Code of practice for property flood resilience

Edition 1

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Code of practice for property flood resilience

Edition 1

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Summary

Property flood resilience (PFR) is an important part of the response to flood risk. PFR includes measures that reduce the risks to people and property enabling households and businesses to reduce flood damage, speed up recovery and reoccupation. PFR measures should reduce the amount of water entering buildings (known as resistance measures), or limit the damage caused if water does enter a building (known as recoverability measures).

This code of practice (CoP) is concerned with PFR measures that can be introduced to buildings at risk from flooding. Often these measures can be installed as part of the repair of buildings after they have been flooded. However, some property owners may wish to be proactive and fit measures in anticipation of a flood.

The CoP includes six standards that specify what should be achieved. These standards will be supported by comprehensive guidance on how the standards should be met by following stages within a PFR delivery process. The guidance is provided in CIRIA C790B *Code of practice and guidance for property flood resilience*, which will be published in 2020.

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Steve has been involved in business management and civil engineering for over 30 years. During this time, he has been involved in the continuous improvement of service delivery across many sectors, including water. Steve is managing director at Whitehouse Construction and is responsible for safety. The organisation has delivered PFR since 2005, and they have been involved in many industry initiatives including, thought leadership roundtables and the production of PAS 1188-2014. Steve is dedicated to bringing rigour and robustness into the delivery of PFR so that those at risk of flooding can have greater confidence in flood resilience.

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1 Introduction

Property flood resilience (PFR) is an important part of the response to existing and predicted flood risk. This is particularly relevant in areas where it is not possible to protect communities by structural flood defences or where it is necessary to manage residual flood risk (where existing defences may be overtopped or fail). PFR, by definition, includes measures that provide a way to reduce the risks to people and property enabling households and businesses to reduce flood damage, speed up recovery, reoccupation of flooded buildings and potentially obtain insurance cover more easily and affordably.

Such measures are aimed at reducing the amount of water from entering buildings (known as resistance measures), or limiting the damage caused if water does enter a building (known as recoverability measures). Recoverable materials and construction methods reduce the probability of permanent damage being caused, maintain structural integrity and aid recovery.

1.1 What is the code of practice?

This code of practice (CoP) is concerned with the physical measures that can be introduced to buildings at risk from flooding. Often PFR measures can be installed as part of the repair of buildings after they have been flooded. However, some property owners may wish to be proactive and fit measures in anticipation of a flood. Throughout this CoP, the term PFR should be taken to mean physical measures applied at the building scale that are aimed at reducing damage to buildings and their contents.

The CoP includes six standards that specify what should be achieved. These standards will be supported by comprehensive guidance on how the standards should be met by following stages within a process. The guidance is provided in CIRIA C790B *Code of practice and guidance for property flood resilience*, which will be published in 2020.

The standards provide a benchmark for good practice to support the consistent and effective implementation of PFR. They are:

- Standard 1: Hazard assessment.
- Standard 2: Property survey.
- Standard 3: Options development.
- Standard 4: Construction.
- Standard 5: Commissioning and handover.
- Standard 6: Operation and maintenance.

1.2 Who is the CoP for?

The CoP is designed to be used by a variety of individuals involved in delivery of PFR, including:

- property owners, occupiers and managers (residential and non-residential)
- engineers, property surveyors, and architects
- manufacturers and suppliers of PFR measures
- construction contractors and installation companies (involved in installing PFR measures)
- local authority planners, developers and regulators specifying PFR for new build and retrofit situations (planners, building control, risk management authorities)
- insurers, loss adjusters and insurance brokers
- sewerage companies.

This CoP applies to residential and non-domestic properties (including both commercial and industrial properties).

1.3 Related guidance

These standards are an extract from CIRIA C790B, which will provide extensive guidance on the specification, installation and operation of PFR. CIRIA C790B, which will be available in 2020, will have four main parts that can be read as standalone or as a larger and comprehensive guide to PFR. These are outlined in **Table 1.1**.

