Overcoming the Barriers to Installing Property Level Flood Protection: an Overview of Successful Case Studies.

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Recent changes in the focus of flood risk management policy in the UK have led to an increased emphasis on making space for water. In the recognition that not all property at risk of flood can or will benefit from traditional engineered flood defences, the need arises to facilitate and encourage the use of property level solutions. Take up of measures by populations at risk have been low in the past and many barriers have been identified which limit adoption. A key informational deficiency is the lack of information about successful schemes. The collation of successful case studies from UK published sources and from flood protection companies, demonstrates that it is possible to design effective property level defence. Analysis of common features shows that in the majority of cases the option to keep water out of the property is preferred. However, many tried and tested flood protection schemes combine both wet proofing (resilient) and dry proofing (resistant) elements. As may be anticipated the experience of past flooding was a critical factor both in the decision to flood proof and in the choice of measures.

Introduction

Property level flood protection is an essential element of modern flood risk management strategy. In the UK and in other European states the notion of permanent engineered defences providing lifetime flood protection for all has given way to the recognition that stakeholders must choose from a suite of appropriate methods to manage the risk from flooding (Rooke 2007, Kelly and Garvin 2007, Ashley *et al.* 2007).

Many studies have observed that the take up of property level measures remains low in most communities at risk of flooding (Correia *et al.* 1998, Grothmann and Reusswig 2006, Thieken *et al.* 2006, BMRB 2006, Harries 2007, Norwich Union 2008). The barriers which have to be overcome in the installation of flood protection methods have also been identified in the past (Sims and Baumann 1987, Grothmann and Reusswig 2006, Proverbs and Lamond 2008, Norwich Union 2008). Barriers include financial, informational, emotional and timing factors. In the six stage path to installation these barriers can be encountered several times and must be repeatedly overcome (Proverbs and Lamond 2008). However, despite these difficulties, there are many examples of home owners and businesses retrofitting protection measures. This demonstrates that it is possible to overcome the barriers. This paper examines a selection of case studies with the dual aim of recording grass roots activity in the academic literature, and of identifying any common features. This may assist in

generating awareness of possible solutions and means of overcoming barriers in the future.

Property Level Flood Protection

Property level flood protection is often categorised into resilient (wet proofing) and resistant (dry proofing) solutions. Resistant solutions are focussed on keeping water out of a property and are typically employed in flood situations with low velocity, short duration and depths below about a metre (Zevenbergen *et al.* 2007). Resilient solutions allow water into the structure of a property and are designed to prevent damage to the interior and contents. Advice regarding the suitability of various measures are available from many sources for example the US Army Corps of Engineers (USACE 1998), Communities and Local Government (Bowker 2007) and the Association of British Insurers (2006).

In order to achieve a water proof structural envelope it is necessary to consider all possible entry points and select barriers to prevent ingress. This selection must then be made from among a bewildering variety of possible solutions. It is recognised that dry proofing may be difficult to achieve (Aglan *et al.* 2004) and that under some circumstances, water must be directed and pumped away from vulnerable points in order to prevent structural failure. Investment in partially resistant solutions or resistance which may be overtopped could be regarded as wasteful of resources because damage may still occur. This may be true for badly designed systems, which have not considered all ingress routes thus allowing other barriers to be bypassed. However, well designed partial resistance may delay or limit water ingress thus allowing time for evacuation and removal of contents.

Once water is allowed into the building however, the danger of structural failure decreases but the internal structures and contents become vulnerable. Any investment in resilience can prove worthwhile, as internal structures may be protected on a piecemeal basis with each resilient measure contributing to cost savings. Resilient approaches may include removal of vulnerable items, protection in situ via waterproof coatings or choice of materials which are not damaged by water, absorb water slowly or dry quickly. It has been noted that the most cost efficient time to undertake resilient installations is during repair or planned renovations (Thurston *et al.* 2008, Proverbs and Lamond 2008). If fast reoccupation is the desired outcome then a holistic approach must be taken, as repair time is determined by the slowest drying structure.

