INTERNATIONAL CONFERENCE ON HUMAN-ENVIRONMENT SYSTEM (TOKYO 1991)

001A SPECIAL LECTURE

FOR HEALTHFUL AND COMFORTABLE HUMAN ENVIRONMENTS

Shigeru GOTOH
Department of Architecture and Building Sciences, Yokohama National University, Yokohama, Japan

1. INTRODUCTION

Today, most of us are living in a situation where artificial and natural environment are co-existing. As our activities are varied from our private life at home to working life, community life and commuting, the time spent under such artificial environments as houses, offices, commercial establishments and transportation systems is increasing. The average time spent by a married male in these closed spaces is said to be over 21 hours a day [1]. Consequently, the influences of these indoor environments (including vehicles) are concerned and have a great meaning, it is strongly hoped that these environmental spaces should be made for us to lead a healthy and comfortable life and an efficient work.

2. COMFORTABLE INDOOR ENVIRONMENT

Though the definition of comfort is not clear, it can be defined as the satisfactory state of factors which determine the environment. To put it more concretely, the factors which are related to the indoor environment can be as follows: thermal and air environment, sound environment, light environment, and others. Each environmental factor includes temperature, humidity, air current and surrounding wall temperature as the thermal factor, indoor air quality, out-coming noise, indoor noise, noise from air conditioner, room acoustic effect, as light environment, lighting environment for making things easily seen, window view, eyes for relaxing, coloring and indoor space atmosphere as sight environment. Other environmental factors include layout of furnitures and office automation equipments, various facilities environment and sanitary environment, for example usability of those equipments and facilities, and its image as a whole. Then when conditions of these factors and elements meet the satisfactory state of mind to the environment, it can be said that it is comfortable.

As comfort is recognized as the matter of mind and greatly appeals to the sensitivity, elements which are concerned with five senses have more direct influences, that is to say, those elements are for sight environment, sound environment, smell, and for thermal sense and vibration sense as skin sense corresponding to the sense of touch. However, in the part of indoor air quality, there are some kinds of substances harmful to our health and cause functional disorder without recognizing so the environment should be "comfortable as well as healthful". Like a sentence from the Constitution of the WHO "Health is a state of complete physical, mental, and social well-being and not only merely the absence of disease or infirmity", the concept of health has changed, in the process of social modernization, from mere physical concept to both mental and physical one and further to the life concept. At home, local community, or working places, a better quality and rich life is required to be realized. This is today's concept of health and this leads to the comfort life.

But in today's world, new difficulties and obstacles are always occurring as society and technology change, so the people have to fight against new factors which threaten our health. Ideal health is there but out of reach [2].

There is another concept of comfort. That is as expressed by the words "pleasant" or "refreshing", the feeling of comfort has a more positive meaning. This is shown by the case that just like receiving a little stimulus, one feels more comfort, in other words, when one is under a little hot or cold stress and then receives an adverse stimulus (by air current or radiation), he feels more lively refreshing. Or it can be the feeling that occurs in the process of transition from the state of stress to its release.

As stated above, it can be said that comfort has negative and positive meanings.

3. COMFORT UNDER THERMAL ENVIRONMENT

Thermal environment includes the intense cold or heat. People live in such environment and control their body temperature. An excess heat or cold brings discomfort. Then thermal environment permits, if the state of mind does not feel thermally hot or cold and can express satisfaction, to say thermally comfortable [3]. This is almost the same as the thermally neutral state. That is, generally, it is difficult to show the satisfaction or it is uncomfortable most of the time since it is a little too hot or cold, and even in the air conditioned room, we can not find many cases that over half of the occupants are satisfied. Thus if a person does not feel uncomfortable and almost satisfied, then it may be said it is thermally comfortable.

In the process that an excess heat or cold is removed, one may feel comfortably cool or warm. Also by constant wind or radiation heat (sunlight etc.), one may feel comfortable or refreshing. Such transitional or dynamic conditions are worth pursuing in terms of comfort, and many researches have been done. Yet, any established theory seems not have been made.

