

Extended summary

Lighting Design in Public Urban Area in Reaching to Sustainable City: Case Study Jesi, Italy

Curriculum: Energetica

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Abstract.

Crimes rarely occur if potential offenders are aware that there are eyes on the street that can witness, report or intervene in their activities. Lighting has a major role in guarding against criminal assault on public streets at night. The lighting needs to illuminate more than just the actual lighting functions; it also shapes the face of the street and defines the residential environment as a "homely" atmosphere.

This research consists of three major steps which are 1) a survey of illumination of public buildings and public spaces, building forms, texture and colour of texture, and electric illumination systems and devices 2) Photographs, interviews and questionnaires to be used to examine different perception and satisfactory and 3) Analysis the efficiency of luminous performance in each places and define appropriate electric illumination.

The residential area in a traditional city is in particular considered in this study. Space syntax models spatial configurations of urban street configurations by using a connectivity graph representation. Such a configuration of connectivity identifies pedestrian access patterns and can be analyzed and selected in a study area. The illumination distribution is calculated and a lighting design framework by Dialux illuminance program is suggested.

The study also found that providing enough luminance does not alone guarantee good lighting design. It is important to note the physical characteristic of the targeted area and its to-pography that also effect to illuminance perception and appreciation.

Keywords. Crime Prevention, Diallux Program, Space Syntax, Street Lighting Design, Traditional City.

1 Problem statement and objectives

Human technological capabilities have created drastic changes in the Earth and its inhabitants. One of the challenges we face today is energy resource depletion and environmental pollution. Population and consumption are two main forces accelerating resource depletion and pollution. While both population and consumption have been increasing very rapidly worldwide, this has led to a rapid increase in environmental impact.

Since the 1990s, along with an increasing concern with outdoor lighting, cities have started to glitter more at night (Jankowski[1]). Lighting at night in public architecture such as historical buildings, museum and outdoor spaces such as sport courses, main streets is also important. Furthermore, urban lighting has increased urban landscape and improves the overall nocturnal urban environment, which explores the various ways to enhance safety, aesthetics, and mobility of urban contents (Boyce [2]). Good lighting of a particular space can be attracted pedestrians to stop by and consider those objects in detail. It can affect the street in how is perceived and used. Furthermore, it reveals the meaning of objects along the street, park and plaza including monuments and buildings and how those objects are perceived. Since then, night visibility has become one of means for completing urban night life to merge with peoples' needs.

Most lighting is powered by electricity grid, which, in turn is supplied largely through burning fossil fuels. Not only are fossil fuels a finite resource that are difficult and costly to extract, but they release emissions that contribute to global climate change, cause air-quality issues such as acid rain and smog, and pose significant risks to human health. In 2007 global CO₂ intensity from electricity generation was around 500g CO₂ per kWh in a proportion of 4.38 t CO₂/capita. In that year, Italy emitted CO₂ more than an average emission with 7.38 t CO₂/capita as the twentieth first rank of OCED countries. (IEA [3]).

In the case of tourist city, it is become more and more significant to create appreciated and appropriated visual qualities of historical architectures and urban public areas to tourists. Many countries throw all their budgets and resources to subsidizing tourism business. If the city can be appreciated and attracted tourist to visit more than once, it will produce a large amount of income from that tourism business.

There are large opportunities for doing research of appropriate illuminations, kind of source of light, building forms, texture and color of surfaces, and the amount brightness which guarantee both of energy saving and increase valued to those historical buildings, public spaces including landmark of cities. Furthermore, the feeling of people that affected from lighting design is also considered because every design is aimed to reach the desire of people. If policy makers would take into consideration and be concerned about lighting design system of urban public spaces which effected to stakeholders' perceptions and preferences, the city would be beautiful and functional. Consequently, the sustainable cities will be created from that way of development.

2 Research planning and activities

This research is an experimental approach that is based on perceptional satisfactory exploration and illumination technological science for buildings and public spaces in tourist city. It considers quality of vision, architectures' appreciation, and efficiency lighting system as a goal of experiment.

