

# RIBA Policy Note

## The value of flood-resilient architectural design

The Royal Institute of British Architects champions better buildings, stronger communities and higher environmental standards through the practice of architecture and our 40,000 members. We provide the standards, training, support and recognition that put our members – in the UK and overseas – at the peak of their profession. With government and our partners, we work to improve the design quality of public buildings, new homes and new communities.

Architecture plays a critical role in mitigating flood risk and improving communities' health and wellbeing during flooding. Good design can help reduce the vulnerability of the built environment to flooding- both by protecting against the risk of flooding and ensuring that buildings are better able to deal with water if flooding cannot be prevented.

With the risk of flooding set to increase significantly due to climate change, the UK needs to consider how best to deal with flooding risk and examine whether new approaches could help minimise the damage to communities and infrastructure. To better manage and respond to flooding risks, the Government will need to work with the construction industry to adopt a new approach to decision making and regulation. This should include:

1. Improving decision-making processes to address a broader range of factors and potential solutions to water management issues
2. Piloting 'Licences for Innovation' to examine the effectiveness of new approaches to managing flood risk in new developments to flooding and ensuring all new buildings incorporate appropriate measures
3. Examining the potential for regulations on flood resilience to be linked to Flood Zone Designations through Building Regulations and planning policy
4. Regulating to ensure that all new developments in flood risk areas demonstrate reduced exposure and vulnerability to flood damage as well as broader benefits to the resilience of the local area
5. Encouraging greater uptake of flood-resilient design by home and building owners exposed to flood risk

Flooding is one of the greatest environmental threats to the UK. It causes an average of £1.4 billion in damage a year to businesses and households, but the impact of flooding goes far beyond the financial costs: it disrupts lives and livelihoods<sup>1</sup> and inflicts profound and long-lasting that extend far beyond communities that were originally flooded.<sup>2</sup> These include direct injuries and physical health problems, but also long-term anxiety and depression resulting from the impacts of damage to homes, having to move out until properties are habitable, and delayed recovery.

Considerable steps have already been taken to improve the protection offered to communities against increasingly extreme weather with up to £3.2 billion of funding available over the next few years. Flood defences covering over 100,000 homes have been built since 2015 and the launch of Flood Re, a joint initiative between Government and the insurance sector, will make flood insurance for home owners at the highest flood risk more affordable. However, Flood Re will only operate for 25 years – during this time, the UK faces a major challenge to retrofit and improve the resilience of both new and existing properties. Unless this is achieved, many homes are likely to become uninsurable again.

Even with continued large-scale investments in flood defences, it will not be possible to keep pace with the growing scale of the problem. As the latest UK Climate Change Risk Assessment makes clear, the UK faces enormous challenges in keeping pace with extreme flood events in the next 30 years. Today, 1 in 6 homes are at risk of flooding but, with the combination of extreme storms, intense downpours and rising sea levels forecast to hit the UK in the next 30 years, this number of at risk homes is expected to double by 2050<sup>3</sup>. Flooding will become the new norm; the Committee on Climate Change warns that “severe flooding somewhere in England in any given year is almost to be expected”<sup>4</sup>.

The implications are huge. In many parts of the country, we can no longer base our approach to managing flood risk on simply keeping the water out; we need to examine how we can design buildings and built environments which are more resilient to flooding. Whilst flood defences may provide protection against river and coastal flooding for large communities, there will always be some properties that cannot benefit from such schemes. As the 2015 flooding in Carlisle demonstrated, property level flood resilience and adaptation is increasingly important even where people are protected by high quality community flood defences. As the risk that existing barriers will prove insufficient in the face of extreme weather grows, the case for making buildings more resilient becomes more urgent.

Instead of focusing primarily on flood prevention, Government policy must start enabling communities and property owners to manage risks. This means better equipping people and businesses to live with water – stopping water entering their properties and speeding recovery if it does.

