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Post-Occupancy Evaluation of Campus Space Characteristics in New University Campuses in Northeast China: A Case Study of Shenyang Jianzhu University Hunnan Campus

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Abstract: After the year 2000, Chinese higher education entered a new round of integration and expansion. During this period, a large number of emerging universities and new campuses were established across the country. The northeast region of China also made significant progress in this wave. The construction of Shenyang Jianzhu University Hunnan campus is one such exemplary case. Using the post-occupancy evaluation (POE) method, this paper systematically evaluates the campus space from the perspectives of planning characteristics, external environment, and architectural space, from the users' viewpoint, to summarize design experiences and address existing shortcomings. The campus layout concept is unique, with distinct design features such as "harmony between architecture, environment, and people," "warm corridors," and "sustainability." However, issues such as poor building orientation and "pendulum-like" activity patterns exist. The analysis of these advantages and disadvantages can serve as a reference for campus renewal and construction in cold regions of Northeast China.

Keywords: Northeast China; Campus Space; Post-occupancy Evaluation; Cold Climate Architectural Design; Shenyang Jianzhu University.

1. Introduction

After the year 2000, Chinese universities began a new round of integration and expansion, with a large number of emerging universities and new campuses established across the country [1]. The northeast region, located in a cold climate, has made significant progress. The construction of Shenyang Jianzhu University Hunnan campus stands as one of the high-quality examples. From the early planning, design, bidding, and construction stages, the university has demonstrated a rigorous organizational approach and deep commitment. As an observer focusing on campus space issues, the author, as a user, conducted a systematic study of this project and witnessed part of the process of improving the campus space.

Shenyang Jianzhu University Hunnan campus, completed in 2003, is located in Hunnan New District, Shenyang City, Liaoning Province, in Northeast China. It is situated on the north side of Hunnan East Road and the east side of Wenhui Street, covering an area of 95.7 hectares with a total building area of 580,000 square meters. The campus serves 18,000 students. The campus is divided into two parts, east and west, with a 756.3-meter-long corridor connecting them[7] (Figure 1). Over the years, the campus environment has become pleasant, and many of Shenyang's modern architectural heritage have been relocated to the campus. A subway station now directly connects to the main entrance of the campus.

The campus construction, based on regional cultural continuity, adheres to the principles of human-centered and sustainable development. It focuses on creating student-centered spaces and environments, showing a positive trend in the development of university campuses. However, "even the wisest will make mistakes," and no plan can be perfect. Some details of the campus space still have room for optimization and improvement. This paper, using post-occupancy evaluation, will analyze the effectiveness and shortcomings of the campus space in terms of ecological and landscape aspects, through field research and user experience. The goal is to provide references for the sustainable development of similar campus spaces in the future.

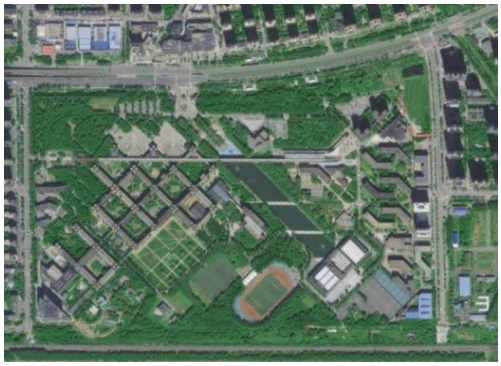


Figure 1. Overall Campus Layout of Shenyang Jianzhu University

2. Campus Planning Characteristics

The overall campus space planning of Shenyang Jianzhu University Hunnan campus is distinctive. Since its completion in 2003, with over 20 years of continuous development and optimization, it has become a hallmark of Hunnan New District in Shenyang. The campus is located along Hunnan East Road, with a plot that is approximately 1 km long from east to west and 660 meters wide from north to south, forming a generally regular rectangular shape. The main entrance of the campus is located on the north side along Hunnan East Road, and the secondary entrance is at the western end of the corridor, facing Wenhui Street. The site's orthogonal relationship is based on the direction of Far East Road to the south and the freight railway line, which creates

an orthogonal transverse relationship with the site.

