

DESIGN STRATEGIES OF URBAN WELLNESS-ORIENTED PUBLIC BUILDINGS ADAPTED TO ALL-AGE NEEDS

DeXuan Chen
Washington University in St. Louis, MO, USA.

Abstract: Against the backdrop of deepening population aging nationwide and the evolving public perceptions of health, the conventional wellness building model targeting only elderly care can no longer satisfy diversified physical and mental wellness demands of all urban residents. Within the broader context of urban stock renewal, developing inclusive, multi-group-adaptable and functionally intensive wellness public buildings has become a key research topic in the architectural field. Centered on all-age inclusive design, this paper integrates theories from environmental behavioral science and wellness architecture to systematically analyze the spatial usage preferences and wellness pain points of the elderly, adolescents, young and middle-aged adults, as well as people with disabilities. Aligned with fundamental design criteria for wellness architecture, this study establishes a comprehensive all-age wellness building design framework covering five dimensions: functional spatial layout, accessible system construction, therapeutic landscape creation, intelligent facility integration, and regional style integration. This research aims to eliminate the design drawback of fixed service targets for wellness buildings, improve the allocation efficiency of public spatial resources, and deliver innovative design ideas and practical references for newly constructed and renovated urban wellness public buildings in China.

Keywords: All-age inclusiveness; Wellness-oriented public buildings; Spatial design; Accessibility optimization; Urban stock renewal

1 INTRODUCTION

According to the 2024 National Population Development Report released by the National Bureau of Statistics, permanent residents aged 60 and above account for over 19% of China's total population, marking prominent characteristics of a deeply aging society and mounting pressure on the construction of elderly care and rehabilitation supporting facilities. Meanwhile, public health awareness has undergone a fundamental transformation in the post-pandemic era. Wellness services are no longer exclusive to senior citizens; surging demand has emerged for adolescent physical and mental health cultivation, sub-health relief for young and middle-aged adults, and rehabilitation care for people with disabilities. All-age wellness has gradually become the mainstream direction of urban public service development. Currently, China's urban development paradigm has shifted from incremental expansion to stock quality improvement, with the revitalization and renewal of outdated public buildings as a core urban development priority, ushering in a window for the renovation and upgrading of wellness supporting buildings [1].

Most domestic wellness building projects still adopt traditional design thinking that restricts service targets to the elderly, resulting in homogenized functional layouts and poor spatial adaptability that fail to meet integrated all-age wellness demands. In contrast, developed economies such as Europe, the United States and Japan have cultivated mature all-age shared wellness spatial systems over decades of research and practice. They implement design modes of time-shared space reuse and dynamic-static zoning, effectively resolving the waste of public resources. Domestic academic research remains concentrated on specialized age-friendly or child-oriented design, while systematic studies on composite all-age wellness buildings remain scarce. Based on the above context, this paper adopts literature review and field investigation grounded in interdisciplinary theories to sort out wellness demands of diverse user groups, summarize prevalent design deficiencies, and formulate standardized, actionable design principles and optimization strategies. The findings seek to advance inclusive, refined development of urban public wellness services.

2 CONCEPTUAL ANALYSIS OF WELLNESS BUILDINGS AND ALL-AGE DESIGN PRINCIPLES

2.1 Conceptual Clarification and Wellness Demands of All-Age Users

Wellness-oriented public buildings occupy a pivotal position in urban wellness supporting systems. Distinct from single-function elderly housing or fitness venues, they prioritize comprehensive physical and mental wellness of users by integrating multiple functions including rehabilitation physiotherapy, social recreation, physical exercise, and psychological intervention. Such buildings take various forms such as community wellness stations, comprehensive wellness complexes, and specialized rehabilitation venues, defined by core traits of open sharing, functional integration and universal public service. Evolved from inclusive design thinking, all-age design breaks the fixed mindset of buildings serving a single demographic [2]. It comprehensively evaluates behavioral patterns and psychological needs of users across age groups and physical conditions, balancing the configuration of mass shared spaces and niche exclusive spaces to narrow gaps in spatial accessibility for diverse populations.

