

Resilience of the built environment

Dr Stephen Garvin – Director, BRE Centre for Resilience

Part of the BRE Trust



- **BRE Centre for Resilience** is a Research Hub that will deliver research and innovation in partnership with government, universities, the construction industry and the insurance sector
- Working together to provide a platform of resilience expertise for the UK, facilitated by BRE and its HEI and private sector partners
- National and global resource for government, local authorities, environment agencies, industry and the public
- Collaborative: 400 ‘friends’
- Partnership – strong leadership based collaboration – government, industry, academic.
- Bre.co.uk/resilience
- www.centre4resilience.org **

Resilience

- ‘the ability of assets, networks and systems to anticipate, absorb, adapt and / or rapidly recover from a disruptive event.’
 - *Cabinet Office*
- Resilience means the built environment being better at preparing for and responding to the extreme weather events, natural disasters, man-made disaster, crime, terrorism, resource loss, fire, IT/cyber failures,



- Inefficient market responses lead to market failures
- Organisational failures and community incoherence
- Complex socio-technical interdependencies
 - Need to understand personal and corporate behaviours
- Knowledge gaps; products and services
 - Unproven responses and technologies
- Lack of standards
- Sudden shocks vs. long term change
 - Non-stationary risk statistics

Resilience Research Programme

Property Flood Resilience

Overheating

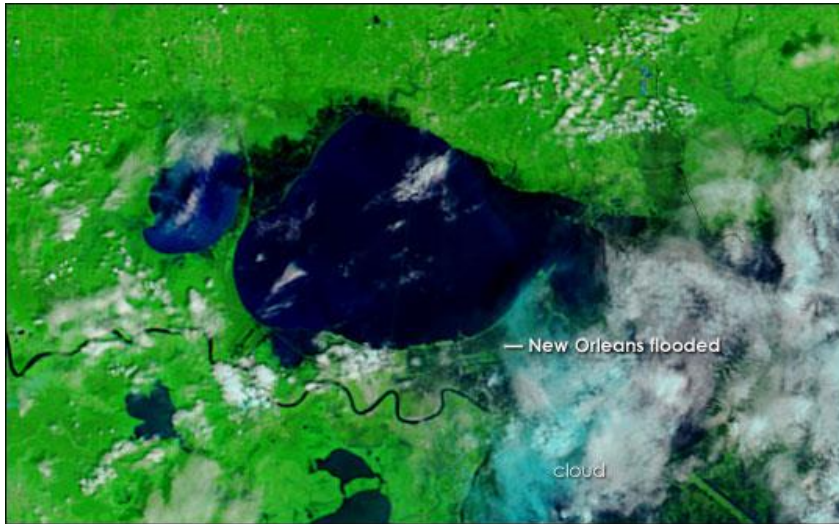
Wind loading

QSAND Development

Community Resilience (University of Brasilia)

Energy Resilience

New Orleans - 2005



August 30, 2005



August 27, 2005

- “In the wake of Hurricane Katrina, much of New Orleans is under water, see the satellite image, taken on August 30, 2005, at 11:45 a.m. Early news reports say that as much as 80 percent of the city is flooded after levies failed to hold Katrina’s massive storm surge back. The flooding is getting worse as water slowly seeps into the city from Lake Pontchartrain”
- 1250 deaths
- 95,000 properties damaged
- 35,000 uninhabitable still

Hurricane Sandy 2012 (November)



US East Coast – sea level

- ‘Sea level rise on the US East Coast has accelerated much faster than in other parts of the world—roughly three to four times the global average.
- Heavily populated region a sea level rise hot spot, cities such as Boston, New York, Philadelphia, and Baltimore could face a more flood-prone future’
- *National Geographic, 2012 (published before Sandy!)*