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<sup>1</sup> [Learning lessons from the 2007 floods](#) (Sir Michael Pitt Review, June 2008)

<sup>2</sup> [The English National Study for Flooding and Health: First year report](#) (Public Health England, January 2017)

<sup>3</sup> [UK Climate Change Risk Assessment 2017](#) (Committee on Climate Change, July 2016)

<sup>4</sup> Committee on Climate Change Adaptation Sub-Committee ([FFP\\_110](#))

## Good design can help future-proof new developments and deliver greater value for money when investments in new flood defences are made

Flood-resilient architectural design is already helping communities around the world to reduce the chances of their lives and livelihoods being disrupted in a flood, and some of this innovation is already being successfully implemented within the UK. However, Government action is required to speed this process up. There is also a need for an awareness-raising campaign to change public ideas about what resilient design means.

Flood defences play an important role in protecting UK homes and communities from flooding. The Thames Barrier protects 1.5 million people and half a million buildings comprising £200 billion worth of assets including many parts of the underground railway network. In many locations, physical flood defences are and will be the only practicable means of reducing flood risk.

Whilst the Environment Agency is a statutory consultee for new developments, urban development and water have a long history which requires a growing level of intervention to protect homes and businesses built in areas which we would no longer deem suitable for development. Rivers and coastal areas benefit from access to water supply and flat land for building, as well as transport links which increase trade opportunities. For these reasons, flooding was rarely a prime concern.

Additionally, in the past local planning authorities did not have to refer to any flood authority when designating land for development, nor did they have to submit plans for consultation to such a flood authority. Inevitably, local authorities which benefitted from business or domestic rates from new development had incentives to give planning permissions without due regard for the flood risk they were exposing new developments to.

As recent floods have shown, our historic development and past weaknesses in the planning system mean that significant amounts of our economic infrastructure and housing have been 'locked into' areas at risk from flooding and are now reliant on flood defences for protection. It is vital that money earmarked for flood defences is spent in a way which maximises the number of homes and businesses protected. At the same time, careful attention needs to be paid to the long-term financial burden on the tax payer of high running and maintenance costs.

The UK would do well to learn from other countries' innovative designs for flood defences that combine flood protection with a range of urban functions such as housing, ecology and transport in one multifunctional structure (case study 1). Such schemes provide practical alternatives in cases where necessary improvement of flood defences compete for space with other functions. This would particularly benefit coastal communities in the UK.

The most significant advantage of good multifunctional design is the potential for financial, social and environmental benefits to accompany the primary objective of reducing flood risk.<sup>5</sup> By adopting this approach, the Government could increase links between flood defence investment and urban regeneration and development. This in turn could also help to attract private investment to co-fund schemes, with a resulting reduction in the cost to the tax payer.

Future flood defence investment should also explore more adaptable design. By incorporating elements that are easily changeable in the future, this type of design can help to minimise future costs when flood defences need to be enhanced to meet future increased flood risks. For example, modular flood defences allow flood barriers to be easily and cheaply built high to adapt to future increases in flooding. It limits the amount of upfront capital that needs to be spent to build the scheme because it does not initially need to be built to its fullest height. However, when climate change forecasts indicate a need to adapt the scheme to higher flood levels, the structure can be easily adapted for minimum cost instead of rebuilding it.

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<sup>5</sup> <http://www.floodprobe.eu/partner/assets/documents/D4.2ConceptsforMFDfinal.pdf>

## Case study 1: Multi-functional flood defence in Katwijk aan Zee, Netherlands

A multifunctional design was used to upgrade Katwijk aan Zee's existing dike in response to increased development and rising sea levels. The new structure, consisting of a storm-proof wall concealed underneath an expanded strip of sand dunes, helped to preserve the village's character in addition to providing added flood protection.

The new dike design also enabled the safe integration of an underground parking lot on the land side of it and restaurants on the other, all covered by the same sand giving the impression of seamless integration. This also helped to tackle the village's growing parking problems, which were obstructing sea views, and provided attractive new recreational facilities for walkers.



