

“Technical Research and Development for Road Policy Quality Improvement” Study Summary

No.	Title	Principal Researcher
No.28-7	Development of Pro-beam Road light	Hokkaido Univ. Prof. Toru Hagiwara

In the present study, we develop a prototype pro-beam road light that is designed to increase the visibility performance of not only a pedestrian crossing the road but also other objects on the road. The prototype pro-beam road light should provide enough vertical illuminance in both the driving lane and the opposing driving lane, and the glare was at an acceptable level.

1. Backgrounds and Objects

Annual fatal accidents in Japan numbered 4,028 in 2015. Fatal pedestrian-vehicle accidents numbered 1,474 in 2015. Of these fatal pedestrian-vehicle accidents, 548 occurred at mid-block locations, and 408 of those 548 occurred at night. To achieve the abovementioned target in Japan, it is required to reduce night time pedestrian-vehicle accidents at mid-block locations. Most pedestrian fatalities at mid-block locations result from the failure of the driver to detect the pedestrian at night. The visibility of pedestrians who cross highways at night should be improved. The present study develops a prototype pro-beam road light that uses pro-beam light distribution. The visibility of a pedestrian who is crossing the road and is illuminated by a conventional road light is known to depend on the relationship between the driver's position and the pedestrian's position. Pro-beam road lights are a fundamental solution to the problem of enhancing the visibility of pedestrians crossing the road.

2. Activities in Research Period

- The study in 2016 assessed the light distribution for pro-beam road lighting using the existing LED lamps. Luminous measurements and subjective visibility assessments on a test track were conducted with conventional road lighting and the proposed pro-beam road lighting.
- The study in 2017 assessed the visibility of crossing pedestrians for two candidate types of pro-beam road lights on a test track using pro-beam luminaires incorporating LED lamps. Based on results, it is considered possible to design a practical pro-beam road light that overcomes these weaknesses of the type-B pro-beam road light.
- The study in 2018 developed a prototype pro-beam luminaire which is possible to install at the actual road. Also, the prototype pro-beam luminaire incorporating LED lamps could provide the improved light distribution that fulfill the lighting performance of the type-B pro-beam road light developed in 2017.

3. Study Results

In the present study, we designed and produced luminaires equipped with an LED module with a lens to achieve the performances of the prototype pro-beam road light shown in Figure 1. The pro-beam road light proposed by the present study is designed to fulfill the criteria, which are defined in "Road Lighting Installation Standards, 2007" of Japan. There are three different types of units, each containing different LED modules with a lens: narrow-angle beam (8 deg.), middle-angle beam (16 deg.) and wide-angle beam (28 deg.). Each unit has a different irradiation angle to satisfy the light distribution of the prototype road light.

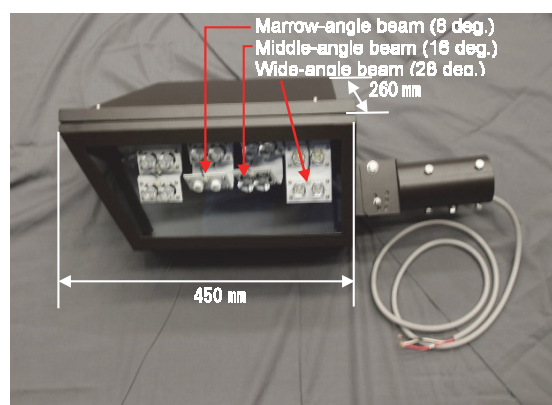


Figure 1 Appearance of the luminaire for the prototype pro-beam road light developed for the present study.

Based on the results of the present study, the prototype pro-beam road lights was found to afford considerably stable visibility performance on the road ahead. The pro-beam road lights provided enough vertical illuminance in both the driving lane and the opposing driving lane shown in Figure 2, and the glare was at an acceptable level. It can be concluded that the pro-beam road light is effective at increasing the visibility performance of a pedestrian crossing the road. However, the visibility performance on the right side of the road was poor, and should be improved by changing the light distribution of the prototype pro-beam road light.