Storms and floods, 2017



British Virgin Isles 2017

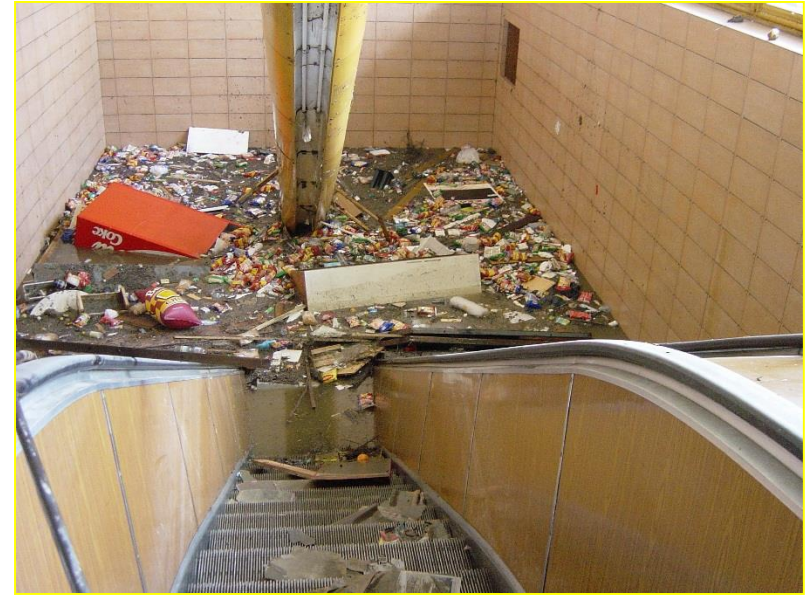


Florida 2017



Houston 2017

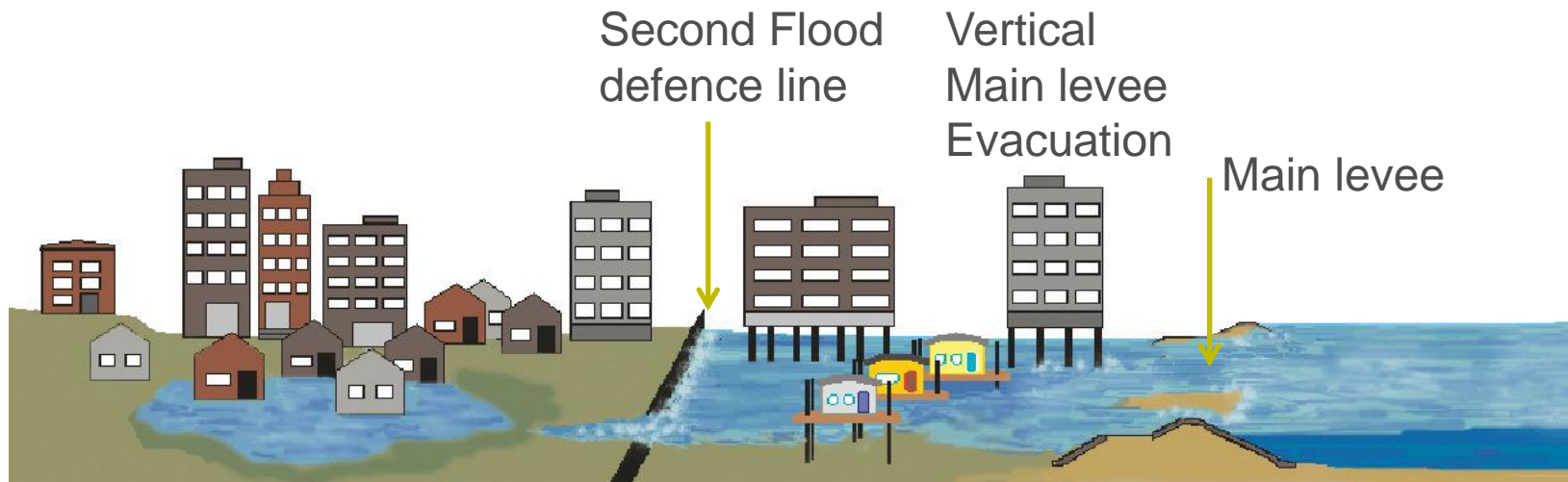




**Flooding, 2002 (Prague,
Central Europe) - ... Floods
Directive 2007**



Germany - cascading flood compartments with adaptive response



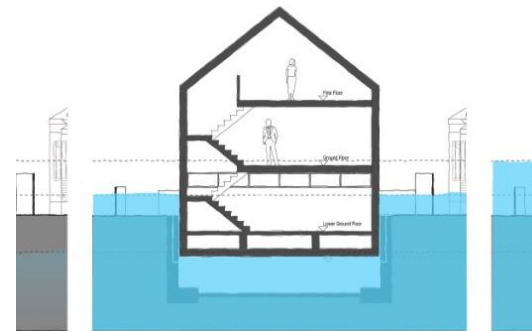
**Adaptation to
flooding dry
and wet-proofing**

**Adaptation by
floating and
amphibious
homes, homes on
piles**

REF: Flood Mitigation Using
Cascading Dike System
Nehlsen, E., Wilke, M.,
Goltermann, D., Pasche, E.

Flood resilience measures

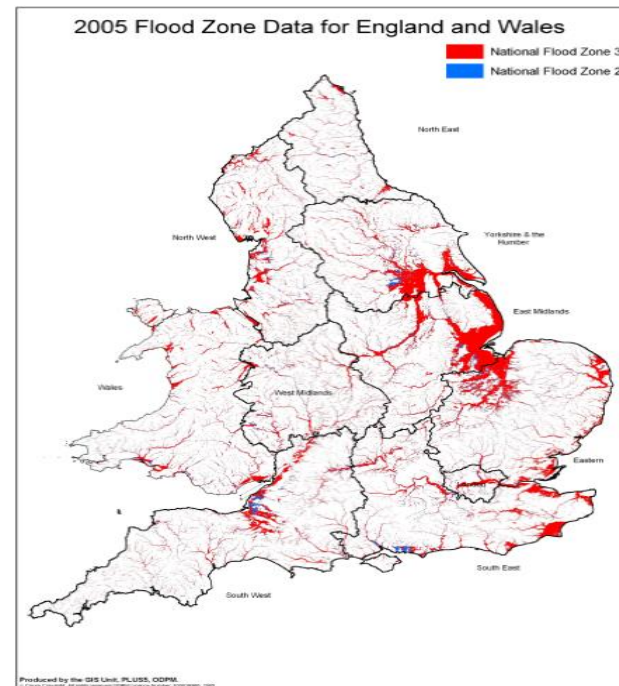
- Avoidance
- Relocate development
- Land and/or property raising
- Innovative design



BACA Architects

