Balancing Energy Conservation by Office Task and Ambient Lighting with Amenability

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1. Introduction

After the Great East Japan Earthquake Disaster, many offices conserved power by switching off some of their lighting fixtures ("reduced lighting"). But although reduced lighting brings significant energy-saving effects, it also forms undesirable lighting environments with dark areas beneath switched-off fixtures. This problem arises because Japanese offices most commonly use a general system of lighting in which fixtures are equally distributed across the ceiling to provide lighting at desk level.

By contrast, the system of task and ambient lighting widely adopted in Europe and America is thought effective from the viewpoint of achieving sufficient brightness at desk level while conserving energy. This system follows the rationale of "the right lighting in the right place at the right time", achieved by using individual desk lamps (task lighting) to provide brightness at desk level while slightly reducing the surrounding brightness (ambient lighting). When a position is unoccupied, the desk lamp can be switched off. If properly planned, this system can be used to form visual environments with a good balance between light and dark while at the same time conserving energy. On the other hand, merely introducing a different system of lighting tends not to improve the amenability of the lighting environment.

In this paper, as a simple example, we introduce a case in which renovations were made to improve the amenability of task and ambient lighting introduced with priority on energy-saving characteristics, but without increasing the consumption of energy, resulting in improved evaluation by users.

2. Example of further renovation to task and ambient lighting

We introduced task and ambient lighting with priority on energy conservation using LED light sources in an actual office, and then further renovated it to improve the perceived brightness (Fig. 1). To obtain a sense of spatial brightness with the minimum possible increase in consumed power, we used ambient lighting to illuminate dark areas of walls and ceilings. We also surveyed the power consumption and evaluation by office workers before and after the renovation. From the results of the survey, it was shown that a vast improvement in evaluation by office workers (such as a sense of spatial brightness) could be achieved after renovation even when the power consumption of the task and ambient lighting method was kept low compared to the general lighting method (Fig. 2).

Figure 1. Task and ambient lighting before and after renovation

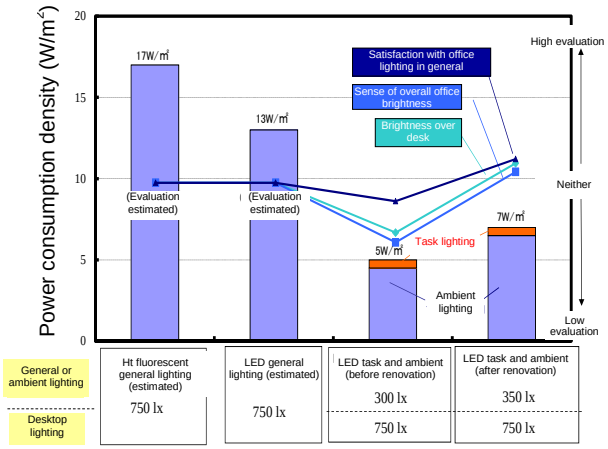

Figure 2. Relationship between lighting method, energy saving and evaluation

3. Conclusion

While the task and ambient lighting method could be seen as effective for conserving energy in offices, the case in this paper shows that the quality of the light environment needs to be fully considered in order to balance this with amenability. This research used the results of the MLIT "FY2010 Basic survey on methods of evaluating energy consumption for building standard development promotion projects and commercial buildings" (representative: Tadahiko Ibamoto, Tokyo Denki University).