	51.3	79.2	47.3	7.6	48.8	51.3	26.1
green tracts	25.3	0.0	0.0	40.2	69.4	27.0	25.3	29.3
sky	16.0	23.3	7.2	2.6	16.2	13.0	16.0	8.2
lighting	0.0	25.4	0.0	0.0	0.0	5.1	0.0	11.4
human	0.0	0.0	7.1	9.9	3.5	4.1	3.5	4.4
automobiles	0.0	0.0	6.6	0.0	3.3	2.0	0.0	3.0

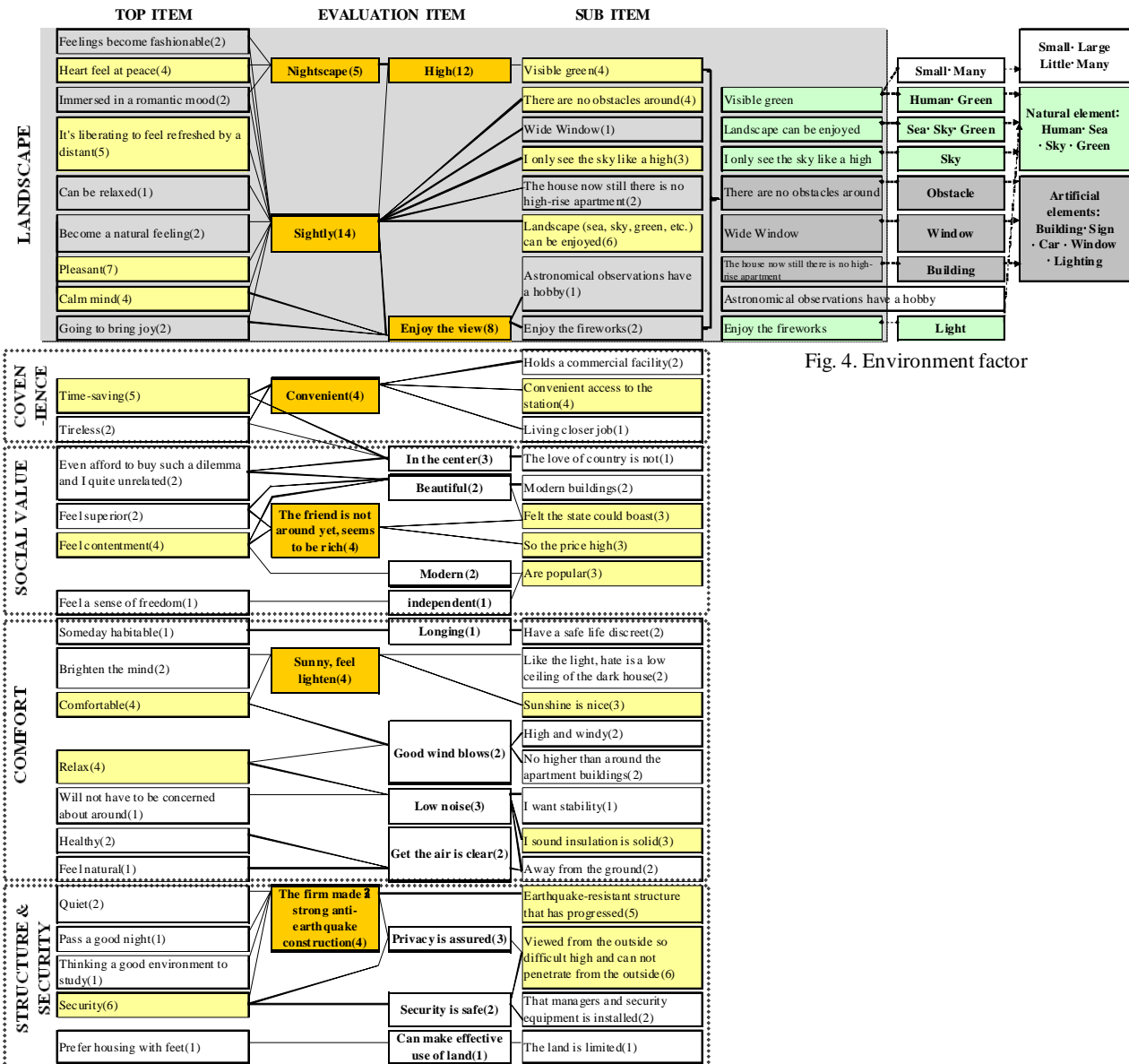


Fig. 4. Environment factor

Fig. 3. General network chart

GROUP 1 _ buildings, the sky and green tracts of land



GROUP 2 _ buildings, the sky and lighting



GROUP 3 _ buildings, the sky, human beings and automobiles



GROUP 4 _ buildings, the sky, human beings and green tracts of land



GROUP 5 _ buildings, the sky, human beings, green tracts of land and automobiles



Fig. 5. Experiment materials

The result of experiments are analyzed by two kinds of viewpoint like the aspect of special qualities of staring gazes on subjects' environmental facts and specialties of each group of facts and we could analysis the facts like:

1) buildings, the sky and green tracts of land

It effects to the degree of attention that change of location and numbers of buildings. Also, green tracts that are surrounded by group of buildings that take up large ranges do not get much attention relatively. It is observed that specialties like noticeable buildings and greens that located at a long distance are noticed.

2) buildings, the sky and lighting

Subjects are pay attention to places that emit light and lighting of famous facilities. Signboards and lighting fixtures of famous facilities are unremovable facts of night views.

3) buildings, the sky, human beings and automobiles

The result of specialties of staring gazes differs from the way to look the facts. In case of low-storied buildings, the level of visions is turned to somewhat upper direction. When we add human beings and automobiles to this background of low-storied buildings, view from upper places are turned to automo-

biles than human and view from same levels are turned to human than automobiles.

4) buildings, the sky, human beings and green tracts of land

When we add some new facts, we can watch the changes of attention immediately. Like this case, subjects pay attention to greens than human when they look lower places from upper place and when their levels of eye are the same, human affects to the degree of attention than greens. From these results, we can observe differences of the degree of attention which arises from the heights and ways to watch the views.

5) buildings, the sky, human beings, green tracts of land and automobiles

According to the kinds of facts are increased, the scope of staring gazes are getting wider but concentration is lowered and the degree of stimuli on subjects are changed by compounding environmental facts. When buildings are surrounded by greens, subjects pay attention to greens and turned their eyes to the direction of buildings. Also, in case of human beings and automobiles, the latter affects more than the former. Thus, when we add some new facts to backgrounds, we can observe the changes of staring gazes case by case.

