EXTERIOR LIGHTING AND OTHER APPLICATIONS

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Contents

1. Introduction
2. Decorative Lighting for City Beautification
2.1. Social and Economic Impact
2.2. Elements to Illuminate
2.3. Planning
2.3.1. Master Plan
2.3.2. Background Study
2.3.3. Site Study
2.3.4. Permission of Authorities
2.4. Lighting Design Approach
2.5. Lighting of Buildings and Monuments
2.6. Lighting of Statues and Sculptures
2.7. Lighting of Interesting Structures
2.8. Lighting of Parks and Gardens
2.9. Lighting of River-walks, Sea beaches or Waterfronts
2.10. Lighting of Pedestrian Areas
2.11. Energy Conservation
2.12. Light Pollution
3. Road Lighting
3.1. Objectives
3.2. Requirements of Drivers
3.3. Design Concepts
3.4. Glare
3.5. Surround Ratio
3.6. Road Surface
3.7. Road Types and Pole Arrangements
3.8. Preferred Pole Positions and Visual Guidance
3.9. Mounting Height and Spacing
3.10. Selection of Lamps
3.11. Selection of Luminaire
3.12. Switching Systems
3.13. Other Energy Conservation Measures
4. Area Lighting
4.1. Illuminance
4.2. Uniformity of Illuminance
4.3. Glare
4.4. Color Appearance and Color Rendering of Lamps

4.5. Selection of Lighting Equipment
4.6. Lighting Design
4.7. Area Specific Lighting Requirements
4.8. Emergency Lighting
4.9. Lighting Calculations
4.10. Light Pollution
4.11. Maintenance
5. Security Lighting
5.1. Residential Area
5.2. Exterior Work Area
6. Sports Lighting
6.1. Primary Users and their Lighting Requirements
6.2. Type of Sports
6.3. Requirement of Basic Data
6.4. Lighting Parameters
6.5. Choice of Light Sources
6.6. Choice of Luminaires
6.7. Lighting Level Recommendations
6.8. HDTV
6.9. Lighting Calculation
6.10. Emergency Lighting
6.11. Light Pollution
6.12. Maintenance
7. Light Pollution
7.1. Inherent Limitations of Exterior Illumination
7.2. Effects on Surroundings
7.3. Limiting Obtrusive Light
8. Lighting Maintenance
8.1. Importance of Maintenance
8.2. Causes for Light Depreciation
8.3. Calculation of Maintenance Factor (MF)
8.4. Planning for Maintenance
8.5. Disposal of Failed Lamps
9. Conclusion
Glossary
Bibliography
Biographical Sketch

Summary

Exterior lighting extends our working hours, social life and recreational opportunities beyond sunset. Good lighting ensures comfortable viewing and productivity, creates pleasant environment, brings out beauty of objects and gives a feeling of security and safety. For a good lighting design, knowledge of light products and lighting requirements to suit the task to be performed and environment are a must. An efficient lighting installation must be a combined operation by all professionals and stakeholders. Each has an important contribution to make and cooperation right from the concept stage is essential.

This chapter describes the planning process, lighting requirements, selection of products and energy-effective lighting design giving a comprehensive overview on all typical exterior lighting applications.

1. Introduction

With the gradual development and availability of electric lighting from the beginning of 20^{th} century, participation in outdoor activities after sunset became popular. Initially, the demands were for road lighting, area lighting for some industrial sectors and some recreational activities like outdoor games. In the last 60 years, these demands have increased manifold. Many activities are carried out non-stop over 24 hours in a day such as, industrial production; utility services like docks and harbors, electricity generating stations, water works etc.; and road traffic with increasing number and speed.

Great developments have taken place in light products – lamps and lighting equipment (luminaires and control gears) – and lighting application technology. It is now possible to provide desired levels of illumination for each application, while maintaining the quality of illumination: uniformity, limitation of glare, faithful color reproduction etc. in an energy-effective way.