Thus in this paper, the subject as the thermal comfort can be in a thermally neutral state or the least physiologically burdened state at the body heat balance, that is, a small metabolic vascular control area. Laboratory experiments show that well [4], and the 2 node models by Gagge and others [5), 6), 7)] show this characteristic well so that it seems to be convenient to use ET*, especially SET* which can express the value in one form, to search the thermally comfort conditions. Then SET*'s comfort area stated in ASHRAE St. 55 ~ 74 & 81 was examined to see whether it is proper in general or not [8].

Expressing ASHRAE St. 55 ~ 74 & 81's comfort area by new SET* [7] will be 22.0 ~ 25.4°C, and our result of examination experiment is close to this, so in principle, 22.0 ~ 26.0 can be the comfort area by new SET*. However, since SET* is expressed by the random combination of temperature, humidity, air current, and radiation as the factors of environmental side, it is natural to set the limit to each factor to be the comfort condition. That is, ① limit for humidity (upper and lower limit) ② limit for air current speed ③ maximum difference of air temperature and mean radiant temperature, need to be concerned.

4. THE NEED FOR THE HYGIENE OF RESIDENTIAL ENVIRONMENT

Being residential environment, which takes the most part of human life, safe, healthy, and efficiency are important factors in determining the nation's happiness and success of the civilized nation, to guarantee this to the working people our nation prescribes this in article 25 of the Constitution and admits people to have the right to claim this.

However, in our country residence is generally thought to be a part of the consuming life, and sometimes feudalistic view that house is no more than a shelter for rain or dew and asking for more is luxurious still remains. Post-war housing policy which encourages people to own houses also shows a part of that view. Residence is not a mere consuming thing, but the most important place of reproduction to heal today's tiredness and make tomorrow's better life and work possible. It is the base of sound life, therefore to keep the house healthy is not luxurious, but can be a kind of human right.

To secure a healthy residence, we cannot ignore the sanitation of village or city as a crowd of residences, namely public sanitation as well as that of individual residence. That is, individual residential sanitation plan has to be combined with community sanitation plan or village sanitation plan in order to secure a healthy residence. In the case that various conditions of healthy residence stated above are satisfied, it is clear that it has enough effect on individual person's sanitation from environmental physiology and hygiene's point of view. That is, physiological influence under bad environment is proved by environmental physiology and a healthy residence aims to avoid such bad influence. Though its effect is proved, it has to be noted in general, sanitation effect of facilities takes a long span to appear and the damage in the bad case appears after its long time of accumulation. Today major injuries and diseases such as cancer, arteriosclerosis, diabetes and accidents have to be considered as a form of expression to which various factors included in life environment and life

behavior are concerned for a long time. Where the preventive measures against the modern diseases are concerned, securing a good quality of life environment or residential environment over a long period of time is needed to slow carcinogenesis or aging changes from environmental control's point of view. In the process of social modernization, the concept of health has changed from physical concept to both physical and mental concepts and further to life concept [9]. Therefore, a healthy residence has to satisfy not only physiological/sanitational factors, but also living and mental requirements.

There is a problem of "over population" which has been paid attention since a long time ago from residential sanitation view point. Especially, bedroom population density has shown the relation to disease infection and infant death rate, and as an up-to-date problem, population density in dwelling (relation between a house and the size of family) is still notable. The relation between housing expenditure and nutrition, and living collapse by loan torture are also notable as social problems.

Among housing problems, there is a deteriorated house problem. This is the problem which is related to the basement class of capitalistic economy structure. When the house is built in the capitalistic profit-oriented structure, the quality of low-rent house which is required by people of such class is forced to be extremely bad to make profit. In the case of general house building, the principle of capitalism, to aim at maximum profit by minimum capital, cannot be broken. Consequently, the quality gradually becomes coarse, and its scale also becomes extremely small and what is called mini-development by escaping from development permission becomes rampant. Furthermore, searching for the least expensive land, it has become to build houses on the inconvenient and bad environmental places. Its extreme case is what is called "slum", and it caused social panic with problems such as insanitary, anti-social characteristic and infectious diseases in the 19th century. Due to such a situation, the British Public Health Law (1848) and Housing Law (1851) were established, while in our nation, such extreme phenomenon has not noticeably appeared, and the situation has compromisingly proceeded until now. In a sense, it can be said that the total society is a kind of slummed city residence.

