1st International Conference on Sustainable Lighting and Light Pollution

City Lights to a Disaster Area -Lighting Installation of Escape Routes and the Outdoor Environment at the Temporary Architecture District-

Shigeo KOBAYASHI[a,*], Masahide KAKUDATE[b]

[a]Tokyo City University, 1-28-1 Tamazutsumi Setagaya Tokyo, 158-8557, JAPAN
[b]BONBORI Lighting Architect & Associates, Inc., 567 Waseda-Tsurumaki-cho Shinjyuku, Tokyo, 162-0041, JAPAN

Abstract

This research targeted a suburban area in Rikuzentakata of the Tohoku district in Japan where large numbers of temporary buildings have been built after the great earthquake 2011. The research aimed to install adequate light fixtures which guide people to higher ground and provide them with the safety and comfort in daily life. The lighting design was examined based on the knowledge of several field surveys and previous researches. Finally, a total of 179 lights, such as incandescent bulbs were attached. The questionnaire survey to residents was carried out before or after the lighting installation. As a result, it was confirmed that the recognition of entrances to evacuate or the evacuation directions which guide to higher ground had increased enough compared with the previous situation. It was also confirmed in the temporary shopping district or the construction office that surrounding visibility and safety had been improved by lighting. The lighting social experiment was conducted over September 2013 to about one month. Most light fixtures have been continuously maintained by residents even after the end of the experiment.

Keywords: emergency light, escape route to higher ground, temporary town, social lighting experiment

1. Research Background and Purpose

Rikuzentakata located in the Pacific coast of the Tohoku district in Japan spreads along the deeply-indented coastline, and has the geographical feature that the tsunami which invades becomes high. Therefore, countermeasures against tsunami, such as a large-sized breakwater, were taken for a long time. However, from the earthquake in 2011, the tidal wave which exceeded assumption invaded and the city area suffered destructive damage. Fig. 1(left) shows the map around Rikuzentakata and the tsunami attainment line in case of the earthquake disaster [1,2]. The tsunami not only attacked the area along the shore(Fig.1 right), but flowed backwards the Kesen river and inflicted damage to the upriver district.

Takekoma-cho which is located in about 3.5-km inland from the seashore, and the sea cannot be directly seen from there. Nevertheless, the tsunami which flowed backwards the Kesen river reached to this place and it suffered damage in residences, fields, streets, and bridges, etc. After the earthquake disaster, this spot was one of the principal points of inland traffic, and a large number of temporary shops, banks, offices, etc. got to be arranged. It became the most active location in Rikuzentakata in 2013 two years after the earthquake disaster.

Even if the town consisted of temporary buildings, it had suffered the damage caused by tsunami, and had already become a place of citizens' daily life. The landscape by inexpensive and colorless materials did not look prepossessing, and people tended to feel uneasy at night in order that there was little light arranged. Therefore, it was essential to guarantee safety and sense of security with lighting at night. This research examined the evacuation lighting for supporting escape to higher ground, and it aimed at realizing the lighting environment that the people of this area could recognize the directions of heights when the following tsunami comes. In addition, the research tried to produce signs of people's existence to the temporary shopping district, and tried to produce the lighting environment in order that people could walk without anxiety at night.

* Corresponding author. Tel.: 81-3-5707-2189; fax: 81-3-5707-2189.
E-mail address: skoba@tcu.ac.jp

In previous researches about the lighting effects of evacuation behavior or evacuation guidance, there are experiments on the inside fire of buildings[3,4,5], experimental simulations which examined the visibility in smoke, and investigations on outdoor evacuation lighting at night[6,7]. About improvement of the evacuation lighting from tsunami at night, the Ministry of Land, Infrastructure and Transport of Japan summarized "The design guideline of the tsunami escape facility of a port" after the earthquake disaster in 2011. The maintenance indicator of the lighting or backup power system was shown. In the areas along the shore of the Pacific Ocean like Hamamatsu, reparation of evacuation lighting is being forwarded by the bounty. On the other hand, the authors accessed into Kamaishi of the Tohoku district immediately after the earthquake disaster 2011, and proceeded investigations of the situation at night. We attached to the central city area the temporary lights which support evacuation guidance, and attached lights to the dangerous location at night. [8,9]. Moreover, the lighting techniques which maintain the balance of evacuation guidance, energy saving, and the local landscape were examined through such activity.

Even when people live in the disaster area temporarily, their safety should be guaranteed as promptly as possible. It is essential to return the research achievements to the disaster area as much as possible. For that purpose, it is required to examine the lighting method flexibly according to the situation and the budget regardless of the existing general standard. This research aimed at realizing immediately based on the field survey.

Fig. 1. Map around Rikuzentakata and the photo after the tsunami attack of the central city area in 2011.