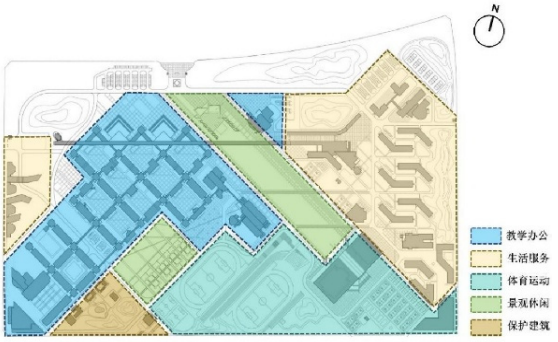


Figure 2. Functional Zoning of Shenyang Jianzhu University

This orthogonal relationship deviates approximately 12° from the true north-south direction. The layout of the entrance, the direction of the corridor, and the floor plans of some buildings are based on this orthogonal relationship. The primary orthogonal relationship of the building floor plans forms a 45° angle with the site's orthogonal relationship. Thus, the arrangement of the teaching area buildings and the placement of some residential buildings follow this standard. The two sets of orthogonal relationships fit together, forming the basic layout relationship of the campus space (Figure 2).

The campus is roughly divided into the eastern teaching area and the western residential area, based on the main entrance axis along the building's orthogonal direction. A series of water features are laid out along this axis, and the corridor spans the water features, connecting the teaching and residential areas. The teaching buildings in the teaching area are arranged in a grid pattern with 80x80m units, forming various courtyards, while the southern part of the campus is designated for sports facilities and the protected building relocation area. All buildings and the series of landscapes are developed sequentially within this layout framework.

Overall, the campus space layout is dynamic and conceptually strong. However, from a user experience perspective, first, the orthogonal relationship of the site and the orthogonal relationship of the buildings are at a 45° angle, which can cause users with a weak sense of direction to get lost in certain spaces. Moreover, the main buildings in the teaching area are not oriented north-south, which weakens the ability of some rooms to capture sunlight and maintain warmth during the cold winter, resulting in poor indoor thermal comfort. The teaching and residential areas are clearly separated and distanced from each other, with the corridor being the primary connector. This layout can lead to "pendulum" traffic congestion issues in a campus life with a regular schedule.

3. Architectural External Environment Space

3.1. Main Squares and Courtyards

The campus planning of Shenyang Jianzhu University is distinctive, with abundant greenery. The collaboration between buildings, landscapes, and greenery has created numerous high-quality outdoor spaces such as squares and courtyards. Among them, the main entrance square, Longtan Square, Tieshi Square, and the courtyards in the teaching area stand out with their unique characteristics and beautiful environments.

(1) Main Entrance Square - Echoing the Old and New

The main entrance to the campus is located along Hunnan East Road. The spatial sequence of the main entrance is symmetrically arranged along an axis, consisting of the following elements: outer square, main gate with the campus name plaque, and the "Old School Gate Pillars" theme landscape square (Figure 3). The square is approximately 45 meters wide and 80 meters long, with dense trees surrounding both sides. The "Old School Gate Pillars" theme landscape, rich in creative and educational significance, consists of four old gate pillars from the original school campus's west courtyard. These were carefully preserved and relocated to the new campus during its construction, symbolizing the continuation of history and the inheritance of culture, silently witnessing the development of the university. In 2018, during the university's 70th anniversary celebrations, the new entrance gate designed by Professor Chen Bochao was completed, further enhancing the landscape sequence at the campus entrance. The new gate is designed in a symmetrical "outer eight" embracing shape facing Hunnan East Road, with walls and gate columns that align with the centrally placed campus name plaque and a water fountain plaza. Pedestrians and vehicles enter and exit through roads on either side of the name plaque, while the new gate columns form a complementary relationship with the relocated old gate pillars. This creates a tightly integrated spatial system for the campus entrance, linking the external city space with the internal circular roads and central water system. The quality of the entrance space is further improved, blending the old and new elements, with clear dimensions, openness, and clarity.