In this way, when the house becomes an object of profit, quality decline is inevitable, while in the case that economical change makes people's living hard, even if healthy houses are waitable, people will require the low-rent coarse houses anyhow. This is the terrible conflict of the capitalistic economy which has proved in the past and present big city's housing problems. Therefore, strong housing policies have to be taken into the nation's administration, and the conflict will not solve until capitalism is partly modified. In promoting it, we have to consider the residential sanitation matters in order to secure the quality of residence as follows [10]:

1) Securance of agreement of the scale of house and family make-up
2) Securance of minimum standard of residential facilities
3) Securance of environmental minimum standard of the community
4) Securance of the rationality in residential area arrangement in city planning
5) Rationalization of the house maintenance

The above are the factors to secure a good living condition, and for such condition, standards have to be set on the scale of the house, lot, structure, facilities and outdoor environment. Then, it is necessary to inspect, guide and aid so that every house can clear these standards. Required measures for that can be basic legislation and establishment of relative laws. From sanitation administration's point of view, it is also essential to establish the organization which can do the inspection, guide, and aid on residential environment and to train and educate the workers required. Furthermore, adjustment and cooperation with relative administration is essential.

5. BASIC CONDITIONS OF HEALTHFUL HOUSING

When we consider the "healthy residential conditions", we believe it is right to base on the following six principles of healthful housing [10), 11)].

1) Prevention of accidents and disasters
2) Satisfaction of physiological requirements
3) Satisfaction of living requirements
4) Prevention of disease and infection

5) Satisfaction of housing economy
6) Mental and sensitive satisfaction

To secure these conditions in individual residence and in the crowd of residences is the aim of the hygiene of housing as public health. The following is the outline of the six principles.

(1) Prevention of accidents and disasters

Natural disasters occur very frequently in the land of Japan, especially the damage by earthquake, storm, or concentrated heavy rain is very severe. Disaster prevention and safety measures are essential against flood damage and land slide caused by housing site development ignoring these natural conditions. There are man-made disasters such as fire, accidents disasters by the defective facilities and traffic accidents. Especially gas explosion and gas poisoning problems are not solved yet. Increase of accidents such as children's fall, fall to the floor and elevator accidents are future problems with high-rise buildings and aged society. Traffic disasters relate greatly to the relation between the residential area and streets, especially in securing of children's playground.

(2) Satisfaction of physiological requirements

(i) Securance of sunshine
This is a right to secure heat energy as well as other advantages of sunshine such as ultraviolet, and also an environmental indicator.

(ii) Satisfaction of indoor climate conditions
Being related to the energy saving, indoor temperature, humidity and its distribution in winter, and securing of proper body heat loss in summer have to be considered elaborately especially for the weak.

(iii) Maintenance of clean air
Especially in present time, in the relation with adult disease, clean indoor air is inportant. NOx with combustion, smoking pollution and toxic gas from new building materials also have to be considered.

(iv) Maintenance of proper daylighting and lighting
There are such problems as decrease of sky factor by the building site narrowing and inadequate light direction in the chair-using life style.

(v) Maintenance of silense
Adequate measure design against environmental noise and indoor noise, and human relationship with neighbourhood noise problem are also important matters.

(vi) Satisfaction of children's physiological requirements
This has to be considered as the matter of securing playground and athletic field in various living forms.

(3) Satisfaction of living requirements

To put it concretely, it is possible that we carry out our private life, family life and social life smoothly. Adjustment of family make-up and room number, population density in dwelling and bedroom population density are required. That is,

(i) Securance of place where sound marital life can be enriched
(ii) Securance of place where children's sound personality can be formed
(iii) Securance of living room where family communication takes place
(iv) Treatment of the aged generation

The social requirements have relation with appropriate population and sound make-up of social life area.

