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Heat resilience and sustainable cooling

Submissions to The Environmental Audit Committee in response to their Call for Evidence

Relevant affiliations:

- Fellow: The Chartered Institution of Building Services Engineers (CIBSE)
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- Committee member: EDGE think tank https://edgedebate.com/
- Committee member: CIBSE Natural Ventilation Group https://www.cibse.org/get-involved/special-interest-groups/natural-ventilation-group
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- Arup Fellow: 28 years working for Ove Arup & Partners before setting up my own practice.

I worked for many years in warmer countries worldwide and observed many examples of how they have already learnt to cope with temperatures the UK can expect. I am now non-aligned in business terms to any organisation with a commercial interest in selling or advocating mechanical cooling.

Given the timescale and timing of this Call for Evidence many organisations have been unable to muster a formal response. Being on the board or committee member for a variety of organisations with an interest in this area I have volunteered to pull together a quick submission.

Heat resilience and sustainable cooling in the built environment is multifaceted, but for this submission the focuses on one particular aspect. In terms of potential scale, cost savings (both capital & running costs), assisting our net zero carbon trajectory, and its social benefit - allowing ceiling fans may well be the largest influence for providing heat resilience for us in the context of most UK buildings currently not needing AC.

The UK debate about the means of keeping buildings sufficiently cool for a warming climate has been severely distorted for many years. This has led to a situation where the most cost-effective means has simply been precluded by our Building Regulations and from planning policy. Without a regulatory framework that allows such low-cost means of achieving compliance, the market drivers are not there for their availability, nor the collective knowledge for applying them, and no demand for a supply chain to provide appropriate products. Indeed, the market pushes in the oppose direction because larger commercial returns markets are to be gained by selling larger more expensive bits of kit – most obviously AC.

One could easily conclude that this is nurtured by the AC supply industry; from consultants, installers, suppliers, manufacturers, and the associated trade organisations, all having a vested commercial interest in stimulating a market for more costly solutions. Consequently, the public and society as a whole is being lined up to be sold over-complex, over-costly, user non-intuitive means of cooling.

The specific objective of this submission is to highlight the main barrier that needs removal to allow the market to push for mass rollout of ceiling fans for warm weather comfort.

Drawing on experience from warmer climates, the first solution considered, and often easiest to retrofit, is ceiling mounted fans. They have the ability to deliver about 3˚˚ C of cooling (ref: CBE Guide Fig 6), in other words twice the scale of climate change average increased temperature we are aiming for, and a sizable reduction in peak temperatures. They can do this for about 10% of the energy use, about 5% of the embodied carbon, and of the order of 15% of the cost of adding AC. They are also far better understood and intuitively controlled by building occupants. In addition, there is growing evidence people physiologically gain more cooling effect than this 3˚ C if they feel they can directly control the cooling means as ceiling fans allow. These are numerous other benefits like less electricity grid demand, and the like, that are not covered here.

In warmer climates there has been a fundamental reawakening to the benefits ceiling fans offer, as I have seen first hand working in Singapore, Australia, Hong Kong and Shanghai – to name but a few. As one example, the USA has recently published new professional guidance (link: Ceiling Fan Design Guide) on how to select and install ceiling mounted fans, which in turn has prompted change in US regulations. This in turn has prompted suppliers to provide the supporting technical data and a wide range of fan products in support. This presentation by University of California Berkeley (Link: UCB-Schiavon) provides a good overview. What is of particular interest for the UK is that for the vast majority of buildings that can currently be naturally ventilated and our climate, they only need to install ceiling fans to be sufficient for climate change without needing any AC.

Those eager to promote more expensive mechanical cooling methods have been known to claim ceiling fans are unsuitable for the UK; our ceilings are too low, humidity inappropriate etc. These are spurious. As the guidance from aboard explains, typical ceiling heights, as we see in the UK are sufficient, indeed our humidity levels are more suitable than say Singapore, etc.