Figure 3. Campus Main Entrance Square Sequence Landscape

(2) Tieshi Square - "Rolling Forward"

The eastern end of the corridor connects to Tieshi Square (Figure 4), which is approximately 60 meters wide from east to west and 100 meters long from north to south, forming a generally diamond-shaped layout. Tieshi Square serves as the central square of the residential area, connecting to the commercial street on the west side, high-rise and multi-story apartments on the east side, and the university's activity

center on the south side. The square is equipped with a variety of landscape and leisure facilities, with tree island green spaces along the visual axis of the corridor serving as visual extension points. The square is laid out in a grid pattern, with landscape features such as goldfish ponds and small tree pools scattered across the area. These are complemented by benches, creating a pleasant scale and making the space ideal for walking. In the evenings, when the lights of the square are illuminated after classes, the space often becomes a gathering spot for enthusiasts of recreational activities such as badminton, shuttlecock kicking, and skateboarding.



Figure 4. Tieshi Square

The theme sculpture group, "Rolling Forward," is a distinctive feature of the square (Figure 5). Located along the eastern axis of the corridor, this sculpture group presents a scene of labor, with the theme "Teachers and students working together to pave the road." It symbolizes the unity and collaborative development of Shenyang Jianzhu University's faculty and students. Interestingly, the sculpture group evolves over time; every 3-5 graduating classes, a new artistic figure representing the most recent graduates is added, symbolizing the continuity of the university's growth and the passing of the torch. This dynamic development adds a layer of "passing on the torch, ensuring continuity." The artistic ingenuity and the integration of functional support for activities create a lively and vibrant atmosphere across the entire square.



Figure 5. "Rolling Forward" Sculpture Group

(3) Teaching Area Courtyards - Serene and Comfortable

By crossing the central water system to the west via the corridor, one can reach the teaching area (Figure 6). The layout of the teaching building complex follows a 45° angle in relation to the corridor's direction. The teaching buildings are arranged in a grid pattern of 80x80 meters, creating more than ten square courtyards, while also reserving space for future development. These courtyards are designed using different internal landscape strategies, and some of the first-floor building interfaces are either open or elevated, creating rich and diverse outdoor spaces that are comfortable and pleasant (Figure 7). The main traffic flow for daily use is through the second-floor internal corridor of the building complex, with few users relying on the ground-floor courtyards as a main pathway. This design enhances the privacy and inward-focused nature of the courtyards.

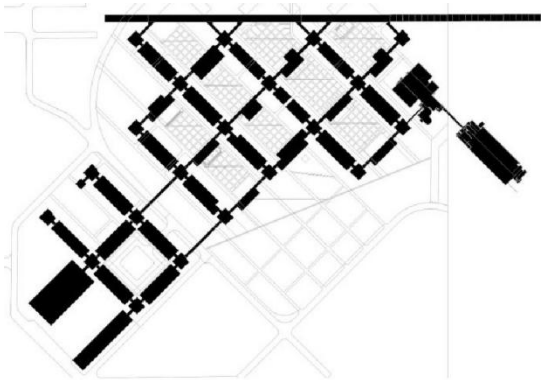


Figure 6. Distribution of Teaching Area Buildings and Courtyards



Figure 7. Winter Scene of a Courtyard

To further enhance the courtyards' appeal, some courtyards are equipped with behavioral support facilities such as fitness equipment, badminton courts, and interactive leisure landscapes. Other courtyards incorporate thematic storytelling elements, such as the Lei Feng Courtyard and the "Dongmao Ku" Courtyard [3]. This series of well-designed courtyards fosters an interaction between the interior and exterior spaces of the teaching area. In spaces where the indoor environment tends to be more enclosed due to the need for heating in cold weather, these courtyards greatly increase the spatial richness, making students more inclined to visit these courtyards, stroll through the teaching area's corridors, relax, or even organize casual activities during their free time.

