

Research on Design Renewal of Street Furniture

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Abstract—After entering the 21st century, China has accelerated its urbanization as quickly as possible, and a great number of new buildings have risen up one after another in cities, the street furniture that has been built in earlier years has a risk of disappearance, and the facilities are little used and in lack of functions. In this paper, the author makes a systematic arrangement of the problems related to the design renewal of street furniture and conducts an analysis of contradiction, resource and function on the needs, environment and object of the street furniture to be regenerated and renewed, and finally creates a street furniture renewal pattern on the basis of systematic innovation, that is to analyze the contradiction between needs, object and environment, make a solution for it, and full use of resources and achieving the renewal of street furniture function. The renewal is reflected in the innovation of environmental features, of street furniture function and of scenario experience in use.

Keywords—street furniture; systemic arrangement; solution of contradiction; function innovation; renewal

I. INTRODUCTION

Public environmental facilities are an important part of the urban environment and a carrier to upgrade the quality of a city, facilitate the public life and beautify the environment in it. Accompanying with the rapid development of society and the continuous improvement of the people's living standards, the requirements of the people on public environmental facilities design in cities have been also enhanced, relying on the innovation, the public environmental facilities design is improved to meet the needs of the people in living, work and leisure and the thirst for spiritual world and culture [1], achieving the harmonious integration of facilities, environment, ecology, culture and technology.

II. CONCEPT AND CLASSIFICATION OF STREET FURNITURE

Urban environmental facilities are a collective term of public facilities installed in a space out of urban buildings, providing the public with leisure, safety, health, convenience for work and living and beautification, it is also called street furniture. According to the function, the street furniture consists of leisure facilities, recreational facilities, traffic facilities, art facilities, lighting facilities, health facilities, special facilities for the disabled and so on. The concept and classification of urban environmental facilities show that the street furniture is systematic and complex.

III. DESIGN ARRANGEMENT OF STREET FURNITURE

The systematic complexity of street furniture determines the complexity for its renewal, and in order to find a solution for the complexity, we must make research on a systemic arrangement. According to factors, structure, function, environment and so on, the renewal of the system is divided into five layers from simple to complex: ① Renewal of factors and structure remain original functions, yet new problems appear, for instance, change outdoor public chairs from wooden to metal, remaining the original chair function, but the production of metal materials may pollute the environment, the renewal is kept at the lowest level; ② Renewal of factors and structure increase accessory functions, LED belts are installed to the safety rail along the sidewalk, increasing the lighting function. ③ Renewal of factors, structure and function improve main functions, as the renewal of blind sidewalks, sound sensors warning devices can be installed at the areas needing signs as intersection of blind sidewalks, important buildings or bus stops and so on so as to perfect the blind guiding function [2]; ④ Renewal and upgrade of factors, structure, function and technologies promote energy saving and environmental improvement, for instance, British Laurence Kemball-Cook invented special floor tiles, which converted the kinetic energy from footsteps into electricity that could be stored and used for low power consumption lighting at night, currently it has been widely used at lighting courts, squares and the like [3]; ⑤ Factors, structure, function, technologies and innovation lead the concept of application, for instance, charging piles used for electric vehicles in cities may change energy structure for vehicles and lead the concepts of living and consumption of the people. Of the five, layers ① and ② are kept in a low level; layers ③, ④ and ⑤ are in a high level, namely complex for renewal, the renewal will bring problems, through the layered analysis, the problems are made much clear, to which the solution will be much accurate.

IV. DESIGN RENEWAL OF STREET FURNITURE

The design renewal of street furniture is focused on three factors, namely environment, object and needs, the environment refers to the place and city where facilities are installed; the object refers to facilities themselves, the needs refer to the needs of the people, including the needs to functions of facilities and to the quality of the environmental space "Fig 1". Both the environment and objects serve the needs, so to analyze the needs of the people is the base for the

research on facility renewal, According to the A Theory of Human Motivation, written by Abraham H. Maslow, American psychologist, founder of humanistic psychology, human needs were divided into five kinds which were graded from low to high, namely physiological needs, safety needs, love needs, esteem needs, need for self-actualization, as well as other needs as desires to know and to understand and aesthetics. The renewal of street furniture is to solve the conflicts between needs and failure to meet the needs.