Government tourism ministries and city corporations have found that travel and tourism can be increased by illuminating historically important monuments and other landmarks, parks and gardens, as well as by providing good road lighting. Road lighting also facilitates prevention and reduction of nighttime accidents.

Good outdoor lighting serves several social objectives. It helps people to carry out their activities safely and efficiently after sunset. It supports economic activities and makes it possible for people to maintain all types of social systems.

Security lighting substantially reduces the risk of crime being an active deterrent outdoors.

With the advent of Television, particularly color TV, organizers of the games and broadcasters found it financially beneficial to hold the games in the evening in large stadia. Sportslighting technology is now sufficiently advanced to face the new challenges posed by improved TV broadcasting technology and cameras.

Choice of floodlights with improper optical characteristics and/or selection of wrong aiming angles can give rise to ‘spill-light’ or ‘obtrusive light’. Sometimes light reflected from illuminated surfaces in the upward direction creates a phenomenon commonly known as ‘sky glow’. All these effects are termed as Light Pollution. It is necessary for the lighting community including the project authorities to be aware of this phenomenon and how it can be eliminated or controlled within a limit.

Light output of each light source decreases with time. The capacity of luminaires to effectively direct the light reduces with collection of dust and moisture on them with time. Good energy-effective lighting needs planned maintenance, without which

designer will have to provide extra light in order to achieve the desired lighting level. Extra light means extra power consumption.

This writing describes all the important application areas in exterior or outdoor lighting detailing in each of these areas: the approach, lighting requirements, lighting equipment to be used, and how the designer has to work in close cooperation with other agencies to achieve energy-effective lighting design. It also details the possible ill effects of light pollution and how to eliminate or control the same. Steps for planned lighting maintenance from the design stage have been described alongwith the good effect on energy conservation.

2. Decorative Lighting for City Beautification

The quality of life after sunset in a city improves with good lighting. Apart from comfort and security in moving around, it is possible to go for relaxation and sightseeing in the evening, when parks, gardens and places of interest are illuminated carefully.

2.1. Social and Economic Impact

City beautification with decorative lighting prolongs the time of social contact among people. There are several direct and indirect influences on economy. There is a growing trend of people travelling more and more. Cities can attract tourists by enriching the nighttime appearance and providing enhanced night attractions. Tourists and local people feel safe to visit well-lit recreational and leisure facilities, particularly outdoor ones. It increases commerce and trade. Illumination of building exteriors is an effective way of advertisement for commerce and industry. It creates positive image of companies, hotels etc.

2.2. Elements to Illuminate

In cities and places of tourist interest, there are many buildings, structures, objects and open areas, which can be illuminated creatively. These are:

- Buildings: Historical monuments like castles, palaces, places of worship.
  Commercial houses, industries, cultural and educational institutes of repute.
- Works of art: Sculptures, statues.
- Structure of interest: Bridges, towers.
- Open areas: Parks, gardens, waterfronts like river walks, sea beaches.
- Pedestrian areas: City squares, shopping districts, roads.

There are some other elements which add to the image of a city. Outdoor advertisement hoardings and signages, if illuminated properly and creatively can make the city landscape more attractive. Decorative lighting on festive occasions and special installations like musical fountain and son-et-lumiere (sound and light) make city more attractive; in musical fountain, the level of water, color and direction of light change with the tune. The entire operation is pre-programmed. In sound and light spectacle,

history and culture of a place are brought out through pre-programmed narration and play of light on the relevant objects.

2.3. Planning

The reaction to the effect of decorative lighting can be very subjective. It is, therefore, very important to plan well before taking up the job.

With the innovation of more and more energy-effective light sources and development of application technology in the last few decades of the 20th century the decision makers found that the relative cost of lighting came down.

2.3.1. Master Plan

Lighting is an expression of civic pride. Area within a city or a sculpture has its own identity or character. All these individual elements must fit into the creation of a lighted environment. Thus a master plan is necessary.

Individual, uncoordinated approaches are likely to bring negative results.

Preparation of master plan needs close interaction among the authorities, architect, city planner, lighting designer and electrical consultant.

