Realization of Building Energy Saving and Solar Heating in Cold Areas based on Computer Technology

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Abstract. The climate of cold area is cold in winter (the average temperature of the coldest month is 0 ~ -10 °C and < -10 °C), the outer envelope of the building bears the interference of low temperature, wind and snow, hot in summer, and the outer envelope of the building bears the interference of high temperature, solar radiation and rain. Therefore, the design of buildings should meet the requirements of winter heat preservation, cold prevention and antifreeze. At present, 95% of the new buildings built every year in China are still high energy consumption buildings. The heating energy consumption per unit building area is about three times of that in countries with similar climate. The building energy consumption in China accounts for nearly 30% of the national energy consumption. With the development of building technology, the improvement of people's awareness of energy and the attention of government departments, China should vigorously develop building energy saving, which is urgent. The demand of solar energy is increasing day by day, and the situation of energy utilization is tense. However, the large-scale use of conventional energy will have a negative impact on the environment. As a kind of renewable energy, solar energy is inexhaustible and will not increase the environmental load. It will become an important part of the future energy structure. In the building energy consumption, the energy consumption of domestic hot water and heating accounts for a considerable proportion. Using solar energy to meet the requirements of low-grade energy consumption, such as domestic hot water and heating, has great energy-saving benefits. Therefore, solar energy heating technology has been paid more and more attention. At the same time, with the development and maturity of computer technology, it also provides more support for solar heating technology. This paper analyzes the realization of building energy saving and solar heating in cold areas by using computer technology.

Keywords: Building Energy Saving, Solar Heating, Cold Area
1. Current situation of building energy conservation in cold area

1.1. Too few human and material resources are invested in building energy conservation

Firstly, in some areas, there is no special person in charge of the energy conservation work, and the management is relatively loose, so the building energy conservation work cannot be carried out systematically.

Secondly, due to the shortage of funds, the basic data required for the heating system reform cannot be collected in place, and many research and development projects are in a state of stagnation, such as the implementation of existing building energy-saving transformation projects is lack of effective means, which is difficult to achieve[1].

1.2. Building energy saving products and technologies are not effectively promoted

Some mature energy-saving technologies and products can not be promoted and applied in time. First, the selectivity of energy-saving technologies and products is insufficient, and some mature new technologies and products can not be promoted and applied in time. Especially in combination with the requirements of fire protection design, the selectivity of building insulation materials is seriously insufficient[2-4]. There is no competition mechanism in the promotion and application of new technology and new products, and the market can not play a full regulatory role. Second, although the performance of new energy-saving materials is excellent, the price is too high to be popularized.

1.3. The progress of heating system reform restricts the promotion of building energy conservation

As the basic work is weak, household measurement, statistics and other basic work are seriously lagging behind, some statistical data are poor in accuracy and timeliness, scientific and unified household measurement statistical system, monitoring system and assessment system have not been established, the statistical strength of each department is insufficient, the implementation of statistical funds is difficult, and it does not meet the requirements of building energy conservation. So far, the reform of heating system in our district has made slow progress, affecting the overall progress of building energy saving[5-6].

2. Development status of solar energy at home and abroad

2.1. Development of solar energy in Europe

Most of the basic heating in Europe is provided by district heating facilities. The heating facilities in Central Europe and Northern Europe are the most perfect. Traditionally, large-scale solar heating plants are mostly used to heat households, which makes large-scale solar heating plant technology get a lot of engineering applications in Europe.

2.2. Current situation of domestic solar energy

China's solar water heater industry has developed rapidly in the past 10 years. At present, it has a unique huge market without government subsidies. However, although the total amount of solar hot water market in China ranks first in the world, the average per capita is only at a medium level. It will be an
effective way to promote and expand the market development of solar energy products to strengthen the intensive, standardized and industrialized engineering application of solar water heating technology, especially the centralized solar heating technology. It can be predicted that if the household solar hot water system has successfully launched the solar hot water product market for China, then according to the climate characteristics and solar energy utilization conditions, the unified planning and construction of large-scale centralized residential district level solar heating system can further expand the solar heating hot water product market and further develop the heating projects in cold areas Exhibition brings new opportunities.

It is not hard to see that the potential of solar hot water system and product market in the future is even greater in cold areas. If we can effectively use solar energy to improve living conditions and quality of life for cold residents through technological development and market guidance. On the one hand, by planning and designing a reasonable solar heating service radius, we can not only provide domestic hot water for cold areas, but also achieve the goal of solving the basic heating for residential buildings in cold areas. On the other hand, for the energy-saving transformation of the existing heating infrastructure in cold areas, the construction of large-scale solar thermal power station combined with the original heating facilities can effectively reduce the use of conventional energy, reduce CO2 emissions and protect the ecological environment of the city by realizing efficiency and energy saving through reasonable energy combination.

3. Technical measures for building energy conservation

3.1. Building shape design

The building orientation should adopt the north-south direction. According to the relevant measurement data, under the same conditions, the heat transfer consumption of the East-West plate building is about 5% higher than that of the north-south direction. The main room shall avoid the dominant wind direction in winter. To control the shape coefficient of buildings is an important index to measure whether the shape design of buildings can save energy. For a certain volume of buildings, the larger the shape coefficient, the greater the energy consumption. Try to reduce the window wall ratio of the building and improve the energy-saving performance of the external window.