Significant disparities in physical and mental conditions among different user groups lead to divergent wellness priorities. Table 1 details the wellness demands of each demographic.

Table 1 Comparison of Wellness Demands Across All Age Groups

User Group	Physical Traits	Core Wellness Needs	Spatial Design Requirements
Seniors (60+)	Deteriorated mobility, reduced sensory acuity, high prevalence of chronic diseases, intense loneliness from solitary living	Chronic disease management, physical rehabilitation training, social recreation, light fitness, emotional and psychological support	Zero-barrier circulation, quiet rest zones, basic medical amenities, anti-collision and anti-slip protective facilities
Adolescents (3–18)	Rapid physical development, abundant energy, limited concentration, susceptible to environmental distractions	Outdoor physical activity, interest cultivation, mental health counseling, parent-child interactive play	Open activity venues, sound-insulated independent study areas, fully protected play spaces
Young and Middle-Aged Adults (18–60)	Heavy work pressure, prevalent sub-health, fragmented spare time, persistent physical and mental fatigue	Stress relief, professional fitness, sub-health conditioning, short-duration fragmented rest	Specialized fitness zones, private decompression spaces, convenient short-stay rest stations
People with Disabilities	Impaired mobility, visual or auditory barriers, high access thresholds in conventional public spaces	Targeted physical rehabilitation, barrier-free circulation, equal social participation, exclusive wellness services	Full accessible circulation routes, dedicated rehabilitation training rooms, adaptive auxiliary infrastructure

2.2 Overarching Design Principles for All-Age Wellness Buildings

Based on field investigations into prevalent industry design flaws and wellness usage demands of diverse groups, this paper summarizes four mutually complementary core design principles covering the full lifecycle of architectural schematic design, renovation construction, and routine post-occupancy operation: safety, inclusiveness, composite intensiveness, and climate adaptability.

1. **Safety:** As the fundamental bottom line, safety eliminates potential hazards from structural fire and seismic resistance, site circulation protection, as well as anti-collision and anti-slip facility design.
2. **Inclusiveness:** The core guiding principle that dismantles demographic service barriers and balances the needs of mainstream and niche users via accessible design.
3. **Composite Intensiveness:** Boosts space utilization efficiency through modular layout and off-peak shared usage to activate idle spaces, cutting construction and operation costs [3].
4. **Climate Adaptability:** Optimizes indoor physical environments through passive design strategies paired with native therapeutic vegetation to create an original wellness environment suitable for all users.

3 SYSTEMATIC DESIGN STRATEGIES FOR ALL-AGE WELLNESS-ORIENTED PUBLIC BUILDINGS

3.1 Strategy for Multi-Functional Composite Spatial Layout

Scientific spatial layout forms the foundation of all-age wellness service delivery, which can be optimized through vertical functional zoning and shared space operation models.

For vertical organization, spaces are stratified by tier: public shared areas, specialized wellness zones, and private quiet zones, mitigating cross-flow crowd interference and conflicts between active and quiet areas. The ground floor accommodates open public spaces for crowd circulation, daily socialization and casual rest. Intermediate floors house specialized wellness zones segmented by age and user type, separated by buffer corridors and green barriers. The top floor features highly private quiet zones for psychological counseling and independent rehabilitation for high-level wellness demands [4].

To ease land resource strain and maximize space efficiency, on-site activity areas adopt composite design instead of fixed single functions. Movable partitions and modular facilities enable flexible spatial reconfiguration. Combined with user schedules, time-shared reuse is implemented to allocate spaces for seniors, working adults and adolescents across workdays, evenings and holidays, fully unlocking the potential of composite spaces.

3.2 Strategy for Full-Coverage Accessible System Design

To enhance the all-age adaptability of wellness buildings, the accessible system is refined from two dimensions: circulation routes and supporting facilities.

