

Research Article

Research on the Collaborative Regeneration of Cohousing Under Spatial Densification Mode

Dong Rui* 

Finance and Economics Dongfang College, Zhejiang University, Hangzhou, China

Abstract

Urban renewal is a necessary process for the transformation from incremental space to stock space, and old communities, as an important part of the urban space system, play a non-negligible role in the reconstruction of community spatial order. From the perspective of community remodeling, this paper summarizes the latest research progress through the analysis tool CiteSpace, explores and researches the design of old residential areas in Hangzhou based on the urban air index oriented residential renewal design based on the planning concepts of "co-living community", "urban spatial morphology" and "community microclimate system". On the basis of combining 3D wind field simulation and fluid mechanics software calculation, this paper explores the collaborative regeneration path of old residential areas under spatial densification mode, this paper studies how to combine scientific planning with resident sharing in a new mode, and on this basis, through the self-regulation function of the environment, let the residential area spontaneously form a complete shared living system, and carry out detailed exploration in the protection and reconstruction of the living environment of the old community, and how to promote the spiritual development of modern neighborhoods through transformation. In order to improve the quality of life of urban residents in Hangzhou, the renewal and regeneration design of old residential areas and the transformation and upgrading of future communities have brought new thinking.

Keywords

Old Neighborhoods, Cohabitation Communities, Microclimate, Urban Renewal, Future Communities, Spatial Morphology

1. Introduction

Since the reform and opening up, the rapid economic development of our city has promoted the complex changes in the social structure and accelerated the evolution process of the urban and rural residential space structure. Under the background of intensive land resources, residential areas are developing in the direction of "high population density" and "spatial densification" of "high-rise buildings". With the derivation of this residential model, more and more people have paid attention to the living environment and microclimate

index in residential areas. On the one hand, the "spatial densification" of residential areas provides the possibility of intensive use of land resources and improving the settlement mode of residents, and on the other hand, corresponding to the high-density population living rate, the per capita utilization rate of various spatial environmental resources in residential areas is also correspondingly reduced, combined with people's reflection on social communication and human settlements since the outbreak of the novel coronavirus

*Corresponding author: dongxiaoyaya@126.com (Dong Rui)

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(2019-nCoV). As a relatively certain and closed environment, whether the microclimate environment is good or not directly determines or affects people's living standards. Therefore, in the renewal design of old residential areas, how to coordinate man and nature; Social and ecological sustainability is particularly important.

According to statistics from the website of the Ministry of Housing and Urban-Rural Development in 2019, there are 170,000 old urban communities in need of renovation in China, involving hundreds of millions of residents. The renovation of old residential areas has become an important livelihood project and development project in recent years. [1] At present, experts and scholars from all walks of life combine the planning practice of human settlement environment design with management, statistics, economics and GIS technology to conduct in-depth research on old city renewal. Scholar Ye Yu et al. (2016), based on urban morphology, quantitative analysis of urban spatial form characteristics and testing of residents' activities, summarized and concluded key spatial form elements that promote urban vitality, and proposed that good urban spatial vitality construction depends on appropriate construction intensity, good street accessibility, architectural form, and sufficient functional mixing degree. The morphology of vitality construction in urban design is explored quantitatively by using space syntax and other analytical methods. [2] Scholars Li Jin et al. (2022) proposed that urban renewal should be based on city policies, life priority and innovation path; It is pointed out that the current urban renewal is facing the pressure of carbon reduction under the goal of "dual carbon", and green development must force the planning industry to innovate the mode and path of urban and rural construction. [3] By combing and summarizing the latest research progress based on the analysis tool CiteSpace, it is found that existing studies mainly focus on application technology and effect evaluation, while there are few cross-research studies on the renewal of human settlement environment, air index and urban environment in old residential areas. Residential areas are a relatively definite and closed environment. Whether its microclimate environment is good or not directly determines or affects people's living standards.

At present, due to the actual situation of urban population structure change and community spatial order adjustment experienced by Hangzhou, practical problems such as spatial densification, residential isolation and environmental pollution in old communities are becoming increasingly prominent. Due to the comprehensive factors such as the current situation of the environment, social circle, and living and travel habits, the living environment of the old community is becoming more and more complex, which brings new thinking and challenges to its renovation.

2. Analysis of the Existing Problems and Needs of the Human Settlements in Old Communities

After data review and analysis, the author divides the residential areas in Hangzhou into three stages: the period of socialist planned economy (1948-1978), the period of planned commodity economy (1979-1991), and the period of socialist market economy (1992-present) according to the construction period [4]. On the basis of a series of policies issued by the Hangzhou Municipal government, such as the Implementation Plan for the Comprehensive Transformation and Upgrading of Hangzhou Old Residential Areas, the Four-year Action Plan for the Comprehensive Transformation and Upgrading of Hangzhou Old Residential Areas (2019-2022), and the Technical Guidelines for the Comprehensive Transformation and Upgrading of Hangzhou Old Residential Areas (Trial). After careful analysis, the focus of this study is positioned as the transformation of the living environment of the old residential areas in the transition stage from the planned commodity economy period to the socialist market economy period. One of the reasons for selecting the residential area in this stage for renovation is that it was in the incremental era in the early stage of socialism, in the period of rapid growth of housing and other needs, the development intensity of residential areas was large, the relatively lack of scientific planning path, and the quality of the living environment was less considered. With the development of The Times, due to the backward planning concept in the early stage, this part of the old community has a poor ecological environment [5] and serious residential isolation. The level of public space is single; Problems such as weak sense of belonging in residential areas. The specific summary is as follows:

2.1. Urbanization Problem: "Standardization" of Settlement Renewal, "Spatial Benefit" Effect Is Weak

Urban renewal is a necessary process for the transformation from incremental space to stock space. In the era of diversified residential demand, old residential areas, as an important part of the urban spatial system, should consider residents' dual needs for living function and space environment in the reconstruction of their spatial order. At the end of 2017, China started the pilot work for the renovation of old residential areas in Xiamen and other places. According to the statistics of the Ministry of Urban-Rural Development, the number of old urban residential areas reported by various provinces and cities in need of renovation reached 170,000 [6]. However, as far as the actual transformation is concerned, most of the domestic transformation cases mainly involve the transformation of basic supporting facilities such as hydro-power and road network, and the template-based transfor-

mation mode cannot effectively solve the problems of residents' communication needs and low utilization rate of public space in residential areas. In order to break through the phenomenon of "template" and "materialization" in the process of renovation of old residential areas in China, the transformation of old communities in our city needs to combine quantitative data and scientific analysis and research methods, discuss the "income of urban living space" from the perspective of urban space vitality creation, and discuss the core issues such as "microclimate system of residential areas", "spatial morphological structure", and "suitability of exchange activities" [7], combined with the theory of new urbanism, emphasizing the reconstruction of people-oriented human settlements and the reconstruction of neighborhood spatial order. It attaches importance to the construction of human activities by the healthy and three-dimensional construction of the living environment in residential areas.