Flood resilience!

- Approximately 6 million properties at risk of flooding across the UK
- Damage to a single property may involve £20,000 to £100,000 to repair
- Type of flood and level of risk varies across the country
- 10% of England and Wales is floodplain
- Millions of new homes by 2050, leading to More runoff, more flood protection, lower storage capacity
- Future problems of housing location due to abstraction and runoff
- Insurance policies and excess will rise
- House prices may be discounted by 20% to 40% in flooded areas
- Every year there are applications to develop in high risk floodplains permitted despite objections from the environment agencies on flood risk grounds

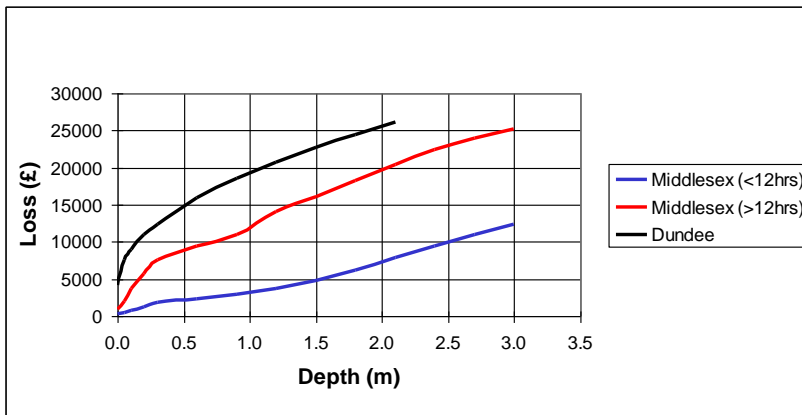


Flood events (UK)

