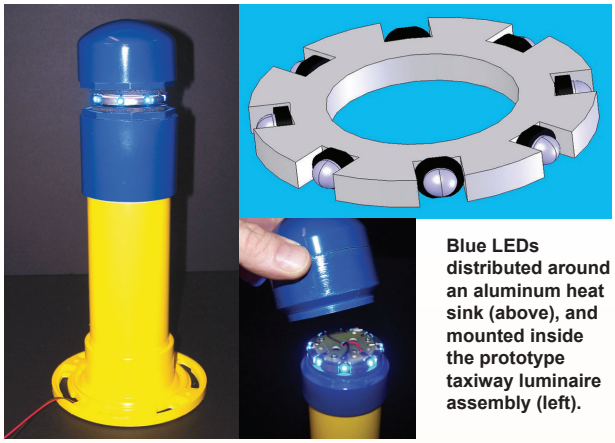
Building a Better LED Airport Taxiway Light

Blue taxiway luminaires guide airplanes between the runway and the airport terminal. Blue-colored optics made of borosilicate glass transmit mostly short-wavelength radiation, which makes traditional incandescent lamps a poor choice of light source; the resulting luminaire efficiency could be less than one percent. LEDs are replacing incandescent lamps in this application. According to U.S. Department of Energy estimates, 50 million kilowatt hours of electricity could be saved each year in the United States if all taxiway luminaires were converted to LEDs. But unlike incandescent sources, LEDs do not radiate enough heat to melt ice and snow from the luminaire's optics. To meet Federal Aviation Administration (FAA) regulations for weatherability, some LED-based luminaires incorporate electric heaters that, when switched on, reduce the energy-savings benefit of converting to LED sources.

The LRC explored new luminaire designs and methods of transferring heat from the LED junction to the optics for the purpose of minimizing snow and ice buildup—without needing heaters.

Design criteria

Nearly all commercial LED-based elevated taxiway luminaires mimic the designs of incandescent models with top-mounted glass domes. Yet there is no requirement for this design. All taxiway luminaires must meet FAA performance specifications in ambient temperatures ranging from –40°C to +55°C. LRC researchers investigated different luminaire assemblies to determine the one that could transfer heat to the optics most efficiently. They concluded that the most efficient design produced the lowest ratio of LED pin temperature (a good indicator of junction temperature, which correlates to LED life) over optics surface temperature.



Blue LEDs distributed around an aluminum heat sink (above), and mounted inside the prototype taxiway luminaire assembly (left).

Design solution

LRC researchers produced a novel prototype design that used several blue LEDs distributed around an aluminum heat sink. This design reduced the size of the optics surface as well as the path length for the heat to travel from the LED junction to the optics for melting ice and snow.

Laboratory tests at room temperature showed that the prototype met FAA photometry requirements. At 10 watts, the prototype was projected to produce enough heat to melt ice and snow at –40°C.

Conclusions

- LED junction heat can be used to raise the optics surface temperature to a level similar to that found in taxiway luminaires employing incandescent lamps.
- At a maximum 10-watt load, an LED solution can be achieved using metal components and no heater.
- If needed, during the summer the LED current can be reduced to save energy further and reduce the junction temperature to extend life.

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