

# Analysis and thinking on energy saving design strategy of HVAC system in civil buildings

Haitao Sang, Yingxia Huo

School of Architectural Engineering, Jiangsu Open University, Nanjing, Jiangsu, 210019, China

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**Abstract:** With the continuous improvement of people's living standards, higher requirements are put forward for the comfort and related functions of civil buildings. Therefore, HVAC system is widely used in modern civil buildings. The design requirements of residents for civil building systems are also increasing. HVAC system is an important system of civil buildings, and its design level will have a direct impact on the internal air environment and comfort of buildings. The power consumption of HVAC system is very obvious. Under the sustainable development strategy, effective energy-saving design must be adopted to solve the problem of high power consumption. Based on the principle of save energy & cut emissions, this paper aims to provide users with a comfortable and healthy environment. Through the use of renewable resources and clean energy, combined with the shortcomings of the current air-conditioning energy-saving design and design standards, it proposes new energy-saving technologies to optimize heating and cooling. Energy-saving design strategies of ventilation and air-conditioning, increasing the promotion of energy-saving HVAC, etc., hope to contribute to the progress and development of energy-saving design of HVAC in civil buildings.

## 1. Introduction

People's life is inseparable from food, clothing, housing and transportation, and department stores, restaurants, residential buildings and stations related to food, clothing, housing and transportation are all civil buildings. Modern people's requirements for civil buildings are not only the residential performance, but also the energy-saving requirements of buildings.

The main function of HVAC system is to regulate the temperature in the building. Whether in summer or winter, the operation of HVAC system needs to consume a lot of energy. With the development of global economy, energy shortage has become a problem facing the world, and China is a major energy consumer in the world. During the rapid development of the construction industry, designers also began to attach importance to the design of HVAC system [1]. As an important system of indoor temperature regulation, HVAC system is a very important part of civil building design, and it should keep running all year round. Through effective energy-saving design of HVAC system, rational selection of energy-saving HVAC equipment, optimization of operation mode of HVAC system, active adoption of new energy-saving control devices, and full utilization of clean energy and renewable new energy, the energy-saving effect of HVAC system in civil buildings can be comprehensively improved, which can reduce its power consumption to a certain extent, reduce the overall power consumption of civil buildings, better meet the requirements of energy conservation and environmental protection in China, and promote the sustainable development of construction industry.

## 2. Significance of energy saving design of HVAC system

At present, the power consumption of China's industrial sector accounts for more than 70% of the total consumption, followed by transportation power consumption and building power consumption. In construction engineering, the power consumption of air conditioning cooling and heating system is half of the overall power consumption of the building. Heating and cooling technology is mainly used in the HVAC system of civil buildings to adjust the indoor humidity and temperature, so as to improve the indoor air quality. HVAC system is the main content of building power consumption, so

it has attracted much attention in the industry [2]. Combined with people's requirements for environmental comfort, HVAC systems generally need to run continuously after installation, and a lot of energy will be consumed in the running process. Under the environment that the country advocates low-carbon and environmentally-friendly lifestyle, the HVAC industry, as one of the industries with high power consumption at present, also needs to achieve energy conservation and environmental protection. Therefore, it is very important to control the power consumption of HVAC in civil buildings and strengthen its energy-saving design. Adopting a reasonable and effective energy-saving design method can maximize the efficiency, not only can play the role of the HVAC system, reduce power consumption, but also contribute to the realization of my country's sustainable development and the construction of a resource-saving and environment-friendly society [3].

### **3. Principles of energy saving design of HVAC system in civil buildings**

#### **3.1 Principles of save energy & cut emissions**

The principle of save energy & cut emissions is to combine energy development and energy conservation, give priority to energy conservation, promote the combination of save energy & cut emissions and social development, and achieve a win-win situation between save energy & cut emissions and social development. The design and use of HVAC system must follow the national principle of save energy & cut emissions, use environmental protection materials, use clean energy and reduce power consumption. In order to ensure the design effect of HVAC, it is necessary to accurately calculate the cooling and heating load, and provide data support for each link, so as to reduce the power consumption of the air conditioning system [4]. When calculating the cooling and heating load, the statistical value of the cooling and heating load of the building should also be combined, and the regression calculation should be carried out, and the calculation result should be taken as the reference value of the air conditioning system design. Specifically, on the one hand, we should optimize the distribution and rational use of energy, so as to reduce power consumption as much as possible; On the other hand, we should try our best to reduce the emission of waste gas to protect the urban environment.

#### **3.2 Health and comfort principle**

The function of HVAC itself is to provide users with comfortable indoor ambient temperature and appropriate indoor air quality. Due to the different climatic conditions in North and South China, heating in winter and heatstroke prevention in summer have a great impact on people's work and life. The use of substandard heating and cooling supply will lead to people suffering from colds or "air-conditioning diseases". Therefore, the indoor design parameters of HVAC system should consider humidity and temperature factors, and the energy-saving performance of the system should be measured by the above factors [5]. Calculate indoor humidity and temperature, define reasonable intervals, and ensure that they meet the living requirements of different time periods.

