The Core Application of Energy-saving Technology for HVAC Systems in High-rise Buildings

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Abstract: Air conditioners were originally high-energy-consuming appliances. The introduction of energy-saving technologies in air-conditioning systems will help achieve energy-saving and emission-reduction goals. At present, the energy-saving technology of HVAC systems has been widely used in the installation and construction of high-rise building electrical appliances, and has achieved good results. This paper will briefly introduce the function and characteristics of HVAC, systematically discuss the energy-saving problems of HVAC systems in high-rise buildings, and discuss the application schemes of energy-saving technologies for HVAC systems in high-rise buildings.

1. Introduction
At present, HVAC is one of the necessary electrical appliances in the installation of building electrical appliances. Although the air-conditioning system can provide a comfortable indoor environment for the citizens, it also exacerbates the problem of energy conservation and environmental protection. In this regard, it is necessary to fully optimize the energy-saving technology of high-rise building HVAC systems, reduce the heat and cold load, make full use of natural resources, thereby improving the efficiency of the use of cold and heat sources, controlling the power consumption of the pumps and the power consumption of the fans, and improving the airflow organization system. To the role of energy saving and environmental protection.

2. HVAC Function and Characteristics
High-rise building HVAC can provide comfortable office and living environment for the citizens, adjust indoor temperature and humidity, maintain reasonable airflow speed, and improve indoor cleanliness. During the normal operation of the air conditioner, the HVAC can keep the human body in a state of heat balance and meet the national requirements for comfort. In addition, in air-conditioned rooms with constant temperature and humidity and meeting the requirements of cleaning standards, HVAC has a good environmental protection [1]. On the other hand, from the perspective of the overall structure, the energy consumption of HVAC systems is higher than that of other buildings, and its energy consumption rate is affected by the internal design of air conditioning systems, component coordination, and system operation management. Unreasonable design will inevitably reduce the use of air-conditioning energy and increase energy consumption. It should be noted that because HVAC is operated by the alternating between hot and cold, the indoor and outdoor air quality and outdoor temperature will affect the energy consumption of HVAC. Therefore, natural resources such as wind and solar energy can be fully utilized. To improve indoor air temperature and humidity and reduce air conditioning energy consumption.
3. Energy-saving Problems in High-rise Building HVAC Systems

3.1 Building HVAC Water System Problem
High-rise building HVAC central heating and heat often cause imbalance of air conditioning water system due to unbalanced flow of air conditioning water system. For example, the air conditioning effect of different floors is inconsistent. The air conditioning effect on the same floor close to the supervisor is good, and the air conditioning effect is far away. Therefore, the unbalanced air conditioning effect is caused by the imbalance of the flow distribution of the air conditioning water system, which is also called the hydraulic imbalance of the air conditioning water system. At present, hydraulic disorders are usually divided into two types, the first is static hydraulic imbalance, and the other is dynamic hydraulic imbalance, the reasons are as follows:

Static hydraulic imbalance (steady-state imbalance): uneven resistance of pipelines, equipment, etc., system design, etc., the system is generally full-load operation. Dynamic hydraulic imbalance (stability imbalance): The main valve of the end equipment or regional air conditioning water system in the system frequently opens and closes, and the system generally operates under variable load conditions.

In addition, there are disadvantages in hydraulic imbalance: the electric regulating valve at the end of the air conditioner frequently operates, the operating noise is too large, the life of the actuator is short, the refrigeration unit has an icing alarm, and it cannot be started. The temperature difference of the return water cannot reach the design value, and the large flow rate is small. The energy consumption is high, the system startup time is long, the air conditioning effect is unbalanced, the control valve is frequently started, the drive is easy to burn, the chiller and the water pump are inefficient, and the problems are more. The traditional solution will control these problems by increasing the pipe diameter of the transmission system, increasing the flow and head of the pump, changing the program to the same program, adjusting the end of the air conditioner or the model of the electric valve. However, the traditional solution will generally Increased cost, resulting in increased pump power consumption, system small temperature difference operation, excessive flow of energy and other shortcomings [2].

3.2 Energy-saving Design Problem of HVAC in High-rise Buildings
The high-quality building HVAC energy-saving design quality largely determines the air-conditioning energy-saving effect. However, in the HVAC design, some designers do not attach great importance to HVAC energy-saving design, there is no air conditioning exhaust preheating system, refrigeration reasonable planning of the unit and the frequency conversion system will inevitably affect the energy saving effect of the HVAC. In addition, in the energy-saving design work of HVAC, many designers did not consider how to incorporate geothermal energy, solar energy and other resources into the HVAC energy-saving system, and did not rationally design air-conditioning ground source heat pump systems and solar heating systems. It is not conducive to improving the energy-saving effect of HVAC [3].

