TDMG Newsletter July 11th, 2011

Volume 2, Issue 1

TDMG News by Bruno Zoccali, President TDMG Inc

The last year has been quite eventful at TDMG. After an expected slowdown in 2009 following the financial crisis, 2010 was the re-birth of R&D for many of our clients. Our work has been quite varied—here are a few examples:

- **Design of a wrist worn device for tracking children and the elderly**
- **Transient thermal characteristics of a thermistor sensor for monitoring height of fluid in grease interceptors**
- **Thermal analysis of conduction cooled communications equipment**
- **Thermal & structural analysis of acoustic devices for industrial and process applications**
- **Data center airflow analysis**
- **Airflow analysis of gravity ventilators for smelting application**

In addition TDMG has entered into agreement with a new business partner to strengthen its service offerings and increase market visibility. In April 2011, TDMG signed a business agreement with EDAForce to increase its marketing reach throughout Canada and North America. We are confident this new agreement will help us grow our business to new heights.

In this issue of the newsletter we will cover the following items: thermal interface materials, novel data center flooring system, and finite element stress & buckling analysis for a shelving rack. I hope you enjoy these topics. Please feel free to suggest anything else that may be of interest to you.

Novel Data Center Flooring System

TDMG has been working with Interstitial Systems to optimize the efficiency of their unique multi-level raised floor distribution system for Data Centers. Data Centers are used to house IT Equipment for everything from banking systems, to air traffic control centers. The last decade has seen tremendous increases in energy consumption by data centers, and now represent up to 2% of the world's energy consumption.

The high heat dissipation from this equipment means these rooms must be properly cooled to manufacturers' stringent specifications for proper operation and longevity. Typically, rooms have been cooled with very costly CRAC units around the perimeter of the room consuming valuable space that would otherwise be used by additional IT equipment.

Interstitial's pressurized system provides ventilation effectiveness, allowing owners to use much larger, more cost effective and energy efficient Air Handling Units located in an adjacent mechanical equipment room. TDMG has provided significant CFD data demonstrtaing the efficiency of the system in comparison to conventional single level floors, and helped to optimize the AHU's operation in a Central Station application, thereby, saving 46% of a specific 9,000 sq ft room's operating energy (over $300,000 annually).

For additional information please contact us or Interstiitial Systems directly.

- TDMG's News by Bruno Zoccali, President TDMG Inc
- Please ask us your questions and give us some newsletter ideas
- Let us know what you think about this newsletter

Inside this issue:

Interstitial System

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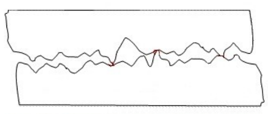
Surface Irregularity



“Thermal interface considerations can be very important in cooling of electronic equipment...the temperature difference is proportional to the heat flux; inversely proportional to conductivity; and directly proportional to thickness...the more localized the heat source the greater the temperature drop will be across the thermal interface.”

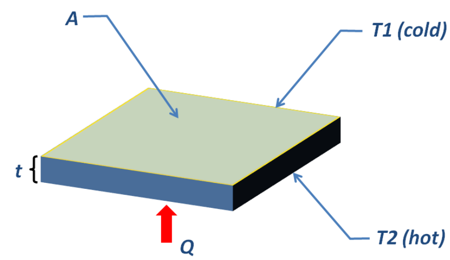
Thermal Interface Considerations

Thermal interface considerations can be very important in cooling of electronic equipment. Firstly why do we use thermal interface materials. As can be seen on the figure at the left, typical materials have surface irregularities which prevent perfect contact between faces. In such examples the simple solution is to apply a “grease’ type material which will fill those air gaps and provide better thermal contact between the faces.

But that is not the only reason for the use of thermal interface materials. For example, if we have one heatsink touching multiple components of different height, we could not guarantee contact on all faces unless the heatsink base was machined to match. Even then, the tolerances would make it such that we could still not guarantee perfect contact on all components. In such cases, we could use a flexible material that would allow the heatsink to fully contact each component while keeping compression loads to a minimum.

Once it is established that a thermal interface material is required, what is the effect of such a material. By definition, conduction heat transfer is defined as follows:

$$Q = \frac{KA}{t}(T2 - T1)$$



Where Q = Heat (W)
K = Thermal Conductivity (W/mK)
A = Area (m^2)
t = Thickness (m)
T2, T1 are the hot and cold temperatures
ΔT = T2—T1

We can rewrite the equation:

$$\Delta T = \left(\frac{Q}{A}\right) \times \left(\frac{1}{K}\right) \times (t)$$

So this tells us that the temperature difference is proportional to the heat flux (Q/A) in W/m^2or more commonly W/cm^2; it is inversely proportional to K conductivity; and directly proportional to t thickness. It is interesting to note the heat flux parameter which indicates that the more localized the heat source the greater the temperature drop will be across the thermal interface. To demonstrate the result of this, below is a table which provides temperature difference values under different conditions.

Heat Flux (W/cm2)	K (W/mK)	t (mm)	t (in)		ΔT (Deg C)	
15.5	6	1	0.039	pad	25.83333	100 W
15.5	6	0.5	0.020	pad	12.91667	2.54 cm x 2.54 cm IC
15.5	6	0.05	0.002	grease	1.291667	(1 in x 1 in IC)
62	6	1	0.039	pad	103.3333	100 W
62	6	0.5	0.020	pad	51.66667	1.27 cm x 1.27 cm IC
62	6	0.05	0.002	grease	5.166667	(0.5 in x 0.5 in IC)
4.65	6	1	0.039	pad	7.75	30 W
4.65	6	0.5	0.020	pad	3.875	2.54 cm x 2.54 cm IC
4.65	6	0.05	0.002	grease	0.3875	(1 in x 1 in IC)

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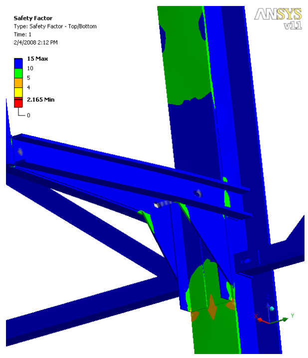
Finite Element Stress & Buckling Analysis for a Shelving Rack System

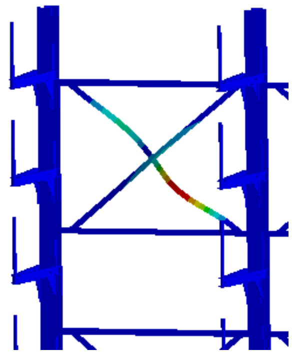
Finite element stress analysis is a very useful tool to evaluate the strength of any structure. In this case, a rack system was considered from both a stress and buckling point of view. The interesting thing about using finite element analysis (or simulation) is that problem areas can be readily identified and solutions implemented prior to building any prototypes, thereby increasing the likelihood of design success.

The structure was discretized using shell and beam finite elements. The loading is applied as per specification and the resulting stresses, deflections, and buckling loads are determined by analysis. The safety factors



can then be established locally to make sure that the structure is safe under the prescribed loading.

The buckling loads can also be investigated to ensure that such an event will not occur during the life of the system.



Should you have any questions regarding this type of analysis do not hesitate to call us or e-mail us.

> "Finite element stress analysis is a very useful tool to evaluate the strength of any structure…"

Give Us Your Feedback

We're looking forward to getting some feedback from you on our newsletter and any questions you may have for us. Please feel free to visit us on our website and leave us your comments on our newsletter page. Thanks for your attention and we look forward to the next issue of our newsletter.

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