A Study and Research on Tianjin Olympic Center Stadium For LED Illumination Art & Innovation Work

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ABSTRACT

On the evening 8.00pm of August 27, 2017, the 13th National Games of the People's Republic of China was grandly opened at the Tianjin Olympic Center Stadium. Chinese President Xi Jinping attended the opening ceremony and announced the opening of the National Games. Millions of the audience either from the crowds sitting inside the stadium or the people (from both China and overseas) watched the opening ceremony live TV broadcast at home and witnessed this national sport event. The Tianjin Olympic Center is able to catch the eyes balls from people all over the world with its uniquely designed stadium shape and dynamic and colored LED illumination methods as the designs highlighted three themes like “green Olympic”, “technological Olympics” and “human centric Olympic”. This paper focuses on the theme of high efficiency and energy savings and summarizes the artistic, creative and innovative work (by proper tailor of light rays and proper color mixings) of the beautification and LED media facade using pixels LEDs. More importantly, the new LED Illumination method and LED media facade utilized the latest technology in LED centralized control system using GPS system and multiple building LED synchronization and DMX 512 control method.The night landscape lighting for Tianjin Stadium not only serves aesthetic value, economical value and environmental value on tourism, but also creates a sparkling and enhancing atmosphere at night and a perfect harmonization with the architecture and sports attribute.The key issues of this study work are the appropriate luminance distribution,luminance and color uniformity, the smart use of color to meet the aesthetics need of the Olympic stadium, integrated application of LED lighting science and technology, creating comfortable and peace illuminated environment of fashioned architectures, enhancing and promoting Olympic spirits, and applying green lighting.

Keywords: dynamic and colored LED illumination, color mixings, LED media facade, LED centralized control system, luminance distribution, luminance and color uniformity, green lighting.

1. INTRODUCTION

In CHina, after the G20 meeting held in Hangzhou 2016 and the BRICS meeting held in Xiamen in year 2017, the usage of LEDs in large scale urban landscape lighting has been emerging very rapidly in metropolitan cities like Beijing, Shanghai, Shenzhen, Guangzhou and others. In the recently SCO summit which was held in the Qingdao on 9 and 10 June 2018, the leader from Kazakhstan, Russia,Uzbekistan,India,Pakistan and others witness the animation, movies played with sound system by using LEDs mesh screens installed on more than 40 over buildings in the seashore of Qingdao and it amazed not only the world leaders but also the tourists from all over the world. (Refer to Figure 1 for the The use of LED in outdoor application includes landscape lighting decorations, bridges, tourist attraction centers, gardens, traditional heritage, signage, lightings used in swimming pool or even underground and many others applications. The usage of LEDs in the LED screen, projection purposes and to draw the contour and outline of the stadium like what are being demonstrated in this paper is becoming more and more popular in China due to LED is a green light source and if this is used and designed properly, it could fulfill the unique illumination requirement, dynamic color changes, lighting artistic effects, and also can achieve a perfect integration of light source and architecture because of LEDs’ small in size and compact luminaires.The Tianjin Olympic Center Stadium covers a total area of 78,000 square meters and has a construction area of 169,000 square meters.It not only ensures the shape of water droplets, but also shows that the building is exquisite and modern, and it presents a unique view of the underwater stadium with water droplets. It also won the title of “Water Drop Stadium”.

Figure 1: More than 40 buildings in the commercial area was decorated with LED mesh screen on it and it can achieve synchronization control for movies, advertisement, display for SCO Qingdao summit. World leaders and thousands of visitors witnessed the opening ceremony.

Figure 2: The skyview of The Tianjin Olympic Stadium at night, the night landscape lighting for Tianjin Stadium not only serves aesthetic value, economical value and environmental value on tourism, but also creates a sparkling and enhancing atmosphere at night and a perfect harmonization with the architecture and sports attribute

Figure 3: photos shows the worker doing the installation for the LED mesh screen on site.

2. Optical characteristic of the LED and luminaires and Color mixing requirements:

Because the LED used in this Tianjin Olympic Center Stadium is meant for LED mesh screen purposes, projections functions and for the application to draw the contour and outline of the buildings. Hence the LEDs and the luminaires has to be carefully selected and designed in order to achieve the illumination requirement (in term of brightness of luminous flux and luminance level), color sensations

(in term of chromaticity coordinates and CCT) and also the intensity distribution of integrated LED chip integrated with the double protection layer.

The Stadium has two LED mesh screen on it, each one is 180 square meter in size and they can be seen even at the distance of 200m.In order to achieve the perfect color mixing and also consistent luminance level for perfect display requirements, the LEDs used in this project must possess three primary colors (Red, Green and Blue) and the fourth colors (warm white 3000K). In addition to luminous flux, the color (primary wavelength) also plays an important role, preferably within a BIN (5 nm) or even smaller. In addition, in order to increase the color that can be mixed and the more perfect blending effect, the selection of the color coordinates of the RGB monochrome LED must cover as much as possible the area of the larger CIE1931 standard chromaticity system.Not only that, the RGB LEDs must be pre-selected and pre-tested to meet stringent requirements of the Peak WLs so that when they are mixed, it can produce vividness color and homogeneous color.For the beam angle, the LED with a wide half angle of 110º was chosen for the LED display, this is to guarantee a perfect blending of color from the muiticolor chips and the LED placements are very closed to each other.

