Lighting Quality in Taiwan's Badminton Courts

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ABSTRACT

This study aims to analyze the quality of lightings in the indoor badminton courts in Taichung, Taiwan. The study was conducted on-site and illuminance values were analyzed. A digital illuminance meter and handheld distance meter were used as the main measuring tools. Data was collected and analyzed by SPSS for 11.0. The results show that Guoguang Badminton Court has reached the "leisure" grade for illuminance, while Hongyi Badminton Court has fallen short of the standard. Second, the maximum/minimum illuminance ratios at Guoguang Court has achieved the standard of grade one, and Hongyi Court is grade two, which means that the two courts have reached the standard for formal contests and general matches respectively. Considering the variance, Guoguang Court was classified as third grade, while Hongyi Court was second grade, both of which have fallen short of the variance standard for formal contests.

Keywords: *Indoor badminton courts, Quality of lighting*

INTRODUCTION

Background

On February 1, 2004, the Executive Yuan introduced the "Taiwan Health Promotion Plan" with the goal of promoting regular exercise, enhancing the number of sports spectators, establishing a healthy campus, and improving public life education and lifestyles in Taiwan (RDEC, 2004). With a high national income and fewer working hours, people gradually have more free time and attach importance to the health issue, and more people enjoy leisure activities and sports. Badminton has become one of the most popular sports in Taiwan. Presently, the number of people who play badminton is approximately 1.2 million (Chou, 2004). Also, in addition to company-based teams (Land Bank and Taiwan Cooperative Bank), more and more universities and colleges have formed school badminton teams, such as National Taiwan Sport University, National Taiwan Normal University, National Chiayi University, Taipei Physical Education College, National Taiwan College of Physical Education, National Changhua University of Education, National Taichung University, National University of Tainan, and National Taitung University (Chou, 2006). Due to the above-mentioned reasons, numerous badminton courts have been built. According to a survey from Anderson's Dreams (2007), the badminton courts in Taiwan total 329, most of which are located in Taipei City/County, Taichung City, and Pingtung County, and the number is still increasing.

Badminton is a multi-direction air sport. During the game, players have to look at the fast-paced shuttlecock in order to strike it, while spectators require a clear view to "get into the action." Therefore, well-designed light quality has become one of the most important facilities in an indoor badminton court. The goal of installing sufficient light facilities is to provide an adequate lighting environment, so that object can be clearly seen by players, spectators, and even television viewers (Liu, Hsu, & Lin, 2005). Also, the USTC (2000) indicated that the lighting in sporting venues should be equipped with vertical illuminance and horizontal illuminance which can illuminate the whole playing field. In addition, in order to avoid glare, the lighting facilities cannot be installed in areas in which the spectators and players often look. According to Tien (1993), lighting facilities in sporting venues should supplement natural light and provide proper illuminance for nighttime contests, so sports lighting is one of the most important facilities in sporting venues.

Liu (1999) observed that, in terms of sports lighting, "illuminance" is the most essential factor. Nevertheless, almost all of the courts in Taiwan are unable to meet the basic requirement for nighttime lighting facilities, and none of the objective and professional organizations have assisted in examining the lighting quality of indoor courts. This is

why it is necessary to examine the lighting quality of the existing badminton courts and report our findings. Thus, this study surveys the lighting of indoor badminton courts in Taichung, and a few suggestions are provided as well.

Purpose of the Research

1. To inspect firsthand the lighting environment on two of Taiwan's indoor badminton courts: Guoguang Badminton Court and Hongyi Badminton Court.
2. To measure the lighting quality at the two courts and analyze the data to provide suggestions for improvement.

Scope and Limitations

1. Scope of the research
   (1) This research used two indoor badminton courts as the subjects. The two courts were the Guoguang Badminton Court and Hongyi Badminton Court.
   (2) When measuring the lights, all light sources were turned on and the measurement was carried out under international standards for the illuminance at badminton courts.
2. Limitations of the research
   (1) This research focuses on the nighttime artificial lighting at indoor badminton courts and excludes the impact of other natural light sources.
   (2) Considering the fact that there can be errors in the data collected by the illuminance meters, this research only presents the figures gathered in a more objective manner.
   (3) Considering the limitation on the length of the article, this article does not provide details on the location of the lampposts and the characteristics of the light sources.

METHODOLOGY

Subjects

An on-site measurement was carried out at two indoor badminton courts: the Guoguang Badminton Court (2009.4.20) and the Hongyi Badminton Court (2009.4.26). All of the two courts are constructed under international standards. All lamps were on during the measurement time and the measurement was done based on international standards on the measurement of illuminance at badminton courts. Figures were recorded and analyzed. The following tables present the standards for the illuminance and uniformity gradient, based on which the collected data were analyzed.

