Study on Layout Model of Cold Residential Area Based on Computer Microclimate Optimization

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Abstract. With the acceleration of the current urbanization process, as well as the in-depth promotion and implementation of the urban residential reconstruction project, the residential building density is gradually increasing, which makes people's living environment gradually affected by the residential layout mode. The reasonable planning of the layout mode of residential area through computer technology is helpful to make the layout of residential area have more comfortable living environment suitable for living. Based on this, this paper first analyzes the component elements of microclimate, then studies the environmental impact factors of cold residential area, and finally gives the optimization strategy of cold residential area layout mode based on computer microclimate optimization.

Keywords: Cold Residential Area, Computer, Microclimate Optimization

1. Introduction

With the iterative development of social economy, people's expectation and demand for living quality are also constantly improving. This rising expectation is not only reflected in the emphasis on the indoor environment, but also reflected in the external aspects such as the layout of residential areas. This makes the regional residential layout model must fully consider the actual microclimate optimization and adjustment, so as to fully consider the impact of residential areas and their coordination. In the research process of microclimate optimized cold residential area layout mode, it should first plan residential area research, then carry out architectural layout design, and finally carry out the overall layout design of residential area [1]. Only in this way can we fully based on people's living conditions and living needs, improve the comfort and livability of residential space environment. It can be seen that the optimization of microclimate environment and the analysis and application of climate concept can improve the living conditions of residential areas and improve the ecological construction of residential areas, and inject new development impetus into the construction of reasonable residential space.

On the other hand, with the acceleration of the current urbanization process, as well as the in-depth promotion and implementation of the urban residential reconstruction project, the density of residential buildings is gradually increasing, which makes people's living environment gradually affected by the residential layout mode [2]. In this context, a series of deficiencies and problems have gradually
emerged, such as the homogenization of the residential layout model, the residential layout model does not adapt to and match the climate environment, and the residential layout model lacks its own special mode and development personality.

![Diagram](attachment://Diagram1.jpg)

**Figure 1.** Change characteristics of urban residential area layout

For the northern cold region, the unique composition of its environment causes the urban microclimate environmental change, so it needs to pay enough attention to the relative relationship between the layout of residential buildings and microclimate [3]. Through the reasonable planning and layout means of residential area layout mode, the residential area layout can have a more comfortable living environment suitable for living. Under the influence of its microclimate environment, the layout of urban settlements will gradually show the characteristics of changes in several aspects as shown in Figure 1. In turn, each residential area will gradually develop and evolve into its unique microclimate environment, thus forming a spatial model of its own development in the adaptive period.

In addition, with the iterative development of computer big data tech, its application in the process of adjustment and optimization of microclimate environment layout in the residential area can optimize the microclimate environment layout more accurately and effectively, so as to make the residential area have a more adaptive local climate environment [4]. Especially for the cities in the northern cold region, on the one hand, its environmental climate will have a direct and significant impact on the layout mode of residential areas; on the other hand, it will strengthen people's attention to the micro environmental climate of residential areas [5]. As an important part of residential area layout design, the optimization of microclimate environment needs to comprehensively consider the influence of various factors as shown in Figure 2 below. It is necessary to make full use of the data analysis advantages of big data tech to optimize the layout mode of cold residential areas and accurately adjust the comprehensive microclimate environment of residential areas. Therefore, it is of great practical value to study the layout model of cold residential areas based on computer microclimate optimization.

![Diagram](attachment://Diagram2.jpg)

**Figure 2.** Key elements of microclimate environment
2. Research and analysis on the components of microclimate

2.1. Elements of microclimate

In order to make the layout of cold residential area more comfortable, in order to better adapt to the different residential needs of cold residents. In the process of the layout design of cold residential areas, we should fully consider and combine the climate characteristics of cold areas, and integrate into the crowd behavior mode, so as to build a more suitable layout mode of cold residential areas, and solve the unreasonable and unscientific layout mode of residential areas in cold areas [6]. The adjustment and optimization of microclimate based on computer can make the residential area more extensible and comfortable, and improve the livability of residential environment. In the component elements of microclimate, it mainly includes solar radiation, wind environment, temperature, humidity and other parameters, which have an important impact on the environment and comfort of residential areas. Therefore, the study of microclimate optimization based on computer is helpful to optimize and evaluate the microenvironment of cold residential areas, and to improve the optimization of residential layout mode.

2.2. Environmental factors of temperature and humidity

In the northern cold residential areas, the temperature is low all year round in winter, which will have adverse effects on people's travel and outdoor activities. As an important component of the northern cold region microclimate, the level of temperature and humidity and comfort degree will have a greater impact on people's travel intention [7]. In cold regions, its climate conditions are very unique, and the application of water landscape and rainwater collection and circulation system is relatively rare, so its microclimate humidity regulation function is weak. In addition, the water landscape system is rarely used in the northern cold regions due to the adverse effects of freezing on the residential structure in winter. However, it is undeniable that water has important application value for regulating the cold and dry microclimate in northern winter. It can not only significantly improve the ecological environment of cold residential areas, but also adjust the temperature, humidity and aesthetic feeling of cold residential areas.

2.3. Sunshine environmental elements

As another important component of microclimate, sunshine environment will have an important impact on the layout of residential areas in northern cold regions as shown in Figure 3 below. Among them, the reasonable layout mode of cold residential area is helpful to build a better lighting environment, to ensure the lighting duration in the building area, and to promote people to go out, so as to improve the comfort and utilization rate of public area facilities.

