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Upfront CFD Helps Displays Light up the World

By Bob Cramblitt
Principal, Cramblitt & Company

In Brookings, S.D., a town of about 19,000 people, big things are happening; things that touch millions of people in nearly 100 countries, from Liechtenstein to China to Brunei.

Brookings is the home of Daktronics, one of the world's largest suppliers of electronic scoreboards, computer-programmable displays, digital billboards and large-screen video displays and control systems.

Out of its 500,000 square-foot manufacturing and office facilities come the displays that show sports fans scores and video replays, advertise new offerings for all types of businesses, tout the stars appearing in Vegas nightspots and help drivers navigate highway systems. In the case of the Grand Lisboa Hotel and Casino in Macau, China, a Daktronics display is a calling card that heralds the excitement to be found inside.

COMPLEXITY BEHIND THE LIGHTS

Daktronics products require integration of complex multiple displays showing real-time information, graphics, animation and video. They have to be built to withstand all types of weather, to dissipate heat generated by LEDs, and look good even when directly opposite an unforgiving sun.

The tool that helps Daktronics analyze these complex factors early in the design process is CFdesign upfront CFD software from Blue Ridge Numerics. Over the course of three years, CFdesign software has become an integral part of Daktronics' product development workflow, giving the company a picture of how designs will perform before major commitments of time and resources are made.

"We use CFdesign in order to thoroughly understand complex electronics cooling situations and make comparisons among different designs before we start to build," said Shannon Mutschelknaus, thermal product development engineer at Daktronics.

BENEFITS VS. COST UPFRONT

A typical project at Daktronics starts with a Pro/ENGINEER model of the display. Native geometry from Pro/E is used by CFdesign to create the analysis model, eliminating the time-consuming translation process required for traditional CFD.

"The CAD/CFD integration is very important to us," Mutschelknaus said. "We want to spend our time exploring design options, not preparing files for CFD."

CFdesign is opened directly in Pro/E using controls within the CAD software's interface. Flow volume, volumetric boundary conditions, and material properties are assigned automatically. After that, all that is left is selecting flow and heat-transfer analysis options. CFdesign automatically generates the optimal mesh and provides access to initial simulation results within minutes.

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Thermally Conductive Epoxy for Electrical Potting

Master Bond EP37-3FLFAN is a thermally conductive and electrical insulative potting compound. It is an attractive choice for applications where a dielectric heat transfer adhesive is required. This two-part epoxy has physical strength properties and a high degree of flexibility that holds up well to radical temperatures up to 250°F and in cryogenic environments down to 4 K. The adhesive exhibits an impressive thermal conductivity of 25 BTU and a volume resistivity of 1 by 1,014 ohm cm, a high insulative capacity for an electrical potting epoxy. This thermal potting compound is formulated to cure at room temperatures and forms tough bonds that are resistant to shock, impact, thermal cycling and chemicals.

EP37-3FLFAN is a well suited potting system and encapsulation material because of its low viscosity and flow characteristics. The uniqueness of EP37-3FLFAN lies in the fact that this thermally conductive adhesive retains a high level of flexibility while having the desirable physical characteristics inherent in epoxies.

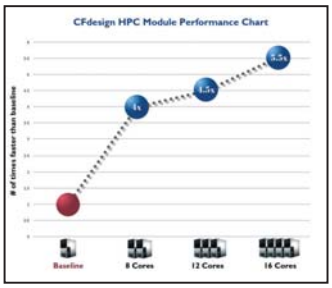
New Epoxy Material Offers NXP Semiconductor Cost Reduction And Material Standardization

Lord Corp., a supplier of thermal management materials, adhesives, coatings and encapsulants to the electronics industry has released a new epoxy adhesive/sealant. Developed for NXP Semiconductor, formerly Philips, the material, Thermoset MA-511, is a one-component thixotropic epoxy material designed for use as either an adhesive or a sealant in microelectronic applications requiring high-speed dispensing.

