

# Research on Inclusive Design of Outdoor Seats: Taking Parks in Hangzhou as an Example

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## To cite this article:

Shi Wenwen. Research on Inclusive Design of Outdoor Seats: Taking Parks in Hangzhou as an Example. *International Journal of Architecture, Arts and Applications*. Vol. 8, No. 1, 2022, pp. 17-21. doi: 10.11648/j.ijaaa.20220801.13

**Received:** March 27, 2022; **Accepted:** April 13, 2022; **Published:** April 22, 2022

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**Abstract:** Under the background of the aging population, the concept of inclusive design was introduced to China in 2010. This paper describes a new method to assess the inclusiveness of outdoor seats by designing the inclusive evaluation tool table from document collection, desk research and analytic hierarchy process which can help to obtain the weight of each evaluation content. By the means of mapping the research and evaluation of 52 parks in Hangzhou in all dimensions, the paper draws a conclusion about the inclusive design of park seats. This research combines the qualitative research with data analysis thus to summarize the problems of inclusive design of the seat in urban park. The first problem is that the seat is damaged to varying degrees, especially from the surface and structure; the second problem is the lack of inclusive design, especially the lack of consideration of seat armrest and seat back; the third problem is lack of careful consideration in material selection; the fourth problem is the lack of accessibility. By analyzing the problem, it puts forward the inclusive optimization strategy for the four dimensions of the layout, function, shape and material of the park seats, in order to improve the humanized design of park seats as well as the inclusiveness of the urban environment.

**Keywords:** Park Seats, Inclusive Design, Assessment, Optimizing Strategy

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## 1. Introduction

Since the birth of China's first park in 1868, design and research achievements have emerged one after another. However, the concept of inclusive design was not popular in China, and few scholars paid attention to the inclusive design research of the park. It can provide humanized services for people with various needs and create broader needs and values in urban public areas [1]. Taking the inclusive design of urban park seats as the starting point, this paper designs the inclusive evaluation tool table of seats through Analytic Hierarchy Process (AHP), uses the method of combining quantitative analysis and qualitative research, reveals the current situation of inclusive design of urban parks, and considers the optimization direction and promotion space.

## 2. Overview of Inclusive Design

"Inclusive design" was first proposed by Professor Coleman of the Royal Academy of Art in 1994. It can be regarded as a design method and process, as well as

philosophy and methodology [2]. It takes "humanistic design" as the core [3], opposes design exclusion [4], emphasizes equality and respects diversity. Firstly, the research of inclusive design takes the theory of user capability and product demand as the research subject. In recent years, domestic scholars had begun to pay attention to inclusive design. They focus on user research, human-computer interaction, design methods and new technology applications, and presents the development trend of diversification of research fields, comprehensive research perspectives and virtualization of research content [5].

## 3. Research on Inclusive Design of Urban Park Seats

The outdoor seat, known as urban furniture [6], is the most common rest facility in urban parks, which can intuitively reflect the inclusiveness and humanistic care of the park, so it is used as the starting point for research. In June 2020, the author used the method of mapping to observe, count, evaluate

and refine the visual landscape information [7] of various outdoor seats set in 52 urban parks, including comprehensive parks, community parks, special parks and amusement parks, which are distributed in the main urban area of Hangzhou.

### 3.1. Design of Seat Evaluation Form

According to the setting requirements of park chairs and benches in code for design of public park [8], code for accessibility design [9], Specification of barrier-free facilities setting in the park [10] and other standards as well as the inclusive design principle, the table of seat evaluation is formulated. The evaluation tool table includes six evaluation contents: setting quantity, setting position, wheelchair parking

space, seat height, seat form and seat material. The score is given in the form of Likert five sub scale, of which 5 points are given for those who fully meet the standard, 4 points are given for those who relatively meet the standard, 3 points are generally given for those who barely meet the standard, 2 points are given for those who do not meet the standard, and 1 point is given for those who do not meet the standard at all.

According to the relevance of importance and inclusive design principles, each evaluation content is scored through AHP to obtain the weight of each evaluation content [11], effectively quantify the evaluation contents of urban park seats, and finally carry out evaluation and research on the spot with forms. See Table 1 for details.