2. Preliminary Survey

Fig. 2 shows the targeted area in this research. There were existing houses which escaped the damage of tsunami, and there were temporary shops and construction offices which were built after the earthquake. Tsunami reached to near the Takata road which is a traffic main line in this district. From the central point, rising grounds are close in the three directions of the north side, the east side, and on the south. As shown in Fig. 2, there are four escape routes for evacuees, A, B, C, and D. The escape route C is looking east and the end beyond the ridge is connected to the sea. The entrance to the heights of the escape route D cannot be recognized from the circumference of the Takata road, and existence of the road is hard to be grasped. Moreover, this direction has overlapped with the Kesen river which tsunami had invaded. When interviews to about 20 local residents were held from February to July 2013, it has been grasped that people tended to feel uncomfortable to evacuate in the east or the south directions. In order that physiographic elements, such as mountains and hills, became hard to be perceived at night, their hesitations to move in the direction of the sea or the river seemed to become stronger.

On the other hand, the escape routes A and B are looking to inland linearly, and it has confirmed that residents had the consciousness of the direction of heights. Therefore, it was concluded that it was essential to let these two routes visualize at night. Based on the visual differences in the daytime and nighttime of the routes A and B, the appropriate lighting methods guided to heights were examined. Lighting arrangement which lets the "entrance", the "course" and the "direction" of the escape route recognize was extracted from the previous research[8].

The examined typical examples of lighting proposal are shown in Fig. 3. The gradient of the escape route A exceeds 10%, and there are few surrounding structures. It was easy to recognize that the road was connected to heights in the daytime. On the other hand, it was difficult to grasp it in the nighttime because the road

curves and disappears from the middle. And moreover, the road was locally illuminated only from one pole light. Then, the following three lighting methods were considered as the evacuation lighting.

(Aa) The intersectional entrance is illuminated to consider as the mark from a principal road.

(Ab) Small lights are continuously arranged to visualize the curve of the road.

(Ac) A symbolic light is provided in the facility on the top of the mountain, and it supports recognition of the geographical feature.

The escape route B is located along the branch of the Kesen river, and consists of a driveway and a promenade. The road gradient from junction is as gradual as about 6%, and it was hard to recognize that the road was rising even in daytime. In addition, the promenade was located in the back side of temporary shops, and lights from them seldom appeared at night. Signs of people's existence were hard to be perceived. Then, the following three types were considered as the method of evacuation lighting.

(Ba) Lights for reflecting in the river are arranged. The direction of the upper stream is stressed by them, and people can walk without anxiety by the continuous lights reflected in the river..

(Bb) Lights are provided as low as possible in the junction of the escape-route entrance, and they are provided as highly as possible at the distant place of the slope. Therefore, the vertical interval of the course is emphasized.

(Bc) Lights are arranged in a long distance by regular intervals. Continuity of the escape route is perceived and the vertical interval is also perceived.

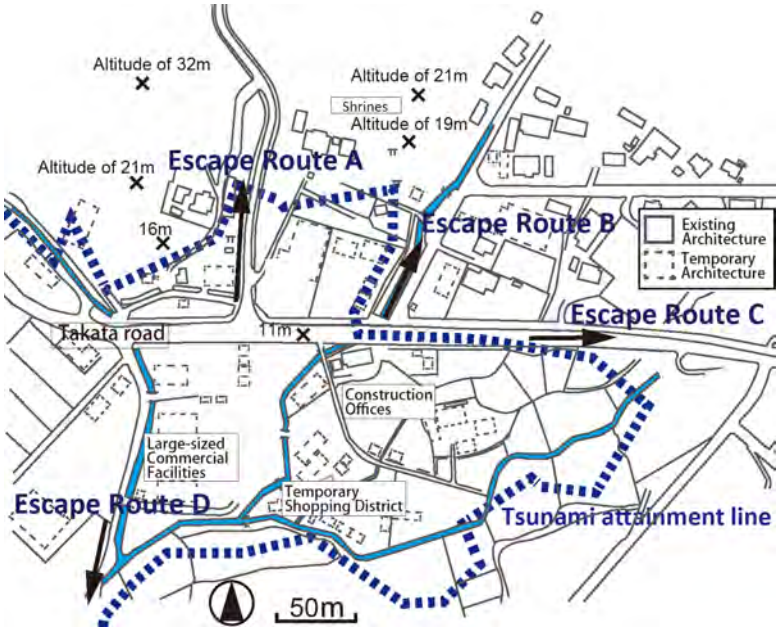

Fig. 2. Tsunami range of access and escape routes in the research area.

Fig. 3. Lighting design suggestions based on the situation of each escape route.

3. Lighting Installation Experiment for Evacuation Guidance

3.1 Lighting Program Outline

The field survey was carried based on the evacuation lighting proposal shown in Fig. 3. Feasibility was examined from power supply positions, required equipments, the attachable places and their difficulties, or the cost, etc. The installation program for carrying out experimental lighting was examined over a limited period of time. The social experiment which realizes evacuation guidance lighting to heights was conducted.

