Research of Human Culture Design of City Public Environment Facilities Based on Kansei Engineering - with Chengdu as Example

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Abstract: Public environment facility, a branch of cityscape, is the most basic material carrier of city cultural image, which reflects the humanistic care of the city and shows city personality. The paper takes city cultural image positioning in Chengdu as the entry point. The current situation of Chengdu public environment facilities is analyzed, the internal logical relationship between public environment facilities and city cultural image is emphasized, and Kansei engineering research method is applied with Chengdu as an example for discussing and establishing an analysis formative model between Kansei image and design formative element. It is expected to provide references for the design of public environment facility human culture.

1. Introduction
China urbanization process is developing forwards at an unprecedented scale and speed, but some constructions that are eager for quick results and quick profits have brought huge impact on old urban texture, thereby resulting in monotonous landscape environment. Public environment facility, as an important detail of urban environment composition, is a window to show the unique humanistic spirit and creative culture of the city.

2. Characteristics and positioning of city cultural image in Chengdu
Chengdu is a famous historical and cultural city with a 4500-year history of urban civilization and a 3000-year history of urban construction. The climate is pleasant, the product is rich, and it suffers from less famines and wars with inherent reputation of 'heaven mansion '. The infiltration of Bashu culture makes the city form its unique urban character and regional culture. Chengdu has been known as 'ancient-Shu civilization, hometown of pandas', 'city of delicious food and Jinxiu Chengdu' [1] and 'city of Tianfu, city of leisure' [2] since the 1980s and 1990s. 'General Urban Planning of Chengdu (2016-2035)' was issued in 2018, which clearly proposed that Tianfu culture should be developed to shape the characteristic features of Chengdu spirit. Chengdu has a long history, and its cultural resources are rich, colorful and unique [3]. Bashu culture, water culture, The Three Kingdoms culture, poetry culture, panda culture, leisure culture, folk culture, etc. are reflected in various city orientations, but no one can comprehensively and clearly reflect Chengdu characteristics, which even can be mixed with positioning of other cities. Therefore, the cultural image and culture features of Chengdu are generalized and deeply explored. Chengdu culture image can be summarized by using the three keywords of 'Tianfu ', 'ancient Shu ' and 'leisurely ', thereby fully demonstrating its cultural foundation characteristics, diversified characteristics and distinct identification.
3. Status quo of city public environment facilities in Chengdu under the background of urban culture

Chengdu has achieved some results in enhancing city cultural image by utilizing public environment facilities currently. 12 cultural totem light pillars in Tianfu Square are typical representatives. Dark pattern of sun god bird is hidden on the top sphere surface as an important symbol of ancient Shu civilization. Yucong in Jinsha culture and Dingzun base in Sanxingdui culture are regarded as main shaping elements of the main body, and Jinsha eye-shaped texture and Sanxingdui cloud texture are regarded as decoration textures. [4] Trashcans in Jinli, Qintai Road, Wuhou Temple as well as other historical and cultural areas, the decorative pictures, texts and shapes on the surface of electronic display station signs reflect the characteristics of Chengdu Shujin, panda hometown, Jinsha culture, etc. [5] the two characters 'Kuan ' and 'Zhai ' of the signs in Kuanzhai alley street blocks are designed as the effect of roof ridges and beams. and the kiosks imitate the shape of chicken buses, a unique means of transportation in Sichuan. The 'fighting style ' architectural structure of western Sichuan folk houses is adopted at the top of waiting pavilion in Wuhousi Street. These typical and representative cultural symbols can trigger people's cultural association, arouse people's historical memory, and highlight the inherent temperament and spiritual outlook of regional culture. [6] However, city public environment facilities in Chengdu still have the following problems.

(1) Blind introduction and poor landing

Foreign design works are completely copies or imitated blindly sometimes in order to show city internationalization and modernization. It is one-sided understanding on public environment facilities design. People will inevitably lose interest and even get bored over time[7] if the role of public facilities cannot be exerted to the maximum according to national conditions and local conditions.

(2) Too stylized and deficient in regional cultural features and systematicness

Although the unity of the whole must be considered in urban public facilities, it is bound to cause aesthetic dissonance and fatigue regardless of the surrounding landscape environment and cultural environment. It is difficult to find the identification features of each section of Chengdu public facilities, and most areas still adopt the same design.