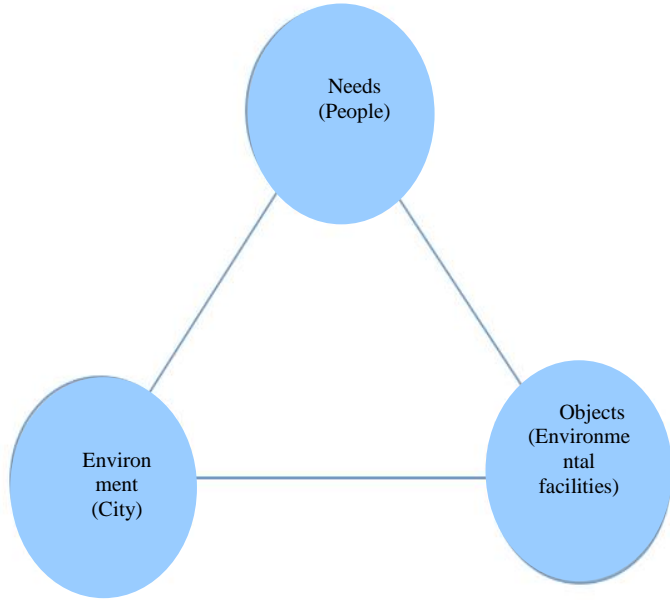


Fig. 1. Relations among needs, environment and objects.

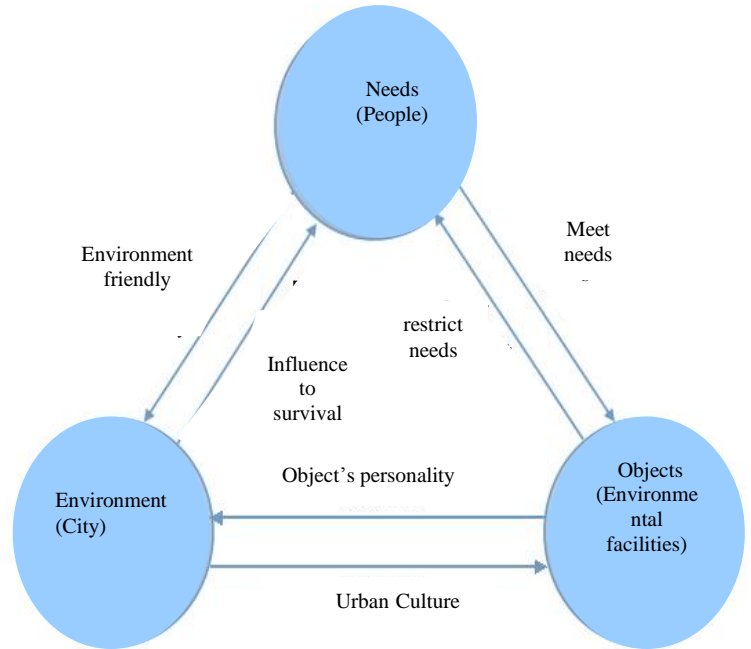


Fig. 2. Analysis of contradiction relations among needs, environment and objects.

A. Solution for Contradictions and Renewal Upgrade

The contradictions of public facilities in cities are diverse, but the type of the contradictions is relatively limited, according to the three factors for street furniture design mentioned above namely environment, object and need, the analysis on relations between the three factors may show the contradictions generated by the design renewal “Fig. 2”, from the figure, it can be seen that the contradiction between need and object is a contradiction between need and restricted need; the contradiction between object and environment is a contradiction between object’s personality and urban culture; the contradiction between environment and need is a contradiction between need of favorable environment and deteriorative environment for survival. All of these contradictions can be summarized as social contradiction, engineering contradiction, contradiction between society and engineering. The design renewal process of street furniture is a systematic process where it needs to analyze social contradiction, clarify social needs, analyze engineering contradiction, innovate facility functions, analyze the contradiction between society and engineering to further improve the facility design. The social contradiction is divided into contradiction of social administration, economic contradiction, cultural contradiction, natural and environmental contradiction, personal aesthetic contradiction and so on. Build a social contradiction-related matrix for public facilities (refer

TABLE I. CORRELATION MATRIX OF SOCIAL CONTRADICTION.

