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2026 Volume 4, Issue 2
Lecture Notes in Education, Arts, Management and Social Science
ISSN(Online): 2705-053X

On the Design of Modern Waterfront Urban Parks from an All-Age-Friendly Perspective: A Case Study of Tai'an Central Park

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Abstract: Against the background of high-quality urbanization in China, all-age-friendly design has become an important part of urban livability. Taking Tai'an Central Park as the research object, this paper adopts literature research, field investigation and questionnaire survey to analyze the current situation of the waterfront park. It is found that there are some problems in the site, such as single function, insufficient consideration of different age groups, ecological degradation, spatial fragmentation and aging facilities. Based on the requirements of Tai'an's upper-level planning such as ecological priority, sponge city and all-age-friendly design, three strategies are put forward: to build inclusive all-age-friendly public space, to realize ecological resilience and low-impact development, and to integrate smart technology and regional culture to create a modern landscape. This study constructs a design framework integrating all-age friendliness, ecological resilience and smart empowerment, which can effectively improve the quality of waterfront space, inherit regional culture, and provide a reference for the design of similar modern urban waterfront parks.

Keywords: All-Age-Friendly Design; Waterfront Urban Parks; Ecological Resilience; Sponge City; Tai'an Central Park; Regional Cultural Inheritance

Online publication: February 26, 2026

1. Introduction

Against the backdrop of high-quality urbanization in China, all-age friendliness has become a key indicator of urban livability. As major spaces for public recreation, health, and well-being, urban parks play a vital role in serving citizens of all age groups. Tai'an Central Park, in particular, is an important urban node that not only serves people of all ages but also carries and conveys local cultural heritage. However, the site currently suffers from common problems such as a single functional structure and insufficient consideration of the needs of different age groups, leaving considerable room for improvement.

At present, upper-level planning in Tai'an clearly emphasizes ecological protection, sponge city development, and all-age-friendly design. Nevertheless, the site still faces challenges such as ecological degradation, fragmented space, and outdated facilities. Therefore, conducting design on this site is of great practical significance.

1.1. Related Concepts

The connotation of all-age-friendly design integrates and extends the single-group-oriented concepts such as child-friendly and elderly-friendly design. It further emphasizes respect for the differentiated demands of different age groups, advocates the shared and multi-purpose use of spaces by people of all ages, provides adaptive spatial environments and supporting facilities, and promotes intergenerational integration.Community parks based on the all-age-friendly concept should focus on constructing functional structures and spatial layouts that meet the needs of different age groups[1].

Figure 1. Site Design Plan

2. Research Methods

2.1. Literature Research Method

This study systematically reviews domestic and international literature related to all-age-friendly public spaces, waterfront park design, sponge city construction, and regional cultural inheritance. It focuses on the core connotation of the all-age-friendly design concept, relevant theories of ecological restoration and functional creation of waterfront parks, as well as special planning documents such as the territorial spatial planning of Tai'an City. Successful cases and experiences of all-age design in similar waterfront parks at home and abroad are referenced to lay a theoretical foundation and provide technical support for this research. Meanwhile, the deficiencies and gaps in current research are identified, highlighting the pertinence and innovation of this study.

2.2. Field Investigation Method

Taking Central Park of Tai'an City as the core research object, field investigations are carried out. Through on-site surveys, image recording, data collection and other methods, the current site conditions are comprehensively grasped. The distribution of surrounding residential, commercial, office, school and other functional areas is synchronously investigated to clarify the park's service radius and core service groups. Combined with the site's historical context, Tai'an's regional

culture is investigated on site, providing authentic and accurate field evidence for the formulation of subsequent design strategies and solving the existing dilemmas of the site.

2.3. Questionnaire Survey Method

A targeted questionnaire is designed for the core service groups of Central Park of Tai'an City, focusing on the functional needs, facility preferences, spatial experience and cultural needs of different age groups (children, adolescents, middle-aged and elderly people). A total of 151 questionnaires are distributed through a combination of online and offline channels. Statistical analysis of questionnaire data clarifies the core needs and differences of people of different ages, accurately grasps the key points and difficulties of park design from the all-age-friendly perspective, and provides data support for the park's functional zoning, facility allocation and spatial creation, ensuring that the design scheme meets practical needs and takes into account diverse groups.

3. Preliminary Analysis

3.1. Site Analysis

3.1.1. Location Analysis

This project is located in Daiyue District, Tai'an City, Shandong Province, at the end of the city's development axis, which serves as a showcase of urban development. As an important area where major public buildings such as the administrative center, business center, and activity center of Tai'an are concentrated, the development axis enjoys a highly advantageous location and forms an essential component of the city's spatial structure. Tai'an Panhe Central Park is a particularly important part of this axis[2].

