



# Research on application and technical optimization of HVAC energy-saving system in building energy saving

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**Abstract.** With the continuous progress of science and technology, building energy conservation has become the most concerned focus in the world today, and the construction industry has the characteristics of high resource consumption, so we should pay attention to energy conservation and environmental protection. This paper focuses on the application research of HVAC energy-saving technology in building engineering, and discusses a variety of technologies that are helpful to improve building energy-saving. Such as accurate calculation of air conditioning load, reasonable selection of heat source and intelligent technology, in order to achieve better system performance, and finally achieve a win-win situation of saving resources and protecting ecology.

**Keywords:** Building energy saving, HVAC, Energy saving technology

## 1 INTRODUCTION

With the development of the times, the improvement of building energy efficiency and the aggravation of environmental pollution, building energy conservation has become an important topic in today's society. Especially for HVAC energy-saving systems, their energy consumption ratio is larger. Therefore, it is particularly important to optimize their design to achieve the purpose of energy saving and emission reduction. The purpose of this paper is to discuss the development trend of HVAC energy-saving system, and give the relevant technical optimization scheme, in order to bring positive inspiration and reference to the field of building energy conservation.

## **2 TO ENHANCE THE PRACTICAL SIGNIFICANCE OF HVAC ENERGY-SAVING TECHNOLOGY**

### **2.1 Reduce energy consumption and costs**

Adopting advanced HVAC energy-saving technology can not only effectively reduce the energy consumption of the system, but also effectively use the latest refrigeration and heating technologies, thus achieving the goal of economy and environmental protection. In addition, the operation flow of the system and the management of the management organization should be improved accordingly, so as to reduce the energy consumption. By using advanced heat recovery technology, we can not only effectively treat waste gas, but also save a lot of resources <sup>[1]</sup>.

### **2.2 Reduce environmental pollution**

In order to effectively use resources, reduce environmental pollution, improve the operating efficiency of HVAC and meet the expectations of users, the energy consumption of HVAC system has a significant impact on environmental pollution, especially in carbon emissions. Therefore, it is extremely necessary to develop advanced energy-saving technologies. For example, advanced refrigeration, heating and other equipment should be introduced, which will not only help to reduce the use of energy, but also help to reduce environmental pollution. Using heat recovery technology, waste heat can be reused, reducing the emission of greenhouse gases such as carbon dioxide <sup>[2]</sup>.

## **3 HVAC ENERGY-SAVING TECHNOLOGY APPLICATION**

### **3.1 Frequency conversion technology**

The vigorous development of inverter technology has become an important application. Compared with the traditional operation mode, the vigorous development of frequency conversion control technology has more advantages, such as faster response time, less maintenance time, greater power consumption and better cost performance<sup>[3]</sup>. In addition, the rapid development of inverter technology also allows users to customize the speed of compressor according to their needs, which makes the operation of central air-conditioning control system more stable and accurate. With the change of ambient temperature, the operation of frequency conversion controller has also changed accordingly. Firstly, they will automatically control the speed of the compressor according to the temperature difference of the environment, so as to achieve the best heating state; Secondly, if the environmental temperature difference is large, they will also control the speed of the compressor according to the actual situation, so as to reduce the heating capacity, further improve the efficiency of the control system and save energy <sup>[4]</sup>. It plays an extremely important role in the field of HVAC, which can not only improve

the efficiency of central air-conditioning control system, but also greatly reduce power consumption, thus improving human experience.

### **3.2 Cold and heat energy recovery**

Adopting cold and heat energy recovery technology to realize the sustainable development of HVAC can effectively reduce greenhouse gas emissions, and then reduce the harm to the environment. In addition, the temperature can be reasonably distributed according to the actual situation, so as to achieve the purpose of reducing greenhouse gas emissions and realize the efficient recycling of funds. Using cold and heat energy recovery technology can not only realize the regeneration of waste heat and waste cold, but also greatly reduce the power consumption of HVAC system, and it also has a variety of application scenarios. Adopting cold and heat energy recovery technology is helpful to effectively use waste heat and cold energy, thus greatly improving the energy saving of HVAC system, reducing operating costs and improving environmental quality. Therefore, it is very important to realize the efficiency and reliability of HVAC by using cold and heat energy cycle system<sup>[5]</sup>.

### **3.3 Utilization of renewable resources**

With the progress of science, we must take more measures to promote and use energy. At present, sunlight, wind energy and geothermal energy have been widely used and achieved good results. We must fully consider how to make better use of these resources and try to turn them into better products. With the improvement of environmental protection awareness, the full exploitation and use of energy will become the focus of building air conditioning system in the future, which provides a strong support for reducing the shortage of domestic resources and promoting sustainable development. During the period of renewable energy utilization, the relevant departments must also compare the effects of various renewable energy utilization based on the local actual situation, and select the most effective renewable energy type, so as to achieve the future development goal of HVAC system as soon as possible<sup>[6]</sup>.