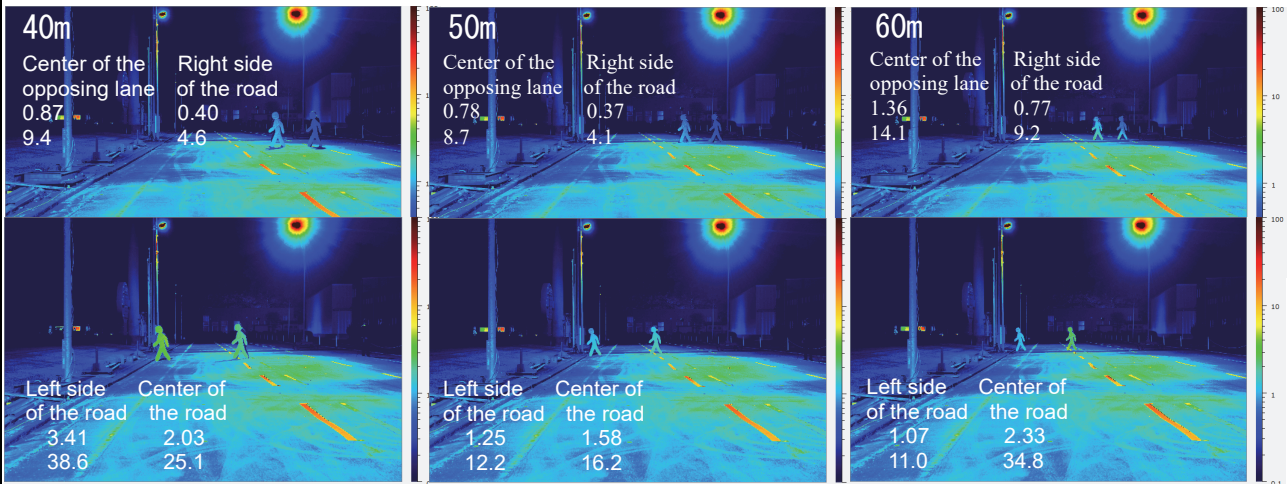


Figure 2 Results of Image, Luminance (cd/m², upper case value) and Vertical Illuminance (lx, lower case value) at the four dummy pedestrian positions.

4. Papers for Presentation

- 1) Hagiwara, T., Kusatake, D., Kouko, S., Todoroki, M., Hamaoka, H., Okajima, K., Kobayashi, S., Fundamental Visibility Assessment for Pro-beam Road Lighting, Transportation Research Board 97th Annual Meeting, 2018.1.
- 2) Hagiwara, T., Kouko, S., Hamaoka, H., Okajima, K., Kobayashi, S., Visibility Assessment of Pro-beam Road Lights at a Test Track, Transportation Research Board 98th Annual Meeting, 2019.1.

5. Study Development and Future Issues

- In the near future, we should perform a feasibility study on the prototype pro-beam road light on a city street where collisions involving vehicles and crossing pedestrians occur in large numbers, in order to reveal the effectiveness of the prototype pro-beam road light.
- The pro-beam road light could have large advantages increasing visibility level at the intersection. Usually, the central area of the intersection is darker than the approaching section. However, the pro-beam road light could illuminate whole area of the intersection uniformly, and also visibility level is high due to long illuminating range provided by the prototype pro-beam road light. However, we should adjust light distributions of the prototype pro-beam road light for the intersection area.

6. Contribution to Road Policy Quality Improvement

Especially, it is large merits of the prototype pro-beam road light that the drivers easily could detect pedestrians on the road before starting across the road, and it is expected to reduce number of pedestrian crashed on the road within downtown area at night. The prototype pro-beam road light could clear demerits of the conventional road light due to changes of positive and negative contrast on the road, and negative effect of combined road lighting with vehicle head light on visibility.

7. References, Websites, etc.

None