Table 1.1 Description of CoP and guidance

Section of document	Description
Part A	This part provides introductory background information on flooding and PFR. This includes information on definitions and overriding principles that are relevant for the document. Part A also includes information on roles and responsibilities, liabilities and contracting approaches that may be relevant for those procuring PFR.
Part B	This part introduces the six standards that describe specific elements of PFR which should be achieved to improve the resilience of a property. The six standards constitute the CoP and have requirements that should be fulfilled.
Part C	This part describes the PFR process in six stages, which relate to the six standards of PFR. Each of the stages has a number of steps that guide the user to successfully implementing PFR and deliver the requirements of the CoP.
Part D	This part provides further information to support the user when implementing PFR. It is linked to the guidance in Part C and provides detailed support to those who require more information.

2 The PFR CoP

The PFR CoP is made up of six standards. Each of these standards have requirements that should be met for them to be achieved. The standards cover the range of activities that should be undertaken to successfully deliver PFR. This CoP is underpinned by three cross-cutting requirements for undertaking PFR as set out in **Table 2.1**.

Table 2.1 Underpinning requirements to undertake the PFR approach

Requirement	Aspects relevant to all stages of PFR delivery
Competence of individuals	All aspects of the PFR process should be undertaken by an appropriate person. This individual should act in accordance with a relevant set of professional standards, carry appropriate professional indemnity insurance and be able to demonstrate required levels of skills, knowledge and experience. This may be done through previous work experience, membership of a professional body and/or certificated training. An appropriate person should always act impartially and without favouring any particular supplier of equipment, materials or services.
Proportionality	It is important that the specification and deployment of PFR is proportionate to the risk to the property and the resources available. For example, if the perceived risk to the property is low then a less detailed and costly property survey may be sufficient. Similarly, if the risk is perceived to be high, then a more detailed survey of the property would be appropriate and more costly PFR measures may be preferred. This common-sense approach should allow a degree of flexibility in relation to the scale of activities undertaken as described within this CoP.
Provision of PFR information and reports to the end user	All communications and reports should be provided in clear and concise language that is easy to understand and appropriate to the purposes for which it is to be used. It should be sufficiently detailed and comprehensive to fully inform any subsequent stage within the PFR process. Any uncertainties in the information given should be made clear in these reports. Information should also be provided at an appropriate time.

2.1 How to use the PFR CoP

The six standards each consists of:

- a brief introduction that sets out the context
- the aim and purpose
- the requirements stating what should be delivered during that stage of the PFR process. If any requirement is not met, the work will not meet the standard set out in this CoP.

At the end of each PFR delivery stage the aim and requirements of the standards should be checked against what has been delivered. Checklists for this purpose are included in **Part D**.

2.2 Terminology

The CoP uses the term PFR to refer to any measures that can be applied at a property level to make people and their property less vulnerable to the impacts of flooding. This includes measures to limit physical damage, which can be referred to as resistance and recoverability. These terms have been used in different ways in different publications. For the purposes of this CoP they are defined as follows:

- **Resistance measures:** use of materials and approaches to manage water entry into the property. This relates to water exclusion, ie keeping water out.
- **Recoverability measures:** use of materials, products and construction methods that prevent the internal fabric of the property from being unduly damaged by flood water and allow it to recover quickly after a flood.

Either or both types of measures can be used to make a building more resilient.

A **Glossary** is included in this guide.

3 PFR Standard 1: Hazard assessment

Introduction

To comply with PFR Standard 1 a flood hazard assessment shall be undertaken to understand how flooding might threaten a property. This assessment shall include the following:

- likelihood of flooding in the property location (and surrounding areas)
- nature of the flooding that could potentially occur
- likely frequency of flood events for the location – including the potential for increased frequency due to climatic change and/or urban development
- susceptibility of the property and its building(s) to flooding, given its surroundings, design, structure, materials used, condition, and adaptations.

Identifying the flood hazard to a property is a critical element in the development of PFR measures. Conducting a flood hazard assessment can be a detailed and intricate process, often requiring specialised skills to interpret information presented within flood maps or other relevant sources.

Aim

PFR Standard 1 shall deliver a property level flood risk assessment, which clearly summarises the available hazard information to determine the likelihood and severity of flooding from different sources. This information will be used to inform the selection and design of PFR measures.

Requirements

1 A survey of the flood risk to the property shall be carried out. The scale and detail of the survey shall be proportionate to the perceived level of risk and the potential size of the project. Surveys shall be extended should a greater complexity of flood risk become apparent during the survey.

2 The site of the property shall be assessed for the likelihood of flooding based on a 'source–pathway–receptor' approach for all potential sources and range of probabilities of flooding.