(4) Prevention of disease and infection

Residential environment often causes the occurrence of diseases and infection. This is not only related with a house, but also closely with the improvement of environmental sanitation facilities in housing site. Major factors are the following.

(i) Safe water supply and prevention of its pollution
(ii) Securance of safe drainage facilities
(iii) Safe and sanitary toilet facilities
(iv) Safety of cooking and bathroom facilities
(v) Prevention of overpopulation and over bedroom population
(vi) Prevention of mouse and sanitary insect pest
(vii) Cleaning and waste disposal problems

Standards for these factors should be considered.

(5) Satisfaction of life economy (housing expenditure problem)

Life expenditure includes the necessary expenses in life such as food expense, housing expense, lighting and heating expense, clothing expense, social expense such as health and sanitation expense, nursing expense, education expense, transportation expense, and culture expense such as social expense and amusement expense. The expenses which relate to the residence are housing expense, heating and lighting expense, part of traffic expense and part of burden expense (tax).

Satisfaction of life economy in terms of residential aspect means that none of the expenses stated above becomes big to no purpose and oppresses the other expenses. Especially, the relation between food and housing expense is very important. Minimum income to obtain sound residential conditions has to be secured, but today's abnormal rise of housing costs causes the lack of balance stated above and makes it difficult to lead a sound life.

(6) Mental and sensitive satisfaction

The increase of high-rise residential buildings and the progress of high density residences have a mental sanitational influence on residential environment. The sense of closed-up with the floor plan made by commercialism and sense of oppression by a housing development which is out of human scale are drawing new problems. The way that the beauty of residential environment as the total crowd as well as the individual should be is now inquired. The demand has proceeded to not giving sensitive stress, but also to producing a imaginary warm environment in people's mind. Amenity is the satisfaction of each factor stated above and in addition to that, to obtain mental satisfaction in the environment in a sense of broad meaning. Harmony with the natural environment including the green and water is also important.

Various evaluating methods and technological Standards and requirements for these above factors are almost completed today. The time seems to have come to promote the measures stated above by improving these methods and standards.

REFERENCES

1) Agency of Economic Planning : The Structure of Living Time, the Ministry of Finance, Bureau of Printing, 1975
2) M. Sato : How to think about Health, Jour. of Architecture and Building Science, Vol.104, No.1283, pp. 30–33, (1989)
3) ASHRAE Handbook 1985 Fandamentals, p. 8.18, 1985
4) Y. Kawashima and S. Gotoh : Characteristics of Temperature Regulation System, Jour. of Heating, Air-Conditioning and Sanitary Engineering, Vol. 53, No.8, pp. 31–38, (1979)
5) A.P. Gagge, J.A.J. Stolwijk, Y. Nishi : An Effective Temperature Scale based on A Simple Model of Human Phisiological Regulatory Response, ASHRAE Transactions Vol.77, Part 1 pp. 247–262, (1971)
6) A.P. Gagge, Y. Nishi, R.G. Nevins : The Role of Clothing in Meeting FEA Energy Conservation Guidelines, ASHRAE Transactions Vol.82, Part 2, pp. 234–247, (1976)
7) A.P. Gagge, A.P. Fobelets, L.G. Berglund : A Standard Predictive Index of Human Response to the Thermal Environment, ASHRAE Transactions Vol.92, Part 2B, pp. 709–731, (1986)

8) J. Saito, H. Ito, K. Fukai, S. Gotoh et al. : A Study on the Corretation between SET* and Thermal Sensation, Part 1–3, Presentations at 1990 SHASE Annual Technical Meeting, pp. 1097–1108, (1990)

9) T. Tanaka : Human Existence and Health, edited by Koizumi and Tanaka "Human and Health", Taishukan, pp. 9–93, 1973

10) A. Satoh : Hygiene of Housing, Sekibundo Press, pp. 10–21, 1957

11) American Public Health Association, Committee on the Hygiene of Housing : Basic Principles of Healthful Housing, 1941