(3) Lack of humanized design

It is in the survey found that the layout of many facilities is rarely considered from the perspective of 'people ', especially the public facilities such as seats, lighting, guiding system, etc. They do not facilitate citizens mainly but acting as props for the urban environment. Different behaviors and psychological feelings of the elderly, children, youth and the disabled in the outdoor environment are not fully considered in some facilities, and they are lack of detailed care. For example, the design and color of the station sign are single, the identification of information is poor, the interface design and the posting form do not conform to ergonomics, users can not find the facilities or they feel visual fatigue easily.

(4) Lack of attraction and failed to mobilize participation of users

Participatory involvement and its degree depend on whether the user's behavioral needs are met or not and whether the emotional needs caused by cultural connotations are met or not. Most public environment facilities are difficult to generate a sense of affinity due to their lack of beauty and cultural attraction. They are similar to decorations, thereby failing to generate deep memories of urban landscape and city image.

4. Public environment facilities are material carriers to construct city cultural image.

The overall cultural image of a city consists of three aspects: material culture layer, behavioral culture layer and conceptual culture layer. The research mainly focuses on construction of material culture layer, which is presented through material carrier. Material carrier mainly refers to visual identification system, which is reflected in city public facilities, main signs and infrastructure projects. Urban public facilities mainly include bus shelters, seats, garbage cans, street lamps, various business booths, public toilets, public bulletin boards, map guidance boards, city information boards, telephone booths and other fixed facilities facilitating people as an important branch of cityscape. [8] Design concept and
morphological semantics contain the humanistic spirit of a city as a medium of people and environment, which can most directly reflect the cultural quality of a city, and it is an indispensable main element in the composition of urban space. Therefore, how to accurately and systematically reflect the temperament and character of Tianfu Chengdu through the carrier of urban public environment facilities and jointly shape the humanistic space with "urban memory points is a direction worthy of our in-depth discussion from the starting point of respecting history and facing the future under the interaction among people, environment, tradition and modernity.

5. Research of city public environment facilities human culture design method based on Kansei engineering

Public environment facilities design is a highly creative field, and the inheritance of urban culture is mainly reflected in the consistency of design value orientation, formal language, technical logic and other factors. The cultural value orientation of public environment facilities is indisputable for historical inheritance and harmonious development. The symbolization of formal language is the principle of human culture design, and technology is the bridge between cultural value orientation and formal language. Rigorous logical methods can stimulate designers' inspiration and creativity, which can form the technical semantics of public environment facilities design.

5.1 Research contents

Kansei engineering is a theory and method for discussing the relationship between the sensibility of 'human' and the design characteristics of 'object' by means of engineering techniques. It can be used to convert the user's hard-to-quantify perceptual demands and imagery into formative elements of design. [9] Processes and results are presented in a quantitative and qualitative manner by combining human, environmental, cultural, social and other perceptual information and formal language elements in the design of public environment facilities. It mainly includes three aspects:

(1) Image recognition of perceptual cognition; typical public environment facility samples are selected, semantic sets of Kansei images are collected and sorted; a questionnaire is made to express all possible Kansei images by using the set of perceptual lexical pairs. A population-oriented image board is established to analyze the data of the results and obtain the cognitive tendency of users.

(2) Qualitative analysis of design formal language; Environmental facilities with Chengdu cultural characteristics are selected, form analysis method is applied to formulate questionnaire samples about language form. Interviews are conducted with experts and professional designers, and the main elements and type classifications constituting public environment facilities are concluded. Formative element tables are established accordingly.

(3) An analysis formative model between Kansei image and environmental facility formative elements is established for users to further understand the relationship between image semantics and formative elements.

5.2 Establishment of image board and quantitative analysis on feelings

Representative public environment facilities in Chengdu at present are adopted as survey samples, and the questionnaire contents mainly involve modeling, function, volume, location, color, material preference and style. KJ method is applied to classify and screen the semantic meaning of Kansei images. For example, five groups of perceptual words are represented by identification, aesthetics, culture, decoration and environmental harmony in the modeling finally. Then, semantic difference method (SD method) is used for measuring psychological feelings, quantitative data of respondents' feelings are obtained as basic data for subsequent analysis and research [10]. A total of 293 valid questionnaires are collected in the project, 44.9% of the respondents are male, and 55.1% are female. Young adults aged 18-30 are the most accounting for 83.67% of the total population. It is followed by middle aged people aged 31-50 accounting for 11.22%, and the rest accounts for 5.1%. The survey results show that the score of modern simplicity and classical is higher among the style options, while the score of local and traditional style is generally lower. It is obvious that the orientation of regional
cultural style with facilities is vague, thereby leading to low sense of identity. High cultural score is only concentrated in a few samples in the modeling options, and most scores are very low, and it reflects that the cultural characteristics of the present Chengdu public seat modeling are not distinct.

