

On Night Economic Highlights of Water Show, Light and Shadow Show Engineering Design

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Abstract:

The excellent design of urban water show, light and shadow show not only reflects the taste and characteristics of a city, but also the connotation of the city, which fully embodies the unity of music fountain and light and shadow function and artistry. This paper expounds the connotation and some basic principles of the design of the light and shadow show project of the water show, and probes into the design concept of the light and shadow show project of the city water show.

Keywords:

Night Economy, Water Show, Light And Shadow Show, Fountain Design, Water Curtain Film

1. The Role of Night Water Show, Light and Shadow Show in Night Economy

Night economy is a new track of urban competition, a new symbol of urban vitality, and a new engine of building city brand, promoting industrial integration and promoting consumption upgrading. Affected by the epidemic, stimulating domestic demand is an important economic measure of the government. At present, many governments in China have issued policies to promote consumption, more good news has been released, and the tourism industry has ushered in recovery, transformation and upgrading. The concept of night economy is “urban night leisure planning”, which also means that “night water show, light and shadow show” will become an important highlight of night tourism and stimulate commercial consumption.

2. Popular Elements of Shuixiu Light and Shadow Show

2.1. Music Fountains and Water Screen Movies in Water Shows

Water show is mainly composed of music fountain and water screen film. In the process of water show performance, according to the ups and downs of the music, the two systems are interwoven with each other. At present, the most brilliant music fountains are mainly composed of seven types of nozzles: two-dimensional nozzle,

spring running nozzle, high-pressure nozzle, gas explosion nozzle, matrix jellyfish nozzle and water fire mixing nozzle; water curtain movies are divided into three categories according to the most popular projection media: fan-shaped water curtain, swing nozzle water curtain and water curtain water curtain.

In the design of a light and shadow water show, we should first make clear the social effects and business goals of the water show, as well as the artistic theme to be expressed. The theme and content of performance is to serve social effects and business goals. Water show light and shadow show project is based on a variety of water type change technology, with lighting night scene effect as a means of expression, with water as the carrier to jointly reflect the landscape effect, so as to achieve the visual art function.

2.1.1. Stage Design of Water Show Light and Shadow Show

The stage design of water show light and shadow show is not that the stronger the sense of science and technology, the better. We should fully consider the cultural and regional differences. In the economically developed eastern coastal areas, some designs with a strong sense of science and technology will be more popular. If the same design is taken to the second and third tier areas in the mainland, it is easy to have a strong sense of violation. At present, there are many epic water show light and shadow show stages in China, but there is no corresponding grand program content. The more luxurious and grand the stage is, the more empty and empty the content is.

2.1.2. Proportion Design of Water Curtain and Fountain

A water show light and shadow show is composed of a water curtain and a fountain. In my many years of work practice, I think the ratio of the width of the fountain to the width of the water curtain is close to 1:0.618. It is reasonable to make some adjustments based on this ratio. The overall effect of the music fountain is most prominent in the long strip design, with arc-shaped running fountain, gas explosion fountain, numerical control swing and fire spray as the main performance forms. Inscribed circle and circumscribed circle are used to plump the whole fountain, and the water type is mainly controlled by numerical control swing, which serves as a foil. The center jet and the circular center jet are also powerful forms. The length to width ratio of a music fountain over 100 meters is about 10:1, so the overall feeling of the fountain will be very harmonious.

In the water show, the fountain is usually designed as the foreground of the water show. In order to make the depth, the fountain is often designed as close range, medium range and long range. The width of the close range, middle range and long range is enlarged step by step, and the height of the fountain is in the order of low, medium and high. The close range is suitable for designing some exquisite water types, and the long range is suitable for designing tall water types. More and more large-scale water shows are designed with fire springs. The audience's perception of water and fire is quite different. Fire will bring vibration and visual impact to the air, and it will last longer in people's optic nerve than water. Fire spring design should be more intensive, not too long, otherwise the audience is prone to visual fatigue. The high water type in the future can provide curtain for projection, laser, beam lamp, etc. Enlarge, extend and contrast the content of water curtain projection to enhance the appeal of its artistic effect.

