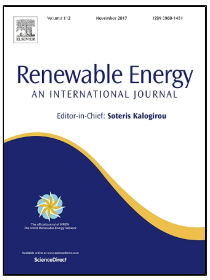
Accepted Manuscript



Environmental Assessment of an Integrated Adaptive System for the Improvement of Indoor Visual Comfort of Existing Buildings

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PII:	S0960-1481(17)30707-3
DOI:	10.1016/j.renene.2017.07.079
Reference:	RENE 9054
To appear in:	*Renewable Energy*
Received Date:	16 August 2016
Revised Date:	08 July 2017
Accepted Date:	16 July 2017

Please cite this article as: A. Michael, S. Gregoriou, S.A. Kalogirou, Environmental Assessment of an Integrated Adaptive System for the Improvement of Indoor Visual Comfort of Existing Buildings, *Renewable Energy* (2017), doi: 10.1016/j.renene.2017.07.079

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ABSTRACT

This research aims to propose and evaluate an integrated adaptive system consisting of individual movable modules for the improvement of indoor environmental conditions. The system was evaluated by means of a natural lighting analysis simulation using Ecotect v5.2 and Desktop Radiance v1.02. Daylighting performance indicators, i.e. daylight factor (DF) and uniformity daylight factor (UDF), were calculated for various geometrical configurations. The analysis suggests that the integration of the system in appropriate geometrical configurations maintains high percentages of the plan area exceeding 2% DF, while it drastically increases UDF above the threshold of 0.40. Moreover, an in-depth analysis of natural lighting levels was performed for south-facing spaces during different periods of the year and hours of the day. In the majority of the cases under study, the proposed system maintains a high percentage of the plan area with lighting levels above 500 lux, while it significantly decreases the percentage of area exceeding 3000 lux and thus minimizes the possibilities of glare issues. The research study confirms the positive contribution of the proposed system as a natural lighting regulation system, while it establishes the concept of prosthetic renovation as a renewable energy strategy for the improvement of indoor comfort of existing buildings.

KEYWORDS – integrated renovation system; adaptive envelope; existing building stock; visual comfort; lighting performance; glare issues

1. INTRODUCTION

The majority of aged existing building stock did not abide by any environmental or energy efficiency principles resulting in high energy consumption. Moreover, visual comfort, i.e. natural lighting performance and glare issues, of indoor spaces in existing buildings cannot be deemed satisfactory. At present, environmental renovation of aged existing building stock for the improvement of indoor comfort, along with the issue of energy efficiency, form fields of high interest and extensive research.

Amongst all energy consuming sectors in Europe, the building sector occupies a considerable part of 40%, due to its low energy performance capabilities [1]. An examination of the energy consumption for an entire year reveals that artificial lighting is responsible for 14% of electricity consumption in the European Union [2, 3].