Katwijk aan Zee dike redesign by Arcadis Netherlands, Royal HaskoningDHV, OKRA Landschaparchitecten, and WB de Ruimte (Photo: © Arcadis Netherlands)

The lack of design perspective in viability assessments for flood defences is a key missed opportunity to provide a compromise between competing functions, increase the benefits an infrastructure project can deliver to communities and to attract private finance to the schemes to ensure their maintenance is sustained.

**RECOMMENDATION 1:** To promote multi-functional and adaptable designs that deliver better value for money, Central and Local Government should work with built environment experts to improve infrastructure investment decision-making processes. They should:

- Increase time spent in the early stages to set objectives and generate better options
- Work across departments and disciplines in the early stages to develop integrated strategies
- Use strategic modelling to evaluate options early on, across multiple outcomes
- Evaluate projects after their implementation to better operate and help set future objectives
- Continuously collect and learn from data



## Case study 2: Linking urban development with flood defences via good design in HafenCity, Hamburg

A unique redesign of HafenCity, Hamburg's low-lying harbour area prone to storm surges, has helped to create a thriving new neighbourhood that doubles up as its own flood barrier.

A series of flood-proof plinths prop all buildings above expected flooding levels (circa 9 metres) enabling excess water to easily course through the development but limiting damage to residents' health and property. Inside, the plinths provide parking spaces for almost all the area's cars, maximising outdoor public space.

Above ground, the district design helps residents survive flood events without significant disruption to their daily routines and livelihoods. Transport corridors including roads and paths for pedestrians and cyclists sit at the same level as the buildings to allow the district to operate without significant disruption during times of high water. As the elevations bring the district to the same height as the rest of Hamburg, residents can stay connected to the city when their island experiences flooding. Retail spaces with flood doors to protect businesses during floods and a floodable promenade connect residents to the waterfront during dry periods.

This design solution enabled the costs of flood-proofing this new community to be distributed and born entirely by developers. Additionally, by embedding flood protection directly within the building fabric, the design avoided the need for significant upfront public investment into traditional dikes to protect the area, which would have taken years to complete to enable safe development and before the city realised any return on investment.



HafenCity masterplan designed by KCAP/ASTOC Architects and Planners (Photo: © HafenCity PressPicture)

## Good design can improve the resilience of housing on flood-prone sites

The National Planning Policy Framework (NPPF) helps to control the level of flood plain development. Councils are expected to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, including floodplains.<sup>6</sup> However, the NPPF does not explicitly rule out development in high flood risk areas. To put this in context, around 10 per cent of England, including large parts of major cities such as Hull, Portsmouth and central London are located in areas with a high-level of flood risk.

There are many sites in urban areas where the costs of stopping or removing flood water would render conventional development financially unviable. Although these constraints often deter development, innovative design solutions pioneered within the UK and around the world have helped to unlock development on many difficult sites, bringing life back to abandoned sites and creating more homes (case studies 3 and 4). Projects like these have a key role to play in enabling new and existing development schemes to safely live with water cost-effectively.

### Case study 3: Climate Adaptive Neighbourhoods in Norwich

The CAN project has advanced the design of an existing masterplan for a major brownfield site redevelopment in Norwich, enabling the development of 72 homes and approximately 2000 square feet of retail and restaurant space in a flood-prone area.

Instead of preventing water from flooding the site, the designers strategically positioned buildings to minimise the risk of flood damage and used building materials which enabled buildings to be resistant to any excess water.

All buildings were designed to be flood resilient, use little water, and avoid overheating – collectively tackling key climate change challenges facing East Anglia. Without increasing capital costs, the designers also made the buildings easy to adapt to change, minimising future retrofitting costs.



Cross-section of the CAN project in Norwich by Baca Architects (Photo: Baca Architects)

<sup>6</sup> [Housing: Floods Lords HL5515](#) answered on 4 February 2016

## Case study 4: Relieving critical housing shortages in Amsterdam via floating settlements

Waterwoningen is a floating neighbourhood off the coast of Amsterdam comprising 75 two-, three- and four-storey units connected to each other and the land via a network of buoyant walkways. The development was conceived to deal with the city's critical housing shortage and to curb inland urban sprawl.

