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Research on Accessible Design of Macau Museum for Disabled Groups

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Abstract: *In today's society, the social or environmental problems that need to be solved and iteratively changed by people are becoming more and more complex. Along with the rising level of people's social life needs, people's demand for cultural life becomes more urgent, and museums become a brief habitat for people after work and study. The problems faced by people with disabilities in museums are not only about accessibility, but also about communication and interaction with other people and exhibits in the museum environment - the problem of barrier-free interaction. This study aims to explore the accessibility design of the Macao Museum, analyze the current situation of the hard and soft accessibility design of the Macao Museum, elaborate on the problems of the accessibility design of the Macao Museum, uphold the concept of humanized design, propose improvement strategies, and strive to help the disabled groups integrate into the public in their daily lives as much as possible through the humanized design of accessibility in all aspects.*

Keywords: *Barrier-free design, disabled people, Macau Museum, barrier-free interaction*

1. Introduction

Table 1: Disability Assessment Registration Cumulative Application Statistics

March 11,2011 to September 30,2022	
Number of applicants for Disability Assessment Registration Certificate	27,231
Note:Each applicant will be counted only once	

Table 2: The cumulative number of people holding a valid disability assessment registration certificate for each category

Disability category	Number of people holding a valid disability assessment registration certificate	
	Number	Percentage
Physical Disability	5,446	33.91%
Visual Disability	771	4.80%
Hearing Disability	4,464	27.80%
Intellectual Disability	1,184	7.37%
Mental Disability	3,047	18.97%
Speech Disability	50	0.31%
Multiple Disability(note)	1,097	6.83%
Total	16,059	100.00%
Note:The licensee has more than one disability		

(Source: https://www.rehab.ias.gov.mo/zh_tw/data.html)

Accessibility is always changing and being upgraded, but in fact, the phenomenon about people with disabilities having trouble getting around and suffering from discrimination is often seen. In the eyes of the general public, the needs of people with disabilities may only be niche needs. But the fact is that China's disabled population reached 85 million back in 2018, which equates to one disabled person in every 16 people. According to the Macau SAR Rehabilitation Services Information Website, as of September 30, 2022, the cumulative number of local applicants for disability assessment registration cards in Macau is 27,231(Table 1), which is 4.1% of Macau's total population of 671,900 people with known disabilities.

The group of people with disabilities in Macau is mainly divided into physical disability, visual

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disability, hearing disability, intellectual disability, mental disability, speech disability, and multiple disabilities[1] (Table 2).Some people in this group are mildly disabled and can adapt to social and cultural life, but more people will not be able to carry out and participate in social and cultural life normally because the accessibility of cultural venues is not well built. The existing barrier-free design of the major venues is null and void for them.

When we focus on the needs of the disabled community in the Macau Museum, it is not difficult to find the inadequacy of the accessibility design. It is difficult for the disabled community to have a good visiting experience in the Macau Museum, lacking sufficient respect and care, and therefore being invisibly shut out. However, if the problems can be optimized, it will be possible to better serve the disabled community in the museum.

1.1. Accessible Design Concept

The United Nations organization's new design proposition in 1974 included accessible design[2].Creating a loving and caring service environment for people with disabilities is something that can be practiced through design[3]. In 1985, China first advocated for the widespread construction of barrier-free facilities by organizing the "Society for the Study of Disabled Persons and the Social Environment"[4].

Accessible design focuses on the human mindset and considers the behavioral aspects as a basis for detailed research, emphasizing design that improves all environments for human use. Accessible design was originally designed to eliminate barriers to the use of users, mainly for groups with physical (non-psychological) barriers to use, and to take corresponding measures to address the inconvenience of the group, in order to create a safe and comfortable, flexible and friendly living space and environment[5]. Thus, under the cry of "people-oriented", accessibility is developing more rapidly in the international arena in terms of breadth and depth.