2.1.3. Proportion Design of Water Screen Video Time in Water Show Light and Shadow Show

In a water show light and shadow show, the time of video program should not exceed 70% of the total time, and 30% of the time should be performed by music fountains and laser beam lights. This is an empirical parameter. Readers can increase or decrease the video time according to their own programs and scripts.

2.1.4. Form and Content Design of Water Screen Film

In most of the projects, the participants put too much energy and time into the form of water screen film video, and the investment in the content is seriously lacking. Film and television special effects do not need to spend too much energy, special effects investment is huge, in the project investment, the technology of tomorrow is always more advanced than today. And the content really belongs to the investor, which is the place to invest a lot of energy. Film and television should pay attention to the guidance of story and emotion, which is the cultural habit of Chinese people, and avoid the light and shadow water show and special effects based performance in the form of evening party.

The design of Shuixiu light and shadow show is based on the project cost, taking into account the surrounding environment, urban cultural tradition and regional customs. The purpose of the design is to determine the number of various basic water types, the combination of water types, and the layout and size of fountain pipeline. The design scheme without fountain cost can not be implemented, it can only be a castle in the air. In the fountain design, there are dozens of basic single water types. How to configure them organically and reasonably determines the final effect of the water show to a great extent. At the same time, as a form of artificial waterscape, water show is a part of the environment. It must be coordinated with the surrounding environment to express a common idea, whether it is cheerful or dignified, whether it is delicate and soft or rough and bold, or other. The design quality of water show light and shadow show is closely related to the experience, artistic quality, aesthetic taste and imagination of designers.

2.2. Design of Main Light and Auxiliary Light in Light and Shadow Show

The main light is mainly project projector and laser beam, beam lamp. Auxiliary light is mainly led lighting series, including LED underwater lamp, buried lamp, DMX512 lamp, line lamp, high light lamp and medium hole lamp. The design of the water show lighting should highlight the key parts of the water show and give consideration to the design concept of the general water type. That is to say, the light and shadow of the water show lighting does not require that all parts of the whole water area environment should be illuminated equally. Instead, according to the principle of highlighting the key points and giving consideration to the general, the main light should be used to highlight the key parts of the water type and the auxiliary light should be used to illuminate the general parts, so as to make the water show full of layers. In the design, the auxiliary light is arranged according to the number of nozzles, and the number will be far greater than the number of main light. But in the design effect and arrangement, the effect ratio of main light and auxiliary light is generally 3:1, which can not only show the visual center of the water show, but also show the overall image of the water show.

Many people who do light and shadow water show design have a wrong idea that fountain equipment is only stage props. As a matter of fact, water dance is not only a prop that can set off the water curtain video, but also a dancer, as well as a laser and beam lamp. Light, shadow and water dance are not only props, but also actors. There is a fusion relationship between them, not the relationship between actors and props. Only in this way can the water dance of light and shadow be perfectly integrated with the content.

2.3. Connotation of Water Show Light and Shadow Show Engineering Design

Under the premise of comprehensive consideration of the natural economy, history, society and regional development of the city, the project of Shuixiu light and shadow show puts forward the macro intention conception of the overall and zoning of the urban night environment, and puts forward the detailed requirements and limiting conditions. In the actual operation process, according to the different situation of each city construction, there are two kinds of operating system: one is the independent operating system of urban water show light and shadow show engineering design; the other is the urban water show light and shadow show engineering design throughout the urban planning and urban design. The first operating system is more direct and effective for the night landscape design of historical and cultural cities, built cities and traditional blocks in cities, or built areas in cities; while the second operating system is more unified and perfect for the reconstruction of new cities or certain areas in cities.

The engineering design of urban water show light and shadow show is a reasonable organization of urban night environment form, and the embodiment of urban aesthetics in the night. The reason why the urban water show, light and shadow show are extracted from the urban landscape and studied separately is that the landscape of the city at night is very different from that of the day. The planners must be familiar with these changes, and if used properly, it will create a moving urban night space effect. The engineering design of water show light and shadow show should not only consider the characteristics of urban space in the daytime, but also change the poor form of space in the sunlight and the uncorrelated form of existence through various methods and means.

