Flood resilience **starts at home**

Anti-flood measures are an essential part of our response to climate change, not just a topic for winter or for high-risk locations, writes Elaine Toogood

Adaptation is an essential component of responding to climate change, and flood resilience is a core consideration. Around one in six UK properties are currently at risk of flooding from coastal and fluvial flood events, and this is set to double by 2050 due to changing weather patterns and increased urbanisation. Designing out avoidable repair and maintenance and extending the usable life of buildings or components will be key to achieving a net zero carbon society – repeated replacement of water-damaged fittings and fixtures has little place in a circular economy.

The threat of water damage is not limited to identified coastal or fluvial flood risk areas. Surface-water flooding, burst water mains and blocked drains affect all buildings irrespective of location. Choosing a water-resilient structure reduces not only the potential damage from external sources, but also other events such as undetected leaky pipes.

Property-level flood resilience

Property-level flood resilience (PFR) refers to physical measures or building components that reduce the risks of flooding to people and damage to buildings, and speed up recovery and reoccupation.

PFR is increasingly recognised as an important part of the strategy for dealing with flood risk. Later this year, the Environment Agency is due to publish its revised National Flood and Coastal Erosion Risk Management Strategy for England. The draft proposals indicate a shift away from potentially limitless barriers and towards an acceptance that some areas will flood, with a greater focus on flood resilience at property level.

The Social Market Foundation think tank, backed by government insurance scheme Flood Re, has proposed that flood performance certificates could, like an energy performance certificate, become an essential part of the information provided at sale or rent of a property, identifying risks and resilience measures.

As part of the Department for Environment, Food and Rural Affairs' Property Flood Resilience Action Plan, construction industry research body CIRIA has produced a code of practice for improving the flood resilience of properties, with more detailed guidance due to be published later this year. It will primarily focus on measures that can be introduced to existing buildings, either during repairs after a flood, or in anticipation of one. But as with retrofit measures for improving energy performance, it is widely recognised that improving flood resilience is much easier when considered from the outset – that is, in new buildings rather than as retrofit measures.

Strategies for property-level resilience

Establishing the type of flood event likely to affect a property is fundamental to establishing an appropriate solution. The design strategy should be based on anticipated flood depth, likely duration and source of flooding, but also take project-specific factors into account such as the cost of construction, the cost and impact of repair, and recoverability after a flood incident.

The first step is avoidance: locating the property at area of least risk and/or raising the accommodation above the predicted flood level. The second is site layout: using the landscape to reduce flood risk or delay its impact on the building, without increasing risk elsewhere, using features such as bunds, sustainable urban drainage systems and storage. Mitigation is the final step, where the layout, choice of construction materials and detailing are developed to keep the water out as far as possible (resistance measures), and minimise damage and speed up recovery when it does get in (recoverability).

REPEATED REPLACEMENT OF WATER-DAMAGED FITTINGS AND FIXTURES HAS LITTLE PLACE IN A CIRCULAR ECONOMY

The strategies for improving the flood resilience of an existing property are far more complex than for a new-build. It is rarely practical to raise floor levels above the predicted flood level, and opportunities for external measures to delay water ingress can also be limited. Mitigation of the building fabric, fixtures and fittings are therefore the main area of focus – but the limitations of existing layouts and sheer range of construction types mean solutions must be tailored to specific situations.

This is one of the challenges of developing appropriate guidance for retrofit. Clearly flood doors, non-return valves and other applied or integrated barriers to water ingress play an important role. More fundamental are improvements to the building enclosure and surface finishes. One method, shown to work effectively at the flood resilience demonstration house at the BRE Innovation Park in Watford, is to line the inside of the ground floor and walls with

◀ Shipston, West Midlands, 2018-ongoing

"As a nation we end up with a cycle of flood-damage-patch-repair, and focus that dwindles away in the spring. Then comes the flood season, everyone is surprised and we are not prepared again," says Richard Coutts, director of BACA Architects. Its amphibious house, featured on Grand Designs, is often rolled out in the press as a solution for "living with water", but a development of 12 homes nearing completion just outside Stratford-Upon-Avon is far more significant as a prototype for new buildings at risk of flooding to avoid this cycle of flood damage.

One could be forgiven for not noticing the flood measures carefully embedded into the development. All principle floors are raised above the Environment Agency's plus-20% climate change fluvial flood level, providing a safe haven within the properties, and there are no bed spaces on ground floors. A significant aspect of the design is the space made for flood water across the site, using a number of complementary strategies.

All the houses use cavity-wall construction, with a concrete block inner leaf. The concrete ground floors are raised on a reinforced-concrete frame, leaving an accessible void under the buildings. Internal walls forming the staircases and halls are also blockwork. "Concrete performs well in a flooded situation,' says Coutts. "It is robust enough to be unaffected by being submerged and dries out at a reasonable rate."

This non-defensive flood-risk management approach is also being adopted by BACA on a 300-home development for Yorkshire Water, working with Harper Perry Architects.

Images: BACA Architects

a waterproofing layer and drained cavity, allowing incoming water to drain away. Such techniques, more commonly associated with basement construction, are increasingly recognised as useful.

It is possible to adopt a "sacrificial" approach, in which elements of a building and its fixtures and fittings are treated as expendable, to be ripped out and replaced after a flood event. But this must be considered very carefully to avoid unnecessary cost of replacement, quite apart from the waste created.

Flood-resilient structures

It is important that the structure is not compromised by a flood event, and crucially repeated events, as this is the most costly and disruptive part of a building to replace. A quick recovery with limited additional expenditure and resources is clearly desirable, and here concrete and masonry construction offer significant advantages. Its performance is not affected by being submerged, or from drying out. Unlike framed solutions, it can also be installed without voids and with very few joints, helping to keep water out. All the recommended and preferred wall and floor constructions in the current British standard, BS 85500:2015 Flood resistant and resilient construction, are made from concrete or masonry.

Concrete and masonry can be both structure and final finish, offering the ultimate in material efficiency both during construction and after a flood. The time taken to dry out some types of water-saturated masonry is sometimes seen as a disadvantage to speedy reoccupation, but this is not an issue with an internally lined and drained solution such as used at the BRE flood house.

Concrete itself is very slow to absorb moisture, and can even be water-resistant, as in basement and swimming pools. There are also numerous clear surface-applied sealants that can limit moisture ingress. Those used to working in concrete understand that it can be supplied in a wide range of colours and textures, often with the appearance of stone. Where an exposed concrete surface is not desired, it also provides an excellent, stable base for other surface finishes, whether robust and waterproof, or sacrificial.

Concrete and masonry walls, floors and stairs, can provide resilience at the core of any building, even if all other measures are not installed from the outset. They can facilitate the application of further resilience measures in the future, as risk of flooding increases, especially if a whole building strategy has been considered from the outset. By embedding good flood-resilience thinking and materials in this quite simple way, we are better preparing our building stock for the future. "Be prepared" has become a mantra for those living with the risk of flooding, and surely all architects and developers should heed this advice.