

## Research on the characteristics and evaluation of nightscape along the LRT line

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### ABSTRACT

With people's increasing demand of nightlife activities, the nightscape has become more important than ever to enhance the image of city. In this study, we tried to analyze the effects and influence of the landscape lighting that produced the nightscape and pointed out that the optimal nightscapes along the LRT (Light Rail Transit) line. We selected the urban landscapes along the LRT wayside as the research objects, used the SD (Semantic Differential) technique to compare the difference between the daytime and the nighttime landscapes by the vision engineering and measurement psychology. As a result, it became clear as follows: 1) image evaluation of the nightscapes got higher estimation than that of daytime landscapes. The importance of the nightscape has been recognized once again; 2) landscape lighting played the important role in the charming nightscape; 3) the optimal nightscapes along the LRT routes could be chosen with the results of factor analysis.

**Keywords** - Light rail transit, Nightscape, Landscape lighting, Image evaluation, Analysis of factors

### I. Introduction

In recent years, with the development of city economy and citizens' lifestyles, most people are busy at work during the day time, night time become their main leisure periods. People start to pay more attention to their nightlife activities in many places in Japan. Therefore, the night landscape of city is as important as how it looks like during the daytime. And sometimes, nightscape can make more impact on people's mind about the city. A city's nightscape can be treated as a re-introduction of the city during the night. With appropriate urban design and landscape lighting system, a city can draw very impressive pictures as its "Identification Card" to the whole world. Many cities, especially some metropolises, have already noticed the importance of nightscape and put efforts in their urban design, such as the nightscape of "Odaiba Rainbow Bridge" and "Tokyo Sky Tree" at Tokyo, Sapporo white illumination" and "Okurayama view point" at Sapporo, the nightscape of Fukuoka city etc..

On the other hand, many papers of landscape lighting design for urban nightscape have already been published such as Y. Nakamura et al. [1], A. Okutani et al. [2], S. Nagayama et al. [3] For example, Okutani et al. [2] for the impression of the landscape lighting, to perform an analysis of the fractal dimension by computer image processing, said the association about the impression evaluation and fractal dimension. In addition, S. Nagayama et

al. [3] examined the color temperature of illumination light source most suitable for Japanese historical buildings. Nevertheless, there are very few papers to describe with respect to attractive creation of city that is based on the characteristics and evaluation of nightscape in cooperation with city development plan [4].



Fig. 1. Toyama castle and LRT vehicle a night.

In this study, we picked up a major local city of Japan, which introduced the Japan's first full-scale LRT (Light Rail Transit) system [Fig.1]. By using visual engineering and psychometric approach, we compared with the nighttime landscape and daytime landscape, tried to analyze the effects and influence of the landscape lighting that produced the nightscape and pointed out that the optimal nightscapes along the LRT line. It is expected to provide basic data for building a beautiful and charming night urban landscape in the future.

## II. Experimental

### <1> Selection of experimental landscapes

We selected a total of 16 places from 5 typical of the landscapes along the Toyama LRT line as well as those have been widely recognized by the citizens. (Table 1).

(1) Cultural and exhibition facility (such as Koshinokuni museum), (2) Historical facility (such as Toyama castle), (3) Administration and public relations facility (such as JR Toyama station), (4) Commercial and tourist facility (such as ANA crowne plaza hotel), (5) Parks and green space facility (such as Toyama ring water park).

Table 1. The number and name of each landscape.

No	Landscape name	No	Landscape name
①	Koshinokuni Museum	⑨	CIC Building
②	city Plaza	⑩	Toyama Ring water's park
③	Toyama Castle	⑪	Daiwa Department Store
④	Toyama Electrical Building	⑫	Marier Toyama
⑤	Toyama City Hall	⑬	Ikedaya Store
⑥	Toyama International Conference Center	⑭	Northern Japan Newspaper office
⑦	Urban Place	⑮	Hokuriku Electric Company
⑧	ANA Crowne Plaza Toyama	⑯	JR Toyama Station

### <2> Preparation of samples

The landscape photography samples were be selected an observation point that can understand the whole pictures and characteristics of the landscapes.

