Energy-saving Analysis of Passive Buildings

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Abstract

The world is now facing environmental pollution and ecological balance damage. Greenhouse gas emissions have already exceeded the self-regulation of the Earth's ecosystems, and global warming. The ozone layer is destroyed, and ultraviolet rays plague humans for their health. Faced with a series of problems, countries have successively promulgated policies on energy conservation, environmental protection and low emissions. According to statistics, in Europe and other developed countries, the annual energy consumption of the terminal building to consume 35% of the total energy [1] , China's construction industry consumes energy accounted for the entire society of total energy consumption by 28%[2] , with China's urbanization continues to develop, and this proportion will continue to increase. Therefore, building energy conservation plays an important role in China's energy conservation and environmental protection actions, and is an important way for China to achieve emission reduction agreements. This article will analyze passive buildings in energy-efficient buildings.

Keywords

Passive building,regionality,airtight thermal bridge.

1. Introduction

Passive building is a low-energy house built by combining various passive energy-saving methods such as natural ventilation, natural lighting, solar radiation and indoor non-heating heat source with energy-saving technologies for building envelopes. Passive architecture originated in Germany, and China's first contact with passive buildings was also derived from Germany. Germany is the most developed country in passive construction. The passive building standards of various countries are also modified based on the German PHI certification. The “Hamburg House” of the German Pavilion at the 2010 Shanghai World Expo became the first passive building to be unveiled in China.Subsequently, the passive building developed rapidly in China. The Qinhuangdao “ on the water side ” Sino-German cooperation passive house demonstration project realized localization through scientific and technological research and development[3] , and then the passive buildings in various provinces and places in China were springing up. Today's passive buildings reduce energy consumption by more than 90% compared to ordinary buildings , air humidity is maintained at 40% to 60% , comfort is greatly improved , and construction costs are only increased by 8% to 10% .

2. Passive Building Related Theory

2.1 Ecological Building

As the name suggests, ecological architecture refers to the application of ecological principles to architecture. By combining with architectural principles, ecological design of buildings is realized, and architecture and nature are harmoniously symbiotic. The combination of ecological principles and architecture provides a theoretical basis for the improvement of general architectural design to ecological architectural design. The concept of recyclability in the ecosystem is to let us learn from a stable self-circulation without burdening the environment. This is the ideal state for realizing ecological architecture.

2.2 Green Building

Green building is known for its focus on “environment” and hopes to provide opportunities for the mutual benefit of ecology and environment with a viable solution, and it has become a theory that is easily accepted by the public. China's "Green Building Evaluation Standards" provides a clear explanation for green buildings, which can be understood as "four sections and one environmental protection." There are different green building evaluation systems around the world, such as the LEED certification in the United States, and the green building evaluation system in China is different. Therefore, whether green buildings reach “green” does not have uniform standards.

2.3 Low Carbon Construction

With the convening of the Copenhagen Global Climate Conference, issues such as carbon emissions and the greenhouse effect have attracted people's attention. Low carbon is an emerging term, low-carbon transportation, low-carbon materials, low-carbon diets, and even low-carbon buildings. The so-called low-carbon building refers to the building's carbon emission evaluation criteria to pay attention to the architectural design and the carbon emissions during its use. The aim is to reduce carbon dioxide and other related carbon emissions through all available methods and means throughout the life of the building.

2.4 Sustainable Buildings

In the 21st century, the world emphasizes the sustainable development of people and nature, emphasizing a sustainable ecological outlook. As a building closely related to human life, the sustainability of architecture is also emphasized. The so-called sustainable building can be summarized as a building designed and built by specific methods and approaches under the guidance of the sustainable development concept. It covers everything from architectural design to building construction, from building construction to building materials, from building operations to building demolition, to economic factors, social factors, ecological factors and so on.

3. Energy-saving Methods for Passive Buildings

3.1 Combine the Regionality of the Building

The regional nature of the building : the inherent properties of the building in the context of a specific climate , region and location ,landform , folk culture , and use of local materials . It contains all the influencing factors and traits associated with existing buildings .

Jiangnan residential buildings, dry-column buildings, northern Shaanxi caves, Beijing Siheyuan and other buildings are designed in combination with the climate and geomorphology of the building. These buildings now seem to take advantage of the most basic passive energy savings. In addition, arcades, porch-style buildings, retreat buildings, and atrium buildings are also passive energy-saving designs. The orientation of the building is at an angle to the dominant wind direction at the location of the building, and natural wind is used to ventilate the building.