3.2.1 Circulation system

Full zero-height-difference design is implemented site-wide; all original elevation changes are converted to standard 1:12 gentle ramps with standalone steps eliminated. Corridor dimensions are standardized: main corridors maintain a clear width of no less than 1.8 meters, and secondary corridors exceed 1.2 meters to allow two-way wheelchair passage. Entrances, exits and elevator doorways are widened to 1.5 meters to accommodate wheelchairs, rehabilitation trolleys

and strollers. Elevators are upgraded with dual-height handrails, low-position control panels and voice broadcast systems to lower usage barriers for vulnerable groups [5].

3.2.2 Supporting facilities

A stratified adaptive approach is adopted for auxiliary amenities. Public restrooms are equipped with mixed-height wash basins, accessible sanitary ware and baby care platforms to cater to diverse users. Dual-height protective handrails (0.9m and 0.7m) are continuously installed indoors and outdoors for both adults and children. Flooring uses anti-slip wear-resistant materials paired with continuous tactile paving. Acousto-optic warning components are installed at high-risk points such as steep slopes and entrances/exits to refine accessible details and build an integrated safe, inclusive circulation service system [6].

3.3 Strategy for Wellness-Oriented Landscape Environment Creation

Indoor and outdoor environmental design constitutes a core component of wellness architecture, requiring refined optimization of indoor ambiance and outdoor landscapes tailored to human physiological characteristics.

3.3.1 Indoor wellness environment

Differentiated lighting and ventilation designs are deployed per functional zone: softer lighting with shading devices is installed in quiet senior rest areas, while adolescent activity zones maximize natural daylight to meet activity demands. A hybrid ventilation system combining natural cross ventilation and mechanical fresh air ensures continuous indoor air renewal. Overall soft furnishings adopt low-saturation warm color palettes instead of high-contrast glaring tones to ease negative emotions and foster a therapeutic indoor atmosphere.

3.3.2 Outdoor site design

Multi-functional wellness gardens are developed on underutilized building land, divided into four functional subzones: ornamental vegetation zones, rehabilitation jogging tracks, parent-child interaction areas, and quiet rest zones. Native, low-maintenance therapeutic vegetation without allergenic pollen is selected, supplemented by aromatic plants to regulate physical and mental wellbeing [7]. Rehabilitation trails feature elastic flexible pavement suitable for all-age slow walking. Vegetation clusters form physical partitions between active and quiet zones to reduce noise interference, enrich landscape layers while integrating recreational and wellness functions.

3.4 Strategy for Hierarchically Adaptive Intelligent Supporting Facilities

The integrated supporting system of all-age wellness buildings is optimized from three perspectives: universal intelligent infrastructure, differentiated smart services, and regional feature integration.

3.4.1 Intelligent construction

Basic equipment including security monitoring, emergency alarms and intelligent environmental regulators is deployed to dynamically collect indoor environmental data and strengthen on-site safety. An online smart service portal centralizes venue reservation, equipment maintenance requests and health data inquiries to streamline venue operation. Meanwhile, hierarchical intelligent configurations are formulated based on behavioral traits of all age groups and people with disabilities: simplified operation logic for senior users, protective fencing and usage duration control systems for adolescents, smart fitness and virtual decompression equipment for young and middle-aged adults, and voice navigation and dedicated guidance terminals for people with disabilities, realizing tiered adaptive smart services [8].

3.4.2 Regional architectural styling

Design balances climatic adaptability and local cultural identity. Facade structures are optimized according to north-south climatic disparities: northern buildings feature enhanced external wall thermal insulation and streamlined exteriors to minimize heat loss, while southern buildings integrate sunshade components and ventilation channels to mitigate indoor heat and humidity. Furthermore, local architectural cultural elements are deeply excavated and incorporated into building facades and landscape nodes via abstract innovative design, avoiding crude copycat antique styles to alleviate homogenization of modern wellness buildings. This approach strengthens users' cultural sense of belonging while adapting to regional climates [9].