3.3 Lack of Uniformity in the Evaluation Plan for HVAC Energy-saving Design of High-rise Buildings
In recent years, various new styles of air conditioning have emerged in the HVAC industry. The air conditioning system control method is also constantly innovating and improving. Currently, HVAC that meets the standard requirements can not only effectively improve the indoor environment comfort and thermal insulation effect. Moreover, it can play an energy-saving role and greatly reduce energy consumption. However, it should not be overlooked that at present, there is no unified and qualified evaluation plan for high-rise building HVAC system design. The evaluation criteria still need to be refined, which leads to high-rise building HVAC designers and air-conditioning assembly personnel. It is difficult to do all the work in accordance with the unified standards in the specific work. If the selected reference scheme is not correct, it will inevitably affect the energy-saving effect of HVAC, and additionally increase the energy consumption of air-conditioning.
4. High-rise Building HVAC System Energy-saving Technology Application Program

4.1 Improve Building HVAC Water System

To optimize the application scheme of energy-saving technology for high-rise building HVAC systems, we must first improve the construction of HVAC water system. For this problem, static balance valve can be selected appropriately. The main function is to change the resistance characteristics of the system to achieve flow distribution. The static balance valve has the opening degree shows that the function of parameter measurement is generally set on the branch pipe at the load side, and its total cost is low, which is generally applicable to the constant flow system [4]. In the process of improving the HVAC water system of the building, the static balance valve and the electric two-way valve can be assembled for the main branch pipe. Usually, the static balance valve is installed on the horizontal branch pipe and the end return pipe of each layer of the fan coil, and assembled. After the static hydraulic balance valve is completed, initial commissioning is used to improve the air conditioning system and gradually eliminate static hydraulic imbalance. Secondly, the dynamic differential pressure regulating valve group and the electric two-way valve can be assembled for the static balancing valve. This method mainly installs the dynamic differential pressure regulating valve group on the horizontal return pipe main pipe of each layer of the fan coil, and the static balancing valve is placed on the end fan coil return pipe. After the completion of the installation of the static hydraulic balance valve, the flow rate of the horizontal branch pipes or the individual fan coils of each layer can be reached at the same time after the commissioning. At the same time, it is necessary to pay attention to regularly clean the air conditioning water pipes, especially the dirt and rust inside the water pipes, and ensure that the sewage can be discharged in time by installing the sewage valve to prevent the water pipes from being blocked by dirt. Moreover, it is necessary to regularly check the insulation materials of the air conditioners and repair the damaged areas in time to maintain the tightness of the insulation structure and maintain the balance of the water system flow. Again, dynamic hydraulic imbalances should be avoided as much as possible. In normal conditions, the air conditioning water loop system may not be fully loaded at all times. When the air conditioning water main valve or air conditioning equipment in a certain area is closed or suddenly started, the water imbalance of the air conditioning water system may be unbalanced, which has a greater impact on the system water flow. Therefore, the air conditioning effect in other areas is affected. The dynamic hydraulic imbalance caused by the fluctuation of the water flow in the system cannot be solved by the static balance valve. The best solution is to use the dynamic differential pressure balance valve. Moreover, to achieve dynamic balance, it is necessary to maintain a constant pressure difference between the dynamically controlled points. The fan and the duct should be connected by a hose. At the same time, the hose should be properly used to connect the fan coil and water pipe of the air conditioner. Maintain a balanced relationship between return water and water supply. It should be noted that the air conditioner itself is inevitably free of moisture and moisture, which is easy to breed bacteria, and gradually destroys the dynamic balance. It is inevitable that some dust will exist on the surface of the air conditioner. Therefore, the management personnel should periodically clean and sterilize the air conditioner to fully inspect all operations of the air conditioner. System equipment, cleaning and maintenance, keeping the air conditioning system running smoothly, and fully implementing the maintenance of the air conditioning system. It should be noted that the influence of noise on the balance relationship of the air-conditioning water supply system cannot be ignored. Generally, the main cause of excessive air-conditioning noise is that the air duct is too long. If the cross-sectional area of the air duct is too large, the air-conditioning room is also relatively large. As a result, the air conditioning noise exceeded the standard. In this regard, it is necessary to appropriately shorten the air duct wiring of the air conditioner, which can save resources, reduce the difficulty of engineering, and reduce noise. In order to effectively prevent the noise hazard, it is necessary to use effective sound insulation measures to install a muffler for the air conditioner. On the other hand, the dynamic differential pressure balance electric control valve can be installed on the air conditioner main equipment side, and the dynamic balance electric motor can be installed by assembling the dynamic differential pressure balance
electric control valve, the static balance valve (optional) and the dynamic balance electric double position valve. The two position valve is mounted at the end of the fan coil and the static balance valve is placed at the horizontal branch. Under normal circumstances, the static balance valve is optional. If the vertical riser is a different type of system with a large degree of hydraulic imbalance, it is necessary to add a static balance valve to the horizontal return pipe and scientifically adjust it at the initial commissioning.

