Application of Light Guidance Lighting in Building Energy Efficiency Based on New Generation Information Technology

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Abstract. This paper firstly introduces the development process and the status quo of light guide lighting technology. This paper also describes the basic structure and the type of light guide lighting system, which are combined with the data of Internet information technology. It provides a reference for the design of routines, the empirical analysis of Shenzhen city in a campus energy-saving building. It analyzes the advantages and problems of the light guide lighting, and puts forward the light guide lighting technology in the lighting design of buildings in the scope of application and its development trend. By using the system to collect the sunlight, the big data on the Internet are analyzed, and the real-time realization of the control of the sunlight, the illumination of the underground measurement and the large building lighting are realized. To make better use of energy, we can improve the energy situation of the current.

Introduction

Nowadays, the Energy conservation and environmental protection has become a social problem which is concerned by all over the world. It is directly related to the sustainable development of the society. Artificial lighting still plays a decisive role in the modern lighting, the world's average lighting power consumption has accounted for 10%~20% of the total power generation, while China's lighting electricity has accounted for the total power generation of 10%~12%. The global energy is becoming increasingly intense, the price is rising rapidly \[1\]. Optical lighting is a new lighting device at the end of 80s of last century popular in foreign countries. Traditional energy lighting equipment does not need to provide daytime indoor lighting, thereby reducing the pollution of traditional energy sources to the environment. The outdoor light is directly introduced into the room as the illumination light, so this lamp has a special lighting effect. New lighting products is a kind of green health, energy saving and environmental protection thing. At the same time, people pay more and more attention to the work and living environment comfort. People gradually from the spirit of the pursuit of comfortable light environment is one of the important pursuits \[2-4\]. The light guide lighting system will collect sunlight to effectively light the flammable and explosive rooms, the indoor dark rooms or the unsuitable rooms for electric light sources, which can effectively reduce the power consumption. The idea of light pipe originated from the association of tap water, since water can be piped to any place where it is needed, and then the light can also be the same as the flow of water. At first, the study of light pipes was carried out in order to carry artificial light until 1990. With the increasingly tense energy situation, natural lighting has become the mainstream of the light pipe technology, and it is also one of the hot issues in the field of lighting \[5\]. The natural light transfers to the dark interior space or underground construction, which can effectively reduce the power consumption of lighting, achieve the good effect and improve the indoor environment, which is an effective way of solar energy utilization.

In 1999, G. Oakley of the University of Nottingham, England, examined the daylighting properties of commercially available conduits\[6\]. Sweden has also carried out the corresponding research work. Because of the simple structure, convenient installation, low cost and good lighting effect, the light emitting diode light collector has been developed rapidly in foreign countries. At present many
companies have the ability to produce light pipe, such as Britain, the United States ODL Company and Japan \(^7,8\). In recent years, with the rapid development of our country's construction and the (increasing) concern of the green environmental protection, the light pipe technology has also rapidly developed. This paper proposes the design of natural light illumination device which is easy to be popularized and used in China \(^9\). Therefore, the utility model adopts a mirror without color difference, and improves the utilization efficiency of the solar energy by using the big data network information technology. The purpose of developing and applying the technology of collecting the sunlight is from the optical fiber which is used to turn the illumination into a kind of green product. It is necessary to study the entire lighting system from the perspective of green lighting, from the light pipe manufacturing, from the fabrication of the light pipe to the whole process before and after use to consider how to save energy and protect the environment. Light guiding device is the core part of the whole lighting system. The performance of the optical fiber and the design of the optical path are directly related to whether the device itself is a key issue of green products. Therefore, the lighting performance of the system needs to be further improved.

2 The network structure of light guide

This paper studies the application of the Internet of things technology in light guide lighting, and establishes a wireless network monitoring platform. Dense network is a kind of distributed system without center node. By the way of random launch, a large number of sensor nodes are densely deployed in the monitoring area. The sensor nodes are integrated with sensors, data processing unit, communication module and energy unit, which are connected by wireless channel and self-organized to form network system \(^10\). The purpose of the invention is to perceive, collect and process the information of the monitored object in the network coverage area. The wireless technology has been widely used in intelligent buildings now, in most cases, it is used in the star topology structure of the base station. Figure 1 gives schematic diagram of light guide lighting network.