Fig. 4 shows the lighting arrangement plan of the escape route A, Fig. 5 shows the lighting arrangement plan of the escape route B. Fig. 6 shows the setting-up situation of the escape route A, and Fig. 7 shows the setting-up situation of the escape route B. In the escape route A, light sources have been arranged near the junction with the Takata road, and they have been arranged from the junction at 100 m ahead the curve. The former intended that the entrance was easily recognized from the circumference, and the latter intended that the distant position and the shape of the road were easily recognized. In the entrance portion, 5 LED foot lights (color temperature 6300K) of 9W have been arranged at both sides of the road (a total of 10 sets). In order that the road shape may be grasped easily, the 13 same foot lights have been arranged along the outside of the curve. LED of white lights was used to improve luminous efficiency and visibility.

In the escape route B, lighting equipment which serves as a mark from the circumference on the bridge (at junction with the Takata road) has been arranged in the lowest position ((1) of Fig. 5 and Fig. 7). Lights were attached to the temporary shop which exists about 80 m ahead in the escape route in the highest possible position in order to stress the geographical vertical interval ((3) of Fig. 5 and Fig. 7). In addition, lights were attached to the back side of the temporary shops or the handrail of the riverbank. They are because the sign of people in those shops can be perceived at the same time the course is recognized ((2) of Fig. 5 and Fig. 7). 20W and 40W of the incandescent bulbs were selected to create warm atmosphere and to be inexpensive.

There were two small-scale shrines in the mountain side of the hill which swerved from the escape route B to the northwest side, and the walk course was also prepared. However, they had not been recognized at all at night. In order that the hill was visualized and the originality of the landscape was strengthened, each shrine was illuminated with the LED floodlights of 5W of the solar battery type ((4) of Fig. 5 and Fig. 7).

These lighting arrangements were finally determined after taking into consideration doing the number of light sources and power consumption as small as possible. The lighting of the escape route A was installed for four days by September 10th to 13th, 2013, and the lighting of the escape route B was installed for 25 days by September 10th to October 4th. All lights were turned on from 18:00 to 6:00 in the next morning.

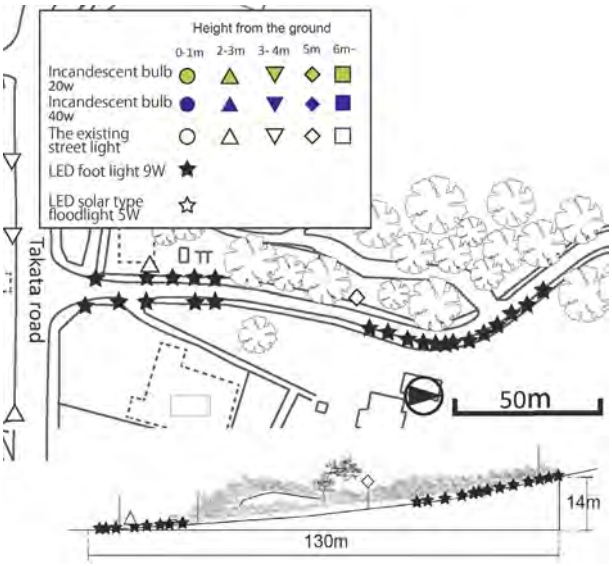

Fig. 4. Lighting arrangement of escape route A.

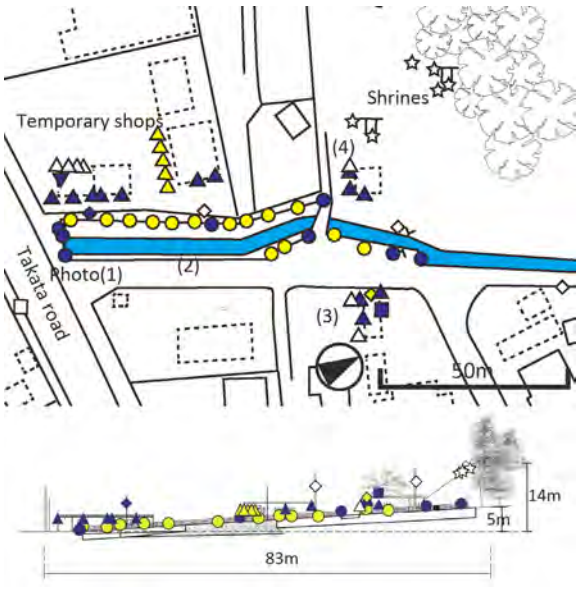

Fig. 5. Lighting arrangement of escape route B.

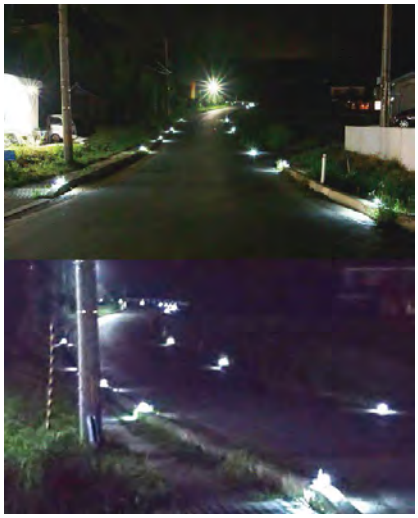

Fig. 6. Photos after the lighting arrangement of the escape route A.

