A case study series published by the UNISDR Scientific and Technical Advisory Group

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The United Nations Office for Disaster Risk Reduction

UNISDR Scientific and Technical Advisory Group Case Studies - 2015

Resilience in UK schools – Reducing overheating to improve health and wellbeing

The problem

The extent and precise nature of future climatic changes in the United Kingdom (UK) are expected to depend upon the geographical location, the time of year and the global greenhouse gas emissions trajectory that is followed. But, in broad terms, projected climatic changes the UK are likely to include warmer and wetter winters, hotter drier summers, sea level rises and more severe weather-related events (1).

Young children and those with certain existing medical conditions are particularly vulnerable to chronic health risks associated with high ambient temperatures. Scientific research suggests that increased ambient temperatures impact on how people learn and behave, and shows that children are more sensitive to temperature variations than adults (2, 3).

Head teachers surveyed for the first annual report of the Building Schools for the Future programme in 2007 (4) reported that they were concerned about rising temperatures in their buildings, with less than one in six reporting that classroom temperatures are adequate throughout the year. In 2010 the National Association of Schoolmasters and Union of Women Teachers (NASUWT) conference called for an upper summertime temperature limit in classrooms of 30^{o}C and a readiness to respond to hot weather conditions (5). This feedback is consistent with supplementary evidence from visits carried out by environmental and engineering consultants AECOM in a project commissioned by Partnerships for Schools, the former national schools delivery body for England, in 2010 (6). This project found that overheating in UK schools is already a problem in many parts of the country. Given this, understanding how the climate may change and adapting for this is already an important issue for those who design and build schools and for those who subsequently manage and operate them.

The science

In addressing the issue of overheating in school buildings, science is critical in three areas. These are:
What are the health and learning impacts of high temperatures in schools, and what level of adaptive capacity do humans have to respond to these rising temperatures?
How can we increase confidence around climate projections and of indoor temperature projections considering, e.g. the impact of improved ventilation, solar shading, green infrastructure, etc.
How can we best design resilient new schools to respond to expected higher future temperatures?
Concerning the second of these areas, designers of new schools are drawing on scientific information about the major climatic changes expected in the UK to help in understanding the potential impacts of future climate conditions, although further work is required to convert data generated by large scale future climate projections into a form suitable for use within building simulations to inform design (7).

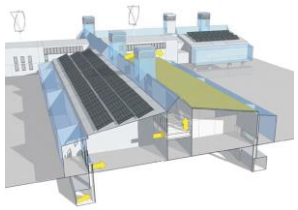
In terms of the response, building designers are evolving novel designs to reduce overheating. In parallel, research is on-going to develop novel construction materials including reflective paints, solar walls and phase-change materials, As an example, the promising use of natural ventilation systems that do not require the use of any fuel- or power- related energy (solar-assisted ground coupling), a school located in the UK has been the subject of a pre-construction design study based on computer modelling (8). In this study, simulation results have been presented for current and projected 2050 future climates, derived from the UKCP09 Climate Projections (1, 7). Given that electricity networks are vulnerable to heatwaves, such solutions completely avoid mechanical air conditioning and so provide a good level of resilience.

The application to policy and practice

Within the UK, research studies and demonstration projects are commonly used to inform the evidence base before changes to policy or government funding requirements are implemented. Building on the extensive scientific research that has been conducted in the area of avoiding overheating (see for example 9, 10) under current and future climates, there have been a number of practical guidance documents produced to help translate the research into policy and practical outcomes (including 11, 12). Moreover, the delivery body for many new schools in England, the Education Funding Agency (EFA), now specifies that under the current climate, adaptive thermal comfort criteria should be used as design standards (see 13, for example), based on the latest industry guidance on avoiding overheating (14).

Did it make a difference?

The EFA has introduced procurement specifications requiring that attention should be paid to climate change adaption (see 13, for example), although they do not currently clearly define as to how current design approaches or requirements should be modified to take account of anticipated future climate change. Two recent examples of adaptation of school buildings to avoid overheating are presented below.



Welland Primary School, Innovate UK Design for Future Climate Research Programme

Problem: As one of several climate change related risks, overheating of internal spaces during summer was assessed to be significant in a pre-construction study.

Solutions: Design features were suggested, including ground coupling using large underground air supply culverts to temper ventilation air, assisted by solar chimneys and attics to increase the natural ventilation flows through the system.

A factsheet can be found here. (15)

Sharrow School Sheffield

Problem: Avoiding overheating needed to be addressed as a design requirement

Solutions:

- Attention was paid to the design of indoor, outdoor and transition spaces to allow adaptive behaviour during hot weather.
- Each classroom has access to daylight, natural ventilation and outdoor play decks.
- The school has a biodiverse green roof, which brings a range of benefits including insulation, rainwater storage, flood mitigation and cooling.

Image courtesy of Bauder Ltd. (6)

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Authors: Ben Smith, Director of Sustainable Development, Design Planning and Economics and Malcolm Orme, Associate Director, Building Engineering (AECOM).

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