3.2. Thematic Landscape Features

At the outset of its planning, Shenyang Jianzhu University carefully considered ecological and green principles to create a park-like campus. Based on the overall planning framework, the campus has developed a series of diverse and distinctive thematic landscapes scattered throughout. Among these, the two major core landscapes are "One Blue, One Green": "One Blue" refers to the central water system, and "One Green" refers to the rice field landscape.

(1) "One Blue" - Central Water System

Upon entering the campus from the main entrance and following the architectural orthogonal axis, a central water system stretches approximately 300 meters long and 60

meters wide, linking the eastern residential area with the western teaching area (Figure 8). The water system begins at Longtan Square in the north and extends to the Sports Center Square in the south. Along both banks, there are viewing and fish-watching platforms, as well as reed wetland landscape strips. In the central part of the water system's rear section is the "Lonely Boat" theme landscape, symbolizing the idea that "the sea of learning is boundless, and one must use hardship as a boat, steadfastly advancing with perseverance." Two pedestrian bridges span across the water system from east to west, facilitating easy passage. In the dry climate of Northeast China, the water system landscape effectively regulates air humidity and temperature, optimizes air quality, and provides a habitat for wildlife and small animals, thus contributing to ecological restoration. In winter, the water freezes, and in summer, the sparkling surface transforms into an ice rink for students and staff to engage in winter sports, adding to the enjoyment and leisure activities on campus during the cold months (Figure 9).



Figure 8. Central Water System Summer Landscape



Figure 9. Central Water System Winter Snow Scene

In the summer, walking by the water is refreshing and pleasant; in the winter, playing on the ice is full of vitality. The integration of the water feature into the campus effectively connects various functional areas and greatly enriches the visual experience during walking and commuting across the campus.

(2) "One Green" - Rice Field Landscape

To the south of the teaching area, there is a rectangular plot of land, approximately 180m by 135m, known as the "Rice Field Landscape" (Figure 10). This area adds a vibrant touch to the current campus scenery and also reserves space for future development. The design is both inspiring and appropriately scaled [4]. Professor Yu Kongjian from Peking University, a key designer of the landscape, has always adhered to the principle of "fully respecting the land and pursuing ecological origins." While designing this campus theme landscape, he took into account that the original land of the campus was agricultural land mainly used for rice cultivation. He creatively introduced the concept of a rice field landscape into the campus space. The design divides the land into 15 smaller plots, reflecting the relationship between cultivated land and the paths of the rice fields, and incorporates elements such as trees and well structures, with a stone inscription by Yuan Longping, which reads "The fragrance of rice fills the campus; growing rice is like nurturing people" (Figure 11). This meaningful inscription captures the essence of the landscape.In the summer, the rice field can be used to cultivate river crabs, support the growth of frogs, provide a habitat for birds, and attract the sound of cicadas, creating a harmonious natural ecosystem. The rice field landscape not only enhances the quality of the campus space but also plays an important role in promoting ecological green development and cultural creative concepts on campus. The rice field landscape is both a scenic feature and a working rice field, following the natural process of cultivation: spring plowing, summer weeding, autumn harvesting, and winter storage. This allows students and faculty to experience local rural culture closely, fostering the inheritance of the Chinese "agriculture and education" tradition [5].The rice field theme is celebrated through seasonal events such as rice planting festivals and rice field cultural photography competitions, combining education with entertainment. Furthermore, the rice harvested each year is used to create the "Jianda Golden Rice" cultural and creative products (Figure 12), which are given as gifts to visitors and guests, receiving widespread praise and affection.