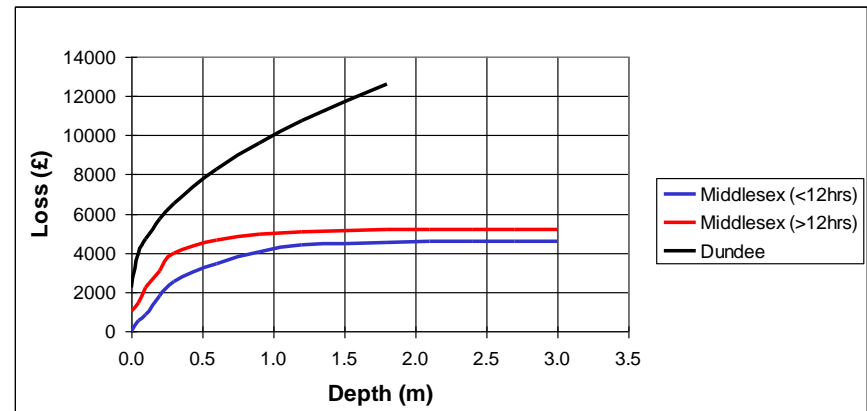
- In the last 10 years Insurers (ABI members) have paid around £6bn* in flood claims.
- Notable losses include:
- 1998 Easter Floods – 4,200 properties flooded, £350m losses
- 2000 Autumn Floods -10,000 properties flooded, **£1bn** losses
- 2004 Boscastle -100 properties flooded
- 2005 Carlisle –2,700 properties flooded, £400m losses
- 2007 Summer Floods –61,000 properties flooded, **£3bn losses**
- 2009 Cumbria –2,200 properties flooded
- 2013/14 Winter Storms – 5,000 properties flooded, **<£1bn** losses
- 2015/16 Winter Storms – Desmond, Eva and Frank - **£1bn**



property damage loss curves



contents property damage loss curves



The Risk Triangle

Insurers have an easy way to reduce risk...



Source: Crichton, 2001

The Risk Triangle

... Just cancel policies



Source: Crichton, 2001

Property – Resistance and Resilience

- flood resistance
 - construction of a building in such a way as to prevent or minimise floodwater entering the building and
 - damaging its fabric - use of low permeability materials.
- flood resilience
 - measures that can be incorporated into the building fabric and/or fixtures and fittings that can be installed, to reduce the consequences of flood water entering the property
 - Use of sacrificial materials for internal or external finishes, e.g. gypsum plasterboard placed so that it
 - can easily be removed below the flooded level and replaced, or materials that can resist the effects of flooding, e.g. tiled finishes.

