

Study on Natural Ventilation Design Method of Residential Buildings in Summer and Winter Areas

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Abstract: The rational use of natural ventilation in buildings in hot summer and warm winter areas is an effective measure to achieve building energy conservation and create a healthy living environment. This paper points out the importance of natural ventilation for building energy saving in hot summer and warm winter areas, focusing on some ideas of building natural ventilation and energy saving design in summer hot and warm winter area and puts forward some improvement strategies to build natural buildings in summer hot and warm winter areas. Provide reference for ventilation and energy saving design.

1. Introduction

For a long time, the construction industry is a major energy consumer. Under the situation of shortage of resources and energy in China, building energy-saving design is imperative. In the past building energy-saving design, natural ventilation has been neglected to a certain extent. Today, the natural environment is increasingly valued, the relationship between natural ventilation and human comfort and building energy conservation is particularly important and is gradually reflected in building energy efficiency. Designed to come. Make full use of natural ventilation in building energy-saving design, so that most of the summer time can reach the comfortable temperature of indoor thermal environment, which can minimize the running time of air conditioning and minimize the energy consumption of operation. Therefore, the effective use of natural ventilation has become an important part of building energy-saving design.

2. The important role of natural ventilation in building energy saving in hot summer and warm winter areas

In the hot summer and warm winter areas, the wind resources are abundant and the average summer wind speed is about 2.5m/s (Table 1). If this resource can be effectively used, the natural ventilation and energy saving of the residential buildings in the hot summer and warm winter areas will definitely be Great contribution to building energy efficiency^[1].

Some researchers used computer energy simulation software (Dest) to analyze various energy-saving measures for summer residential buildings in summer hot and warm winter areas and obtained the energy consumption level of air-conditioning refrigeration in summer: after increasing natural ventilation, summer indoor air-conditioning refrigeration The energy consumption is reduced by about 30%. It can be seen that natural ventilation can greatly reduce the energy consumption of buildings in summer and improve the indoor thermal environment. Comprehensive energy saving measures comparison of energy saving measures: Each energy saving measure reduces the summer air conditioning energy consumption in summer hot and warm winter areas more or less. The most prominent impacts are external window energy saving measures, building sunshade and natural ventilation. We can find that natural ventilation plays a significant role in reducing the indoor cooling energy consumption in summer. Therefore, we must pay special

attention to the application of natural ventilation measures that have not received enough attention in the past^[2]. The relationship between natural ventilation effects is as shown in Equation 1.

$$\begin{cases} Y' = \beta_0 + \beta_1 x'_1 + \dots + \beta_m x'_m + \varepsilon \\ \varepsilon \sim N(0, \sigma^2) \end{cases} \quad (1)$$

3. Design ideas for natural ventilation and energy saving in summer hot and warm winter area

3.1 Design Ideas for the General Plane Layout of the Building

In the hot summer and warm winter areas, the overall layout of the building is closely related to the natural ventilation efficiency of the building. In the specific residential design, as far as possible, the orientation of the building is adapted to the dominant wind direction in summer and the appropriate building density and point building layout are used to create conditions for the natural ventilation of the house. Especially in the arrangement, it is better to combine the specific dominant wind direction orientation step by step, which can facilitate the summer ventilation in the site and block the winter cold wind. In the residential building design, computer-aided design software is introduced as much as possible, such as the introduction of Ecotect (Eco-Building Master) software for the best orientation simulation of buildings in the hot summer and warm winter areas. It is not suitable to adjust the layout of the building, the wind direction can be guided by the plant configuration of the site to improve the local wind environment^[3]. The annual energy consumption is shown in Figure 1.

