

NRC Publications Archive Archives des publications du CNRC

Patterns of lighting use in a medium open-plan office. Pt. 2 Levy, A. W.

This publication could be one of several versions: author's original, accepted manuscript or the publisher's version. / La version de cette publication peut être l'une des suivantes : la version prépublication de l'auteur, la version acceptée du manuscrit ou la version de l'éditeur.

For the publisher's version, please access the DOI link below. / Pour consulter la version de l'éditeur, utilisez le lien DOI ci-dessous.

Publisher's version / Version de l'éditeur:

<https://doi.org/10.4224/40000569>

Building Research Note, 1979-02

NRC Publications Archive Record / Notice des Archives des publications du CNRC :

<https://nrc-publications.canada.ca/eng/view/object/?id=1fcbbc93-3282-4089-b169-830e73772c8f>

<https://publications-cnrc.canada.ca/fra/voir/objet/?id=1fcbbc93-3282-4089-b169-830e73772c8f>

Access and use of this website and the material on it are subject to the Terms and Conditions set forth at

<https://nrc-publications.canada.ca/eng/copyright>

READ THESE TERMS AND CONDITIONS CAREFULLY BEFORE USING THIS WEBSITE.

L'accès à ce site Web et l'utilisation de son contenu sont assujettis aux conditions présentées dans le site

<https://publications-cnrc.canada.ca/fra/droits>

LISEZ CES CONDITIONS ATTENTIVEMENT AVANT D'UTILISER CE SITE WEB.

Questions? Contact the NRC Publications Archive team at

PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca. If you wish to email the authors directly, please see the first page of the publication for their contact information.

Vous avez des questions? Nous pouvons vous aider. Pour communiquer directement avec un auteur, consultez la première page de la revue dans laquelle son article a été publié afin de trouver ses coordonnées. Si vous n'arrivez pas à les repérer, communiquez avec nous à PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca.

BUILDING RESEARCH NOTE

PATTERNS OF LIGHTING USE IN A MEDIUM OPEN-PLAN OFFICE. 2

ANALYZED

by

A.W. Levy



05947

Division of Building Research
National Research Council of Canada

Ottawa
February 1979

PATTERNS OF LIGHTING USE IN A MEDIUM OPEN-PLAN OFFICE. 2

by

A.W. Levy

This is the third report in a continuing series of studies^{1,2} of the pattern of use of artificial lighting in office and school buildings. A time-lapse camera, mounted in the ceiling of the office, took a photograph every 6 minutes on Super 8 mm colour film, recording the time of day, the instantaneous lighting power load and occupancy within the office space. The office was located on the first floor of a 3-storey building at NRC, Montreal Road. Data were collected over a 45 working day period (Monday to Friday inclusive) between 5 January and 18 April 1978.

DESCRIPTION OF OFFICE

A plan of the office, with luminaire layout, switching arrangement, camera location, and field of view is given in Figure 1. Only the south wall contained windows; these covered 11 per cent of this wall area. Reading, writing, typing and work of a clerical nature are the major tasks performed in the office. Hours of attendance for the twelve occupants were between 08:15 and 16:30. Cleaning work commenced between 07:00 and 07:20 and was completed before office personnel arrived in the morning.

Recessed luminaires, 1220 mm by 610 mm, with prismatic diffusers each contained either four or two, 1220 mm cool white fluorescent lamps. The variation in the number of lamps per fixture is illustrated in Figure 1 and is the result of an earlier "de-lamping" program. The horizontal illuminance at desk height varied between 700 to 1000 lux at a power loading of 26 W/m².

No daylight data were collected because of the small contribution it made to the effective working area illuminance level.

RESULTS

The average kilowatt-hour equivalent load¹ consumed in each hour is given in Figure 2 and the percentage occupancy in Figure 3.

Selective switching of the luminaires occurred on only 11 days of the 45 monitored; with one exception, this took place before 08:00 h.

The cleaning staff were therefore the only personnel to utilize separately the two switching circuits available. Consequently the pattern of hours of use for the two switching zones are almost identical and follow the pattern obtained for the equivalent kilowatt-hour profile illustrated in Figure 2, since a fixed load, equal to the total lighting power load, was switched on on nearly all occasions.

