

EMPIRICAL RESEARCH ON LED LIGHTING FOR SPORTS VENUES

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Summary:

LED lighting began to be used in indoor sports facilities around the early 2010s, with adoption increasing steadily as the technology became more efficient and cost-effective. In 2015, Safeco Field, the home stadium of Major League Baseball's Seattle Mariners, replaced traditional metal halide lamps with LED lighting, making it the first Major League Baseball stadium in the United States to introduce LED lighting. The introduction of LED not only effectively reduces glare and shadow areas but also creates a better game atmosphere for players and spectators. Additionally, after replacing traditional metal halide lamps with LED lighting, Safeco Field reduced its annual lighting expenses by \$50,000.

Even though the experience of using LED lighting in many large sports venues internationally has been quite successful, there are still some challenges faced by the relevant authorities in Taiwan when it comes to using LED lighting for outdoor sports venues. LED lighting technology continues to make breakthroughs, addressing many traditional issues. However, because sports lighting is influenced by factors such as the sports space, direction of play, speed of the sport, and television broadcasting, the requirements are more stringent than those for general lighting.

Due to continuous breakthroughs in LED lighting manufacturing technology in recent years, the use of LED lighting in sports venues in Taiwan has flourished over the past few years. However, sports lighting is influenced those mentioned factors above, which imposes stricter limitations and requirements compared to general lighting. Given the high maintenance costs of metal halide lamps, Taiwan has gradually started replacing traditional metal halide and mercury lamps with LED lighting.

This study compares the following through on-site measurements: 1. The results of illuminance simulation versus actual measurement results, 2. The illuminance results of indoor sports venues after replacing metal halide lamps with LED lights, and 3. The illuminance results of

outdoor sports venues after replacing metal halide lamps with LED lights.

The result shows as follows: 1. In outdoor sports venues, the simulated illuminance and actual measured average illuminance differed by 10.3%, but the uniformity discrepancy reached up to 36%. 2. Replacing metal halide lamps with LED lighting in indoor sports venues resulted in a 47.5% reduction in energy consumption and a 254% increase in average illuminance. 3. Replacing metal halide lamps with LED lighting in outdoor baseball field resulted in a 40% reduction in energy consumption and a 165% increase in average illuminance in infield, 280% increase in average illuminance in outfield. 4. Each watt per square meter can provide an average illuminance of around 65 to 75 lux.

Conclusion: 1. The discrepancy between the computer-simulated illuminance and actual measurements is significant, particularly in terms of uniformity. It is recommended that a rigorous adjustment process be conducted after completing the simulations. 2. Replacing metal halide lamps with LED lighting in indoor sports venues resulted in a 47.5% reduction in energy consumption and a 254% increase in average illuminance. 3. The energy-saving effect of replacing metal halide with LED has been highly effective, even exceeding expectations. It is recommended that sports venues use these results to design the most optimal lighting solutions. 4. LED lighting in sports venues can be influenced by various factors, such as the lighting curve, luminous efficiency, and luminous flux, which vary between brands of sports-specific fixtures. However, to roughly estimate the total wattage of lighting fixtures needed for a venue, a general guideline is that each watt per square meter can provide an average illuminance of around 65 to 75 lux. A 500-square-meter basketball court with a total lighting wattage of 4,000 watts would have an average illuminance of approximately 520 to 600 lux.

Keywords: Sports lighting, Metal Halide lighting, LED lighting.

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