EXAMINERS

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SPORTS LIGHTING

A THESIS

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BY

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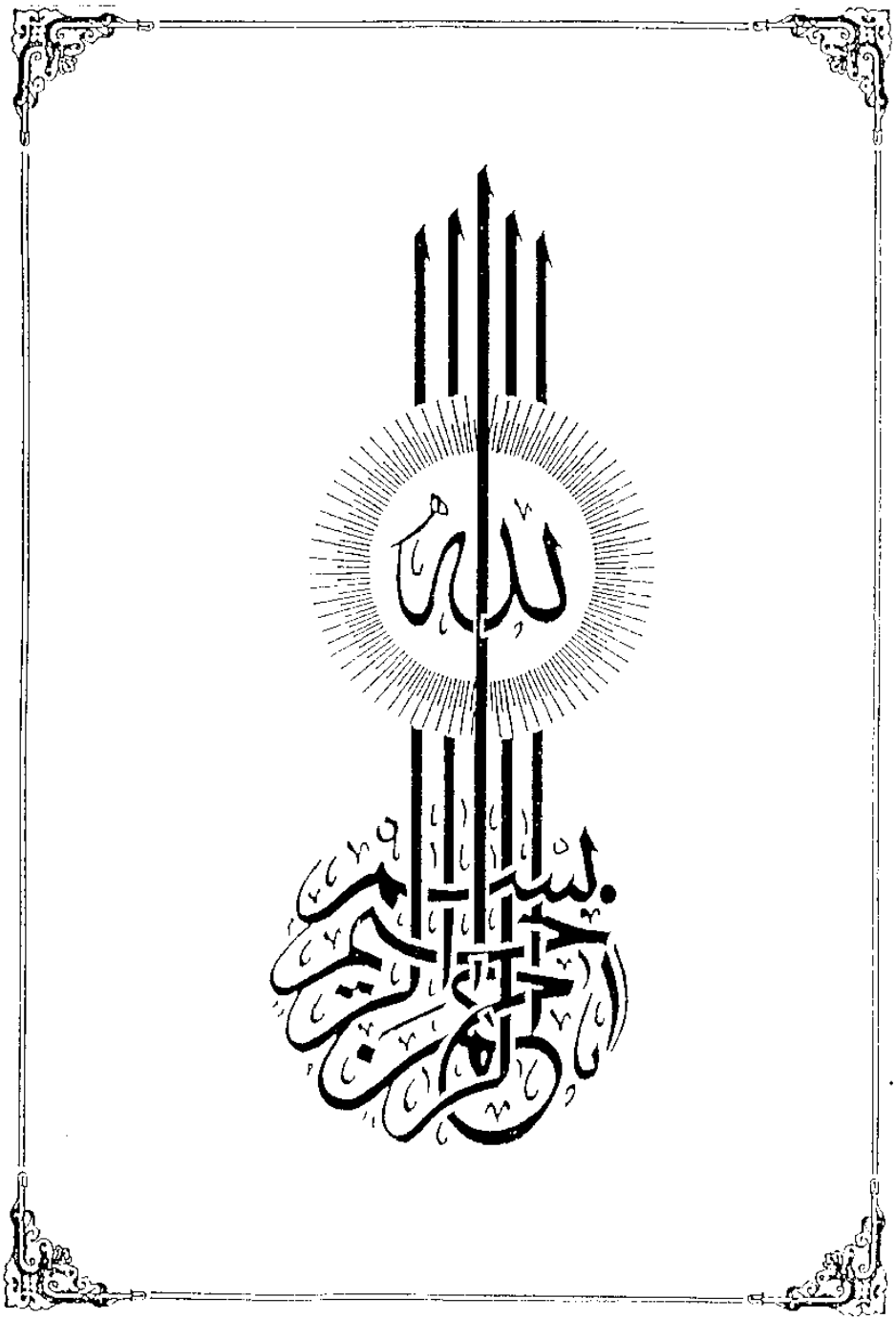

LIST OF SYMBOLS

A	:	Area.
a	:	Major radius of an elliptical spot area.
α	:	Aiming angle of a luminaire.
b	:	Minor radius of an elliptical spot area.
β	:	Beam spread.
c	:	Velocity of wave propagation.
d	:	Viewing distance.
E	:	Illuminance.
F	:	Luminous flux.
f	:	Frequency.
H	:	Mounting height of a luminaire.
h	:	Plank's constant.
I	:	Luminous intensity.
L	:	Luminance.
λ	:	Wavelength.
ω	:	Solid angle.
R	:	Radius of a spherical zone.
r	:	Distance, radius of a sphere.
θ	:	Inclination from normal.
v	:	Volt.
w	:	Watt.
Z	:	Width of a spherical zone.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL :

Sports lighting, the theme of this thesis, is one of those modern branches that have acquired an increasing importance amongest other branches of lighting engineering. This is because the world in which we live now pays unusual attention to following the different international sports tournaments; a case that has imposed a remarkable care when illuminating competition courts and stadiums, especially if such competitions were to be transmitted live on T.V. all the world over.

However, although sports lighting is a recently introduced term in the science of lighting, the science of lighting itself may be the oldest branch of science man has ever known. People have noticed, from the very beginning of their existence on earth, the natural sources of light to be sun, moon, and stars. Later on, artificial sources of light were discovered, all were chemical sources i.e.light was produced by burning some

substance. So, fire lasted for thousands of years as the main artificial mean of lighting.