By designing the units for offsite manufacture and assembly within 4 months, the designers enabled the cost of the new homes to be brought in line with similar-sized dwellings elsewhere in Amsterdam's new suburbs. However, few are as easily accessible from the city centre as Waterwoningen- just a 15min tram ride from the city centre.



Waterbuurt development by Marlies Rohmer Architects & Urbanists (Photo: Roos Aldershoff)

Because innovative developments like these are a first of their kind, statutory guidance, building standards, and approved construction techniques for new flood resilient properties are lacking. This makes it impossible for innovators to secure loans from traditional funders, warrantors and mortgage providers, resulting in much less experimentation taking place than otherwise could. The Government needs to become more proactive in filling in these voids to enable more market-driven innovations that can reduce the vulnerability of new developments to flooding.

Building regulations that adequately address flood resilience will help to stimulate an effective market for flood resilient property. They would also address the existing 'disconnect' between planning requirements for building flood resilience measures and their implementation, which is not always followed through into construction<sup>7</sup>.

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<sup>7</sup> [Future Flood Resilient Built Environment](#) (BRE, 2016)



**RECOMMENDATION 2:** To encourage market-driven innovations that can reduce the vulnerability of new development to flooding, and ensure all new buildings incorporate appropriate measures, the Ministry of Housing, Communities & Local Government should work with built environment experts, the Environment Agency and the Department for Environment, Food & Rural Affairs to examine the feasibility of introducing Building Regulations, planning regulations and planning guidance for flood resilience and resistance that are linked to Flood Zone Designations:

- Flood resilience measures should be advisory but not mandatory in Flood Zone 1.
- As flood risk increases in FZ 2 and 3 or where surface water flooding may be an issue such as urban areas, the resilience measures should increase. That way the response is proportional.

It will take time to incorporate resistance and resilience requirements into Building Regulations for properties in flood risk areas. To fill in this void, RIBA is supporting the Construction Industry Research and Information Association and Better Regulation Executive in developing the Property Flood Resilience Code of Practice and consolidated guidance that provides a standardised approach for the delivery and management of flood resilience measures<sup>8</sup>.

In the lead up to Building Regulations for flood resilience and resistance, market-driven innovations in flood resilient design should also be fostered via the planning system. One solution could be Licences for Innovation which enable innovative designs to unlock flood-prone sites for suitable development. Based on strong overarching environmental design aspirations, the licenses would allow more flexibility in terms of compliance with current planning policy.

Each city region or local authority could be enabled to grant up to 5 licenses a year to encourage public and private companies to innovate and compete to find ways to deliver more housing, more quickly, and more sustainably.

The administrative bodies should distribute the licenses based on the innovation's potential and achievability, and tax breaks should be made available to these demonstration schemes. The tax breaks should be conditional upon projects meeting key milestones during construction, and should be maintained for a pre-determined period subject to an evidence base being presented post-occupancy to demonstrate the schemes met their original goals and objectives.

Should projects under the licence fail to meet original goals and objectives, they should be placed on 'watching briefs' – allowing up to two years to rectify and modify building schemes to meet their original targets. If, following this period, the schemes continue to fall short of original briefs, the buildings would have to be brought back in line with current and building codes to ensure their compliance with conventional regulations.

The licenses would incentivise public and private companies to innovate and compete, yielding schemes that both alleviate housing pressures and stimulate technological creativity which could be exported to the rest of the world, giving the UK a competitive advantage. Successful pilots would incrementally raise the bar for sustainability and filter into policy reform. Additionally, the License for Innovation would provide funding organisations the confidence to invest in alternative approaches to property

**RECOMMENDATION 3:** To enable innovative design that unlocks flood-prone sites for suitable development, the MHCLG should explore the potential for trialling Licences for Innovation. Local Enterprise Partnerships and Combined Authorities should be encouraged to work with local authorities to bring forward new project types.