Although the consistent light output performance of LED chips are indeed important, but because the outdoor LED adds a double protection layers of LEDs, the variables that may result in light and color quality during the double protection packaging process are: Consistency of the packaging material, machinery between the injection molding equipment and the equipment variances, injection molding techniques and proficiency, packaging environment and temperature, material thickness and shape, etc. The thermal conductivity of the packaging material is also very important. The color parameters of all LEDs will change with the temperature of the PN junction of the LED. The encapsulated LED must effectively enable the LED heat conduction from the inside to the outside so that for all the photometric and colorimetric parameters can be consistent. The key to the entire technology is a superior double protection packaging material and packaging process control.

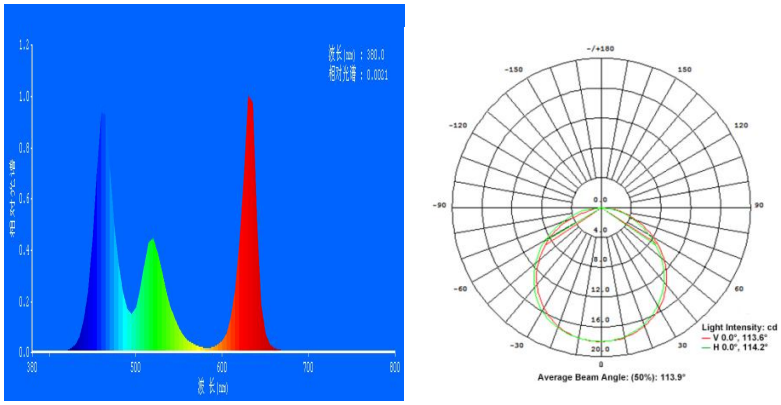

Figure 4: The LEDs are carefully tested for its spectral power distributions and spatial distribution

Figure 5: The LEDs are carefully tested for its spectral power distributions and spatial distribution using calibrated 1.5m integrating sphere and GO2000.

3. Safety, efficacy and reliability of LED system:

Because LEDs luminaires are installed in the public area with thousands of visitors, the fire safety of the led luminaires used are indeed important, hence the LEDs module are properly designed and encapsulated to achieve the fireproof grade of V-0 and the IP protection grade of IP68, this is to ensure the fire safety requirements and also the protection against the rain fall, dust and extreme environment from damaging the LEDs. Not only that, the material used in the encapsulation and to create a double protection layer of the LED must possess good transmittivity (more than 90%) so that the photon are not being trapped by the protection layer and yet it is sufficient to protect the LED from water leaking in. Furthermore, because of the heat generation from the high power LED, the material also consists of the heat dissipation nanotechnology material in order to ensure excellent heat dissipation to guarantee high reliability of LED life time. Furthermore, more heat is able to be dissipated to outside environment means the improvement of the lumen efficacy of the LEDs.

4. Lighting Control System:

The stadium are lighted with lighting through the intelligent DMX control system centralized control system, synchronization control, in the major festivals to achieve light synchronizations among the three halls. And it can fulfill the human interaction with the lights in the entire Olympic center. Not only that, the three hall can also be switched between synchronization control and individual control to meet the lighting needs of each venue in different scenarios. By receiving satellite signals, multiple controllers can be synchronized globally and stored on an SD card to meet the need of customers to synchronize multiple controllers in a situation when multiple buildings cannot be connected.

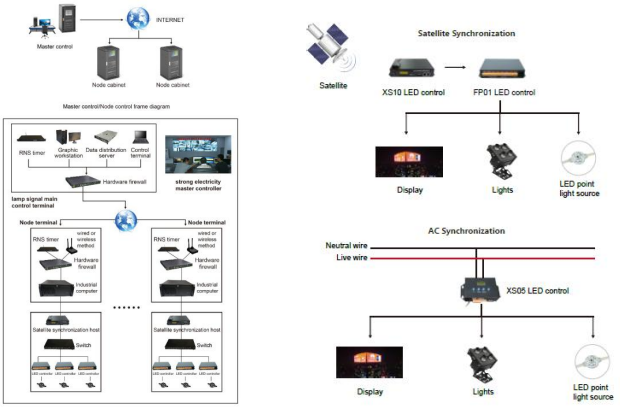

Figure 6: The lighting system control using internet (left) and using Satellite Synchronization (right)

5. CONCLUSIONS:

This paper demonstrates step by step on the research and development of making and realization of beautification and night landscape lighting using professional LED mesh screen and LED application for projection and for contour and outline drawing in Tianjin Olympic Center Stadium. Many technical difficulties and challenges (like LED Optical characteristics, luminaires performance, lighting control system etc) need to be resolved and handled in order to produce a perfect color sensations for the visitors and world leaders. The successful of the realization of the LED beautification and night landscape lighting in Tianjin Olympic Center Stadium not only could boost up the name and fame of Tianjin City, but it could bring economical and aesthetic value.

REFERENCE

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