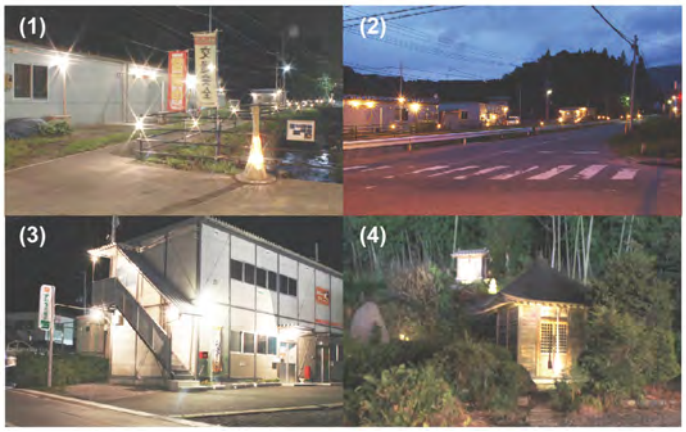

Fig. 7. Photos after the lighting arrangement of the escape route B. The number shows the position in Fig. 12.

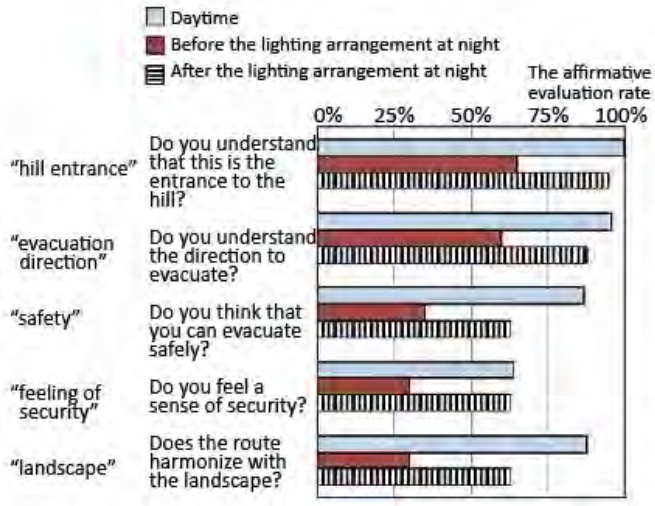

Fig. 8. Questionnaire result of escape route A (N= 11).

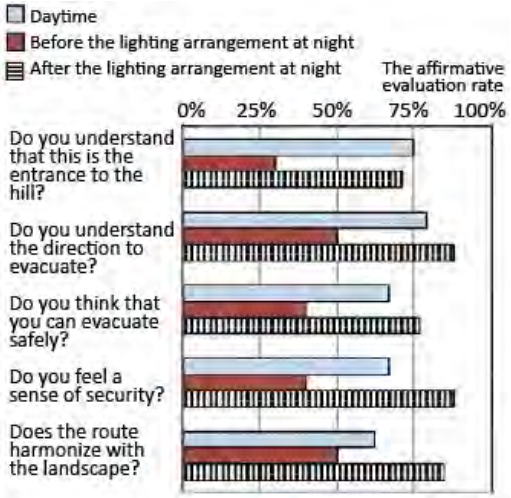

Fig. 9. Questionnaire result of escape route B (N= 17).

3.2 Evaluation to Evacuation Guidance

A questionnaire which evaluates the efficiency of evacuation guidance to people who live or work in the Takekoma area was carried out. It was evaluated to three conditions of daytime, the night before the lighting arrangement, and the night after the lighting arrangement. The questionnaire consisted of five items of “Do you understand that this is the entrance to the hill?", “Do you understand the direction to evacuate?", “Do you think that you can evacuate safely?", “Do you feel a sense of security? ", “Does the route harmonize with the landscape here?”.

Each item was evaluated in four grade, "I think so", "I rather think so", "I do not rather think so", and "I do not think so." 11 subjects answered to the escape route A, and 17 subjects answered to the escape route B. They stood near the entrance of each escape route of the Takata road and evaluated those items.

Fig. 8 shows the questionnaire result of the escape route A. It shows the ratio of the subjects who answered "I think so" or "I rather think so" (affirmative evaluations). In order that the slope of the escape route A is comparatively strong, the recognition of the daytime of the "hill entrance" and the "evacuation direction" were evaluated highly. However, in the night before the lighting arrangement, the evaluations became low. Affirmative evaluations were less than 50% about "safety", "feeling of security", and the "landscape." Since the range illuminated from the existing street light was limited, it was considered that the route could not be

recognized continuously. On the other hand, evaluation increased after the lighting arrangement at night, and affirmative evaluation exceeded 50% by all the questionnaire items. It has confirmed that lights arranged around the junction strengthened recognition of the "hill entrance", and the lights arranged along with the curve of the road strengthened recognition of the "evacuation direction". However, as compared with evaluation of daytime, evaluation of "safety" and the "landscape" dropped to some extent. As reasons which was not evaluated safety, some subjects mentioned that "neither a building nor a pedestrian was in the surroundings" and "the road was illuminated too much partially". In addition, as reasons which did not harmonize with the landscape, "it is not an originally beautiful road landscape" or "white light provides a cool impression" were mentioned.

