

Research on Application of New Prefabricated Green Building Technology Based on Green Building Industry Chain

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Abstract

As is known to all, energy is very important for the development of the current era. With the gradual progress of urbanization, the energy consumption per unit prefab floor area in China has reached more than three times that in developed countries, which has a very serious impact on both resources and environment. With the rapid development of China's social economy, the prefab construction industry has made some progress to some extent, but it has become the key to prefab building design to pay attention to energy saving design in prefab building design. In this paper, the energy-saving design of prefabricated building design will be analyzed, so that the use of energy efficiency is greatly improved.

Keywords: Prefabricated Building Design Energy Saving, Importance, Measures;

1. Introduction

The concept of "prefabricated building energy efficiency" has had different meanings in the world. In the 30 years since the world oil crisis in 1973, it has gone through three stages of development in developed countries. But it soon changed to "conserve energy in prefab buildings," meaning reduce the loss of energy in prefab buildings. More recently it has been commonly referred to as "improving energy efficiency in prefabricated buildings", that is, not in the negative sense of saving, but in the positive sense of improving efficiency. In China, it is still commonly referred to as energy saving in prefabricated buildings, but its meaning should go to the third level, that is, rational use and efficient use of energy in prefabricated buildings and continuous improvement of energy utilization efficiency^[1].

2. Concept and design status of energy conservation in prefabricated buildings

2.1. What is energy saving in prefabricated buildings

Prefabricated building energy efficiency refers to the fabricated by adopting reasonable construction design and selection to meet the requirements of energy-saving wall materials, roofing insulation materials, doors and Windows, air conditioning and other measures, so that god's building, compared with no energy saving measures of housing, in guarantee under the condition of the same indoor thermal comfort environment^[2, 3], it can improve the efficiency of electricity utilization, reduce the prefabricated building energy consumption.

2.2. Application status of energy-saving design

In recent years, China's prefabricated building industry has developed rapidly, which requires a large amount of energy for construction and operation, especially for heating and air conditioning energy consumption of prefabricated buildings. Compared with developed countries, energy conservation in

China started late, and energy waste is very serious. Figure 1 illustrates the material and energy consumption process of the whole process of prefabricated building

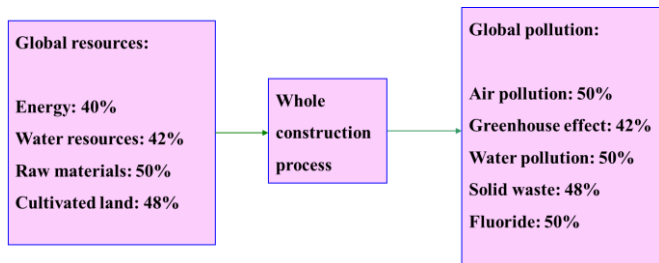


Figure 1. Material and energy consumption throughout prefabricated buildings.

As shown in figure 1, the energy conservation of prefabricated buildings largely restricts the implementation of the "sustainable development" strategy. The heating consumption of prefabricated buildings in China is 4-5 times of that in developed countries, and the roof is 2.5-5.5 times. The external window is 1.5-2.2 times, the air permeability of doors and Windows is 3-6 times, and the total energy consumption is 3-4 times. If high energy consumption is allowed to prevail in the prefabricated building industry, the energy consumption of prefabricated buildings will grow much faster than the possible growth rate of energy production in China, which will consume more manpower and material resources. At present, energy consumption of prefabricated buildings accounts for about 28% of the total energy consumption of the national economy, and the trend is increasing. Energy consumption of prefabricated buildings not only affects the energy supply of the country, but also affects the level of energy use efficiency as well as the environment. Therefore, it has great potential to carry out energy conservation work of prefabricated buildings^[4].

