II.4 Consideration on the water environment performance of the architecture

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Abstract

From the research situation of water supply and drainage system and water environment field in recent Japan, this paper showed the approach of the water environment performance in the architecture. Moreover, the issues that should cooperate with other research field were shown.

Water environment steering committee in Architectural Institute of Japan (AIJ) announced "Approach on the formation of the water environment in the building and circumference" in December 2008. In the script, five items on "security of the safety and maintenance of the health", "symbiosis with the nature", "resource conservation and energy conservation", "formation of the society assets", "succession to the future generation" have been advocated. This content is introduced.

Moreover, working group for water environment performance on architecture of AIJ selected eight evaluations of the water related equipments of the housing. These are "safety and sanitary", "functionality", "durability", "maintenance", "environmental loading reduction", "suitability to the architecture", "amenity", "correspondence of elderly persons". The result of trying this evaluation in actual housing is shown.

In addition, the outline is shown on development situation of "The BEST Program" which is the Integrated Energy Simulation Tool for Buildings and MEP Systems. Moreover, the simulation result on energy consumption and water consumption on the rainwater utilization is shown.

Finally, the issues to be tackled by the field of water supply and drainage system and water environment cooperating with other architecture field in future, is shown.

Keywords

Water environment performance; Sanitation; Infrastructure; Hot water supply; Architectural planning.

1. Introduction

Water environment field in the architecture of Japan is handled as one of the building equipment, and the positioning as an environmental engineering is insufficient. The researcher of this field in Japan is very few. In Japan, the field of the building engineering is distinguished from the civil engineering field, and research and education field, which are identical with architecture design and building construction field have been formed. However, the existence in the architecture has not been very much recognized in present state in the water, since the infrastructure of water supply and sewerage exists.

It is not possible to use present building, when supply and drainage of the water are not possible. And, they are necessary as a lifeline of the building. In addition, the water environment problem is a global problem. Quantitatively and qualitatively sufficient water is necessary to safe and sanitation of human and region.

It is a purpose of this paper to recognize the positioning of the water environment in the architecture to other field. Mainly on the architecture including city and earth, the challenge of the research in Japan is outlined on the water environment performance. And, the matter with other field to should be cooperative will be discussed in future.

Still, this paper reconstituted the content lectured in the research council of environmental engineering department at Annual meeting on Architectural Institute of Japan (AIJ) 2008.

2. Activity on water environment steering committee of AIJ

Water environment steering committee in AIJ is active two fields concerning water supply and drainage system and water environment. It is active, while facility and principle and design field cooperate in the wide frame of "water". In fiscal 2009, next five subcommittee and special committee are active including the committee.

1. The formation examination subcommittee of the sound water environment.

Popularization and enlightenment pamphlet for the architect on "Approach on the formation of the water environment in the building and circumference" is being made.

2. The rainwater architecture standardization subcommittee.

The work on the decision of Architectural Institute of Japan Environmental Standard (AIJES) on the rainwater utilization followed for DIN 1989 of Germany has been done. In fiscal 2009, it became a responsible organization of AIJ engineering department design competition "The architecture which enjoys rain and controls water in the city".

3. City and water-familiarization subcommittee.

The research on the action of the human and organism in the waterfront, and the community planning of the citizen subject mainly on the waterfront are carried out.

4. Effective advantage utilization special research committee in the woody biomass resources.

Concerning the maintenance of global environment by the reduction of CO_2, pickup and the effective advantage utilization are examined from the viewpoint of architecture field in respect of the woody biomass.

5. Architecture and urban environment future model special research committee

It is a committee for the purpose of making up environment model of architecture and city by each particular field cooperating. At present, the parameter to be introduced into architecture and urban environment model in the existent city is examined.

Still, in this steering committee, AIJES-W001-2009: "Guideline for architectural planning and waste treatment system which contributes to recycling promotion of non-industrial wastes, operations management of large-scale office and commercial facility and multiple dwelling house" it was published in February, 2009. It is first AIJES as an water environment field.