Improved social contradiction		Social Administration	Economy	Culture	Environment	Personal Aesthetics
		1	2	3	4	5
Deteriorative Social contradiction						
Social Administration	1		1,3,4,5	1,2,5	1,2	1,2,3
Economy	2	2,3,4,5		1,2,5	1,2	1,2,3
Culture	3	2,3,5	1,3,4			1,2
Environment	4	2	1,3,			
Personal Aesthetics	5	3	1,3	1,2		

Seen from the nature of public facilities in cities, it is generally shown as engineering contradiction, which is divided into: physical contradiction and technical contradiction. The physical contradiction refers to a parameter owning two opposite characteristics as hot and cold in temperature, long and short in geometry size, soft and hard in rigidity, etc. Technical contradiction refers to a technical system where when a parameter is improved, the other one will become worse, for example, if the brightness of streetlamps is increased, the energy consumption will increase, and a technical contradiction contains certain physical contradictions. For the public facilities in a complex system, the engineering contradiction can be changed for design renewal, i.e. put forward functions for design renewal, summarize problems to be solved, confirm parameters of technical contradictions, adopt the contradiction parameter matrix, apply the innovation principle concerned to the design, solve the parameters of technical contradiction and achieve the whole renewal led by technical innovation [4].

The engineering innovation not only solves the main engineering contradiction but also solves the social contradiction to some degrees, however, due to the complexity of social contradiction, it may cause new contradictions or sharpen other social contradictions, which is called contradiction between the society and engineering. For instance, the lighting facilities in cities beautify the cities at night yet it may impact the sleeping of residents, or the dazzle light may influence the health and traffic safety, increasing social contradictions. According to the design and planning, solve factors of the contradictions, optimize the design to achieve the innovation results; through the renewal of concept, technique, management and art, solve the contradiction between the society and engineering so as to achieve the street furniture function as well as the coordinated development of environment and culture.

B. Make Full Use of Resources for Renewal and Upgrade

Resource is the collective term of material, energy and information that can be exploited and used by human being, which can be divided into natural resources, time resources, space resources, material resources, energy resources and information resources[5]. Full use of resources is to maximize the use of resources, minimize the resource consumption so as to reduce costs and maximize the value. The resource consumption of environmental facilities consists of internal resources consumption and external resources consumption: the internal resources include intellectual resources, material resources, time resources, space resources and energy resources needed during the design and production of environmental facilities; The external resources include time resources, material resources, space resources, energy resources, information resources needed for the operation of environmental facilities. During the design of environmental facilities, first, confirm its functions, then find the ideal solution and barriers encountered, analyze the reasons and seek countermeasures from resources, the ideal solution for the lowest consumption of internal resources is the integration and innovation of new technologies and new materials such as 3D printing technology. The ideal solution for the lowest

consumption of external resources is the integration and innovation of Internet of things, new materials and new energy such as social affairs management via Internet of things, application of solar energy and the like.

C. Facility Innovation Driven By Functional Innovation

Public facilities in cities are designed to serve the city, serve the people, and realize the function through use. Seen from the demand, the facilities should continuously meet the needs of the people such as work, residence, transportation, recreation, etc., meeting these demands to improve the function innovation of public facilities in cities.

Seen from the function of street furniture, the functions of public facilities in cities consist of internal functions and external functions [6]. The internal function refers to the function of internal environment of the facilities, including main function, basic function, auxiliary function, non-mandatory function, the main function is the purpose of facilities; Basic function is a guarantee for the completion of main function; auxiliary function is a guarantee for completion of basic function; non-essential function is a guarantee for the completion of auxiliary function. External function is a function through public service facilities are reflected in the external environment as natural and ecological environment, places, manifestation of service facilities, management and use. Both internal function and external function are the function of facilities and reflected through use "Fig. 3". The upgrade of function design is a systemic function innovation to make comprehensive analysis on external function structure and internal function of service facilities, which drives the overall update and upgrade of service facilities. First method, build a structural matrix module integrating internal systematic function and external systematic function "Fig. 4", find the correlation between internal and external systems, analyze good and harmful functions within the factors of function-related parts, research the substance-field relation between good and harmful (G-H) functions, guarantee the good function and remove the harmful one for facility renewal or change harmful function to good function for facility innovation, the renewal is achieved via the design of part relations in sub-systems of functional parts, where new parts are inlaid or useless or harmful parts are removed. For instance, "solar energy bus shelter", its main function is for waiting; its basic function is for identification of traffic information, rest, shield, security, reading, news; its auxiliary function is lighting, beautification, solid duration, information query, media; its non-essential function is supply of energy, communication networks, energy-saving and low carbon. Combined with external system functions – ecological environment, performance, place, management, use and so on, and a substance-field (S-F) relation is formed through a matrix, removing harmful functions, and finally building a solar energy bus shelter characterized of convenience, safety, humanization and smartness. Second method, build a structural model relying on factors of the sub-system of internal functional parts of public service facilities, rearrange and regroup the factors and summarize main function, basic function, auxiliary function and non-essential function, combined with external functions to create a new functional

