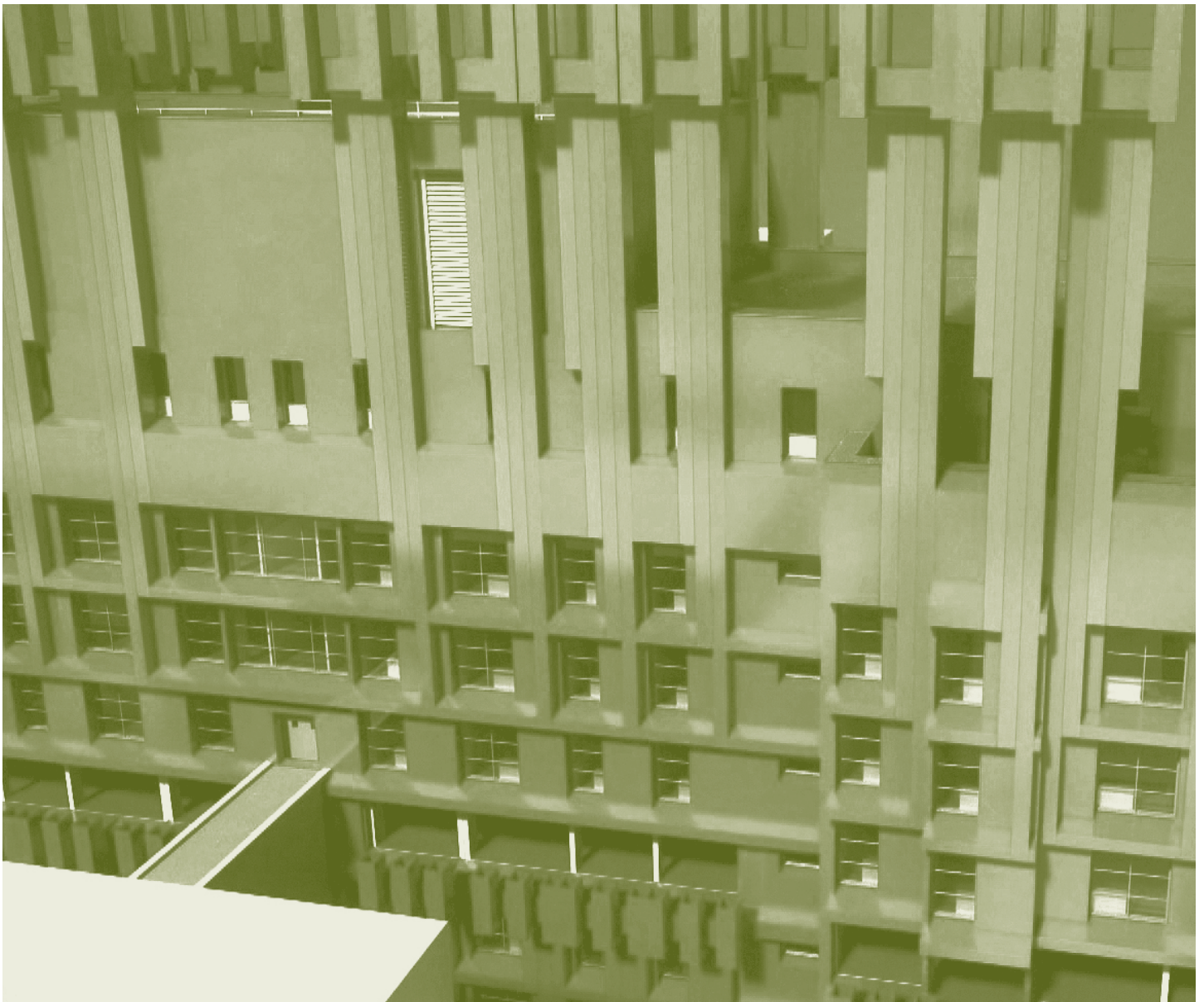


Avoiding summer overheating while saving energy in acute hospitals

Buildings overheating in summer is a problem already affecting acute hospitals. Climate change is likely to make this problem worse, while air conditioning is expensive and energy intensive. Are there other options?



**Living With Environmental Change
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The Living With Environmental Change Partnership brings together 22 public sector organisations that fund, carry out and use environmental research and observations. They include the UK research councils, government departments with environmental responsibilities, devolved administrations and government agencies. The private sector is represented by a Business Advisory Board.

Summer heatwaves have adverse consequences for hospital patients and staff. Increased use of mechanical cooling would seem to be the inevitable response, but widespread air conditioning would undermine NHS targets for carbon reduction. Are there alternative ways of providing safe temperatures in hospitals whilst also saving energy and costs?

What are the problems?

Summer heatwaves cause a range of problems:

- In 2013 a hot spell in England was estimated to have caused 650 premature deaths. The 2003 heatwave led to over 2,000 premature deaths in England and Wales.
- The elderly, the chronically ill, and the very young are most at risk of health effects during heatwaves, and likely to make up a large proportion of patients in acute hospitals.

Some wards in UK hospitals are already uncomfortably hot during an average spring and summer:

- High night time temperatures may make sleep difficult.
- Poor control strategies may mean that one “set point” activates the heating across a whole hospital, regardless of varied internal uses and schedules.