5.3 Qualitative analysis of design formative language and establishment of formative element table

5.3.1 Functional formative element
The activity form of people in various public places is investigated. Three basic functions of public facilities, easy identification, easy use and easy cleaning, are made clear, thereby meeting the requirements of ergonomics as far as possible, and reflecting the scientific nature of their functions. They should not only solve the problems of convenience and comfort, but also stimulate and guide the development of urban cultural forms. They should have clear recognition feature.

5.3.2 Modeling formative element
Modeling is the element that can reflect the city cultural image most directly. Inspiration should be found from local unique cultural elements, historical relics and artifacts, such as local folk customs, traditional crafts, life forms, folklore, celebrities and historic sites, and folk buildings, etc. Design must be based on the law of modeling. Modeling, decoration, pattern and other aesthetic factors are mobilized for creative ideas, thereby reflecting its ideality. The deep feelings of local people are implied by the marks of history in specific regions, such as Chengdu Kuanzhai Alley, Wuhou Temple, Manjuri Academy, Dufu Hall, Qingyang Palace, and Daci Temple, etc., which are integrated with the feelings and human veins of Chengdu people in the public space of these special regions. They have cohesive force of interpersonal and human nature. Modern design techniques are used for transforming urban cultural connotation into formal visual symbols in the design of urban public facilities. These symbolic elements can arouse modern people's exploration, memory and reflection on the past so as to improve people's cultural identity and loyalty to the city.

5.3.3 Material and process formative element
It is necessary to understand and master the characteristics of materials. Meanwhile, the ecological environment and cultural environment also should be respected. The materials used in facilities conform to the practical requirements of local environment as well as local customs and cultural habits. For example, Chengdu in southwest area is warm and rainy. Materials should be moistureproof and rustproof. Annual sunshine amount is lesser, material color is mainly bright, and local bamboo material resources also should be fully used for reflecting local characteristic. Meanwhile, we should understand new technologies, new materials and new technologies at any time so as to provide possibilities for various materials to give full play to their beauty in texture.

5.3.4 Color formative element
The interaction of regional culture, aesthetic needs, social background and so on should be fully considered in urban public facilities color. The characteristics of cultural distribution is combined to further distinguish and plan the main color system and auxiliary color system of facilities in the general direction of urban main tone, thereby making them consistent with the geographical environment, urban pattern, historical culture, folk customs, surrounding buildings and landscape environment, thereby achieving a unified and coordinated effect. For example, the color system of Chengdu public environment facilities should be distinguished. More industries are integrated at Jinniu District in the north and Chenghua District in the east, which are represented by orange. Jinjiang District in the southeast area contains Funan river system with the most distinctive landscape features, which is represented by blue. South high-tech zone has a large number of government enterprises and scientific research units, which are represented by yellow; Wuhou Temple, Dufu Hall, Qingyang Palace, Wangjiang Park and other historical and cultural scenic spots in the southwest Wuhou District are represented by traditional vermilion. The west Qingyang District has Baihuatan
Park, Huanhuaxi Park, People's Park, Jinsha Site and other natural landscape and cultural sites, and they are represented by green. The use of different hues with uniform lightness not only achieves integrity, but also can improve the identification. It is in line with the overall appearance of the area.

5.3.5 **Structure formative element**
Reasonable structure mode can not only meet the basic function, but also can strengthen the cultural characteristics of facilities. For example, the slope roof, thin sealing eaves and bucket girder frame in western Sichuan residential buildings are all parts of the structure and decoration. The artistic modeling and structure of each component are closely combined. Therefore, public facilities not only meet the mechanical characteristics but also meet the unity of technology and art, thereby reflecting the cultural characteristics.