*Table 1. Evaluation of seat inclusiveness.*

Serial number	Evaluation content	Evaluate specific requirements	Weights
1	Set quantity	20%-30% of tourist capacity	22.13%
2	Set position	Chair spacing is within 100m; Reasonable distribution in barrier free garden road; Good accessibility, no steps and obstacles	20.55%
3	Wheelchair parking space	Quantity meets 2% -3% of garden chair	10.27%
4	Seat height	Set different seat height and conform to ergonomics	19.36%
5	Seat form	With armrest Skin friendly;	20.55%
6	Seat material	Smooth surface; Less heat absorption	7.14%

### 3.2. Investigation and Analysis

The statistical results show that the average score is 2.568, with the full score of seat inclusive design performance of 52 parks is 5, the lowest score is 1 and the highest score is 4.18. Among them, there are 16 parks with scores ranging from 1 (included) to 2, accounting for 31%, 19 parks with scores ranging from 2 (included) to 3, accounting for 36%, 15 parks with scores ranging from 3 (included) to 4, accounting for 29%, and 2 parks with scores ranging from 4 to above, accounting for 4%. From the overall data, the degree of inclusiveness of seats in Hangzhou urban parks is uneven. Only a few parks show the excellent inclusiveness performance, meeting the requirements in terms of number of facilities, setting positions and wheelchair parking spaces. There are also very few parks that do not meet the requirements at all, according to the evaluation content. Other parks, regardless of their size and geographical location, are evenly distributed at all levels, see Table 2 for details.

*Table 2. Statistical results of park seat in inclusive design performance.*

Score	Number of parks	Proportion	Chart
1 (included)-2	16	30.77%	
2 (included)-3	19	36.54%	
3 (included)-4	15	28.85%	
4 (included)-5	2	3.85%	

In terms of the number of seats, the evaluation results show

that the average score of each park is 3.54, which is still far from satisfaction, indicating that the number of seats in some parks is obviously insufficient. It is worth noting that, lack of seats may cause fatigue and uneasiness, especially for those people in poor health condition.

The evaluation result of set position shows that the average score of this item is 3.19, even worse than the previous item. The seat position of some parks is unreasonable. Most of the seats in the parks are embedded in the greening area. The close contact with the green plants will reduce the comfort, and there is a lack of wheelchair space around the seats. The seats in some parks are set on the uneven pebble pavement with one or two steps, which shows poor accessibility. Further more, the seats in some parks are set beside the non- motorized lane, which gains potential safety hazards.

Visitors can get the theme of the park through the form of seats. Therefore, seats in the park also play a role of transmitting aesthetic value and infiltrating regional culture. The seats with design sense and theme elements in the 52 parks are the seats of Qianjiang Century Park, Zijing Park and Mishi Cultural Park, as shown in Figure 1. The seats in Qianjiang Century Park are made of stainless steel and anti-corrosion wood. At the same time, the seat surface is widened and the shape is simple and modern, echoing the concept of the park. The seat of Zijing park is carved with baubinia pattern on the back of the chair, which saves materials and reflects the name of the park. Mishi Cultural Park adopts bronze cast aluminum and uses sheet materials to make three-dimensional shape, which owns novel shape and simple process. Other parks seats are not specially designed in shape.



**Figure 1.** Examples of seats with design sense.

According to the author's statistics, among the 76 photos about seats collected from 52 parks, 20 seats have armrests, accounting for 26.32%. The proportion of seats with armrests is relatively low. At the same time, no cases of seats with multi armrest were observed. Among the 76 photos, 35 photos show the seats have backrests, accounting for 46.05%. Some parks use benches without backrests to replace chairs, and others are designed at a 90 degree angle, which is not in line with the ergonomic backrest design.

### 3.3. Summary of Main Problems

The problems found through the investigation are: first, the seat is damaged, material aging, paint falling off, surface cracking, chair leg fracture, seat sinks into the ground, etc. Second, lack of inclusive design, lack of backrest and armrest, non-compliance with ergonomics, multiple seat heights are not available, etc. Third, lack of careful consideration in material selection, and some materials are not suitable for outdoor environments. Fourth, poor accessibility, such as setting in grass, platform with one or two steps higher, a square without any shade, no wheelchair parking space, etc. See Figure 2 for details.

## 4. Inclusive Design Strategy of Park Seats

This field survey triggered the author's thinking on the inclusive design of outdoor seats and outdoor spaces in domestic cities: improving the inclusive design is an effective way to alleviate the contradiction between the current aging population, fewer children and cross-border areas. The improvement of inclusive design needs the mutual promotion of the upper and lower social levels: the government and relevant planning departments set up laws and regulations and refine specifications; park designers and outdoor seat manufacturers continue to strengthen the awareness of inclusive design thus to design and produce park seats with inclusive design; the media from all walks of life should strengthen the education of the public. That way, create an inclusive and humanized social atmosphere through the joint efforts of the government, enterprises, designers, media and the public.

### 4.1. Layout of Seat

National standards require that the number of seats in a park should meet 20%-30% of the number of tourists. Foreign code of practice usually consider the maximum foot distance of wheelchair users and crutches users. Generally speaking, wheelchair users need to rest every 150 meters and crutch users need to rest every 50 meters. The setting distance of park seats should not exceed 50 meters. The layout should be set reasonably with reference to the park design specifications and tourist moving lines, so as to provide timely and necessary rest for visitors.