4 EMPIRICAL CASE ANALYSIS

4.1 Project Overview

A community comprehensive wellness center in urban Hangzhou is selected as an empirical case to verify the practical value of the proposed all-age wellness design strategies. The project is a stock renewal project of an outdated public building with a total construction area of 2,860 m², serving three mature surrounding residential communities with approximately 12,000 permanent residents and a demographically diverse user base.

Prior to renovation, the building operated as a conventional elderly care station with single-purpose services limited to daytime care and basic senior wellness. The aging building suffered incomplete accessible supporting facilities, underutilized idle spaces, and severely flawed service models and spatial layouts, failing to satisfy differentiated wellness demands of seniors, adolescents and working-age adults. The entire renewal renovation adopted the all-age wellness design principles proposed in this paper to formulate a localized community-adapted renovation scheme.

4.2 Graphic Analysis of Renovation Schemes

Renovation optimizations are carried out simultaneously across three core dimensions—functional zoning, accessible facilities and outdoor landscapes—balancing usage demands of all age groups in response to site conditions, resident wellness needs and renovation constraints of aged buildings. Figure 1 compares the proportion of functional spaces before and after renovation.

In terms of spatial functions, pre-renovation resource allocation was severely imbalanced: over 70% of space was dedicated to senior wellness with no exclusive zones for adolescent activities or young adult decompression fitness, resulting in highly limited service coverage. Post-renovation, idle areas were re-divided and integrated to add dedicated functional spaces including parent-child activity zones, youth fitness zones and adult physiotherapy areas, alongside an expanded proportion of public shared spaces. Spatial functional barriers were eliminated to cover all age groups and maximize activation of inefficient idle spaces.

For accessibility upgrades, 12 obstructive staircases were demolished and replaced with gentle accessible ramps to resolve internal circulation elevation issues. Main corridor widths were expanded to 2.0 meters to meet two-way wheelchair passage standards. Dual-height handrails, mixed-height washstands and seating were installed throughout corridors and restrooms to accommodate usage habits of seniors and minors alike [10].

For outdoor landscapes, a 560 m² composite wellness garden was constructed, subdivided into parent-child play zones, rehabilitation jogging tracks and quiet therapeutic rest zones, integrating multi-purpose functions of leisure, rehabilitation and daily socialization.

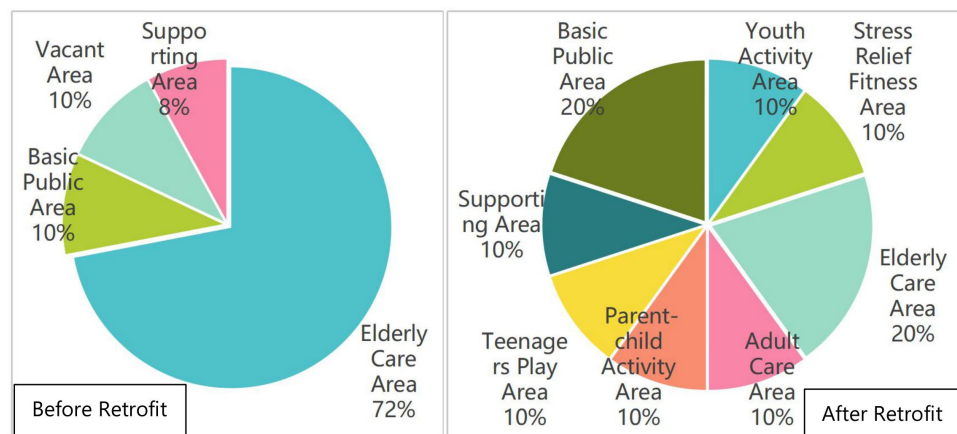


Figure 1 Comparison of Functional Space Proportions Before and After Project Renovation

4.3 Evaluation of Renovation Outcomes

After the renovated facility entered trial operation, its performance was comprehensively assessed through operational data and user feedback (see Figure 2). Average daily visitor volume rose from 29% to 92% of venue capacity, while space vacancy rates dropped from 34% to 8%, marking a qualitative leap in space utilization efficiency. An anonymous satisfaction questionnaire distributed to all-age local residents yielded an overall satisfaction rate of 94.3%, with the vast majority of users approving spatial functions, facility configuration and landscape environments.