More recent changes may compromise performance of buildings:

- Patient safety concerns mean that windows typically now only open 100 mm, but older hospitals relied on wider opening windows for natural ventilation and passive cooling.
- Lightweight suspended ceilings mask the thermal mass of buildings, which would normally retain “coolth” in summer.
- Internal courtyards, essential for natural ventilation and daylight, have been filled in, creating buildings wholly dependent on mechanical ventilation and cooling.
- Temporary “modular” buildings are popular with NHS managers but are lightweight structures that will tend to overheat as temperatures rise, requiring mechanical cooling.

Guidance documents are treated as default performance “standards” to be followed exactly

- Technical guidance from the government is used as a contractual “standard”, particularly when new hospitals are constructed. The result has been the sealing up of new buildings and the use of full mechanical cooling or air conditioning.
- More realistic “adaptive” comfort models offer greater scope for low energy solutions, reflecting real patient and staff experience of temperatures.

What alternatives are there to energy-intensive air conditioning?

Energy use across the NHS estate is already responsible for 30% of UK public sector carbon emissions. There are alternatives to air conditioning:

Building mass and orientation may be used to positive effect:

- Historically buildings were designed with close reference to their site, in order to profit from the prevailing winds and to avoid solar overheating.
- Pre-1948 buildings demonstrate resilience to overheating because they are heavyweight and often have high ceilings. They potentially form a more climate resilient resource than might be expected.

Natural ventilation is about more than opening windows:

- Natural ventilation employs sophisticated strategies such as Advanced Natural Ventilation to move air through a building.
- This has strong historical precedents and has been deployed successfully in large non-domestic buildings.
- While full air conditioning with filtration is necessary in some clinical spaces, up to 70% of the floor area of an acute hospital can be ventilated naturally, with a further 10% using a hybrid strategy that brings in mechanical systems when necessary.
- Pathogen control research suggests that natural ventilation need not pose additional infection control risks and may even be safer than mechanical options.

How can these ideas be applied to a new-build hospital?

A low-energy consuming new-build acute hospital could incorporate:

- Clinical spaces located in a medium-rise building of three or four storeys, with open courtyards that facilitate a natural or hybrid ventilation strategy while also providing daylight and views.
- Fresh air supply to the building, pre-cooled naturally in a low level chamber (easily accessed for cleaning) and ducted through the building. It would rise under its own buoyancy and exhaust via dedicated outlet stacks. No supply or exhaust air would be allowed to pass from one space into another.
- “Thick” walls forming the building’s elevations, within which the air supplies, exhausts and other services are co-located. Openings would be shaped and sized to fend off unwelcome solar gains whilst preserving good daylighting, particularly in winter.
- Single patient rooms that are naturally ventilated but in a more sophisticated and controllable way than by opening windows alone.

What are the options for refurbishment of older buildings?

Although individual buildings and sites have their own issues, the NHS estate presents a number of recurrent basic building types (Victorian Nightingale wards, 1960s slab blocks and 1970s/80s Nucleus courtyard plans).

These offer options:

- In an industry-standard refurbishment of a 1960s ward block, insulating and sealing it, and installing an efficient ventilation system, could halve its energy use until warmer summers prevail.
- Using natural ventilation and external solar shading devices could deliver even greater resilience and savings:
 - The building is wrapped in a deep wall that shades the windows and accommodates ventilation stacks.
 - Natural ventilation is deployed, with cross-over ducts allowing ventilation across the building without the need for air to pass from one space to another.
 - Exhaust is via operable windows and the external stacks.
 - Suspended ceilings are cut back to expose the mass of the building structure to help stabilise temperatures.
- Refurbishment of pre-1948 buildings offers the opportunity to improve further the already relatively high resilience of this type whilst enhancing patient privacy and dignity.
- The options in many cases have the advantage that they transform the external appearance of the buildings. They can be delivered in phases, so that adaptive re-engineering can be rolled into routine maintenance work.
- Once buildings are adapted, mitigation follows; energy saving measures such as energy efficient lighting and renewable energy devices can make a cost-effective contribution.
- Research reveals that passive/natural strategies would provide comfortable environments into the 2040s outside major urban areas of England.

What are the messages for decision makers at local and national levels?

- Low-energy, climate adapted refurbishment and energy saving design of new hospitals need not be more expensive options.
- Achieving a significant reduction in energy demand, and thereby carbon emissions, does not require the replacement of the existing NHS estate.
- Passive cooling strategies can adapt existing buildings to avoid or minimise the need for energy-hungry air conditioning.
- Embedding fundamental low-energy design principles in new hospital buildings – orientation, shading, organised natural ventilation – can achieve the best targets required.
- Refurbishment need not be a cosmetic exercise but can deliver significant reductions in energy use and greater comfort.
- Low-energy design and refurbishment can achieve an improved patient experience in the present whilst also delivering future resilience.

Further information

This note was written by Professor C. Alan Short and Dr Alistair Fair. It draws on Design and Delivery of Robust Hospital Environments in a Changing Climate, a research project devising and testing potential refurbishment strategies for representative NHS hospital buildings and spaces. The project is funded by the Engineering and Physical Sciences Research Council as part of the Adaptation and Resilience in a Changing Climate programme, with additional support from the Department of Health.

Useful resources: A summary of the refurbishment work can be seen in a 30 minute film, which may be viewed at www.sms.cam.ac.uk/media/1446036

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