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<sup>8</sup> [Code of Practice and guidance for property flood resilience](#) – RP1055



## Good design can harmonise development with water, revitalizing city centres and providing affordable housing in desirable locations

Many urban areas are underutilised in cities facing housing pressures. Today, we are witnessing bold experimentation and innovation from cities like Liverpool, Hamburg and Amsterdam which are employing flood-resilient design to re-use and re-imagine previously underused canals, wharfs and docks to provide housing in desirable locations and revitalise city centres (case study 5).

### Case study 5: Making water the lifeblood of communities, Liverpool Waters

Liverpool Waters is a £5.5 billion, 30-year regeneration scheme of Liverpool's disused historic docklands in a world-class, mixed-use waterfront. The scheme will lead to the creation of five new dynamic neighbourhoods spanning 2 kilometres of river frontage, part of which is classified as a World Heritage site.

By bringing various water space owners together, the Liverpool City Region Combined Authority was able to co-ordinate and designate developable water space in this central location. A successful masterplan provides a basis for the creation of 90,000 residential units and facilities for business, leisure and culture, which will yield 20,000 new jobs. To ensure all new development is underpinned by good, flood-resilient design that delivers wider community benefits, the Combined Authority set out a Water Spaces strategy for the scheme.

The strategy prescribes a range of appropriate activities within each neighbourhood and provides guidance on scale, massing and planning envelopes for potential investors. The next level of detail sets out Development Principles that focus on preserving and enhancing specific qualities of waterside settlements, respecting the historic setting and ensuring flood resilience at both dockside and water level.



Liverpool Waters. Masterplan developed by Chapman Taylor Architects; Water Spaces Strategy developed by BACA Architects (Photo: Chapman Taylor Architects)

Water spaces tend to be under the control of many different authorities and government bodies. If, like Liverpool, these water space owners were brought under one umbrella (e.g. a Combined Authority) to co-ordinate and designate developable water space in cities, attractive sites could be unlocked for development. For example, if only 5% of enclosed water spaces in London were considered for floating development, this could provide an additional 3000 homes or businesses in the capital where land prices come at a premium.

While floating homes and restored dock-side warehouses will require a specific set of standards and bespoke conversations about managing risk, the reality of most development in flood risk areas is much less radical. With growing pressure on land supply and huge financial rewards available to land promoters who can successfully bring forward land for housing use, a growing number of homes are being built on land which is or will become vulnerable to flooding.

Where risks of this sort are recognised at the outset, there are a number of ways in which regulation can ensure that any development which does take place does not lead to further increases in risks. Some of these solutions will be design based (case Study 6) while others are less visible. As a basic principle, regulations should require that development is taken forward in a way that minimises the vulnerability of the new buildings to flooding while reducing the overall exposure of local communities (and those downstream) to flooding as a result of new development.

**RECOMMENDATION 4:** To harmonise development with water, revitalise city centres and provide affordable housing in desirable locations, flood-prone cities with housing shortages should seek to adopt regulations which require all new developments in flood risk areas to demonstrate reduced exposure and vulnerability to flood damage as well as broader benefits to the resilience of the local area.

- Water space owners should be brought under one umbrella (e.g. Combined Authority) to co-ordinate and designate development sites on disused water bodies where this method would be an appropriate means of delivering flood resilience and affordable housing.
- Development on these sites should be in line with the RP1055 code of practice and guidance for property flood resilience.

## Case study 6: The Home for All Seasons, flood-resilient design that prioritises resident's protection, comfort and independence

This future-proof design draws on the principles of good place-making to improve the experience of residents in the face of extreme weather conditions.

The design uses resilience to a variety of hazards as a feature to enhance the way in which residents can live and enjoy their homes. Living areas and utilities are positioned on the first floor to limit the level of disruption flooding causes to their daily lives, while elevated walkways at the same height enable residents to safely move around during a flood, reducing demand on emergency services. During normal conditions, the walkways are used as private balconies and the buildings are accessed from the ground floor.

In the event of a flood, residents can move their vehicles to designated safe zones and head back along the walkway, checking in on their neighbours before returning to their homes. After a flood, rooms on the ground floor can be hosed down, disinfected and life can continue as normal. This is drastically different from the lengthy and stressful upheaval that often occurs when a community floods. The development is designed to minimise water displacement to surrounding areas, enabling compatibility with sustainable urban drainage strategies and unobstructed through-flow of water.