3.2 No Heat Bridge

Thermal bridge refers to reinforced concrete or metal beams, columns, ribs, etc. in the outer wall and roofing structure.There is a difference in heat transfer performance between these parts and the main wall material, resulting in discontinuous insulation layer, when the indoor and outdoor temperature is certain when the temperature difference is reached, this part will become a densely convected area, which we call a thermal bridge. Building thermal bridges mainly include:He thermal bridge, thermal bridge formed by heat transfer difference of materials, thermal bridge formed by concentrated heat flow, and thermal bridge caused by inconsistent thickness of insulation layer of building components. Thermal bridges generally appear in the following parts: the outer window, the parapet wall, the wall pipe and other parts.The design and construction method of the heatless bridge used in the passive house:

The doors and windows used in the passive house are aluminum-clad doors a window in which the inner and outer aluminum alloys are connected by a nylon connecting member having high heat

insulating properties to form a broken bridge, thereby being able to the inherent high thermal conductivity of the aluminum alloy effectively prevents the loss of heat;

The window of the passive room is installed on the outside of the masonry wall, half of the entire window is wrapped in the insulation layer, and the outside of the window frame falls on the wooden bracket.This avoids the direct contact of the window with the main wall, thus forming a heatless bridge structure.

3.3 Better Air Tightness

As one of the key points of ultra-low energy building design, airtight design is of great significance to the thermal performance of building envelopes. Good air tightness of the building can effectively reduce wind penetration, reduce uncontrolled ventilation, avoid mold, condensation and damage caused by moisture intrusion, and reduce external noise and air pollution, thus ensuring indoor environment comfort. Balanced indicators to improve the quality of life.

3.4 Fresh Air Heat Recovery System

Because of the good air tightness of passive buildings and the good quality of air in passive buildings, passive buildings must be equipped with mechanical exhaust and mechanical fresh air. The new wind heat recovery system uses the waste heat in the exhaust air to heat the fresh air to save energy.

3.5 The Use of New Insulation Materials and Shading Technology

Low-E glass, foamed concrete shear wall, nanoporous insulation material, vacuum insulation board and other materials can improve the insulation effect of the building and achieve energy saving purposes[4] .

External shading measures, usually the sunlight is blocked by the sunshade before reaching the window surface, and the fixed external shading measures are more conducive to energy saving. The design of the balcony space, heat loss usually occurs at the connection between the balcony and the main structure. Frequent use of the balcony will also increase the heat loss of ventilation. Therefore, the balcony should be placed on the inside of the external insulation or use the broken balcony system.

3.6 Using Solar Radiation and Geothermal Energy

Today's photothermal efficiency can reach 40%, and photoelectric efficiency can reach 10%. The installation of photovoltaic panels on the roof of a building can effectively utilize solar energy and reduce the application of the building to the power system. Geothermal energy is mainly used in fresh air heat recovery systems.

4. Problems and Obstacles

1. Passive buildings in China draw heavily on the relevant practical research results of foreign countries, especially Germany. Germany's passive ultra-low-energy building system, compared with conventional buildings, through the low thermal insulation performance of the external protective structure and mechanical equipment system, to adjust the indoor environment to achieve a comfortable experience of different energy consumption, high emission mode, the use of complete closure The internal environment, assisting a small amount of energy consumption, to achieve ventilation and ventilation, to ensure high comfort [5] . The climate in Germany is relatively simple, and China's climate is complex and diverse. Whether the German passive house certification standard that I borrowed from is applicable throughout China remains to be verified by experiments.

2. The insulation and other technical equipment added by the passive house are not reflected in the performance of the ecological evaluation index of the whole life cycle of the building. These also require experimental and data support.

3. In order to pursue energy-saving indicators, most passive buildings are only technical overlays, regardless of the excessive cost.

4. In addition to the country’s first pilot projects, specific policy measures were not seen. At each provincial level, Shandong Province is passive The public demonstration project of the building has

given a subsidy of thousands of yuan per square meter; however, for private projects, no substantial substance has been seen. Sexual financial support. In project approval, land supply, credit, taxation, education and training, publicity and guidance, urban planning, inspection Local governments are still lacking in a series of links such as collection, construction, design, standard setting, energy conservation incentives, area accounting and sales. Strong policy support.

5. Conclusion

The emergence of passive buildings can solve the global energy crisis and the global environmental crisis. China is the largest developing country in the world, facing the world's biggest energy shortage challenge and environmental degradation challenge. Therefore, passive buildings will have huge room for development in China. However, China's passive buildings are developing late, far behind developed countries. China's passive house standards and certifications are also heavily borrowed from Germany. But China's geography and climate are vastly different from Germany's. China needs to develop standards and certification technologies that meet its own standards. In the energy saving of passive houses, we must constantly focus on the existing six energy-saving technologies and continue to innovate. And continue to expand new energy-saving technologies.

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