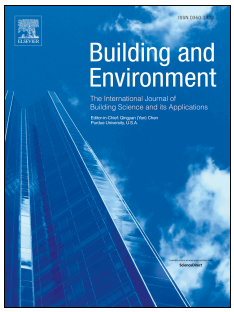
Accepted Manuscript



Impact of daylighting on total energy use in offices of varying architectural features in Italy: Results from a parametric study

Anna Pellegrino, Silvia Cammarano, Valerio Loverso, Vincenzo Corsrado

PII: S0360-1323(16)30352-3

DOI: 10.1016/j.buildenv.2016.09.012

Reference: BAE 4634

To appear in: *Building and Environment*

Received Date: 20 June 2016

Revised Date: 27 August 2016

Accepted Date: 9 September 2016

Please cite this article as: Pellegrino A, Cammarano S, Loverso V, Corsrado V, Impact of daylighting on total energy use in offices of varying architectural features in Italy: Results from a parametric study, *Building and Environment* (2016), doi: 10.1016/j.buildenv.2016.09.012.

Impact of daylighting on total energy use in offices of varying architectural features in Italy: results from a parametric study

Abstract

The growing attention towards the optimization of the overall performance of a building, in terms of both indoor environmental quality and energy consumption, has brought about the need to carry out analyses, which consider the interactions of all affecting parameters. In particular, thermal and daylighting analysis should be carried out in synergy to ensure the best performance in both domains. Within this framework, the paper presents a study on daylighting and energy behavior of rooms with different architectural features. The study has been conceived to account for a broad range of possible configurations of office buildings in the climate site of Turin (Northern Italy), and has been performed through numerical simulations carried out with Daysim and EnergyPlus. The results outline the daylighting performance (in terms of spatial Daylight Autonomy (sDA)) and the energy demand for lighting, heating and cooling and demonstrate that optimizing daylighting can lead to a reduction of the total energy demand of an office.

1. Introduction

Daylight is a feature of many buildings and it is highly regarded by people who, generally, prefer to live and work in spaces where daylight is available and a view to the outside, through windows and rooflights, is accessible. The potential positive impact of daylight on people's visual performance, comfort, and well-being has been extensively investigated from the past to the present days and fundamental reviews on the topic have been carried out by various authors [1,2]. Results demonstrate that daylighting in buildings, and especially in work places, is desired by most users and a proper use of daylight contributes to occupants' performance and well-being. Furthermore the effects of light on people's health (effects beyond vision), has been object of investigation during the last fifteen years. Health effects depend, among the other factors, on people's exposure to light and on its spectrum, and daylight is recognised to be the most energy-efficient means to deliver a proper light exposure [3].

In addition to that, and taking into account the broader issue of sustainability, from environmental quality to energy issues, daylight is an important resource to improve the energy efficiency of buildings. The planned use of natural light can become a cost-effective strategy to reduce energy consumption, mainly by minimizing the use of electric lighting, but also because of its influence on the heating and cooling loads of a building.

Electric lighting is estimated to account for a significant part of the overall energy demand of buildings (15 - 20% of the total building electricity consumption) [4,5] and the potential of daylight exploitation to reduce electricity consumption associated with lighting requirements has been demonstrated in several past and recent studies, as reported also in some literature reviews [6,7]. Maximizing indoor daylight availability by means of a proper design of spaces, openings and shadings or by the use of appropriate daylighting systems is the first approach to achieve the goal of energy conservation related to lighting [8,9,10,11,12,13]. Reinhart [10] investigated the influence of various design variables on daylight availability in over 1000 open-plan office settings with different external shading contexts, glazing types, façade orientations, ceiling designs and partition arrangements, located in five different climatic sites. One of the outcomes was the influence of glazing visible transmittance on the energy consumption for lighting: the reduction of transmittance from 75% to 35%