(1)Photographic equipment as the shooting conditions digital camera (CANON EOS Kiss X5), lens focal length 35mm equivalent 28mm equivalent, dedicated tripod.

(2)Take photos' date and time to be selected in the good weather, during 11:00 to 15:00, and after sunset 19:00 to 21:00 by consider the order light.

(3)Shoot position in LRT wayside road centerline supplementary near and then, the height from the ground to the center of the camera lens is set to 1.5 m.

(4)Photography quality can be maintained at high quality pixels, the alignment condition of the four or more points. Our vision and visual angle also taken into consideration, and conscious so that it becomes a natural scenery samples as possible.

According the above-described criteria were taken photographic samples. In reading all the photos have taken a personal computer, we have

created day landscape 16 pieces, night landscape 16 pieces of a total of 32 points of the experimental observation for the landscape sample. Actually used the nightscape samples are shown in Fig.2

### <3> Experimental method

We did all of experiment under the conditions of a dark room. The distance of the subject's anterior 4 m place the screen (W2.4m × H1.8m) for presenting the landscape sample, using a projector, and is presented in a random one by one slide experimental landscape samples on the entire surface of the screen. (Fig.3).



Fig. 2. Sample photos of nightscape in LRT line

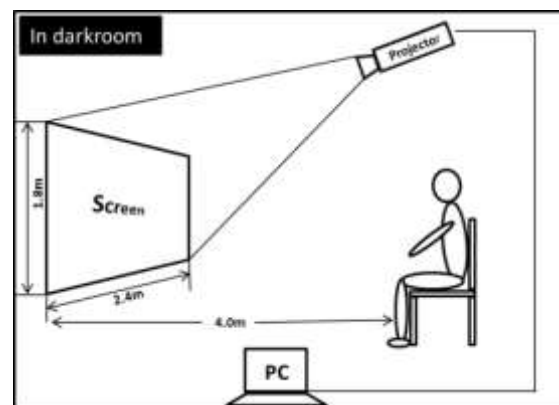


Fig. 3. Experimental image.

Subject observed the presentation of the landscape sample in one minute, thereafter, evaluates the impression felt the scene sample data sheet using the SD method of psychological techniques. In order to prevent accidental filling, etc., it is assumed that fill one by one for one scene sample.

The configuration of the subject are 25 students (18 males, 7 females) of the Faculty of Engineering

with 23.8 average age, both are familiar to the SD method. In addition, psychological subject, namely in consideration of feeling and physical condition, etc., in order to measure and reduce the error as much, experiments were performed while taking a break at fixed intervals.

<4> Experiment SD method

Semantic Differential technique is a typical method in performing landscape image evaluation test was developed by C.E.Osgood [5]. Impression evaluation by SD method, for a given impression measure, is an evaluation method for numerical select the degree to which subjects felt. This method, it is possible to quantify the evaluation value for each evaluation item, it is possible to comparative analysis between a plurality of target. We selected 20 pairs of impression adjective words in this experiment. Rating scale in seven stage such as neutral around the (0 points), toward the respective adjective little (1 or -1), quite (2 or -2), very (3 or -3) (Fig.1).