Figure 10. Rice Field Landscape



Figure 11. Yuan Longping Inscription Stone



Figure 12. Jianda Golden Rice Cultural and Creative Products

(3) Other Landscapes



Figure 13. "Great Birdcage" Snow Scene



Figure 14. "Strength" Sculpture



Figure 15. Sino-Finnish Low Carbon and Energy-Efficient Residential Buildings

The campus space framework of Shenyang Jianzhu University is characterized by distinctive features. Building upon the two core landscapes of the natural theme—"One Blue" Central Water System and "One Green" Rice Field Landscape—numerous other thematic landscapes are scattered throughout the campus to meet various needs. Examples include: public art such as the "Great Birdcage" Peacock Garden (Figure 13) and the "Strength" Steel Beam Sculpture at Wulihe Stadium (Figure 14); green and low carbon demonstration features such as the Sino-Finnish Low Carbon and Energy-Efficient Residential Buildings (Figure 15) and the Sino-German Energy-Efficiency Demonstration Center; and cultural and historical elements such as the Bawang Temple Academy and the old buildings of Shengjing Shiyi Hospital. These creative and thoughtful designs allow users to wander through the campus space, experiencing constantly changing and fascinating views.

4. Major Architectural Spaces

4.1. Corridor Space

(1) Design Concept and Strong Spatial Identity

The corridor is one of the important features of Shenyang Jianzhu University Hunnan campus. "Place" is an important carrier for memory events and recognition. No matter where the students of Shenyang Jianzhu University go after graduation, when they talk about their beautiful college years, they will always remember the corridor and related campus spaces. The corridor is 756.3 meters long and 8 meters wide, running through the eastern and western living areas and the teaching area (Figure 16). The corridor has three levels: the first level is elevated, the second level is an indoor corridor, and the third level is an outdoor corridor [2]. The spacious scale and the rich support for various activities make the corridor a vital space for many students and faculty, who often gather and organize activities there, making it a popular space.



Figure 16. Interior Space of the "Corridor"

However, the presence of the corridor also influences the outdoor route choices of students. The experience of the corridor space changes with the length of use. For short-term visitors, the campus space is beautiful, the corridor space is distinctive, and the experience is novel and interesting. But for residents, the corridor limits the route between the living and teaching areas, leading to a "pendulum" effect in commuting, similar to the commute between a "sleeping city" and the central urban area. The campus has abundant green spaces, and students could have more transportation options to move around, such as cycling, roller skating, or skateboarding. However, the corridor limits these choices to some extent. Students are often seen rushing in the morning, eating bread and drinking boxed milk, crowded in the corridor heading to the teaching area; at noon, they hurry through the corridor to the cafeteria; in the afternoon, they continue classes until evening and wander exhaustedly through the corridor. The corridor seems to be a barrier between users and the beautiful campus scenery. Fortunately, the school has rich spatial resources, and in their leisure time, many students break free from the monotonous "pendulum" commuting model and choose more diverse, interesting routes to enjoy the campus scenery. In this way, a balance is achieved between the use of the corridor and surrounding landscape

systems.

(2) Climate Adaptability of the Corridor Space

The air-driven heating system leads to high maintenance costs and poor thermal comfort. Most of the indoor spaces on campus rely on central air-conditioning for winter heating, instead of the traditional water-circulation heating system, which is uncommon in teaching buildings in Northeast China. However, relying on air-conditioning for heating in cold regions can lead to excessive energy consumption, overly dry indoor air, and uneven thermal distribution, resulting in poor thermal comfort. This issue is particularly prominent in the teaching spaces of the campus, especially in the corridor, which is spacious and elongated with extensive glass curtain walls. This design makes it difficult to maintain thermal comfort during winter and leads to significant heat loss, causing high energy consumption (Figure 17).There has been ongoing debate in academia about the creation of thermal comfort in public spaces in Northeast China. On one hand, some scholars, based on environmental health concepts, argue for lowering the thermal comfort standards in public buildings in Northeast China to achieve energy savings and emissions reduction. On the other hand, some scholars firmly support creating a moderately redundant thermal comfort space in Northeast China during the winter. The debate continues, and no conclusion has been reached. Furthermore, the air-driven heating system is not well-suited for widespread adoption in Northeast China because of the region's already dry winter. The air-driven system further dries the air, which can lead to discomfort and health issues for people staying indoors for extended periods. The maintenance cost of cleaning and maintaining air ducts is also higher than that of traditional water-circulation heating systems.

