Minimizing energy consumption for artificial lighting in classroom aiming for a nZEB using LED luminaires and daylight harvesting: The potential of Greek classrooms

L.T. Doulos [1,2,3*], A. Kontadakis[1], A. Tsangrassoulis[1]

[1] University of Thessaly, Dept. of Architecture, Volos, Greece
[2] School of Applied Arts, Lighting Design, Hellenic Open University, Patra, Greece
[3] Lighting Lab, National Technical University of Athens, Heroon Politechniou, 9, 15780 Athens, Greece
*Corresponding author: ldoulos@mail.ntua.gr, Tel.: +30 6937086820

Relevant topics:

- Topic 1. Lighting, Appliances and Equipment
- Topic 13. Sustainable and smart communities, districts and cities

Abstract

The energy consumption for the artificial lighting in school buildings represents the largest proportion of the final electricity consumption. In Greece there is a large number of school buildings with quite old lighting systems using luminaires with T8 and sometimes T12 fluorescent lamps with electromagnetic ballast and degradated translucent diffusers. Moreover, although daylight availability is adequate during the year, there is a missing opportunity for energy savings, since daylight harvesting techniques with photosensors are not used. Scope of this paper is to present the benefits achieved from upgrading the artificial lighting system of a typical classroom using available technologies. This oral presentation will present the energy savings potential by using efficient luminaires and proper planning by customizing LED luminaires fitting for Greek classrooms. In addition, possible energy savings will be presented in cases where the luminaires are combined with a daylight harvesting system.

More analytically the following issues will be discussed and presented:

- The typical classroom in Greece and the installed power for artificial lighting profile from 1970 until now (type and number of luminaires, installed power per classroom).
- The potential energy savings when a new lighting system is adopted using LEDs, achieving the design illuminance values as described in European Norm 12464-1, 2011.
- Estimated energy savings from daylight harvesting using photosensors and various scenarios (using stand alone photosenors and photosensors for each luminaire). This will be realized using a full simulation of the dimming system, integrating measurements results from the drivers used.
- Measurements of LED dimming drivers (consumed energy versus lighting output) and their effect to energy savings as described above.
- Differences in lighting design and energy consumption between AC and DC (power input) LED luminaires in an effort to examine their potential power supply from renewable energy sources.

National Building Code ensures that in school buildings an increased Window to Floor ratio should be used. This, together with their daytime operation offers the opportunity to achieve a near zero energy school building. We believe that the use of occupancy/daylight controls

should be obligatory in school buildings. The reduction of the lighting energy consumption together with the adoption of DC drivers makes possible the connection with renewable energy sources such as photovoltaic panels.

Key words

Artificial lighting upgrade, Daylight harvesting, nZEB, School building

Acknowledgement

This work is part of a post doctoral research, which was realized by means of an IKY scholarship. The latter is funded by the action «Strengthening Post Doctoral Research», the resources of Operational Program «Human Resources Development Program, Education and Lifelong Learning» priority axis 6, 8, 9 and co-financed by European Social Fund – ESF and the Greek government. Their contribution is greatly appreciated.

References

- European Norm 12464-1: Light and lighting—lighting of work places Part 1: Indoor work places, 2011.
- L. Doulos, A. Tsangrassoulis and F. Topalis, “Multi-criteria decision analysis to select the optimum position and proper field of view of a photosensor“, Energy Conversion and Management, 86 (2014) 1069–1077
- L. Doulos, A. Tsangrassoulis and F. Topalis, “Quantifying energy savings in daylight responsive systems: The role of dimming electronic ballasts“, Energy and Buildings, 40 (2008) 36–50
- L.T. Doulos, A. Tsangrassoulis, P.A. Kontaxis, A. Kontadakis, F.V. Topalis, “Harvesting daylight with LED or T5 fluorescent lamps? The role of dimming“, Energy and Buildings, 140, (2017) pp. 336-347