Light Pollution Measures of Excessive Light

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Abstract

In this paper, the light pollution at night is about the urban landscape. Light pollution, improve the aesthetic, visual and so ensure the safety of existing lighting causes excessive light, visual interference means. In terms of new pollution, light pollution is one of the nightscape of the city is analyzed. In addition, part of astronomical observations are analyzed with respect to light. So the improvement of lighting in light pollution measures, lighting changes the wavelength of the light-sensitive compensation rate according to the method by considering the light distribution design is proposed.

Keywords: *light pollution, lighting*

1. Introduction

Light pollution unnecessary artificial light of various problems arising from the means. Light Trespass, Over-Illumination, Glare, Light -Clutter, Sky Glow And so are able to distinguish between the types.

To instantly solve these problems by blocking sunlight from light entering the eye so that measures to prevent the unpleasant glare, In an environment where the access to the many people copper since the turn of the vision, the direction of the runway in front and the balance consideration of vertical illuminance glare caused by sunlight reflected back as well as the glass case in the glare of the lights are also considering the establishment of new organizations, choose the lighting angle, glare degree of visual impact to the eye and the glare of a light source direction because in forming smaller angles, exposed to light for some reason, compelled to use it whenever possible so that the angle of gaze away from the installation location of the light source should be selected In this paper, due to excessive light, light pollution cases were evaluated by SQM-L(Sky Quality Meter).

2. Format

2.1 Light Pollution Definition

IDA (The International Dark-Sky Association: IDA)In the light pollution are defined as follows: “Sky Glow, Glare, Light Trespass, Light Clutter due to the adverse effects of artificial light, including some in the harmful influence of the visual field, a phenomenon also is a waste of energy.

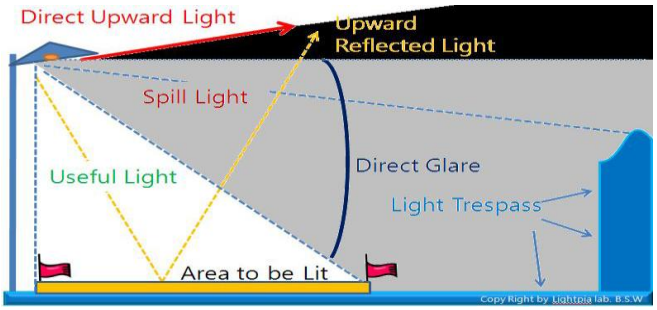

Fig.1 Page Margin

Fig. 1, Leakage light means from the light fixture is beyond the scope of the target which illuminated. Upward than the horizontal beam of the light beam is the beam toward the upper direction. Downward than the horizontal beam of the lamp light is downward toward the light. Glare is a sight that did not include the distribution of the which optimal luminance distribution exists. Luminance range is wider horizons of power loss, or feel discomfort on a visual means of the state. Useful light can be determined by factors other than light pollution. In addition, due to direct sunlight, glare and light pollution as well as human or animal ecology, insect behavior, such as a bad influence.

For example, excessive in light of the bees and birds has been hindered by the ability to fly. Getting out into the void in light of excess light energy is wasted, but also to other issues of light pollution have been raised. According to the International Energy Agency announced in 2006 as the current and inappropriate use of lighting is still used for lighting by 2030 and a 80% increase in power but when used appropriately, such as the current level of 2030, even to suppress power consumption That have been proposed. In terms of light pollution, astronomical observations, the center will focus on the lighting.

2.2 Light Pollution Research (Night Sky)

Light pollution is a major star in the night sky is an invisible phenomenon. Nature of the night sky with the naked eye clearly shows thousands of stars and galaxies. However, with advanced local light pollution does not look at all the Milky Way. The stars are identified by eye are very limited. In addition, the light pollution in the vicinity of the town by prolonged exposure to photographers when shooting, the entire screen by the light of a street lamp that is bright green.

Fig. 2 SQM-L

Fig. 2 represents the SQM-L and the star rating, its ratings will be displayed on the visual acuity can be measured. Using SQM-L can be measured in the absence of a bright sky. That

portion of the lens pointing to the sky and the distance by measuring the star ratings are measured values.

Fig. 3 Point View

Fig. 3 is the city of Gwang-Ju as a view of the sky the night sky, that is a photo display of the measurement sites.

Table. 1 Site Specific Magnitude

Date	Location	magnitude	range (pc)	subdivision
9.16	A	20.1	26	E1, E2
″	B	16.1	27	E3
″	C	17.3	26	E3
9.17	A	19.8	28	E1, E2
″	B	16.5	23	E3
″	C	16.8	25	E3
9.19	D	15	28	E3
″	E	12.9	x	E4
9.27	D	14.5	27	E3
″	E	13.5	28	E4
10.1	F	15	26	E4
″	G	13.1	x	E4
10.6	F	13	28	E4
″	G	15.2	23	E4
10.16	E	13~14	x	E4
″	B	16.5	27	E3
″	C	16.0	28	E3

Table 1 as defined by CIE in the category distinction was designated as zone 4 environment.