The project site extends from Changcheng Road in the west to the planned southern extension of Wangyue East Road in the east. The entire site is divided into northern and southern sections by the Pan River. In the northern section, Panhe North Street and a planned road pass through the middle of the site. The total area of the park is approximately 38 hectares.

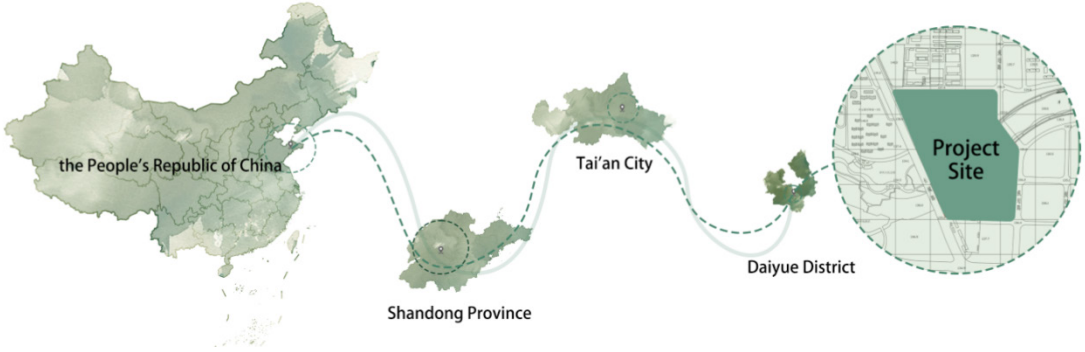

Figure 2. Site Location Analysis Diagram

3.1.2. Upper-Level Planning

Tai'an's upper-level planning takes ecological priority, sponge city development, and all-age friendliness as its core principles, providing mandatory guidance and technical support for urban park construction.

The Tai'an Territorial Spatial Master Plan (2021–2035) establishes the spatial pattern of "mountains, city, fields, and the Wen River," strictly protects ecological red lines, strengthens blue-green ecological networks and biodiversity conservation, and promotes the integrated restoration of mountains, rivers, forests, farmlands, lakes, and grasslands.

The Tai'an Sponge City Special Plan proposes a sponge city framework of "one belt, six corridors, and two centers." Guided by the principle of low-impact development, it specifies control indicators such as the annual runoff control rate and coordinates the processes of infiltration, detention, storage, purification, utilization, and discharge of rainwater, thereby

enhancing urban water safety and resilience.

The Tai'an Green Space System Special Plan (2022–2035) focuses on universal and equitable access, implementing the goal of "access to greenery within 300 meters and access to parks within 500 meters." It improves the 15-minute living circle and the provision of all-age public services, emphasizing barrier-free, age-friendly, and child-friendly facilities, and promoting the transformation of park green spaces from purely scenic landscapes to service-oriented and people-centered public spaces.

3.1.3. Climate Analysis

Tai'an is located in a warm temperate continental semi-humid monsoon climate zone, characterized by distinct seasons, synchrony of rainfall and heat, and abundant sunlight. The average annual temperature is about 13°C, with an average of -2.6°C in January and 26.4°C in July. The average annual precipitation is about 680 mm, most of which is concentrated from June to August. Rainfall is unevenly distributed over time and space, and short-duration heavy rainfall often occurs in summer. Spring and autumn are relatively dry, while winters are cold with little snow.

Influenced by the topography of Mount Tai, the area also exhibits significant local microclimatic characteristics, with notable variations in vertical temperature and wind speed. The annual sunshine duration is approximately 2,500 hours.

3.2. User Analysis

The park serves a highly diverse population. Different age groups, social strata, user groups, and time periods of use all generate significantly different demands for park functions and services. Therefore, the planning and design should fully take into account the daily leisure needs of surrounding residents, the short-term rest and exercise needs of workers in nearby industrial, commercial, and financial districts, the outdoor recreation and educational needs of teachers and students from nearby schools, as well as the recreational needs of tourists visiting from other parts of the city.

Based on questionnaire surveys conducted among surrounding user groups, their needs were analyzed in tabular form.

Accordingly, the design should create highly participatory and experiential activity facilities together with an all-age service system. By organically integrating the landscape with diverse and distinctive activities, the park can attract participation from people of different age groups, thereby forming a unique spatial character and sustained vitality.

