



Cumberland Lodge, the venue of the Conference, close to Royal Windsor Castle (in the end of the boulevard).

# The Windsor conference focused on the cost of comfort indoors



**Summary by**  
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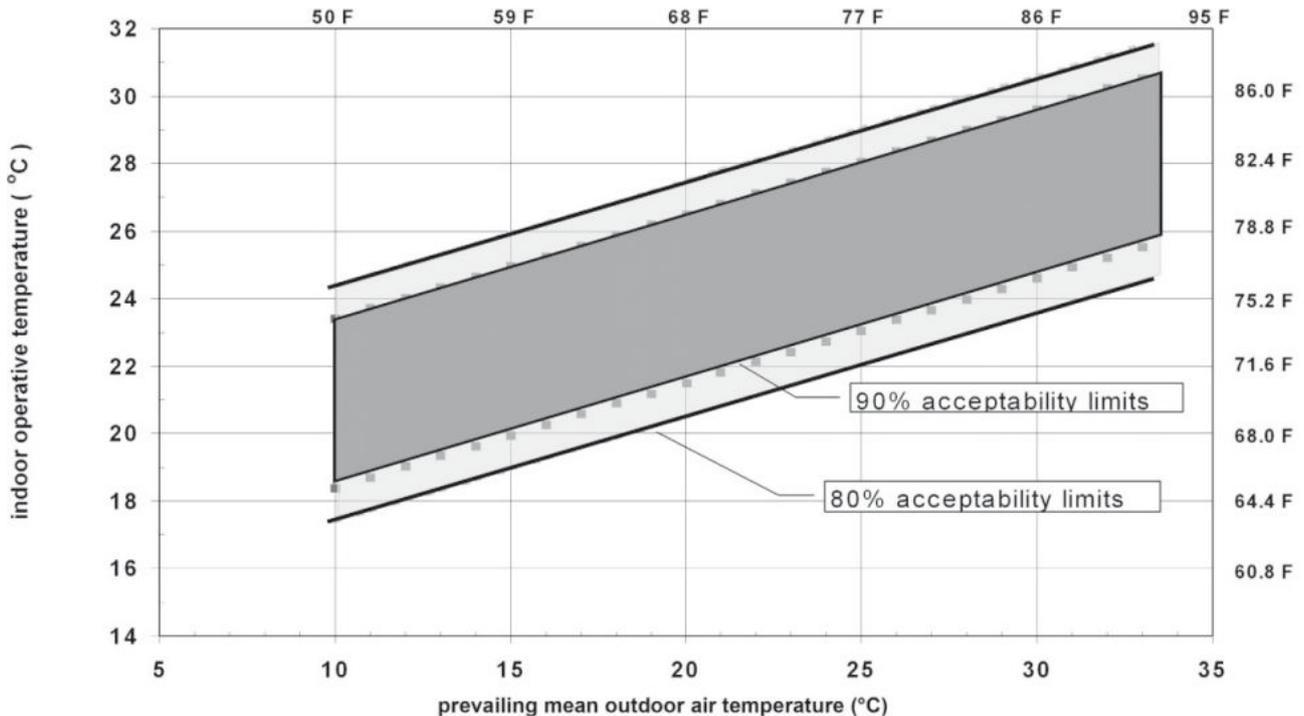
Cumberland Lodge is situated in the heart of the Great Park of Windsor Castle just west of London. The Queen has granted the use of this beautiful seventeenth-century house as a conference centre for ‘discussions aimed at the betterment of society’. It is here that the biennial Windsor conferences have been held over the last 20 years to provide a forum for the discussion and development of the science of thermal comfort and its impacts in terms of energy use in buildings.

Because the venue is located in the middle of the Great Park, and the conference is residential delegates have plenty of opportunity to socialise and exchange ideas and views in this congenial rural setting. These conversations have in turn led both expert and novice researchers to explore and expand new approaches

and ideas, and innovative experiences and research findings in the atmosphere created by a unique location and the knowledgeable ‘Windsor’ audience. The conference has witnessed and informed many major developments in the field over the last two decades - particularly in the field of adaptive thermal comfort.

In the late 20th century, Standards such as ISO7730 were used to suggest limits for the indoor thermal environment based on the Predicted Mean Vote (PMV) index based on a simple steady-state physiological model. The model worked quite well in buildings with mechanical heating or cooling but the thinking that a ‘right’ temperature actually exists meant that the recommended thermal comfort limits tended to shrink at a time when narrower limits were assumed to be better.

A constant indoor temperature was one way to provide comfort – but was it the only way? Other researchers, using field studies, had found that the conditions people find comfortable change from season to season or climate to climate. This realisation led to the approach called adaptive comfort (Nicol et al 2013). A major contribution of the early Windsor conferences was to encourage and help guide the development of ‘adaptive’ standards for indoor temperature.



**Figure 1.** Acceptable operative temperature ranges for naturally conditioned spaces. Source: ASHRAE 55 (2013).

The science for these standards is based on analyses often first aired at Windsor. Their significance was that they recognised that indoor temperatures which might be unacceptable in buildings with mechanical cooling or heating could often be found comfortable in the more variable conditions found in naturally ventilated buildings. The standards (ASHRAE 55 and CEN 15251) have now been in place for some years.

## Windsor 2014

The theme of Windsor 2014 was *Counting the cost of comfort in a changing world*. The theme was not strictly adhered to as Scientific research tends to follow the interests of the researcher and of the funding bodies, but it did lend some direction to the deliberations at the conference.

Several problems of and challenges for adaptive standards were addressed with some papers dealing directly with weaknesses in the current standards and in particular with the ranges of acceptable environment they allow. Others investigated the applicability of standards based studies done largely in offices with adult populations.