Table. 2 CIE Local Area Basis

local	section	local brightness	section
E1	Natural	dark landscape area	National Park
E2	suburbs	low luminance area	industrial park ,suburbs
E3	city	medium luminance area	industrial park ,housing
E4	center	high luminance area	downtown, commercial center

Measure is not passed on time 20:00 to 20:30 minutes, tried to measure the star looks sunny.

'A' place had little or no street lights by a visual count was available. 'B' is the place to light street lamps light up a circle is difficult to observe the stars and, 'C' places where the 'B' Street reported receiving less of the impact was highly rated. 'E' Business district downtown locations around the street lights and signs as sculptures are almost impossible to measure because the visibility was not performed because a bright light.

2nd Street and the ambient illumination measured at the same place where there was no change in measured values. When the value of 'F' and 'G' represents a similar position than you can see the difference.

2.3 Light Pollution Survey by Excess Light

Against lighting the sky with excess light is wasted energy that is leaked, it is cause for being unable to observe the night sky. In addition, the pedestrian street of the excessive brightness should interfere with the driver's vision. Street lights at night in the bright light in dark places to see if our eyes were open again, the pupil is a contraction may take time to adapt to dee.

Excessive brightness of LED lighting glare when looking directly into the phenomenon occurs. Light intensity measurements indicate higher than normal street lights. The average roughness of the measuring places Max. 78lux, Min. 18.6lux, average brightness 7500cd/m² respectively. The difference between the maximum and minimum illumination of the light environment was found that an imbalance occurs.

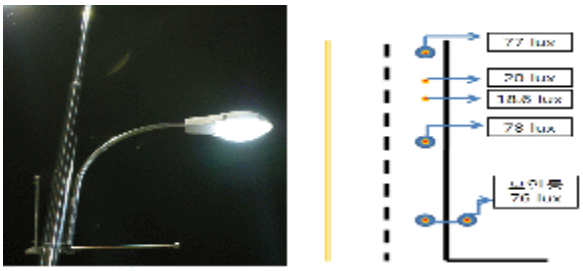

Fig. 5 LED Street Lighting, Illumination

Fig. 6 Intersection View

Excessive advertising in the building of reservoirs around the intersection, intersection, lighting and security caused by the direct glare and excessive brightness were observed.

Fig. 6 shows the illumination from the bottom section of the city center, measured by the result. Illumination of the city center with a 145 ~ 880 lux lighting appears to have been determined. "S" buildings as well as landscape lighting, if the sky is the projection of light pollution is acting as enemy elements. Main street and near the road due to the brightness of the street survey results directly to excessive glare occurs. Look at the sky and the sky brightness in terms of eye fatigue symptoms appear impossible that I could see the night sky observation.

3. Light Pollution Measures

Loss of light, the glow of light pollution to be smaller, reducing the sky brightness, glare reduction brings. To solve this problem is to identify the exact problem, then you need some way. To achieve the purpose of lighting the light of the minimum strength required, the preemption timer or manually by using the sensor does not require lights lighting is needed.

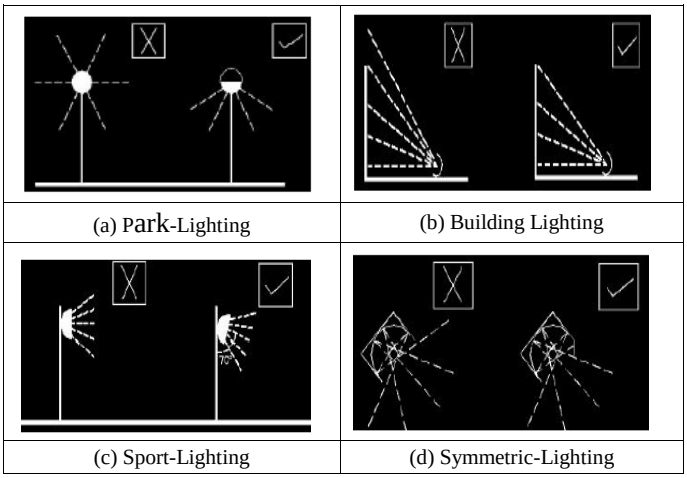

Fig. 7 Adjustment of Lighting Fixtures in the Right Direction

In order to improve the base illuminator shown in Fig. 7 an example is needed. Fig. 7-a to use a park or residential lighting in the overall accuracy than one trillion people dispersing upward lighting and down lighting should be used. Fig. 7-b, as the floodlights illuminated the building's surface If you want to avoid excessive upward light visibility of pedestrians should be designed so as not to irritate. Fig. 7-c, such as exercise facilities and lighting equipment used in the projection angle to reduce the refractive index very important and should be below

70 degrees can be minimized. Fig. 7-d using a symmetrical lighting equipment should be used more asymmetric.

