B&R Enclosures Pty Ltd

Managing Airflow in a Data Centre
Technical Paper

INTRODUCTION

Data centre manager's face daily challenges of ensuring their centres are run in a cost effective and productive way. Money spent on electricity charges or new equipment is closely scrutinised, and is expected to be minimised without negatively affecting the performance of the centre.

This paper discusses the most effective ways to manage airflow in a data centre. Savings can be made not only by optimising air-conditioning usage, but also by reducing equipment turnover. With these cost savings, data centres can become more environmentally friendly by drawing less power. Ensuring optimum temperatures are maintained in the centre also extends the life of equipment, saving costs on replacement.

WHAT ARE THE MOST EFFECTIVE WAYS TO MANAGE AIRFLOW?

Hot aisle / cold aisle containment

Designed to prevent air temperature zones mixing together in a data centre, hot and cold aisle containment increases cooling efficiency, while reducing power consumption. Organising a data centre in the traditional hot and cold aisle arrangement can reduce energy consumption by up to 20%[1]. Pairing this design with a containment system can further reduce energy use by an average of 16%[2]

In a cold aisle containment system, cold air is fed through a false floor into a contained aisle, as shown in Figure 1. This air flows into the front of the data racks, removing heat from equipment, and is expelled as hot air through the rear of the cabinet. Hot air is then removed by the data centre Heating, Ventilation and Air Conditioning (HVAC). This design reduces the possibility of hot air re-entering the system, and makes for a more energy efficient cooling system.

Hot aisle containment works to the same principles as cold aisle containment, however the rear of the server rack is contained. Hot air generated by equipment is drawn out through the floor, and cooled before re-entering the centre.

With the hot or cold aisle contained, the area requiring cooling reduces greatly in size. This ensures that less power is required by HVAC to keep equipment running at the desired temperature.

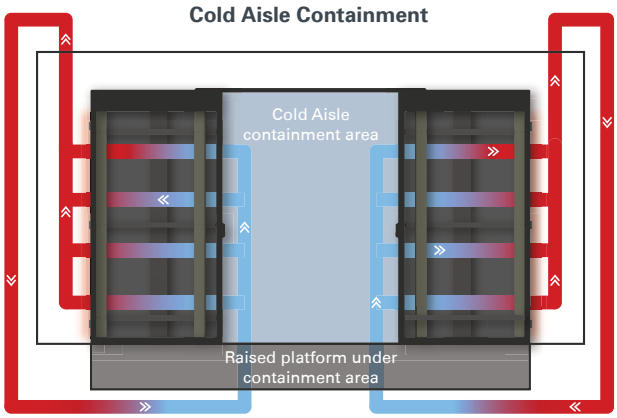


Figure 1: Cold Aisle Containment diagram

Blanking panels

Open panel spaces in a cabinet allow cold air to bypass equipment, reducing the efficiency of a data centre's cooling system. Air will follow the path of least resistance, flowing through open panel spaces, and reducing the volume of cold air that reaches equipment.

This can have a significant effect on equipment, especially in the upper racks of a cabinet. This equipment already experiences increased heat loads, as hot air rises from equipment below. Reduced airflow could cause the upper equipment to run too hot, shortening its life.

Blanking panels also prevent hot air moving back through the servers to the cold aisle. Where this happens, HVAC sensors in the cold aisle will report the temperature as higher than it is, making the air conditioner work unnecessarily hard to reduce the temperature.

Loading a cabinet from bottom to top and closing off remaining spaces with blanking panels will make a significant difference in a data centre. These improvements will reduce the volume of wasted cold air, and ensure equipment is cooled consistently.

Segregation Panels

Segregations panels serve the same purpose as blanking panels, but on a cabinet to cabinet scale. Installing segregation panels between cabinets ensures airflow runs from front to back through the rack, without contaminating the air in adjacent cabinets

This is especially important in multi-tenant environments, as it is essential to stop hot air from one entity's equipment affecting equipment belonging to someone else.

Mesh doors

Mesh doors are a basic yet effective way to improve airflow through server racks. Mesh doors allow air to flow freely through a cabinet, while maintaining a securely sealed enclosure. The ideal percentage of open space finds a balance between promoting airflow and maintaining security.

A key factor when choosing what percentage of open area is necessary in a cabinet door is pressure loss. Higher pressure loss through a cabinet door leads to less air reaching equipment, diminishing the effectiveness of HVAC. As shown in Figure 2, as the percentage of open mesh in a door increases, the pressure loss decreases with relation to impact velocity.

In most data centres, the air impact velocity on the door is approximately 1.5m/s. At this velocity, pressure loss through mesh doors can be up to 250Pa, depending on the percent of open area.