Papers reported comfort studies using different occupants and occupancy patterns in homes where people may have different motivations and access to adaptive opportunities, and also in laboratories or mosques where occupancy may be very different from day to day and

variable within any day. Evidence was given that schools may need to be considered differently as the sensitivity of children appears to vary from that of adults. Extreme climates such as the high Himalayas and the Arabian Desert can suggest comfort limits which may seem strange to people from more temperate climates.

A paper from Australia explored the effect of the motivation - two groups of Australians characterised as 'thermal mavericks'<sup>1</sup> one in Melbourne and one in Darwin show a keen interest in environmental concerns. Preliminary results show how motivation can stretch the 'comfort zone'. The Melbourne cohort were comfortable at lower temperatures than the ASHRAE adaptive model predicts as acceptable, while the Darwin cohort are comfortable at higher temperatures.

<sup>1</sup> The term 'thermal maverick' refers to those occupants who choose to live in atypical dwellings that do not necessarily have extensive heating or cooling. In Australia, 17.4% of households do not have heating and 26.9% do not have cooling. In the study of these households, specifically dwellings incorporating earth construction components in a cold temperate climate and naturally ventilated houses in a hot humid climate, occupants reported to be comfortable at, or even preferred, conditions outside of the ASHRAE adaptive comfort standard. It has been suggested that the study of 'thermal mavericks' may "make the strongest case against the further spread of ambient temperature standards". Thanks are due to Lyrian Daniel and her co-workers at the School of Architecture and Built Environment, The University of Adelaide, Australia for their permission to use **Figure 2** and for these notes on thermal mavericks

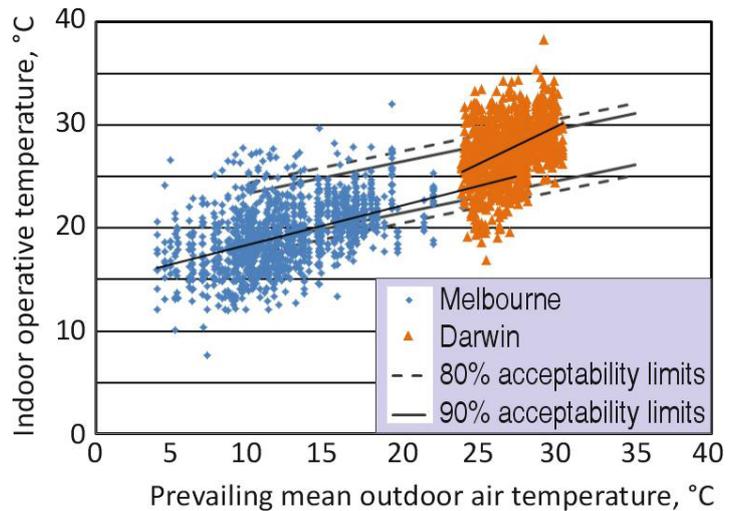
## Controls and the re-emergence of physiology

The control of indoor conditions in buildings is an enduring Windsor theme. How best can we use windows, fans and shading, for instance to change indoor conditions? Should they be controlled according to an automated algorithm or left to the control of building occupants? How can appropriate simulation algorithms be developed to represent these stochastic factors in a realistic way?

In the early conferences on thermal comfort, a major concern centred on the physiological model of comfort and the definition of its constituents (clothing insulation, metabolic heat and so on). One notable development at Windsor 2014 is the re-emergence of the physiologists. Their concerns are more with the dynamic relationship between occupants in their buildings, reflecting again the emerging 'whole system thinking' within comfort theory. Change is increasingly recognised as natural in our relationship with our environment, stasis is not only expensive to achieve, but often runs counter to our best interests. Even for older people an unvarying environment is not just psychologically boring but may also be reducing the ability of the individual to physiologically cope with change.

### Avoiding Overheating

Much is said about avoiding overheating in buildings especially in the light of global warming, but the exact meaning of the term and the ways to characterise it are still ill-defined. CIBSE has produced a technical memorandum which presents an approach based on sound adaptive principles linked to the European standard



**Figure 2.** showing the range of temperatures found comfortable by the 'mavericks' in Melbourne (blue) and Darwin (brown) compared to the ASHRAE 55 adaptive comfort zones. The 'best fit' lines for each group are also shown (Source: Daniel et al).

EN15251. Evidence from simulations predicts that well designed buildings can stay comfortable as people adapt to new conditions.

The Australian Mavericks will have a different definition of overheating from European office workers, school children or Tibetan householders. This leads to the question "Is temperature the best measure of thermal comfort?" and if not how to best account for climate, culture, ventilation strategy, and, yes, the cost of comfort (or should that be discomfort)? There is still much to discuss at the next Windsor conference scheduled for 7–10<sup>th</sup> April 2016 at Cumberland Lodge. ■

## References

A range of papers developed from papers presented at Windsor 2014 will appear in forthcoming issues of both Building Research Information and Architectural Science Review and will, with the whole gamut of presented papers and ideas from the conference, now available on the NCEUB website, provide a rich and evolving feedstock for the discussions at the next Windsor conference to be held on the 7th – 10th April 2016 at Cumberland Lodge.

A short history and overview of the Windsor conference can be found at <http://windsorconference.com>.

Conference papers mentioned and the full conference proceedings can be downloaded from [http://nceub.org.uk/W2014/webpage/W2014\\_index.html](http://nceub.org.uk/W2014/webpage/W2014_index.html).

Nicol, JF, Humphreys MA and Roaf, SC, (2012) Adaptive thermal comfort: principles and practice, London Earthscan/Routledge.

TM52:2013 The limits of thermal comfort: avoiding overheating in European buildings, CIBSE Technical Memorandum, No 52 London Chartered Institution of Building Services Engineers.