# Let there be light : the impact of window blinds on daylight-linked dimming and automatic on/off lighting controls

Galasiu, A. D.



**Publisher's version / Version de l'éditeur:**

*i Homes & Buildings, 1, Summer 1, pp. 10-12, 2004-06-01*

**Let there be light : the impact of window blinds on daylight-linked dimming and automatic on/off lighting controls**

**Galasiu, A.**

**NRCC-47290**

**A version of this document is published in / Une version de ce document se trouve dans :**
**i Homes & Buildings, v. 1, no. 1, Summer 2004, pp. 10-12**

# Impact of window blinds on daylight-linked dimming and automatic on/off lighting controls

## By Anca Galasiu

Studies have shown that daylight-linked lighting control systems such as automatic on/off and continuous dimming have the potential to reduce the electrical energy consumption in office buildings by 30 to 60%. However, in practice, most daylight-linked systems installed in buildings do not provide the anticipated energy savings.

Window shades used for sun shading and glare control impact the energy performance of these systems. Projected energy savings are reduced by occupants changing the position of the blinds when direct sunlight reaches their work area, but seldom resetting the blinds for useful daylight admittance after the unwanted conditions diminish. Leaving the blinds closed unnecessarily reduces the amount of daylight available at the photosensor and prevents the photocontrolled lighting systems from achieving maximum energy savings. Photocontrolled blinds can reduce the limitations of manually operated blinds by closing automatically when the interior has too much glare or is too hot, and re-opening later to admit useful daylight.

NRC's Institute for Research in Construction conducted a research project to field-measure over a year the performance of two commercial photocontrolled lighting systems: continuous dimming and automatic on/off. Both systems were evaluated for various configurations of manual and photocontrolled automatic venetian blinds. Performance indicators measured included space illumination and lighting energy consumption.

**Experiment configuration**
The experimental site consisted of four adjacent private offices situated in Ottawa, Canada. Each office had a floor area of 14 $m^2$ and a height of 3 m, and was used from 8 AM to 5 PM during weekdays by their regular occupants. The lighting energy consumption of each system was recorded daily from 6 AM to 6 PM.

**Photocontrolled lighting system**
The original lighting fixtures in two side-by-side offices were provided with a commercial photocontrolled dimming system that continuously adjusted the power to the lamps based on a signal received from a ceiling photosensor. The system was calibrated to complement the available daylight and maintain a constant illuminance level on the workplane of 570 lux, the design illuminance at night under full electric lighting.

The lighting fixtures in the other two offices were equipped with a commercial photocontrolled on/off system operated by a signal received from a ceiling photosensor. The automatic on/off lighting system was calibrated to turn the lights off when the average illuminance from daylight on the work area exceeded 570 lux, and turn the lights on at full power when the illuminance dropped below this level. To prevent the lights from constantly changing between the on and off states in response to short, transient conditions, the control system had a timer that maintained a given state for at least two minutes.

Lighting system calibration and benchmarking tests were conducted periodically to verify the similarity between the electrical lighting systems of each pair of rooms, the relative deviation resulting from instrumental error, the rooms' relative position to the exterior environment, and the systems' components and operation. During these tests all blinds were fully retracted, simulating spaces in which a photocontrolled lighting system would provide the maximum lighting energy savings. Results showed that the offset in daily lighting energy consumption between each pair of rooms was about 5% under clear and partly cloudy sky, and less than 2% under overcast sky, regardless of season. This offset became part of the benchmarking in subsequent calculations.

**Photocontrolled shading system**

The venetian blinds of one ''on/off'' office and of one ''dimming'' office were modified to incorporate motorized drives and photocontrolled command units. The motorized photocontrolled blind system was designed to operate similarly to an automatic photocontrolled lighting system and included a photosensor installed in the window frame, which monitored the external daylight levels. The blinds were programmed to maintain a preset level of indoor illumination throughout the day, and to close completely at night.

Both the manual and photocontrolled blind systems were monitored over two periods of the year to account for seasonal variations. A total of 10 static blind configuration tests were conducted for the manual venetian blinds. Each blind configuration was monitored for 5 to 10 days to include various sky conditions. The motorized automatic blinds were monitored separately for a total of four months, two in the winter and two in the summer.

**Results**

Under clear sky and with blinds fully retracted, both lighting control systems were able to provide considerable lighting energy savings (50-60%) when compared to the lights being fully on during the same 12-hour daytime interval. These savings dropped, however, by 5 to 45% for the dimming system, and by 5 to 80% for the automatic on/off system with the introduction of various window blind configurations. This proves that in real installations window blinds have the potential to affect significantly the performance of these systems.  In this study, the impact of the blinds on the lighting consumption was a function of the variability of daylight levels due to the sky condition, which fluctuated largely from one season to another for the automatic on/off system, but showed no significant seasonal dependency in the case of the dimming control system.

Both lighting control systems achieved greater energy savings when used in combination with photocontrolled venetian blinds than when used in combination with most static blind configurations. This was a direct result of fact that the photocontrolled blinds were able to adjust their slats periodically according to the variations in external daylight levels, which improved the saving potential of both systems by 20-50%. However, the photocontrolled blinds used in this experiment did not always adjust in the most optimum way.  Occasionally, under clear sky the blinds allowed direct sun to reach indoors, while at other times, under overcast sky, the blinds did not adjust to a fully horizontal position even when the indoor daylight levels were very low. It is believed that future enhancements to this system would further improve its lighting energy savings potential.

The automatic on/off lighting control system, unexpectedly, achieved greater lighting energy savings than the continuous dimming control. Firstly, this was because the components of the dimming system required more power to operate.  Secondly, the minimum power usage of the dimming system was 15% of maximum power load even under clear sky conditions when the automatic on/off system was turned off.  These two factors out-weighed the occasions when the on/off system was at 100% and the dimming system was at less than 100%. However, these results were obtained in a highly daylit setting and the continuous dimming system may be relatively more advantageous in other settings. In well daylit environments, nonetheless, a continuous dimming system combined with a lights-off capability would to be a more desirable and energy efficient solution.

**Conclusion**

Daylight-linked lighting control systems have the potential to reduce the electrical energy consumption in office buildings by 30 to 60%. Knowledge of the effect that window shading devices have on the performance of photocontrolled lighting systems will allow a better selection of the most appropriate design solution for each individual application. The results of this research will foster more accurate estimates of the energy saving potential of these systems, and improve the likelihood of attaining savings in real applications.

---

Anca Galasiu is a member of the research staff  of the Indoor Environment Program of the National Research Council's Institute for Research in Construction. She can be reached at (613) 993-9670 or at anca.galasiu@nrc-cnrc.gc.ca