

Review of Building Energy Saving Techniques

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Abstract: The pace of building energy saving in our country is late, compared with developed countries, and the consumption of building energy is much higher. Therefore, it is imperative to open up new building energy saving techniques and heighten energy use efficiency. The approach of realizing energy savings is to exploit greatly and use reproducible new energy while trying to reduce total energy demand quantity in buildings. It can then reduce the utilization of energy that can easily lead to environmental pollution in building areas. Reducing total energy demand quantity in building mainly embarks from the following aspects: building programming and design, round safeguard structure, enhancing energy using efficiency of the end-User and heightening total energy using efficiency. The utilization of new energy plays an important role in the aspects of saving energy and protecting the environment. In contrast with the past, building energy savings put forward a higher requirement for building materials. Building materials play a very important role in building energy savings.

Key words: energy saving techniques; energy efficiency; programming and design; building materials

1. INTRODUCTION

The consumption of building energy is namely the consumption of building using energy, including heating, air condition, supply of heat water, cooking and family electric equipment, mainly heating and air condition energy consumption, accounting for 50% - 70%^[1]. With the rapid development of our economy and improvement of people's life level, the building energy consumption is gradually increased. The ratio of building energy consumption in total social energy

consumption has got to 20% - 25%, but in western countries, it is 30% - 40%. So with the improvement of people's life level, the town turning course becomes more and more quick, the housing system revolution has been deepen, the housing energy consumption will increase gradually. The increase space is very great and it is a main increase point of energy consumption in future. In 1999^[2], the energy consumption gross takes account of 26% of world energy consumption gross, and building energy consumption has already been close to energy consumption gross of our country. Because the population of our country has around four point five times of American population. We can imagine that if average building energy consumption level achieves average level of America, building energy consumption of our country will take account of 40% of total energy consumption of the whole world. This situation is incredible. With the gradual increase of our country's economy, people have higher requirement to building environment. How do we do in building energy conservation? But building energy conservation can not cost the convenience and health of men, or energy conservation will become no meaningful. The so-called building energy conservation is illustrated that heightening energy using efficiency, and attain biggest economic and social effect through costing limited resource and smallest energy consumption. So building energy conservation is an important measure of carrying out sustainable stratagem, realizing layout aim of country energy conservation and reducing greenhouse gas, it accords with global development tendency. There are two solutions, one aspect is reducing the requirement

of building energy consumption by exploiting sustainable energy, another aspect is heightening efficiency of energy consumption system, and decreasing terminal energy using quantity^[3].

2. REALIZING TECHNIQUE METHODS AND TRENDS OF BUILDING ENERGY SAVING

After rough estimation and adopting efficient building technique measures the building energy consumption can be reduced 2/3 to 3/4. So in the course of building layout, design, construction and using and in the condition of making housing environment convenient, it is good for realizing the aim of building energy conservation and environment protection to adopt reasonable building energy conservation techniques. Speaking commonly, the methods of conserving energy can be showed that when trying to reduce energy demand gross in building, reproductive new energy can be exploited greatly, then the using quantity of energy which can cause environment pollution easily can be reduced^[4].

2.1 Decreasing Energy Demand Gross in Building

According to statistic, in developed countries, air – condition heating energy consumption take account of 65% of building energy consumption. At present, the energy consumption of heating air – condition and lighting increase more quickly than energy production. So decreasing cold, heat and lighting energy consumption of building is important content of reducing building energy consumption gross. It can be realized from following aspects.

1) Layout and design of building

Faced with global energy environment problem, many design ideas came up, such as low energy consumption buildings, none energy consumption buildings and green buildings and so on. In essence, builders are required to consider the problems from whole design concept, and make collaboration with energy analysis experts, environment experts, equipment master and structure master. When doing building layout and design, we should consider problems from weather conditions of great area and aim at specific environment climate characteristic and

think much of using natural environment to try to reduce dependence to building equipments. The specific measures can be classified into three aspects: choosing address of buildings reasonably, adopting reasonable outside environmental design, designing reasonably the shape of buildings. Reasonable building shape design is key part that use adequately micro-environment outside of building room to reform micro-environment inside of building room. At the same time, relative software can be used to do optimization design, such as PHOENICS, Fluent and so on. They can be used to analyze whether air flow is open.