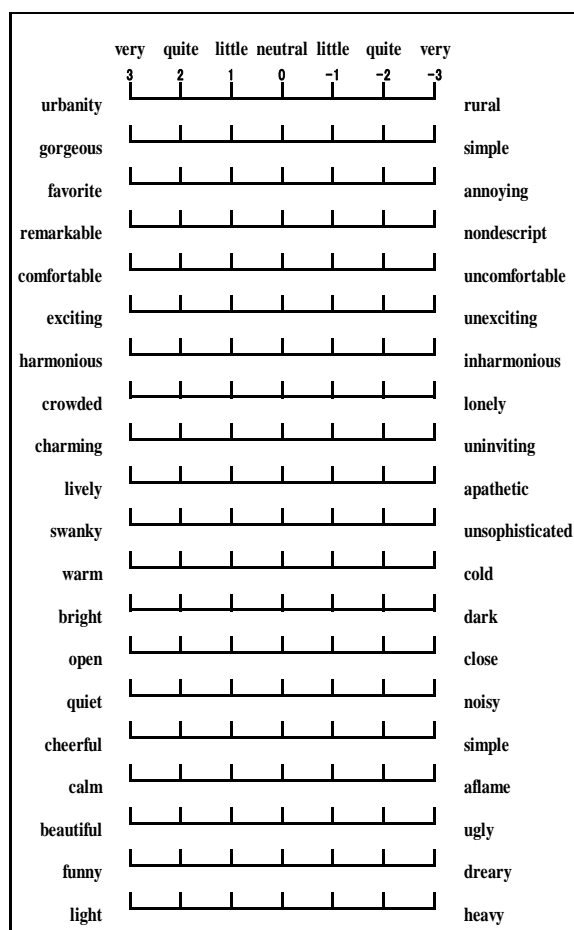


Fig. 4. Bipolar scales defined with adjectives on each end.

The analysis of the evaluation data of the SD method, we used the factor analysis method. This analysis made it possible to grasp the overall impression to the target from the impression words that are similar to.

III. Results and Discussions

<1> Impression results

We showed an example of the image evaluation result impression evaluation results in Fig.5 (a) ~ (d). For each landscape sample, it is intended that the average value of all image evaluation results of the displayed on the polar coordinates. In each figure, placing the adjective of positive impression in the circumferential direction. The radially taking an evaluation value, the evaluation value of each adjective enough to be located outside the circle indicating that is high. Parameter is "night" and "day."

First, Fig.5 (a) showed the average value, it can be said that shows the respective landscape evaluation trend day landscape and night landscape. Overall image evaluation of the day landscape and light-up night Landscape is, "night landscape ", the area surrounded by the closed curve in the order of "night landscape" is larger. That is, in the evaluation of the landscape samples showed that the image evaluation of the "night landscape" is above it in the overall the "day landscape".

Then, we showed for individual landscape. In koshinokuni museum of Fig.5 (b), higher overall trend compared image evaluation is that of the daytime "night landscape" can be seen. The difference was remarkable in adjectives such as (urbanity), (gorgeous), (remarkable), (exciting), (crowded), (lively) and (warm).

In Fig.5 (c) Toyama Castle, (light) and (quiet) a high evaluation value of "night scene" with the exception of the indicated. Specifically, the evaluation value of the adjective and such as (funny), (favorite), (remarkable), (comfortable), (harmonious), (attractive), (charming), (bright), (quiet), (calm) and (beautiful).

On the other hand, JR Toyama station in Fig.5 (d), different from the previous results, the variation of the evaluation value is large, the tendency of evaluation is reversed in the [Day Landscape] and [night Landscape] is shown. In particular, the evaluation of adjectives such as (urbanity), (comfortable), (harmonious), (beautiful), (funny) and (light) value that has been shown very low.

