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SERBIAN ZNEB AND PNEB - OPTIMIZATION OF ENERGY CONSUMPTION

Abstract: Today, significant part of the total energy consumption is related to the building, so research and development of methods for improving energy efficiency in buildings are very important. In this paper it is investigated the Serbian residential building with photovoltaic panels and solar collectors on the roof in order to achieve the concept of ZNEB (zero net energy building) and PNEB (positive net energy building). The building with district space heating is analyzed. Energy optimization (including embodied energy) was performed with the major aim to determine the optimal area of the PV array and solar collector area on the roof. The residential buildings with variable thermal insulation thickness, variable electric energy consumption and variable domestic hot water consumption are investigated. The buildings are simulated in EnergyPlus environment. Open Studio plug-in in Google SketchUp was used for buildings design, Hooke-Jeeves algorithm for optimization and GENOPT software for software execution control. The obtained results gave the optimal size of PV array and solar collectors system. With these optimal sizes, the concept ZNEB and PNEB can be achieved.

Keywords: ZNEB; PNEB, Photovoltaic; Solar collector; Optimization.

1. INTRODUCTION

In recent years, question of energy security and stability has become the cardinal question of the entire world economy, economic and social system. EU in addition to its high level of development and evolution of its own relationship to the energy efficiency and energy security, are also faced with a problem of reducing the global warming due to the growing use of fossil fuels. In the energy sector, the most important mechanisms for the fight against climate change are generally known - increasing energy efficiency and the introduction of renewable energy sources in the production, transmission, distribution and satisfying energy needs.

Renewable energy sources are inexhaustible energy sources and have an important role in reducing emission of carbon dioxide into the atmosphere. In the future, solar energy will be very important as a form of clean and renewable energy, especially because of the prevention of the serious consequences of global warming. Solar energy can be directly transform into electricity by PV array, or can be transformed in heat energy in solar collectors. On that way, solar energy may be used for heating, cooling, lighting and electric equipment in the buildings.

In Serbia, the building sector consumes more 40 - 50% of the total used energy [1]. An intention of our country to become a member of EU obliges us to reduce the energy consumption by 20% and to obtain 20% of total energy from renewable energy by 2020 [2]. To achieve these goals, some advanced energy concepts for built environment should be applied such as a zero-net energy building (ZNEB) and a positive-net energy building (PNEB).

Many of scientists defined ZNEB, PNEB, and NNEB in the past decade [3, 4]. By definition, ZNEB produces all energy it consumes during year, PNEB produces more energy than it consumes during year, and NNEB produces less energy than it consumes during the year [5, 6].

In this paper, energy consumption is analyzed for a residential building with PV array and solar collectors installed on the roof - Figure 1 [7]. Residential building with district heating system is

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