

Energy saving system of terminal regulated air volume in intelligent building

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Abstract: This paper describes the application and the prominent energy saving of the new technique Terminal Regulation Air Volume (TRAV) air conditioning systems in intelligent building. Furthermore, it studies the problem taking full advantage of the Building Automation System (BAS) to save energy and to meet with demands of the intelligent building individuation.

Keywords: terminal regulation air volume (TRAV); intelligent building; direct digital control (DDC); energy saving

With development of economy and technology, under the global sustainable development theory, intelligent building has already become the leading direction developed in real estate investment in the range of the world because of its superiority, such as comfortable, high-efficient, security, energy-conservation and so on. The building energy-saving technology, one of intelligent building key technology, has gotten unprecedented development too. The energy-saving technology which accounts for 40%~60 % air conditioning systems of energy consumption of the building emerges constantly too. In air conditioning energy consumption, it accounts for more than 30% to send systematic energy consumption. As a kind of controlling mode of new air conditioning system which can save energy consumption of fan further, TRAV not only has remarkable energy-conserving results but also can satisfy the individualized request of the air conditioning.

1. Control modes of an intelligent building of air conditioners systems

In order to improve comfortable degree of building, save manpower, reduce energy consumption, and maintain equipment scientifically, one of the main functions of Building Automation System (BAS) in intelligent buildings is to realize electromechanical equipment manage, monitor, operate and control. The control mode and management of air conditioning system is: Put checked datum into direct digital control (DDC) (voltage, electric current, etc.) through transducers (temperature, humidity, pressure drop and so on), then turn imitated signals into digital signals by analog-to-digital converter (A/D) in DDC, send these

digital signals to the microprocessor in DDC, at last, begin logical operation in the microprocessor. The software in the microprocessor has controlling function of equipment and energy, operating functions of management, self-diagnosing ability, alarm and interlock etc., for instance, optimization of on-and-off and machine numbers control of the relevant equipment, controlling enthalpy value and time district etc., Some software still have controlling functions of self-adaptation and self-learning. The microprocessor will analyze and compare the imported data, then it will transfer signals of action instruction that are analyzed according to presetting software program into digital-to-analog converter (D/A), (D/A) turns digital signals into imitated signals, for example, transfer the signals of voltage or electric current into corresponding actuators (such as wind valve, flow regulating valve etc.), actuators operate in order to change operating condition of experiments, thus improve system and reach parameter demands of air conditioning system. At the same time, these data though checking and dealing transfer into central computer in general monitoring room to be managed generally by workers. Moreover central computer also demand every DDC, and modify regulate software presetting of all or part of DDC set points. All DCC

2. Terminal regulation control of VAV air conditioning system for intelligent buildings

According to variety of indoor load, VAV system maintain parameter demands of indoor temperature and humidity by changing air supply. Traditional VAV air conditioning system of saving more energy changes with air-consuming, according to static pressure variety

of monitoring points of measured main duct, regulate fan speed in order to maintain their static Pressure and satisfy system variety of air supply. Therefore, choosing the monitoring points will influence operating condition and energy-consuming of air conditioning of system equipment directly.

Programs can be carried out automatically or manually. (See Fig.1)

The control of TRAV air conditioning system of intelligent building is made up of terminal control units of VAV, indoor temperature controller, actuator of terminal valve and direct digital controller DDC, etc. Indoor temperature controller has inner temperature detector. VAV controller placed in the system end compares indoor actual temperature detected by detector and designed temperature, outputs regulating signals to flow regulating valve actuator after analyzing parameter difference, then changes valve opening degree to change corresponding air supply of air vent, thus we can regulate indoor temperature in settled range. Through pressure drop device of terminal VAV controller, we can monitor pressure variety in duct at

any moment, adopt cascading/PI regulation to make terminal air supply maintain designed level, thus we can remove influence of valve opening degree by pressure fluctuation in duct. At the same time varying-speed fan speed of air supply of air conditioning system is put into direct digital controller DDC according to indoor inner temperature probes, the microprocessor analyzes synthetically all of detected data that is passed by terminal equipments of this system, then decides variety of air supply of air conditioning system and output command signals and regulate speed of varying-speed fan, Thus reach the synchronism between fan speed with the demanding air supply of the system [2]. Because TRAV system analyzes synthetically according to parameters detected by all temperature probes, demands speed regulation of varying-speed fan to adapt variety of system's air supply, so we improve precision and veracity, make the synchronism between fan speed with the demanding air supply of the system directly. So, its effect of energy-conserving is more remarkable than traditional VAV air conditioning system. (See Fig.2[3]).