The research is mainly focused on lighting performance and the satisfactory of the users. The patterns of perception with exhibiting of historical features, factor of architectural el-



ements and appropriate illumination of public spaces in tourist city are explored in order to get information for improving the city both in saving energy and electric illumination. The method and procedures of research is explained in diagram as figure 1.



Figure 1 Research outline



3 Analysis and discussion of main results

This study discusses urban environments and spaces for aiming an appropriate street lighting design. In order to understand how the spatial layout of buildings and cities influences the human movement and social interaction, a space syntax program is introduced as a tool of examination. Since a space syntax program can represent the connected spaces as a matrix, then, the program simulated the connected accessibility by its mathematical properties. The space syntax model of Jesi is introduced to analyse and sort out the most accessible street to pedestrians. The results from space syntax program showed that Costa Lombarda is carried the highest probability of accessibility.

The Costa Lombarda Street is located on the eastern part of an old city area of Jesi. It is set on slope of 20 meters approximately in difference from the origin of the street to another end of the street at 142.06 meters in length. A lay-out is in an irregular shape and contained ladle to serve its topography. The street is the main core that links all sub streets in that area altogether and is filled with housings along both sides of the street. Most of lighting fixtures are High Pressure Sodium lamps that produce excellent lumen maintenance and last long life. Due to disadvantage of colour rendering of HPS, then, it is a poor choice when colour characteristics are needed.

For proposing guideline for Costa Lombarda Street, satisfactory survey and illuminance value are input for analyzed. The questionaired show that 77% of the respondents had spent time at night in the city at least 2-3 times per week. They spent nocutral time to meet friend and do walking in 44% and 36% respectively. They tended to used more than 2 hours at outside the house in each time. One-third of them are satisfied with illumination level at downtown of Jesi. About 46% of people consumed night time at the public area of the city such as public plaza and parks. Regarding to satisfaction survey it can be said that urban public space in Jesi is contained significant importance for doing an illumination design.

Furthermore, an examination of quantity of luminance on Costa Lombarda Street has been done by both measurement and calculation method. An experimental outcome informed that quantities of luminance on Costa Lombarda Street beneath their posts are going along with standard of EN 13201(CEN [4]). However, both of measured results and mathematic results are shown in the same way that the luminous flux that is transferred to the next lamps is of quite low value because of distance of settings which is a little bit far apart from each other. It is possible to assume that its low intensity result is caused of its dirty, lamp life that nearly terminated, and materials which reflect light beam at low percentage on both of the buildings' wall and pavement. It is further revealed that there are pools of darkness at a distance between adjacent lit.

In addition, it is important to note that an irregular pattern of street and topography of the area also effect to illuminance. Because of non-geometric street and levelled area, then, there are some buildings that obstructed the luminous streak distant which need to consider in case by case.

Before proposing guidelines for the targeted area, the quantity of illuminance accuracy comparison between mathematic formula of point by point method and DIALux illumination software are made. It is revealed that simulation program has released lesser error from the real situation. Therefore, an advice to improve illumination quantity is done by DIALux program. It is suggested to in-place some luminaires that provided by private sector and increase lighting settings on the dark pool area of the street at their best application height in order to increase confident detection and recognition to pedestrian visibility. Furthermore, an advice has suggested to do maintenance to the lighting source and painted a brighter colour to the walls and pavements lightened for gaining more reflection.



4 Conclusions

An overall, it can be concluded that an illuminance value on Costa Lombarda Street does not provide enough luminance for pedestrians who are passing by, and guarantee safety for the residents and a suggestion framework is required.

According to Costa Lombarda street is functioned as a connected walkway between housing where there are no any architectural elements that would create architectural appreciation, therefore, the study is aimed to the quality of vision more than decoration appreciation.

Nevertheless, providing enough luminance does not alone guarantee good residential lighting. Another important concern of good lighting is the physical characteristic of the targeted area. Therefore, besides calculating luminance to serve enough security purpose, lighting engineers should study and understand areas in parallel, especially street lighting design of a traditional city whose streets are not in a regular angle throughout the line or settle on platform. Furthermore, the luminaries themselves, which produce yellow/orange light, make residents difficult to distinguish new-comers and colors of objects. It would be better if we could develop technology to release its weakness and ensure that external lighting systems are designed to use energy efficiently.

References

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