2.2. Planning Research Question: Explore the Scientific Path of Organic Renewal of Stock Space

The urban planning research described in this paper is based on the simulation calculation of Fluent wind field, combined with the design parameters of residential microclimate, and comprehensively considers the scientific path of future community organic renewal from multiple perspectives such as urban climatology, spatial form of residential area and residential renewal design, so as to improve the quality of living environment of old community. In recent years, scholars at home and abroad have conducted exploratory research on the relationship between urban climatology and urban morphology, and the relationship between urban sustainable development, climate and architecture has been paid more and more attention. At present, in building climatology, studies on the relationship between regional climate, building and indoor environment have been relatively mature, but most of these studies focus on how to create a comfortable indoor climate environment, and the research scope is mostly focused on the relationship between building structure, material, form and climate.

At present, domestic and foreign studies on the spatial form of residential areas and local microclimate of residential areas are not deep enough, and relevant studies only consider it as the background climate conditions of buildings, and the results are difficult to combine with the renovation design of residential areas in practice [8-10]. How to integrate the results of microclimate data with specific residential design strategies and morphological control criteria in Urban Spatial morphology. How to provide efficient and intuitive inductive reference for the differentiated development of cities and residential areas through modern metrological analysis, so as to update and perfect the existing mature residential space and finally "transform" into an effective design method is the problem we need to study.

2.3. Social Composition Problems: the Population Structure Is Complex, the Phenomenon of Residential Isolation Is Serious

The traditional residential area planning is designed and built to meet the greatest residential demand, and the spatial form of the residential living environment formed in this way is too uniform and standardized. In addition, the commodification of housing has led to the problems of single spatial and place level, insufficient characteristics, low functional mixing, and lack of spatial emotion in the initial planning of modern communities. Detailed interpretation of the "2019 Zhejiang Provincial Development and Reform Commission's Notice on Carrying out the Pilot Application for Future Community Construction in Zhejiang Province", we can think about how to combine the design of scene system architecture, space carrier, visual design, scale standards and mechanism guarantee in the construction of future community neighborhood scenes to study the transformation plan and implementation path of community openness and shared neighborhood space. It can be seen that the transformation of the living environment of the old community is not a single thing, but a complex sociological problem.

Taking Jiangcun Garden, Xihu District, Hangzhou as an example, the community is a relocation house, and after on-site investigation, most of the residents in the community are tenants, except for the original residents. Due to the complex population structure, the diverse talent structure of households, and the different living purposes, values and interests of residents, it is difficult to construct neighborhoods with the same ownership requirements, and the phenomenon of residential isolation is becoming more and more serious.

In summary, the current renewal of old residential areas is based on a broad and friendly network of good-neighborly relations, and pursues a "community lifestyle" that "shares" the connotation of the community [11], combined with the reflection on the environment and climate in the post-epidemic era, we need to combine scientific research methods such as urban microclimate analysis into the stock transformation of old residential areas, pay attention to the combination of design and scientific analysis, and pay attention to the study of urban form at the micro level, so as to build a theoretical foundation for the evolution and development of inclusive and symbiotic "sustainable forms" [12]. Raise urban renewal to a scientific and three-dimensional high-level level.

3. Analysis of the Connotation of Cohousing and Research on the Renewal Strategy of Old Community

The Cohousing is a reflection on the existing living model in the post-industrial era, as a new type of community that is

all-round open and sustainable and shared [13]. In the face of the problems of residential isolation, single level of public space and place, and weak sense of belonging to residential areas in the information age, the emergence of Cohousing is of great practical significance for promoting community development and stabilizing social order. In the author's view, the study of Cohousing should not simply stop at the discussion of community construction, layout form, management mode, etc., but expand the connotation of "Cohousing model" to "fully understand the life and social attributes of the city, strive to expand the urban public space and improve its public use" [14], and strive to create a "sense of community" among neighbors. The focus of residential renewal and transformation is placed on the in-depth exploration of environmental sharing and management, community space organization, and stabilizing community neighborhood relations.

3.1. At the City Level: Build a Scientific and Ecological Residential Community

Nowadays, in the face of the poor quality of the human environment in traditional residential areas, the low degree of functional mixing, the lack of spatial vitality caused by the lack of interpersonal communication, residential segregation and other "urban diseases", the author believes that the renewal design of the old residential areas, in addition to learning from the core objective of the foreign Cohousing model that "encourages extensive interaction and open communication between residents" [15], it is also necessary to focus on the scientific and rational construction of residential ecosystems, building community life philosophy and values. In recent years, Zhejiang Province has successively proposed various provincial and municipal policies such as the Pilot Work Plan for the Construction of Future Communities in Zhejiang Province and the Implementation Plan for the Implementation of the Provincial Construction Action Plan in Hangzhou, which intends to introduce the design concept of "service + sharing + experience" into the future residential community projects to design a community with humanistic care. The humanized community that can share space landscape and service facilities makes the experience of residents in the old community no longer stop at the simple "living", but attaches importance to people's social, spiritual, material, physical and psychological needs, so as to build a new type of neighborhood network. This kind of design expansion is of great practical significance to stimulate the vitality of the community and create the transformation of the living environment of the harmonious coexistence between man and nature.

3.2. Planning Level: Three-Dimensional Reconstruction of "Science" and "Environment" in the Future Community

As a subsystem of urban space, residential areas must be

constructed within the network of urban planning. In the post-epidemic era, we should deeply reflect on the living environment, incorporate the factors of residential microclimate into the data analysis at the planning interface, comprehensively consider the composite path of Hangzhou's future community organic renewal design from multiple perspectives such as residential space form and residential renewal design, and discuss the reconstruction of neighborhood space in old residential areas from the perspective of spatial reconstruction. Based on this, we can design through the three-dimensional reconstruction of "science" and "environment" in the planning interface. First, at the "scientific" level, through scientific data analysis, the design of public space and service systems in residential areas should be updated, and the boundary effect should be brought into play, and the potential internal and external network integration should be guided to form an open dynamic interface [16]; Second, at the level of "environment", through the diversified and multi-level composite "spatial environment" renewal of the environmental landscape, a unique "community" atmosphere is created, so that different groups of people in the residential area have different behaviors and social activities at different times of the day. Through the three-dimensional reconstruction of the planning interface, it creates a greater attraction and radiation than a single-function community, allowing residents to return to all aspects of social life.