3. The importance of energy saving design for prefabricated buildings

Energy conservation in prefabricated buildings is the fundamental requirement for China's low per capita energy and resource occupancy. Too low per capita energy resources and too high per unit of GROSS

national product energy consumption has long been a prominent problem in China's economic and social development. Therefore, energy conservation of prefabricated buildings will become the primary issue to improve the energy use efficiency of the whole society. Energy conservation in prefabricated buildings contributes to sustainable development and environmental protection. Prefabricated buildings the design life of not less than 50 years in our country, in such a long time, will cost a lot of energy, how to improve the indoor comfort at the same time, improve the utilization rate of energy and can make the prefabricated building, the decrease of the total level of the road of sustainable development, is the realization of the national economy and an important content of sustainable development of the society, and protect the resources, the important measures to reduce environmental pollution^[5-7].

4. Energy saving measures in prefabricated building design

4.1. Ventilation design of the house

The main orientation of prefabricated buildings should cater to the prevailing wind direction in summer (north-south or near north-south layout is preferred in most parts of China), which is conducive to natural ventilation and improves the comfort of living. At the same time, the solar radiation received by the south-north prefabricated buildings in summer is much less than that received by the east-west prefabricated buildings, as shown in Table 2 below:

Table 1. Proportions of different directions in ventilation design.

Ventilation direction	Window wall area ratio
North	0.25
East and West	0.30
South	0.35

As shown in Table 1 above, such a layout can save air conditioning in summer: in winter, prefabricated buildings are exposed to the opposite amount of solar radiation as in summer, thus saving energy needed for prefabricated buildings' insulation. The prefabricated building spacing should be appropriately increased to

meet the requirements of sunshine spacing for local planning departments. Increasing the space between prefabricated buildings is beneficial to the air flow in the residential area -- the air volume increases and the wind speed increases, so as to increase the heat exchange between prefabricated buildings and air, effectively reduce the temperature of prefabricated buildings, and thus reduce the energy consumption of prefabricated buildings.

4.2. Adopt energy-saving glass Windows

Modern prefabricated buildings tend to have a large area of glass lighting, while ordinary glass Windows of ordinary residences adopt ordinary glass. Although the cost is low, the thermal insulation effect is poor, which cannot prevent the heat energy in sunlight from being transmitted to the interior, nor can it prevent the indoor heat energy from leaking in winter. If you choose high-quality glass can make the indoor temperature relatively stable. The heat transfer K value of ordinary glass is 5.8w /?O? While the heat transfer K value of high-tech energy-saving glass is only 1.6 ~ 2.0W/ m2.O? In winter, a room with ordinary glass loses more than three times as much heat per square meter per hour. So the room will feel quite cold in winter, to warm up, the air conditioner needs several times more power consumption to achieve balance. There is also a low radiation coating glass synthetic insulating glass, in the summer than ordinary glass energy saving more than 60%, and winter can save energy saving more than 70%, so, the use of good quality glass can effectively save air conditioning or heating and the cost of consumption.

4.3. Design energy-saving lighting

In China's civil prefabricated buildings, lighting power consumption is not only large but also wide, so choosing the right lighting equipment is very important for energy saving, and the chosen electric light source should have high luminous power. The luminous efficiency of incandescent lamps used in daily use is generally about 15Lm/W, while the luminous efficiency of T5 widely used at present can reach about 90Lm/W, and can significantly improve the characteristics of lighting, which is very suitable

for office buildings and residential buildings.

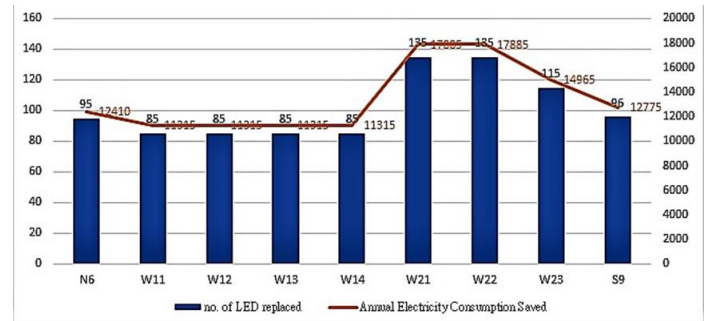


Figure 2. Comparison diagram of designing energy-saving lighting instead of traditional lighting (From August to October).

