**Article:**

Alshdaifat, A. and Fotios, S. (2024) Visiting academic. Lighting Journal, 89 (2). pp. 50-52.

Lighting research

# VISITING ACADEMIC

*Industrial placements can be invaluable for PhD students in terms of helping to broaden subject knowledge and learn about the practical application of ideas. In return, they can also be a great ideas-generator for the placing employer*

**By Aysheh Alshdaifat and Professor Steve Fotios**

The University of Sheffield's stunningly lit concourse, by Arup. Photograph by Arup and Midi Photography

Aysheh Alshdaifat is a PhD student at the University of Sheffield's School of Architecture. She is an early-stage researcher within the LightCAP project, where her work on outdoor lighting is supervised by Professor Steve Fotios.

LightCAP is a European Training Network, under the Marie Skłodowska-Curie actions framework. Being a PhD student, Aysheh's research concentrates on very specific questions and requires in-depth consideration of research methods to ensure her findings are robust.

Therefore, in order to broaden her subject knowledge, she spent one month with Arup in Sheffield to learn about issues of practical application.

The focus of Aysheh's research is lighting for pedestrians. Road lighting standards, like BS54891:2020, offer guidelines for design, such as the average illuminance required in subsidiary roads [1].

These values, as most ILP members will be well aware, are defined by lighting classes P1 to P6, and which recommend average horizontal illuminance levels ranging from 2 lux to 15 lux. The aim of such guidance is to provide a common framework for design.

In subsidiary roads, pedestrians are defined as the key user group. As BS54891:2020 states, the recommended guidance should: 'Enable pedestrians and cyclists to orientate themselves and detect vehicular and other hazards. It can allow pedestrians to recognize other pedestrians and feel more secure.

'It also has a wider social role, with the potential of helping to reduce fear of crime and to discourage crime against people and property. It can contribute to commercial and social use at night of town centres and tourist locations by improving the daytime and nighttime appearance.'

This definition describes the need for lighting to support visual performance and visual perception. In recent years, we have recognised that lighting impacts on non-visual human responses, such as alertness. However, these effects are not yet explicitly accounted for in BS5489-1.

Aysheh's PhD research is investigating non-visual impacts of lighting, specifically the degree to which road lighting conditions affect the alertness of pedestrians. Using lighting to enhance pedestrian alertness would contribute to a reduction in the risk of trips, falls and collisions with other road users.

Enhancing alertness would help pedestrians perceive potential hazards more quickly, enabling them to adjust their movements accordingly to avoid injury.

Previous research tells us that blue light can improve one's alertness more than orange light. Research of non-visual effects of lighting has, however, tended to focus on applications for interior spaces and does not represent the experience of pedestrians in terms of light level and duration of exposure.

Aysheh has conducted two experiments in which alertness was measured under different lighting conditions in the evening.

The test schedule simulated an evening routine, with two hours exposed to lighting conditions characteristic of typical domestic settings. This was followed by one hour exposed to one of four lighting conditions.

## FOUR LIGHTING CONDITIONS

The four lighting conditions, defined by photopic illuminance, melanopic EDI and CCT, were:

- a near-unlit environment (<0.5 lux, <0.5 lux, 2700K);
- an illuminance and spectrum representative of typical road light (8 lux, 3.4 lux, 2700K);
- the same photopic illuminance as road lighting but with increased short-wavelength content to better simulate the circadian system (8 lux, 10.4 lux, 5800K); and
- an extreme condition (83 lux, 98.8 lux, 5800K).

