

Miloš Matejić<sup>1)</sup>  
Milorad Bojić<sup>1)</sup>  
Nenad Petrović<sup>1)</sup>  
Nenad Marjanović<sup>1)</sup>  
Mirko Blagojević<sup>1)</sup>

1) Faculty of Mechanical  
Engineering, University of  
Kragujevac, Serbia  
{mmatejic,bojic,npetrovic,  
nesam,mirkob}@kg.ac.rs

## COMPARATIVE ANALYSIS OF ALTERNATIVE SOLAR COLLECTORS FOR LOW-RISE HOUSING UNITS

**Abstract:** Thanks to modern technological advances, a large number of various solar collector types have been developed to date. They vary in their exploitation characteristics, dimensions, mass, efficiency and of course price. Within this paper, for set roof surfaces, various types of solar collectors were used. Calculations of their installed and exploitation characteristics have been performed. Following the calculations an installation possibility analysis was performed to accommodate the fact that the collectors vary in their exploitation characteristics, dimensions, mass, efficiency and of course price. This paper also presents results of solar collector comparisons as well as directions for choosing an optimal solution.

**Keywords:** solar collectors, comparative analysis, domestic use, low-rise housing

### 1. INTRODUCTION

The total amount of energy on the earth, except for geothermal, nuclear and fossil fuel energy comes from solar radiation. From the total amount of solar energy which reaches our planet around 30% is reflected from the atmosphere, while the rest is absorbed through it. Direct solar radiation energy can be used through its transformation to heat, electric or chemical energy. Of the aforementioned types of energy the easiest transformation to achieve solar energy to heat energy. Installations which achieve this energy transformation are called solar collectors. Dependent on the construction and method of collecting solar radiation energy, there are flat and focusing solar collectors. Flat solar collectors can reach temperatures of the working fluid of up to 100<sup>0</sup> C, while focusing solar collectors can heat the fluid up to 3000<sup>0</sup> C. Flat solar collectors are more widespread in use.

As a widely used, solar collectors represent a very current and attractive research subject in the field of renewable energy sources worldwide. As a result of research in this field various types of solar collectors have been developed: flat solar collectors with parallel tubes, flat solar panels with serpentine tubes, flat solar collectors with serpentine tubes between two plates, and solar collectors with vacuum tubes.

A very important characteristic in the

efficiency of a collector is its position relative to the direction of solar radiation. Tand et al. [1], made a comparative analysis of vacuum solar collectors by measuring their efficiency according to their tilt angle towards the sun. Chen et al. [2], have made a comparative analysis of flat solar collectors with parallel tubes which have the same tilt angle. The difference between the compared flat solar collectors was in the cross-section of the tubes which transported the work fluid. Smyth et al. [3] compared various vacuum solar collectors on which various types of sleeves were installed. Zhang et al. [4] tested vacuum solar collectors with and without a heat shield. Fong et al. [5] made a comparative analysis between building integrated solar collectors and classic roof collectors. Ayompe et al. [6] experimentally compared flat solar collectors with parallel tubes and vacuum collectors for domestic water heating use. The same authors [7] tested flat solar collectors with parallel tubes as a better solution for domestic use. Azad [8] made an analysis of three types of solar collectors built into the same installation with the same exploitation conditions. Ceron et al. [9] conducted a numerical analysis with various versions of flat solar collectors which had parallel tubes above the absorber plate. In Serbia, a study of the amount of solar radiation was made, [10]. This study was done for the area of the Autonomous Province of Vojvodina.

In this paper a comparative analysis of two