Lighting energy consumed between 08:00 h and 17:00 h accounted for 85 per cent of the total daily average consumption; 6 per cent of the energy was used before 08:00 and the remaining 9 per cent after 17:00 h. On two occasions, the lights were inadvertently left on until midnight. Nearly all of the 6 per cent use before 08:00 h can be attributed to cleaning activities. Since the occupancy data (Figure 3), indicate the absence of office personnel after 17:00 h, the 9 per cent energy use during this time period can be attributed to security personnel and simply wasted energy consumption during unoccupied hours.

DISCUSSION OF RESULTS

As with previous studies no complaints were forthcoming from the occupants of the office space regarding the operation and use of the camera. The occupancy and lighting energy consumption pattern is very similar to that of the previous open-plan office studied. In both offices, between 09:00 and 16:00 (the core-hours), the full lighting load was used all the time, independent of the number of persons occupying the space. Occupancy data demonstrate that, for the present office, at least one person was in the office during the core-hours which includes the mid-day lunch period. Very little use was made of the two separate switching zones; some occupants informally interviewed did not even know of their existence.

CONCLUSIONS

The pattern of lighting use for the two open-plan offices studied to date (the present study and Ref. 1) are very similar. Lighting use profiles are independent of the number of switching zones, daylight penetration and individual occupant habits. One hundred percent lighting load use occurs between the core-hours 09:00 and 16:00.

In the present office the space was occupied by at least one person on each day during the core hours, but never after 17:00 h and rarely before 08:00 h. Eighty-five per cent of the total daily average lighting energy use was consumed between 08:00 h and 17:00 h, 6 per cent before 08:00 h and 9 per cent after 17:00 h. Very little use was made of the two-zone switching facility; only the cleaning staff make use of this facility.

Any economic conservation measures must be addressed to the core-hours 09:00 h to 16:00 h since this is when most of the energy is consumed. Very little daylight penetration occurs and it is therefore unlikely that photo-electric controls will be of any benefit. Greater

individual control of lighting use would seem to offer the most promising energy saving potential. This could be achieved through a number of control devices currently being developed at DBR.³ All the devices attempt to make it economically feasible for the occupants of open-plan offices to remotely control their immediate individual lighting zone. Devices include a simple ceiling-mounted pull cord switch, ultrasonic and infra-red wireless control, wireless fibre optic switch control, and occupancy detectors. It would be most informative to retrofit this office with one or more of these switching controls and monitor any change in the level and pattern of consumption. If after such a retrofit no reduction in energy consumption was achieved, indicating that provision for more frequent switching is unnecessary and economically undesirable, it would be advisable to consider changing the fluorescent luminaires to HID lamps (metal halide or high pressure sodium) and take advantage of their higher lamp efficacies and longer lamp life.

REFERENCES

1. Levy, A.W. Pattern of Lighting Use in Large Open-Plan Office 1. Preliminary Study and Evaluation, Nat. Res. Council, Div. Bldg, Res., BR Note 129, June, 1978.
2. Levy, A.W. Pattern of Lighting Use in a School Classroom 1. A Preliminary Study and Evaluation. Nat. Res, Council, Div. Bldg, Res., BR Note 132, Nov. 1978.
3. "Lighting Controls, Patterns of Lighting Consumption and Energy Conservation". Paper presented at IEEE-IAS, 1978 Annual Meeting to be submitted for publication in IAS Transactions.