1.2. Universal Design Concept

Initially, universal design was called "broad design" in Europe and the United States. 1987, universal design was first proposed by Ronald L. Mace, a professor at North Carolina State University in the United States, and later developed the orientation of universal design into "universal design". The core of Universal Design is the ability to create and deliver a design for all. The core of universal design is a design that can be used by all people, that is, all designs can be used without secondary design or special improvement in the use of the environment, products and communications based on the maximum consideration of all users and the way of use. Thereafter, universal design is the design ideology that every designer seeks to maximize the inclusion of all uses[4].

1.3. Museum Accessibility Design Principles

1.3.1. Safety

As a large place open to the community, museums have a responsibility to ensure the safety of each visitor, both inside and outside the museum. In general, museums pose no threat to the personal safety of able-bodied people[6]. However, for people with disabilities, their ability to adapt and react to the environment is not comparable to that of ordinary people due to their physical limitations, so it is necessary to cut through the different demands of different people in order to create a safe and humane visiting environment.

1.3.2. Convenience

Museums are public institutions that serve human and social development and have a unique position and role in economic and social development[7]. It is necessary to provide a convenient and comfortable experience for visitors to museums during their visit. The mobility and responsiveness of the disabled community is hardly the same as that of ordinary people, mainly due to mobility constraints, which in turn leads to the need for a more accessible and accessible environment for this group of people. Therefore, museums should make universal design as much as possible to facilitate the convenience of diverse groups and ensure the visiting experience.

1.3.3. Easy to identify

The main point is that the information design and logo design is easy to identify. Therefore, it needs

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to be simple and clear so that visitors can better grasp the information and identify it at the first time. There are many people with disabilities who lack physical mobility, slow reaction ability, and weak hearing and vision, so their ability to plan for risks and identify the environment is relatively insufficient, and they need more care in the signage system and hints from the people involved in the design of the museum.

2. Research Methodology

In this study, the field survey method, literature survey method, and descriptive research method were used to conduct an in-depth study on the accessibility design of the Macao Museum.

2.1. Field Survey Method

The field survey was conducted in the Macao Museum to obtain intuitive first-hand information. This method was used to explore the accessibility design of the Macao Museum and its effectiveness, as well as to examine the current state of the museum and its existing regulations at the national level.

2.2. Literature Survey Method

Through the collection and summarization of multi-media resources and existing literature, the literature was analyzed and re-categorized for conceptualization. Through the establishment of specific research objectives, an understanding of Macau museums was formed, and this allowed for in-depth consideration of museum accessibility design.

2.3. Descriptive Research Method

Through periodic data collection, the existing phenomena, laws and theories are described and explained through their own understanding and verification, and through analysis, comparison and generalization, in order to reveal the essence and provide reference.

3. Research Analysis

3.1. Features of the Macao Museum and its Mission

3.1.1. Features of the museum

The Macau Museum was built in the 1990s.It’s divided into three floors,two of which are built under the platform of the original Fortress, one of Macau's most famous historical sites, except for the uppermost floor, which is paved over by the original weather station. The top floor was created by paving the ground floor of the original weather station. The view of the entire Macau landscape from the top of the fortress has been preserved as much as possible.

Specifically, the museum is a platform for the full display of Macau's history and diverse culture. The exhibits in the museum are rich and diverse. Its rich and profound history and culture, as well as the historical changes in Macau over the centuries, are collected, preserved, studied, disseminated and exhibited. And it shows the public the beautiful scene of residents from different countries and with different cultural backgrounds living in harmony in Macau.

The Macao Museum has three levels of exhibition galleries. The first floor is the original footprint of the civilization of the Macau region, exhibiting the early history of Macau, as well as the trade, religious and cultural contacts between the Chinese and the Portuguese in Macau, and the growing richness of Macau culture over the centuries.(Figure 1)The second level mainly bridges Macau's folk art and traditions, exhibiting the traditional culture of Macau, including folk art, religious rituals and folk celebrations (Figure 2); the third level showcases Macau's contemporary urban landscape and the characteristics of residents' lives, and will also involve literary works and artworks based on Macau (Figure 3).

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Figure 1: First floor of the Macao Museum.

Figure 2: Second floor of the Macao Museum.

Source: https://www.macaumuseum.gov.mo/zh-hans/visit/about-us#menu-1

Figure 3: Third floor of the Macao Museum.