2.4. Basic Principles of Engineering Design of Shuixiu light and Shadow Show

2.4.1. The Principle of Unity of Science and Art

As an integral part of urban landscape design, water show light and shadow show engineering design plays the same important role in beautifying urban environment as daytime landscape. Excellent urban water show, light and shadow show engineering design, it not only reflects the taste and characteristics of a city, more importantly, it shows the connotation of the city, fully reflects the unity of science and art of dynamic landscape.

2.4.2. Principle of Coordination with Urban Night Scene Lighting

Urban nightscape lighting takes lighting as the main means to show the artistic vitality of urban landscape. Urban road lighting and nightscape water show light and shadow show both influence and correlate with each other. Excessive rendering of nightscape lighting will inevitably bring light pollution and other problems, while enhanced road lighting will weaken the nightscape effect. Therefore, the water show

lighting and shadow show project should be coordinated with the urban nightscape lighting, and the reasonable optimization design can not only meet the requirements of illumination, but also be beautiful and generous, leaving a deep impression on people.

2.4.3. The Principle of Forming Identification

Every city has its own history of development, and on this basis, it has established its own image. Excellent engineering design of water show light and shadow show can make the image of a city more distinct and more desirable. According to the characteristics of different cities, it is very important to design and form a standard urban night scene, It can be positioned as a tourist city, a political and cultural center city, a commercial city, an industrial city, a civilized old capital, a new city, an entertainment city, etc. according to the attributes of the city, it can also be positioned as a coastal city, a mountainous city, a port city, etc. according to the geographical environment and regional characteristics, and it can also be positioned as a mineral product. For example, Xi'an city water show light and shadow show is positioned as a historical and cultural city and a modern international metropolis, with Xi'an Qujiang Datang Furong garden and Datang never night city water show light and shadow show and the night lighting of modern tall buildings as node signs It not only maintains the historical and cultural tradition and the overall pattern of the ancient capital, reflects the traditional local characteristics of the nation, but also integrates with the spirit of the new era, shaping the great image of Xi'an, which is simple, magnificent and spectacular.

2.4.4. Principles of Unified Planning

In the early stage of the construction of urban water show, people just build the city's landmark area into water show light and shadow show, and manage it by themselves. As a result, the whole city's water show, light and shadow show, landscape disorder, the overall effect is poor, waste of human, material and financial resources, did not receive obvious effect. With the development of urban night economy, people gradually realize that the light and shadow show project of urban water show is a systematic project. Only when a series of urban elements such as buildings, squares, parks, streets and natural landscape are coordinated and organically combined, and unified planning is carried out, can a harmonious and beautiful picture of night water show be formed. Planning is to determine the suitable image characteristics of the city and the future construction and development direction of the water show light and shadow show system from the macro perspective, so as to make the city night scene step into the track of scientific development.

2.5. Discussion on design concept of Shuixiu light and shadow show project

2.5.1. The Relationship Among Three Levels of Urban Water Show, Light and Shadow Show Engineering Design

The overall planning, detailed planning and specific scenic spot water show design of urban water show light and shadow show project have mutual influence and restriction. The overall planning of urban water show light and shadow show project is the guidance and premise of detailed planning and specific scenic spot water show design, and the latter must be designed according to the principles determined by the former. And the master plan is not unchangeable, it is flexible, according to the social

and economic development, in the construction practice of urban night landscape constantly find problems, and gradually improve.