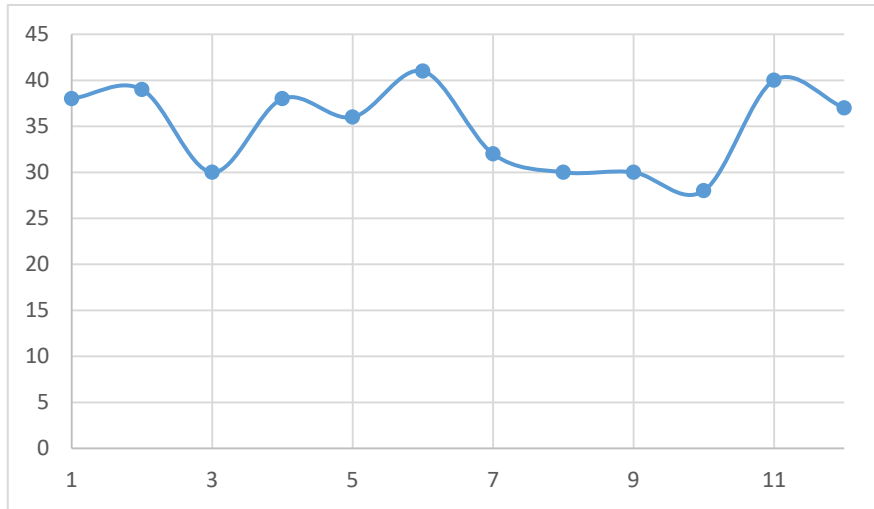


Figure 1 Annual energy consumption

3.2 Design idea of building unit plane

The plane flat layout of the building can better obtain natural ventilation than the compact plane. The room is shallow (usually 14m is suitable), which is more conducive to the formation of natural wind. Therefore, the position of each large deep room should be optimized. The wall is consciously designed into a variety of movable partitions to facilitate the formation of a wind; the courtyard is actively set up and the courtyard inside the house can be used as a cold source or a heat source to enhance ventilation. When the walls are surrounded by the front and rear of the house, the air in the small courtyard in the south side rises due to the sunlight, so that the cooler air in the small courtyard in the north side is introduced into the south courtyard through the north and south windows, which has the effect of room ventilation.

In summer, the average outdoor wind speed in summer hot and warm winter is generally 2.5m/s, which is slightly lower than the wind speed requirement for natural wind ventilation (generally not less than 3~4m/s), but the outdoor wind speed in summer still has wind speed for most of the time>

2.5m / s, should actively optimize the single-plane layout to make full use of the wind speed during this period to achieve natural air pressure ventilation^[4].

3.3 Design idea of building unit profile

In the section design, the chimney effect can be used to perform the "extraction of wind" in the upper and lower sections of the stairs, the public space and the like. For best results, the chimney ventilation openings should be placed close to the floor and ceiling. The air outlet can double as a high side window. In addition, the blowout is designed as a "venturi tube" tapered section, which also enhances the ventilation effect. Because as the cross-section becomes smaller, the flow velocity of the bottom-up air in the section increases, thereby increasing the air pressure difference between the inside and the surrounding room, which is beneficial to "exhausting". Another method that is now more popular as "solar chimney" is to use the collected solar energy to heat the air in the chimney, which can also increase the air temperature difference between the air inlet and the air outlet to enhance the ventilation effect.

In addition to the natural ventilation effect, it can also be used for overhead in the first floor design. This kind of strategy is aimed at the hot summer climate in the hot summer and warm winter areas, which can greatly improve the wind environment inside the building community and eliminate some static wind areas.

3.4 Design Ideas for Building Single Facade

In the optimization of the design of the single facade of the building, the general optimization strategy is to open large windows on the windward and leeward sides of the building, or to design ventilation openings on the facade to obtain the wind. Or the opening of the roof can ventilate the entire building and can use various forms of openings, such as monitoring holes, turrets, tiger windows, small roof towers, ridge vents and gable vents. Different roof forms have different natural ventilation effects. According to the study, the roof with a slope of $<45^\circ$ has a small wind pressure difference between the front and the back and the natural ventilation effect is not obvious; the larger the slope, the more obvious the pressure difference between the front and the back and the better the natural ventilation. However, the roof with large slopes has a large amount of consumables and is difficult to construct. Therefore, it is necessary to select a suitable roof form based on the actual situation.

Three-dimensional greening can also be applied to the building facade to enhance the natural ventilation effect in summer. In some multi-storey and high-rise residential design, the greening facilities integrated with the wall design such as planting Table and flower stand can be cut off on the outer wall. If conditions permit, automatic sprinkler facilities can be set on the frame to imitate the "double skin". The principle is to form a green barrier. The application of the frame not only improves the leakage caused by the damage to the wall caused by the climbing of the vines on the wall, but also the air-damp layer between the frame and the wall forms a ventilation shaft, which enhances the natural ventilation effect. At the same time, the heat on the wall is taken away. A certain regular air deflector is arranged on the facade of the building, so that the outdoor wind flow is introduced into the room through the wind deflector and the positive pressure function of the building ventilation can also be increased. In the design, some stainless steel, high-strength plastic, glass steel and other durable materials can be used as the wind deflector. In addition to the function of air guiding, it can also be decorated to bring beauty to the building. Optimize the design of the sunshade components on the facade. The purpose of the sunshade is to block direct sunlight and reduce the indoor temperature. At the same time, it can also shade the wall and reduce radiant heat, cause air pressure difference, accelerate indoor air circulation and enhance ventilation effect. In the shading treatment of Minnan residential houses, there are many methods, such as concave sunshade, small balcony shade, raft, porch shade, door and window visor, riding shade, etc., which can be used for reference to design shades that meet the requirements of both shading and ventilation^[5].

4. Conclusion

In short, the use of favorable factors in the hot summer and warm winter regions to reduce building energy consumption, reflecting the design concept of building climate adaptation. Natural ventilation is a healthy, low-cost, environmentally-friendly way to save energy in buildings. Designers should make the best use of architectural design to enhance the quality and value of the building, to meet the comfort and health of people and to achieve a healthy and comfortable building.

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