#### **3.3 Using the principle of nature**

Natural resources are substances that human beings can obtain for production and life in nature, including unrenovable resources and renewable resources. Among them, renewable energy can be reused, such as solar energy, wind power, geothermal energy, hydropower, etc., as shown in Figure 1. In the design of HVAC, the regenerative properties of renewable energy are rationally utilized, combined with the characteristics of short regeneration cycle and environmental protection, to reduce the power consumption of the HVAC system [6]. When choosing a cold and heat source, it is necessary to use a centralized setting of chillers, and centrally set heating equipment and heat exchange equipment. If there is a thermal power plant around the building, the waste heat of the thermal power plant should be used as a heating measure. If the cooling conditions are good, make proper use of the cooling function. If there is heating in the surrounding area of the building, it will be used as the heat source of the HVAC system. If the geothermal resources and water resources around the building are abundant, the water source heat pump can provide heat and cooling [7].

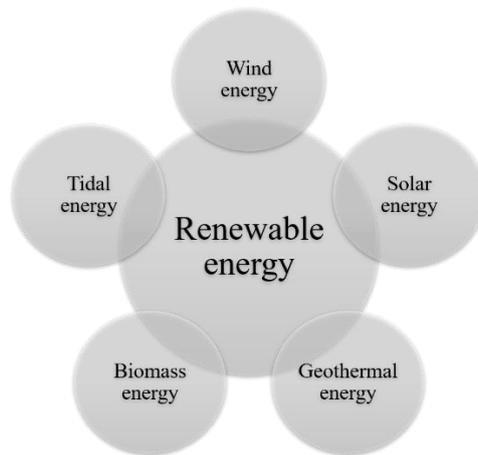


Figure 1 Renewable energy

## 4. Measures for energy saving design of HVAC system in civil buildings

### 4.1 Application of heat recovery technology

In order to reduce the power consumption of HVAC system, we must reduce the waste of waste heat and strengthen the design of heat recovery. During the operation of HVAC system, a large amount of heat will be released, and it is a pity and waste if this heat is allowed to be lost to the air. Therefore, heat recovery technology can be applied to collect this heat and send them to the required place in the form of fluid conduction, so as to better meet the damp and heat conditions inside HVAC system [8].

### 4.2 Application of ground source heat pump technology

The so-called ground source heat pump technology mainly refers to the use of shallow geothermal resources as the energy basis for building heating and cooling. Because geothermal energy is mainly located in shallow underground space, it is less affected by seasonal changes and can maintain a relatively stable temperature [9]. In addition, the ground source heat pump can also be used as a heat storage device for the HVAC system, so that the HVAC system can make full use of energy, and can also effectively reduce power consumption and waste. Generally, a compressor can be used to absorb the heat energy in the natural environment, so that the absorbed heat energy can be transmitted to a high-temperature heat source after a certain treatment, thus greatly saving the amount of non-renewable energy such as coal and oil, and achieving a better energy-saving effect. Therefore, designers can use ground source heat pump technology to achieve the purpose of energy-saving design according to the actual situation of civil buildings.

### 4.3 Using solar energy technology

Solar energy is also renewable energy that can be used in HVAC system. At present, China has made great progress in the use of solar energy in two forms: active and passive [10]. The active solar energy system is relatively complex in design, while the passive solar energy system is relatively simple in structure and does not need other auxiliary energy sources. Because the technology of solar energy active utilization system is complex, which requires high level of designers, and its design and construction cost is relatively high, its popularization in design practice is limited to some extent. In contrast, the passive application system of solar energy has the advantages of simple structure and wide adaptability.

### 4.4 Optimize the layout of HVAC system

In order to better achieve energy-saving effect, in the design of HVAC system of civil buildings, designers should further optimize the pipeline layout of the system to ensure that the pipeline design of HVAC system is simple and clear, and the system can effectively and independently control and adjust the temperature and humidity of each room. In this way, users can make personalized

adjustments to the HVAC system according to their actual needs, which can not only effectively reduce the power consumption of the HVAC system, but also make users more reasonable in terms of expenses [11]. In addition, designers can use natural gas to provide electric energy for users through co-supply technology, and then make full use of power generation waste heat to heat or cool civil buildings, so as to achieve the purpose of adjusting indoor temperature. This co-supply technology can effectively reduce the impact of HVAC system on the environment during operation, at the same time, it can make full use of resources and effectively reduce power consumption.

#### **4.5 Using automatic control technology of HVAC system**

The rapid development of science and technology has brought new opportunities and technical support to innovation and Reform in various fields, including construction engineering. The use of intelligent control system and computer detection system can timely grasp the outdoor climate and indoor moisture and heat load of the building, and formulate reasonable and feasible temperature and humidity control measures on this basis without affecting the daily needs of building users [12]. The use of new control equipment can greatly improve the quality and efficiency of HVAC operation. Building users can pre-set the HVAC system according to their own needs, realize humanized operation and operation, and reduce power consumption at the same time [13].

### **5. Conclusions**

The building industry has developed rapidly in recent years, but it has also caused a large power consumption in the development of the building. Building HVAC system is a unit with large power consumption. Energy-saving design of HVAC system of civil buildings is related to the realization of reducing building power consumption. In response to the strategic goal of China's sustainable development, it is necessary to strengthen the energy-saving design and application of HVAC. In order to effectively improve the energy-saving design of HVAC system, in the design process, we must strictly follow the energy-saving design principles and promote the application of advanced energy-saving measures, so as to achieve good energy-saving design effect, not only improve the energy-saving effect, but also provide users with a comfortable and healthy space environment. To sum up, the energy-saving design of HVAC plays a very important role in civil buildings. In the design, use and promotion of HVAC, we should also attach importance to the integration with energy conservation and environmental protection.

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