BEATING THE HEAT IN DATA CENTRES (THE GREEN WAY)

Data centres, like all buildings, can also be sustainable and energy efficient.
Data centres are buildings dedicated to housing computer systems and associated components, such as telecommunications and storage devices. In recent years, sustainability concerning energy use in data centres has become a growing concern. According to energy efficiency expert Mr Anders Andrae, Principal Architect of Huawei Technologies in Sweden, data centres consume about 2 percent of all electricity worldwide. This figure could rise to a global total of 8 percent in 2030.

In Singapore, studies done by the National Environment Agency in 2010 estimated that the total electrical energy usage of data centres is 3.6 percent of Singapore’s total electrical energy consumption. The energy consumption demand of data centre buildings is estimated to grow to 2,260 GWh by 2015, which is a 51 percent increase over 5 years. In 2020, these figures could only be even higher.

Real estate consultancy firm Cushman & Wakefield also ranked Singapore as the third most robust data centre market in the world, jumping four spots from seventh place in 2017 to third, while retaining the top spot in the Asia Pacific region. This suggests that energy consumption by data centres in Singapore has been increasing and will continue to increase in the years to come.

There are many reasons as to why energy consumption in data centres is at an all-time high. Trends such as 5G, Industry 4.0, mobile internet and internet TV have led to an ever-increasing demand for data. This in turn has led to a constant need to upgrade equipment and expand data centres. In addition, instant retrieval and access of data have now become a default expectation. As a result, data centres have to be in constant operation. Therefore, it is of no surprise that data centres expend large amounts of energy and generate an immense amount of heat at the same time. In fact, ventilation systems can account for up to 35 percent of energy use in data centres and energy used by fans contributes to a large portion of this statistic.

There are many ways to ventilate a data centre. As there is no standard in the design of data centres, the design of ventilation systems within them vary as well.
FACILITY COOLING

In the FanGrid configuration (Fig. 1), multiple centrifugal fans operate in parallel to ensure the necessary inflow with a high level of efficiency.

Powerful and efficient axial fans that operate in parallel are the perfect choice for the controlled exhaust (Fig. 2). Diffusers can be mounted to provide an additional reduction in noise levels and higher efficiency.

SERVER RACK COOLING

Powerful compact fans, typically available in axial, centrifugal or diagonal configurations, are used to keep server racks (Fig. 3) cool.

AREA COOLING

For data centres in particular, fans on condensers have a high duty cycle. They are usually found in data centres of various sizes.

In area cooling, Computer-Room Air-Conditioning (CRAC) units (Fig. 4) are of particular importance. CRAC units should be capable of maintaining constant temperature and humidity levels. Ideally, they should also be energy efficient, so as to reduce costs in operations.

But wait – there’s more. Keeping the (often sensitive) information secure is of utmost importance. The type of data stored encompasses all facets of modern life. This includes, but is not limited to, credit card information, banking transactions, cloud data and websites.

For data centre owners, losing any amount of data can be devastating. This can occur in a multitude of ways, such as security breaches or the overheating and subsequent spoiling of equipment. Therefore, reliable ventilation equipment is of paramount importance.
CONVENTIONAL FAN DESIGN & ALTERNATING CURRENT (AC) MOTORS

In older data centres, AC belt-driven fans (Fig. 5) are used. Belt-driven fans, however, are susceptible to the accumulation of dirt particles. While filters can lessen the impact, this then leads to the need for constant maintenance, where old belts and filters are replaced with new ones.

New technologies, such as the fans from ebm-papst, are able to resolve such issues and improve energy efficiency at the same time.
MODERN FANS & ELECTRONICALLY COMMUTATED (EC) MOTORS

Fig. 6

EC technology is the latest motor technology available that can meet the high efficiency standards of today. EC motors have a higher performance that spreads across a wider operating point. In contrast with traditional AC motors, they are extremely efficient, especially at reduced speeds.

The EC fan comprises of an integrated system (Fig. 6). It contains (a) Conversion Electronics, (b) Speed Control Electronics, (c) Stator and (d) Rotor. There are a few reasons why EC technology saves more energy as compared to AC.

Soft-Start (Fig. 7): When switching an AC motor on, it reaches its peak power rating before tapering off to the desired power level. In contrast, for EC motors, a soft-start occurs before it elevates to the desired power level.

Power is proportional to revolutions/min$^3$

Variable Speed Control (Fig. 8): In AC motors, there are limited speed settings. This results in energy use that is not necessary. In contrast, EC motors can regulate energy use based on the conditions of the environment, resulting in improvement in energy efficiency.

An immense amount of research and development was necessary to develop these efficient technologies. Refinement in other aspects of the fan, such as the impeller, further improves the performance and thus efficiency of the equipment. The combination of all of these factors in EC fans (Fig. 9) thus results in much lower energy use compared to conventional/AC ventilation equipment.

Fig. 8
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Thirty meters beneath Stockholm’s tranquil Södermalm district is one of the most secure – and extraordinary – data centres in the world. In a retired fallout shelter called Pionen, data centre operator BAHNHOF stores its customers’ data behind steel doors that are 50 centimetres thick.

Previously, this James-Bond-inspired data centre utilised inefficient belt-driven AC fans in their CRAC units. ebm-papst Sweden was tasked to modernise Pionen’s ventilation system.

In the upgrade, the CRAC units were retrofitted with ebm-papst’s EC centrifugal fans, also known as the RadiCal (Fig. 9). These are low pressure fans with backward-curved blades.

In total, the upgrade saved BAHNHOF 275 megawatt-hours of energy annually. It spends about 40,000 euros less on its annual electricity bill. In addition, there is no longer a need to conduct frequent maintenance as the EC fans do not use a belt-driven system. With this upgrade, not only did BAHNHOF save on operation costs, they also took a step forward in keeping their operations as eco-friendly as possible.

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