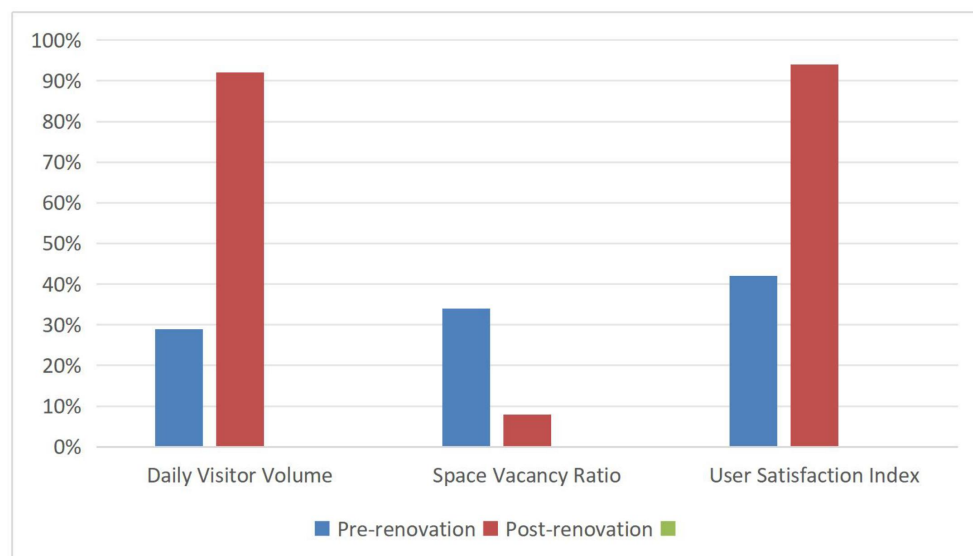


Figure 2 Comparison of Operational Performance Before and After Renovation

This renovation successfully addresses common industry pain points of traditional community wellness buildings: single demographic service targets, poorly adapted facilities and severe space waste. It fully verifies the strong operability and adaptability of the all-age wellness design strategies proposed herein. The renewal model is applicable to most aged community wellness building renovation scenarios across China, and delivers clear design references for newly constructed all-age wellness venues, forming a replicable practical template for the transformation and optimization of community wellness architecture [11].

5 CONCLUSION AND OUTLOOK

Against the dual trends of urban stock renewal and nationwide wellness development, this paper addresses industry pain points including fixed service demographics and poor spatial adaptability of wellness buildings. It constructs a multi-dimensional all-age wellness building design framework validated via a practical renovation project, delivering novel design ideas for both the renewal of aged wellness buildings and new construction projects.

This research still bears notable limitations: the sample coverage is narrow, with no comparative analysis of wellness venues in different climate zones and of varying scales. The proposed design strategies lack refined graded quantitative indicators, and their adaptability in large-scale wellness complexes remains to be verified.

For follow-up research, the sample scope can be expanded to conduct comparative studies on projects across climatic regions and building scales, quantifying design parameters for various spaces and facilities to improve the generalizability of the strategies. Further research can deeply integrate digital technologies such as big data simulation and BIM parametric design to conduct simulated deduction and iterative optimization of spatial layouts, indoor environments and landscape configurations, gradually developing a standardized, refined all-age wellness design system. These efforts will advance the transformation and upgrading of China's public wellness service models, enabling wellness buildings to truly deliver inclusive shared services for all population groups.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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