3.3. Social Level: Discussion of Co-Living Mode and Integration of Social Resources

In the theory of new urbanism, it is proposed that "the basic starting point of new urbanism is to reshape neighborhood communication and create better and dynamic communities." The reconstruction of urban community space is the reconstruction of neighborhood space order based on a clear understanding of the nature of urban community space, which is constructed through the transformation and reshaping of "urban renewal" [17]. From the perspective of the current development direction of community renewal in Hangzhou, the government and design team have carried out research on "urban renewal to community transformation" and "regeneration of future community". Open, interactive, multiple and interoperable healthy living space environment has become a new direction in the transformation process. Such "co-living community" emphasizes how to integrate time resources, space resources and interpersonal resources, and studies how to combine scientific planning with residents' sharing under a new model. On this basis, through the self-regulation function of the environment, residential areas can spontaneously form a complete social system and sharing system. Thus, the sustainable development of the community environment and the mixing of the matrix space are realized, and the spatial texture of the residential area forms a diversified effect such as "heterogeneous isomorphism".

among people of different strata, different ages and different levels of education in the same space.

4. Research on Microclimate of Cohousing from the Perspective of "Data Science"

4.1. Research Methods and Data Sources

From the era of increment to the era of stock, the renewal of old residential areas should be more scientific and targeted. In this paper, the bibliometric analysis method was used, the software CiteSpace 6.1. R6 was used to search the whole

database of Web of Science, and the combined keyword method was used to conduct a comprehensive search, and the keywords were "residential communities or community microclimate, urban renewal and Low carbon transformation". A total of 1428 journal articles were preliminarily obtained. After identifying and deleting the literature with low relevance and non-research literature, 1369 documents in the 10 years from 2014 to 2024 were screened as the research objects as the basic data source for drawing a visual knowledge graph in this study. With the help of keyword co-occurrence network graph and bibliometric word frequency analysis, the research hotspots of old communities abroad are revealed [18]. (Figure 1)

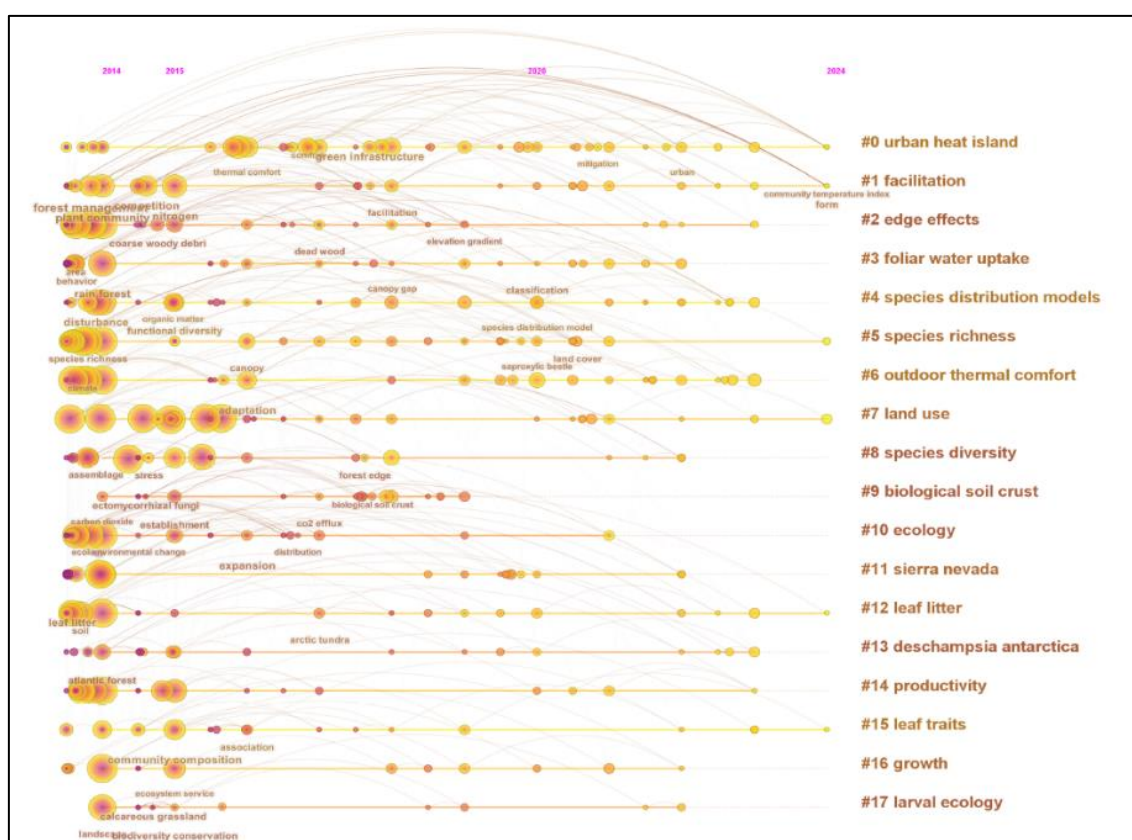


Figure 1. 2014~2024 study correlation time zone map.

The keyword co-occurrence network graph can show the correlation strength and frequency of different keywords, which can help researchers discover the research hotspots in this field. Based on the analysis of the keywords of 1369 articles, the authors found that the research time zone map of urban renewal and old community renovation in foreign countries and the research hotspots at different stages are urban heat island, edge effect, ecology, outdoor thermal comfort, land use, etc., and other research contents such as biological soil crust, species distribution pattern, productivity, leaf traits, etc., also show the research content of ecology,

botany and old community transformation.

Through cluster analysis, the results showed that the main keyword clusters were urban heat island, climate change, environmental protection, and biodiversity, and other clusters such as community, microclimate, and landscape design were generally widely valued (Figure 2). In addition to the correlation between urban heat island, climate change and environmental protection, other related studies, such as human settlements and urban heat islands, residential areas and climate change, have been relatively independent in the past ten years, which reflects that there are few interdisciplinary

studies on the renewal of human settlements in old residential areas, air index and urban environment, and it is recom-

mended to carry out detailed analysis.