2.5.2. Design of Scenic Spots of Urban Water Show Light and Shadow Show Project

The project design of urban water show light and shadow show is carried out under the guidance of urban night landscape planning (including the overall planning and detailed planning of night landscape), which is the overall design of night landscape elements of specific scenic spots. Based on the analysis of site conditions, surrounding conditions and structure materials, the overall design of water show, light and shadow show elements in scenic spots is generally completed by landscape designers and electrical engineers. While meeting the requirements of the upper level planning, we should take the modeling and aesthetics as the starting point, and on the premise of considering people's use and functional requirements, decorate the environment more beautiful, so as to show the night landscape image of water show, light and shadow show. Therefore, the designer must carefully study the method of water type transformation of music fountain according to the specific situation of night environment, in order to create the best effect of light and shadow show.

3. A Case Study of the Water Show, Light and Shadow Show Project in Zhangjiakou, Hebei, China for the 2020 Winter Olympics

In order to meet the 2020 Beijing Winter Olympic Games, Zhangjiakou, Hebei Province, China, has upgraded the landscape along the line. The biggest highlight is the water show, light and shadow show project in this area that we participated in. The Shuixiu light and shadow show project, completed in August 2019, is designed and constructed according to the new concept. The Shuixiu light and shadow show project adheres to the principle of simplicity but not simplicity, and is the representative work of the new generation of fountains at home and abroad. Shuixiu light and shadow show project is elaborately planned, designed, constructed and arranged. It adopts many advanced new technologies and new equipment in the current fountain industry, and realizes the major innovation of fountain technology, including: adopting the integral lifting floating body technology, the whole fountain can achieve self lifting without any impact on the lake landscape; adopting the single point control technology, the single fountain can be controlled Head, a single lamp, a single device to achieve independent control, so as to truly achieve the "water dance", the artistic level and appreciability to achieve a qualitative leap; the use of multi posture nozzle technology, the same nozzle can show a variety of water effects, greatly enriching the fountain's technical form and spatial level; the use of numerical control gas explosion technology, in order to achieve the explosion effect at the same time, it has a great impact It can realize energy saving; it adopts high-power and high brightness underwater LED light, which can realize pure white and 256 degree color conversion; it adopts a new generation of frequency conversion technology, which can realize stepless change of water type; it adopts high-power and miniaturized outdoor square sound system, which takes into account the square landscape and sound effect; it adopts a multi integrated control system, which can control the time precision up to 0.01 seconds, realizing the precision The design concept of water art theater is adopted to arrange the water dance action and show the water dance art in the form of song and dance drama. In a word, the overall layout of Zhangjiakou music fountain is simple but varied, the effect is beautiful and magnificent, and it has a strong technical

level, era atmosphere and cultural connotation. (the real scene is as follows: Figure 1, Figure 2, Figure 3)



Figure 1. Live review of water show auditorium.



Figure 2. Live scene of water show.



Figure 3. Real scene of water show performance 1.

3.1. Hydraulic Calculation

The relationship between nozzle and water type is one-to-one. Once the fountain scheme is determined, the outlet size and spray height of the nozzle are determined.

Total head calculation:

$$H = H_1 + H_2 + L \quad (1)$$

Where: H is the total head; H_1 is the net head; H_2 is the loss head; L is the vertical height from the pump outlet to the nozzle outlet. The head loss includes the local loss caused by the pipeline along the head loss, elbow and diameter change, and the calculation is complex and inaccurate; in engineering, 10-30% of the net head is often taken as the loss head. The net head is the height of the nozzle. It is determined by the actual pipeline.

Flow rate of single nozzle:

$$q = \mu s v \quad (2)$$

Where: q is the nozzle flow rate; μ is the flow coefficient, 0.62-0.94 [1]; s is the nozzle outlet area; v is the nozzle outlet flow rate. Considering that the outlet of most nozzles is round, if the diameter is set as d , then:

$$q = \frac{\pi}{4} \mu d^2 \sqrt{2gH} \quad (3)$$

If a pump is set as a sprinkler for water supply, the flow rate of the pump is required to be:

$$Q = \frac{\pi}{4} \mu n d^2 \sqrt{2gH} \quad (4)$$

Diameter of main water supply pipeline:

$$D = \sqrt{\frac{4Q}{\pi V}} \quad (5)$$

Where: is the velocity of water in the main pipe. Considering the head loss and wall pressure of the pipeline, the cross-sectional area of the main pipe is required to be greater than the sum of the outlet areas of all water supply nozzles in principle when determining the diameter of the main pipe.

