Making sustainable, flood proof houses - issues and opportunities
by: John Alexander

With very few exceptions will flood protection be considered by many architects and property developers. In my view, most so-called best practice or innovative housing designs do not consider flood protection and so their design makes them vulnerable to water ingress in many ways. Quite why this is so is a matter of conjecture; but the following factors seem to me to play quite a significant part:

• *marketing*: emphasizing flood protection in new-build properties highlights the fact that such properties are indeed at risk of flooding, and this acknowledgement can be seen as an obstacle to property sales;
• *cost*: instead of being seen as an investment that protects the value of the asset, flood protection is often seen as an additional cost, which either reduces developers' margins, or inflates the up-front cost of the property;
• *aesthetics*: flood protection measures are seen by some (homebuyers, conservationists, architects) as something of an eyesore that detracts from the otherwise aesthetically pleasing qualities of the home;
• *social convention*: many prospective purchasers find having power sockets at a flood-resistant 1 metre above floor level unusual and, therefore, off-putting.

It is understood in the UK that you can only protect buildings to a maximum height of 600mm before the hydrostatic load on the exterior of the building will start to cause structural damage to the property. Older stone built houses, those with some new types of cavity wall insulation (e.g. Isotherm and purpose built properties) can withstand 900mm or higher with a structural survey. When considering flood protection at the block level it is good to start with an understanding of some of the terms we use and the rules we adhere to as flood protection practitioners. First of all, what is the difference between flood resistance and flood resilience?
Flood resistance: The idea is to keep the water out as long as possible up to the pre-determined height (e.g. 600mm). If the building is the subject of flash flooding this simply means protecting all the vulnerable openings such as doors, low-level winds, air brick and weep holes. If the flooding is ground water, surface water or river overflows, where the duration is greater than 24 hours, then attention to the walls and floors will also be essential, especially the join between wall and floor, where the greatest vulnerability exists.

Flood resilience: The next thing to ensure is that the internal fabric of the building can be recovered as quickly and cost effectively as possible. There are zero cost techniques for doing this in both new and retrofit properties. Install the plaster boards horizontally, raise the power sockets to a height of 1m, tile floors and fit lift-off rising butt hinges onto all ground floor doors. For existing buildings that persistently flood above the pre-determined height (600mm) then further measures can be taken using materials that do not absorb water, such as Dragonboard (a manganese oxide building board) for walls, floors, ceilings, architrave, skirting, etc., and Sealwise WCB in the fabrication of kitchens, studios, workshops, toilets, etc.

For new build then, of course, flood resistance should play the biggest part of the design by using suitable floor methods and raising elevations above the anticipated flood level. Interestingly, flood protection is also about low carbon buildings. A number of solutions for flood proofing a house will also allow it to become carbon neutral. For example, a house designed and built entirely of Dragonboard on a metal framed structure (clad internally & externally) can be built to a Code for Sustainable Homes Level 6, or retrofitted to a Sustainable Code Level 5. It will also give the property an in-built 2 to 4 hour fire retardant factor. Incorporating SUDS (sustainable urban drainage systems), water harvesting and renewable energy sources into the design will complete the package - and could even allow a Sustainable Code 6 house to be built in a flood plain!

Building protection rules: In my view, before occupiers start protecting their buildings they need to understand the flood risk first. This applies to new build, as well as existing housing and commercial property. I would argue for the following 7-step process of risk identification and management:  

In summary, there is a need to identify the risk, mitigate the risk and insure the residual risk. It is worth remembering that there will always be a residual risk in any flood mitigation solution as they all have design limits. In the housing scenario offered above this would be the pre-determined height (600mm) and in off-building schemes such as permanent flood walls/bunds it would be the return period, e.g. 1 in 100 year return event. As well as return periods these latter designs could also be based on how intrusive they are (height wise) as well as budget restraints.

Education: This is key. In my view, the biggest hurdle to providing sustainable flood resilient housing is the lack of knowledge amongst home owners, property developers and architects. I suggest that agencies and other government bodies who implement these schemes should do more to inform people of the residual risk. This in turn would mean that more would be done by property owners to protect their homes and businesses. In an industry dominated by small- to medium-size enterprises (SMEs), big budget advertising to the masses is not feasible so other methods must be used to raise awareness of the solutions available. One route is to get insurers to certify flood protection products as they do with fire and burglary solutions. In contrast with preventive measures taken in respect of both fire protection and protection from burglary (through, for example, the installation of smoke alarms and intruder alarms respectively), property owners who install manual flood barriers get no credit from the insurance industry, either in terms of reduced premiums or excesses. This is in spite of the fact that the cost of repairing damage caused by flooding is in most cases much higher than losses incurred through either burglary or fire.

Another is to provide models of what can be done. My company is planning to build a flood resilient house at our premises near the Innovation Park at the Building Research Establishment (BRE) in Watford, UK, in conjunction with BRE and Baca Architects. This building, which will be a hybrid incorporating residential, commercial and retail property types, will showcase all the latest flood protection solutions available in the market today and some forthcoming innovations.
Industry innovation: The flood protection market in the UK is very competitive, and even though it is still relatively small it is also very innovative. The drivers for this are, I believe, the insurance industry and home owners. The insurance industry is pressing for passive and automatic barrier solutions, whilst home owners are demanding aesthetically pleasing and architecturally incorporated solutions that don't necessarily identify incorporated flooding solutions to prospective buyers. A number of these examples are described and illustrated below.

Thus, passive solutions for houses include flood doors that look like normal doors. These are automatic barriers that companies are sourcing from the UK and abroad. They operate on the incoming flood waters, and when not in use are virtually hidden from view.

Automatic flood proof roller shutter doors and automatic rising barriers are also possible. The latter can be virtually any height and width, and are suitable for pedestrian and vehicle entrances,
as well as being used across highways for community wide applications. Similarly, SMART automatic air bricks can act as simple replacements for standard single sized air bricks. These can automatically close when the floodwaters arrive while still allowing sufficient air flow when fully open.

Flood safety doors, meanwhile, demonstrate how we now come full circle to the issue of flood resistance and flood resilience. A well-designed flood door will not only keep the flood waters out but it will also let the water in when the pre-determined height has been reached. Safety of people and (structural) security of buildings should be paramount in the design of these flood (safety) doors.

This is of course why flood-proofed kitchens and flood-proofed walls and floors are important in the small number of homes that will flood to depths greater than 600mm. The introduction of seals onto the doors and drawers of these kitchens means that the contents will remain free from contamination and flooding when the waters arrive. Simply hosing down, disinfecting and allowing to dry naturally will ensure people can be back inside their homes and running their businesses within 4 weeks of the flood event rather than the months and sometimes years that occurs now. Such internally flood-proofed kitchens also have to meet aesthetic criteria and models are now appearing from Germany, as most occupiers will not tolerate metal, industrial looking kitchens in their homes, regardless of how waterproof they are.