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COOLING FINS SHAPE OPTIMIZATION OF LED LUMINAIRE BODY

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ABSTRACT

Industrial applications of LED (light-emitting diode) technology for the streets, terminals, stadiums etc. luminaires are taking more and more important role in lightning industry. Even though LED luminaires are much more energy efficient than traditional lighting however these luminaires are exposed to high temperature influence. In this work the luminaire body cooling is investigated at variable environmental conditions such as wind speed, direction and ambient temperature. Properties of the cooling fins of luminaire body are investigated using FEA models as well as appropriate metamodels. Numerical procedures of the cooling fins robust shape optimization will be discussed in details.

Keywords: LED luminaires, finite element analysis, metamodeling, shape optimization.

INTRODUCTION

Nowadays very actual is LED luminaire usage in different industrial and infrastructure applications. LED luminaries must be not only highly energy efficient but also up to quality lightning parameters and with high electrical and mechanical safety. Luminaires must work in the specified temperature limits to warranty the stable and qualitative light flow. It is very important to ensure LED's with appropriate cooling to increase their lifetime and lightning quality.

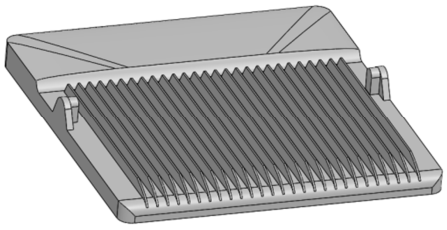


Fig. 1 - Flood light luminaire

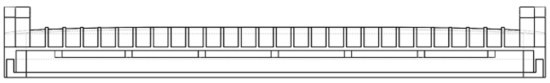
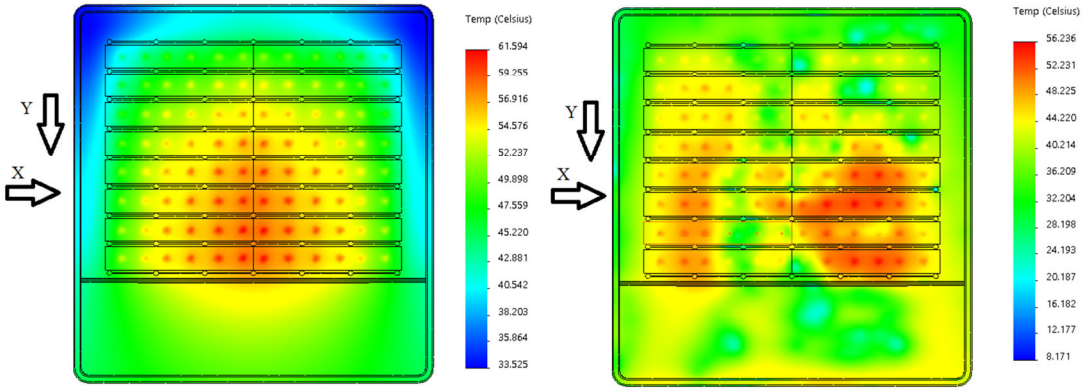


Fig. 2 - The initial shape of cooling fins

In this work the flood light luminaire (Fig.1) cooling fins are designed. LED's cooling is analyzed at maximum power (750W) and different environmental conditions - wind speed, direction and ambient temperature. FEA is used to evaluate temperature responses of the luminaire body for different parameters and initial shape of cooling fins (Fig.2).

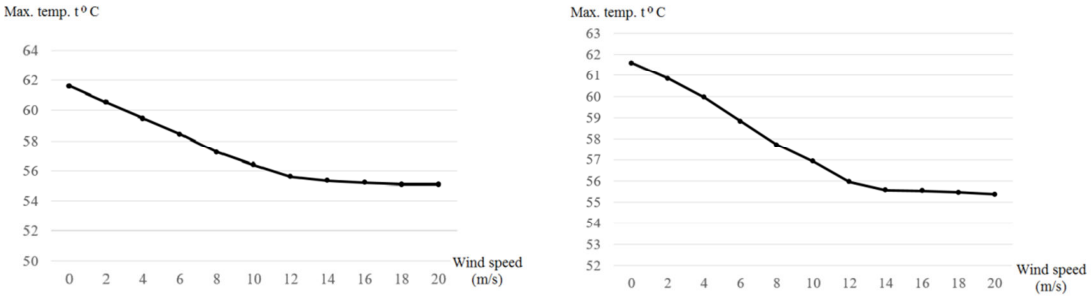
PROCEDURE AND RESULTS OF OPTIMIZATION

Dependence of temperature on LED's (Fig. 3a, 3b) from different wind directions and speeds are found using FEA. Thermal analysis shows that wind direction has a significant effect on luminaire cooling at ambient temperature 20^0C. Wind in *x* direction (Fig 4b.) ensures better cooling than wind in *y* direction (Fig. 4a.). The obtained results are used for metamodel based shape optimization of the flood light luminaire aluminum body cooling fins.



(a) (b)

Fig. 3 - Luminaire temperature for different wind direction



(a) (b)

Fig. 4 - Dependence of maximal temperature in luminaire body from wind speed

In work [1] shape optimization of construction has been performed considering strength parameters. For the LED luminaire it is important not only strength but also temperature characteristics. Using of metamodels allow taking into account the influence of variable environmental factors on designed mechanical element shape without time consuming computations. Developed methodology and software are successfully used for shape optimization of the LED luminaire cooling fins that allow giving practical recommendations for manufacturers.

REFERENCES

[1]-Janushevskis A., Melnikovs A., Janusevskis J. Robust Shape Optimization of Composite Structure Using Metamodels. Engineering Optimization IV - Chapter 121, 2015 Taylor & Francis Group, London, ISBN 978-1-138-02725-1, pp. 715-720.