

The Development Trend of Office Space Lighting Design

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Abstract—In recent years, with the development of interior design and the improvement of the quality of life, people pay more attention to indoor lighting design of the office space. This paper has studied the development trend of office space lighting design through in-depth analysis of the development of science and technology, application of new materials, the change of lighting concepts, utilization and popularization of new energies and their influence on office space lighting design in order to provide a useful reference to the future design.

Keywords—office space; lighting design; people-oriented; intelligent; diversified

I. INTRODUCTION

Compared with lighting in commercial space, museum or art exhibition halls, we pay more attention to the effect of light on physical body and visual psychology in the lighting design of office space. Today, in some offices, people combine outdoor light and indoor space, and promote energy-saving lamps with accurate light distribution in order to achieve the purpose of saving energy. This design combines the indoor environment and lighting irradiation way and it is beneficial to people's physical and psychological health, but it is not widely applied by the society. The mainstream thought on modern office lighting design is saving energy, controlling cost, the introduction of lighting control system, people orientation and etc.

II. FACTORS AFFECTING THE DEVELOPMENT OF OFFICE SPACE LIGHTING DESIGN

A. The Development of Science and Technology

Traditionally, we should consider some important factors, including illuminance, brightness, environment color and the color-developing performance of light source in designing office lighting. These factors mostly are quantitative indexes in lighting. On the other hand, after decades of research and development, it is an easy job to meet requirements for simple quantitative standards of office lighting. The research tends to focus on how to meet people's psychological need on working environment lighting through indoor brightness distribution, glare control, light color use, automatic dimming and etc. That is to make office lighting more comfortable, flexible and suitable to physiological rhythm changes, rather than to improve brightness simply and limitlessly. The office lighting study is to make it suitable for

physiological characteristics and living habits of the Chinese. In general, most of our office space lighting is traditional grille fluorescent lamp, including tube fluorescent lamp and twin-U compact fluorescent lamp. Only a small number of office space or very limited areas adopt indirect lighting lamp. At the same time, our current domestic office lamps companies mainly are selling embedded grille lamps.

Modern information technology has been changing today's world rapidly, meanwhile people's life style and thinking mode also change with the development of society. The information age brings us new technologies beyond our imagination, forming a new concept presented before people. The rapid development of society will inevitably lead to changes in design concept. The design concepts cling tightly to life style in modern time and the development level of science and technology. A significant trend in modern office space design is that we are no longer limited to only focusing on the physical design of object, but paying more attention to "immateriality", such as system, structure, intelligence, interface, atmosphere, interaction and information entertainment service. We stress to create a working environment that can unleash creative potential of office crowd and make them comfortable and highly efficient.

Architects are actively making technology and art harmonious and unified in order to meets the wisdom and emotional needs of people in this information society. The modern office space also embodies the perfect combination of technology and art. As people make a higher requirement for art, it appears vivid streamline design. The continuous progress of technology makes it possible to meet new requirements for art aesthetics. The lighting is one of the most important links in interior design of office space. Can you imagine there is no light at night? If it is not out of people's inner needs, designers can not give space vitality no matter how they create designs.

With civilization of mankind, progress of society and improvement of people's lifestyle, people have higher and higher requirement for lighting quality and become particularly sensitive to light. So we continuously put forward new requirements for light source. For example, people require not only regulating lighting brightness but also color according to the environment, season, time and mood, which is also a direction to develop new light sources. The development and change of the light source promote the development of lighting design, which makes the indoor

lighting design of the office space better reflect the diversified characteristics, creates new design thoughts and new life environment.

B. The Application of New Materials

The development history of human society is as a material development history. From the pottery age, the Bronze Age and the great industrial age until today's information age, every appearance of new material has brought a qualitative leap to the human development. The material plays a very important role in the development of art. From Chinese and foreign art history, we can see obviously that Eastern and Western art develop along with the change of material itself. Since twenty-first century, with the development of industry and technology, the design is obviously beyond geographical and space constraint, quickly stepping toward the direction of internationalization. Lighting designers no longer only use traditional materials, such as metal, ceramic, enamel, glass material, also use natural materials, such as paper fiber and fabric. Even wood and bamboo materials have been widely used in lighting design. The high technologies have created many other new materials, which greatly stimulate the lighting designer's inspiration and imagination.

For indoor lighting designers, materials are means to create new things and express ideas. In the process of creation, design works are not to manifest material itself no matter it is natural material or man-made material, lighting material or interior decoration material. As a creative work, design fundamentally changes the traditional properties of the material and gives new meaning. The modern indoor lighting design emphasizes form of materials and space combination shaped by materials.