Table 1: Variance standards for sporting facilities

1st Grade	0.15
3rd Grade	0.30
4th Grade	0.35

Source: Jim, Jeff, & Mike (2003).

Table 2: Illuminance standards for sporting facilities

For leisure purposes	150~300LUX
For contests	300~750LUX
For formal contests	750~1500LUX

Source: Xu, S. X. (1994).

Table 3: Maximum-to-minimum illuminance ratio at sporting facilities

1st Grade	2.0
2nd Grade	2.5
3rd Grade	3.5
4th Grade	5.0

Source: Jim, P., Jeff, K., & Mike, G. (2003).

Tools

The following paragraphs summarize the meters used in this research:

1. Laser distance meter: Handheld distance meter was used to measure the height of the lampposts and the measurement spot. Its average degree of accuracy: (0.3~30m/1~100ft) ±2mm (±3/32in), maximum: (0.3~30m/1~100ft) ±3mms (±1/8in). The laser distance meter was used to survey the the height of the lampposts at the badminton courts.
2. Illuminance meter: Digital illuminance meters were used as the main tool. The DPI was 0.01Lux~0.1kLux/0.01fc~0.01kfc and its degree of measurement accuracy was ±3% rdg± 0.5% f.s. The illuminance meter was used to survey the distribution of illuminance at the badminton courts.

Data Processing

Figures collected at the two badminton courts were statically analyzed using SPSS for 11.0. The statistic methods used are as follows: descriptive statistics, average, and variance.

RESULTS AND DISCUSSIONS

Illuminance of Guoguang Badminton Court

The horizontal illuminance of Guoguang Court was measured at 186 Lux, which only meets the standard of leisure grade. The maximum/minimum illuminance ratio is 1.9, which also conforms to the formal contest standard (the international standard of maximum/minimum illuminance ratio is under 2.0). The illuminance variance of Guoguang Court is 0.28, classified as leisure grade. Thus, the horizontal illuminance and illuminance variance of Guoguang Badminton Court needs to be improved if a badminton contest is to be held there.

Table 4: Results of Illuminance Analysis of Guoguang Badminton Court

mean horizontal illuminance	186 Lux	leisure grade
mean vertical illuminance (east/south/west/north)	92 Lux	
maximum/minimum illuminance ratio	1.9	1st Grade
variance	0.28	3rd Grade

Illuminance of Hongyi Badminton Court

The horizontal illuminance of Hongyi Court is 117 Lux, which falls short of leisure grade. The maximum/minimum illuminance ratio is 2.2, which only meets the standard for general matches (the international standard for formal contests should be under 2.0). In terms of variance, Hongyi gets 0.21, which is in the standard range of general matches. The results show that the horizontal illuminance of Hongyi Badminton Court is apparently inadequate. Therefore, if formal contests are going to be held at Hongyi Court, the horizontal illuminance needs to be improved, and the maximum/ minimum illuminance ratio and variance should be enhanced to the 1st grade.

Table 5: Results of Illuminance Analysis of Hongyi Badminton Court

mean horizontal illuminance	117 Lux	leisure grade
mean vertical illuminance (east/south/west/north)	71 Lux	
maximum/minimum illuminance ratio	2.2	2nd Grade
variance	0.21	2nd Grade

CONCLUSION AND SUGGESTIONS

Conclusion

In the past, the lighting facilities of sporting venues attracted little attention, so that problems like glare and insufficient illuminance had impacted the contests and other sports. Badminton is ranked the sixth most popular leisure

sports in Taiwan (Sport Affairs Council, 1999), and badminton courts are ranked second in the survey for most frequently used sports facilities (Mou & Wu, 2002). Since the shuttlecock is comparatively small in size and it moves fast, the importance of lighting quality in badminton courts cannot be overlooked. Thus, how to ensure and maintain lighting quality has become a vital issue for players and court owners.

This study aims to analyze the quality of lightings in the indoor badminton courts in Taichung, Taiwan. The results show that Guoguang Badminton Court has reached the "leisure" grade for illuminance, while Hongyi Badminton Court has fallen short of the standard. In badminton games, the object (ball) moves fast and accordingly inadequate illuminance may impact players' judgment and cause eye fatigue. The maximum/minimum illuminance ratios at Guoguang Court has achieved the standard of grade one, and Hongyi Court is ranked grade two. Considering the variance, Guoguang Court was classified as third grade, while Hongyi Court was second grade, both of which have fallen short of the variance standard for formal contests.

Suggestions

1. Not only should the light of badminton courts have adequate horizontal and vertical illuminance, but also glare resulting from uniformity and illuminance should be prevented.
2. In order to reach optimal lighting standards in badminton courts, the court owners are recommended to invite professionals to assist in designing the lightings.
3. The lighting facilities need regular maintenance and cleaning in order to maintain the lighting quality of badminton courts.

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