At the initial stage of design, all kinds of users should be invited to participate in the development of the park project [12], organize users and inclusive design experts to set up an advisory group to participate in the whole process of design and construction, provide suggestions and implementation supervision, so as to improve user research and find the pain points and real needs of user groups; in the design and planning stage, designers and planners should fully consider the differences of various vulnerable groups in action ability, perception ability and cognitive ability, and form an inclusive park design scheme with humanized design as the core from the aspects of functional layout, moving line, number of seats, the form of seat and seat setting position. Considering the setting position of seats, starting from the accessibility of wheelchair users, stroller pushers, the elderly and other different groups and the possibility of scene triggering, the seat position shall not be embedded in the greening area, platforms and steps shall be avoid around the seats. It is considered to reserve space for the stay of wheelchairs and strollers. A sufficient number of seats shall be set around the children's play space, garden landscape and social square where tourists stay more, so as to provide a comfortable rest environment for children's care, park sightseeing and social communication for the elderly.

### 4.2. Inclusive Design of Seat Functions

The main function of the seat is to provide rest, so it should be safe, comfortable and inclusive. Provide necessary auxiliary support for sitting and standing posture conversion, backrest rest and other movements. For example, the function of armrest is to play an auxiliary role in the conversion of sitting and standing posture and when it is difficult to extend

the hip and bend the knee [13], which can provide external support and help for the elderly, pregnant women, people with mobility disorders and other people. Therefore, the setting of armrests should be considered in the seat design, especially in parks with large proportion of elderly users such as comprehensive parks and community parks. For another example, the ergonomic backrest can alleviate the waist pressure and fatigue of the seated person, and can also appropriately prolong the sitting time. Therefore, the seat backrest shall be properly set. At the same time, when designing the inclination angle of the back, the relevant ergonomic dimensions shall be referred to, and the back design of  $97^{\circ} \sim 112^{\circ}$  [14] shall be adopted to ensure that the seated person has a comfortable posture.

#### 4.3. Inclusive Design of Seat Shape

The survey shows that the vast majority of park seats are metal skeleton and wooden seating surfaces, which are monotonous and stereotyped and lack of personalization and diversity. This problem may be caused by "market inertia"[15]. On the one hand, it is relatively simple for seat manufacturers to use existing standards to design and manufacture products, while innovation and inclusiveness are regarded as an unstable risk factor. On the other hand, the market is mainly led by usability and economy, and does not pay enough attention to modeling design, which leads to the lack of creativity and breakthrough in the design of outdoor seats. In addition, the neglect from the purchaser is also a reason not to be ignored.



Figure 2. Park seat mapping survey.

#### 4.4. Inclusive Design of Seat Materials

In addition to comfort and interest, park seats should also consider whether the seat materials meet the requirements of durability, skin affinity and sustainability. Firstly, targeted inclusive design shall be carried out according to the characteristics of common seat materials. For example, the corrosion-resistant wood is the first choice because of its comfort, skin friendly and heat insulation performance, but the corrosion-resistant wood is prone to aging, corrosion, paint falling and easy to damage clothes, so it shall be maintained in time or replaced with plastic wood materials. The stone is difficult to set the chair back due to its own weight, so it should be combined with other materials. Metals have good durability, but they are hard, and usually with large specific heat capacity, which will burn in summer and frostbite in winter. Therefore, it is considered to soften the inherent impression of cold and rigid through modeling design and combination with other materials. Cement materials shall be replaced by new composite materials. Secondly, in the selection of materials and modeling design, we should consider the maintenance in the stage of post occupancy, therefore the components of the park seats should be relatively easy to maintain, materials that can be replaceable and implement process that are convenient. After all, the sustainability of park seats is also a very important aspect.

## 5. Conclusion

The use of urban parks to alleviate urban contradictions has long been a precedent, and there are many successful cases. On the other hand, as a green infrastructure, the connotation and extension of urban parks should be fair, universal and inclusive. At the same time, we should also note that the research on the inclusive design of park seats can be described as a glimpse of the leopard in the tube-to see only one spot: it is only a small part of the environmental inclusiveness of the park, and the improvement of the overall environmental inclusiveness of the park is the fundamental purpose. However, starting with the inclusive research of park seats, this paper starts with the theory of inclusive design, studies the current situation of inclusive design of park seats by qualitative and quantitative methods, and puts forward optimization design strategies, in order to help explore new ideas for the improvement of park experience, which is also a rich attempt to enrich China's inclusive design theoretical system. At the same time, it is a beneficial supplement to the promotion of new style of urbanization, people's livelihood and well-being, healthy aging and child-friendly design.

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