3.2. Buffer space

"Buffer space" in the south facade of the building is set with a large glass face "sunshine room", also known as "buffer space". This space, like a collector, has a good function of absorbing and storing heat. It is similar to the way of closing balconies with glass windows in many parts of China. Its function is like a greenhouse. In winter, it can effectively improve the room temperature and reduce the heating energy consumption. When the temperature in the "buffer space" rises, the heat will be absorbed by the floor and wall, and then slowly released indoors. If a movable insulating layer or ventilation system is set in it, the heat obtained from it can be reasonably distributed indoors according to the needs. "Buffer space" is suitable for cold zone climate, and is widely used in Western Europe, northern Europe and North America (Figure 1). In addition, the atrium can be used as a buffer space, where the physical function and connotation of the atrium are more abundant than the traditional meaning of the atrium. In winter, the atrium is a closed large warm room; it becomes a thermal buffer space between the office and the external space, playing a "greenhouse" role of heat preservation and energy conservation.
4. Solar collector

Most of the solar collectors are placed on the roof, but there are also solar collectors integrated with walls or windows, such as window collectors (Figure 2). It is a device that combines windows with collectors. It uses high-strength transparent glass to make a sealed box. When it is exposed to sunlight in winter, its internal temperature can reach 30-70 °C. The heat can be directly released to the room or transmitted to the heat storage room with pebble as the main material through pipes, and then released at night. If this kind of window collector replaces ordinary windows, it can save at least 10% of heating energy.

4.1. Natural ventilation

One of the effective ways to strengthen natural ventilation is to organize the ventilation, the other is to set up the ventilation pipe. The ventilation pipe in the house can ensure the normal ventilation under the
static or weak wind conditions. At present, because of the direct natural lighting and ventilation, many toilets in residential buildings have cancelled the ventilation channel, so that it is easy to transmit bad smell to the hall or the room, so as to reduce the air quality. Therefore, the ventilation channel with control valve should be set in the toilet to ensure the constant negative pressure. In the past, the realization of indoor natural ventilation depended on the opening of doors and windows or a large number of permeated wind due to poor tightness of doors and windows, which wasted a lot of energy in winter. The ventilation pipe can control the indoor natural ventilation. At present, the practice of some developed countries is to set up small ventilation channels on the external walls or windows. Each room has an air flow control valve. In winter, the outdoor fresh air will enter the room after being heated in the basement through the ventilation channels. In this way, the natural ventilation of the room can be maintained under the condition of ensuring the air tightness of doors and windows in winter, and the fresh air can be discharged from the ventilation passage or attic of the kitchen or toilet after passing through the room.

4.2. Natural lighting (sunlight)

In the design, strengthening natural lighting can save energy consumption. The reflective mirror or edge can be set on the window and indoor by the reflection principle of light. This can not only prolong the time of natural lighting, but also improve the indoor light comfort. In general, the window can only provide the standard light within the range of no more than 3m from the window, so the area with a larger depth must be supplemented by artificial lighting. After adding reflective facilities, the natural light can be evenly covered into the area with a depth of 7m, thus saving energy. In order to ensure the natural lighting and ventilation of the building, the ratio of the window opening surface on the facade to the actual wall surface shall not be less than 50%.

4.3. Integration of solar water heater and building

Solar energy has become the first choice for renewable energy utilization because of its advantages of clean, huge reserves, low cost, no regional restrictions and high energy quality. Especially in multi-storey buildings, the application of solar water heater has got unprecedented development. The sunshine in severe cold area can also meet the sunshine requirements of solar water heater. At present, the most popular installation method of solar water heater in multi-storey buildings is to install it on the roof. However, it also has many defects, not only seriously affecting the city landscape, but also there are many security risks. Only after the integration of solar water heater and building can solar water heater be widely used. The integration of solar water heater and building is to fully integrate solar water heater and building and realize the harmonious unity of overall appearance. The use function of the building is organically combined with the use of the solar water heater to form a multi-functional building component. The space is cleverly and efficiently used to make full use of the solar energy available part of the building - the sunny side; the synchronous planning and design, the synchronous construction and installation can save the installation cost and the construction cost of the solar water heating system, and the installation is in place once to avoid the later stage Inconvenience caused by construction to users' life and damage to building structure; comprehensive consideration of building structure and solar energy equipment coordination and harmony, reasonable structure, so that the solar hot water system and building integration, does not affect the appearance of the building.
4.4. Ice storage in winter

In order to make full use of the natural ice and snow resources in winter, ice and snow storage is adopted in winter. The ice and snow melting in summer will release the stored cooling capacity, which will be used as the cooling source of air conditioning in summer. Because of the climate characteristics of severe cold area, the air conditioning time in summer is short and the total cooling capacity required is less. Adjusting the storage capacity of ice and snow can provide all or part of the cooling capacity of air conditioning in summer, which can reduce the design cost. The initial investment can reduce the operating cost. Different from the traditional ice storage technology is the ice making method. The traditional ice making method needs to consume a lot of electric energy or other fuel energy. Making full use of the climate superiority brought by the geographical location, making full use of the inexhaustible and inexhaustible energy from nature will bring considerable benefits to human beings, which will be a significant development in the energy conservation development.

5. Summary

Building energy conservation is the turning point of China's construction industry towards sustainable development, and also a long-term strategic aspect of China's national economic development. In the coming decades, the housing industry will still maintain a rapid growth trend, and the energy-saving design of residential buildings will have a profound impact on the development of our country.

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