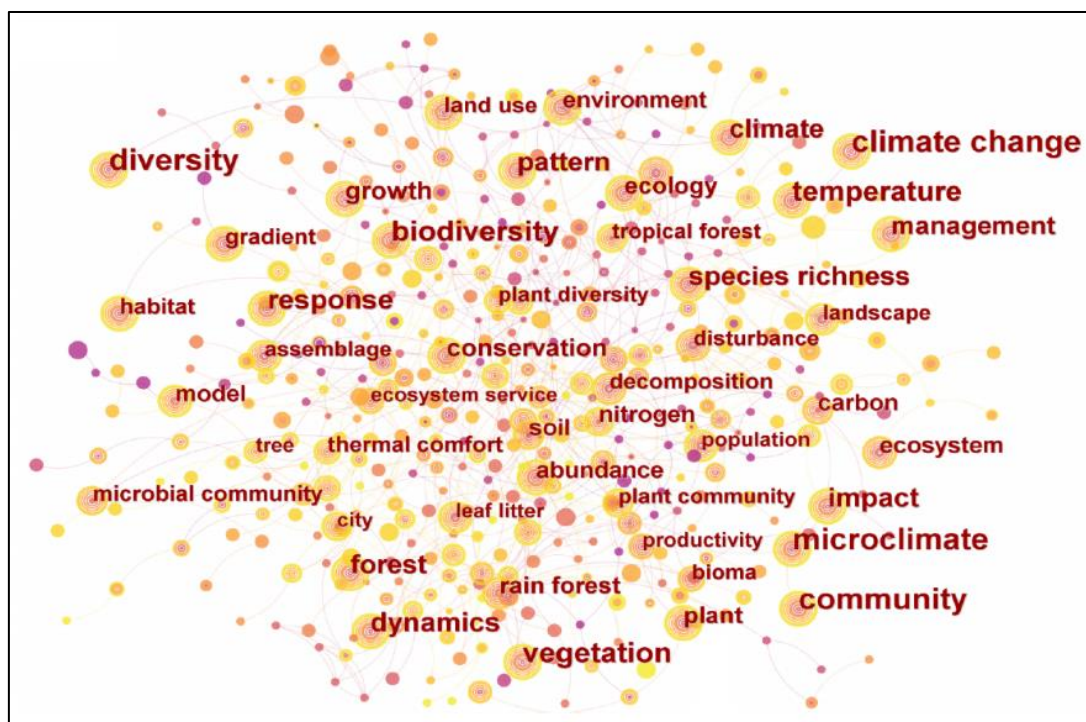


Figure 2. Keyword co-occurrence map.

From the perspective of domestic research and analysis, in 2014, based on the proposal of the National New Urbanization Plan 2014-2020, scholars such as Long Ying in China proposed a "large model" research paradigm, which evaluates the role of a series of pan-smart city technologies in the process of urban development and operation in the context of the fourth industrial revolution, analyzes the general laws of scientific measurement methods and urban system development, and then guides the coordination between future technology development and urban planning, design, construction, and governance [19]. To achieve the purpose of improving the existing urban theory or proposing a new theory, which can be used as a reference for the formulation of urban development policies.

Based on the correlation strength and frequency of different keywords presented by the keyword co-occurrence network diagram, combined with the research hotspots in related fields at home and abroad, this paper intends to qualitatively analyze the relationship between the spatial morphology and microclimate design parameters of the Guang'an residential area of Jiangcun Garden, Hangzhou, and summarize the changes of the microclimate morphological factors of the residents' living environment and the residential area as a well-documented quantitative index, so as to provide a scientific basis for the transformation of the public space environment renewal design in the residential area. Offering new possibilities for resilient development in older

communities.

4.2. The Level of Data Analysis

In this case, combined with Fluent wind field simulation, by embedding local meteorological data, CFD software was used to simulate Guangan Yuan small area of Jiangcun Garden in Hangzhou City with data model of 1:1. The overall model area was 282770.3m², and the internal flow field area of the community was 88599.815m². The total number of grids, and the mesh refinement of the internal flow field area, is 68002. In order to study the influence of external wind field on air flow inside the cell, Ansys Fluent 19.2 was used for simulation. In the process of CFD simulation, the inlet of the internal flow field is taken as the characteristic size (the inlet direction of the internal air in the selected community is taken as the direction of the incoming flow), and according to the wind speed of Hangzhou is 1.3-2.2m/s as the reference flow rate, it is assumed that the air flowing through the community is 1.7m/s, and the gas is incompressible air. The numerical simulation was carried out in the four directions of southeast and northwest, and the building length in the direction of incoming flow was taken as the characteristic dimension, and Re> was calculated. 2000, all in the turbulent phase. The Couple method is adopted. Considering the solution accuracy, the second order upwind solution is adopted. The convergence

condition is that the flow at the exit is stable, and the average flow rate of the internal field is stable, and the fluctuation difference is less than 0.1%. A total of 10,000 steps are calculated to ensure the stability of the value.

The final simulation results are produced in the form of the overall flow field distribution map, combined with the current situation of the residential area spatial form by quantitative statistics through graphics processing software, and the key research areas are analyzed and studied. [20]

4.3. Analysis of the Overall Flow Field Distribution and Air Index in the Residential Area

According to the previous investigation of the community, we found that the crowd in the community mostly gathered at the entrance and exit of the community and the public area before the two residential buildings. According to the direction from north to south, we briefly defined the following eight areas for subsequent detailed analysis, as shown in the figure below:

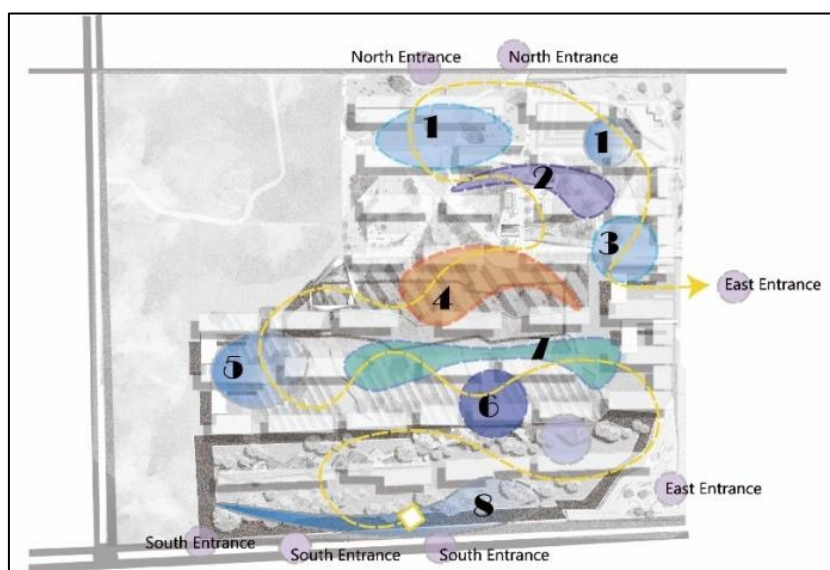


Figure 3. Floor plan analysis of the residential area.