Fig. 9 shows the questionnaire result of the escape route B. In order that the escape route B has a gradual slope, only about 75% of subjects evaluated the "hill entrance" and the "evacuation direction" affirmatively in spite of daytime. In the night before the lighting arrangement, these evaluations dropped further and affirmative evaluation was less than 50% according to all the items. Although the escape route B was brighter than the route A, the recognition of being connected to the hills was weak. Since there was nearly no light inside the promenade of the riverside, it was also difficult to be able to walk without anxiety. On the other hand, after the lighting arrangement, evaluation of all the questionnaire items increased extremely. Especially, evaluation of the "evacuation direction" became higher than daytime. It was considered that the arrangement pattern of lights emphasized the vertical interval. As reasons it was evaluated safety, "brightness increased across the board", and "people's existence got to be perceived for temporary shops", etc. were mentioned. In addition, many comments like "the lights arranged along the riverside are suitable for remembering the geographical feature and river." were obtained about the "landscape".

Fig. 10 shows the areas which the escape routes A and B have been recognized from the circumference in the daytime and nighttime. Three examiners walked around the area, the points which each escape route has grasped visually were investigated, and the range which two or three examiners have recognized was expressed on the map. The figure shows that the both of escape routes got to be recognized from the broader range after the lighting arrangement. The recognition range of the escape route A has expanded to about 150-m distance in the large-sized commercial facilities side of the opposite direction to the route. The recognition range of the escape route B has expanded to more than 150-m beyond in the west cross direction to the route. The small lights arranged continuously were outstanding in this district. Therefore, they might have attracted residents' attention and supported the route recognition from a distant place.

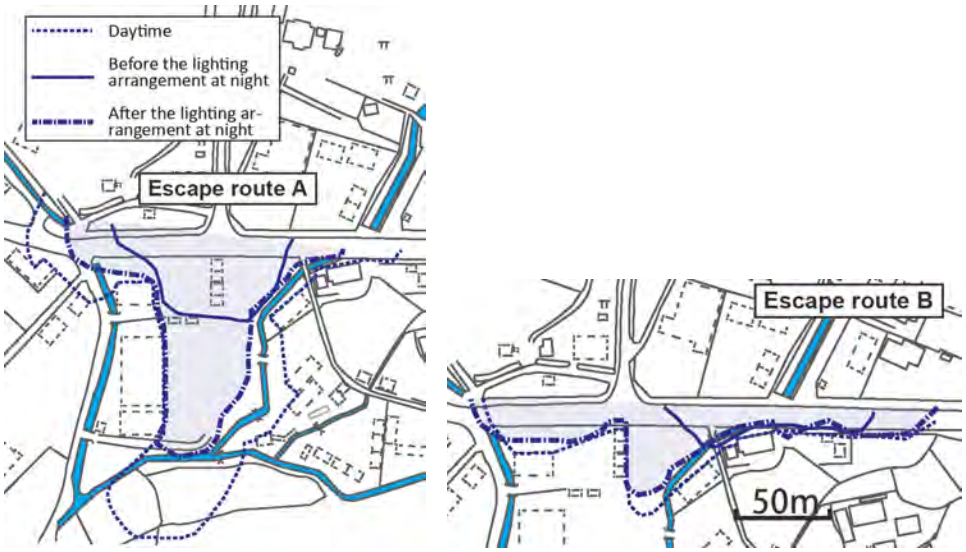

Fig. 10. The recognition ranges of each escape route.
Shading shows the recognition ranges after lighting arrangement.

4. Lighting Arrangement to Temporary Shopping District

4.1 Experiment Outline

The temporary shop group which was situated across the Takata road from the escape routes A and B was a place in which people gather most in this district. Interviews about "nighttime safety", "feeling of security", and "how to spend in the evening" were held to the shopkeepers, shoppers and construction workers from February to July, 2013. As a result, the following three problems have been grasped. First, dimples were located around walking routes, riversides, or the back side of buildings, and they were hard to be visible at night. Second, it was hard to recognize spatial relationship with the Takata road or other facilities. Third, atmosphere became gloomy at night more than daytime, and visitors could not stay comfortably and could not spend outdoors for a long time. Based on these problems, a couple of lighting programs for the temporary shopping district and construction office were examined.

Fig. 11 shows the conceptual diagram presented to the community in July, 2013. As shown in the figure, the role of five lighting, "I: Light which works as a landmark", "II: Light for leading to a destination", "III: Light which expresses humanity", "IV: Light which improves safety", and "V: Light for providing visual harmony to the district ", was established. About I and II, lights are to be provided in the gates and the bridges for pedestrians, and the destinations are expected to become more intelligible. It is planned that the lights are arranged in the upper position of telegraph poles or leading-in poles, and it is expected to improve the visibility from a distance. The lights of III are to be provided in the walls and stairs of temporary buildings, and they are also provided around benches which people often use for their break. They are expected to give people's existence and to support people's rest outdoors at night. The lights of IV are to inform the dangerous zones and the boundary of the site, and improving safety is expected. The lights of V are to illuminate temporary shops, construction offices, and houses. with the same light source and technique. They intended giving harmony to the whole landscape, and also intended developing shared consciousness to people who live and work in the same district.