facility finally. For instance, main function of streetlamps is lighting; its basic function is safety, energy saving and reading; its auxiliary function is beautification, duration, supply of energy; its non-essential function is communication and seat. After regroup the sub-system functions, its main function is seat; its basic function is lighting, safety, energy saving, reading; its auxiliary function is beautification, duration and supply of energy; and its non-essential function is communication, thus, it will form a new public service facility - multi-functional outdoor chair.

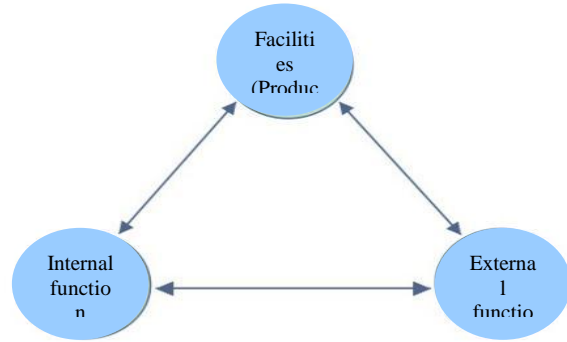


Fig. 3. Analysis on function components of environmental facilities in cities.

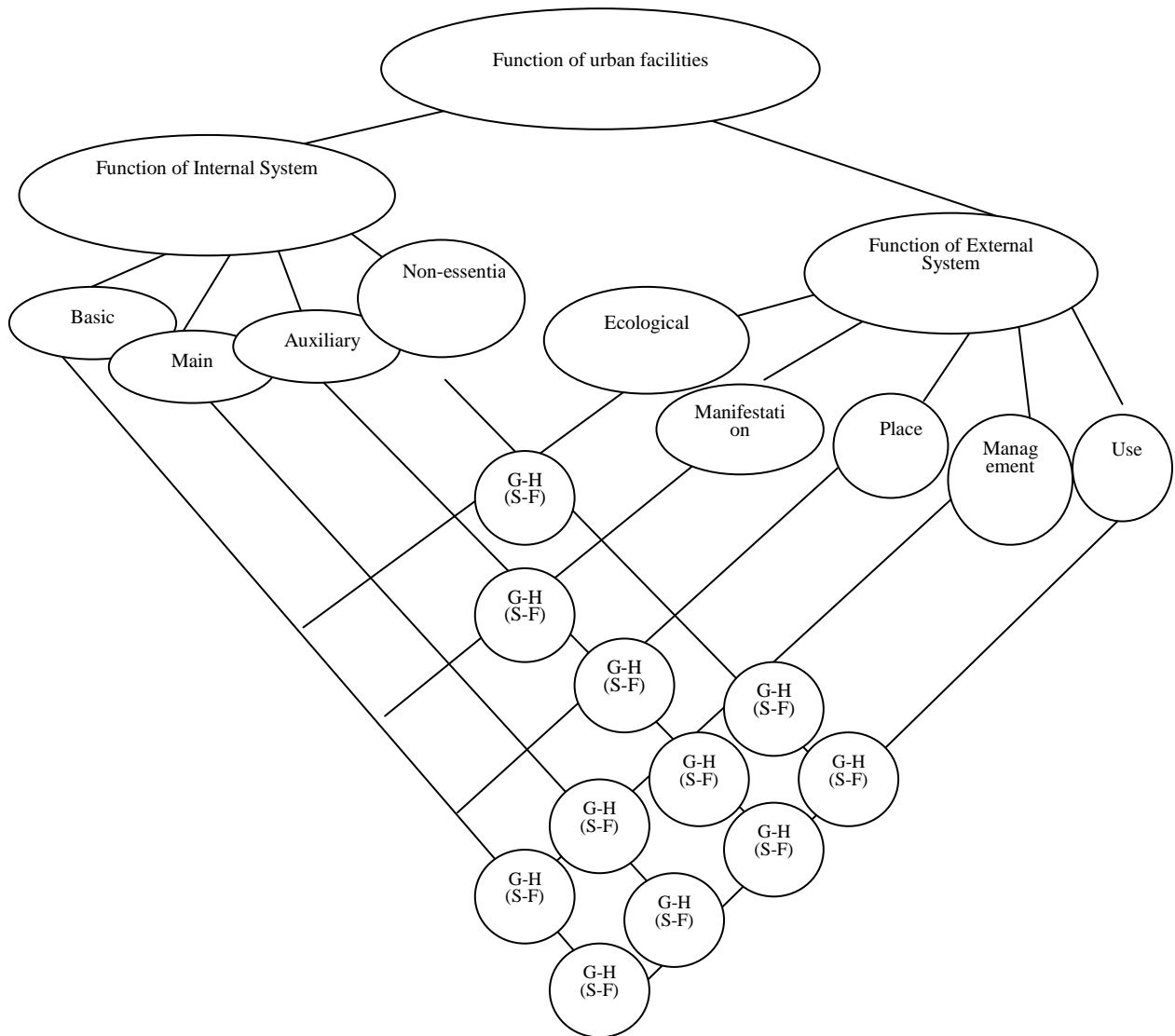


Fig. 4. Structural matrix model of internal and external system functions.

V. REFLECTION OF DESIGN INNOVATION IN PUBLIC FACILITIES IN CITIES

①The innovation of public facilities in cities is reflected in the relation between facilities and environment. Any facility is installed in an environment of a city, different urban environment has different regional culture and natural environment formed by geological climates in a city, areas and places may vary in the same city, so the public facilities in cities should depend on the local culture, natural environment, climate and on the places. The regional culture is gradually formed after a long term deposits of modes of the people in thought and behavior within a certain time and area, including substance, systems and concepts, which are mostly reflected in material culture and immaterial culture [2]. Facility is a sub-system of the environment in a city, a part of cultural substance carrier of the city, and its innovation is surely reflected in the regional culture and other one. The design renewal shall give full consideration to the influences of local seasons and climate changes and its application in different seasons and climates, in the meanwhile, the design renewal shall make it fit the color, mechanism, shape of corresponding places, reflecting the features and significance of the places such as the environmental facilities