The alertness of test participants was assessed using different measurements. These were analysis of:

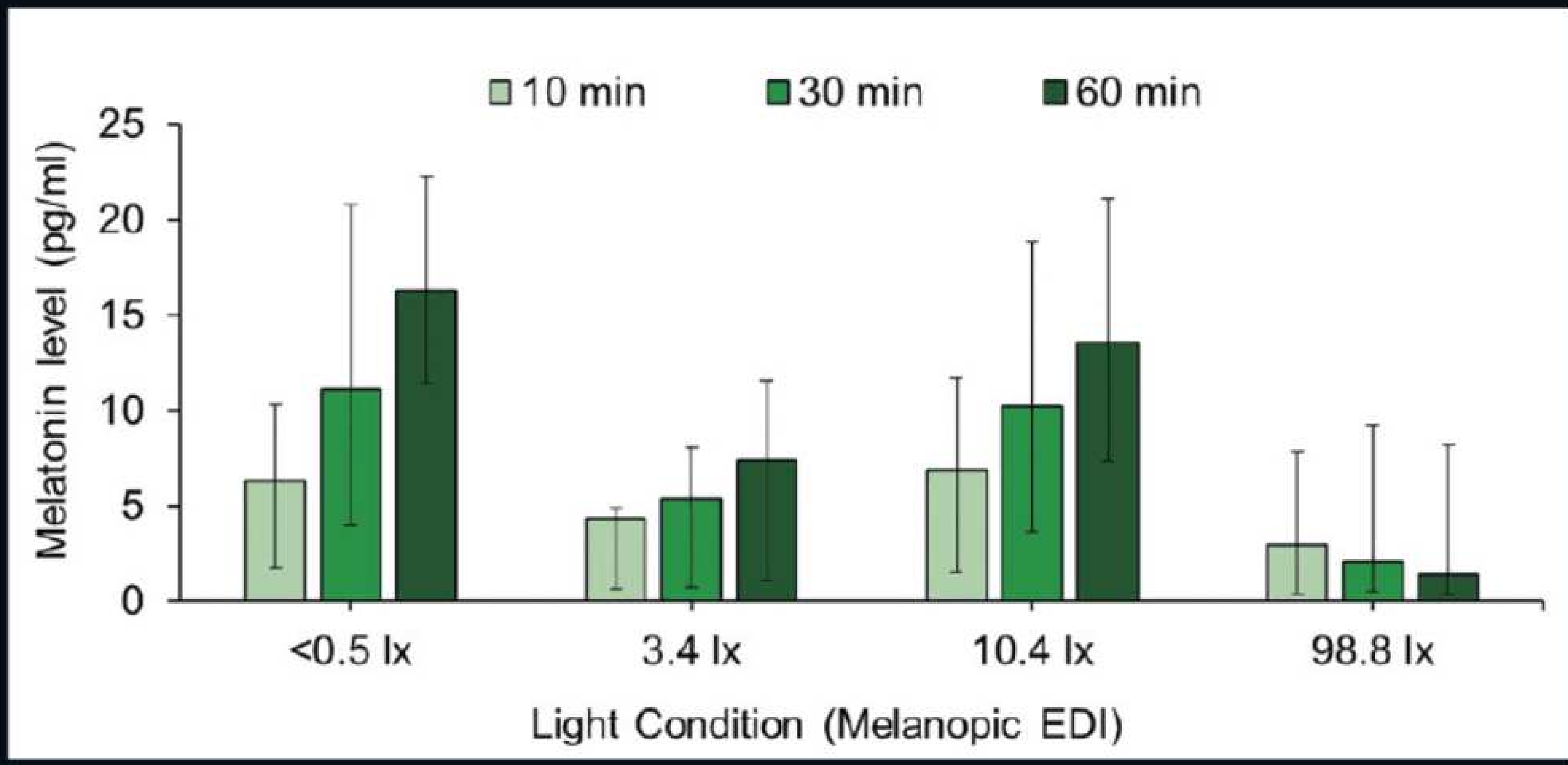


**Figure 1. Melatonin levels recorded through the test lighting phase of the experiment under each lighting condition**

- melatonin levels obtained from saliva samples,
- reaction time to an auditory detection task,
- and self-reported levels of sleepiness. These samples were collected at 10, 30 and 60 minutes from the start of the final hour.

Figure 1 above shows the melatonin levels under each lighting condition in the test phase. The extreme light condition with higher melanopic content was sufficient to enhance alertness.