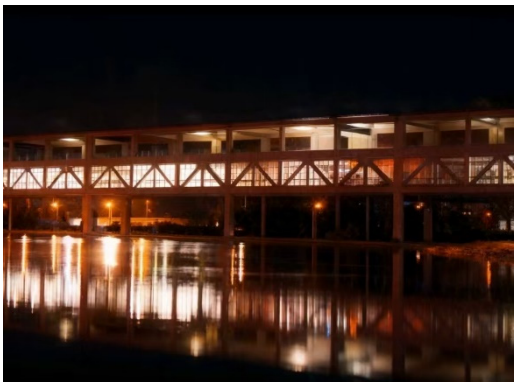


Figure 17. Exterior Night View of the Corridor

To address this, it is possible to consider adding green plant landscapes, ornamental fish ponds, air purification, humidification, and aromatherapy devices on the glass curtain side to adjust the air humidity and improve air quality.

4.2. Teaching Area Spaces

(1) The Homogenized "Grid" Layout Leads to Poor Recognizability

The architectural layout of the teaching area adopts a homogenized "grid" layout, forming rectangular courtyards and leaving room for future expansion of the teaching area (Figure 6). From the users' perspective, the teaching buildings are laid out in a uniform, grid-like manner, with courtyards of the same size, uniform facade styles, similar room dimensions, and similar functions, resulting in poor spatial recognizability. Additionally, the signage system uses a dull naming convention based on "letters and numbers" to designate each teaching unit, further weakening the recognizability of the teaching spaces.

New students with weaker spatial perception often need to refer to the campus map to find their classrooms when they first arrive at the teaching area, and they frequently get "lost" before they get accustomed to the layout. Even long-term students and faculty still need to consult the campus map when trying to find classrooms they don't visit frequently. Some faculty members jokingly refer to this situation as an "on-the-job spatial perception and map-reading training ground" that enhances students' spatial awareness. However, from the perspective of usability, this layout does indeed cause inconvenience.

To solve or enhance the recognizability, various approaches can be employed to optimize the space. These include increasing thematic diversity in each teaching area, such as through colors, motifs, and spatial changes. Additionally, incorporating different materials and enriching the plant layout can help enhance the individuality of each building. Also, replacing the current signage system with one that is easier to remember and find could comprehensively alleviate the issue of weak recognizability.

(2) The Corridor's Main Axis Flow Model Leads to Long Walking Distances

The corridor is the primary route connecting the living and teaching areas, and it serves as the main thoroughfare for students commuting between the two areas. However, the connection between the grid-like teaching building complex and the corridor is limited. This results in classrooms or rooms near the corridor being easy to find and access, while classrooms or rooms farther from the corridor have poor accessibility and are less frequently used. Additionally, if students walk to the rooms located at the far end of the corridor, the walking distance increases significantly, making the experience less pleasant. To address this, less teaching-related and more independent functions, such as faculty offices, research institutes, laboratories, and campus enterprises, are placed at the far ends. This arrangement somewhat alleviates the issue of long walking distances in the teaching spaces. These independent functions can further enhance accessibility by setting up independent entrances and integrating them with ground-level routes.

(3) Compact Functional Layout Leads to Insufficient Public Leisure Space

The compact, intensive layout of the teaching area prioritizes efficiency and cost control during its design and construction. Classrooms are arranged in tight, orderly rows, and little consideration is given to the need for leisure activities during breaks, resulting in a high-density "classroom settlement" that can feel monotonous and dull. Moreover, the connection between the classroom buildings' interior spaces and the courtyards is limited, with many of them being visually accessible but not physically reachable. These combined issues reduce the overall appeal of the teaching area. Outside of class, students have little desire to spend time in the area[6].