Therefore, we should try to use natural light in the design, such as the use of partition dual switch control, automatic light saving lighting control. For the traditional halogen lamp, tungsten filament lamp can be replaced by fluorescent lamp; mercury lamp can be replaced by sodium gas lamp, composite metal lamp. When decorating besmear, choose bright color to improve the result of indoor illum. Try to replace more than 20 W fluorescent lamps with 40 W or 60 W fluorescent lamps, which can also achieve the purpose of energy saving.

4.4. Ground energy saving design

In the energy-saving design of prefabricated buildings, the insulation of the ground is often ignored. Practice has proved that if the ground is not insulated, the energy consumption of heating will increase, and it is easy to dew and frost the corner near the ground. The ground energy-saving insulation can be designed according to the specific requirements of the project.

4.5. Energy saving design of prefabricated building envelope

The energy saving design of the prefabricated building envelope mainly includes four aspects: the external wall heat preservation structure, thermal bridge blocking technology, roof heat preservation and insulation technology, basement exterior wall and ground heat preservation technology, high-efficiency energy saving external window and curtain wall system, control of window wall area ratio, shading

facilities, utilization of natural ventilation and lighting. The second is the recovery and utilization of waste heat/cold in prefabricated buildings. Use solar energy, shallow soil heat energy, surface water heat energy, wind energy, etc. Fourth, other technologies to improve comfort, such as floating floor technology, two-layer overhead ground system, drainage technology after sanitary fixtures are on the same floor, reclaimed water treatment and reuse system, intelligent building automatic control system, etc.

At present, energy saving design plays a very important role in prefabricated building design. First, as the energy consumption of prefabricated building is large, and with the progress of The Times, residents have higher and higher requirements on prefabricated building, and the resource consumption also increases, therefore, the application of energy saving design technology is very necessary. Second, the pace of urbanization is getting faster and faster, and the area of prefabricated buildings is getting larger and larger. Prefabricated buildings, which are energy-consuming prefabricated buildings, have a negative impact on environmental protection, resource and energy management, and gradually cause energy crisis as time goes by. Third, China has been ignoring energy problems for a long time, resulting in the lag of energy-saving technology compared with developed countries. To sum up, China's prefab building design must strengthen and improve energy saving technology in order to alleviate the problem of energy saving.

5. Problems in the application of energy-saving design in prefabricated building design

5.1. The relevant policies are not perfect

Although relevant laws and regulations have been promulgated in China, most of them are mandatory and lack of economic incentives. In foreign prefabricated buildings, in order to encourage the development of prefabricated building energy conservation design technology, the state will give appropriate economic incentives according to the percentage of energy conservation, or energy-saving equipment installed in prefabricated buildings, etc.,

to improve the enthusiasm of prefabricated buildings in applying energy-saving technology. Therefore, our country lacks a complete set of laws and regulations, which hinders the development of energy-saving design technology to a certain extent.

5.2. Lack of comprehensive understanding of energy conservation

Due to the short application time of energy saving design technology in China, the relevant competent departments, construction workers and even the people's understanding of energy saving in prefab buildings is not comprehensive enough. As a result, the competent department lacks supervision, special supervision institutions and supervision system, which makes it difficult for the envoy design technology to get good publicity, and the people have insufficient understanding of energy-saving prefab buildings, so the envoy design technology lacks a good application environment.

5.3. Lack of relevant technical support

Support of prefabricated construction lack of relevant technology is embodied in two aspects, on the one hand, the national long-term neglect energy-saving prefabricated construction, causes our country professional energy-saving reform of the prefabricated construction company is less, and fabricated need according to the existing residential building energy saving, energy saving renovation, which requires professional prefabricated building energy-saving renovation company according to the actual situation of the residence, selecting the appropriate energy saving building materials. The overall data is shown in Table 2 below:

Table 2. The development of national energy-saving prefabricated buildings in recent years.

