

### Introduction

In order to identify suitable design changes which would improve thermal performance, ATS Europe used Future Facilities' 6SigmaET simulation software to simulate the existing LED replacement street lamp. The results were verified against experimental data obtained. Design modifications were made to the lamp's internal structure, with the outer casing unchanged.

### How Difficult Can LED Lighting Be?

LED lighting can be an effective method to reduce the operating cost of lighting systems. Reduced cost is achieved directly by reduced power consumption and indirectly by longer replacement intervals. This can typically be years instead of months as with traditional lighting systems. However, unlike traditional lighting solutions, LEDs have a maximum junction temperature of around 100°C whilst other lighting solutions are at around a couple of thousand degrees Celsius.

This means that for LEDs lighting, there needs to be an effective heat transfer path to the ambient air. Improving heat transfer is often associated with increased costs leading to a more expensive product. The challenge is to provide an effective cooling solution whilst being as cost effective as possible.

### The Street Lamp Challenge

A major cost of lighting a highway, provincial road or local street is the direct electrical cost; but the indirect costs can also be significant. These indirect costs include the cost of closing of a highway for routine maintenance of the lighting systems, the labour and equipment costs involved and the extra cost of unplanned maintenance of a critical lighting system. Direct replacement of a traditional street lamp with an LED based lamp with a much higher reliability and lifetime will have long term benefits for the local state and municipality. The challenge for a street lamp is in its environment and performance.

Lemnis Lighting B.V. asked its partner ATS-Europe B.V. to evaluate an existing LED replacement street lamp for design changes which would improve its thermal performance.

Since the lamp will be outside, it will need to have an IP rating of 66 (IP 66 or Ingress Protection Rating 66 is a standard which specifies a product's particle and water ingress protection) and this requirement for sealing the lamp means it's not easy to get cooling air to the hot LEDs. Where the performance of the lamp is related to its size, its weight will be of concern. If it is too heavy, it cannot be a direct replacement for a traditional lamp.

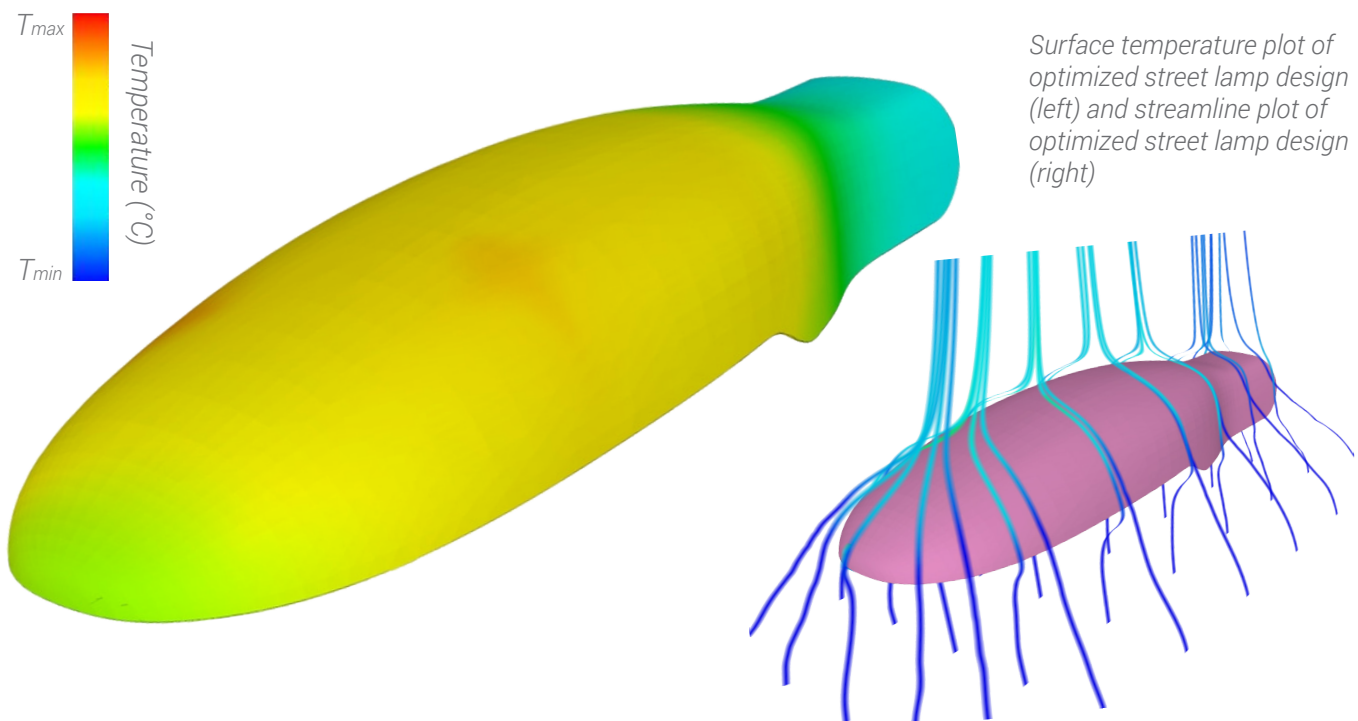
“6SigmaET allows for the rapid thermal evaluation of different designs... this is critical to the short term and long term success of our LED product.”

Norbert Engelberts  
Director, ATS Europe  
Optimal Thermal Solutions BV

## The Results

It was found that 6SigmaET was, on average, able to predict the heat sink temperatures within 5% of the experimental data. The infrared image of the top lamp surface was also comparable to that obtained by the software.

Through optimization of the internal lamp structure, the LED temperature was decreased by a maximum of 35% with an average of 19%. The improvements were made with only a 13% increase in the lamp's weight, which is within the acceptable range. This was all done without having to change the outside of the lamp - overall, a successful project.



*6SigmaET, a computational fluid dynamics (CFD) simulation tool, brings new levels of productivity to electronics cooling design. Thanks to its ease-of-use, it overcomes many of the problems that have plagued analysis tools from the beginning. Boasting substantial automation and intelligence, 6SigmaET is already being used by a global community of design engineers.*

ATS Europe provides leading-edge thermal management solutions to its European partners. ATS and ATS-Europe engineers have over 100 years of collective thermal management experience, 35 patents, over 70 professional publications, and receive continual requests for technical presentations at international and national conferences. Their engineers from across the globe collaborate to provide next-generation products and custom solutions to meet growing thermal management and packaging needs.