Advocates of resilient solutions propose them on the grounds that they are more versatile and do not require deployment. The annoyance of false alarms is lower and from an insurance point of view the risk of warning failure is removed. However, the emotional preference for keeping water out is commonly recognised (Harries 2007, Lamond and Proverbs 2009) and may lead to a preference for resistant measures.

The case studies

For this analysis case studies were drawn from UK sources, mainly online such as: the National Flood Forum; the Flood Protection Association; websites of resistant and resilient product suppliers and government documents. Table 1 shows the breakdown of the case studies by main source, although some were available from

more than one source. The amount of information available on the case studies varied depending on the source and further details were sought from the originators. However the set of data was still incomplete for many case studies. It should also be noted that (apart from the National Flood Forum case studies) the authors have not verified this information Inclusion in the study does not imply endorsement of particular solutions or companies.

Table 1: case study sources

Source	Reference/website	Number
Floodguards	http://www.floodguards.com	9
Defra scoping report	(Bowker 2007)	4
National Flood Forum	http://www.floodforum.org.uk	11
Floodgate	http://www.floodgate.ltd.uk	1
Flood Protection Association	http://www.floodprotectionassoc.co.uk	8
Norwich Union	http://www.floodresilienthome.co.uk	1
ODPM guidance	(ODPM 2003)	4
Property care association	http://www.property-care.org	1
Caro Flood Defence Systems	http://www.caro.co.uk	4
Total Flood Solutions	http://www.totalfloodsolutions.com	14
Flood Ark	http://www.floodark.co.uk/arkaction	1
All case studies		58

Two of the case studies are detailed below, illustrating a mainly resilient and a mainly resistant solution.

Case Study 1: resilience

A house in Oxford was flooded three times, in 2000, 2003 and 2007. After 2007 resilient features were installed. Figure 1 illustrates several features of the scheme. The stone floor which replaces an oak one has been sealed to make it waterproof. Wooden panelling was replaced with simulated plastic wood. Grilles were inserted to allow the brickwork below to breathe. Sockets were raised throughout.

Figure 1: resilient case study Source National Flood Forum

Other features not illustrated include a sump and pump system, a cheap, disposable kitchen with plastic legs and raised appliances.

Case Study 2: resistance

A frequently flooded 16th Century detached property in Worcestershire has flooded 23 times since 1970. Protection measures tried in the past included pump and sump, wrapping in plastic and door barriers. These measures had failed in some floods including 2007. The latest installation of veneer walling, pumps sumps, door guards and non-return valves protected the property to 680mm in 2008. Figure 2 illustrates the way in which the scheme has been designed to be sympathetic to the character of the period building.