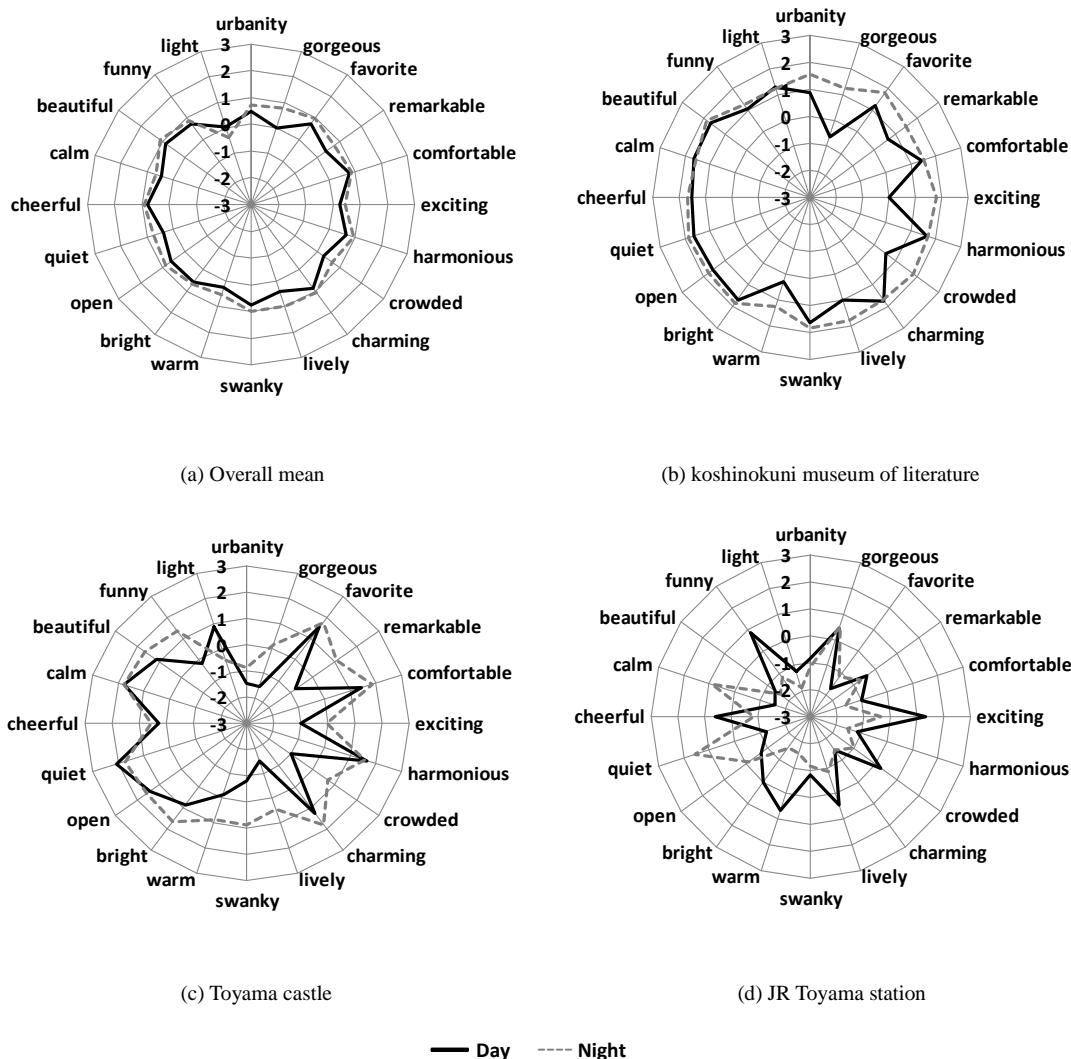


Fig. 5. The result in each landscape

### <2> Factor analysis

By the analysis to better interpret the scene sample results factor analysis, on the basis of the results obtained from the subjects and subjected to factor analysis with respect to average data of an image evaluation of each adjective pair in the landscape sample it was [6].

In performing the factor analysis, principal component analysis was performed for firstly determining the number of factors. The eigenvalues of the factor for the correlation matrix between each adjective pair I is shown in Fig. 6. Eigenvalues 1.0 or more factors are two extraction (see Table 2) cumulative for the contribution rate was 80.06%, in consideration of the possibility of semantic

interpretation is the number of factors and "2" was conducted factor analysis.

As a result, it shows the contribution rate after varimax rotation until the resulting second factor and the factor loadings of each adjective pair in Table 2. Factor loadings indicates the influence factors on each evaluation item, factor of interpretation I went in load factors.

The first factor is 48.53% contribution rate, (comfortable), (harmonious), (beautiful), (charming), (favorite) from being included adjectives such as, it was interpreted as [Evaluation] factor.

The second factor is the contribution rate of 31.53%, (lively), (crowded), (exciting), (gorgeous), such as an adjective of factor loadings since the

amount is high, it was interpreted as [Activity] factor.

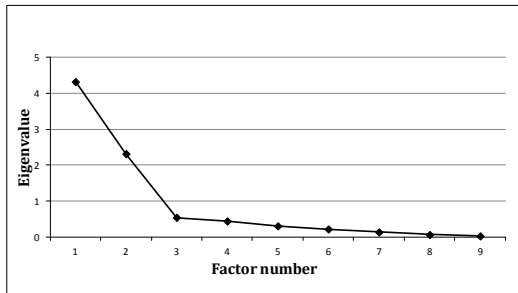


Fig. 6. The intrinsic value of factor.