3 The potential source(s) of flooding shall be determined using appropriate methods of hazard identification. This shall be accompanied by an assessment of flood frequency, as well as depth and duration for all sources at a range of return periods.

4 The property flood risk assessment shall take account of relevant flood risk information from local authorities, utilities and other environment agencies. It shall take account of additional flood risk information from other relevant sources (including property owners).

5 The potential routes of floodwater (pathways) to the buildings/structures within the property from the sources shall be identified.

6 The pathways for flooding from each source to the property and likely speed of onset shall be identified, including measures that currently exist, or are planned, for controlling that pathway at the property, community or catchment scale (including flood defence works). This analysis shall include all relevant structures near to the property.

4 PFR Standard 2: Property survey

Introduction

The identification and delivery of PFR relies upon information provided by a suitably detailed survey of the building(s) at the property. The design, materials, condition, orientation, and exposure of buildings will vary greatly and a survey, unique to each building, is a critical element to identifying suitable resilience measures.

Aim

PFR Standard 2 requires that an appropriate survey of the property and end-user requirements is carried out. The purpose of the survey is to assess the current level of flood resilience of the property to provide the necessary information for the identification of the PFR options suitable for the property. Each building and structure at the property shall be surveyed.

Requirements

1 The scale and detail of the survey shall be proportionate to the level of risk and the size of the project. The survey shall also identify appropriate approaches to increase resilience and minimise damage, with reference to the end-user needs.

2 The survey shall establish the building type, age, construction, condition, operation and contents as described in Defra (2012).

3 The current level of PFR shall be established, including estimating the water leakage resistance capacity of the walls and floors, the recoverability of the materials and components, and end-user capacity to implement measures.

4 The method of drying and decontamination of the building after a flood shall be assessed, including the impact of wetting of building materials and that of voids and cavities in walls and floors.

5 The ground conditions on the site shall be established, and in particular, the potential for water to transfer through the ground or from an adjacent building into the building shall be assessed.

5 PFR Standard 3: Options development

Introduction

Following achievement of PFR Standards 1 and 2, the options for implementing PFR are set out. The possibilities are discussed with the end user and the most appropriate PFR measures are selected and specified for implementation.

Aim

PFR Standard 3 allows options for PFR to be identified and considered. These options shall reflect the outcomes from Standards 1 and 2, and PFR measures suitable for the property and specify the most suitable PFR measures for the property. The options for PFR will consider the use of:

- measures that restrict water entry to the building under defined conditions
- materials that are recoverable after water contact
- services, fixtures and fittings that are recoverable by their location and/or ability to resist water damage.

The design and specification will be based on the information provided by Standard 1 and 2, and the measures specified shall be selected impartially.

Requirements

1 An options appraisal of flood resilience measures shall be undertaken based on the information generated within Standards 1 and 2. These appraisals shall also evaluate costs and benefits of suitable approaches, end-user needs, operation and performance.

2 The appraisal of these options shall consider the lifetime maintenance and operation requirements of the measures specified.

3 Wherever possible and where relevant, specified PFR measures shall make use of products and processes that are compliant with a recognised industry standard and/or are warranted.

4 The preferred options shall be agreed and documented.

5 This specification shall be set out in drawings and/or written text and shall adequately describe the measures to be taken and their method of installation.

6 The output is the identification and specification of the most suitable PFR measures for the property. This information shall then be developed into a construction/installation plan, undertaken by the appropriate person before any works or installation commence.

6 PFR Standard 4: Construction

Introduction

The achievement of the specification outcomes depends on the construction activity and installation of PFR measures. Ultimately, the quality of construction will help to ensure that the PFR measures installed will deliver the levels of resistance and recoverability required to meet the needs of both the building(s) and end users. This will then provide confidence to the end user and those providing insurance and/or maintenance to the building(s).

Aim

PFR Standard 4 ensures that the construction works deliver the benefits anticipated from the specified PFR measures, which are as a result of PFR Standard 3 outcomes.

Requirements

1 The appropriate person shall deliver all the necessary works associated with the construction and installation of PFR measures.

2 Where subcontractors are used, the appropriate person shall retain overall responsibility for the works.

3 All necessary preliminary work, including drying out and decontamination where appropriate, shall be carried out before implementation of PFR measures. These works shall be carried out in accordance with the design and specification in PFR Standard 3, and shall take due note of the flood risk assessment (PFR Standard 1) and the survey (PFR Standard 2).