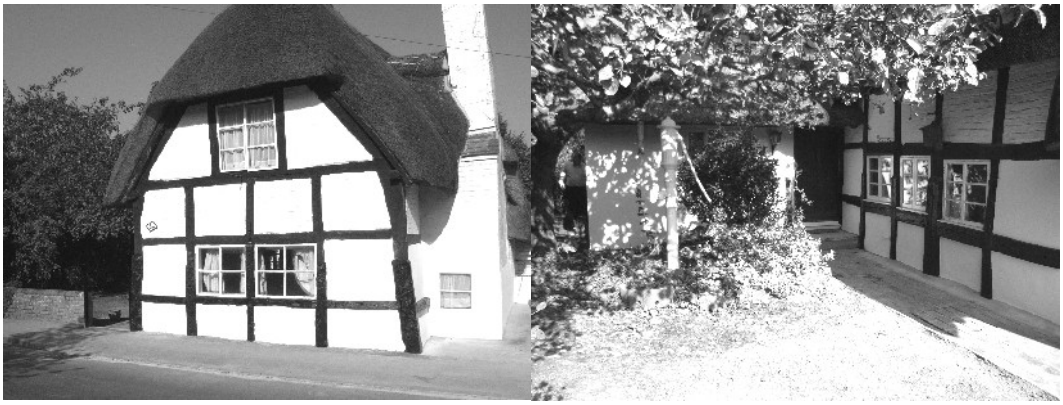

Figure 2: resistant case study **Copyright Total Flood Solutions**

Analysis of features

The case studies represented a variety of flood scenarios, property types, flood and insurance histories. Geographically there were examples from Scotland, Wales and many English regions. It is clear that there are some common features of property level protection systems but that the choice of particular products and approaches is sometimes determined by the choice of installer.

Choice of protection system

Given the range of possible solutions available it is difficult for property owners to choose the solution most suited to them. The British Standard kitemark scheme certifies a defined performance standard for products but does not assure that they are appropriate for an individual scheme. There is also no professional qualification which assures competence in assessing property level flood protection needs. In these case studies some had done extensive research into flood protection and selected their own system, home made flood boards and creative use of resilient materials featured in these schemes. Others had employed experts to design solutions for them. While these could be independent surveyors, they were more frequently suppliers of protection products. Choice of expert was sometimes based on recommendation, on observing neighbours with successful schemes. Companies used by the Environment Agency or those using kitemarked products were also favoured.

Type of installation

Only three case studies consisted of resilient solutions alone, 36 solutions were resistant and 18 were combined. The prevalence of resistant methods could partly be due to the case study sources. However, even in case studies where resilience was the aim of the project, such as the Norwich Union Flows project (Norfolk County Council 2005) or in Peter Rawcliffe's flood resilient home (Rawcliffe 2008), door barriers were usually included as well. The first preference seems to be to keep water out (Proverbs and Lamond 2008), and only where it is recognised that barriers can be breached, or that water may exceed a metre, is resilience also included.

The simplest type of installation (shown on the NFF website) was a single gate guard, preventing water from reaching the vulnerable parts of the property. For many properties door, window and brick guards were sufficient to protect against flooding. Others, with more permeable walls or longer flood duration, needed flood skirts, veneer walling or coated brickwork. Finally others combined resistant and resilience including tiled floors together with sump and pump systems in case of seepage or overtopping.

Property Types

The majority of the case studies featured detached property. One of the many possible explanations for this tendency is the greater difficulty in defending attached property if neighbouring property is not protected. Solutions to this difficulty observed in the case studies included collaboration between neighbours. For example two semi-detached neighbours both installed self sealing 'smart' airbricks to protect against a regular shallow flood problem. Twelve semi detached properties collaborated to build a wall, whilst council properties were all protected by council-provided door guards. In such cases of course it is important that neighbours assist one another during deployment.

Flooding history

Flood history is an important component in the motivation to undertake measures (Grothmann and Reusswig 2006, Lamond and Proverbs 2009) and this was reflected in the case studies. Information about history was available on forty examples and only two of the properties had not been flooded in the recent past. One of these was a coastal property which was increasingly threatened by the policy of managed retreat, but which had not flooded since 1953; the other was required to undertake measures due to planning regulations. Flood experience ranged from one to 23 floods, but the majority suffered more than one flood before installing measures. Owners believed that the first flood was a 'one-off' or said that they were waiting for 'something to be done' about the risk. Conversely, others had insurance problems, particularly commercial properties, and were forced to take steps after one large claim.

Deployment

One of the advantages of resilient over resistant solutions is that the latter often rely on deployment. Insurers might regard the need for deployment as a risk and for some case studies cover was conditional on barriers being in place during the flood. However, many of the case studies were hybrid system designed to keep water ingress to a minimum level but backed up with resilient features. Other resilient solutions involved moving items, sometimes deploying hoists or removing doors and

cabinet fronts. For these case studies, contrary to conventional wisdom, the examples requiring no deployment usually involved resistant features such as raised thresholds and 'smart' or periscope airbricks but were limited to very shallow flooding. This finding highlights the importance of good flood warnings and deployment plans whether resistance or resilience is planned.