To alleviate these issues, the principle of "balance between work and relaxation" should be applied. Public activity spaces can be added at certain intervals in areas with high classroom density, such as near large lecture halls. These spaces could combine features like coffee bars, water stations, and interaction corners, along with landscaping and diverse behavior-support facilities, to improve the overall interior quality of the teaching area. Furthermore, direct access to

courtyards should be established, and clear functional guidance should be provided. Simple sports and fitness facilities could also be added, allowing students to conveniently use the courtyard for physical activities during long breaks, while enjoying nature, improving their eyesight, and promoting health.

4.3. Residential Area Spaces

(1) Poor Uniformity in High-Rise Apartment Rooms

The campus has two high-rise apartment buildings, each with 15 floors, arranged in an L-shaped layout. Due to height restrictions, the buildings' massing appears slightly squat, and the large rooftop signage further diminishes the aesthetic appeal of the structure (Figure 18). Additionally, the building's floor plan uses a square core as the center, with standard floor layouts extending in an L-shape, and the apartment rooms are arranged along internal corridors on both sides. This layout results in the northeast- and northwest-facing rooms receiving little direct sunlight, especially during the cold winter months. The lack of sunlight combined with cold northwest winds leads to lower indoor comfort in these rooms, while the south-facing rooms perform much better in terms of thermal comfort.



Figure 18. High-rise Apartment

Furthermore, wild birds frequently nest on the exterior of the high-rise apartments, including the balconies and rooftops. The design of the "balconies" only includes windows and railings but lacks an accessible door to enter the balcony. This design creates potential safety risks, and due to the inaccessibility of the balconies, birds' nests accumulate. The lack of timely cleaning results in poor sanitation, and many residents use the balconies as storage spaces for seldom-used items. During windy spring and autumn seasons, these stored items can be scattered or even fall from a height, creating safety hazards.

To address these issues, aesthetic design improvements can be made for the high-rise apartments to enhance their urban display and visual appeal. The north-facing rooms can also have their insulation improved, and methods such as offering room discounts or implementing a room rotation system could mitigate the negative impact of room uniformity on the user experience. Additionally, the balconies can be upgraded with safety measures, and doors can be added to make the balconies more accessible and allow for safer, more reasonable use of the space.

(2) Wind Effects Due to Multi-Story Apartment Layout

The multi-story apartment complex consists of six buildings, each six stories high, arranged at a 135° angle relative to each other (Figure 19). During the design phase, the multi-story apartments were initially planned using a "settlement courtyard" concept, with several buildings forming a small courtyard plaza. However, as the design was refined to improve land use efficiency, the final plan placed the buildings in pairs, sequentially aligned in a row. Due to the parallel arrangement of the buildings, the openings face the northwest, aligning with the prevailing winter winds in Shenyang. This configuration causes the buildings in the multi-story complex to experience sustained cold winds during winter, which negatively affects the thermal comfort of the surrounding outdoor environment.



Figure 19. Multi-story Apartment

To mitigate the issue of cold winter winds, it is suggested to add pine trees or other landscape plants with winter benefits at the northwest corner of the apartment complex to help reduce the excess winter wind.

5. Conclusion

Through qualitative analysis of the post-occupancy evaluation of Shenyang Jianzhu University Hunnan campus, the characteristics and shortcomings of the campus space in terms of planning, external environment, and architectural space have been outlined. The design of this campus space is rooted in the inheritance of regional cultural context and adheres to the principles of human-centered and green ecological design, providing a high-quality example and reference for campus architectural design in cold regions of Northeast China. The optimization and improvement of the campus space is continuously evolving. Although there are some shortcomings in certain details, these deficiencies provide valuable opportunities for dynamic and adaptive growth from "overall construction" to "refined optimization." This process offers clear directions and intrinsic momentum for the sustainable long-term development of the campus. It will drive the construction of campuses in cold regions of China toward a future of high-quality development.

Acknowledgments

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