Energy-saving Analysis of Energy Consumption in Public Buildings and Case Application

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Abstract. This paper introduces the basic principles and characteristics of the energy consumption monitoring system, design situation, equipment parameters, system form and application examples of energy consumption monitoring system in public buildings, explains the role of public building energy monitoring system. Starting from the artificial collection and data transmission, this paper analyzes the application status of public building energy consumption monitoring technologies, and based on this, proposes application countermeasures based on energy conservation management under public building energy consumption monitoring system, which can provide some references for energy-saving application technology in public buildings.

Keywords: Energy consumption, energy-saving.

1. Introduction
With the rapid development of China's economy, the problem of high energy consumption of buildings is becoming more and more prominent, through the construction of building energy-saving supervision system, building energy consumption monitoring platform is gradually established, which can monitor the energy consumption of buildings in China, so as to promote the energy-saving level of buildings, and provide data basis for energy-saving transformation. We should establish the building energy monitoring system.

2. Composition of Energy Consumption Monitoring System
The building energy consumption monitoring can conduct sub-item metering of building energy consumption, and conducts distributed monitoring for all circuits. The energy consumption monitoring system uses the energy automation monitoring system to conduct accurate measure of energy consumption of end users, remote transmission of measure data, data collection and storage, data statistics and analysis, provides effective monitoring of energy equipment for the energy management department, and provides energy management decision-making basis for energy authorities.
Fig.1 Schematic diagram of energy consumption monitoring system

Energy consumption monitoring system monitors energy consumption of buildings in real time with modern information technology, and transmits the collected energy consumption data to the data center through the network, then process, analyzes, and displays the various types of data (as shown in Fig.1), and meets the data usage needs of various users. The monitoring indicators include classified energy consumption such as power consumption and heat consumption (cold), the power consumption is divided into 4 items, including lighting socket power, air conditioning power, and special power.

3. Functions of Energy Consumption Monitoring System

The energy consumption monitoring system carries out sub-item measure on various electricity consumption of buildings, collect all measurement data and save them in the central database for statistics and analysis; monitor voltage, current, power, power factor, power, etc., monitor the load changes of various power circuits, timely find various power abnormal conditions; evaluates the energy utilization efficiency by using the energy consumption per square meter per year and the energy consumption per person per year for the collected measurement data, the specific values of the building area and personnel can be configured to improve flexibility of system functions; graphically display the operating status of power supply and distribution equipment, as well as the trend curve, size, and proportion of voltage, current, power, and water consumption, the system prints or displays the energy and water consumption report by day, month, and year, provide reference for energy-saving research, design and construction of buildings; provide accurate energy consumption data and decision-making basis for building energy consumption statistics, auditing, supervision and law enforcement departments; the system also reserves system interfaces for the access of other energy supervision systems and the connection of the upper-level energy monitoring system.

4. Research Status of Energy Consumption Monitoring System of Buildings

Through literature research, it was found that the research on energy consumption monitoring of buildings is mainly summarized into three aspects: data collection end, the focus is mostly on the research of data collector technology and performance, and research on key technologies in the installation and construction of collection instruments; data transmission, focus on the application of energy monitoring data network transmission; data center and monitoring system development, the research focuses on study of data center software design, platform architecture and monitoring system functions.
In summary, the research on building energy consumption monitoring system has been rich, and the development of energy consumption monitoring also indicates that the platform construction technology is relatively mature, but more important is the development of monitoring data, namely the application research of data in energy conservation management is slightly lacking, only a few typical cases. Therefore, it is necessary to carry out application research on monitoring data in energy conservation management, and provide reference for building energy conservation work.

5. Practical Application Analysis of Energy Consumption Monitoring System

This paper combines actual engineering cases, focuses on the application of monitoring data around the daily management, optimized operation and energy-saving transformation.

Operation management is a cost-free, low-cost means of energy conservation, by monitoring data, management loopholes can be discovered and unnecessary waste can be reduced. For example, T office building usually opens air conditioning systems on weekdays and closes on weekends. However, it was found that the air conditioning mainframe was closed during the summer weekend from August 2nd to August 3rd, while other cold station equipment, cooling pumps and cooling towers were still running (as shown in Fig.2). The main engine is turned off, and the cooling system does not work even if the conveyor system is turned on. After talking with the operation management personnel, it was found that the cold station equipment was not closed on weekends due to the negligence of the management personnel, as a result, cooling pump and cooling tower were turned on for two days on weekends, which increased electricity consumption by 4 000 kW/h, which accounts for 15% of the power consumption in this week.

![Fig.2 Air conditioning power consumption of T typical building](image)

The S building adopts a multi-connected air conditioning system, and the outer window can be opened. According to the local climate, it is generally necessary to turn on the air conditioner from April to October, there is no cooling demand in other months, or it can be met by opening the window. However, the S building opened the air conditioning system in winter and summer (as shown in Fig.3). If the operation management can be strengthened, the air conditioner will not be turned on in November-December and January-March, and it is expected to save 17% of air-conditioning power consumption throughout the year.
Another example is the A office building of, the working hours of working day is 9:00-18:00, and the building is equipped with an electric water heater. The monitoring found that the electric water heater has hourly power of 0.4~23 kW·h, and the monthly power consumption is 1 400-2 400 kW·h, and the annual power consumption is 22913 kW·h. Moreover, it was found that the electric water heater was in working state for a long time, and it was turned on 24 hours a day, even if it was not turned off during the weekend and after work hours. Due to loopholes in the management, the building electric water heater is operated within an unreasonable period of time, because the electric water heater is not closed during the period without use, the power consumption is up to 5472 kW·h. If the management is strengthened and the power is turned off in time, the power consumption of the electric water heater can be saved by 24% (as shown in Fig.4).

6. Conclusion
This research combines practical cases to analyze the application of energy monitoring systems in buildings. Through system and data analysis, we can find and eliminate energy consumption loopholes or management loopholes, adjust or change operating parameters, strengthen the refinement of equipment systems, discover the direction of energy saving potential and guide energy-saving
transformation. It is necessary to strengthen the analysis and application of data, so that it can play a greater role and promote the development of building energy saving.

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