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## MULTI CRITERIA OPTIMIZATION OF LOW-RISE DETACHED HOUSE HEATING SYSTEMS IN AN ATTEMPT TO MINIMIZE ENVIRONMENTAL DAMAGE AND MAXIMIZE COMFORT OF USE

**Abstract:** This paper analyzes the process of multi-criteria optimization in Design Builder software. The analysis is oriented on the process of achieving, analyzing choice of an optimal solution for the specific case of a low-rise detached house project. Presented are, the criteria for optimization and used parameters. This research verifies the assumption that it is possible to minimize price, damaging effects on the environment and discomfort in housing units, which is proven by the results of this research.

**Keywords:** multi-criteria optimization, Design Builder, discomfort, CO<sub>2</sub> emissions

### 1. INTRODUCTION

The modern approach to projecting and building of low-rise detached housing units includes predictions of behavior and optimization in realization. With this in mind it is necessary to include the optimization process in developing solutions of these objects. Besides this approach it is necessary to implement new energy sources- renewable resources with a goal to increase all positive effects while at the same time minimizing negative effects. This at the same time represents the analysis thesis of this paper.

Up to date in various optimization methods have been used in research of heating systems as well as other parameters which influence the heating system. In order to achieve the highest possible thermal comfort in a house, the type of heating is very important, [1]. In paper [2] the same authors researched ventilation systems, using COMIS software. With heating efficiency aside from ventilation and heating systems the

organization of the floor plan also has a large influence, [3]. The goal of this type of research is to have the house be close to achieving a zero-net energy use as much as is possible under external conditions, [4]. A very important aspect of achieving good results is accommodating the house to its climate region and based on that planning the use of electrical energy, [5,6]. Combining all these parameters into a single-criteria or multi-criteria optimization is possible in Design Builder software, [7]. This software package enables optimization and calculation of costs of building an object, as well as all necessary installation which it may contain.

For the purposes of this research an analysis and calculation of the projected object was performed, as well as a multi-criteria optimization, solar panel systems for producing electric energy and heating water (PV panels and solar collectors) and lastly a comparison of results was performed. Based on this comparison conclusions were drawn with an idea to