A revolution in the field of lighting took place when electric sources of light have been used. Tomas A.Edison succeded on May, 2, 1880 in using his multiple system of distribution, with a constant voltage dynamo, to illuminate a steamship called Colombia with 115 incandescent lamps[1]. Since this date, electric sources of light have replaced the chemical ones and electric lamps have been commercially and economically applied everywhere.

Nowadays, the field of lighting undergoes a process of evolution. The dividing lines between interior and exterior lighting are losing ground and the basis of illumination engineering has become functional rather than positional. For instance, sports lighting may be indoors or outdoors but still needs special basic considerations and general requirements as sports lighting. So, we are entering into a new era of lighting design and illumination engineering.

1.2 BASIC CONSIDERATIONS :

Dealing with sports lighting, we have to consider many factors which greatly affect the quality requirements of the lighting and the installation design aspects. These considerations can be divided into 3 groups; one is related to the type of sport ,another is related to the type of area, and the third group is related to the type of user .

1.2.1. The type of sport

Two factors related to the type of sport have a major influence on the quality of lighting required . These are the apparent size and the apparent speed of the playing object (often a ball).

(1) The apparent size : depends upon the physical size of the playing object and the viewing distance.

(2) the apparent speed: depends upon the speed of the playing object and the direction of movement relative to the direction of view.

Certain types of sports have only a limited number of main viewing directions for the players. For example,

with tennis, the main viewing direction is in the longitudinal direction of the court. Higher demands will be made on the lighting as the speed of the playing object increases and its size becomes smaller. The main viewing directions can also influence the siting of the luminaires[9].

1.2.2. The type of sports area :

Important considerations regarding a sports area, as far as the lighting is concerned, are :

(1) sports area dimensions.

(2) the spectator facilities.

(3) reflectances of boundary surfaces.

(4) whether or not sports area is covered.

(5) whether or not there is daylight penetration.

The dimensions of a sports area influence the quality requirements of the lighting (because different viewing distances are involved) and also the siting possibilities of the luminaires. The overall dimensions of a sports area are determined by the type of the sport or sports catered for, and by the sort of spectator facilities

provided: no grand-stand, grand-stand at one side, grand-stand totally enclosing the playing area, etc.

A surface is made visible by virtue of lighting being reflected from it and entering the eye of the observer. It should thus be appreciated that the reflectances of the surfaces of the sports area play a role in the final lighting effect achieved. These boundary surfaces may be ground (grass, gravel, .. etc.),walls, or ceiling. Often the height and construction of the ceiling also have an important bearing on the lighting possibilities. Halls with daylight penetration call for special attention to avoid adaptation problems, whereas this problem cannot exist in halls without daylight penetration.

1.2.3. <u>The users</u> :

Three types of users with different activities can be distinguished:

(1) the players taking part in the game, the referee,and (during training) the coach.

(2) the spectators entering, staying in, and leaving the sports facility.

(3) the television, recording the performances.

The players must be able to clearly see all that is going on in the playing area, so that they can deliver the best possible performance. Spectators have to be able to follow the performances of the players and the development of the game in an agreeable environment. They must be able to see their surroundings and immediate neighbours as well. The lighting should also help the spectators to safely enter and leave the sport facility. With large crowds, this security aspect in very important.

Finally, for television coverage the lighting provides the conditions necessary to guarantee good picture quality (today usually in colour) . Not only pictures of the game, but also close-ups of the players and spectators should also be possible.

1.3 light sources :

In sports lighting the following lamp types are used :

(1) incandescent (tungsten and tungsten - halogen).

(2) tubular fluorescent.

(3) high-pressure mercury.

(4) high-pressure sodium.

(5) metal-halide.

Advantages of the ordinary tungsten incandescent lamp are: its low initial cost and excellent colour properties. Its efficacy (lm/w) however, is very low, resulting in a high energy consumption per lumen. Furthermore, its life is comparatively short. The incandescent lamp can therefore not be recommended from an economical point of view. However, the tungsten-halogen incandescent lamp has an approximately fifty per cent higher efficacy, a longer life and is available in small-sized high-wattage versions suitable for use in floodlights. Because of this and because ignition and reignition are instantaneous, this lamp is ideal for providing emergency lighting in outdoor facilities. Its efficacy is so low that it cannot be recommended for general sports lighting (11).

Tubular fluorescent lamps have high luminous efficacies. However, a fluorescent lamp's colour

properties are dependent upon the type of fluorescent coating used. Many fluorescent lamps have spectra that are suited to colour television and filming, but the physical length of them and their rather low luminous flux make them unsuitable for floodlighting. In interior sports lighting they are employed to advantage in ceiling luminaires to obtain glare-free installations[6].

The high-pressure mercury lamp gives white light with moderate colour properties. Its efficacy is also moderate. The lamp has a compact, ovoid-shaped form . Since the introduction of the more efficient and also more compact highpressure sodium and metal-halide lamps, they are applied in preference to the high-pressure mercury lamp in new sports lighting installations.

The high-pressure sodium lamp has an even higher efficacy. Its colour propertics resticts its use to those application where colour does not play an important role. It has a yellow-white colour appearance. High-pressure sodium lamps are available in 2 versions: tubular clear and ovoid-coated. Because of its small