Group	Demand Focus	Typical Activities	Facilities
Children	Activity Amusement	Amusement, Science Popularization Education, Outdoor Activities	Small Playgrounds, Sculptures, Science Popularization Signage
Adolescents	Activity Diversity	Outdoor Activities, Science Popularization Education	Activity Venues, Landscape Structures, Science Popularization Signage
Adults	Landscape Features, Featured Facilities	Strolling, Jogging, Outdoor Activities, Science Popularization Education, Cycling	Science Popularization Signage, Jogging Paths, Sculptures, Landscape Structures
Families	Landscape Features, Leisure Space	Leisure Strolling, Picnicking & Camping, Outdoor Activities, Celebration Events, Science Popularization Education	Large Lawns, Picnic Areas, Open-air Theaters, Featured Signage
Groups	Venue Characteristics	Photo-taking, Outdoor Activities, Picnicking, Celebration Events	Sculptures, Activity Venues, Featured Signage, Open-air Theaters, Picnic Areas
Elderly	Landscape Features	Strolling, Outdoor Activities, Resting	Walking Paths, Rest Seats, Accessibility Facilities

Figure 3. Population Analysis

3.3. Analysis of Historical and Cultural Context

The site is located at the end of Tai'an's development axis, and its cultural foundation is rooted in the city's developmental context characterized by the integration of mountains and city and the blending of ancient and modern elements. From the perspective of historical evolution, Tai'an has undergone multiple stages of development and has gradually formed an urban character that combines traditional heritage with modern vitality. The area in which the site is

located is one of the core zones bearing the tasks of urban renewal and functional enhancement.

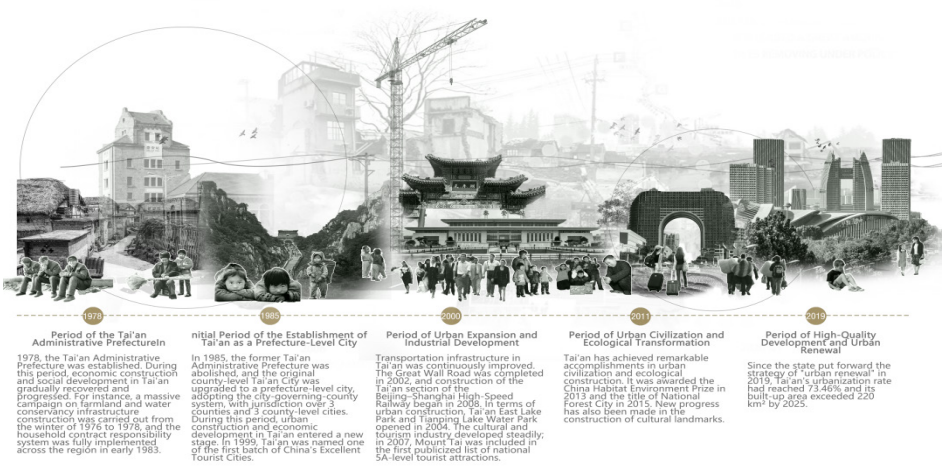

Figure 4. Historical Evolution of Tai'an City

From the perspective of cultural identity, the site is deeply nourished by both Mount Tai culture and Dawenkou culture. Cultural symbols such as the stone inscriptions of Mount Tai, Dai Temple, Tai'an shadow puppetry, and the Dawenkou cultural site together form the cultural background of the site and provide rich creative resources for the design of a modern park.

As the core axis for displaying the city's image and upgrading urban functions, the development axis not only continues the city spirit of peace and prosperity but also carries the mission of connecting the ancient and the modern. It is therefore imperative to reinterpret traditional elements in contemporary forms so that the site can become a cultural link between the city's past, present, and future.

Figure 5. Cultural Context Analysis of Tai'an City

3.4. SWOT Analysis

(1) Strengths (S)

The site enjoys a superior location and convenient transportation. It lies at the end of Tai'an's development axis, adjacent to the municipal square and Wanda Plaza, with dense surrounding facilities and a well-developed road network. The existing waterfront wetland ecology of the Pan River provides a natural foundation for ecological construction. In addition, the site is embedded within the cultural sphere of Mount Tai, enabling the integration of cultural resources and the sharing of municipal infrastructure, thus reducing construction costs.

(2) Weaknesses (W)

Water quality and shorelines along some sections of the Pan River have degraded, weakening ecological service functions. The river also divides the site, while the pedestrian circulation system and cross-river connections are

inadequate, resulting in spatial fragmentation. Existing facilities are outdated and lack smart, barrier-free, and all-age-friendly amenities, making renovation relatively costly.