![Figure 3. The influence of sunshine environment on residential layout in cold regions](image-url)

In addition, sunshine will have an important impact on the Microclimate Ecology of cold residential areas, such as the types and growth status of plants in the residential areas. Generally speaking, sufficient sunshine environment will make the growth state of plants better, and fully integrate the characteristics of plants, building environment, reasonable distribution of plant layout, help to play the role of plant microclimate regulation [8]. On the other hand, the density of plants in
residential areas will reduce wind speed and absorb light radiation, thus promoting the further optimization of microclimate in cold residential areas.

2.4. Wind environment elements
In northern cities, there are often complex wind environments in the residential areas of cold regions, and the wind speed has obvious differences in different seasons. For example, in cold winter, the wind speed is mainly lower, while in summer, it is mainly large ventilation, so as to reduce people's perceived temperature of solar radiation. As far as the buildings in cold residential areas are concerned, the layout of residential areas will cause serious interference to the wind environment. Different residential layout will have different interference on the wind environment, which will lead to the complex state of the wind field in the residential area, and then affect the surrounding microclimate environment.

3. Analysis on environmental factors of cold residential area

3.1. Influencing factors of wind environment in cold residential area
First of all, in the aspect of the impact of the building orientation on the wind environment in the cold residential area, the orientation of the building in the cold residential area will have a significant effect on the wind speed and air volume in the residential area [9]. For example, in summer, in order to enhance ventilation, buildings need to have corresponding air ducts; in winter, it is necessary to reduce the heat dissipation in residential areas, so as to achieve the effect of keeping warm. For the internal buildings in residential areas, the ventilation is related to the wind direction projection angle. Secondly, in terms of the impact of plane combination on wind environment, determinant layout is often used to improve the ventilation in summer, while staggered layout is mostly used in winter to achieve better overall wind protection effect. In addition, compared with determinant, the central layout has no obvious change in the wind shadow area, but the wind mobility in the wind shadow area is weakened, and the wind speed ratio at the building corner in the windward direction decreases.

3.2. Influencing factors of sunshine environment in cold residential area
First of all, in the aspect of the impact of residential orientation on sunshine, it mainly includes the appropriate building orientation, such as building orientation and sunshine distance, building orientation and sunshine spacing coefficient on the sunshine hours at the bottom [10]. It also includes the best building orientation under the influence of solar radiation, such as the need to convert the building spacing based on the influence of building orientation on sunshine time. Secondly, in the aspect of the influence of architectural layout form on sunshine in cold regions, different determinant layouts have their own characteristics and applicability, which generally include determinant, enclosed type and mixed type, as shown in Table 1 below.

Table 1. The expression types of determinant layout

| Types      | Sub-types          | Specific performance                      |
|------------|--------------------|------------------------------------------|
| Determinant| Parallel           | The most common and most frequently used layout |
|            | Staggered          |                                          |
| Enclosed   | U-shaped layout    | High plot ratio and good sunshine condition|
|            | L-shaped layout    |                                          |
| Hybrid     | Mixed-type         | Buildings get more sunshine time          |
|            | Single-type        |                                          |

4. Optimization strategy of cold residential area layout model based on computer microclimate
4.1. **Computer based optimization strategy for monsoon environment**

First of all, it is necessary to reasonably choose the dominant building layout type, so as to deal with the winter wind environment more calmly. Secondly, it is necessary to select the optimal architectural layout type. In the case of high overall wind environment requirements in cold residential areas, several layout modes such as enclosed type and mixed type are adopted. In addition, it is necessary to avoid adverse architectural layout types and create a good winter wind environment. Finally, the relative position relationship of buildings should be set reasonably. The difference of relative position and distance of buildings leads to great change of microclimate environment in residential area, so as to realize favorable adjustment of microclimate environment of building layout space.

4.2. **Computer based optimization strategy for monsoon environment**

First of all, it is necessary to ensure the internal ventilation environment of the residential area and ensure and promote the heat exchange inside and outside the residential area. Secondly, in order to obtain a lower temperature and humidity index, the appropriate temperature and humidity environment should be selected within the comfortable range of the overall environmental level. In addition, it is necessary to reasonably deal with the architectural layout of new and old areas, create a more comfortable microclimate environment, and realize the effective adjustment of the spatial environment of the whole cold residential area. In order to coordinate the optimization of microclimate environment in winter and summer, it is necessary to reasonably determine the dominant seasonal factors, eliminate the poor architectural layout mode, consider the layout elements in many aspects, and better weigh the choice of architectural layout mode in winter and summer. Finally, it should use computer tech to optimize and adjust the microclimate based on the residents' behavior characteristics and climate protection.

5. **Conclusion**

In summary, the application of computer big data tech in the adjustment and optimization process of microclimate environment layout in residential area can optimize the microclimate environment layout more accurately and effectively, so as to make the residential area have more adaptive local climate environment. For the cities in the northern cold residential areas, the environmental climate will not only have a direct and significant impact on the layout mode of residential areas, but also strengthen people's attention to the micro environmental climate of residential areas. In this paper, through the research on the components of microclimate, the environmental elements such as temperature, humidity and sunshine are analyzed. Based on the analysis of environmental factors in cold residential area, the influencing factors of wind and sunshine environment in cold residential area are studied. Through the research on the optimization strategy of cold residential area layout mode based on computer microclimate optimization, the optimization strategy of monsoon environment and microclimate environment based on computer is analyzed.

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