According to the analysis of the overall wind direction and climate of Hangzhou, the northerly wind is more dominant in Hangzhou from September (autumn) to February of the following year, and even the whole winter half year for about 6 months [21]. Therefore, in this data simulation, we have made a focus on the analysis of the north wind, specifically see the overall flow field distribution diagram below.

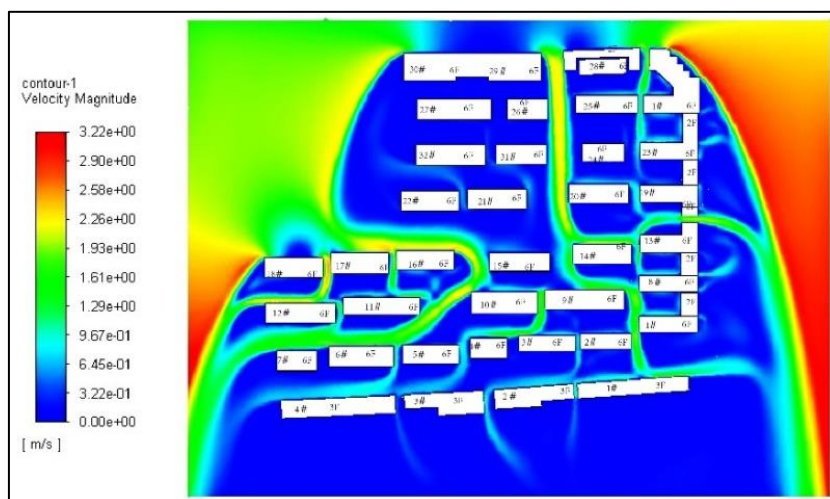


Figure 4. Northerly wind speed distribution map of the community.

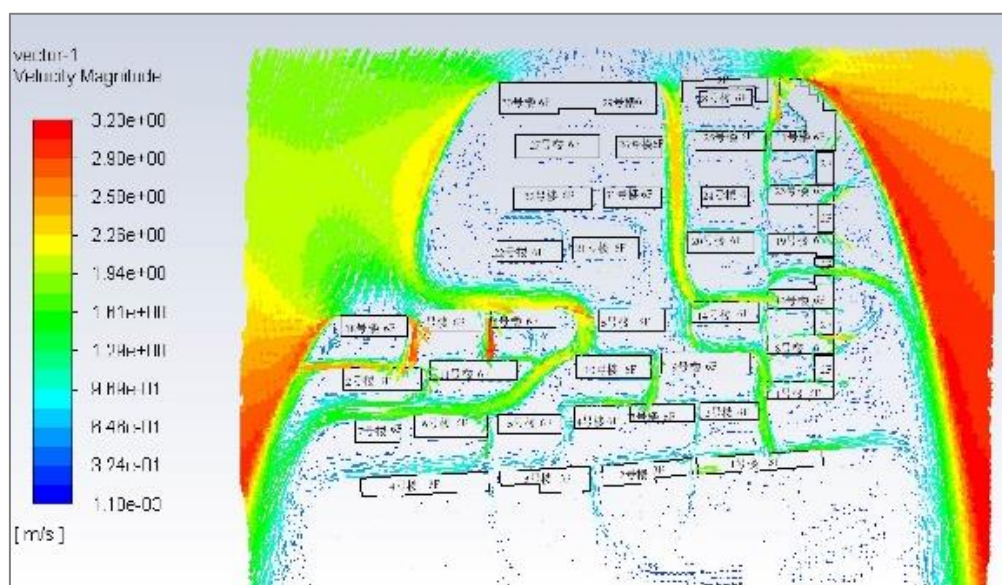


Figure 5. Vector diagram of northerly wind flow velocity.

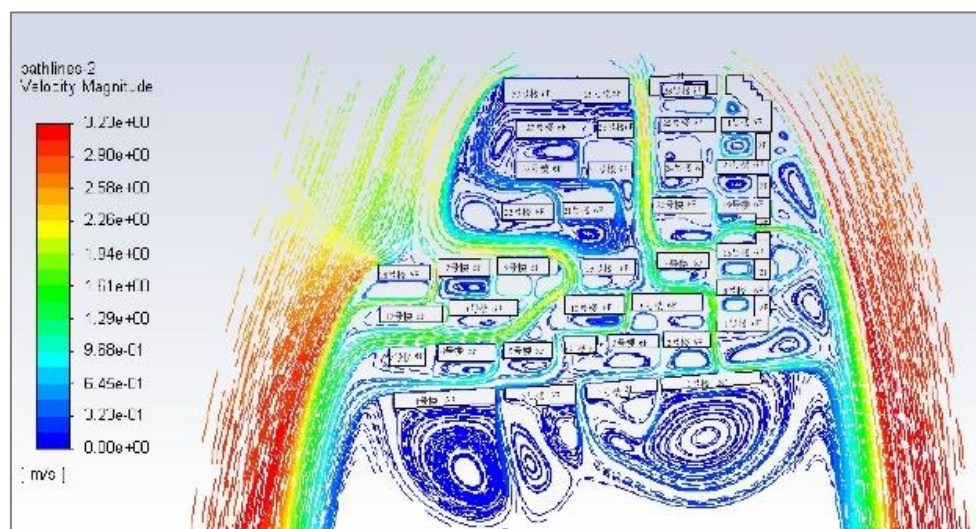


Figure 6. Diagram of the northerly wind flow.

According to the diagram effect of the flow field diagram and the flow diagram (red indicates the maximum wind speed and blue indicates the wind speed is 0), it can be found through the analysis of the internal flow field that the wind speed to the north (area 1) is rapidly attenuated due to the shielding effect of 28, 29 and 30 residential buildings and commercial podium buildings. The wind speed in most areas of the community is lower than the average wind speed of the incoming stream (1.7m/s), the average wind speed of the region 2 is 0.30m/s, the average wind speed of the region 3 is 0.46m/s, the average wind speed of the region 4 is 0.41m/s, the average wind speed of the region 5 and 6 are 0.51m/s and 1.27m/s, respectively, and the velocity of the region 7 is 0.63m/s. The wind speed in Area 1 was 0.44m/s, and the wind speed in area 8 was 0.11m/s. The wind speed between the two buildings in the direction of wind flow is relatively

large. Since the buildings in the southwest direction are not shielded along the direction of wind flow, the wind speed of areas 5, 6 and 7 is significantly greater than that of other areas in the community that are shielded. As can be seen from the trace diagram in Figure 6 (shown as blue vortices), there are a large number of flow vortices inside the community. In areas with low speed, such as regions 1 and 8, and other areas with dense buildings, the air flow occlusion area caused by obvious vortices can be seen. The formation of return area leads to the obstruction of regional air flow. The more densely built area, the more obvious the blocked area of flow, and the more prominent the air retention effect, which is not conducive to the exchange with fresh air. Although the air in region 6 is in a densely built area, due to the diversion effect of the buildings in the southwest and the buildings in the north, the air is gathered in the sidewalk area, resulting in a

relatively high flow speed in the region. As can be seen from the flow diagram, there are fewer vortices in the area, and the exchange speed of fresh air has been greatly enhanced.