Based on the conceptual diagram, the specific lighting positions and the power supply system were confirmed. Detailed arrangement was determined examining each lighting effect. Fig. 12 shows the final arrangement plan of lighting. The incandescent bulbs of 20W and 40W were chiefly used for the light source. The lighting fixtures have been arranged for 25 days by September 10 to October 4. Lighting time was 18:00 to 6:00 in the next morning.

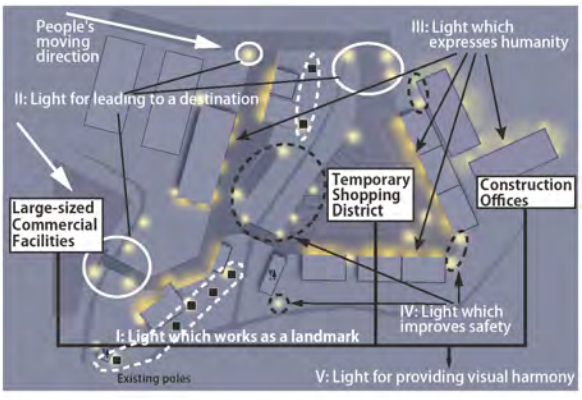

Fig. 11. Lighting installation diagram to temporary shopping district.

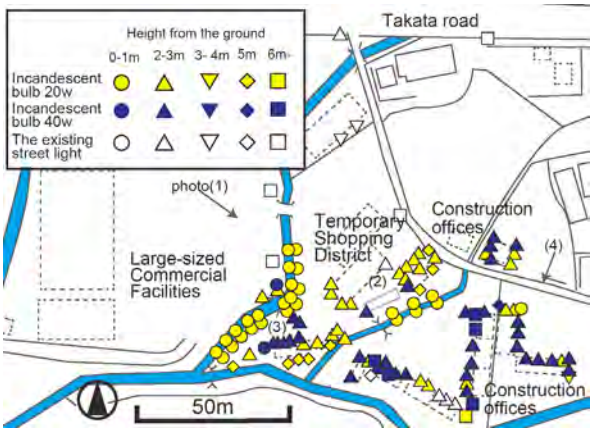

Fig. 12. Lighting arrangement around temporary shopping district.

4.2 Experimental Result

Fig. 13 shows the night view after lighting arrangement. The number of (1) - (4) shows the position in Fig. 12. Lights were attached to the riverbank which had been extremely dark along the walk route in the low position 1 m or less-above ground. Lights were chiefly attached to building facades at 2-3m height. In addition, lights were attached to the place where the cognition from distance was required in the high position of more than 5 m using existing structures ((1) of Figs. 12 and Figs. 13). Lights were attached near people's faces at the places

of the benches, the tables, and the under the eaves which were used for their break ((2) (3) of Figs. 12 and Figs. 13). The night landscape of this district was coordinated as well as lighting arrangement of the escape route A by distributing warm color small light sources for construction offices or temporary shops ((4) of Figs. 12 and Figs. 13).

Table 1 shows the number of lights and power consumption which were used in this lighting installation that combined the escape routes and the temporary shopping district. It is the sum total arranged at the place which exceeds 60,000 square meters. Although 179 lights have been arranged, each amount of light flux was as small as 500 or less lumen, and the sum total was only about 55,610 lm. It is equivalent to about 13 mercury lamps (4,200lm) of 100W used in the neighboring parking lot etc.

Table 2 and Fig. 14 show the result of measured illuminance and color temperature. The illuminance of the principal places which were able to be walked was measured (31 points before lighting installation, and 49 points after installation). It is shown that the road surface illuminance and vertical illuminance became high after lighting installation, and the color temperature generally became low. Fig. 13(1) shows that the temporary shopping district changed to be easily recognized from a distance, and Fig. 13 and Fig. 14 show that lighting distribution and the color temperature got to be coordinated on both sides of the Takata road.

The questionnaire survey was carried to the workers and residents in their 20's to 70's. 16 subjects answered in the daytime, 18 subjects answered in the night before lighting arrangement were, and 16 subjects answered in the night after lighting arrangement. The result is shown in Fig. 15. Generally high evaluation was obtained after lighting arrangement compared with before lighting arrangement at night. Especially, evaluation of "prediction of being rescued when a crime and an accident happen" is high, and has exceeded rather than daytime. It can be said that the lights attached to the walls of buildings or under the eaves not only illuminated surroundings brightly, but they contributed to giving existence of people. Since evaluations of "a feeling to relax outdoors" and "desire to walk along the outdoors" also increased at night, it can be said that such lights extended the opportunity of nighttime activities. Actually, people who relax on the table and benches got to be observed after lighting arrangement. These activities had hardly existed in the previous lighting environment.