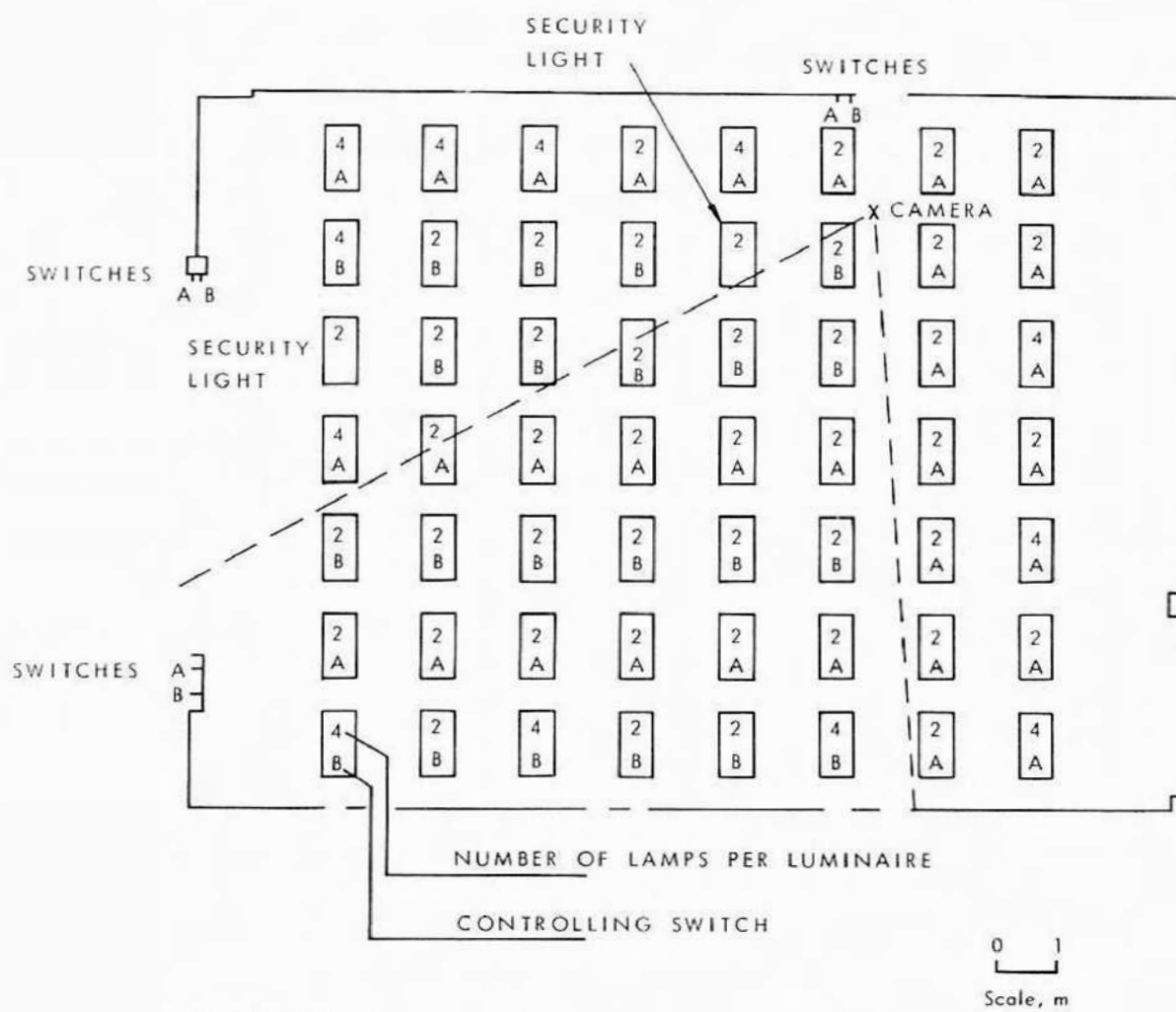


FIGURE 1
OFFICE PLAN

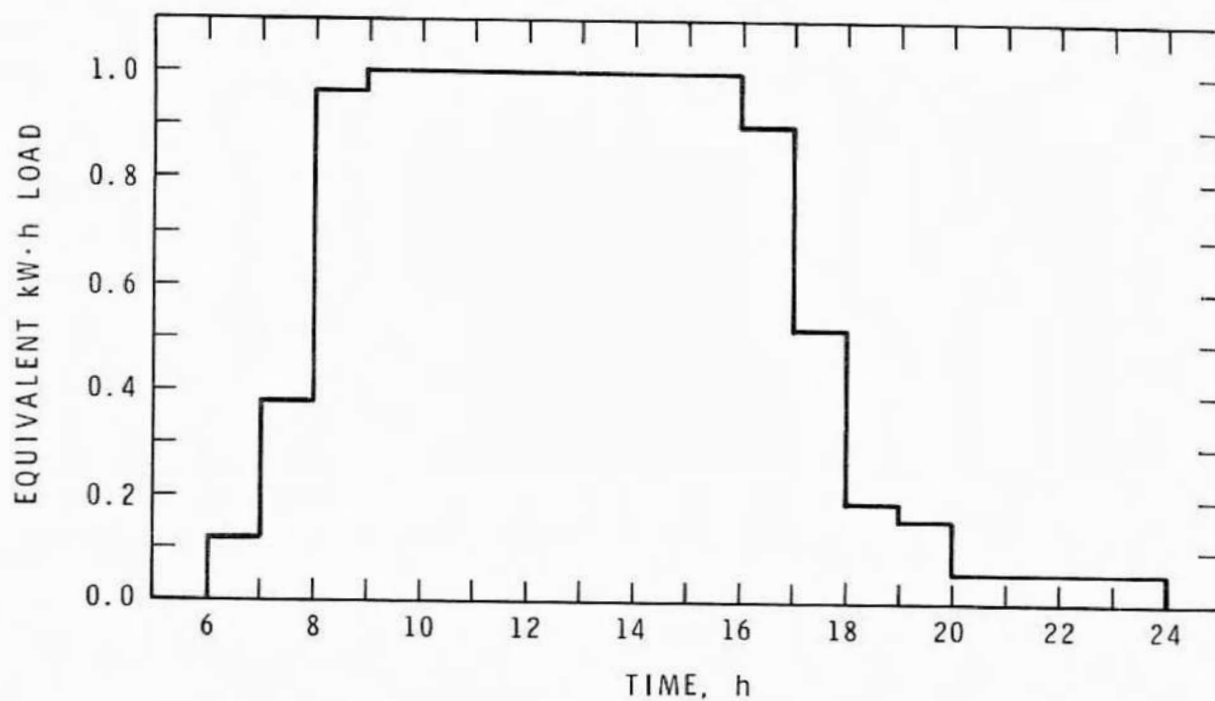