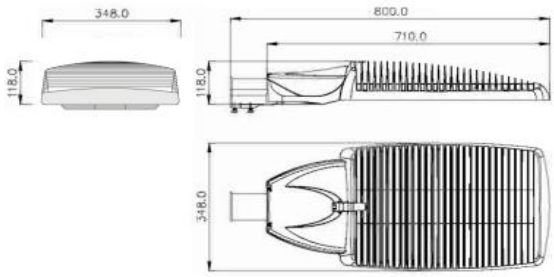

Fig. 8 Full Cutoff Fixture

Fig. 8 is exactly the direction needed to investigate improved lighting, street lighting equipment and a high luminous intensity Full-Cut off mechanism is used to backlight the necessary parts. Full-Cut off, where more than 90° from the vertical angle of light intensity caused 0cd/m², 80° -90° between 100cd/m²(1%) is not more than lighting.

3.2 Considering the Redesign of the Fixture's Optical Theory

Fig. 9 and Fig. 11, the simulation was designed with the program Photo Pia 3.0. Street light distribution to achieve an effective form of conventional spherical Lambertian Type a wider light distribution in the LED Side Emitting Type LED using a refracting plate was designed.

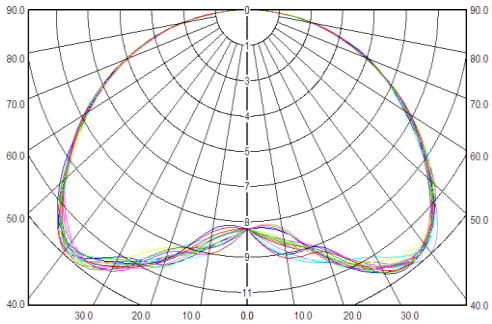

Fig. 9 Side Emitting LED Photometric Curve

Fig. 9 Side Emitting LED backlight and the main light distribution curve of the 60 widely spread in the length direction is the luminous intensity. Refractive index of refraction through the plate theory to study the light distribution curve was applied [2].

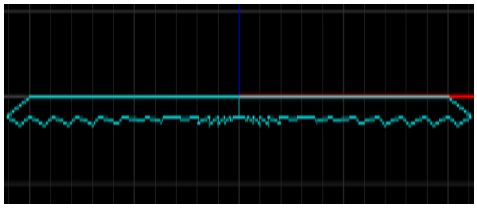

Fig. 10 Refraction of the Material on Board

Fig. 10 shows the refraction of the material on board as a picture, it was set in Clear Polycarbonate. The refractive index is 1.59 Aim Point to 9 specify the number and symmetry were given a total of 18 points. Left side, wide angle toward the midpoint of the angle formed narrow effective light distribution curve was found.

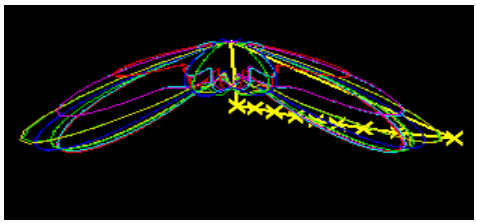

Fig. 11 Aim Point (Angle)

Fig. 11 as the Aim Angle, while passing through the lens of each party Aim Point shows the angle change is a picture. For each point of light is refracted when the incident angle was set out. From left to 4, 15, 25, 33, 39, 44, 49, 54 and 60 degrees. Aim Angle through a nine-point set of LED lights is the optimum implementation of light distribution.

4. Conclusion

The light to prevent light pollution reduction, improvement of lighting fixtures, the selection of efficient lighting, lighting plan should be reviewed. Include specific measures to minimize light pollution and to identify the exact problem and to achieve the purpose of the light sources of minimum intensity is required. Using occupancy sensors, timers or manually off unnecessary lights, work processes and methods according to the choice of efficient light sources are used depending on the lighting plan. Also observed by periodic cleaning and replacement of light through the first means will be needed to maintain that it was managed. According to the compensation rate from 3.2 photosensitive deal considering the redesign of the change in wavelength Photo Pia 3.0 simulation program was used.

As a result, the refraction angle of light distribution plate designed to adjust the lighting and light pollution of the optimum implementation of light distribution to minimize the elements presented.

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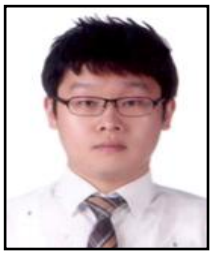

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