Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 140 (2017) 207–216

Energy Procedia

www.elsevier.com/locate/procedia

AiCARR 50th International Congress; Beyond NZEB Buildings, 10-11 May 2017, Matera, Italy

Effects of louvers shading devices on visual comfort and energy demand of an office building. A case of study.

Francisco Fernández Hernández*[a,b], José Manuel Cejudo López[b], José Miguel Peña Suárez[a], M Carmen González Muriano[a], Simón Carrillo Rueda[a]

[a]*Altra Corporación Empresarial, Marie Curie 21, Málaga 29590, Spain.*
[b]*Energy Research Group, ETSII University of Málaga, Doctor Pedro Ortiz Ramos s/n, Málaga 29013, Spain*

Abstract

Daylight contributes to indoor visual comfort, enhances user satisfaction and productivity, and explains partially that, in office buildings, the use of glass in the facades has increased in the last few years, even in places where solar gains through windows contribute largely to glare, thermal discomfort and, consequently, excessive energy consumption. This paper evaluates the energy demand and visual comfort of a real case office building placed in a Mediterranean city, with a high window wall ratio (WWR). South oriented facades receive such a high solar gain that cooling demand cannot be handled by the current HVAC system. As an environmental friendly solution, a shading control strategy based on vertical and horizontal louvers is proposed.

Peer-review under responsibility of the scientific committee of the AiCARR 50th International Congress; Beyond NZEB Buildings

Keywords: daylight, visual comfort, control shading, energy demand.

* Corresponding author. Tel.: +34 902 400 445; fax: +34 902 400 446.
E-mail address: ffernandez@altracorporacion.es

1876-6102
Peer-review under responsibility of the scientific committee of the AiCARR 50th International Congress; Beyond NZEB Buildings
10.1016/j.egypro.2017.11.136

1. Introduction

Energy efficiency and human comfort are the main priorities of the users in the building operation. In this sense, the coordinated performance of HVAC systems, shading devices and electric lighting, based on advanced control strategies, improve energy efficiency by minimizing heating and cooling loads, electric lighting consumption, and assuring visual and thermal users comfort.

The literature review about the effects of daylighting in buildings, the control shading strategies, the integration with HVAC and electric light control systems, etc., is much extended. In this case, the papers of interest analyzed deal with: the type of adequate shading device, the influence of simulation parameters (WWR, building orientation, glazing, etc.), the most used software for the simulations, and the results and conclusions of other cases of study.

Daylight regulation can be done with a great variety of shading devices (blinds, overhangs, venetian blinds, louvers, roller shades, etc.). Bellia [1] and Kirimtat et al. [2] highlight the complexity of classifying the shading devices but suggest a simple classification based on its place in the building (external or internal) and if it is fixed or movable (manual or automatic). Meerbeek et al. [3] show the complexity of the interaction between an automation controls of motorized exterior blinds with users in Dutch offices. Lee et al. [4] describe an experimental case of an office in Oakland (EEUU) with an automatic control of internal venetian blinds, achieving energy savings of 15% and 50% in cooling and electric lighting, respectively, with an optimal 45º slat angle.

The effects of shading devices in visual and thermal comfort depend on different parameters. Shen et al. [5] investigate the balance between daylight and solar gain control in offices with internal blinds according to orientation and WWR. They obtain optimal benefits in south orientation with a WWR of 30-50%. Datta [6] shows how fixed and external horizontal louvers can reduce 70% the cooling demand in terms of an optimal design of louvers parameters: length, distance between louvers and the angle of the tilt. Tzempelikos [7] evaluates a manual control of a roller shade in an office building in Montreal, and study the influence of the glazing transmittance in daylighting.

The case of study proposed in this paper is an office building with a high glazing area in south and east façades. The building is located in Málaga, a city with a Mediterranean climate with a high number of sunlight per year. Users of the building complain about thermal disconfort during all year due to high solar gains. Therefore, a solution based on static shading devices to mitigate solar gains is analyzed. Horizontal louvers for south façade and vertical louvers for east façade are proposed. This louver configuration is recommended by the daylight guidelines [8] provided by the Building Technologies, Department at the Lawrence Berkeley National Laboratory. North façade is not shaded because it receives very little direct solar gain.

There are different simulation tools used for analyzing, designing and evaluating the daylight value, indoor thermal and visual comfort. Some programs are specific for daylight and other for the thermal analysis. The most used in the literature review for daylight are Radiance [9], Evalglare [10] and Daysim [11], and for thermal analysis: EnergyPlus [12] and Trnsys [13]. The methodology followed in this paper is shown in Figure 1.

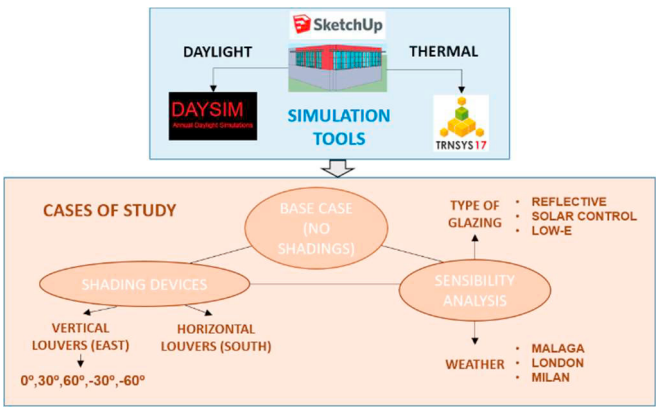

Fig. 1. Methodology: shading control strategies.