3. The water environment performance of architecture, city and earth

3.1 The water environment performance in the architecture

1. "Approach on the formation of the water environment in the building and circumference"

In "Approach on the formation of the water environment in the building and circumference" announced in December, 2008, the five matters of "security of the safety and maintenance of the health", "symbiosis with the nature", "resource conservation and energy conservation", "formation of the society assets", "succession to the future generation" has been raised as the matter in which all the humans who participate in the architecture should try (**Table-1**).

Table-1 Contents of "Approach on the formation of the water environment in the building and circumference" [1)]

1. Security of the safety and maintenance of the health
Supply of the safe water
Construction of the equipment which does not put the injury out
Security of the water in the emergency
Consideration of the water which is related to the air environment
2. Symbiosis with the nature
Advantage utilization of water resources in the region
Consideration in the storm drainage
Consideration for the water quality of the drainage
Utilization of the thermal resources of the water
Consideration to the natural ecosystem
3. Resource conservation and energy conservation
Promotion of the water saving
Promotion of the effective utilization of the water
Consideration to the energy conservation in the equipment
Introduction of the optimum system with small load to the environment
Promotion of reuse and recycling of the equipment
4. Formation of the society assets
Life-lengthen of the equipment
Systematic maintenance
Maintenance and creation of the landscape
5. Ssuccession to the future generation
Promotion of community planning and education which recognize the importance of the water
Improvement of information for inheriting technology and culture
Support and cooperation of the security of water and the improvement on the sanitation

2. Environment performance of the kitchen and sanitary space

In the Working group for water environment performance on architecture, which was active over fiscal 2001-2004, kitchen and sanitary space in which the improvement needs in the housing was high were noticed, and the method for comprehensibly

displaying these kitchen and sanitary space and performance of plumbing system was examined.

In this WG, eight evaluations of "safety and sanitary", "functionality", "durability", "maintenance", "environmental loading reduction", "suitability to the architecture", "amenity", "correspondence of elderly persons" were set as environment performance of kitchen and sanitary space.

It was tried that it established evaluation point of the 5 stages on multiple evaluation items involved for these and displays the water environment performance as a space according to the radar chart (**Figure-1**).

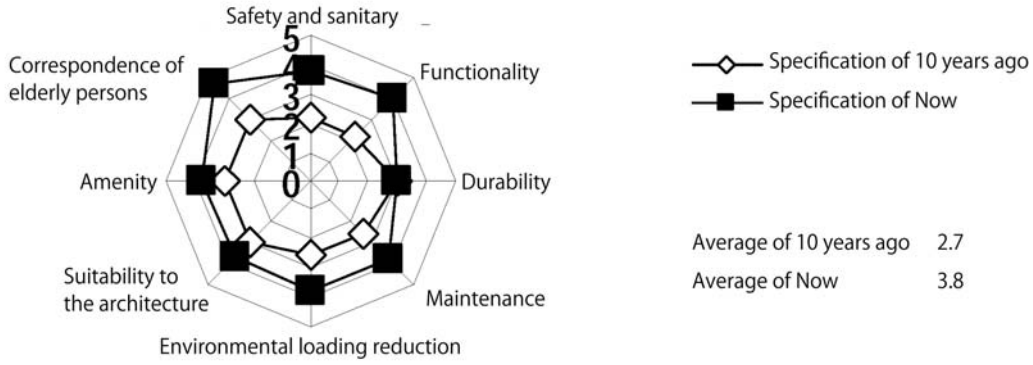

Figure-1 Radar chart of water environment performance in the kitchen [2)]

3.2 Water environment performance to be examined, while the architecture considers urban and global environment.

1. The evaluation on rainwater utilization and wastewater reuse and these runoff controls.

Rainwater utilization and wastewater reuse have been examined until now from the viewpoint of quantity example for effective utilization of water resources, reduction of tap water and the water quality.