C. The Change of Lighting Concepts

Characterized by computer and network, the information society has changed the way we live and the work way of designers as well as design form and content. The application of computer micro processor has liberated the constraint on product form in the mechanical time. Designers could use their creativity and imagination to create more forms. At same time, consumer's need for diversified product encourage the change of design form. Various types of designs have become a strategy for businessmen to occupy market or a reflection of young designers to create something new and original. The internal changes in design works reflect people's serious reflection and rational understanding of some problems in the development process of industrialization. The environmental pollution caused by industrialization makes designers realize the responsibility to protect nature. The concern for people themselves makes designers reflect what we should leave for later generation. Nowadays we promote diversification, and design can reflect new technologies and provide good functions. Design should also reflect new ideas in environment, ecological, geographical and humane and etc.

With the development of modern industrial technology and modern science and technology, architecture faces the challenge of various ideological trends in this new era. The

creation form and concept of interior design is constantly improving and advancing, which directly affects the development and change of indoor lighting design. The idea of sustainable lighting design has become the developing trend of all walks of life. The sustainable lighting is a modern lighting that shall not only meet the essential requirements of lighting to providing high-quality lighting environment, meanwhile, this artificial lighting environment shall be beneficial to people's physical and mental development. The lighting idea is to create a comfortable, safe and economic environment, and thus to improve people's behavior quality, promote physical and mental health and embody lighting culture. In addition, it is beneficial to environmental protection and ecological balance. The propaganda of "green lighting" has a far-reaching significance in our country in recently years, which mainly promote electric light source, lighting accessories and lighting system composed by dimming control components with high social efficiency, long service life, safe and steady performance, in order to reduce lighting load installation power, save electricity in lighting, reduce the environment pollution caused by power generation, improve people's work and life quality and protect ecological balance. It is complicated system engineering. The main purpose of green lighting engineering is to save electricity, protect environment, improve quality standards and certificate system of electricity-saving lighting. The design idea of sustainable lighting and green lighting is not only for the purpose of saving energy and improving economic efficiency but also for resources utilization and environmental protection. The lighting design shall meet the higher requirements of the quality of lighting and visual environment, therefore we can not rely on lowering lighting standards to achieve energy-saving goal, but make full use of modern technology to improve the design level and method of lighting engineering and the efficiency of lighting.

D. The Utilization and Popularity of New Energy

Energy is the pillar supporting the survival and development of modern human design. Since the industrial revolution in seventeenth century, we have begun to mine underground coal and oil in a large scale and they are main energy in nowadays for our survival and development in the earth. But in the long run, these resources are limited and only "renewable energies" are unlimited. Solar power is fully clean, relatively extensive and adequate, sustainable and free of maintenance. It has many other advantages that conventional resources do not have, so it is a most important new energy in twenty-first century.

With the progress of science and technology, scientists have developed some new promising ways of generating electricity, which has broke the limit of traditional power generation and greatly improved the conversion efficiency from primary energy to electrical energy. It is a revolutionary change in the energy industry. The appearance and application of new energy are affecting all relevant categories. The lighting design is also changing quietly in various industries.

III. THE DEVELOPMENT DIRECTION OF OFFICE SPACE LIGHTING DESIGN

A. *People-oriented Development*

The development of high technology is most likely to create a social phenomenon that people follow the same pattern and feel monotonous and indifferent. The nature of human beings needs nature and art. We need art and emotion especially in this high-tech society. Under good material condition, the environmental art design begins to "return" to nature. The "return" is not back to simply primitive state but to create a "return" space with high-tech means. For example, share same space and provide urban citizens natural environment. It is an inevitable development trend to transform people-orientated design to nature design. In the information era, the technologies realize the ideal of human supremacy. The design is designed for a specific individual or a small group of people. The concept is no longer occupying the center of ergonomic factor with the average value of most people as design parameters. There will be more design works on the basis of personal or a small group's specific office and dimension demand. The design that designers design according to personal physiological needs and psychological needs will be main application form in ergonomics.

In designing indoor lighting, we should not only consider nature and characteristics of indoor space environment, but also take physiological and psychological characteristics of ordinary users and special crowds into account. With the advent of the information nature, the production of goods becomes extremely simple and convenient. It is no longer a problem to meet our material needs and cost. The concept of humanity and personality people pursuing in handicraft industry era will re-occupy the center of the design concept. Human are one part of nature. Our nature makes us always pursue "the unity of human and nature". Human's physiological and psychological needs are one part of nature. The plain people-oriented concept is transformed as the development trend in the information age, even as design principle, which also improve and perfect the people-oriented indoor lighting design in scientific level.