This can be seen as a decrease in melatonin level in contrast of the other lighting conditions in the test phase: the differences were suggested to be significant. The same conclusion was drawn from analyses of the other measures.

In addition to conducting such experiment in Aysheh's PhD studies, her job in the LightCAP project includes two periods of secondment. These are a chance to work in different locations and on different issues as a means to promote a broad subject knowledge. Arup is an industrial partner in the LightCAP project.

Arup's Sheffield studio includes outdoor lighting design in its portfolio, and hence Aysheh sought to conduct her industrial placement with them. That portfolio includes the pedestrian concourse on the University of Sheffield campus and Hull city centre, as are both illustrated on these pages.

## INTERACTION WITH DESIGNERS AND MANUFACTURERS

The secondment was limited to only four weeks. Nevertheless, in that time, Aysheh engaged in different activities and worked closely with field experts.

One of the most engaging experiences that she was invited to share at Arup involved meetings with leading lighting manufacturers and suppliers of light sources and fixtures.

During these meetings, the representatives bring along their latest product releases and showcase the potential of their products. Their demonstrations offer valuable insight into how these products can enhance and catalyse new road lighting design ideas.

One of them presented the potential to add a sensor to the light post, which gives the ability to switch from one light spectrum to another in case there is no one using the road – which has less impact on wildlife.

Another presented a new recessed linear LED with various colour temperatures available that applicable to use for internal and external sites and can be fixed at external ground not just at walls.

These regular interactions between lighting designers and lighting manufacturer representatives foster a feeling of collaboration and teamwork that is essential to success.

In addition, Aysheh attended the Arup team regular presentations, where they present their noteworthy experiences in lighting design projects as well as give updates on their latest areas of research.

One of these noteworthy presentations focused on the topic of light pollution, including the non-visual effects of road lighting for pedestrians.

As part of this, the team developed a comprehensive document outlining a global approach for reducing light pollution. This included a conceptual

→

# Lighting research


Catenary lighting in Hull city centre, one of the Arup schemes Aysheh worked on


Figure 2. The initial treatment plan for the landscape of a city centre project

approach, a stage-by-stage approach, detailed guidance and standards collection, and case studies.

Aysheh was also invited to participate in a meeting focused on daylight and shadow building assessment. This meeting was about the use of Sketch-up and Rhino software to create a 3D model of two new proposed buildings that will be added to an existed school building in London.

The objective of this meeting was to assess the impact of these new buildings on the daylight received by surrounding buildings and form a recommendation for the building designers.

Finally, Aysheh contributed to determining the artificial lighting levels for the landscape of a city centre project. This work included considering the skyglow and light pollution when proposing a treatment plan.

After several consultations and meetings with the project leaders from Arup, the lighting design concept was to create a sense of continuity for walkers strolling through the landscape in the evening.

To achieve this goal, the first step was determining road usage in the project area, then exhaustively studying the standards documents and, finally, meticulously selecting the best lighting level for each road in the project area. Figure 2 shows the initial concept of the treatment plan. It was a hugely useful and informative experience, both for Aysheh and the Arup team.

Gaining an appreciation of the demands of lighting design give Aysheh a better understanding of how meticulously conducted research feeds in to lighting application. ■

**Aysheh Alshdaifat** is a PhD student in the School of Architecture at the University of Sheffield. **Professor Steve Fotios PhD BEng(Hons)**, PGCE, FHEA, FSLL, MILP is professor of lighting and visual perception at the University of Sheffield

## ACKNOWLEDGEMENTS

The LightCap project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement (No. 860613).

Aysheh also writes: 'My thanks for Florence Lam and Arfon Davies from Arup for this opportunity, and Helen Wright, who ensured that I would gain the most from my time in Arup.'

REFERENCES

[1] British Standards Institution. 2020. Code of Practice Design of Road Lighting Part 1: Lighting of Roads and Public Amenity Areas. BS5489-1:2020. London: BSI, 2020.