![Figure 1. Schematic diagram of light guide lighting network.](image)

2.1 Structure diagram

The internal optical lighting system lighting device through the outdoor natural light and gathered into the system, and then through the light guide device of special production intensification and high efficient transmission, through the diffusion system under natural light to light, thus breaking the
"lighting completely rely on the power" concept. The common light pipe system is mainly composed of three parts, the lighting part, the light guide part and the astigmatism part. The lighting part is usually a transparent glass cover. The side is placed on the floor or roof, the light guide part is light pipe, the pipe wall is in general more than 95% of the reflectivity e reflective material, and light pipe can be rotated to change the light bending angle and length. Astigmatism part is a device for scattering light through the light guide transmission to the interior the light of uniform illumination, and it can avoid glare effect. In accordance with the lighting mode, the light pipe can be divided into active and passive. The active light pipe collects sunlight through a condenser, and then transfers the sunlight to the room. Because the condenser is equipped with the sensor and the feedback device, which may cause the condenser the direction of illumination always to the sun[11, 12]. The effect of this kind of light tube is quite good, but the cost of the condenser is quite high. In addition, the light transmission light pipe can also be divided into the light guide and light mirror light with catheter. The light guide is seamed to leave a long light slit on the tube wall, so as to enable the light to irradiate on the working surface of the light pipe, the light in the transmission process is easy to cause leakage, so the efficiency is not high, rarely used in practice.

2.2 Selection of catheter

Tracking condenser lighting system single-sided concave mirror used in this paper, including two parts tracking concentrating system and light guide lighting system, which can track the condenser system through an independent control system to track the sun and high concentration and injection position locking of the emitting light, the light guide lighting system will track the condenser system introduced by the light controllable infrared cut-off filter and guide, the converged light can be more effective evenly distributed in the room around, it can easily realize the automatic tracking of the sun, and the sun's light increase the output light energy density, and will be more uniform light the distribution in the room around the size of infrared energy[13]. The sun's light can also reduce the burden of indoor air conditioning, to achieve energy-saving and lighting effects; we can reduce the temperature by a light[14]. The received light photosensitive receiver signal is transmitted to the controller, the controller through the radial motor and weft drive box for automatic control, by adjusting the screw rod and the nut with the realization of the dish elevation. We can also match with the arc gear and the reflecting plate to achieve the reflecting disc level adjustment, so that the reflection disc is always in the plane vertical to sunlight. Figure 2 shows light guide natural light illumination system structure.

![Figure 2. The structure of natural light illumination system.](image)

2.3 Empirical analysis

We take the construction of a university in Shenzhen as an example, the school's Campus Internet regulation light guide lighting technology in the empirical analysis of the construction of
energy-efficient lighting area of 35000 square meters. The "standard" architectural lighting design shows that the area of Shenzhen belongs to the area of light climate zoning, annual average illuminance 25klx < EQ < 27 k LX. The average illuminance of 26 k LX was calculated to get the standard illuminance value. When the outdoor critical illuminance is greater than 26klx, the greater the indoor illumination, the greater the lighting range, the brighter the room. The above indoor illumination is derived from the state of sunny days, rainy days, except for special weather. In accordance with the distribution requirements, the use of 420 sets of light guide system configuration. We can analysis of direct electricity consumption[15].

(1) According to the "standard" architectural lighting design, classroom emergency lighting in the ground illumination requirements of 20 LX ~ 30 LX ~ 50 LX, the corridor ground illumination requirements of 30 LX ~ 50 LX ~ 75 LX, when the corridor illumination is 80lx, a single area electricity is 8w/square meters.

(2) The average daily illumination of the light system is about 15 hours.

(3) By drawing the classroom photoconductive lighting system, lighting comprehensive area of 35000 square meters (1), (2), (3), gives a day lighting electricity costs.

$$35000 \times 0.008 \times 15 = 4200 \text{kw.h}$$

So we get a day of the total amount of electricity 4200kw.h.

Fluorescent lamp ballast power consumption of electricity accounted for about 20%-30% lighting, calculated by 25% years, the ballast power cost is 4200kw.h * 25% = 1050kw.h. Day lighting total power consumption is about 4200 kwh + 1050 kwh = 5250kwh, so the total power cost is about 5250kwh * 365 = 1878250 yuan. According to the analysis of the national saving materials, the traditional electric lighting lamps need to be replaced within 3 years, the project also need to pay the cost of regular maintenance and renewal of lamps. Electrical lighting equipment maintenance costs 140 thousand yuan/year, replacement fee of $70 thousand/year. The light pipe system from the installation and use belongs to one-time investment. With relatively high efficiency, we can effectively compensate for insufficient artificial lighting. To sum up, the annual operating costs of electric lighting system is about 168.83 million.

3. Conclusion

The utility model reduces the energy waste and the hidden danger of the electric lighting in the daytime, prolongs the service life of the lamp, reduces the cost of manual maintenance and renewal of the equipment. It will bring considerable economic benefits. However, some defects of light pipe system limits its use and promotion, light pipe system and other systems need to be considered, such as ventilation system, optical photovoltaic system, combined with the new technology. It can not only improve the performance of the light pipe, but also expand the scope of its application. The future of light guide lighting technology is our implementation of building energy-saving emission reduction, environmental protection and health. This is a kind of technology which can promote sustainable development, and needs to do more comprehensive application research for the industry. The use of daylight lighting in the building by net, not only helps to achieve the purpose of energy saving and reduce the CO2, but also it can improve the working environment of employees. Light guide lighting has broad application prospects, in line with the basic national policy of energy conservation and emission reduction.

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