As seen in Figure 2, 63% open mesh doors will have a negligible pressure drop at these velocities. At 63% open mesh, the pressure drop has a very small gradient, meaning that even as the impact velocity on the mesh door increases, the pressure drop only grows a small amount.

Most Computer Room Air Conditioners (CRACs) generate more than 20Pa of pressure. As seen in Figure 2, this is more than enough to overcome the pressure drop at a 63% open mesh door with significant impact velocities in a containment situation.

In a data centre environment, a 15kW heat load in a 45RU cabinet would require 3500m³/h of airflow. This is equivalent to a 1.35m/s impact velocity, as shown on Figure 2. In a containment situation with a positive aisle pressure this will be more than the pressure drop of the doors and the equipment will receive sufficient airflow.

With such a negligible restriction to airflow, open mesh areas greater than 63% offer no real advantages. With 63% open mesh doors, data centres can ensure superior airflow is promoted, while maintaining high security enclosures.

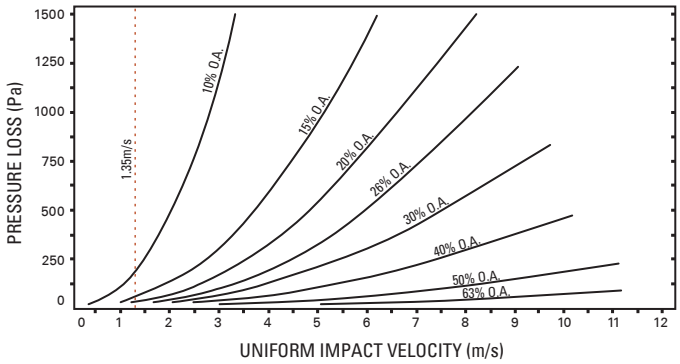


Figure 2: Pressure Loss vs Impact Velocity for Open Area (O.A.) Perforated Plates. (Source: Industrial Perforaors Association, 1993.)[3]

Intelligent PDUs

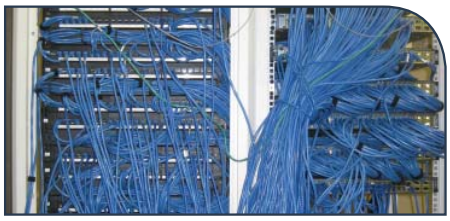
Intelligent PDUs, or iPDUs, are an essential accessory in a data centre. Monitoring temperature and humidity in a cabinet, iPDUs can locate hotspots, allowing data centres to implement solutions where needed. Using this information, data centres can also help identify the optimum running temperature of their HVAC.

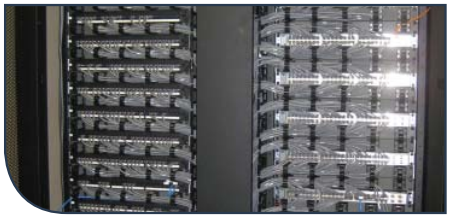
Fans for individual cabinets

Installing cabinet fans can help ensure sufficient airflow is maintained throughout a data centre. Fan kits can be installed in the roof and doors of cabinets. The number of fans able to be installed depends greatly on the amount of meshing available, as well as the size of the fan.

Three high flow door fans, capable of moving 1700 cubic metres per hour each, would be needed to cater for a 15kW heat load in a 45RU cabinet.

Before cable management





After cable management

Cable management

Keeping cables tidy and contained allows hot air to flow freely away from equipment. Without cable management, hot spots develop as air becomes trapped between equipment and cables, and isn't able to move with the airflow.

Using integrated cable management also presents a more professional image, and ensures cables don't become fatigued as they are weighed upon by a mass of other cables.

CONCLUSION

A combination of the controls discussed will ensure airflow is managed as efficiently as possible in a data centre. Working with these designs and products, data centres can save money and promote a green and sustainable working environment.

B&R Enclosures' team of experts have developed a wide range of Data ICT products. B&R can now offer a complete airflow management solution, from containment systems to Intelligent PDUs.

All B&R's data solutions are fully configurable to suit any application. Our technical sales team are available to assist when deciding what airflow management is required in your data centre.

References

[1] Tripplite. (n.d.). Rack Basics: Everything You Need to Know Before You Equip Your Data Centre. Tripplite.

[2] Collins, J. (2013, June 18). The evolution of design and data center cooling. Retrieved from Data Center Dynamics: http://www.datacenterdynamics.com/critical-environment/the-evolution-of-design-and-data-center-cooling/80398.fullarticle

[3] Industrial Perforators Association. (1993). Designers, Specifiers and Buyers Handbook for Perforated Metals. Industrial Perforators Association.

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