The material cures rapidly, offers suitable adhesion to a variety of plastics and its thixotropic rheology allows shape to be maintained after dispensing.

CFDesign HPC Module Accelerates Flow and Thermal Design Studies

Blue Ridge Numerics, Inc. has released a new module that design engineers can experience dramatic speedup of simulation time for complex flow and thermal projects using the latest CFdesign high performance computing (HPC) Module. The module allows CFdesign users to harness



the power and investment of their existing Windows HPC networks, whether in a data center or a smaller cluster environment. The module allows customers to conduct more design studies in less time and reduce the time it takes to achieve solutions for large complex models. Mechanical and product design engineers in either scenario described above will benefit from the decreased time required to optimize flow and thermal performance during the digital design phase, resulting in increased productivity and a more optimized final product design.

The CFdesign HPC Module serves companies across industries and with varying applications. The examples below exemplify the increased speed for simulations spanning natural convection, HVAC airflow patterns and drilling in the oil and gas industry.

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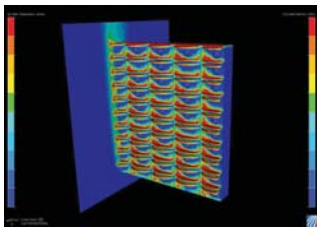


A natural convection, solar and electrical heating analysis generated by CFdesign software for a small section of a Daktronics display system.

For less demanding designs, Daktronics runs an airflow/ventilation analysis to compare different design options and optimize the airflow through the system. For designs incorporating complex thermal cooling systems, Mutschelknaus and his colleagues, Sunil Gaddam and Kurt Peters, run natural convection and airflow analyses. Associative data between CFdesign and Pro/E makes it easy to run a simulation, do a 3D design review, make appropriate design changes, and see the impact of those changes in minutes.

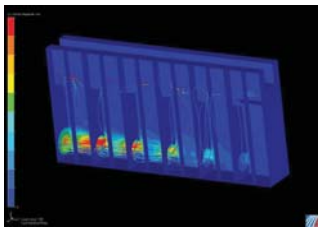
"We use CFdesign in the early stages of the design to compare benefits vs. cost for different combinations of components, fans, heatsinks, enclosures and materials," Mutschelknaus said. "With this information, we can narrow our options to two or three different designs that we'll physically prototype."

New solar loading functionality in CFdesign has also played a key role in Daktronics' design work. Solar loading depicts radiation through transparent media and even shows shadowing based on the sun's movement. Set-up is simple: specify the time of year, time of day, and location on the globe using a database within CFdesign or by assigning specific latitude/longitude coordinates, and click the mouse to see the simulation.

"Time-stepped solar simulation has enabled us to optimize display contrast by varying sizes and shapes of shading louvers on the display face," said Mutschelknaus. "It's another way that upfront CFD has helped us determine performance in the early design stages."

WIDESPREAD IMPACT

According to Mutschelknaus, nearly every project at Daktronics benefits from moving CFD upfront in the design process.



A CFdesign flow analysis of the inside of a Daktronics display. The supply and return from this unit are connected to a packaged air conditioning system.

"We've been able to make key improvements such as fan hoods with lower pressure losses, more efficient combinations of fans, tighter pixel pitches for outdoor use, improved display contrast, and reduced operating temperatures of electrical components. We've even been able to design some displays without ventilation fans."

Although Mutschelknaus acknowledges that upfront CFD has probably saved Daktronics substantial time and money, his focus is on the greater opportunities it has opened up.

"It has helped us engineer higher-quality products that are superior to our competition, break down existing design barriers and define realistic expectations of a product earlier in the design process."

At its core, breaking down barriers and defining realistic expectations are what good design is all about. At Daktronics, that translates into everything from the utilitarian football scoreboard at a proud Texas high school to the spectacular light show adorning the facade of the Grand Lisboa in China.

Bob Cramblitt is a technology writer who focuses on new developments and processes that make a definitive difference in how we work and live.

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