According to the hydraulic calculation results of the fountain, the selection of nozzle, pump and pipeline is made. All nozzles in Zhangjiakou project are made of 304 stainless steel with corrosion resistance. All fountain pipes are made of 304 stainless steel. (Figure 4, Figure 5)



Figure 4. Real scene of water show performance 2.



Figure 5. Real scene of water show performance 3.

3.2. Sound System Design

Zhangjiakou Shuixiu light and shadow show project, according to the actual use needs and the current use experience of similar squares at home and abroad, determines that the main sound reinforcement system for subjective multi-channel sound reinforcement adopts multi-channel sound reinforcement mode, taking into account the stereo sound reinforcement mode of SIS spatial imaging, that is, the left, middle and right three channel sound reinforcement mode. The sound reinforcement system of the auditorium can realize single channel sound reinforcement, left and right two channel sound reinforcement, left middle right three channel sound reinforcement.

The sound reinforcement system is classified according to the sound field coverage, including the following subsystems:

- a. Left and right main channel speaker system design;
- b. The design of main amplifying and auxiliary loudspeaker system;
- c. Design of subwoofer system;
- d. The design of the loudspeaker system for the audience station;
- e. Design of auxiliary loudspeaker system in auditorium;

3.2.1. Design of Left and Right Main Channel Speaker System

The left and right channel loudspeakers are installed on both sides of the auditorium, covering the left and right auditorium area respectively, which is the main part of the whole sound reinforcement system. 16 double 12 inch linear array loudspeakers are used for the left and right channel main loudspeakers, which are mounted on both sides of the front edge of the main console. 8 linear array loudspeakers are used for each channel. Covering most of the audience area, using left and right channel stereo sound reinforcement can effectively reduce the audio-visual distortion, so that the audience can get better hearing effect when enjoying the performance.

3.2.2. Design of Main Sound Reinforcement and Auxiliary Sound System

As the audience area is 400m long and 30m wide, in order to improve the sound field uniformity of the whole auditorium and play the role of audio and video, we set up 8 double 12 inch linear array sound compensation speakers on both sides of the main amplifier to supply sound to the audience area on both sides

3.2.3. Design of Subwoofer System

In order to expand the lower limit of low frequency and get better performance, we should set up ultra-low frequency speakers. We also designed two groups of four double 18 inch professional subwoofer systems, which are installed directly under the main amplifier,

3.2.4. Design of the Main Stand Return Loudspeaker System

In order to ensure that the entire stand has a uniform sound field distribution and make it easy for each audience to monitor the actual effect of the performance clearly and realistically, we have configured another four mobile loudspeakers in the main stand to provide return sound, forming a uniform rostrum monitoring sound field.

3.2.5. Design of Supplementary Loudspeaker System in Auditorium

Considering the large area of the audience area and the high and low angle of the auditorium, in order to ensure that the audience area can get a uniform sound field distribution, we have configured a horn full frequency speaker in front of each audience area and on the opposite bank of the lake as a sound supplement, which further strengthens the sense of sound space. Use 10 horn full frequency speakers. (Figure 6).



Figure 6. Audio installation.

3.3. Layout Design of Water Screen Film

The scheme of this project takes the 50 m by 18 m fan-shaped water curtain as the carrier. Through intelligent control, it perfectly combines the naked eye 3D video, music, interaction and lighting, and integrates them into the mountains and rivers, and in the scenery of overlapping peaks, trestles and yuyuqionglou. With crisscross streamers and bright aesthetics, it outlines a gorgeous picture for the night. The arrangement of the water screen film is as follows:

a. Title (total time about 1 minute)

The water curtain shows that the Phoenix begins to take off. After 30 seconds, it shows "Phoenix dances for nine days, and the water is beautiful."