At present, in "The BEST Program" which is the Integrated Energy Simulation Tool for Buildings and MEP Systems (the following BEST) promoted by Institute of Building Environment and Energy Conservation (IBEC), it can be calculated the energy consumption on rainwater utilization and wastewater reuse with air conditioning equipment and electric equipment (**Figure-2**).

The energy consumption increases on rainwater utilization and wastewater reuse, since energy consumption for double piping and water purification increases, when it is observed in the building of the simple substance. However, it is connected for the reduction in the energy consumption concerning water supply in the city scale. And, the countermeasure to city flood alleviation for the local heavy rain is also important environment performance required for the architecture. It is necessary to appropriately evaluate effect of decreasing of the load for the city infrastructure.

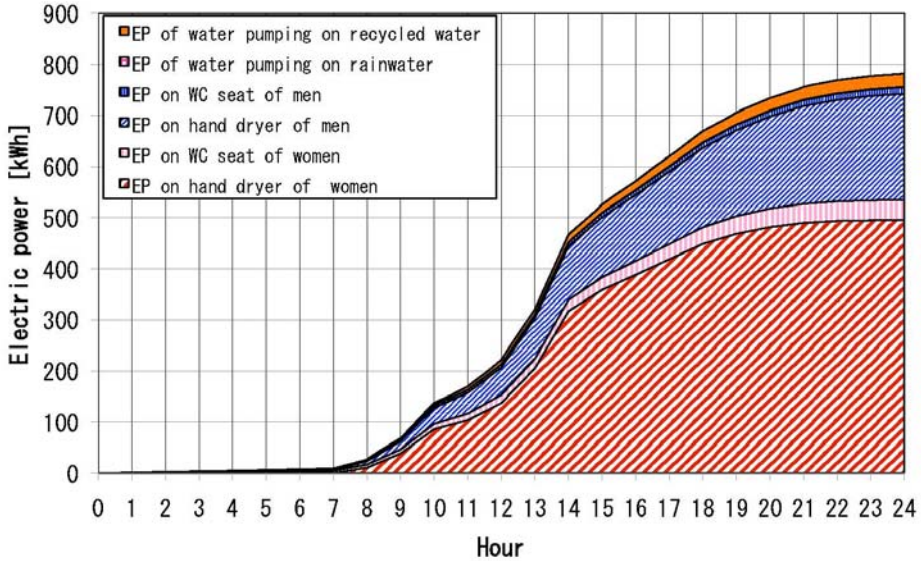

Figure-2 Total energy of rainwater utilization in the apartment house [3)]

2. The evaluation in the water usage of the architecture from the viewpoint of the virtual water

The water supply use in Japan decreases by popularization of the water conservation type equipment, etc. In the other, the use of the bottles water increases. And the proportion of the virtual water (the water which the foreign country with the import of cereal and meat consumes) increases.

From this fact, it is necessary to evaluate water usage in the human and architecture in addition to the water conservation in the plumbing system from the viewpoint of these. This fact is important in order to catch the appropriate water supply load in the building.

3. The problem of the water environment in global environmental problem.

As a global environmental problem, there are 1. Global warming (rise in the sea water temperature), 2. acid rain, 3. Marine pollution, 4. Shortages in the fresh water resources, etc. as a problem of water itself. And, there are 1. Diminishing tropical forests, 2.

Environmental pollution of developing country, 3. Desertification, 4. Decreases in the biodiversity, etc. as relating problem.

The water circles sky, surface and underground in three forms of gas, liquid and solid. By architecture and infrastructure, which the human produced, the new water cycle system has been constructed.

All architecture activity with estate development such as consumption of the energy by the use of fossil fuel and wood use are related on the global environmental problem on hydrologic cycle.

All architecture activity with estate development such as consumption of the energy by the use of fossil fuel and wood use are related on the global environmental problem on water cycle. It is necessary to catch the water problem as not only therefore water environment field but also problem of the whole architecture.

4. The problem, which should wrestle by cooperating with other field

1. Grasp of various water usages in the architecture and the effect

In the architecture, the water is large used for the cooling of the air-conditioning system.