2.3.2. Background Study

It is necessary to study the historical background and architectural details of a monument or an artistic object/structure. This will help to understand which parts of the monument are important and need highlighting for the benefit of the visitors.

2.3.3. Site Study

Visiting the site at different time of a day is important. This will reveal how the sunlight from different angles brings out the architectural features. In some cases interacting with visitors can also be beneficial, as their reactions can tell what they appreciate.
Positions of trees, bushes, foliages, water bodies etc. should be studied carefully. It is important to know the seasonal growth of greeneries and variations of water levels. These information determine the positions and color of light sources.

Lighting in the surrounding areas must be known. This helps to decide the desired illuminance on the object.

Viewing points for the visitors or people passing by should be known to decide the aiming directions of the luminaires, while eliminating the glare.

2.3.4. Permission of Authorities

For installation of the lighting equipment, permission of all concerned authorities should be obtained. Master plan needs the initiative, approval and backing of the highest level

of civic administration. For historical monuments, archaeological department responsible for conservation and maintenance should agree with the installations to be done in and around the premises, and lighting effect to be obtained.

If the location of a monument warrants it, consultation with the authorities like Aviation, Maritime, Defence Services etc. might be necessary.

2.4. Lighting Design Approach

Biggest challenge faced by a lighting designer for decorative lighting is to decide on the appropriate and feasible lighting effects. Lighting effect depends on several factors as given below.

2.4.1. Selection of Light Sources

Color characteristics (color temperature and color rendering index) of light sources are important to bring out the color of the object to be illuminated.

Wattages of the light sources to be used depend on how much light (lighting level and uniformity) is necessary.

2.4.2 Selection of Luminaires

Light distribution characteristics (wide, medium or narrow beams) and physical dimensions determine the choice. In some cases, there can be difficulty in placing a large luminaire. Then, several smaller luminaires with matching light sources will have to be used to get the same amount of light on the object.

Luminaires should have appropriate mounting and aiming facilities. They should be easy to maintain and have proper IP classification (see Section 8).

2.4.3. Trials

When a large and complex building structure is involved, particularly historical monuments, site visits and study of site plans, drawings and photographs taken from different angles may not give full idea to the designer. It is advisable to carry out trial installations at various parts of the building to actually see the effects.

2.5. Lighting of Buildings and Monuments

Most of these lighting installations are done by floodlighting.

2.5.1. Positioning of Floodlights

Positioning depends on the surface or the object to be emphasized, the volume to be highlighted, and the relative locations of the viewers. All these and the lighting in the environment and the distances between the available spaces for the lighting equipment

and the object, determine the quantity of light (lamp-luminaire combination) necessary for the desired effect.

Floodlights are generally installed in the immediate surroundings of the building to illuminate the façade and other surfaces, but can also be mounted on the building if the lighting effect demands it.

2.5.2. Managing the Shadows

While illuminating a building with architectural elements, the designer has to keep in mind how to utilize shadows to good effect and how to avoid them.

In order to highlight an element, it is necessary to keep the immediate surroundings, which may not be of interest, in shadow. Also shadow brings out the relief of the surface or different planes or volumes. If the building or monument is just flooded with light or if the direction of light is perpendicular, there will be no shadow and the surface in question appears flat. So, to make the monument or building more interesting, intelligent use of more light, less light and shadow is necessary. Even it is quite often necessary to leave some parts unlit to provide a contrast.

2.5.3. Aiming of Floodlights

Lighting effect looks natural and balanced, when all shadows cast under artificial lighting, are in the same direction, as happens during daytime. So, all principal luminaires or floodlights should be aimed in the same direction for lighting a surface seen in one field of view. The average minimal light directional angle shall be 45 degree with the normal to the surface. This angle has to be increased if the relief is particularly low. On the other hand, if there are large projections, they can create large shadows on some interesting parts. To soften these shadows, there should be complementary floodlights with light of less intensity at about 90 degree.

Viewing directions of the observers also has to be kept in mind. To make the relief and the shadow visible, there should be at least 45 degree angle between the direction of light and the viewing direction.

