



With a warming climate and increasing airtightness in new homes, tackling overheating is becoming a growing concern. But with higher quantities of glazing in greater demand in residential dwellings, managing the two issues in tandem needs careful consideration, says ROGER HUNT

SEE THE LIGHT,
don't feel the heat

Climate change coupled with the introduction of highly insulated low and zero carbon homes means that the need to tackle the separate but related issues of overheating and daylighting has moved up the agenda. Both factors directly influence comfort and energy use in buildings and, importantly, raise concerns about health and wellbeing.

On average there are 2,000 heat-related deaths a year in the UK and this figure is expected to rise to 7,000 a year every summer by 2050. Meanwhile, surveys reveal that around 90% of those asked appreciate having sunlight in their homes. Sunlight, especially direct sunlight, is seen as providing light and warmth, making rooms look bright and cheerful and also having a therapeutic, health-giving effect.

In the past, overheating has tended not to be seen as a problem because homes were thermally massive and 'leaky' in terms of air movement so were able to operate adequately at higher external temperatures. Conversely, new homes are highly insulated and often have little thermal mass to absorb heat, so may overheat internally to uncomfortable levels.

According to the NHBC Foundation, reported cases of overheating in existing dwellings are still relatively low when considered in the context of the size of the UK housing stock. In some 'energy efficient' developments the story is different, with problems experienced due to higher levels of airtightness and thermal insulation coupled with lightweight construction, so the need to understand and carefully manage the risks is growing.

Overheating tends to occur more frequently in towns and cities where problems are exacerbated by the so-called urban heat island effect where the hard surfaces of buildings, roads and landscape store and radiate heat, which cannot easily be dissipated by natural air movement due to the density of the built environment.

The NHBC Foundation guide, 'Understanding overheating – where to start: An introduction for housebuilders and designers', points to the fact that the cause of overheating within homes is largely

cumulative. Contributory factors include external heat gain from the sun, retained by energy-efficient glazing units, and internal heat gains from lighting, domestic appliances, building services and even occupants.

An important factor for design and construction teams to bear in mind is that heat gain can even vary by floor, points out Neil Smith, group research and innovation manager, NHBC. "In an apartment complex, each home must be treated independently of others when considering mitigation and reduction measures. Equally, the fabric of the building has a role to play in overheating, as the use of heavyweight building materials can help keep temperatures under control when applied in conjunction with adequate ventilation."

Previous assessments and existing research have tended to make the assumption that window opening is enough to counter the build up of heat, says Smith. "The government's Standard Assessment Procedure (SAP) – applied uniformly across the housing stock and throughout the UK – also makes equally simplistic assumptions about ventilation. Unfortunately, in practice, this is not the case, as window opening is simply not an available option to homeowners in some urban locations due to security and noise concerns."

Another significant cause of overheating is communal and district heat systems with pipework routed in unventilated common areas. This frequently runs at high temperatures year round because of the need for domestic hot water. To avoid overheating, pipework must be well insulated and located and installed with care.

The biggest challenge is undoubtedly balancing the risk of overheating with the need to include enough glazing to let in adequate daylight. The BRE good practice guide 'Site Layout Planning for Daylight and Sunlight' by Paul Littlefair, principal lighting consultant BRE, states that interiors with a very high average daylight factor (ADF) of over 6% sometimes have problems with summertime overheating or excessive heat loss in winter. The ADF is a measure of the overall amount of daylight in a space. The BSI code

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BELOW Radian's Stoneham Green development

BELOW MIDDLE At Chobham Manor, PRP assessed the development according to the CIBSE 2013 criteria for overheating

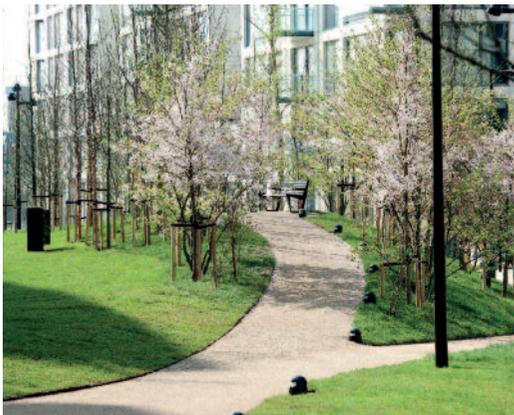
OPPOSITE PAGE

TOP LEFT Carefully orientated glazing is a key feature at Derwenthorpe, a development built in partnership by the Joseph Rowntree Housing Trust (JRHT) and David Wilson Homes, in Osbaldwick, York

LEFT MIDDLE Trees and shrubs help mitigate the urban heat island effect at developments such as Get Living London's East Village

RIGHT The Code for Sustainable Homes Level 6 homes designed by PRP at Greenwatt Way in Slough, Berkshire, were well lit by daylight





of practice for daylighting recommends an ADF of 5% for a well day-lit space and 2% for a partly day-lit space. Below 2% the room will look dull and electric lighting is likely to be turned on.

