Thermal destratification, the missing link?

5 August 2012

John Brodie, Vim Sustainability Pty Ltd

26 July 2012 – The current scramble for energy saving options in buildings has seen a plethora of solutions being considered such as LED lighting, efficient airconditioning systems, sub metering, variable speed drive units and improved building fabrics The use of any or all of these options will improve the resource footprint of a building resulting in lower costs to the building owner or occupier.

Strangely enough, one of the simplest carbon and energy reduction initiatives to implement in both existing and new facilities is thermal destratification or thermal equalisation of spaces. Yet in Australia there is scant use of this simple but effective initiative. Rated by the Carbon Trust UK as one of the top three carbon reducing initiatives in any type of building thermal destratification is conspicuous by its absence in Australian as a carbon solution for the built environment.

In all buildings cold air falls, pushing hot air up; in winter all of the hot air in our buildings is sitting up under the ceiling or roof, – where it is of no use to anyone – and in summer the cold air is pooling down on the floor area, where is it keeping your feet cool but not much else.

This is thermal stratification.It is also found in water – so when we swim in pools or lakes we notice the warm water is at the top and the cold water is at the bottom. Thermal destratification is undoing that situation by using a specific type of fan design to move that hot to cold air or vice versa to where it is needed – that is, where the building users are.

In conditioned spaces the airconditioning typically over delivers either heating or cooling to compensate for the stratification phenomenon in order to provide “comfort”’ at 1.5 metres high, where the inhabitants reside. This costs a lot of money and creates a lot of carbon.

In winter, the heat up under the ceiling, can be up to 14 deg C higher than the temperature at floor level, depending on floor to ceiling height (See Building Services Research and Information Association accessed 20.7.12). This heat is also increasing the Delta “T”, http://wiki.answers.com/Q/What_is_DELTA_T, between inside and outside, accelerating the rate of hot air that escapes through the roof in winter. That is heat you could be capturing and reusing free of charge.

Now mechanical engineers will argue that good airconditioning design will ensure there is no stratification in spaces but the success of specific thermal destratification fans (such as the patented AirPears®, http://www.theairpear.com//) across America, Europe and the United Kingdom indicates differently.

Ceiling fans can't destratify very well as they aren't designed to move the air very far.) In the UK major retailers such as Morrisons, Tescos, Sainsbury's and John Lewis, just to name a few, are utilising thermal destratification because it saves them significant amounts in operational heating and cooling energy. It removes hot and cold spots across their stores while also ensuring the freezing cold fridge aisles become warm and comfortable (measurably increasing dwell times and removing condensation from fridge doors, quickly drying up floor spills and issues such as condensate drainage) with no impact on fridge or open freezer cabinet performance (Morrisons, 2007, showedreduced temperature stratification in chiller aisles from 6-8 Deg C to 1-2 Deg C. www.airius.co.uk). Morrisons now specify thermal destratification in all stores.

Thermal destratification units are pushing air around the building at a significantly lower energy cost than the airconditioning system. This improvement in airconditioning efficiency is exemplified by anecdotal evidence from Waitrose, a major British retailer, indicating that the use of thermal destratifcation fans can reduce the capital cost of new air conditioning in their stores by 30 per cent. Plus measurably reduce the running costs of that system.

The United States Navy did its own research and found a simple payback of 5.2 years with 40 per cent reduction in energy savings in two facilities using thermal destratification fans. (International Energy Agency, April 2010, http://www.iea.org/)

Enough horse power can move large quantities of air anywhere. The trick is to move large amounts of air with little amounts of horsepower. For thermal destratification to be effective units need to be specifically designed to silently move large amounts of air in a directional flow using extremely low amounts of energy. This maximises efficiency as the air can be directed accurately to where it needs to go and ensures there is no energy being wasted creating circular air motion as is common with typical ceiling fans or airconditioning fans.

The way these thermal destratification fans work is through the use of a patented multi vane "stator" design situated at the outlet of the fan that "corrects" the circular flow of air coming off a rotating fan and transfers it to columnar laminar flow with increased throw distance in whatever direction you are pointing the nozzle of the fan. The velocity of the air column induces surrounding air to entrain in the column, effectively multiplying the air turned within the space. The non-turbulent air column continuously moves towards the floor where it impacts and is distributed radially to thermally equalise a space.