The Home for All Seasons designed by JTP and The Environmental Design Studio (Photo: JTP/ The Environmental Design Studio)

## Good design makes communities healthier and safer before, during, and after flooding events

As demonstrated by examples from all over the world – from Hurricane Katrina in New Orleans in 2005, to the 2007 floods in the UK – investing in preventing or limiting the impacts of extreme weather is much cheaper and has less social impact than recovering afterwards. Not all risks can be prevented, but pre-emptive action to reduce the impact of extreme weather and a swift, effective response to the event can reduce the health and financial impact of an event and speed up recovery.

Flood defences and the right insurance cover are vital in protecting homes and businesses against the worst effects of flooding. But increasingly, the use of resilient design is becoming a key tool in reducing the misery and disruption caused by flooding, particularly in areas which do not benefit from flood defence protection or experience fluvial or ground surface flooding.

Resilience can be designed into buildings either as a preparatory measure or during the repair of properties after they have been flooded. These measures can help to limit the number of residents that need to be rescued from their homes, are displaced for months, and those who endure lengthy periods of loss adjusting and reconstruction. They can also aid rapid recovery, enabling households and businesses to simply wash out and disinfect after flooding, rather than requiring wholesale replacement of the fabric of the property (case studies 6 and 7).

Despite the obvious advantages of this approach, the take up of flood resilient measures remains low. It is not yet normal practice for properties in areas at high flood risk to be made more resilient following a flood. Resilient solutions can be developed through research and innovation, but there is a need to address policy and practice in order for such solutions to be implemented early enough in planning and building new developments. The Property Flood Resilience Action Plan set out an aim that within 5 years, it would be standard practice for properties in the UK at high flood risk to be made resilient.<sup>9</sup> The RIBA welcomes this goal, we hope that our recommendations can help move us towards reaching it.

**RECOMMENDATION 5:** To ensure flood-resilient design is more proactively taken up by home and building owners exposed to flood risk:

- Local Planning Authorities should incorporate plans for improving existing buildings' flood resilience in Local Plans. They should work with communities at significant flood risk to develop building improvement plans to help them build capacity to manage flood risk.
- Local Planning Authorities should be able to use CIL and S106 contributions towards helping communities realise flood resilience improvements to existing buildings, providing these plans are embedded within Local Plans.
- The MHCLG should amend building regulations to require buildings being rebuilt or renovated to incorporate climate resilience improvements.
- Defra, Environment Agency and Department of Health should incorporate a section on flood resilient design in the next iterations of the National Flood and Coastal Erosion Risk Management Strategy and National Adaptation Programme.

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<sup>9</sup> The Property Flood Resilience Action Plan, Dr Peter Bonfield OBE, Department for Environment, Food & Rural Affairs, September 2016, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/551615/flood-resilience-bonfield-action-plan-2016.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/551615/flood-resilience-bonfield-action-plan-2016.pdf)



## Case study 7: 'Flood-resilient retrofit' design enabling households to move back to flooded property within an hour, BRE Flood Resilient Home, Watford

This pilot scheme was developed to demonstrate alternative post-flooding home repairs that will not be affected by subsequent flooding.

The designers adapted a model Victorian terraced house with materials that enabled it to become resistant to flooding (up to 600 millimetres deep), such as flood resistant doors, windows, kitchen, wallboards and insulation. To enable the property to cope with water levels exceeding this depth, a range of resilient measures had been incorporated, including higher electrical outlets, building materials with water-repellent seals and an automatic sump that detects and removes any excess water from the property. These features enable the property to dry out quickly and become habitable shortly after a flooding incident.

A 'live flooding' of the property had demonstrated the property can dry within an hour, proving the success of flood-resilient design in limiting future damage potential of floods, even in traditionally built properties.



'BRE's Flood Resilient Repair Home designed by BACA Architects in collaboration with Defra, Natural Cement and AXA