4 The construction work shall be undertaken in accordance with good practice, including relevant standards, guidance and legislation, and shall comply with the Construction (Design and Management) Regulations 2015 (CDM 2015).

5 All PFR measures shall be inspected during construction by an appropriate person (see Table 2.1).

7 PFR Standard 5: Commissioning and handover

Introduction

An important element of any construction project is commissioning and handover. These elements demonstrate that the construction activity undertaken, and the measures installed within the property deliver the levels of PFR required by the end user. It also sets out all operational and maintenance requirements of the PFR measures installed.

Aim

PFR Standard 5 ensures that the completed PFR construction work will operate effectively as designed, and that the end user has all relevant information and has been instructed in any deployment, operation and maintenance requirements.

Requirements

1 PFR measures shall be inspected during construction (PFR Standard 4) and on completion by an appropriate person (see Table 2.1) to ensure that the work meets the specification requirements of PFR Standard 3. The inspection shall be conducted in an objective and impartial manner.

2 Any products used that have an agreed in situ flood resistant test procedure shall be tested after their installation within the building(s) at the request of the end user. These tests shall be supervised by an appropriate person (see Table 2.1).

3 The appropriate person shall provide all relevant information on the PFR works, design, specification, and operation and maintenance requirements in a project file (ie a handover 'pack') to the end user.

4 Where PFR measures need to be deployed for flood events, a person shall be nominated and agreed to take responsibility for deploying the measures in the event of a flood warning. This person shall be referred to as the 'nominated person'.

5 The appropriate person shall demonstrate the method of deployment of measures (where appropriate) to the nominated person and shall ensure that this person understands how to prepare for a flood.

8 PFR Standard 6: Operation and maintenance

Introduction

Properties with a defined flood risk are likely to remain at risk over time. It is possible for the level of risk to the property to increase due to factors such as climate change and urbanisation. To maintain a level of protection to a property, the PFR measures installed should be operated and maintained following the guidance provided in the handover pack.

Aim

PFR Standard 6 ensures that the completed PFR construction works are properly operated and maintained, and that any demountable measures are stored correctly. Note that the responsibilities and duties for operation and maintenance are defined as part of meeting the requirements of Standard 2.

Requirements

1 The appropriate person, in accordance with CDM 2015, shall provide an operation and maintenance plan to the end user at the point of handover (PFR Standard 6).

2 The nominated person shall ensure that the PFR measures remain operative by following the guidance provided in the handover pack.

3 In the event of a flood warning, the nominated person shall deploy any measures following guidance provided in the handover pack.

4 Any operation of the PFR measures shall be recorded and the information retained and kept securely as an appendage to the handover pack.

5 All maintenance work shall be recorded and kept securely as an appendage to the handover pack.

6 The PFR measures shall be reviewed periodically to ensure that they continue to meet the needs of the end user and that the nominated person can continue with their obligations.

7 After a flood event the PFR measures shall be fully checked and inspected by an appropriate person taking account of the information in the handover pack. Any necessary maintenance shall be commissioned.