Flood Resistance



Flood Resistance

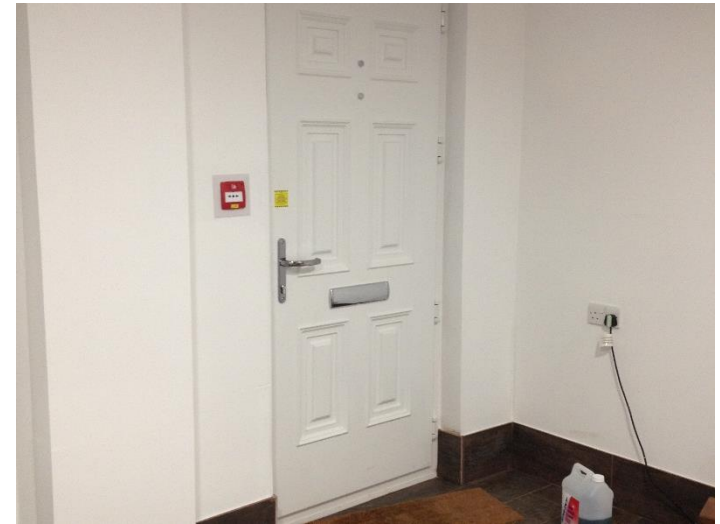


Property Flood Resilience: Demonstration – Victorian Terrace



Resistance

- Flood resistant doors
- Flood resistant windows
- Solid brick external walls with external render (2 coat proprietary system)
- Resistance design to 600 mm depth
- Controlled inundation to property beyond this depth



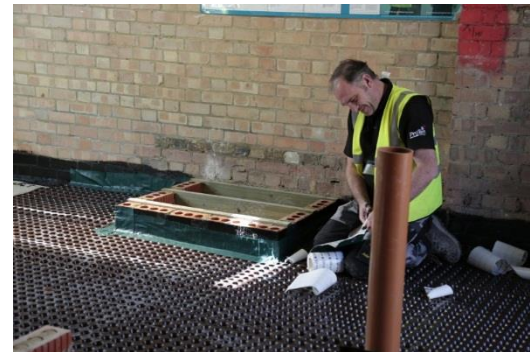
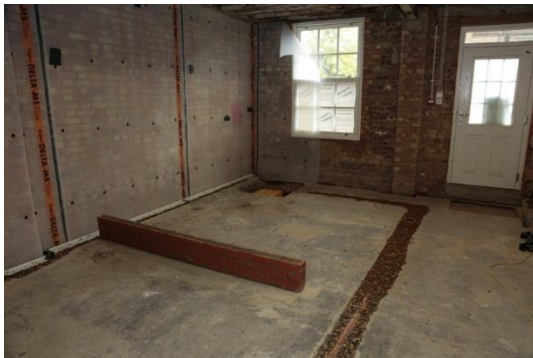
Floor

- Original concrete floor; 100 mm on ground
- Profiled drainage membrane
- Resilient insulation boards
- Screed membrane
- 50 mm self levelling concrete screed
- Ceramic tile finish, turned up walls by 150 mm, fully bedded in waterproof adhesive



Cavity drain membrane and sump pump

- Cavity drain membranes as internal barrier, wrapped around the walls, laid across the floor and sealed using adhesive
- Water drains to a sump pump



Walls

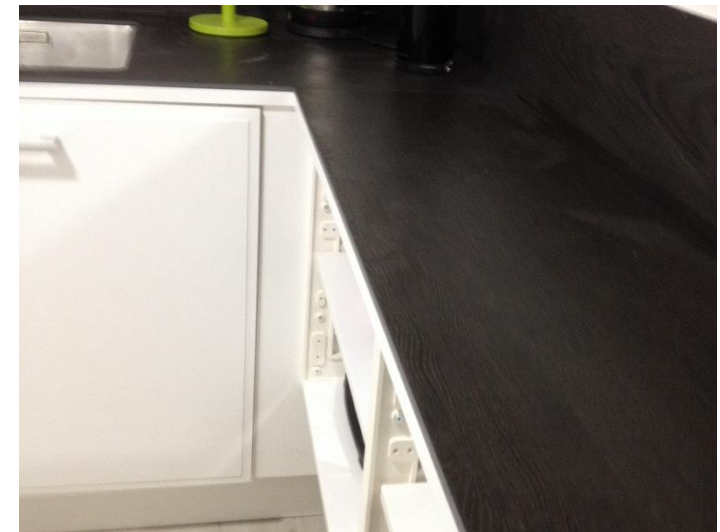


- Resistance and resilience
- Resistance: Cavity drainage membrane, drain and pump: groundwater and external water under force
- Resilience: membrane prevents wetting of wall, resilient plaster, resilient insulation and wall board finish; drying of cavity via ventilation or limited removal / replacement of boards and insulation