Cost and financing

Cost information was available for 22 case studies. The cost of solutions for domestic property varied from £50 for a single gate barrier to £30,000 with a median cost of £8,000 and a mean average of £10,142. On average those solutions which included resilient measures cost more than those without. However, some resilient solutions cost very little, especially those which were installed during restoration work. These installation costs often compared favourably with previous bills for restoration.

Payment details were available for 26 case studies. Of those the owners were wholly responsible for payment in 15 cases. Grants paid for five, five were paid for by a combination of owner and insurer, and one was wholly financed by the insurer. The insurer funded cases were usually installed during restoration and included resistant and resilient features.

Performance of systems

Performance data was not always available: 22 case studies reported the results of testing in real floods. As might be expected, given the source of the case studies, all but two proved successful in defending against floods. One case study, a wall surrounding several properties, was eventually overtopped, but allowed residents plenty of time to move furniture and limited the damage. The other case study involved seepage through walls which had not been protected. The owners had not taken the advice of the installer of the barriers that such protection was necessary but are now waterproofing the walls as well.

Many resistant measures kept water completely out of properties, contrary to perceptions that this is nearly impossible (Elliot and Leggett 2002, Aglan *et al.* 2004). Many of these were expensive individually designed systems costing £20-30k but others were just carefully placed door guards. Clearly understanding the nature of the flood risk to a property is vital. Once this is achieved then designing an optimal defence is possible. In the UK where the majority of properties are flooded to a fairly shallow depth, simple resistant solutions can be very effective (Wassell *et al.* 2009).

Insurance

Insurance information was available for 19 case studies and 18 of these had full flood insurance. One commercial property was uninsured for flood. This supports findings elsewhere that flood risk property can find insurance (Lamond 2008) but these case studies show more evidence of owners driven by insurance costs to install measures than previous surveys. Four examples stated that insurance was conditional on measures. A further five had gained cheaper insurance directly through installing measures. Premiums of over £3,000 and excesses of up to £30,000 had been avoided.

Summary and conclusions

The case studies collected for this analysis reflect a growing trend to property level protection and are illustrative of a wide range of scenarios facing property owners and residents in the floodplain. However, due to the sampling method, they do not represent a sample of typical floodplain properties, or of all attempts to protect against the effects of flooding. On the whole they are successful case studies that illustrate what can be done to protect individual properties against flooding.

In common with previous research these case studies illustrate the desire of property owners to keep water out. Evidence, via testimonials and photographs was gathered that resistant property level measures could defend property against deep and prolonged flood events. Some owners had tried more than one solution and arrived at a system that suited them via trial and error.

The case studies show that successful flood protection is possible and can give floodplain residents great peace of mind. Systems need to be carefully designed to take account of flood risk and the needs and preferences of the property owner. Professional surveys can assist this design process and recent developments in the industry mean that there both independent surveyors and flood protection companies that can supply surveys and tailor solutions.

At an average cost of £8-10k these case studies represented significant investment. Finance problems were overcome by these most property owners by self funding with a few using grants or insurance funding. Self financing is not an option for all property owners and a couple of these installations had stopped short of complete protection due to financial limitations. In the aftermath of a flood is often the optimum time to install resilient flood protection. For many property owners this allowed much of the cost to be absorbed within the insurance claim. However, there was no evidence to suggest that those using grants or insurance funding had spent more or had better protection.

In examining the motivation to make the investment the need to gain insurance cover was mentioned in some case studies, particularly for commercial property and appears to be a growing concern. Peace of mind was another driver: in common with much previous research the overwhelming majority of case study properties had been flooded in the past.

This paper has summarised a sample of case studies, most of which were collected from online sources. As such they are available to floodplain residents with the desire and commitment to seek them. However more property owners might be encouraged to install protection if such case studies were publicised in a timely fashion to recently flooded populations.

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