9 Glossary

Appropriate person	One of the duty-holders described under CDM 2015. They should act in accordance with a relevant set of professional standards, carry appropriate professional indemnity insurance and can demonstrate the required levels of skills, knowledge and experience and, as defined in the regulations, have a construction-related or a flood and water management background (see **Table 2.1**). This individual should have the necessary capabilities and resources, with right blend of skills, knowledge and experience, who understands their roles and responsibilities when carrying out work. They shall always act impartially and without favouring any particular supplier of equipment, materials or services.
Construction Design and Management Regulations 2015 (CDM 2015)	UK health and safety policy covering all aspects of construction activity and designating specific actions to stakeholders.
Decontamination	The removal or neutralisation of potentially-harmful substances from an object or area.
Drying	The removal of moisture from a building or building materials.
End user	The occupier of the property who is likely to deploy, operate and maintain any PFR measures.
Event (flood)	The occurrence (at source) of a flood hazard (such as surface water, river flooding). This is often used in accordance with a probability of a flood occurring (eg 1 in 100 flood event – or one per cent annual chance of meeting or exceeding this level).
Flood defence	Infrastructure used to protect an area against floods such as floodwalls and embankments. Normally these are designed to a specific standard of protection.
Flood map for planning	A map for land-use planning and development purposes, showing what flood zone (under National Planning Policy Framework (MHCLG, 2019) definitions) a proposed development is in.
Flood recoverability	The use of materials, products and construction methods can be recovered after flooding, ie managing water entry.
Flood resilience	The combination of flood resilience and flood recoverability.
Flood resistance	The use of materials and approaches to safely keep water out of the property. This relates to water exclusion, ie keeping water out.
Flood risk	An expression of the combination of the flood probability (or likelihood) and the consequences of that flood event. The higher the likelihood and the greater the impact of flooding, the higher the level of flood risk. Risk = Probability (or hazard) x Consequences (or impact).
Flood risk management	Means of mitigating flood risk.
Flood source	Where the flood water originates. This may be one, or a combination, of the following types of flooding: • flooding from rivers (fluvial flooding) • flooding from the sea (coastal flooding) • groundwater flooding • surface water flooding • sewer flooding • asset failure flooding (eg dam failure) • compound flooding.
Frequency	The average rate of occurrence of an event (eg flood).
Hazard	The potential to produce harm.
Maintenance	The process of preserving the condition of products and measures on a regular basis (normally in line with a defined schedule).
Nominated person	Identified individual who has specific responsibilities for related tasks.
Operation	The use or deployment of PFR measures during a flood event.
Pathway	The route that flood water takes to reach a property.
Probability	The average chance that something could happen. Normally expressed as an annual probability.
Property flood resilience (PFR)	Flood resilience related to buildings within the curtilage of a property.

Receptor	The entity that may be harmed by a particular hazard (eg a person, property, or habitat). For example, in the event of heavy rainfall (source) floodwater may propagate across the flood plain (pathway) and inundate building (receptor) that may suffer material damage (the harm or consequence).
Recoverability	The use of materials, products and construction methods that prevent the internal fabric of the property from being unduly damaged by flood water and allow it to recover quickly after a flood.
Requirement	A step to meeting specified aspects of PFR.
Residual risk	Risks remaining after actions have been taken to mitigate flood risk.
Resilience	The capacity that people, groups or structures may possess to withstand or recover from emergencies.
Resistance	The use of materials and approaches to manage water entry into the property. This relates to water exclusion, ie keeping water out.
Return period	The average period of occurrence of an event. When applied to flooding it is normally expressed in years. Return period is the inverse of frequency.
Risk	See Flood risk.
Severity (of flood hazard)	The potential maximum impact level of a source (or combination of sources) of flooding at a specific location.
Source (flooding)	See *Flood source*.
Stage	The individual parts of the process of delivering PFR.
Subcontractor	The person or organisation responsible for delivery of part of the construction or installation works normally employed by the principal contractor as defined in CDM 2015.
Survey	An inspection and assessment of a building, land or water body, including other information sources, as part of the PFR process.

References

DEFRA (2012) *Property flood protection: flood risk report*, Department of Environment Food and Rural Affairs, London, UK
www.gov.uk/government/publications/property-flood-protection-flood-risk-report

MHCLG (2019) *National Planning Policy Framework*, Ministry of Housing, Communities and Local Government, London, UK
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

Statutes

The Construction (Design and Management) Regulations 2015 (No.51)

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City University of London
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Environment Agency
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Zero Waste Scotland

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Property flood resilience (PFR) is an important part of the response to flood risk. PFR includes measures to reduce the risks to people and property enabling households and businesses to reduce flood damage, speed up recovery and reoccupation. PFR measures should reduce the amount of water entering buildings (known as resistance measures), or limit the damage caused if water does enter a building (known as recoverability measures).

This code of practice (CoP) is concerned with PFR measures that can be introduced to buildings at risk from flooding. Often these measures can be installed as part of the repair of buildings after they have been flooded. However, some property owners may wish to be proactive and fit measures in anticipation of a flood.

The CoP includes six standards that specify what should be achieved. These standards are supported by comprehensive guidance on how the standards should be met by following stages within a PFR delivery process. The guidance is provided in CIRIA C790B *Code of practice and guidance for property flood resilience*, which will be published in 2020.

AVIVA

Department for Infrastructure
An Roinn Bonneagair
www.infrastructure-ni.gov.uk

Environment Agency

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BUILDING SCOTLAND'S RESILIENCE TO NATURAL HAZARDS

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