

Datacentre Thermal Analysis at K8T Ltd:

An innovative approach to analysis and simulations

Overview

In recent years thermal analysis has become an important part of design, operation and upgrading of any datacentre. In some cases, thermal analysis means a detailed study that includes simulation of the facility using a complex Computational Fluid Dynamics (CFD) model. However, at K8T Ltd experience has shown that the detailed thermal maps generated by the CFD simulations are not always needed. Significant value can be gained from an intelligent review of thermal load and cooling airflows to instantly identify potential difficulties.

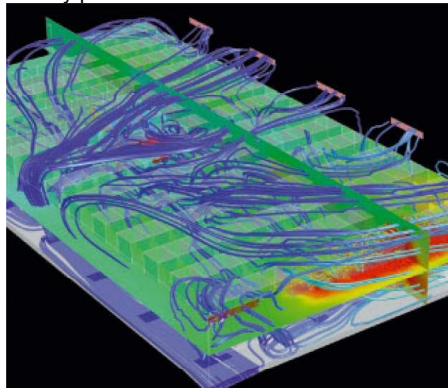


Fig 1. Typical CFD results indicate detailed flow paths and temperature profiles.

Thermal Analysis using CFD

CFD (Computational Fluid Dynamics) is an approach used to solve the fundamental equations for flow, pressure and turbulence within a geometrically defined region. Solutions take several hours or days to obtain using high performance serial and parallel computing facilities and the output includes detailed maps of flow parameters and temperature throughout the air within the datacentre. The value of this analysis is clear as the detail that is achieved is second to none but you are limited to analysing specific scenarios and you will typically try worst case and expected normal scenarios at a particular point in time. The results are rapidly outdated as usage profiles or equipment upgrades can change the situation in some cases daily. Some key issues associated with the CFD approach to thermal analysis include:

- Limited scenarios can be run. (You either need to continually rerun analyses or use judgement to assess that what is happening lies within previously solved ones.)
- Getting good data for the analysis. (Having a detailed knowledge of the thermal heat load in terms of the specified and actual usage is critical to having a good picture of what is happening. Poor data leads to

inconsistent results and incorrect decisions.)

- Wasted effort running and analysing scenarios that are little different from each other or that lead to obvious conclusions.

An innovative approach to thermal analysis

At K8T it is considered ineffective to continually rerun CFD models when only a few well-chosen ones are needed. The approach for undertaking a thermal analysis is summarised in Fig 2.

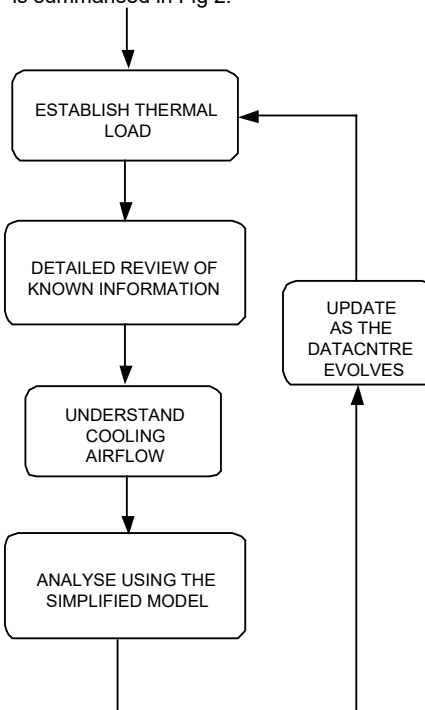


Fig 2. A systematic approach to thermal analysis of a datacentre

First the focus should be on understanding the inventory. This is needed to establish both rated and operational equipment heat loads which then allows the robustness of the analysis to be understood in relation to the current operating situation and potential for future additional heat load from using the inventory at full capacity.

The next step is to take advantage of any data available from commissioning or monitoring. This might be limited but in some cases the airflows in the datacentre can be very well mapped and it is not necessary to do detailed

airflow models if sufficient reliable measurements have already been made. The cooling airflow distribution is critical so an airflow CFD simulation can also be invaluable at this point to really understand the specific features of a datacentre. In particular we are looking to establish how well cooling is supplied to different equipment and different zones or regions. A number of simple analyses can then be undertaken and the air temperatures estimated around the datacentre based on the expected operational loads.

In this way, CFD becomes a tool for use on a regular but less frequent basis or for unusual or irregular scenarios. The simplified approach that maximises the value of both observed and simulated data provides the day-to-day thermal analysis needed in support of the datacentre facilities management.

Bespoke software to manage all data associated with the thermal analysis

To help in undertaking thermal analyses like this, K8T have developed K8Tram. This is a software tool used to manage the information needed for thermal analysis including any measurements and results. It can also be used to rapidly setup a detailed airflow simulation and summarise the important results when CFD simulation is needed.

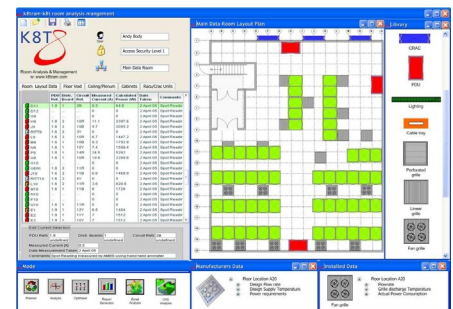


Fig 3. K8Tram software tool

K8T computational modelling services

K8T Ltd provides computational modelling services ranging from specific consultancy projects to bespoke software tools. Services are dedicated to providing a cost effective rapid response to specific troubleshooting issues or to address longer-term facilities development.

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