According to the overall wind direction and climate analysis in Hangzhou, the southwest wind is dominant in early June,

and the east wind is dominant in August. Considering the residents' normal use of the community throughout the year, the overall climate and data were analyzed in combination with other wind directions. The following figure shows the distribution diagram of the overall flow field respectively.

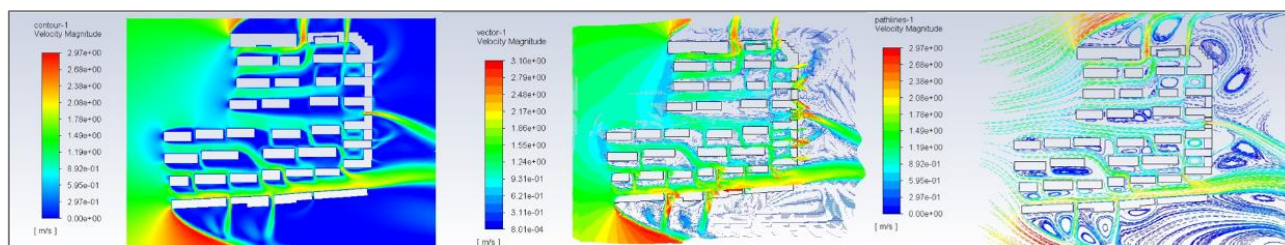


Figure 7. The overall flow field distribution of the westerly wind.

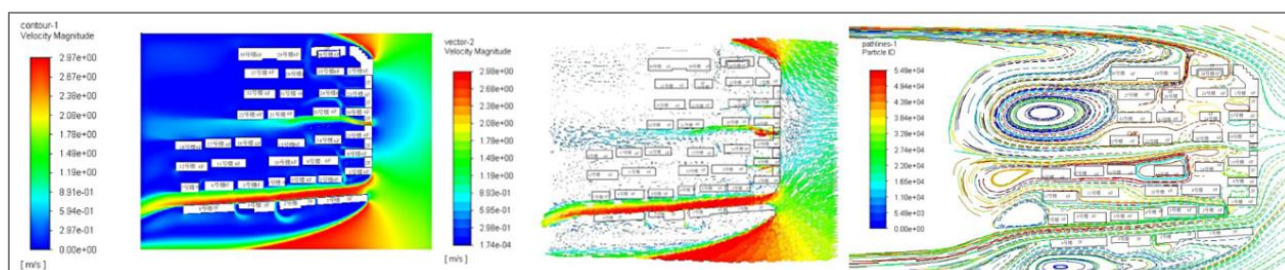


Figure 8. The overall flow field distribution of the east wind.

According to the flow field diagram analysis of southwest wind and east wind, it can be seen that during June, the overall wind speed of this community is good, and the air index is reasonable, which is more suitable for public activities such as exchange and walking. However, there are small blue swirls between the 6 and 7 houses and the 11 and 12 houses, indicating that the fresh air exchange in the area is poor and needs to be improved by updating the design. During August, a large area inside the community was blue and the air index was not good, which needed to be transformed and upgraded in multiple dimensions through subsequent design.

4.4. Design and Transformation Point Analysis

Combined with the current situation of the community, the microclimate index of the four wind directions of southeast, northwest and northwest can be calculated as follows: (1) Region 1, region 8: The two outer rows of residential and commercial podium areas in the north and south direction of the community have a large barrier to air, so the air index of this area is poor, and it is easy to form air fluid swirls, which is not conducive to the exchange of fresh air. Therefore, the transformation of this area can be carried out through the planting of three-dimensional greening, and the air replace-

ment and renewal design can be tentatively designated as inter-house garden (A1) and leisure lawn (B3). (2) Region 2, Region 3; Area 7: Combined with the east-west entrance Settings and data analysis of the community, the area with good air flow between the houses is proposed to be designed for the enhancement of public activity areas, which are designated as youth courtyard (B1) and leisure exchange area (A2). (3) Area 4: The east-west direction with the main entrance as the axis has a good annual air flow rate, which can be used as the center for divergence design in the design transformation. For example, it can be defined as the central public space of the community by taking advantage of the relatively good annual wind speed conditions in this area, and selected for overhead design, so as to make better use of the geographical advantages of this block, tentatively named as the central platform activity area (C1). (4) Region 5: This region has good air flow rate for 9 months of the year, and the distance between houses is large, which can be used as the promotion area of intergenerational elderly care area (C2); (5) Area 6: According to the wind speed distribution cloud map, it can be seen that the air velocity in this area is good throughout the year, and the distance between houses is large, so it can be designed as a tidal road for public activities (A3). The specific analysis is as follows:

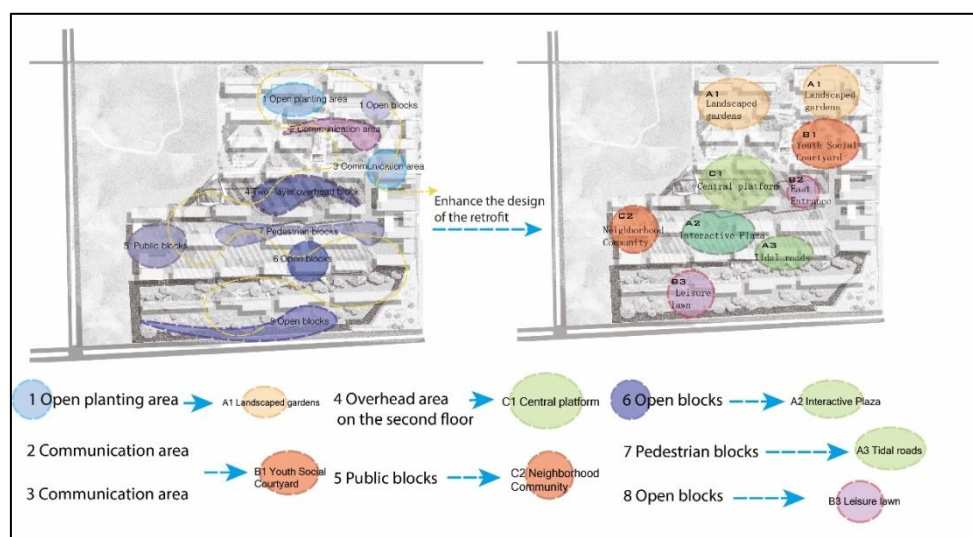


Figure 9. Conceptual diagram of the planning and design.