(3) Opportunities (O)

The surrounding area has a dense residential population, generating strong demand for high-quality public spaces suitable for all age groups and providing a solid basis for creating inclusive public scenarios. Policies related to sponge city construction and urban renewal offer financial and technical support for ecological restoration and smart upgrading. Relying on Mount Tai's cultural and tourism resources, the site can develop new waterfront leisure and cultural experience formats and become a new urban cultural tourism node. Digital technologies can also help transform the park toward smart management and interactive experiences, thereby improving service efficiency.

(4) Threats (T)

The occurrence of extreme weather events places higher demands on flood control, drainage, and ecological resilience design. Existing nearby public spaces are functionally homogeneous, which may disperse visitor flows, so the park must establish differentiated competitiveness. Ecological restoration and facility maintenance require continuous financial investment, while sustainable operation mechanisms remain to be improved. In addition, local culture may be reduced to superficial symbols unless the deeper essence of Tai'an's regional identity is fully explored to create a distinctive spatial character.

4. Design Concepts and Strategies

4.1. Strategies for Creating All-Age-Friendly Public Space

The design of an all-age-friendly urban park should be grounded in humanistic principles, accurately identify the needs of different age groups, and, in combination with the site's densely populated residential surroundings, create a hierarchical and composite park space suited to the behavioral needs of users of different ages.

Based on the results of user surveys and the distinct needs of residents of different age groups, the site functions are carefully divided into an elderly wellness and rest area, a youth sports and fitness area, a children's play area, and a family-oriented shared social area, so as to achieve clear separation between dynamic and quiet activities, well-organized circulation, and complementary functions.

In terms of infrastructure, the design pays particular attention to the comprehensiveness of facilities for all age groups. It responds to the outdoor space needs of different populations. For children, dedicated play facilities such as slides, sand pits, and water play areas are provided to create a sense of fun. For teenagers, entertainment, fitness, and sports facilities are arranged to meet their needs for outdoor activity. For middle-aged users, more fitness equipment, jogging tracks, and seating areas are provided for exercise and leisure. For older adults, spaces for square dancing and tai chi, as well as chess tables and seating, are included to meet their fitness and recreational needs[3]. In short, the design of all basic facilities emphasizes inclusiveness and functional completeness for users of all ages.

In spatial design, this proposal strengthens the barrier-free system by incorporating gentle ramps, continuous tactile paving, anti-slip pavement, and age-friendly handrails, thereby improving accessibility and safety throughout the site. At the same time, the layout of facilities is optimized according to user behavior patterns, with shaded woodland spaces, seating, fitness equipment, and safe children's play facilities to meet the diverse needs of all age groups for leisure, exercise, social interaction, and wellness. The northern half of the site, close to the commercial district, is designed as an open recreational and leisure space, while the southern half, where residential communities are concentrated, is developed into a more community-oriented public space within a 15-minute living circle.

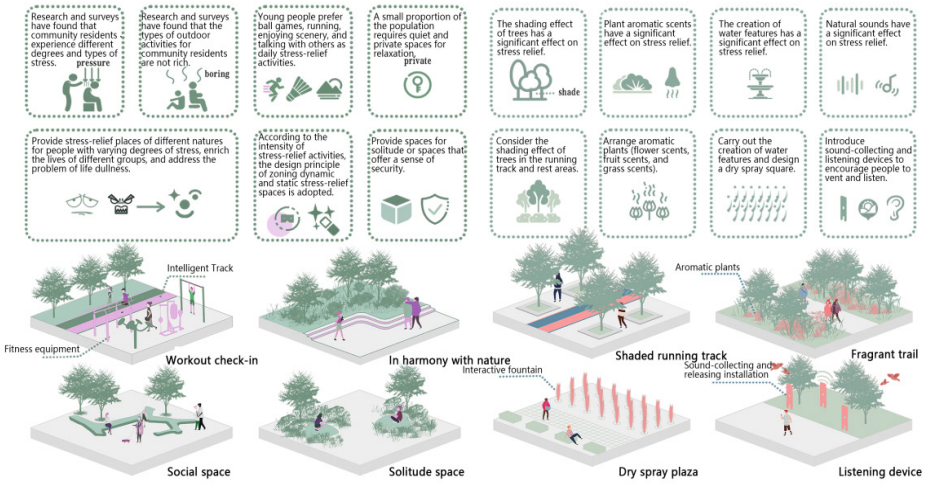

Figure 6. Strategies for Creating an All-Age-Friendly Public Space

4.2. Strategies for Ecological Resilience and Low-Impact Development

Following the principle of ecological priority and the requirements of sponge city construction, the design reshapes the site ecologically and enhances its hydrological resilience. Through micro-topographic adjustment, waterfront landscape improvement, and the construction of native plant communities, the design creates a near-natural, low-maintenance, and ecologically efficient green space system, strengthening the site's ecological functions such as carbon sequestration, oxygen release, cooling, humidification, and habitat provision.