installed in the Beijing Olympic Village “Fig. 5”. ② Facility renewal is reflected in the facility itself and on the multiple function, integration and complexity. For instance, as shown in “Fig. 6”, it can be used as a seat when it is sit on; it will be a sculpture when it stands alone. The multiple function, integrity and complexity are reflected in its application, environment friendly and beautiful shape, in the materials’ green, low-carbon, natural and engineering applicability as well as the application of new technologies, for instance, OSROM energy-saving bus stop, the light will be off if there is nobody at it, otherwise, it will be on, which is reflected in the appearance arrangement, shape, proportion and sense (as shown in “Fig. 7”). ③The innovation is reflected in the scenario experience of people—product—place, an experience of humanized scene, and the facilities are experienced by the people during the use, and the needs of the people for experience include full function, convenience, safety, fine appearance and conform to human engineering, etc. some facilities need interactive experience, for instance, the urban information enquiry system, its experience is interactive and simple, the information is made clear, easy for operation and interesting.



Fig. 5. The environment facilities of Beijing Olympic village.



Fig. 6. The chair in park. [7]



Fig. 7. French High-Tech Bus Station.

VI. CONCLUSION

The research on the regeneration design of street furniture is a systematic process, aiming to analyze the contradictions between needs, object and environment, relying on the contradiction models, a final solution is found for the contradictions; make full of use resources and achieve the renewal and upgrade of the street furniture function so as to meet the increasing needs of residents for material culture in the country. The design renewal of street furniture is reflected in the upgrade of environmental characteristics in places, in the upgrade of facility functions as well as the upgrade of experience for the people during the use of facilities.

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