5. Research on the Regeneration Path of Composite Community Under the Spatial Densification Mode

Based on the above data analysis and discussion, it can be seen that areas with average air flow index need to be improved through design transformation, and areas with better microclimate index can be designed to better serve residents' public activities and exchanges. In the following, we will explore the renewal path by combining the concept of "co-living community" collaborative regeneration.

5.1. Three-Dimensional Transformation of Community Space Environment Ecology

In the era of commercial mass production, the traditional "here and now" neighborhood communication caused by the "invisibility" of public communication mode is difficult to meet the current "diversified" and "non-regional" communication mode. The theme of this case is "collaborative regeneration of Cohousing". In practice, according to data analysis, the space of the community is divided into three levels: "fluid connection", "open/semi-open enclosure" and "hierarchical overhead". From three directions, the plan nodes, facade design and public space of the community are updated and transformed multidimensional and three-dimensional, and on this basis, the specific nodes of the co-living mode are transformed modularized and quantitatively. The single space and collective space between the living units are combined to form a shared activity area with spatial diversity and functional variability, and finally form a community full of spatial vitality.

Different from the decentralized living space and centralized co-living community planning system in the original

co-living community theoretical system, this project breaks the closed space structure of the residential area through three-dimensional and multi-dimensional space construction. Different space forms fully consider the core idea of urban vitality construction theory around the "future community" model in the design and transformation. Pay attention to the accessibility of the public area, the construction of the architectural form of the communication space, the renovation and renewal of the functional mixing degree of the activity area; While meeting the basic material and cultural needs of residents, it advocates functional mixing, carries out a series of humanized design docking of high-level emotional needs such as public activity space, living environment and community belonging, and reshaping the living atmosphere of "healthy", "fashionable" and "inclusive" from the perspective of "densification" of residential areas.

5.2. Space Resources Mining Integration, Design Transformation "Light Intervention"

In the updated design of this case, priority is given to the division of public space and the upgrading of residential environment, so as to optimize the space between houses to the greatest extent. By planning the three-dimensional "light intervention" transformation of interface time and space, respecting the ontology, completely preserving the original layout and architectural form of the community, making full use of the originally neglected public space, carrying the inherent expectations of the population for the housing, and paying attention to and realizing the sustainable development of the transformation of the old community.

For example, as the main public space of the residential area, the pedestrian path in A3 area is generally neglected in the reconstruction area, and most of the community reconstruction emphasizes the road improvement and route plan-

ning. In this case, according to the calculation of wind speed, we defined the public space of A3 area as a walking activity area. In the design, we adopted the attitude of light intervention, absorbed the experience of various large-scale urban roads in road construction, and introduced the new concept of "tidal road". In the process of transformation, the concept of "friendly walking road" is implanted in it, and the central activity area is used to divide the road into two sides of "Morning and evening", and the location near the parking lot is basically the crowded place. Idle road resources in the

direction of low traffic flow are used to supply vehicles in the direction of high traffic flow, so that the relationship between upstream and downstream traffic demand and supply on the same road section is relatively balanced [22]. In order to conform to the design theme, bright and bright colors are used in the color, and the children's activity center is set up in the function. Considering the fast pace of small family life, children can relax and entertain before their parents, ensuring the double safety of children and driving. (Figure 10)



Figure 10. Tidal road reconstruction diagram.

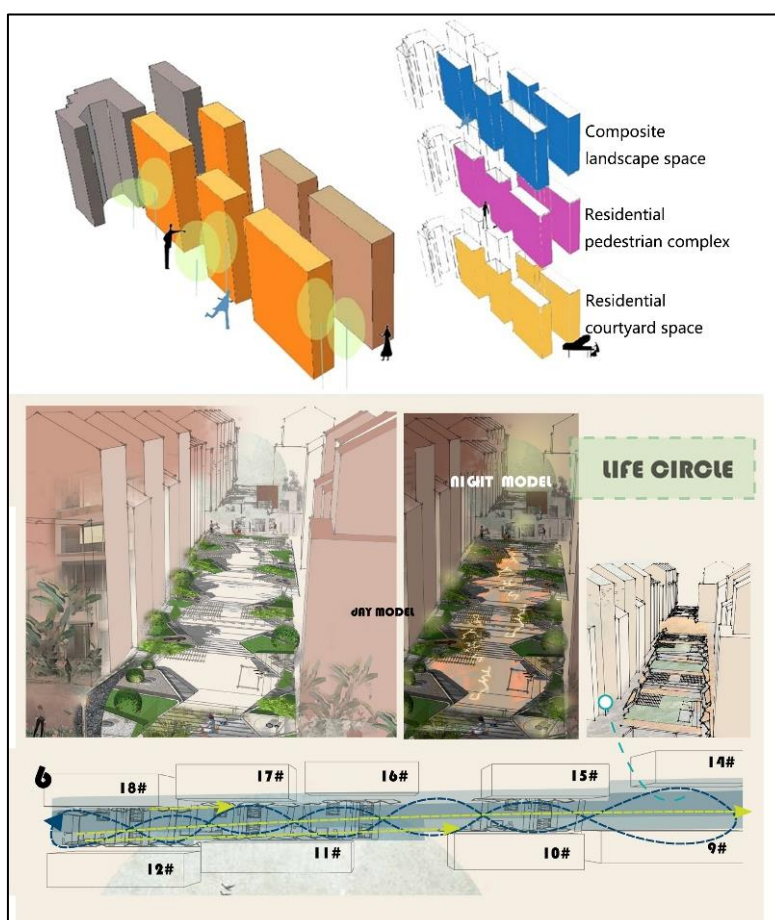


Figure 11. Schematic diagram of landscape greening transformation.