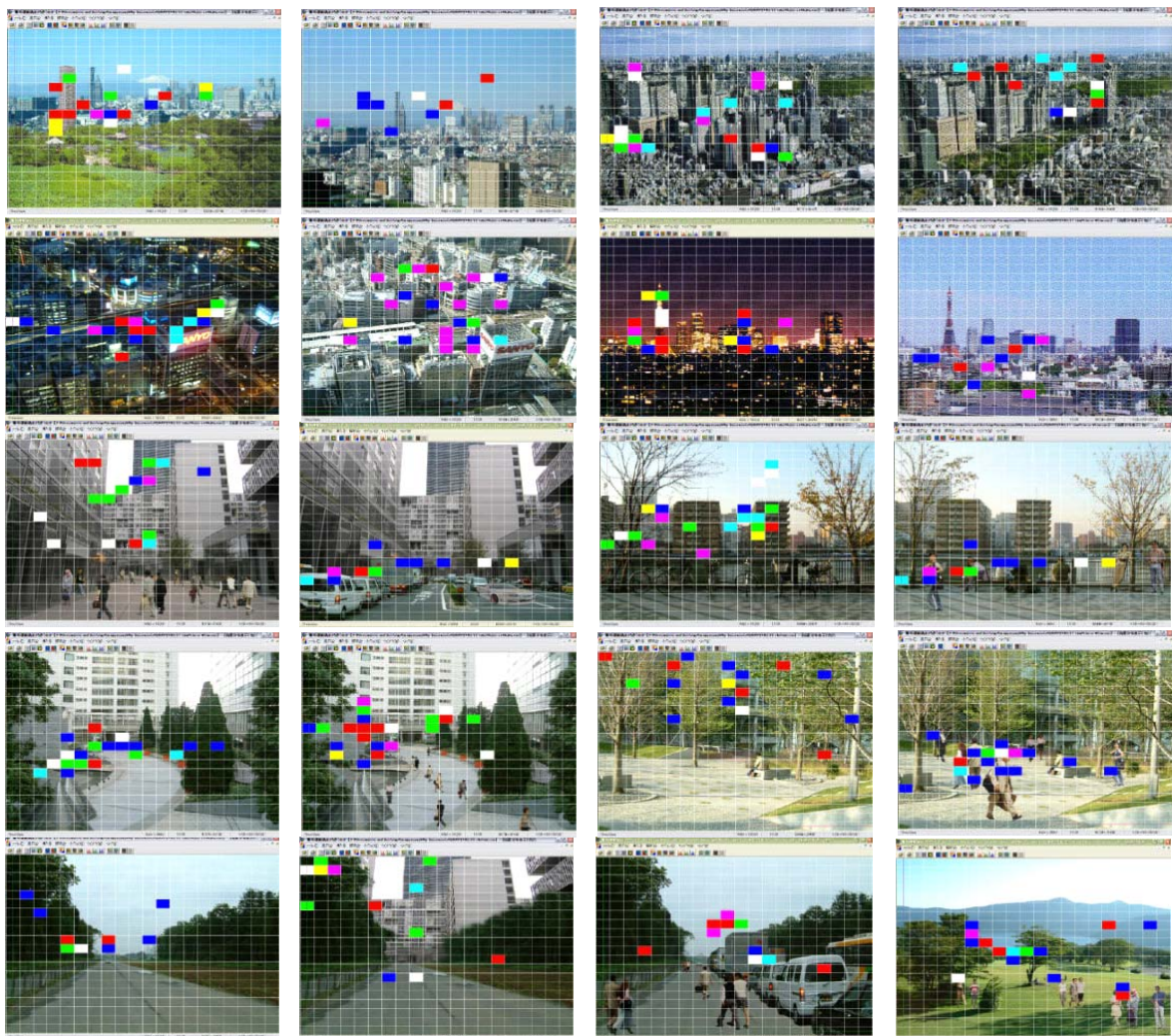


Fig. 6. Gaze characteristics ; position diagrams of subject M

For example, First, the subjects with M gaze characteristics looked up slightly when they viewed a building from a lower level (Fig. 6). Concerning the views of the accompanying car and person, it was found that the subjects focused more on the car than on the person when looking from a higher level and the other way round when looking from the same level. Other characteristics included the influence of the changes in the positions and number of buildings on the subjects' levels of attention and greater attention paid to distinctive buildings and greenery in the distance when the line of vision was higher and longer.

It was also found that lighting was an essential element of landscape because the subjects paid greater attention to signs glowing at night than to signs in the daytime, as well as to the lighting of famous facilities.

Gaze characteristics differed depending on the direction of the height of elements. While the range of gaze extended with an increase in types of elements, the subjects' ability to concentrate lowered, indicating that the degree of stimulation to the subjects varied by combinations of environmental elements.

In the case of a building surrounded by greenery, the subjects' lines of vision were concentrated on the building although they paid attention to the greenery.

In the case of a person and a car, the influence of the car was greater. Changes in attention caused by the addition of new elements this varied by scene.

Since the influence of greenery on the degree of attention was greater than that of a person when looking down on the scene and it was the other way round when looking from the same level, it was also found that the degree of attention to the person and greenery would vary depending on how a new element was viewed.

4. CONCLUSION

As a result of testing methods for evaluating environmental design elements from the viewpoint of sensibility ergonomics, it was found that the combination of an interview by the repertory grid method and an experiment using an eye-mark recorder was an effective evaluation method from the viewpoint of sensibility ergonomics.

It is considered to be needed the study of the necessity of evaluation by intuitive judgments of human and the study of the experiment conditions for such evaluation.

Evaluation items, such as convenience, social value, comfort, structure and security, obtained from the interviews by the repertory grid method must also be examined physiologically through the sorting of environmental elements. More specific studies based on the comparison of different items will be necessary. The eye-mark recorder experiment was chosen as a physiological examination method in this paper because one of the evaluation items, landscape, had visual characteristics.

In future physiological examinations of diverse evaluation items, however, it will be necessary to introduce examination methods suited to the characteristics of respective items.

Studies of effective evaluation methods for such environmental design elements are thought to contribute to environmental design planning in the future.

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