2) Enclosure structure

The design of constitute parts of building enclosure structure have great influence on building energy consumption, environmental capability and air quality inside room. The expense of increasing enclosure structure takes account of 3% – 6% of total investment and it can conserve energy for 20% – 40%. Through reforming heat performance of building enclosure structure, the heat transferred to inside room can be decreased in summer and the heat transferred to outside room can be decreased in winter, then building cold and heat consumption can be reduced. Firstly, improve heating performance of component parts of enclosure structure, it can be usually carried out through changing the heating performance of component materials. Secondly, according to local climate, location and direction of buildings, the computation of building energy consumption software DOE-2.0 is used to guide to choose optimization methods of enclosure structures. At last, the technique and economic feasibility of component parts of enclosure structures are estimated to make sure enclosure structure which is feasible in technique and reasonable in economy^[5].

3) Heightening energy using efficiency of terminal user

Only the high efficient air-condition and heating system and the decrease of cold and heat burden are carried out at the same time, the heating and air-condition energy consumption can be reduced in deed. Firstly, high efficient air-condition equipment system can be designed according to feature and

function of buildings. Secondly, energy management and monitor system are adopted in the course of using. Then heating and air-condition burden is predicted based on building dynamic model and the run of air-condition system is controlled. In other aspect such as family electrical product and official equipment, the product with energy conservation qualification should be used greatly.

4) Improving total energy using efficiency

In the process of conversion from once energy to terminal energy used in building equipment system, the loss of energy is great. So it should be estimated from whole process, and then the energy using efficiency and influence on environment of energy can be reflected completely. The energy consumption equipments in buildings, such as air-condition, water heater, washer and so on, should choose energy sources supply with high efficient. For example, as fuel, natural gas has higher energy efficiency than electricity energy. If the second era energy system can be adopted, different grade heat energy can be adequately utilized, the energy using efficiency can be improved with maximum.

2.2 The Utilization of New Energy

In the aspect of energy conservation and environmental protection, the using of new energy plays an important role. The new energy usually indicates common energy and reproductive energy, includes solar energy, terrestrial energy, wind energy and biology material energy. The various fashions of solar energy using have been explored universally and the development direction has been pointed out clearly, then solar energy get some initial utilization. (1) As an important program of solar energy, the solar energy by using heat to generate electricity gets mature, America and Australia invest to build a batch of experimental solar energy power plant to realize commercialization of using solar energy heat to generate electricity. (2) With the development of using solar energy light to generate electricity, foreign countries have built many light power station. (3) At present, a great number light pumps have run in the whole world. (4) Solar water heater techniques get relatively mature, correspondent technique

standard and criterion have been possessed. But the functions of solar energy water heater still need more perfection. (5) Passive type of solar energy buildings have been applied universally because its structure is simple and price is low. (6) Solar energy absorbed refrigeration techniques occur very early, and they were applied in air-condition field greatly at present, solar energy absorbed refrigeration is in the moment of sample machine developing and experimental research. Solar energy dryness and solar energy kitchen have attained great application. But in the whole, the using scale of solar energy isn't great, the techniques aren't perfect and low degree of commodity. When using terrestrial heat energy, on one side, high temperature terrestrial heat energy has been used to generate electricity and heating and hot water supply, on the other side, terra source heat pump and wind system can be used to generate electricity, and it applied to more coasting mountain areas and high buildings which easily caused strong wind. But in the field of buildings, the common using form of wind energy is natural wind flow fashion.

3. NEW TECHNIQUES OF BUILDING ENERGY SAVING

Ideal energy conservation buildings should demand following points in least energy consumption, one is at different season and different areas that can control reception and prevent sun radiation, secondly, it can keep the convenience of room in different seasons. Thirdly, necessary ventilation and gas exchange can be realized. At present, the methods of building energy conservation mainly include: try to reduce consumption of non-reproductive energy, improve using efficiency of energy, reduce energy loss of building enclosure structure, decrease the energy loss of building establishment operation. In these three sides, high new techniques play a crucial role. Of course, building energy conservation also adopt some traditional techniques, but it is based on advanced experiment reasoning and scientific theory analysis.

