Chill out and save

An independent study by EDSL shows chilled beam technology has potential energy cost savings of 22 per cent on average, says Andrew Jackson

As reported earlier this year in RAC, the Chilled Beams and Ceiling Association (CBCA) had identified the buying habits of building owners and specifiers of cooling, who would go with 'what they know' as a key issue. And adding to this, the recession was putting focus on lowest capital cost, providing a significant challenge for chilled beam and ceilings manufacturers to prove that, over time, this approach isn't necessarily the most economical.

To help counter these preconceptions, the CBCA launched a free guide entitled, 'An Introduction to Chilled Beams and Ceilings', and Technical Fact Sheet 001 on 'Thermal Comfort', which were the first steps in a structured programme by the CBCA to be more pro-active, by driving best practice standards into the spotlight and highlighting the benefits of these types of cooling systems.

The latest study reveals critical considerations for energy savings in commercial buildings. The results, from the new EDSL Tas Energy Study, conducted in collaboration with the CBCA, looked at annual plant energy cost comparison and concluded that potential energy and cost savings can be made using products that are already available on the market

Critically, these energy cost savings were shown to amount annually to approximately 17 per cent for a passive chilled beam system and approximately 22 per cent for the active chilled beam system, over the generic VAV fan coil system modelled.

Fig 1: Findings of the EDSL test – based on 13p/kWh for electricity and 5p/kWh for gas

	Location	Consumption (kWh)			% SAVE RE FCU	Running costs (£)			% SAVE RE FCU
		FCU	ACB	FCU-ACB		FCU	ACB	FCU-ACB	
1	London	198897	163756	35141	17.7	£22,463	£17,984	£4,479	19.9
	Birmingham	185447	150598	34849	18.8	£20,516	£16,076	£4,440	21.6
2	London	404008	327919	76089	18.8	£46,093	£36,425	£9,668	21.0
	Birmingham	375536	299479	76057	20.3	£42,117	£32,456	£9,661	22.9
3	London	392231	319457	72774	18.6	£44,616	£35,366	£9,250	20.7
	Birmingham	365010	292599	72411	19.8	£40,778	£31,575	£9,203	22.6
4	London	800175	642348	157827	19.7	£91,894	£71,892	£20,002	21.8
	Birmingham	742509	584320	158189	21.3	£84,051	£64,004	£20,047	23.9
Average		432977	347560	85417	19.7	£49,066	£38,222	£10,844	22.1

Sharing knowledge

This chilled beam technology is not new. Over the past eight years chilled beams and ceilings have taken significant market share from the industry's alternative air conditioning technologies. However, since the introduction of EC motors for FCUs, the route to market for chilled beams has been hindered somewhat, as they do not use or require any secondary fans.

That said, we would welcome the additional SFP allowances that are afforded to FCUs. Although the CBCA considers the additional SFP allowances for secondary fans as opposed to what the central AHU is allowed, (the same for both systems), to be unfair, the recent energy studies demonstrates that chilled beams should still be considered shoulder to shoulder with other cooling technologies, as the potential energy savings are considerable.

Over the years we've witnessed confusion regarding chilled beams and ceilings product performance, and wanted to settle this with the clear facts. It is also important, in light of the changes to Part L, for projects to deliver government energy targets, recently announced as 9 per cent for non-domestic buildings.

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In addition, increasing energy costs are a major issue, which means the running costs and whole life-cycle costs of products require serious consideration.

Chilled beam solutions may have higher capital costs than some alternatives. However, this study illustrates chilled beam technology is also performance led. Of course, price is important in product selection. However, to ensure value for money it is important to consider whole-of-life costs early on in a scheme, as products installed today need to meet demands of occupants over many decades. With few moving parts, such as motorised fans, on-going maintenance requirements of chilled beams are reduced. How often is the maintenance demand and cost considered with the initial capital cost?

Interestingly, the use of chilled beams is usually directly linked to owner-occupier and government funded projects. In these cases, the client can usually afford to accept the initial capital cost, then maximise the asset over the long term so they reap the ultimate benefit for themselves.

Individual stakeholders involved in the process of selection have to work closely together. Some of the most common considerations made by the project stakeholders will vary from building owner to consulting engineer, through to architect. Where a building owner is concerned, specification may depend on how informed they are of the various different AC systems available and what their professional team propose is most appropriate for their building. While with consulting engineers it will be about what system they have experience of, and the performance criteria. Balancing

function and aesthetics will be key for architects.

The main aim of the CBCA is to help educate project stakeholders so that they can make more informed considerations. It is our strong belief that chilled beam technology is a viable alternative and often should be the first choice. Hopefully, this EDSL report and our ongoing drive for relevant and factual information in the market will enhance the decision making process.

We welcome the debate the report is creating, as these findings mean the market can now ascertain for themselves the conclusions that can be drawn from this study. This is timely for the industry as a whole to examine the options for cooling technology, in order to assess the most energy efficient options.