These features account for some of the remarkable returns on Investment noted by overseas users. Some customers advise around three months' payback (Impress Metal Packaging, UK, 2011 advised it saved $100,000 for an outlay of $35,000 in three months in investments and energy savings on heating and cooling by up to 50 per cent.

In addition, thermal destratification provides great value in summer as it gently and economically moves air around a space without turbulence, significantly increasing the efficacy of the airconditioning system and user comfort so that set points can be raised or lowered depending on the season, or the airconditioning will simply be required less and less. System cycling is minimised, which also means less maintenance. In addition the cold air pooling down at ground level is bought

up to body level meaning the airconditioning is not over delivering to compensate for this. The hot air sitting overhead, which impacts negatively on comfort, is minimised by mixing it in with the cooler air from the floor improving comfort. (American Society of Heating, Refrigerating and Airconditioning Engineers, http://www.ashrae.org)

Thermal destratification works in so well in existing buildings and new buildings because it is very easy to retrofit or install, resulting in easy and very low purchase and install prices. It is as simple as installing a new light fitting. Wire them in, hang them from the roof or install in the ceiling using a special ceiling kit and turn them on.

Prices start as low as $500 with around 12 watt power consumption. As they use such low power they can be run all year round. There is no commissioning or detailed design engineering required resulting in a low-cost, no-maintenance outcome. No structural supports or engineers inputs are needed as the units are very light (4-20 kilos) depending on the size of the unit, are compact and require little or no maintenance (subject to brand and type).

Also there are no rotating blades like in ceiling fans that can be seen or accessed by the occupant. All is hidden in a small self-contained unit ensuring minimal cleaning or safety issues. Plus the impact on ceiling spaces and layouts is a lot less than with traditional ceiling fans.

The concept is also very effective in non-conditioned spaces such as warehouses where people complain of being cold in winter and all the heat generated by machinery and people is sitting up at the roof. Bring that heat back down cost effectively and you have provided heating in your facility for almost no cost. Circulate the air gently and cheaply in summer and you once again improve the comfort of the user. In addition the surface and air temperature in a space is equalised, also improving thermal comfort.

Take indoor pools for example. In these types of facilities thermal destratification fans have shown to measurably reduce the pool heating costs as well as remove condensation on the surfaces while also removing toxic chlorine gas from the water surface in chlorine based pools. In greenhouses it has a great impact on plant growth and flowering while reducing heating costs. It can be used to change the cycle of flowering in green houses, resulting in produce being offered outside normal supply seasons which can mean a higher sale cost for the supplier.

The key to thermal destratification is ensuring you have a unit that can direct the air flow so the very top and very bottom room temperatures are mixed in controlled fashion, using very low powered motors. This also means you can direct the flow of air to where you want it. A normal fan won't do this. It uses a lot more energy and can't push the air in a single direction for any distance. It will just turbulently mix the air where it is turning. To be effective you need to consider a true destratification fan system.

The final clincher for thermal destratification is that is applicable to almost every style or type of retrofit or new building application from single stores such as chemists, hospitals, supermarkets, retail complexes, manufacturing plants, defence facilities, hotels, atriums, schools, warehouses, offices, aged care projects,. pantechnicon trucks, football stadiums, gymnasiums, picture theatres….the list is endless. All for a low install and running cost resulting in proven paybacks.

In a recent retrofit trial in a major 6000 square metre retail store in Australia running 60 odd units all year round costs around $1200 a year when they have a heating and cooling bill of around $100,000 per annum. With an overall cost of $70,000 to supply and install and overall energy bill savings of even 20 per cent there is a 3.5 year payback. This doesn't account for indirect costs such as longer lamp life as the ceiling level temperature is lower, reduced aircon maintenance, and the removal of uncomfortable hot and cold spots in the store.

If you think about it, thermal destratification is a simple concept that makes a lot of sense. It is surprising that this simple solution hasn't been implemented in Australia to any great degree. If you have a building where heating and cooling cost a lot to run or you are trying to condition huge spaces or even make non conditioned spaces comfortable in a cost effective manner it may be worth looking into this.

If your airconditioner needs replacing it may be cheaper to install and run thermal destratifcation fans and use them to assist your airconditioning system. If you implement it you may save a lot of money and save significant amounts of carbon too. You will….remove the missing link!

John Brodie is managing director, Vim Sustainability Pty Ltd, http://vim.net.au/

© Copyright The Fifth Estate Pty Ltd 2015 | Contact Us | Terms of Use | Advertise | About Us