3.1 Reducing Energy Consumption and Improving Using Efficiency of Energy

In order to retain environment quality of living space, warmth is required in cold season to improve temperature of room, cold is required in hot season to reduce temperature of room. When drying humid is required and when wet humidity is required to discharge. These usually need consume energy to realize them. From the angle of energy conservation, the efficiency of heating or refrigeration should be improved. It includes the efficiency of equipment itself, efficiency of tube net transfer, measure of user end and the efficiency of control equipment of room inside environment. These all require high and new techniques in design, setting, run quality, energy conservation system modulation, equipment materials and management model industries. At present, there are three types of new techniques in the aspect of heating system energy conservation. (a) Tube net flux is distributed reasonably through using computer, balance valve and aptitude meter. It not only perfects heating quality, but also save energy. (b) Quantity of heat assign meter and thermoregulation valve are set in user radiator. (c) New types of heat preservation materials package tubes are used to reduce heat loss of tube. In recent years, low temperature floor board radiation techniques have been argued that energy conservation effect is good.

3.2 Reducing Energy Loss of Building Enclosure Structures

Energy loss of building enclosure structures mainly come from three parts, one is outer wall, secondly doors and windows, and thirdly roof. The energy conservation techniques of the three parts are concerned with building field of many countries. The main direction is that developing high efficient, economic and heat insulation materials and feasible techniques to improve heat preservation performance of enclosure structures^[6].

1) Energy conservation techniques of outer wall

As far as wall energy conservation is concerned, the traditional method that applying heavy single material to increase wall thickness to attain heat preservation, and the composite wall body has become artery of wall body. Composite wall body usually is comprised with RC and heat preservation

and heat insulation materials. At present the production of materials of building requires particular craftwork and equipment, not completed by traditional techniques.

2) Energy conservation techniques of door and window

Doors and windows have the roles of lighting, ventilation and enclosure structure, and it plays an important role in the art treat. But door and window are parts that caused easily energy loss. In order to increase lighting and ventilation areas, the doors and windows areas of buildings becomes bigger, there will be veil wall buildings of all glass. This provide higher requirement to outer enclosure structure energy conservation. At present, the treat with energy conservation of door and window mainly perfect heat preservation performance and improve close performance. In our country, after twenty century ninety ages, plastic door and window are used greatly, and it will replace steel and aluminum materials with high energy loss. In order to solve problems that caused great energy loss by big area glass, people apply high techniques to process common glass to various particular glasses.

3) Energy conservation techniques of roof

Heat preservation and insulation are very important in enclosure structures energy conservation. In cold areas, heat preservation layer should be set up to prevent the loss of room heat. In hot areas, it can prevent solar radiation heat to transfer to inside of room. But in the cold and hot areas, building energy conservation should consider winter and summer. The common techniques for heat preservation is to set light material with little heat transfer coefficient to preserve energy. The methods of heat insulation and temperature decrease list as follows: built on stilts to ventilate, store water in roof, spray water in time and green roof. These methods all demand the requirement of energy conservation in roof to different extent. But the most popular is the utilization of aptitude techniques and ecology techniques.

3.3 Reducing Operation Energy Consumption of Building Equipments

Heating, refrigeration and lighting are the main parts of building energy consumption, reducing these parts of energy consumption will play an important role. In this side, some successful techniques can be used for reference. For example, energy conservation building of BRE is so. In the aspect of building enclosure structure, advanced energy conservation control system is adopted office buildings. Open interlayer is used inside buildings to ventilate naturally. Wind flow in from grid window of back of building and out from grid window of face top wall, it will form natural ventilation. High efficient energy boiler and common boiler are used in the office building, and two types of boiler are controlled by computer to use alternately. The room temperature is regulated by heating and refrigeration tube system buried in the floor. The building also applies the technique of radiator refrigeration by input cold water under the floor. In order to reduce man-made lighting, this office building adopts whole direction combination heating system, controlled by building management system, every unit has daylight, controlled remotely by users and managers through monitor.

3.4 Exploiting and Utilization of New Energy

When saving non-renewable energy sources, man still look for and exploit and utilize new energy to adjust to the reality that population increase and energy decrease. This task is endowed with modern people by history, and the exploiting and utilization of new energy are certain to depend on high technology. For example, when we exploit and utilize solar energy, wind energy, tide energy, water power, terrestrial heat and other renewable natural energy, we must resort to advanced technique methods, and perfect and improve it to utilize energy more efficiently. For example^[7], people can utilize solar energy to heating, solar energy water heater can transfer solar energy to electricity energy and combine photo-electricity and building components.