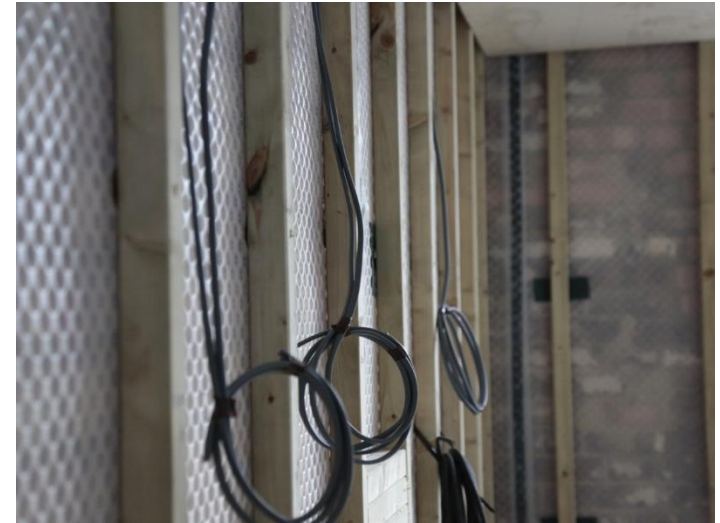
Resilient kitchen

- No MDF or chipboard components; or laminated or melamine surfaces
- Resilient composite material
- Ceramic work tops
- Tiled under units



Services

- Electrical: wiring hung from ceiling down walls
- Sockets located above flood level (800 mm, 1200 mm, 1500 mm)
- Water: non-return valves on toilets, kitchen supply / drainage



