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The Possibility of Energy Saving in Interior Lighting Using the New Type of Lamps

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Abstract: The paper presents the results of measurements of illuminance level and analysis of possibility of electrical energy saving in the interior lighting of one educational institution. The measurements of illuminance level were carried out in the typical medium size lecture rooms because they are present in the majority of faculties and high schools throughout the country. The lecture rooms analyzed are of about 80 m² area with 82 sitting places. The level and spatial uniformity of illuminance level were calculated. The values obtained were compared with the recommended values of optimal level of illuminance according to the rules and regulations in Western Europe and Serbia. The results show that the illuminance level does not meet requirements of standards. This paper proposes several energy efficient solutions to a problem of low-level illuminance in classrooms. The analysis of improving the quality of the lighting was done in DIALux software tool where the replacement of existing fluorescent lamps with new fluorescent and LED lamps was analyzed. The results show that the proposed solution can achieve a reduction of total electrical power of installed lamps and electricity consumption up to 44%.

Keywords: energy efficiency, quality of lighting, illuminance level, DIALux software tool.

1. Introduction

The electrical energy consumption is in great increase related to other energy categories, first of all due to its efficacy and cleanliness. Total electrical energy consumption for electrical lighting on the global level is about 19% of overall consumption, because all over the world over 33 billions of lamps are in use and they spent about 2650 TWh of electric energy [1-2]. Nearly 43% of energy consumption for lighting belongs to commercial sector, what accounts about 1133 TWh. About 31% is related to lighting in the residential sector, namely, 811 TWh, as 18% is distributed to industrial sector, about 490 TWh. Eight percent spends to outdoor lighting. In 27 European Union countries share of electrical energy consumption for lighting is lower than in the global level and amounts 14% [1].

It is to be noted that some luminaires present highly inefficient consumer. Incandescent bulbs converse only about 5% of electrical energy in the visible light, as remainder part of energy transforms itself to heat. Compact fluorescent lamps are characterized by about 20% of efficiency. In order inefficiency to be presented, we can compare electrical lamps and bulbs with other household appliances. For example, electrical heaters, washing machines, and toasters converse electrical energy into heat with efficiency of 70%. Electrical motors of hear fans are of 90% efficiency. This way, it can be seen that electrical lighting is very inefficient and that consumes a lot of energy. Accordingly, in this field great amount of energy can be saved, maybe more than in any other energy sector [3].

In this paper three cases are analysed for electrical energy consumption reduction. The analysis is related to five classrooms in Faculty of technical sciences in town Čačak. Two goals are of main concern, namely reduction of electrical energy consumption, and improving of lighting quality. The DIALux software tool, made by DIAL [4], is employed. In the second section, current state of quality of lighting in one of the classrooms is presented. Namely, results of illuminance level measurement at some points in the classroom are shown. In the third section, parameters of rooms (dimensions, wall colours, reflection of walls and ceiling, furniture in classrooms, etc.) implemented in DIALux software tool are presented. Section four presents results of numerical simulations done by DIALux, for three analysed cases. Layouts of classrooms, isolines of illuminance level, average value of illuminance level, uniformity factor of illuminance, and displacement of luminaries in the classrooms are shown. The fifth section deals will installed total electrical power of luminaries in all three cases, as well as per cent reduction of electrical energy consumption on the yearly basis.