Table 2. Factor loading to adjectives

Variable Name	No.1(Evaluation)	No.2(Activity)
Comfortable	0.969047172	0.04943547
Harmonious	0.934657141	-0.025114283
Beautiful	0.921890238	0.115394226
Charming	0.902306398	0.138171099
Favorite	0.894991338	0.046307605
Calm	0.883632875	-0.177324858
Cheerful	0.800734429	0.557142167
Swanky	0.780504913	0.674065295
Funny	-0.718055535	0.586844132
Lively	0.199353347	0.950263054
Crowded	0.243656404	0.945828803
Exciting	-0.058079067	0.907254039
Remarkable	0.366687188	0.885814567
Gorgeous	-0.305178155	0.844292318
Bright	0.340734429	0.808441318
Warm	0.454123061	0.79036606
Open	0.179133633	0.750652953
Light	0.520504913	0.71660601
Urbanity	0.343843896	0.366060098
Quiet	0.18654283	-0.27535434
Contribution Rate	48.53%	31.53%
Cumulative Contribution Rate	48.53%	80.06%

Based on the factor analysis results, it shows a graph plotted together factor score of each sample (Fig.7). The horizontal axis first factor [Evaluation] factors, and the vertical axis is one that took the [Activity] factor. The first factor [Evaluation] factor is preferably enough to go to the positive side, this indicates that it is not preferred as it goes to the negative side, the second factor [Activity] has a positive direction "lively thing" and "liveliness" it is expressed, the negative direction indicates that

"settle" and a "gentle". Further parameters are the two stages of the points indicated by triangles is "night scene", the point indicated by diamonds "daytime scenery".

From Fig.7, [Activity] in the "night landscape" as a whole tendency, and [Evaluation] means that has been shown to be higher than the "day landscape". In particular, in the [Activity] of the vertical axis, they tend to factor score can be greatly increased in the "night landscape" was seen. This difference is mainly is due appropriate landscape lighting effects at night, as compared to it more lively than "day landscape", it is believed that because gave a certain impression of vitality.

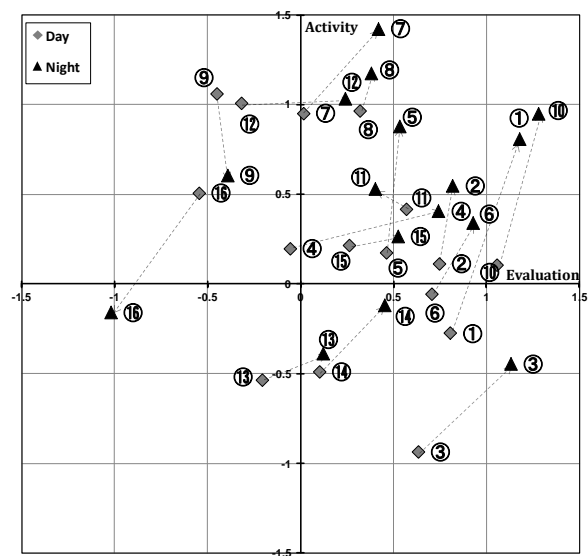


Fig. 7. The rendering effect in each landscape

Specifically, particularly high landscape sample of evaluation in the "Activities" of the vertical axis, ⑦Urban Place, ⑧ANA Hotel and ⑫Marie Toyama, both of which are night landscape. Day and night of ⑬Ikedaya, day and night of ③Toyama castle, it is very low factor score in the night of the ⑯JR Toyama Station was shown. The main cause of such negative evaluation is due to the "vibrant and lively" of the commercial and tourist facilities scenery, historic landscape, such as ⑬Ikedaya and ③Toyama castle is an al-quiet is calm." It is considered to be because the relatively susceptible to impression.

On the other hand, Toyama Station of public facilities, station square and sidewalks is relatively narrow, is an adjective on the airy "light", evaluation, such as "open" is low, also in the only part in the night light-up the station building

Because only been implemented, that the overall light is small and I are considered to mainly cause.