Year	Proportion of construction in urban construction /%	Comprehensive application rate /%	Construction form innovation rate /%	City overall construction optimization rate /%
2011	39	33	20	36

201	40	37	23	45
2				
201	44	45	23	55
3				
201	46	47	26	65
4				
201	48	50	29	70
5				

As shown in Table 2 above, on the premise of ensuring effective supervision, the government selectively increases the opening of data to the outside world at different levels. But at present, the supply of energy saving building materials and materials cannot fully meet the energy saving needs of prefabricated buildings, which hinders the development of energy saving of prefabricated buildings. On the other hand, the shortage of energy saving technical personnel, the current technical personnel and construction personnel are not up to the standard, resulting in the inability to carry out further research on energy saving technology, and ultimately it is difficult to reflect the energy-saving effect of prefabricated buildings.

6. Application of energy saving design technology in prefabricated building design

6.1. Energy saving design of prefabricated building planning

Prefabricated building planning is the premise of prefabricated building design, and prefabricated building planning mainly considers the overall shape, overall combination and sunshine of prefabricated building, etc.

First, in terms of the shape design and overall combination of prefabricated buildings, different forms of prefabricated buildings have different requirements for energy conservation design. Therefore, prefabricated construction workers should first consider the modeling of prefabricated buildings, and the modeling should be as simple as possible, in order to use modeling energy saving to achieve the effect of emission reduction. Secondly, the space between prefabricated buildings should be considered and the design planning should be at a reasonable balance point. For example, the inlet and

outlet can be combined with the characteristics of the dominant wind direction to facilitate air flow and promote heat exchange. In this way, the design technology with the advantage of natural design can reduce the energy consumption of prefabricated buildings and achieve the effect of energy conservation and emission reduction.

First of all, prefab architects should avoid east-west orientation and choose northwest or near North and South as the best choice. Secondly, considering such external factors as climate, construction land and geographical location of prefabricated buildings, the design of sunshine and orientation will be affected to different degrees. Therefore, designers of prefabricated buildings should have a comprehensive understanding of all factors and formulate a good design plan after comprehensive consideration of all factors. For example, the rooms of prefabricated buildings can be designed to be leeward and sunny in winter to reduce the heat dissipation effect of the envelope.

The problem that is proportional to area of window and metope. Prefabricated construction design should follow the prefabricated building energy efficiency design standard "the relevant provisions of design planning, at the same time, the prefabricated buildings should be fully considered in topography, local winter sunshine condition as well as the comprehensive factors such as prefabricated building lighting and ventilation requirements, try to reduce the window wall ratio, in order to reduce resource consumption.

6.2. Energy saving design of envelope

In the energy saving planning of prefabricated buildings, the heat conduction and cold penetration of prefabricated buildings have an important influence on the energy consumption of prefabricated buildings. Therefore, in the energy saving planning, prefabricated building designers should pay special attention to the characteristics of prefabricated buildings and related indicators.

First of all, the wall is the main body of prefabricated building envelope. Therefore,

prefabricated building designers should carefully consider the wall energy saving design in the early stage of prefabricated building design planning. At present, most of China's prefabricated buildings still use traditional solid clay bricks when laying walls, and the insulation quality is determined by the thickness of the masonry. However, this wall-laying method consumes too much resources and violates the principle of energy conservation. In order to promote the development of external thermal insulation technology of prefabricated building on the basis of energy saving planning and design, prefabricated building designers should adopt composite thermal insulation wall technology and hollow masonry wall technology instead of clay brick wall method.