3.1.2. Mission of the Museum

The social function that museums often develop under popular perception is the collection and study of precious exhibits, but with the iterative upgrading of museums, providing a comfortable, quiet and relaxing learning space for the viewer has also become one of the existing functions of museums. The Macao Museum also makes a point of stating that the museum's mission is to develop the cultural and museum business, to preserve cultural heritage, and to promote the unique Chinese and Western multicultural characteristics of Macao.

3.2. Current status of museum accessibility design

In recent years, the country has been promoting the development of cultural tourism industry, and along with this cultural fever, various museums have sprung up. Macau has gradually focused on cultural tourism while developing its gaming industry, providing a good opportunity for the development and construction of museums. However, the increase in the number of museums has not been followed by the construction of barrier-free facilities in the museums, making it difficult to provide a good visiting experience for the disabled groups.

Firstly, the degree of importance does not reach a certain standard, and the accessibility design is avoided, making this construction simply failed to be popular. Because its concept is not deeply rooted in people's hearts, people's recognition and awareness of accessibility design is relatively weak, thus leading to a serious lag in the concept of accessibility design of museums. If the builder just for the immediate economic interests and ignore the humane barrier-free design, then it is also against the basic guidelines of design - design is for human services.

Secondly, there is a lack of clarity about the audience of accessible design. In the basic perception, we generally think that accessible design can only serve people with disabilities, but in fact, if accessible design can be taken seriously, it can be developed into a universal design that serves all human beings[8]. Accessible design is a new design concept proposed by the United Nations for the planning and design of people with disabilities. Barrier-free design emphasizes that in the modern design with high

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development of science and technology, all the planning and design of public space environment, various architectural design and facilities, which are related to human clothing, food, housing and transportation, must fully consider the needs of people with different degrees of physiological disabilities and people with declining ability of normal activities.

3.3. Current status of the research group

Today, the total number of people with disabilities in China is nearly 85 million[9]. How to provide a barrier-free environment for the disabled group is an important issue that deserves our consideration[10]. The accessibility design in China is basically intermittent. From a macro point of view, in fact, not only the accessibility design is intermittent. The whole social life circle of disabled people in China is very far from the life circle of able-bodied people.

For people with disabilities, they travel for the same purpose as regular people, to learn to work and live. Studying and working is not just a means of earning money for anyone either, it is also part of our daily social life. There have been calls to reintegrate people with disabilities into society. But this return to society does not mean a one-sided appearance on the street, but rather the basic state of normal social integration, such as participation and collaboration in social activities. Thus, the social role of living and working is invariably magnified, and is a segment that people with disabilities are eager to integrate. But the real situation is that they are often confined to their homes because of their inability to integrate into the social staple. When confronted head-on, it becomes clear that what this group lacks is a social life, a sense of social presence, and that the significance of travel is minimal for them.To use an analogy, the process of returning people with disabilities to society can be likened to repairing an aqueduct. This long aqueduct needs to wait until each small section is repaired before it can be diverted. Looking back, the whole aqueduct has actually taken shape, but intermittently, the occasional section in the middle is repaired again perfect, but can not see the water flow at the end of the aqueduct.

Nowadays, many public venues have accessible designs, but still do not see much use by people with disabilities, mainly because the accessibility is not good enough. The link between caring for people with disabilities and museums is inclusive of the growing pursuit of global issues and the development goals of practical concerns[11]. It is impossible to ignore such a pressing issue at hand. It is also consistent with museums' efforts to eliminate discrimination and to treat all visitors fairly and equally.

The current development of accessibility design for museums in China is lagging behind. As can be seen from the one-size-fits-all model, the way many museums serve people with disabilities today is to send exhibitions and exhibits to a specific occasion, such as an orphanage. So the service model is relatively single.

3.4. Problems in Accessible Design of Macao Museum

3.4.1. Hard construction issues

The first is the lack of infrastructure construction. The Macau Museum, formerly a public cultural service venue in the Macau region, has an accessible ramp and an accessible elevator designed for people with disabilities visible in its premises, but it only conforms to the relevant standards of the Accessible Design Code and part of the Museum Architectural Design Code, and still does not have hardware facilities such as restrooms for the disabled and reading rooms for the blind (Figure 4). While modern technology is developing rapidly, eye control technology, intelligent wheelchair, indoor positioning technology, augmented reality technology and other technologies can provide brand new support for serving disabled people to facilitate their visits to museums.