## **4 SPECIFIC MEASURES TO IMPROVE HVAC ENERGY-SAVING SYSTEM**

### **4.1 Accurate calculation of air conditioning load**

The calculation result of cooling and heating load of air conditioner directly affects the main engine power and terminal equipment, so the air conditioning load should be calculated as accurately as possible, so as to determine the main engine power reasonably and avoid energy waste. The cooling load of air conditioner in summer is affected by many factors, including the heat from the building envelope, the heat dissipation capacity of human body, the heat dissipation effect of indoor electrical equipment and the temperature change of food. In the early days, the summer heat gain of air-conditioned

area was calculated manually. At present, the building cooling load calculation software is mainly used to achieve accurate calculation. At present, the manual calculation method is still feasible. For example, the heat emitted by the human body may cause the indoor temperature to rise. Therefore, when calculating the cooling load of air conditioning, the heat dissipation factor of the human body must be considered, and the calculation formula can refer to Formula (1).

$$CL=C_{cl}CQ \quad (1)$$

In the formula, we call the cooling load caused by human activities  $CL$ , the cooling load coefficient  $C_{cl}$ , and the heat generated by activities  $Q$ , and finally use  $C$  as the calibration coefficient.

#### 4.2 Reasonable selection of heat source system

When choosing the heating mode, it should be decided according to the characteristics of the building. For small buildings, if heating is needed in winter, air source heat pump can be considered; For large buildings, if heating is needed in winter, you can consider using ground source heat pump or boiler. In a word, when choosing the heating mode, it should be decided according to the specific situation. Secondly, the configuration and design of heat source system should be considered. When configuring and designing the heat source system, we should minimize the waste of energy. The cooperation between heat source system and HVAC system should also be considered to realize the optimal control and energy-saving effect of the system. Finally, the heat source system should be maintained and managed. Check and maintain the heat source system regularly to ensure its normal operation and stable performance. At the same time, scientific operation and management methods should be adopted to regularly monitor the energy consumption and performance indicators of the heat source system, find problems in time and take measures to adjust and optimize them. It is very important to adopt the correct heat source technology to improve the operation quality of HVAC [7].

#### 4.3 Make full use of natural ventilation

The main function of the ventilation system is to help reduce the indoor temperature, discharge excess water and keep the indoor air fresh. It does not need to use electricity, so it has obvious energy-saving advantages. In the architectural design stage, the orientation and structure of the building should be reasonably designed according to the seasonal wind direction and the characteristics of the regional microenvironment. According to the characteristics of the wind direction in summer, the included angle between the windward surface of the building and the wind direction should be controlled between 60 and 90 degrees, at least 45 degrees [8]. In order to make full use of through flow, the layout of urban buildings should be inclined and staggered. In addition, the design of wind catcher is beneficial to the formation of pressure gradient, and then strengthen the effect of natural ventilation. Ventilation is used to evaluate the effect of natural ventilation, and ventilation should be calculated when designing natural

ventilation system to realize quantitative control. The natural ventilation rate  $G$  under hot pressing power is calculated according to Formula (2).

$$G = 3600 \frac{Q}{C(t_p - t_{wf})} \quad (2)$$

In this formula,  $Q$  represents all indoor residual energy,  $C$  represents the relative temperature of air,  $t_p$  represents the exhaust temperature, and  $t_{wf}$  represents the outdoor temperature in summer.

#### 4.4 Effectively combine intelligent technology

Using intelligent technology, we can monitor the indoor and outdoor climate in real time, and optimize the cooling scheme according to this information<sup>[9]</sup>. In this way, we can not only obtain high-quality cooling, but also effectively improve heat efficiency. In addition, we can also use frequency converter to speed the cooling tower, condenser and defroster to further improve the cooling efficiency. By using frequency conversion technology, we can not only improve the air quality in summer with the change of seasons, but also monitor the heating situation in winter and reduce energy consumption as much as possible. By adopting advanced intelligent control technology, we can not only make the HVAC system more efficient, but also grasp its operation more accurately, and issue warnings in time to provide valuable information. In addition, we can also use this information to improve the performance of the system, and take targeted protective measures to further improve energy efficiency<sup>[10]</sup>.

## 5 CONCLUDING REMARKS

In a word, construction companies must vigorously promote and use HVAC and air purification technologies. This will help us to make better use of these technologies, greatly reduce our energy consumption and alleviate our environmental problems. We must give full play to the potential of these technologies and take active measures. Relevant enterprises should strengthen the application of frequency conversion energy-saving technology, cold and heat energy recovery and renewable resources utilization; Measures such as accurate calculation of air conditioning load, suitable heat source system, full use of natural ventilation and effective combination of intelligent technology can significantly improve the performance of HVAC, so as to save resources and reduce pollution. In order to better promote future building energy conservation, we must vigorously develop scientific technology, reform effective management mode, and actively build a long-term and sustainable building energy-saving product.

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