INSIGHT#6 : **RESILIENCE**

Concrete offers resilience in an uncertain future

A resilient built environment is one that shows long-term durability, has low maintenance requirements and is resistant to extreme weather events, while remaining adaptable to changing uses. Resilience has become an increasingly important design factor as climate change has moved up the agenda, and issues such as summertime overheating and extreme flooding have come to the fore. Such factors underline the need to consider projects on a whole-life basis for environmental, economic and social impacts.

Concrete is capable of being fit for purpose for thousands of years with relatively little maintenance in a wide range of conditions. It can be used in aggressive and exposed environments such as on brownfield sites and for coastal defences, and can help to mitigate, or even avoid, the impact of extreme weather events.

The inherent thermal mass of concrete is also key to providing future-proof buildings. By moderating temperature extremes, it combats overheating and maintains a comfortable internal environment, particularly when combined with active or passive cooling.

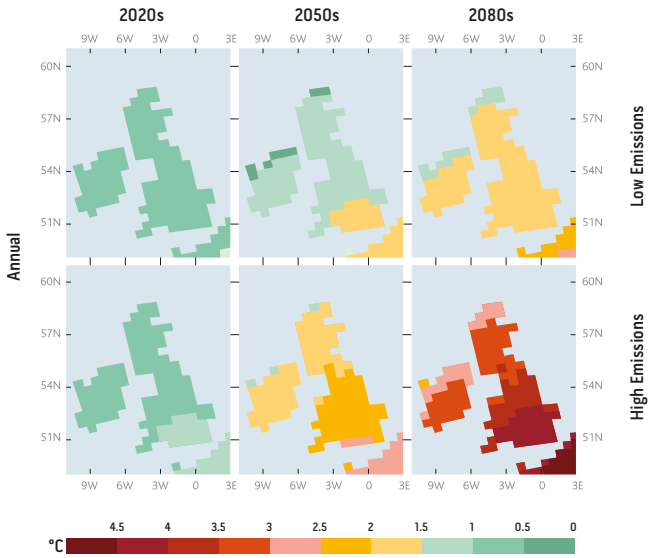
Another important performance benefit of concrete is that it does not burn. This is due in the main to cement and aggregates which, when combined within concrete, form a material that is inert and, importantly for fire safety design, has relatively low thermal conductivity. This means that the effect of fire is limited to the surface zones of the concrete with the middle of the element often unaffected. This resilience to fire ultimately provides life and property safety.

Research and development has established the best means to ensure concrete continues to perform in our changing environments, and this is supported by the latest standards and design codes. Innovation is ongoing – for example in the development of admixtures and alternative cementitious materials, which will ensure that concrete's important properties can be maintained cost-effectively as concrete specifications evolve and material availability changes.

The Hoola development in London Docklands by CZWG comprises two residential towers of 23 and 24 storeys. Both buildings have a concrete core that supports oval in-situ concrete floorplates and distinctive precast-concrete balconies. Concrete is a natural choice for apartment blocks because of its resistance to fire, strong acoustic properties and inherent thermal mass

Right: These maps produced by climate change research body UKCIP show two different forecasts for UK temperature increases in the 2020s, 2050s and 2080s, based on low-emission and high-emission scenarios

Photo: Jack Hobhouse



‘DESIGNERS HAVE TO MINIMISE THE RISK OF OVERHEATING’

Lynne Sullivan is founder of LSA architects and chair of the Good Homes Alliance

Why is overheating a problem, and why now?
We are in a warming climate (see map below). We’re also getting higher densities and new typologies such as single-aspect apartments. Because there is more focus on energy efficiency, we’re getting more airtight buildings but ventilation systems aren’t always performing as they should. All these things together create a perfect storm of overheating, which is particularly a problem for vulnerable people and those who are inside all day.

What are the potential solutions?
While overheating is increasing, we’re also understanding more about how buildings perform in use. The perfect solution is for designers and planners to understand the causes of overheating and for these to be controlled by the Building Regulations, which are shortly being reviewed to address energy efficiency and other issues. This will take time. Meanwhile, a draft review of the National Planning Policy Framework (NPPF) has flagged overheating as an issue for planning authorities, but until the regulations change a method for managing this is unclear. The Good Homes Alliance is producing guidance to address some of these issues at the early stages of design.

What can designers and planners do to help?
First they have to be aware of the issues causing overheating and design to minimise the risk, including night cooling where possible – this can be a challenge in urban areas with noise and security issues. Exposed thermal mass, which can absorb heat during the day, can help reduce excess heat, provided it can be dissipated at night through ventilation. Any single-aspect flats need to be properly shaded. Designers also need to be aware of the potential for overheating caused by communal heating systems, which need to be highly insulated. It’s important to flag up all these issues at an early stage of design review.

What role can concrete play in maintaining comfortable temperatures in a warmer future climate?
A lot of research has been done on the use of exposed concrete for thermal mass. We’ve been a bit slow to explore its potential, which could also lead to some interesting hybrids – for example, the integration of thermal mass into lightweight buildings. With the reviews of the Building Regulations and NPPF, the overheating issue is clearly on the agenda – we will now need to fine-tune our ability to manage it.

Image: PRP Architects

5.5M

PROPERTIES ARE AT RISK FROM ALL TYPES OF FLOOD IN ENGLAND AND WALES

PRP Architects modelled the impact of climatic conditions up to 2080 as part of its design for 140 apartments/care beds at Red Lodge in York. The architect used overheating risk mapping to understand not only what was required to cope with a predicted temperature rise of 7.5°C by 2080, but also whether this capability should be built in from the start, or whether the building could be adapted over time. The conclusion was to use thermal mass, high-performance glazing and natural ventilation with scope to add in new measures in 2030, 2050 and 2080.

FLOOD-RESILIENT HOMES

Concrete has several properties that make it a good choice for homes in flood-prone areas. It has the strength to keep water at bay and few construction joints to let water through. It can be designed to resist very high loads, and is robust enough to withstand impact from debris.

But concrete doesn't only help to keep water out of a property. If water does get in, concrete is also easier to wash and disinfect than materials such as timber, and more resistant to rot or fungal growth. This reduces cost and disruption, particularly for short-duration floods.

Reinforced concrete or concrete blocks can be used as the structural wall in a solid-wall solution, or as one or both of the leaves in a cavity-wall construction. Another approach is to adopt an insulated concrete formwork system, which uses rigid insulation as the mould within which ready-mixed concrete is cast, before being finished with a surface treatment. The insulation properties are unaffected by moisture, making ICF appropriate for most flood situations. Where it is not possible to place the ground floor above the predicted flood level, a reinforced concrete slab, at least 150mm thick, is the preferred construction solution.

Photo: Hanson UK

The £62m upgrade of Blackpool's sea defences, built using precast concrete containing 50% GGBS. The Environment Agency's National Flood Resilience Review, published in 2016, highlighted the dangers of coastal flooding