For tall and large monuments visible from many places, a principal viewing place must be decided in consultation with the authorities and the lighting design should be done for this viewing direction.

2.5.4. Backlighting

Sometimes an object can be more interesting to see in silhouette or as a dark object. Here floodlights must achieve a fairly uniform bright background surface to the object. Additionally, light of a very low intensity on the object is sometimes necessary to bring out the shape.

Lighting the rear surface of the object can also bring good effects by creating light patterns due to construction feature on the rear surface.

2.5.5 Colored Light

Sometimes colored lights are used to emphasize some surfaces or objects. This has to be done very carefully, as there are many delicate issues involved.

Viewers should be able to easily interpret the reason for the effect of the design. Colored lights falling on the adjacent surfaces can create unacceptable contrasts. When the building façade is made of different materials, more care has to be taken, as colored light may create an unbalanced effect.

Colored filters have their own limitations. Plastic filters may not be suitable for using continuously for a long period due to the temperature rise. Glass filters can be heat resistant, but have limited choice of colors.

When a colored filter is used over the front glass of a floodlight, the light output is reduced. This might lead to either using lamps of higher wattage or increasing the number of floodlights. Both alternatives lead to wastage of energy.

2.5.6. Glare Control

Direct and/or reflected glare should be controlled, so that residents in the neighborhood and motorists on roads nearby are not inconvenienced.

2.5.7. Daytime Appearance of the Installation

Luminaires along with their supporting structures should look aesthetic to the visitors and passers-by during daytime. If necessary, coloring may be done to match with the environment or camouflaging done for the same purpose.

2.5.8. Ease of Maintenance

The design should make the installation easily accessible for regular maintenance involving lamp replacement, cleaning and setting right any disturbed luminaires.

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Biographical Sketch

Pranab K. Bandyopadhyay - 48-year career in lighting started with Philips India, where he handled lighting design, technical application, and quality assurance of luminaires, before heading a team in the Lighting Design & Engineering Centre.
Realized large number of high profile energy efficient lighting projects: indoor and outdoor sports stadia, decorative lighting of a famous garden and landmark monuments, major roads, heavy engineering industries, metro rail station, offices and banks, and son-et-lumiere (sound and light) spectacles at historical monuments. Many of these received international acclaim.
Was a member representing the lighting industry in the Government of India Standing Committee on Energy Conservation and while formulating the policy, carried out country-wide survey to determine the consumption of electrical energy in the lighting for the first time in 1980s.
Completed 40 years of association with the Bureau of Indian Standards as a member in all lighting committees, convenor of several panels and chairman (since 2003) of the Luminaire and Illuminating Engineering committee formulating the National Lighting Code 2010. Many of the current standards and codes of practice were drafted by him.
Associated actively with the CIE from 1987, as a member of Division 5: Exterior Illumination and Other Applications; chaired two technical committees and was a member in several others till 2005, and

prepared guides and technical reports. Was Editor, CIE Division 5 and Member Publication Board (1995-2005). He has received CIE Award in 1999 at the CIE Session, Warsaw.

His interest in lighting education took him to actively support starting of undergraduate courses at Jadavpur University, Kolkata in 1983 and Manipal Institute of Technology, Manipal in 1989. Both the courses since developed into Master degree courses. Delhi University appointed him as an external examiner for Ph.D. thesis on a research on residential lighting. University Grants Commission, Government of India, appointed him as a Visiting Professor for the Master of Engineering (Illumination) course at Jadavpur University. He is the Advisor (Design) to the School of Illumination Science, Engineering and Design (SISED), Jadavpur University.

He is a founder member, a Fellow, past General Secretary (1990-96) and past President (1997-2003) of Indian Society of Lighting Engineers (ISLE). He was also Director, CIE India Committee (1997-2007).

He has attended many international lighting conferences from 1974 and delivered lectures including a keynote address in the CIE 1995 Session, New Delhi.

He is a lighting quality application consultant.