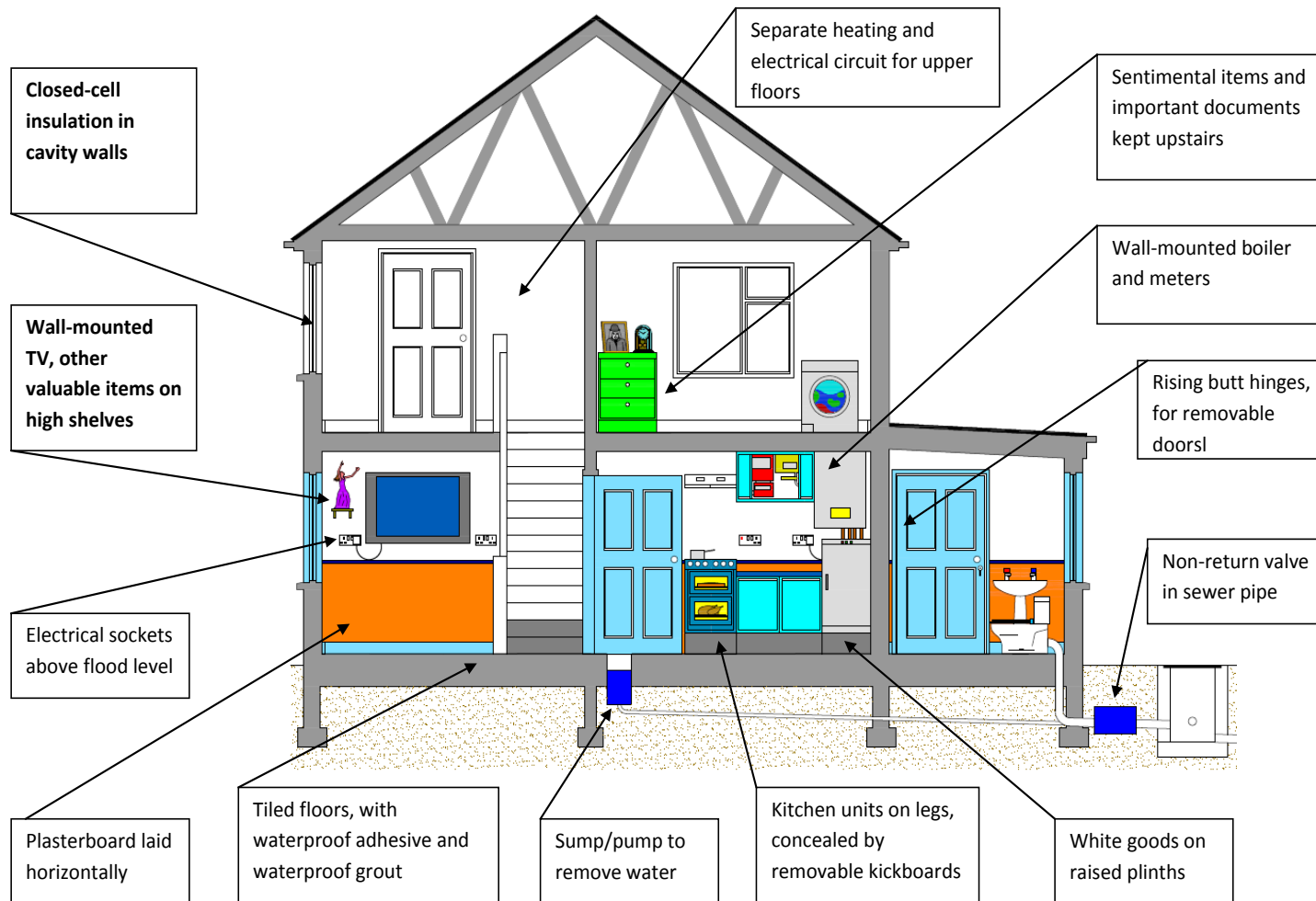
Resilient house on BBC Countryfile



Resilient house: expelling water quickly



The Flood-Repairable House



Adapted from original image courtesy of the Eastern Solent Coastal Partnership (www.escp.org.uk)

Property Flood Resilience Action Plan

Industry group constituted by Defra



- Task Group 4 Identified the need for independent surveyors to provide information to property owners about the installation of flood resilience measures
- Training
- Certification
- Standards

Property Flood Resilience-database

- Innovate UK supported project (UFR Project)



- Project partners:

- BRE
- LexisNexis
- AXA
- Liverpool City Council



- The project intended to create a means for insurers to find the 'missing piece of data' which could help them provide more appropriate insurance cover to properties in high flood risk areas, or where properties have suffered repeat flooding events.
- The project has developed a database (PFR-d), on Property Level Protection and resilience of buildings, and a framework for the PFR-d to integrate with surveyors and insurers existing systems.

Property Flood Resilience Surveyors Scheme

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Education

:



Certification

:



Information:



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- BRE Global (supported by BRE Centre for Resilience, BRE Academy training and RICS) has responded to the Action Plan and announces the **Certification Scheme for Independent Property Flood Resilience Surveyors**

- Will provide surveyors with skills and access to the Property Flood Resilience Database (PFR-d)

Property Flood Resilience: Code of Practice

The overall aim of the project is to:

“develop a robust and authoritative Code of Practice (CoP) and consolidated guidance that provides a standardised approach for the delivery and management of property flood resilience (PFR).”

- Project team
- BRE
- University West of England
- Whitehouse Construction
- CIRIA (PM)
- Funders
- AVIVA, EA, Scottish Government, Welsh Government, NI DfI

Buro Happold: Resilience Framework Tool



Flood Resilient Repair Project: Partnership

BRE Trust	Centre for Resilience			
AXA	AVIVA	ABI	Lloyds	Cunningham Lindsey
PCA	BDMA	Aquobex	UK Flood Barriers	
CBA	BRUFMA	BASF	Celotex	Kingspan
Natural Cement Distribution		Isothane		
Delta Membranes Proten		BACA Architects		
Defra	Environment Agency			
Miinus Pustelli	Bellitex	Dragon Board		

Thank you