Marylís Ramos, associate director environmental at PRP, says that these figures have been taken into account on projects such as Chobham Manor, one of the neighbourhoods being developed on Queen Elizabeth Olympic Park in Stratford, East London. Here PRP initially considered daylighting, in that window sizes were a given, in terms of analysing overheating.

"By calculating the daylight first we were able to see

which rooms had an ADF of 6% and above and those areas were immediately placed at high risk for overheating. It's about optimisation; it's finding that sweet spot. Overheating and daylighting are equally important and neither one trumps the other; it's having the right tools to figure out where the right balance point is."

At Chobham Manor, PRP assessed the development according to the CIBSE 2013 criteria for overheating, as well as provided a commentary on how the development can address urban heat island mitigation. As a first step, PRP worked to establish climate-proofing concepts for optimising building

form and orientation, options for natural ventilation and cooling and thermal mass. Fine-tuning of glazing specifications, ventilation strategies and fabric details was then carried out and tested using dynamic thermal simulation software to develop recommendations to mitigate overheating for both current and future (2030) weather conditions.

Paul Littlefair says that one problem in many developments – particularly in flats with standard designs – is that all the windows are the same size. "That's fine perhaps for the people higher up the flats where they've got good daylighting but often people on the lower levels, where it's a dense situation and they've got tall buildings next to them, get low levels of light. One of the things we encourage architects to do is to think about how much daylight is available in this situation and then design the windows to suit, even if that means having more glazing on the lower floors."

Glazing for penthouses also has to be considered carefully warns Littlefair. "Penthouses often have really good views so have huge amounts of glazing and then you can get situations where you get overheating."

Orientation is another factor that should be given careful consideration in order to minimise solar gain during summertime, although Littlefair highlights the fact that often architects are quite constrained in what they can do, especially on smaller sites.

Shading in the form of external shutters, awnings and blinds is a key element in maintaining daylight levels while mitigating overheating. Ramos says that the problem with these devices is that they don't work if the residents don't use them correctly. "We tend to propose them with the caveat that the residents must be educated in how to use them. The problem in the UK is that the behaviour to use shutters and blinds is not ingrained in the way that it would be in more Mediterranean climates where the knowledge of how to use them is passed down through generations."

Trees and shrubs help mitigate the urban heat island effect but Littlefair explains that, if they are to



THIS PIC Shading to avoid solar gain at Hastoe Housing Association's Wimbish Passivhaus development

BELOW Natural light was a priority for the interiors of The Prince's Foundation Natural House built at the BRE Innovation Park, Watford

RIGHT Balancing daylighting and overheating is important in well-insulated, airtight homes such as this high-spec housing development in Scotland where DuPont membranes are being used



be used to provide effective natural shading, they may have to be quite close to the building. "You can get problems not only with loss of daylight but also with the tree roots causing subsidence and heave."

Ramos believes that landscaping is not always an immediate solution because of the length of time that plants take to grow to be effective but she does see it as a potential long-term solution as temperatures rise due to global warming. "Landscaping may be a good mitigation strategy for say 2030 or 2050 because you can put the plants in now and, by the time it gets to that point, they will be fully grown and they will work."

Interestingly, Jonathan Rickard, head of design and compliance at Radian, claims that the affordable homes provider has not had any problems with daylighting or overheating issues but these are factors being considered in all of its new schemes.

At Radian's Stoneham Green development of 11 Code for Sustainable Homes Level 6 houses in Southampton, it was necessary to raise the level of the ground floor of the properties so that the windows were the right height to achieve the required daylight levels. "Daylight and internal qualities are incredibly important to us and for our residents," explains Rickard. "We want to let as much daylight in as possible while mitigating overheating. Achieving that may have an impact on costs and on the insulation that we use so getting that balance right is quite delicate – it requires very much a holistic approach to sustainability." ^{sh}

FURTHER READING

Overheating in New Homes: A review of the evidence, NHBC Foundation
Solar shading of Buildings, BRE Press

CONTACTS

BRE www.bre.co.uk
NHBC Foundation www.nhbcfoundation.org
PRP www.prparchitects.co.uk

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