(Source: Author's self-photography)

Figure 4: Infrastructure problems.

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Secondly, the barrier-free flow design is intermittent. The barrier-free flow lines of the Macao Museum building and the surrounding environment of the Fortress where it is located and the functional space and traffic space inside the museum itself cannot form a working and closed-loop pathway. For example, outside the Macao Museum, the entrance of the Stone Gate has a sloping threshold (Figure 5); after entering the Stone Gate, the barrier-free elevator in the right-hand room door is blocked by chairs, fire extinguishers and other miscellaneous objects; the ramp to the platform is extremely steep (Figure 6), and the steps are unreasonably set and do not contain safety handrails to interrupt the possibility of disabled people to move forward on their own, so the last kilometer of barrier-free access and the smoothness of the barrier-free flow is also an urgent issue to be solved.

(Source: Author's self-photography)

Figure 5: Current Status of barrier-free streamline.

(Source: Author's self-photography)

Figure 6: Current Status of the ramp.

Accessible interaction design in the pavilion is also relatively lacking. On the second floor of the pavilion, there are only audio-visual devices at some nodes for initial interaction between visitors and exhibits (Figure 7), which is fine for able-bodied people, but for people with disabilities, the experience is almost non-existent.

(Source: Author's self-photography)

Figure 7: Current Status of the interaction design.

3.4.2. Soft construction issues

First, there is a lack of specific evaluation criteria and corresponding evaluation systems. The research on museum design mainly focuses on the functional level, light environment creation and display of museums. In contrast, there is a lack of systematic evaluation systems and design standards for the design of accessible environments such as audiovisual services, public information communication, and guide design systems in museums.

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Secondly, the degree of refinement of the accessibility design is insufficient. It can be seen that the accessibility design of the Macao Museum focuses on the disabled and elderly groups, but this also neglects the multiple needs of parents who travel with young children.

Third, the design of accessibility at the communication level is insufficient. Macau museums are slightly built in terms of hardware facilities, while in terms of soft needs they still need to be improved. Therefore, museum service staff should establish a perfect awareness of services for people with disabilities. Due to the special nature of the group, physical and mental development and cognition will be different from the normal people. Most people with disabilities have certain psychological barriers. It is not clear that the museums in Macau provide accessible communication channels and staff. This should be supplemented with relevant design psychology for guidance.

4. Accessible Design Improvement Strategies for Macau Museums

4.1. Hard construction design improvement

4.1.1. Shared equipment construction

To make up for the high investment in infrastructure and long working hours, new solutions can be adopted for the operation of barrier-free systems. With the development of technology and the Internet of Things, new multifunctional intelligent wheelchairs can be used to solve the inconvenience caused by the terrain, and also enable the disabled to "walk" freely and safely in the venue, while equipped with intelligent glasses that are integrated with audio-visual, to enhance vision, hearing and control the wheelchair so that the disabled cannot do the operation. The venue can be equipped with an Internet of Things (IoT) system, and the eyes and wheelchair can form a matching device that can be connected to the IoT system so that the staff can achieve targeted assistance for the disabled. At the same time the above mobile devices can be used by users on a rental basis.

4.1.2. Optimize the design of accessible flow lines

The barrier-free flow design of the Macao Museum should start from the connection between the external space and the internal space. The problem of how to enter the museum should be solved first. And then start to consider how to effectively and reasonably design the accessible route without affecting the overall planning layout of the museum, so as to efficiently meet the needs of people of all levels of needs in the museum in the visit and record, communication and other aspects of the needs of various types of barrier-free facilities.

The barrier-free flow design should start from the entrance of the museum. In order to form a closed loop, or set some room for maneuvering, and connect the main exhibition areas and public service areas as much as possible. In addition, a signage guidance system for people with different conditions, such as visually impaired or hearing impaired, can be set up on the accessible section at the same time.