Affirmative answers were obtained also about "the lights are suitable for the district", "the light works as strengthening the people's relation", and "the lights work as forming the spatial continuity over the surrounding landscape." The comments that "The scene changed drastically only by attaching simple electric bulbs at night", "It is important that the lights aiming at disaster prevention or crime prevention just because this town experienced the earthquake disaster", "While feeling uneasy at an unfamiliar place, such lights impress warmth and relationship." were also obtained.

Fig. 13. Photos after the lighting arrangement to the temporary shopping district.
The number shows the position in Fig. 12.

Table 1. Number of installation and power consumption of lights.

	Light source	Unit power consumption [w]	Unit luminous flux [lm]	Color temperature [K]	Number	Power consumption [w]	Luminous flux [lm]
Escape route	Incandescent bulb	20	175	2,850	20	400	3,500
		40	495	2,850	24	960	11,880
	LED foot light	9	320	6,300	23	207	7,360
	LED solar type floodlight	5	200	2,900	6	30	1,200
Temporary shopping district	Incandescent bulb	20	175	2,850	65	1,300	11,375
		40	495	2,850	41	1,640	20,295
				Sum total	179	4,537	55,610

Table 2. Average illuminance on the road.

	The number of measurement	Average road surface illuminance [lx]	Average vertical illuminance [lx]
Before lighting arrangement	31	2.0	2.4
After lighting arrangement	49	6.0	4.3

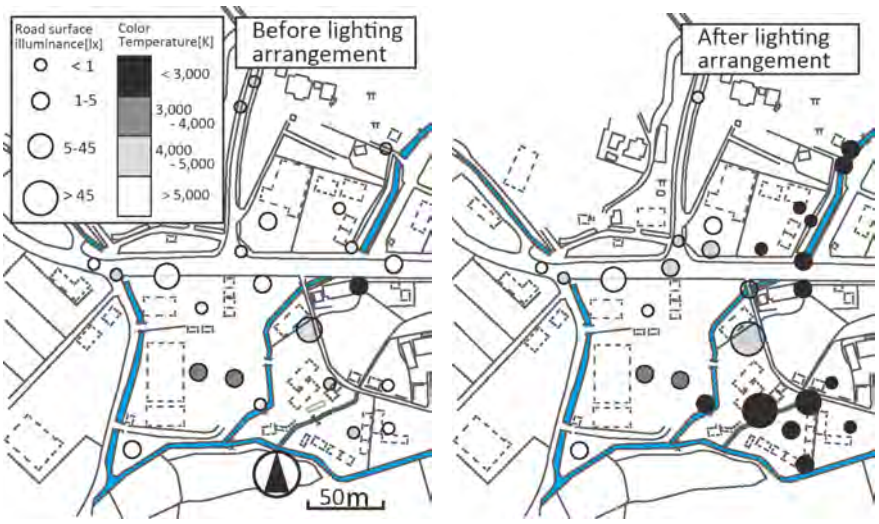

Fig. 14. Road surface illuminance and color temperature distribution of the target area.

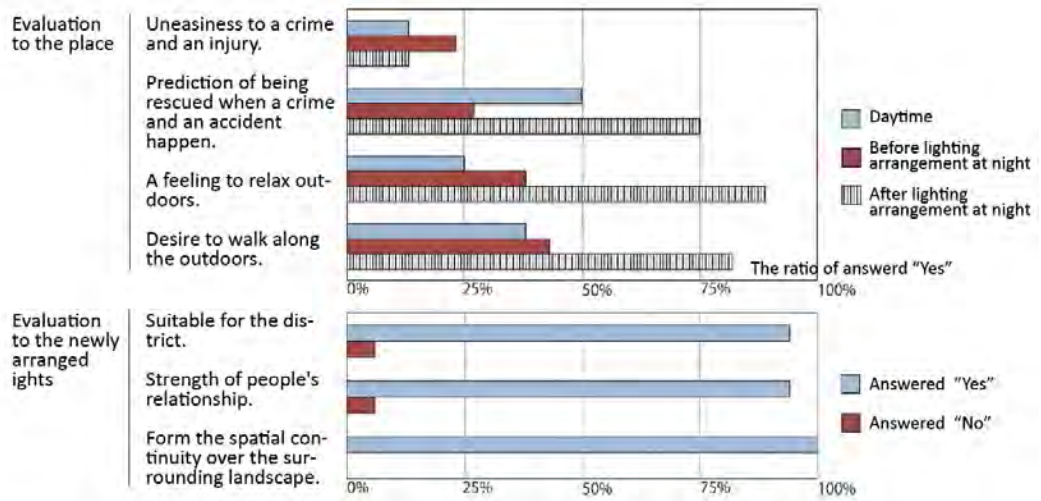

Fig. 15. Questionnaire results in temporary shopping district(N=14-18).

5. Conclusion

The importance of evacuation to higher ground away from a tsunami safely at night has been recognized right after the Great East Japan Earthquake in 2011. This paper has reported the achievement of lighting social experiments in which evacuation lighting equipment was placed to a disaster area.