B. *Intelligent Development*

In the modern architecture environment, the requirements for lighting quality are more and more high. Lighting is not simply to turn on the light, but to create a pleasing artistic atmosphere, so that people work and study at most appropriate visual conditions and get good enjoyment. The intelligent lighting design with high technology as means is to control lighting brightness, color and time according people's need for lighting environment to provide a good lighting condition and save lighting electricity maximally. To artistic lighting, it is essential to control lighting intelligently. We can achieve the best state only through effective control on artificial light's brightness, looming, strength and movement, lighting angle and range to establish light composition, order and rhythm, and give full play to the light of artistic expression.

The appearance of electronic lighting switch and the application of intelligent lighting control system achieve the best use of lighting function and the perfect artistic effect. In the indoor lighting design, we use many control methods to realize the intelligent control and regulation on lighting. The control mode of rocker switch is the most common control method currently. But its circuit is complicated with large loss. There is a far cry from the pursuit of "people orientation" in this age. It is a simple and less expensive control method to use the breaker, but there is generally a large number of lighting in office space and the switch may waste electricity. For timing control, we can use BAS interface and realize its function through control center. We can set a whole day's work and rest time. It can realize its function by setting value, but it is difficult to adapt to the changeful climate and special circumstances. It will be very troublesome to change setting value. The photoelectric switch control is an photoelectric switch controlling lighting through setting illuminance. The most major advantage is energy-saving, because its operation method is to set illuminance through measuring the illumination of working plane and then control lighting switch automatically. By using this method, it can use outdoor natural light furthest. It can provide a steady visual environment without the influence of season and external weather. The intelligent control method has been introduced into our country in recently years. This intelligent control system is a completely digital, modularized and distributed intelligent control system. Every function of system is stored in certain module. If one module breaks down, only its own function fails. It will not affect the function of other modules. In this way, it avoids occurrence of a lot of unforeseen circumstances, which will not led to the failure of the whole lighting system.

The intelligent lighting control system of Australia Bunche Engineering Electronics Company has adopted the most advanced electronic technology, which could regulated the light of incandescent lamp, halogen lamp, fluorescent lamp, neon lamp, lamp band, metal halide lamp with special ballast and most other light source lamp. The system can use natural light intelligently. If the outdoor light is strong, the indoor light will become dim; if the outdoor light is weak, it will become bright automatically. In this way, it maintains the indoor illumination constant and automatically realizes the reasonable energy management and other functions, saving more than 20% ~ 50% of electricity. The intelligent indoor lighting design use new technology and provide an indoor environment suitable for people's psychological needs. At present we also began to use the intelligent lighting control system, but most of lighting designs are created by foreign designers. If our domestic designers can improve ourselves to international standards in this field, we will make a great improvement in the intelligent lighting aspect.

C. *Diversified Development*

At the beginning of twenty-first century, design starts to transform from new born state into a profound state with various artistic pattern and value. With comprehensive thinking, there appears a serious of styles to seek a variety of visual pointcut in modern life. The design works of all existing schools, including classic, modern and

contemporary art school, can provide reference for designers. The abundant design art garden has provided enough resources for designers to create works that can reflect life and times. The diversification of design directly reflects the complexity and diversity of this time. The modern interior lighting design has developed into a more diversified development stage with integration of various styles and combination of modernism, postmodernism, high-tech style, ecologism, deconstructivism and neo-modernism. In the development course of modern indoor lighting design, it has a great improvement in forms, perfection of style, and wideness of exploration space, rich materials and completion of function setting. The boundary of art and design is worn down and permeated. Every efforts to explore the richness of lighting design expression beyond life function, lighting design's pure concept, art and personality have built a variety of landscape in this diversified and rich lighting design circle. The interior lighting design cares about cultural trend, high technology and time spirit, provide the combination of high technology and emotion, pursue complex, refine and new visual effect, forming diversified characteristics in modern society. Under influence of every kind of culture, thought and principle, the design pays more attention to people-oriented spirit, technology, nature and emotion expression. Therefore, under diversified ideological trend the lighting design presents an opposite, diffused and syncretic development trend and reflects the interweaving of people-oriented thought, personality and emotion.

IV. CONCLUSION

This paper has discussed modern office space lighting design through the development of science and technology, application of new materials, change of lighting concept and utilization and popularization of new energy and studied the development trend of office space lighting design in order to provide a useful reference to design in the future.

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