(with related videos of lotus and blue and white porcelain)

b. General Situation of Zhangjiakou (5 minutes in total)

Zhangjiakou, also known as "Zhangyuan" and "Wucheng", is a prefecture level city under the jurisdiction of Hebei Province. It is located in the northwest of Hebei Province, at the junction of Beijing, Hebei, Shanxi and Inner Mongolia. It is the intersection of Beijing Tianjin Hebei (Bohai Rim) economic circle and Hebei Shanxi Inner Mongolia (outer Great Wall) economic circle. It is the central city in the northwest of Hebei Province and the transportation hub connecting Beijing and Tianjin and Shanxi and Inner Mongolia.

Great Wall Museum

Zhangjiakou City is the largest area of the Great Wall, known as the "Great Wall Museum". Two million years ago, ancient human beings flourished here; 5000 years ago, the ancestors of the Chinese nation, Huangdi, Yandi and Chiyou "lived in Zhuolu", which opened the beginning of Chinese civilization. During the spring and Autumn period and the Warring States period, Xiongnu and Donghu lived in the north, while Yan and Dai lived in the south. (Commentary with video)

Great rivers and mountains, passionate Zhangjiakou

Chongli and Chicheng in Zhangjiakou are the largest natural ski resorts in North China, known as the Oriental Davos. On July 31, 2015, President of the International Olympic Committee Bach announced that Beijing and Zhangjiakou, Hebei Province, have won the right to host the 2022 Winter Olympic Games. In December 2017, he was elected as "China's top 10 ice and snow tourism cities". (Commentary with video)

Tourist attraction

There are 60 A-level scenic spots in the city, including 11 4A scenic spots, 30 3A scenic spots, 19 2A scenic spots, 74 star hotels (22 hotels above four stars) and 98 travel agencies. Zhangjiakou has three national nature reserves, one National Forest Park, 16 provincial forest parks and one provincial scenic spot. The main scenic spots are as follows: Huangdi city ruins cultural tourism area, Zhangbei Zhongdu grassland resort, Xiaowutai Jinhe scenic area, Nuanquan ancient town, air grassland, Yuzhou ancient city, Datang hot spring, Guyuan Great Wall manor, changchengling Cuiyun mountain, Qiaoxi dajingmen scenic area, duolemidi ski resort, Huanglong villa, Jiming post (explanation with video)

c. Songs (total 14 minutes)

I love China, good day, William tuer Overture, radsky March, welcome to Zhangjiakou, wave of Gulangyu, Spring Festival Overture, Meihua Sannong, I love you China, bright red sun never sets, beautiful grassland night, etc.

i. Water Screen Movie (8 minutes in total)

Animation production of "night tour of Zhangjiakou by elves"

ii. Epilogue

Guests from afar you want to stay (2 minutes)

iii. End of film

After the end, the water curtain shows "beautiful Zhangjiakou, unforgettable tonight". (Figure 7, Figure 8, Figure 9)



Figure 7. Installation of project in computer room.



Figure 8. Real scene of water show film 1.



Figure 9. Real scene of water show film 2.

3.4. Laser Show Design

In this scheme, a total of 5 sets of 30W full-color laser lights are arranged, 3 sets are arranged in the center of the machine room, and one set is arranged on both sides of the subjective shadow stage. The laser software is pangolin beyond4.0 ultimate. Beyond is the latest and most professional laser performance software in the world. It integrates all the functions of quickshow and LD2000. In the laser programming of this project, in addition to the application of basic laser patterns, we also use 3DMAX to make 3D animation and then convert it into laser show program, making the laser effect more bright, gorgeous and three-dimensional. (Figure 10, Figure 11)

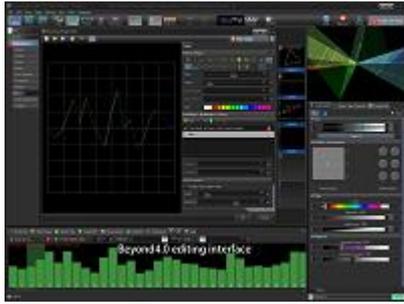


Figure 10. Beyond4.0 Editing interface.



Figure 11. Laser show.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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