4.1.3. Light and shadow system to improve the interaction system

For the existing interactive facilities in the venue, upgrade to close projection screen, the projection screen size can be customized size, and each projector can change different text and video. Alternatively, some of the glass in the venue can be replaced with transparent led displays. This not only allows the audience to intuitively see the presented introduction video but also to see the related items displayed through the screen. The combination of the above two can elevate the interactive system in the venue to a new level.

For the visually impaired group, there can be audio guide for information transmission, and try to reproduce the artifacts so that they can be touched, etc.

4.2. Soft construction design improvement

4.2.1. Build relevant design standards and evaluation system

Barrier-free design has long been on the international stage, so it is slowly developing into a universal concept and becoming more and more mature. The world's major countries have begun to have as a result, the development of relevant accessibility design standards and technical standards and regulations, etc., is a good model for our museum accessibility design.

In recent years, the domestic barrier-free design development is certainly rapid, where the outstanding

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performance lies in the barrier-free access and barrier-free bathroom in public space. In contrast, domestic laws and regulations on accessibility and design standards are very lacking in strict requirements for the relevant implementation departments, and the design of accessible environments and landing products in museums also lack professional guidance and evaluation standards.

Some of the existing design codes in China are relatively old, such as the design standards in the Accessible Design Code. In fact, it is based on the human body size standard measured in 1988, so it does not meet the actual situation of our contemporary people, and the data used so far is seriously lagging behind. This has a direct impact on the design of museums in terms of accessibility, which makes the predetermined effect of using deviate from the actual effect. Therefore, it is especially important to establish a special accessibility design standard and evaluation system for museums, which can consider the accessibility design of information, psychology, access, and service from the facilities, and make it more systematic and standardized. This will make the design of barrier-free environment more complete, and also directly raise the awareness of barrier-free for all people, which is of great social significance.

4.2.2. Build an inclusive barrier-free design

Zhao Weiru, who has been studying accessibility design for many years, said: Only by mentioning the inconvenience of the disabled group can we make a more friendly and inclusive barrier-free environment. As a huge carrier of culture, museums have a variety of social responsibilities and need to serve different types of people, so as to provide the maximum convenience for different groups, so the barrier-free design should be as much as possible to maintain the diversity of integration, specializing in the detailed structure of barrier-free design. For example, the handrail of ramp, the guidance system of corner, etc.

4.2.3. Filling the communication gap

At present, there are still gaps in the guided tour services made by the Macao Museum for people with disabilities. It is necessary to focus on the independently developed tour system services in the Mainland, which includes special tour services for ordinary people and for people with disabilities. What's more, a visual aid guide mode should be considered in terms of functionality, which is more conducive to the visually impaired visitors.

With this in mind, museums targeting the deaf population as a group also need sign language navigation. Considering that the museum may have financial and other practical difficulties, it can try to cooperate with public welfare organizations such as the Youth Volunteer Association to meet the needs of special groups while also increasing the publicity of the need for people to care for and understand special groups, and can also recruit professionals in the recruitment process to provide professional interpretation services. Therefore, through the help of interpreters and volunteers, the Macao Museum can replicate the products so that people with disabilities can have zero contact and better understand where the heritage is.

5. Conclusions

The treatment of special groups is a measure of civilization. Humanity has developed to this day, relying on an ancient legacy of mutual collaboration. When we focus on the needs of people with disabilities in museums, it is not difficult to find loopholes in the design of museum accessibility, and it is difficult for people with disabilities to have a good experience in museums, lacking sufficient respect and care, thus being rejected by museums. But in fact, if the problems can be optimized, it can better serve the disabled groups.

This study analyzes the current situation of hard and soft accessibility design in Macao museums, and reflects on the existing problems of accessibility design in Macao museums, and lists the soft and hard accessibility design optimization strategies with the concept of humanized design, aiming to help the disabled groups to improve their museum visiting experience as much as possible through the humanized design of accessibility. It also provides suggestions to the authorities for them to better join the cultural life of the society. Therefore, the implementation of museum accessibility design needs a long effort for society and for us, in order to reconstruct a socially sustainable research paradigm.

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