FIGURE 2
EQUIVALENT kW·h LOAD

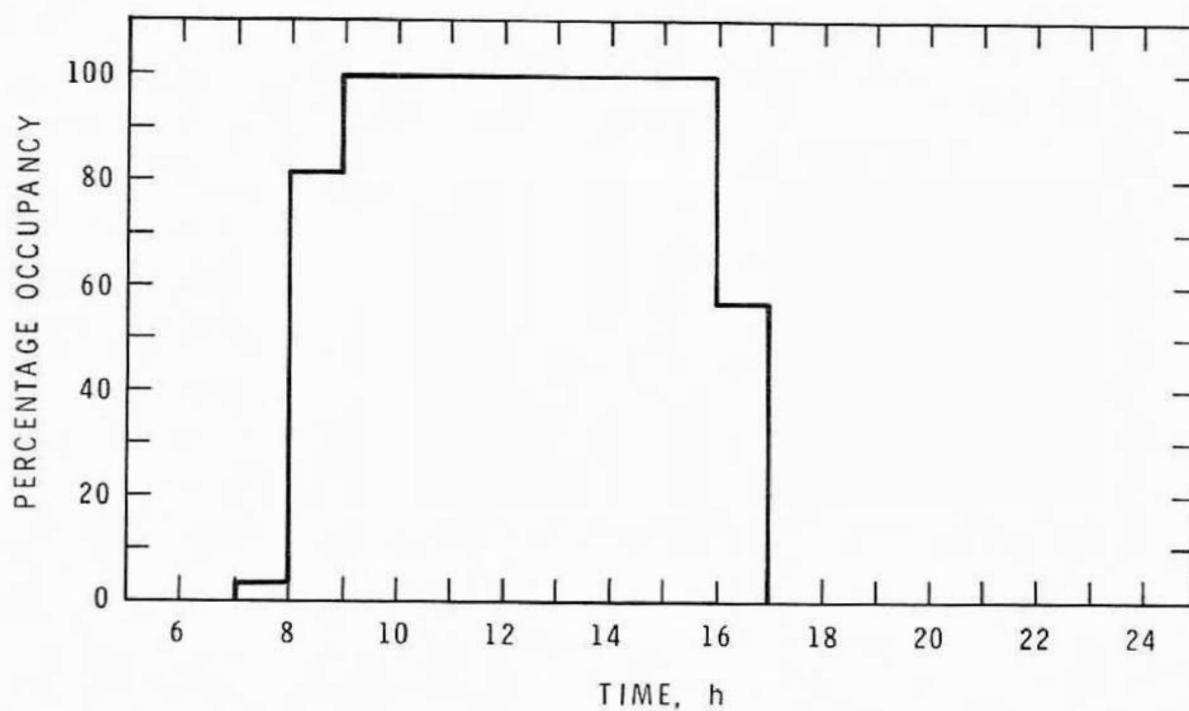


FIGURE 3
OCCUPANCY PATTERN