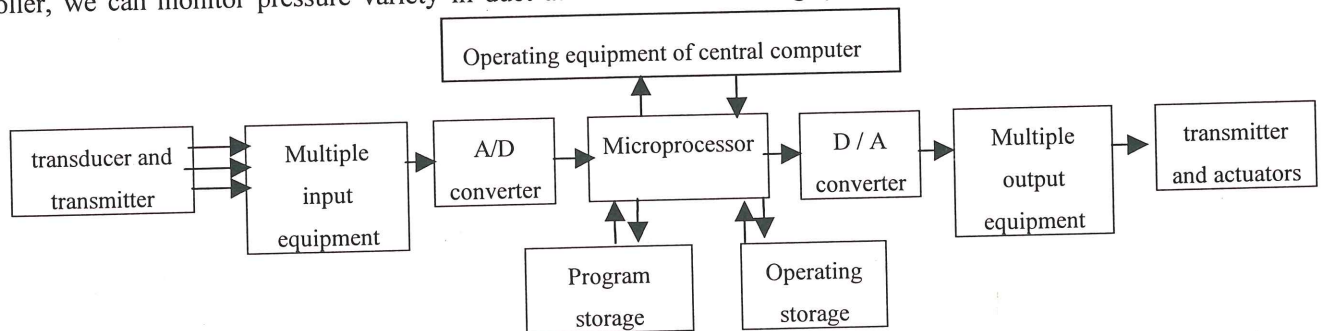


Fig.1 Management mode of DDC controlling

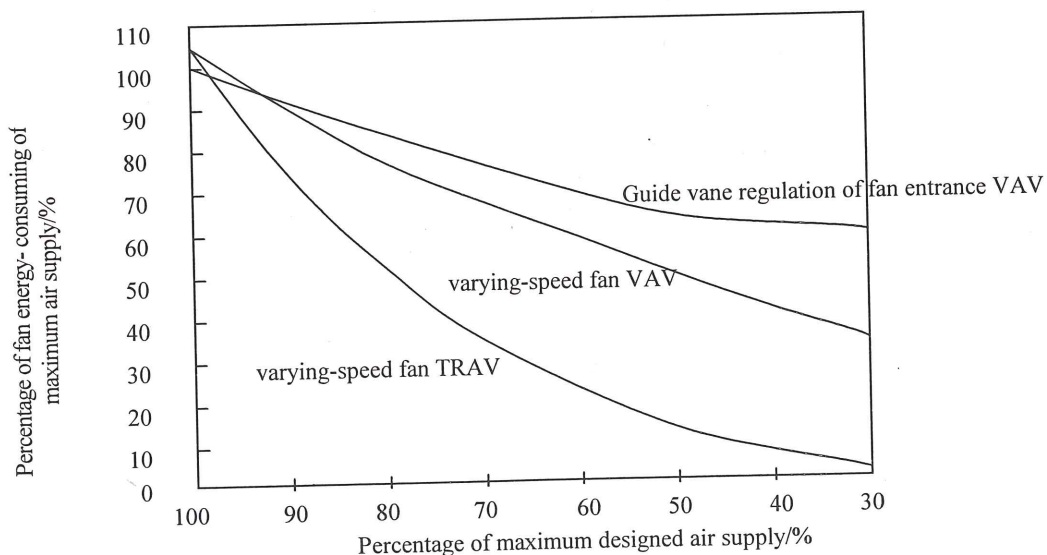


Fig.2 Energy-saving characteristics of TRAV

3. Discussion on intelligent building air conditioning system

Because of energy-saving characteristic of TRAV system, when air supply is 20 % to 25 % of greatest common air supply, fan's energy-consuming is only 2 % of energy-consuming which fan produces greatest common air supply, therefore, through time setting of DDC software, for instance, lead outdoor fresh air by adapting less energy-consuming of fan for supermarket and office building at night, we can maintain air circulation in buildings, improve indoor air quality, reduce harmful gas concentration. Besides, we can set outdoor temperature probes, when outdoor temperature is detected less low at night in summer, we initiate fan in the zone of low energy-consuming, put outdoor cold air into indoor in order to pre-cool and save energy.

For satisfying intelligent building individualized requests, we decided to adapt background air conditioning and air supply mode of double ducts of terminal air conditioning. The process is: 1. make air conditioning of fresh air which deal with fresh air load as background air conditioning, controlled by CAV in order to insure fresh air supply; indoor load is dealt with by terminal air conditioning and controlled by VAV, put fresh air to working tables through personal static boxes of open offices or air vent of ground air supply column, then regulate air supply of air vent in the worktable according to personal demand; 2. In order to make workers get better air quality, we can think that disposal fresh air is sent to worktable first. Because the proportion of fresh air supply in whole air supply in a year is very less, but in order to insure fresh air supply, fresh air is still adapted by CAV system and terminal air conditioning is adapted by VAV system. Finally, mix fresh air and part of circulating air by dealt with by terminal air conditioning before send fresh air to air conditioning zone, then change air supply of terminal air conditioning to accommodate personal demand change. Control air supply of which is sent to worktable and background air conditioning by terminal

air conditioning is passed to DDC according to open condition of every worktable and data of indoor temperature probe, then send control signals to regulate open degree of every controlling valve after software DDC analyzes synthetically.

Besides, set manual control on-off, at the same time, set probe that can induce indoor workers. When time which last people leaves reaches leaving time length which is designed by software DDC, air supply sent to indoor or worktable is shut up automatically; when somebody enters, DDC can send signals at once, then open to supply air automatically. Thus, function of delaying closing indoor air supply can reduce energy-consuming that is formed by forgetting shutting indoor air supply of air conditioning in order to reach energy saving of " people walk lamp put out", moreover, this function can not affect people's requests of using air conditioning.

TRAV system is used rarely at home, because it expects relatively reliability of controlling system, and the systematic cost is relatively high. It's used in intelligent buildings abroad at present. With the development of the economy of our country and progress of technology, price of the electronic apparatus is declined and its performance and function is better and better, TRAV system will enter our lives step by step because of its energy-saving and humanization. In near future, more, better, more humanized system will also present with the development of science and technology.

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