4. EXPLOITING OF BUILDING ENERGY SAVING NEW MATERIALS

1) Outer wall heat preservation and decoration

face system^[8]

The system occurred in the last energy crisis in the end of last century seventy ages, firstly used in the commercial building, then applied in the civil buildings. Today, EIFS system take account of 17.0% in the utilization of outer wall of commercial building, 3.5% in the civil buildings, and it grows rapidly at the rate of 17%-18% every year in the using of civil buildings. This system is outer wall heat preservation with much layer heat preservation, applied in the civil and commercial buildings. ELFS system include following three parts: the main part is heat preservation board made of polystyrene foam plastic, it is commonly 1-4 inch thick, fixed to building outer wall in the fashion of synthetic plastering agent or mechanism. Long and waterproof polymer slurry grass roots in the middle part, which mainly used on the heat preservation board and increase and transmit outside force in fiberglass net. Beautiful and long surface covered layer is outside part.

2) Building heat preservation and insulation board system

This system can be used in the civil and commercial buildings, a wall body, floor board and house surface material with high performance. In the middle of the board material is polystyrene plastic with filling layer, it is commonly 4-8 inch thick, different board face layer can be adopted in two surfaces according to requirement. The buildings of this material have the characteristic of high strength, good effect of heat preservation, low price, simple construction, energy conservation and environmental protection. SIPS has commonly a width of 4 inch, and at most it can come to a length of 24 inch. The size has been a series, and many plants can make it according to engineering need and practical size, and can be supplied in the form of whole set, and truly realize industrialization of house production.

3) Outer wall system of heat insulation and cement mould

This product is one type of insulation and mould system, made from polystyrene foam plastic used in the fashion of circulation and jelling materials of cement types. When construction, it is level or upright and matched with steel bar, after wall body is

constructed, the insulation mould will be a part of permanent wall body, then concrete wall body of heat preservation and insulation can be formed inside and outside wall body at the same time. The mould material outside concrete wall surface meets the requirement of heat preservation, noise isolation and fireproofing.

5. CONCLUSION

The building energy consumption in China is extremely wasting at present. The rise speed of architecture energy consume is much higher than the possible rise speed of energy production in our country. The state energy production can not support the demand of energy if the conditions continue to develop in high energy consumption in architecture. And we have to organize large-scale of old house energy saving reforming, this will consume lots of manpower and material resource. If we increase the efficiency of energy consumption in architecture positively, the conditions of lack of energy sources will be greatly alleviate in our country and accelerate the construction of social democracy development.

The energy saving of architecture is an integrated system engineering which cover many trends. The technology of energy saving in architecture deals with architecture technology, material technology, energy technology, intelligence technology, Bionics Technology, waste recycling technology and so on and also relate to design, construction, policy which is a all round integrated system engineering. It is not enough to save energy in architecture base only on architect and we also need other energy saving products which have high

technology developed in other industries. Such as energy saving elevator, energy saving air-condition, energy saving lamps and develop new energy using technology. The energy consumption in architecture is low or nearly zero and produce energy at last.

REFERENCES

- [1] Yan Liu, Yilin Gao. The application of energy saving of building [J]. Building Materials of Liaoning, 2004(2):16-17 (In Chinese)
- [2] Yanbing Kang, Zhiyong Ma. The using fashion of renewable energy in the field of building energy saving [J]. China Energy, 2002(6):37-40(In Chinese)
- [3] Xiangzhong Tang, Chang Shu. Building energy saving is too important [J]. The Foreign Science of Building Materials, 2006,27(1):17-18 (In Chinese)
- [4] Yaming Fan, Xingyou Li, Xiangzhao Fu. Summarization of methods of building energy saving and measures [J]. Journal of Chongqing College of building, 2004,26(5):82-85 (In Chinese)
- [5] Jianmin Zhou, Dong Zhang, Keru Wu. Building materials of phase change energy store [J]. New Types of Building Materials, 2003(11):10-12 (In Chinese)
- [6] Feng Li. Building energy saving and high techniques [J]. Exploit of Building Techniques, 2004,31(10):96-98 (In Chinese)
- [7] Taizhong Hu. Discuss about main methods of improving energy efficiency of building [J]. Energy Base Construction, 1994(6):43-44 (In Chinese)
- [8] Guanqun Zhao, Yunxia Lei. American new types of wall body materials of building energy saving [J]. Building Materials of Liaoning, 2003(3):16-17 (In Chinese)