4.2 Adhering to the Energy-saving Design Principle of High-rise Buildings HVAC
In the design of HVAC energy-saving systems for high-rise buildings, designers must adhere to the following three principles:

First, the principle of energy conservation and environmental protection. The goal of achieving energy conservation and environmental protection is to design the first principle of HVAC energy-saving systems for high-rise buildings. Therefore, in the design work of HVAC energy-saving systems for high-rise buildings, we must first abide by the principle of energy conservation and environmental protection, so that air conditioners can create a comfortable indoor environment while saving energy. Temperature, air and humidity, control the proportion of energy-saving parameters, and take into account the impact of outdoor temperature and humidity on the internal environment and air-conditioning energy-saving effect.

Second, the principle of humanization. If the air conditioning system can uniformly heat the room, the energy utilization rate can be greatly improved. It is not neglected that in order to ensure the energy-saving effect of air-conditioning, it is necessary to take into account the comfort of indoor personnel. This requires emphasizing the principle of humanization, that is, the principle of people-oriented, which can not only save energy and protect the environment, but also maintain a comfortable indoor environment. [5].

Third, the principle of science. To improve the energy-saving effect of high-rise buildings, the design of a complete air-conditioning energy-saving system is not an easy task, but to adhere to the scientific principle, in the process of designing HVAC energy-saving systems, comprehensive consideration of building structure design and interior decoration plan In order to design the most scientific and reasonable HVAC system.

4.3 Improve the Evaluation Plan for Energy-saving Design of High-rise Building HVAC
To fully optimize the energy-saving technology application plan for high-rise building HVAC systems, it is necessary to combine the standard requirements with the building structure and interior decoration features to compile a comprehensive high-rise building HVAC energy-saving design evaluation plan to promote energy-saving air-conditioning applications. In addition, the use of new technologies has a good role in promoting China's new energy development, economic construction and environmental construction. In the high-rise building HVAC energy-saving design, attention should be paid to the introduction of new energy development technologies, and high-rise building HVAC energy-saving design. The evaluation plan specifies the specific measures of geothermal heat pump air conditioning system design, solar refrigeration system design, natural heating system design, etc., so that the high-rise building HVAC energy-saving technology can be further optimized, improved and promoted.

4.4 Optimize Energy-saving Technology for High-rise Building HVAC
To fully optimize the energy-saving technologies for high-rise building HVAC and improve the energy-saving effect of air-conditioning, the following four tasks must be done:

First, improve the air conditioning cold storage technology system. Under normal circumstances, there are two types of air conditioning cold storage technology systems, namely air conditioning ice storage system and air conditioning water storage system. Both systems store cold energy by coagulating the medium or lowering the temperature of the medium, and then, through sensible heat and latent heat, the stored cold energy can be recycled by raising the temperature of the medium or melting the medium. The perfect cold storage system consists of, cold storage device, cold water main
unit, plate heat exchanger, pump valve and automatic control system. The air conditioning cold storage technology system must fully optimize these combined equipment, and promote the tight integration of the cold water main unit and the cold storage device, control the good cold water host capacity in order to improve their interactions.

Second, optimize the air conditioning thermal storage technology system. In the design of HVAC thermal storage technology system for high-rise buildings, the current common system is the electric boiler regenerative system, which uses water as the main heat storage medium, and its heat source is an electric boiler, which is then heated by cheap power resources. The water medium is stored in a hot water storage tank to provide sufficient hot water for air conditioning heating. To optimize the air conditioning thermal storage technology system, it is necessary to do the maintenance work of the electric boiler, make full use of the low valley electricity, and take advantage of the air conditioning thermal storage technology system to avoid the unintentional emission of harmful gases and reduce the operating costs.

Third, improve the exhaust heat recovery system. Most air-conditioning systems need to design a fresh air system to control indoor harmful gases, purify the air quality, ensure that fresh air can enter the room smoothly, design the exhaust system, continuously improve the sensible heat recovery and total heat recovery, and improve the plate-type sensible heat exchanger and runner. Equipment such as total heat exchangers, plate-type heat exchangers, and intermediate heat medium heat exchangers.

Fourth, optimize the condensing heat recovery system of the refrigeration unit. To improve the energy-saving technology of HVAC, it is necessary to focus on optimizing the condensing heat recovery system of the refrigeration unit, continuously improve the condenser and incubator accessories, and do regular maintenance work.

5. Conclusion:
To sum up, to comprehensively improve the energy-saving technology of high-rise building HVAC systems, it is necessary to adhere to the energy-saving design principles for high-rise buildings, and to compile a comprehensive evaluation plan for HVAC energy-saving design of high-rise buildings to comprehensively improve various technical systems.

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