5.3.6 **Volumetric formative element**
A reasonable public facility not only has the beauty of shape and structure, but also needs to be refined on the sense of volume. The result of volume distribution and combination will derive a variety of forms and form different schemes, which affect the basic form and structure of public facilities directly. [11] The reasonable use of bulk formative element causes local changes on the premise of overall composition. Facilities are lively, harmonious and unified with the surrounding environment.

5.3.7 **Direction and spatial formative element**
The direction combination or space layout is often used to enrich the overall image in public facility setting. Horizontal and slanting, dense and dispersive, same direction and opposite direction make people produce wide and narrow, illicit close and open, order and random feelings. Reasonable arrangement of public facility direction can improve the efficiency of use. They are combined with cultural symbols to form an overall pattern, thereby improving the degree of integration with the environment. They also can form indication to the direction of human behavior.

5.4 **Establishment of mathematical and physical analysis model between intention and formative elements**

(1) **SD method** is adopted for quantifying formative tendency in the **intention board questionnaire**. Formative element set and comment set are determined from the formal language questionnaire analysis as follows:

- **Elements set**: \( X=\{ \text{function (X1), modeling (X2), material and process (X3), color (X4), structure (X5), volume (X6), direction and space (X7)} \} \)

  Each single element can be subdivided into 5 sub-elements, such as: function (X1): identification (a1), convenience (a2), comfort (a3), cleanliness (a4), personalization (a5), etc. Modeling (X2): identification (b1), aesthetics (b2), culture (b3), pattern decoration (b4), environmental coordination (b5), etc.

  - **Comment set**: respondents are required to make subjective selection of an formative element in the assessment scale from the first order to he fifth order. For example, \( Y=\{ \text{excellent (Y1), good (Y2), general (Y3), poor (Y4) and worse (Y5)} \} \).

(2) Integration of single element evaluation sets into the **comprehensive evaluation set table**

| Formative element | Y1 | Y2 | Y3 | Y4 | Y5 |
|-------------------|----|----|----|----|----|
| X1                | a1 |    |    |    |    |
|                   | a2 |    |    |    |    |
|                   | a3 |    |    |    |    |
|                   | a4 |    |    |    |    |
|                   | a5 |    |    |    |    |
(3) Determination of fuzzy set of element importance

The importance of each factor in the design must be given due to different influences of various factors on facilities, namely the fuzzy set of importance: (weight 1, weight 2... , weight 7), user evaluation and the Delphi Method are adopted for importance degree set. Users can be divided into local residents and tourists from other areas to determine their preference for various elements of different public facilities in Chengdu.

Fuzzy set of importance of local residents (B1, B2, B3, B4, B5, B6, B7)

Fuzzy set of importance of tourists from other areas (W1, W2, W3, W4, W5, W6, W7)

Formative element importance fuzzy sets (Z1, Z2, Z3, Z4, Z5, Z6 and Z7) are obtained by combining with the Delphi method. Namely different weights are also given. For example, the importance fuzzy set of 7 morphological elements of public seats is (0.58, 1.0, 0.76, 0.43, 0.52, 0.17, 0.22) in human culture design.

(4) Respective fuzzy comprehensive evaluation set of (J1, J2, J3, J4, J5) is obtained according to the calculation of 'main element prominence model (the first-level fuzzy evaluation set)= importance fuzzy set (weight) * comprehensive evaluation set'.

(5) 1 score is given to 'very good', 0.8 score is given to 'good', 0.5 score is given to 'general', 0.3 score is given to 'not so good', and 0 score is given to 'bad', and the rating parameter vector = (1.0, 0.8, 0.5, 0.3, 0) T is obtained.

(6) The inner product of the vector is utilized to calculate the final total score of P.

\[ P = 1*J1 + 0.8*J2 + 0.5*J3 + 0.3*J4 + 0*J5 \]

The pros and cons of the scheme (namely popularity) are measured by comparing the size of the final evaluation index 'P', the 'P' is greater, the design scheme is better. On the contrary, the design scheme is worse. Therefore, we can finally determine the best design scheme among multiple design schemes.

6. Conclusion

The composition of 'line' and 'surface' is firstly realized in the process of urban construction and planning, but it cannot be ignored that the 'point' of public environment facilities should be used for further improving and enriching city landscape space. The research method of Kansei engineering is applied to seeking the correlation between perceptual intention vocabulary and design parameters of public facilities, thereby exploring similarity of technical expression and cultural value orientation in the design of public environment facilities human culture.

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