The design diverts river water into the site, adhering to the sponge city philosophy. Permeable pavement materials are adopted, and rain garden technology is introduced. Sponge facilities such as ecological retention ponds, grassed swales and permeable pavement are arranged to construct an integrated stormwater management system featuring infiltration, detention, storage, purification, utilization and discharge, so as to improve the site's ability to regulate rainfall runoff[4].

Through the interweaving of ecological boardwalks, multi-layered plant communities, and natural shoreline waterfront spaces, the design strengthens the connection between landscape and ecological needs, achieving a coordinated integration of ecological restoration, landscape creation, and stormwater management, and ultimately enhancing the park's overall ecological resilience.

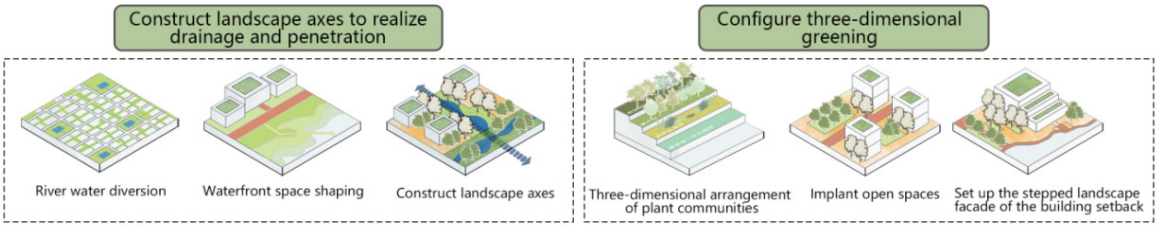

Figure 7. Ecological Resilience Design Strategies

4.3. Strategies for Landscape Innovation Empowered by the Integration of Smart Media

As a modern urban central park, the design is supported by digital technology and media art, deeply integrating smart services, cultural communication, and landscape space to modernize park functions and upgrade visitor experience in an immersive way. Intelligent guide systems, environmental monitoring terminals, smart lighting, and interactive media installations are arranged at key nodes throughout the site to improve management efficiency and service quality.

At the same time, the design combines the two major urban characteristics of Mount Tai culture and the city's

development axis. Through technologies such as light-and-shadow media, digital interaction, and AR experiences, regional culture is transformed into a landscape language that can be perceived and actively engaged with, thus shaping a modern park image characterized by both local identity and a sense of technology.

By organically integrating smart facilities, the cultural spirit of Mount Tai, and spatial scenarios, this design promotes the transformation of the park from a traditional landscape carrier into a composite space for smart services, cultural display, and science education, thereby enhancing its recognizability and contemporary value.

5. Conclusion and Prospects

In the context of high-quality urbanization in China, all-age-friendly parks have become a core direction for the construction of urban public spaces. Their planning and design must balance ecological protection, public needs, and cultural inheritance. Based on the regional characteristics of Tai'an and guided by the principles of ecological priority and people-oriented design, this study constructs a design framework that integrates all-age friendliness, ecological resilience, and smart empowerment. It further deepens the contemporary expression of regional culture and promotes the transformation of waterfront parks from merely meeting functional needs to enhancing spatial quality. In doing so, it contributes to the implementation of all-age-friendly parks and supports the overall improvement of urban quality in Tai'an.

Disclosure statement

The author declares no conflict of interest.

References

[1] Yang K, Wu HR, 2024, Research on Spatial Vitality Improvement Strategies of Community Parks from the Perspective of All-Age-Friendliness: A Case Study of Qianjin Park in Changchun City. Jiangxi Building Materials, (4): 125-127.

[2] Wang L, 2023, Research on Planning and Design of Tai'an Panhe Central Park from a Low-Carbon Perspective (Master's thesis, Shandong Agricultural University).

[3] Shen HY, Liu SR, 2024, Research on Urban Park Design from the Perspective of All-Age-Friendliness: A Case Study of Tanghe Park in Qinhuangdao. Industrial Design, (6): 71-74.

[4] Xuan L, Xu SW, 2018, Planning and Design of "Central Park" in Chengdu High-Tech Zone. Planners, 34(8): 138-145.