The findings of this research come at a time when energy demand and supply is top of the news agenda, and as the impact of the UK's energy capacity gap is being examined both by policymakers and commercial and public property owners. As an industry it is important we share knowledge to help design or refurbish buildings to perform more efficiently. Chilled beam technology offers a viable solution– its technology that is available today and proven to enable energy savings.

Summary of findings

This new EDSL Tas Energy Study has simulated the dynamic thermal performance of four differently sized office buildings, and compared the energy consumption, CO_2 emissions and the running costs of different HVAC systems within these office buildings. The three systems analysed were:

- VAV fan coil units with EC motors
- Passive chilled beams (95 per cent Convective/5 per cent Radiant)
- Active chilled beams

The building models have Part L2 Notional constructions and glazing percentages. The models have been zoned as specified in the NCM (National Calculation Methodology) Guide modelling guide and incorporates 6 m perimeter zones, which enable the different solar gains to be analysed.

Each HVAC system included a high efficiency chiller, which supplies chilled water to the terminal units being analysed. An air source heat pump supplies heating and cooling to the DX coils in the AHU, which includes heat recovery – the AHU for all systems is sized to provide the minimum fresh air requirements, in accordance with NCM methodology for an internal office environment.

All systems included a boiler with an efficiency of 90 per cent and DFX performance was taken from typical Mitsubishi VRF heat recovery unit.

The annual plant energy running costs savings achieved using chilled beams can be seen in fig 2. The chart is split for each particular building and shows the available annual running cost saving expressed as a percentage against the VAV fan coil system benchmark (100 per cent).

The completed energy study modelling clearly shows that both the passive and active beams' energy consumption is lower than the VAV fan coil system; the average annual energy cost saving over the buildings for both locations is approximately 17 per cent annual for the passive chilled beam system and approximately 22 per cent on average for the active chilled beam system over the VAV fan coil system modelled.

Interestingly, although the passive beams system used less energy than the VAV fan coil system, the passive chilled beam systems energy consumption was slightly higher than the active beam system. This was primarily because the passive beams displacement ventilation system requires a higher fresh air supply temperature (to meet occupant comfort) than that of the active chilled beam system.

Both systems had the same fixed AHU SFP's. The increased air supply temperature on the modelled displacement ventilation system results in increased energy usage on the fresh air re-heat DX circuit and also in less airside cooling being available. Therefore, during certain times of the year, where outside conditions effectively allow the active beams to have a higher level of 'free' airside cooling than a passive system, the passive system will have to make up any shortfall or airside cooling via waterside cooling, which results in a slight increase in the chiller energy consultation.

Additional energy savings can be achieved by increasing the chilled water flow and return temperatures to the chilled beam units - the relationship between water flow temperature and chiller coefficient of performance (COP) as modelled.

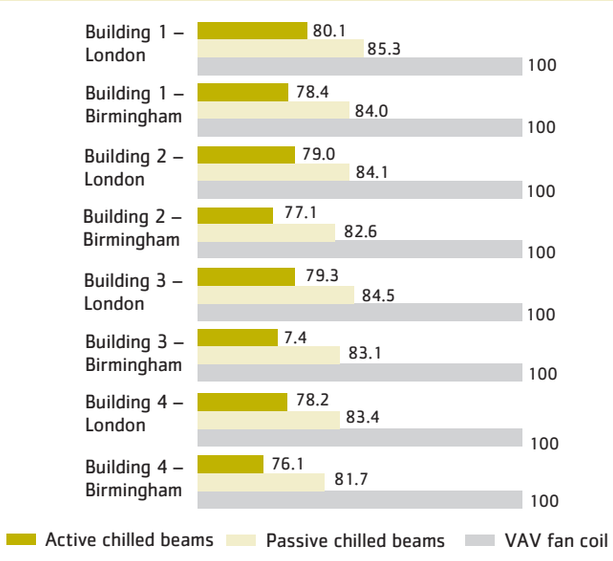
Recent advances in chilled beam design has also provided high performance beams. These could be used as high efficiency by keeping the same linear meters/quantity of units on project designs as traditionally associated, but with elevated water temperatures as a few deg C above the industry standard of 14 deg C flow significantly reduces energy consumption as proven during this energy study.

For every 1 deg C above the industry chilled beam standard of 14 deg C flow it potentially reduces circa 3-4 per cent on the overall system energy consumption.

However, if capital cost reduction is the driver, rather than energy reduction, the use of high output beams as high efficiency to reduce overall project quantity/linear meters of active beam, designers should be mindful of guide lines for occupancy comfort (ISO 7730) when using as high output.

Andrew Jackson is chairman of the Chilled Beam and Ceiling Association

Fig 2: Annual plant energy cost comparison (%)



Selecting a system

The main considerations for system selection:

- Does the system being considered meet the performance specification?
- Is the solution energy efficient?
- Does it comply with Part L of the Building Regulations
- Is it a sustainable solution (optimise free cooling / couple with a sustainable technology i.e. ground source)?
- Does it provide good thermal comfort for the occupants?
- What's the life expectancy of the system / terminal units?
- What are the maintenance requirements? How much does it really cost a team to maintain the system over its lifetime?
- What are the operating costs?