Application of non-linear programming to optimize buildings' solar exposure

P.A Fokaides, A Panayidou, C Hadjichristos, M.C Phocas

www.elsevier.com/locate/jobe

PII: S2352-7102(16)30135-8
DOI: http://dx.doi.org/10.1016/j.jobe.2017.04.007
Reference: JOBE246

To appear in: *Journal of Building Engineering*

Received date: 17 August 2016
Revised date: 12 April 2017
Accepted date: 17 April 2017

Cite this article as: P.A Fokaides, A Panayidou, C Hadjichristos and M.C Phocas, Application of non-linear programming to optimize buildings' solar exposure, *Journal of Building Engineering* http://dx.doi.org/10.1016/j.jobe.2017.04.007

Application of non-linear programming to optimize buildings' solar exposure

Fokaides, P.A[a*], Panayidou, A[b], Hadjichristos, C[b], Phocas, M.C[b]

[a]School of Engineering, Frederick University 7, Y. Frederickou str., 1036 Nicosia, Cyprus

[b]University of Cyprus, Department of Architecture, 75, Kallipoleos str., 1678 Nicosia, Cyprus

[*]Corresponding author. p.fokaides@frederick.ac.cy (P.A. Fokaides).

Abstract

Buildings' passive solar energy utilization is based on the absorption of solar radiation by the building interior, as solar radiation penetrates through the glazed elements, or by the building shell per se. The quantity of absorbed solar energy depends on building's shape, the orientation of its exposed surfaces to radiation, the shading equipment and the absorption coefficient of the concerned surfaces. This study introduces a novel approach that enables the optimal design of a building shell based on the optimization of its solar exposure. Non-linear programming (simplex algorithm) was used for determining the optimal building geometry. The objective function considered was related to the optimization of building's solar heat gain. The optimization constraints represented a list of morphological and seasonal restrictions expressed as non-linear functions. The cumulative seasonal and annual solar exposure of the considered building was resolved by employing the methodology described in the EN ISO 13790:2008 standard. The investigated subject was a single story, convex quadrilateral detached dwelling with one pair of parallel sides. The calculations were performed for two typical meteorological years (TMY) of two European cities, each one representing dense populated latitudes of the European continent, with summer and winter dominant weather conditions. The results of this study are expected to contribute to the establishment of a parametric design procedure aiming to the optimization of building's annual and seasonal solar exposure, based on specific design inputs.

Keywords: Environmental design, solar heat gain, Simplex algorithm, optimisation.

Nomenclature

Symbols