Also, the [Evaluation] of the horizontal axis, day landscape and night view of high landscape evaluation ⑩Toyama ring water’s park, noon Jing and night view of Takashi countries Cultural Center ①, ③Toyama castle it is a night scene. On the other hand, evaluation low landscape, ⑯ JR Toyama Station, there was a daytime scenery and night view of the ⑨ CIC building. From the above, a high valuation landscape, green a lot, lighting tended to stand out landscapes and beautifully lit up the Toyama Castle unique landscapes such as an LED, such as maintenance has been Toyama ring water park. On the other hand, low landscape of the valuation, the commercial ones, are in the city, such as station building, include the landscape to receive the mundane impression. Further, the main cause of negative evaluation in night view of the CIC building may be due to fluorescent mercury lamp has been used to light up. As a feature of the fluorescent mercury lamp illuminance for low color rendering property but can be secured, the landscape can be mentioned disadvantages would appear dimensionally such as gray color. In addition, JR Toyama Station, it is believed to inhibit the [Evaluation] of the landscape due to the impact of the wire such that has been spread around in large utility pole and sky before station building.

In order to select the best night landscape from the above results, for each landscape sample, first factor score (Evaluation), second factor score (Activity) a comprehensive evaluation value obtained by adding the two factor score (The sum ) a vertical bar graph comparing than to display in

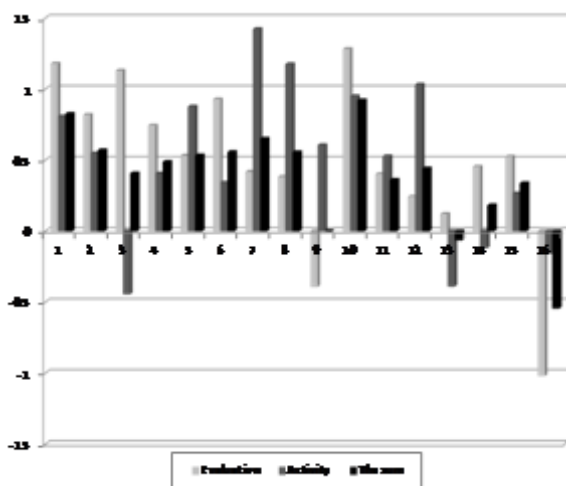


Fig.8.

Fig. 8. Factor value of landscapes.

From the above, indicating night optimal view-points in LRT wayside for each type of landscape (Table 3). In order to select a view point, it is desirable that the first factor as [Evaluation], second factor [Activity] choose both together high, function and the role that is determined by the type of landscape to say the landscape and bite me different. For example, such as the downtown commercial and business landscape includes, but is liveliness and vigor is a good thing high activity for sought, on the other hand, such as the Toyama castle historic landscape, the elements of such calm and tranquility also important some because of the high score of [Evaluation] is desirable.

Table 3. Night view points along the LRT line.

Landscape type	The optimal nightscapes
Park	⑩ Toyama ring water park
Culture	① Koshinokuni museum of literature
	⑥ Toyama international conference center
	② Toyama shimin plaza
Business	⑦ Urban place
	⑧ ANA crowne plaza toyama
	⑫ Marier toyama
Public facility	⑤ Toyama city hall
History	③ Toyama castle
	④ Toyama electrical building

By the way, the impression of the streets that tourists and business travelers visiting the Toyama is overlooking out of the Toyama Station, and directly connected to Toyama impression, should be noted and particularly important because it is a major impact on consumer confidence and expectations during your stay. But factor score of ⑯JR Toyama station as shown in Fig.8 is very low value both [Activity] and [Evaluation] , around utility wire poles underground development future, such as the improvement of the light-up and station building design is required, it is important to attempt to further image enhancement.

#### IV. Conclusions

From this experiment, image evaluation for the night landscape of LRT along the line has been shown to tend to exceed this of daytime landscape, the importance of nightscape has been recognized again.

Leading to a night landscape, the first factor [Evaluation] leads to the "amenities creation" and "image-up effect" of the landscape. The second factor [Activity] of a cityscape "creation of bustle" it was found. Furthermore, in order to elect a more preferred "night scene" is to be considered by the factor analysis results about the factors scores greater factor loading [Evaluation] and [Activity] has been suggested to be effective.

To produce a beautiful attractive night landscape, the role of the landscape lighting are important, rather than merely applying illumination, I considered there is a need to be done with an understanding of the landscape of the characteristics and purposes.

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