For example, according to the data analysis of B3 region, the air index of this region is poor, and it is easy to form air fluid vortex, which is not conducive to the exchange of fresh air. Therefore, the transformation of this region can be carried out through the planting of three-dimensional greening to carry out air replacement and renewal design (Figure 11). As a leisure lawn, the design uses the open road area between the houses on both sides as a private garden and a creative camping lawn for air renewal and evolution; In order to promote the communication between people of different ages, hard floor lighting is set in the long distance and large area of road activity area to enrich the function of public space and broaden the imagination space of road design; In the public life, cultivate the habit of residents' different use of the road, and realize the idea of sharing the living circle in the road transformation.

5.3. Create a Three-Dimensional Circle and Share a New Model of Public Space

The renovation of this case considers the actual living sit-

uation and personnel structure layout of Jiang Cun Garden, and proposes an updated design strategy combined with "composite" and "collection" to "create a three-dimensional circle and share public space".

First of all, it is the "compound" strategy, which is derived from the "space" and "environment" dimensions in the planning level of the third part, and its goal is to expand the space sharing scope and diversify the definition of public space. Taking into account that most of the residents in this community are resettled houses, many of them are older people. After field investigation, we found that there is a large vacant space between the two buildings in C2 area. Based on the above data analysis, this area can be transformed into a public exchange area. In the design process, through the division of dynamic and static areas, the overhead platform of the static area is set on the corridor to meet the function of leisure tea; The activity area is arranged under the corridor, which is functionally subdivided into leisure and fitness activities and children's activities, forming a family activity mode of intergenerational care (Figure 12).

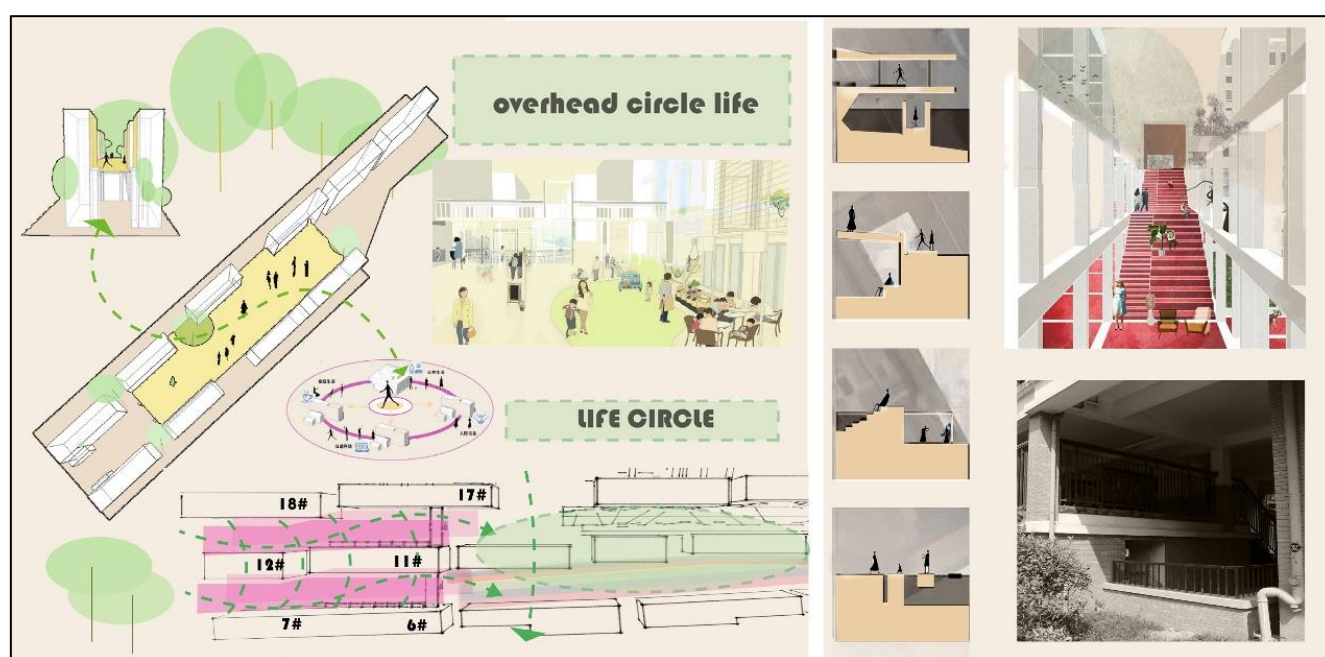


Figure 12. Schematic diagram of public communication space and overhead area.

Secondly, it is the "collection" strategy. In the public area between B2 houses in this community, the overall wind speed and air index are good according to the data analysis. The strategy for the renovation of this area is defined as the purposefully connecting different needs of residents in space to stimulate their sense of identity and participation in the public space. According to the field survey, the young people living in this community have a great demand for communication

and leisure after work, so the design of "experiential courtyard" is put forward accordingly. The vertical design of the courtyard is conducive to the circulation of the micro-climate of the residential area, and the design harmonizes the space, environment and human needs to create a friendly and pleasant community atmosphere and a comfortable and natural social environment. (Figure 13)



Figure 13. Conceptual design of the "experiential courtyard".

Based on the analysis of "community microclimate system parameters", the three-dimensional space processing makes full use of the geographical conditions of the public space, and the landscape is either independent or attached to the building, so that the public space design of the residential area is not only limited to the optimization of the plane transformation, but also extended to the composite renewal of the three-dimensional level. Such a design can cover most of the needs of family activities, achieve the sharing of resources for all ages, effectively deal with the current residential design of the elderly group insufficient consideration, elderly environment facilities lag, intergenerational separation phenomenon and other problems, and produce good social effects.

6. Conclusions

Based on the above discussion on the protection and reconstruction of the living environment of the old residential district, how to promote the development of modern neighborhood spirit through renovation, and combining the knowledge system of sociology, ecology, anthropology, etc., we can draw some innovative inspirations for the future community transformation model of Hangzhou brought by the renewal and regeneration design of the old residential district under the spatial densification model.

First of all, the quantitative study of "community microclimate design parameters" will play a certain reference role in the scientific path construction of future communities, and is expected to promote the development of human settlements science in China. Secondly, the renewal and transformation mode of "Cohousing" is an effective resolution of the current phenomenon of "residential isolation". The design and transformation of this case provides a new choice for the improved residential area and a new idea for the vitality construction and sustainable development of the old community. Thirdly, in the post-epidemic era, this paper expounds from a new perspective how to pursue the concepts of "sharing", "environmental protection" and "health and

wellness" for the community to get along with each other, reshaping the harmonious relationship between neighbors, studying the problem of human settlement environment from the perspective of urban sociology, and conducting "urban repair" design from the spatial and temporal boundary effects of the community. It is an advance test of the future green community and smart community. [23]

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Author Contributions

Dong Rui is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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