And the role of the water which is related to air conditioning and heat of the architecture and city of humidifying, water sprinkling and fog cooling system, etc. increases.

In until now water environment field, investigation and prediction of the water consumption on the application, which the human actively uses, are made to be the research object. In the future, it is necessary to grasp various water consumption included except for these application. And, it is necessary to synthetically clarify effect on water cycle, water quality and energy consumption of the building.

2. The optimization of hot water supply heat source and the effective utilization of hot water supply waste heat

In the home of Japan, the proportion of CO_2 discharge that the hot water supply occupies is 13.8% [4]. Reduction of the hot water use and improvement in the energy efficiency are effective for the reduction of the CO_2 discharge.

There are the case in which it is handled in the water environment field and case in which it is handled in thermal environment and building equipment field on the hot water supply. However, load pattern that the human actively uses is important for the hot water supply. It is possible that this point utilizes the storage of the research in the water environment field.

Utilization of thermal energy got in cogeneration and solar heat panels, etc. and waste heat management of hot water supply, which becomes an unused heat must be examined, while it will cooperate with other field in future too.

3. The architectural planning of the kitchen and sanitary space

To decide the arrangement in the building is the kitchen and sanitary space especially drainage and vent system. Therefore, the relation with the architectural planning field is very big.

The examination is required on the water usage in the building on the design of facility and space from the psychological and physiological side, because it occurs by the active and human activity many.

Then, it seems to be the necessity that the research is tackled by the expansion of research object of the psychophysiology field in the water environment field by the field of the mutuality cooperating.

The water usage in the building produces many by the human action. Therefore, the examination from the psychological side is important for the design of facility and space.

It is necessary that the field of the mutuality cooperatively tackle the research by the expansion of research object of the psychophysiology field in the aqueous environment field.

5. The problem of water environment field concerning other field

In the future, next 3 points are raised within the problem in which the water environment field in water environment steering committee or relating institute should wrestle as a result of relating to other field.

1. The examination concerning the water environment on the problem on the security of the sanitary environment of the building

For example, it is related to the problem of air quality (generation of Legionnaire's disease) and thermal environment (cooling effect) in the environment where the water becomes a condition of the aerosol. In the future, the necessity of academically determining the standard on application and water quality of the rainwater utilization, which is suitable for it, has been indicated.

In addition to this, the following must be examined concerning air environment and thermal environment: Available application, effects and risk, etc.

2. Reduction of the energy consumption in the plumbing system and examination from the wide and long-range view

The part as above-mentioned way and contact between other building equipment and city facility is abounding for the examination on the energy saving.

In the future, the linkage system between air conditioning equipment and electricity equipment in the BEST must be made to be the thing of which in addition, the accuracy is high. And, evaluating scale is also expanded in the city infrastructure, and by having long-range view by the LCA, evaluating things, etc. must examine ideal way of water environment system in the low carbon society.

3. How rainwater utilization and improvement of the water-familiarization space are concerned in the relaxation of thermal environment of city (heat island) or building, and examination on the appropriate form

By cooperating the role which water such as water surface, water sprinkling, wall cooling which are effective in the heat island relaxation fulfils with fields such as urban environment and city facility, it must be pursued.

6. Conclusions

The science field is segmented, and building and system as a whole city become difficult to be seen. In the meantime, it is important to grasp the whole system, because the water circulates in respect of the earth. Therefore, the activity in which many fields had the aqueous environment in mind is important. It is important to send information in the form in which each fields are comprehensible in other field. The proclamation of "Approach on the formation of the water environment in the building and circumference" by water environment steering committee is the concrete activity, which had this fact in mind.

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8. Presentation of Author

Hiroyuki Kose is the Associate Professor at Toyo University, Faculty of Information sciences and arts from 2009. Special fields of study are plumbing engineering, water environment and environment enhancement. At present, I am a leader of water environment steering committee of AIJ (Architectural Institute of Japan).