Second, the door window is the weak link that consumes heat, basically have the effect that reduces indoor air and outdoor air heat exchange. Therefore, prefabricated building designers should reasonably choose the window type to ensure air tightness, and should avoid using fixed Windows and push-pull Windows. In the meantime, want to control window door ratio, reduce window open area, enlarge fixed window sash area, narrow gap. Second, prefab designers should improve the thermal insulation of the window frames, such as choosing materials with low thermal conductivity represented by plastic steel. And prefabricated building designers can make reasonable use of glass, such as heat-absorbing glass, heat-reflecting glass, etc. Finally, you can also consider setting up an external shading system, or sticking transparent polyester film on the Windows, according to the following formula for detection and construction:

$$\text{Energy saving}(A, B) = \frac{s(A,B) - s(A)s(B)}{\sqrt{s(A)s(B)(1-s(A))(1-s(B))}} \quad (1)$$

As mentioned above, for roof energy saving A and B, prefabricated building designers should first reasonably choose insulation material A and scientifically set the roof shape B. Among them, the roof material, to avoid the choice of high water

absorption of materials, if must use a high water absorption of roof material, also want to consider a good vent, or choose the overhead insulation board. For the shape of the roof, prefabricated building designers can use sloping roofs to save energy consumption. In addition; prefab designers can lay insulation or loose materials such as glass wool or expanded perlite to serve as insulation for the roof, while also reducing energy consumption.

6.3. Measures for other integrated technologies

In addition to energy conservation in prefabricated building planning and envelopment structure, there are other comprehensive technological measures that can play a role in energy conservation and emission reduction.

As energy saving design in prefabricated building design is a comprehensive problem, it involves various factors such as natural environment, residential planning and residents' needs. Therefore, designers of prefabricated buildings should not only consider the practicality of prefabricated buildings, but also comprehensively consider the structure, construction, materials, water heating and other aspects of prefabricated buildings, so as to improve the quality of prefabricated buildings and reduce energy consumption of prefabricated buildings.

Secondly, prefabricated building designers should focus on the research and development of energy saving technology, improve the quality of prefabricated building materials, improve prefabricated building construction technology and prefabricated building energy saving technology. In particular, attention should be paid to the following: we should have a long-term and international vision and communicate with countries with better energy conservation technologies, so as to further study and study their energy conservation technologies and accumulate advanced experience in energy conservation prefabricated buildings, so as to improve the quality of our energy conservation prefabricated buildings, as shown in Figure 3 below:



Figure 3. Environmental diagram of an energy-saving prefabricated building in prefabricated design.

As shown in figure 3 above, the green parts are all prefabricated buildings of residential houses. The designers conduct theoretical analysis on the energy conservation of prefabricated buildings, so as to develop the red area on the left that is suitable for China's actual conditions. At the same time, prefabricated building designers should focus on the use of energy saving materials, vigorously develop and study energy saving equipment in prefabricated building, especially the research on the combination of prefabricated building technology and high and new technology. In addition, prefab building designers should promote and popularize advanced energy-saving technologies.

For example, popularize the use of solar energy. Solar energy is a new kind of energy; it can be used as coal, oil, electricity and other supplementary energy and alternative energy. As the purest energy, solar energy can effectively avoid the environmental pollution caused by coal and oil, and can also reduce the energy consumption of coal and oil. Therefore, in view of the use of solar energy, prefabricated building designers should consider good solar installation position, the building of prefabricated building beautiful effect combined with the use of solar energy, and then design a prefabricated buildings are beautiful as well as energy saving, meet the demand of residents, promote the sustainable development of the society.

7. Conclusion

Energy conservation of prefabricated buildings is an inevitable demand of economic development under the global energy crisis. Energy is the essential material basis for human survival and development. Modern society advocates energy conservation and emission reduction, low carbon and environmental protection. Therefore, urban prefabricated buildings not only need to be beautiful, but more importantly, designers are required to set energy conservation and emission reduction as the standard. In a word, energy-saving design is the key to energy conservation of prefab buildings. Only by connecting with reality and giving full play to our subjective initiative, can we create new development opportunities for prefab building industry.

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