The suburban area in Rikuzentakata of the Tohoku district was targeted where large numbers of temporary buildings have been built after the earthquake. The lighting program was carried based on the knowledge of field surveys and authors' previous researches, and 179 lights, such as incandescent bulbs, have been arranged. The questionnaire survey to residents was carried out before or after the lighting installation. As a result, it was confirmed that the recognition of entrances to evacuate or the evacuation directions which guide to higher ground had increased enough compared with the previous situation. It was also confirmed in the temporary shopping district or the construction office that surrounding visibility and safety had been improved by lighting. The lighting social experiment was conducted over September 2013 to about one month. Most light fixtures have been continuously maintained by residents even after the end of the experiment.

Even when people live in the disaster area temporarily, their safety should be guaranteed as promptly as possible. This research aimed at realizing immediately based on the field survey. The reasonable and energy efficient lighting could be realized by designing according to the required performances for the location. The improvement of evacuation lighting would lead regional development in disaster areas. These activity achievements will contribute to immediate lighting environment improvement of a disaster area when similar damage occurs in the future.

References

[1] Verification Report on Disaster Response in the Great East Japan Earthquake in Rikuzentakata City, Rikuzentakata City, 2014.2.
[2] GSI Website: 1/25000 Shinsui hani gaikyozu (Flood area maps (Japanese)) http://www.gsi.go.jp/kikaku/kikaku40014.html (accessed 30 Nov. 2014)
[3] YAMADA Tokiyoshi, KUBOTA Katsuaki, ABE Nobuyuki, IIDA Akihiko: Visibility of Emergency Exit Signs and Emergency Lights through Smoke, Report of National Research Institute of Fire and Disaster, No.99, pp.227-235, 2005.3.
[4] Mulder M., Boyce PR: Spectral effects in escape route lighting. Lighting Research & Technology, Vol.37 No.3, pp.199-218, 2005.
[5] PROULX G, KYLE B, CREAK J: Effectiveness of a Photoluminescent Wayguidance System, Fire Technol, Vol.36 No.4, pp.236-248, 2000.11.
[6] Tadashi Doi: The Present Status and Problem of the Outdoor Disaster Prevention Lighting Systems, Journal of the Illuminating Engineering Institute of Japan, 92(8B), pp.502-506, 2008.8.
[7] Ports and Harbours Bureau, MLIT: Tsunami Evacuation Guidelines, 2013.10.
[8] Hiroshi Mae, Masahide Kakudate and Shigeo Kobayashi: Lighting Improvement to Facilitate Evacuation to Higher Ground away from Tsunami at Night : A Case Study in Kamaishi City, Iwate Prefecture, Journal of the Illuminating Engineering Institute of Japan, Vol.97, No.11, pp.721-727, 2013.11.
[9] Shigeo kobayashi, Masahide Kakudate, Kaho Wakayama and Rikuo Nishimori: City Lights which Facilitate Evacuation to Higher Ground: The Improvement Design Started from Social Lighting Experiments, Journal of the Illuminating Engineering Institute of Japan, Vol.98, No.4, pp. 176-180, 2014.4.

.

Shigeo KOBAYASHI

Professor, Department of Architecture, Dr.Eng.
Tokyo City University

Researching Experience

2011 Professor, Tokyo City University
2004-2005 Visiting scholar, University of Nevada, Las Vegas (UNLV)
2003 Associate Professor, Musashi Institute of Technology
1998 Doctor of Engineering, Tokyo Institute of Technology
1991 Bachelor of Engineering, Tokyo Institute of Technology, Department of Architecture

Research Topics

Developing energy-efficient street lighting

Examining attributes of safe-feeling street lighting through experiments on scale models. One of the results was founded that intensity lighting could be reduced with good natural surveillance such as lights coming through windows.

Examining lighting effects on human behavior

Conducting many field experiments to research human behavior in non-uniformly illuminated space. Especially, characteristics of conversational behaviors in offices, schools, cafes, and public spaces were investigated.

Books

1. The Art of the Lights Found with Photographs: Raichosha, 2010, This book was published in Japan and Taiwan.
2. Lighting by Yourself: Ohmsha Ltd., 2010
3. Stadtbild der Nacht: Ein abendlicher Gang durch die Metropole Tokio : Lichtregion: Positionen und Perspectiven im Ruhrgebeit, pp.97 - 108 , 2011 , Klartext Verlag (Published in Germany)
4. Environmental Design by Light and Color, Ohmsha Ltd., 2001 (Chief Editor). This book was published in Japan, Korea and China.

Prizes

1. The Prize of Architectural Institute of Japan(AIJ) 2010; A Study about the Evaluation of Architectural Environments Based on Human Behaviors
2. 2008 IESNA International Illumination Design, Award of Merit; Campus illumination
3. Design Award for Light and Lighting 2008 (The Illuminating Engineering Institute of Japan); Campus illumination 2007
4. SDA Award(Japan Sign Design Associatio) 2006; Yatuso and Gokayama Lighting Design

Contact Address

1-28-1 Tamazutsumi,Setagaya-ku,Tokyo 158-8557,Japan
+81 357072189
skoba@tcu.ac.jp
http://kobayashilab.net/en/