So why do UK regulations preclude ceilings fan? This is because our regulations only consider air and radiant temperature. Historically they have not included air movement and natural evaporate skin cooling. A simple change to our UK building regulations to allow air movement and skin evaporative cooling would eliminate this historical anomaly. It would also allow planning policy to use the same methodology in their requirements for assessing buildings for their suitability for future climate adaptation. Such a small change to regulations would be far more effective in the UK because the need for AC is often far more marginal (particularly as EVs make streets clearer and quieter).

All the above is not to say there is not a place of more energy intensive AC, but as the growing USA experience illustrates, ceiling fans should also be used to reduce the energy use of AC systems by providing a first stage of cooling, reserving the AC mechanical cooling only for higher temperatures. Just as they can be used alongside AC, ceiling fans are fully compatible with almost all other passive and low-energy cooling solutions.

In summary:

Where barriers need to change to allow general use of ceiling cooling fans:

- Air movement using skin evaporative cooling needs to become a recognised form of cooling.

- The Building Regulations Part L should be changed to include locally control air movement instead of just relying on air/radiant operative temperature as their comfort definition.
- Planning policy like the London Plan's Cooling Hierarchy should specifically add this as an option.

- UK design guidance is needed on how designed and select ceiling fans for cooling.
- UK design guidance is needed on how ceiling fans can become the intermediary step between passive cooling and AC, reducing installed AC capacity and delivering greater energy savings.
- Build the current UK immature product supply chain so it provides product performance data to allow correct ceiling fan selection.

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References:

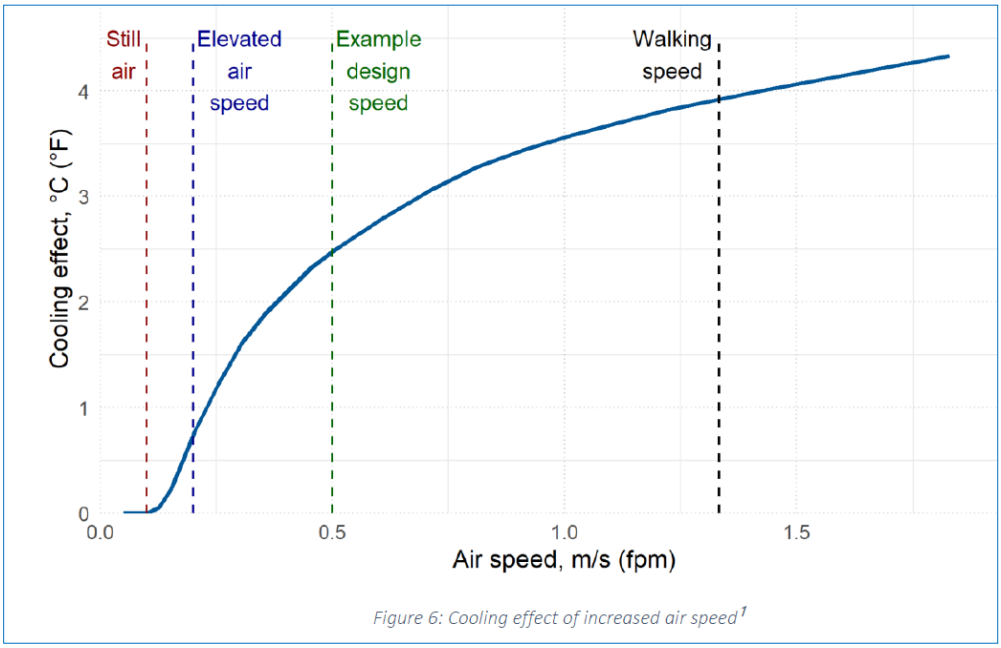

Figure 6: Cooling effect of increased air speed[1]

1. CIB - Ceiling Fan Design Guide Figure 6:

2. https://cbe.berkeley.edu/wp-content/uploads/2020/04/CBE-Ceiling-Fan-Design-Guide-V0.pdf
3. Presentation: https://www.youtube.com/watch?v=O_fqlmxrjF0
4. Presentation slides: https://berkeley.app.box.com/s/fanyuj36lrttbb25exn0hjhzmgpayu5m