

RESILIENT CONSTRUCTION MEASURES FOR EXTENSIONS IN SHDC

General advice for resilient design

Ground supported floors are the preferred option and concrete slabs of at least 150mm thickness should be specified for non-reinforced construction. Hollow slabs are not suitable if the elements are not effectively sealed.

Suspended floors may be necessary where ground supported floors are not suitable, namely in shrinkable/expanding soils (e.g. clay) or where the depth of fill is greater than 600mm. Uplift forces caused by flood water may affect the structural performance of a floor. Suspended floors are generally not recommended in flood-prone areas, for the following reasons:

- the sub-floor space may require cleaning out following a flood, particularly a sewer flood. In order to aid this process and where accumulation of polluted sediment is expected, the sub-floor space should slope to an identified area and be provided with suitable access
- if cleaning is required, floor finishes may need to be removed to provide access to the sub-floor space. Cheaper, sacrificial, finishes would be the best option.
- the steel reinforcement in the concrete beams of 'beam and block' floors may be affected by corrosion and its condition may need to be assessed following repeated or prolonged floods.

Suspended timber floors, particularly when including timber engineered joists, are not generally recommended in flood prone areas because most wooden materials tend to deform significantly when in contact with water and therefore may require replacement. Rapid drying can also cause deformation and cracking.

Reinforced concrete floors are acceptable but may be prone to corrosion of any exposed steel in areas of prolonged flooding.

Hardcore and blinding: good compaction is necessary to reduce the risk of settlement and consequential cracking.

Damp Proof Membranes (d.p.m.) should be included in any design to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer. Experience in Scotland has indicated that welted joints in the d.p.m. are an effective jointing solution.

Insulation materials: Water will lower the insulation properties of some insulation materials. Floor insulation should be of the closed-cell type to minimise the impact of flood water. The location of insulation materials, whether above or below the floor slab, is usually based on either achieving rapid heating of the building or aiming for more even temperature distribution with reduced risk of condensation. Insulation placed above the floor slab (and underneath the floor finish) rather than below would minimise the effect of flood water on the insulation properties and be more easily replaced, if needed. However, water entry may cause insulation to float (if associated with low mass cover) and lead to debonding of screeds.

No firm guidance can be provided on best location for insulation where the primary source of flooding is from groundwater. For other types of flooding, placing insulation below the floor slab may be adequate but it is important to recognise that the characteristics of the insulation may be affected by the uplift forces generated by the flood water.

Floor finishes: suitable floor finishes include ceramic or concrete-based floor tiles, stone, and sand/cement screeds. All tiles should be bedded on a cement-based adhesive/bedding compound and water resistant grout should be used. Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material. Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable.

Floor sump: provision of a sump and small capacity automatic pump at a low point of the ground floor is recommended in cases where the expected probability of flooding in any one year is 20% or a frequency of flooding of more than once in five years (see Section 4). This system will help the draining process and speed up drying but it may only be effective for shallow depth flooding. The dimensions of the sump and its operational procedure would be calculated and agreed with the planning authority based on the predicted volumes of water to be drained.

Services: under floor services using ferrous materials should be avoided.

General advice for resilient design

Ensure high quality workmanship at all stages of construction.

Masonry walls:

Ensure mortar joints are thoroughly filled to reduce the risk of water penetration. If frogged bricks are used, they should be laid frog up so that filling becomes easier and coverage more certain. Bricks manufactured with perforations should not be used for flood resilient design.

Where possible, use engineering bricks up to predicted flood level plus one course of bricks to provide freeboard (up to maximum of 0.6m depth above floor level); this will increase resistance to water penetration. Blocks (and dense facing bricks) have much improved performance when covered with render.

Aircrete blocks allow less leakage than typical concrete blocks but concrete blocks dry more quickly. Therefore, design of blockwork walls needs to take into account these two opposite types of behaviour and consider whether drying or resistance to water is most relevant in each situation. For a "water exclusion strategy", the expected amount of leakage is minimal and therefore, Aircrete blocks are recommended, although they may retain moisture for longer than concrete blocks. Compared with heavier blocks, Aircrete may offer less restraint to floor/slab edges which under the action of uplift forces could promote the opening up of floor/wall junctions.

Do not use highly porous bricks such as hand made clay bricks.

Solid masonry walls are a good option but will need to be fitted with internal or external wall insulation in order to comply with Building Regulations.

Clear cavity walls, i.e. with no insulation in the cavity, have better flood resilience characteristics than filled or part filled cavity walls as they dry more quickly. The requirements for insulation can be satisfied by external insulated renders or internal thermal boards.

There is evidence that thin layer mortar construction (or thin joint, as it is also commonly known) is a good flood resilience option.

Framed walls: Avoid timber framed walls containing construction materials that have poor performance in floods, for example oriented strand board and mineral fibre insulation. Timber framed walls are not recommended in a "water exclusion strategy". Steel framed walls may offer a suitable alternative option but specialist advice needs to be sought on how to incorporate resilient materials/construction methods in the design, in particular with regard to the insulation.

Reinforced concrete wall/floor construction should be considered for flood-prone areas, i.e. where the frequency of flooding is predicted to be high (see Chapter 4). This form of construction is effective at resisting forces generated by floodwater and will provide an adequate barrier to water ingress (provided service ducts and other openings into the building are adequately sealed). Design details for this type of construction are beyond the scope of this document.

External renders are effective barriers to water penetration and should be used with blocks (or bricks) at least up to the predicted flood level plus the equivalent of a course of bricks as freeboard. Structural checks may be necessary to ensure stability, because of the external water pressures that could occur for design flood depths above 0.3m. External cement renders with lime content (in addition to cement) can induce faster surface drying.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary.

Cavity insulation should preferably incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fibre batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

Internal linings:

Internal cement renders (with good bond) are effective at reducing flood water leakage into a building and assist rapid drying of the internal surface of the wall. The extent to which render prevents drying of other parts of the wall is not currently clear. This may be important, particularly for solid wall construction. This applies also to external renders.

Avoid standard gypsum plasterboard as it tends to disintegrate when immersed in water. Splash proof boards do not necessarily offer protection against flood waters, which may remain for some time and exert pressure on the board.

Anecdotal evidence suggests that internal lime plaster/render can be a good solution. Lime plaster depends on contact with the air to set and harden. Because of this, full strength lime plaster, which typically requires over 6 months, was not possible to test. Consequently, no assurance can be given for its performance. Tests performed when young showed that it crumbles very easily under high water pressure.

General advice for resilient design

Where possible, all service entries should be sealed (e.g. with expanding foam or similar closed cell material).

Pipework: Closed cell insulation should be used for pipes which are below the predicted flood level.

Drainage services: Non-return valves are recommended in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging. Maintenance of these valves is important to ensure their continued effectiveness.

Water, electricity and gas meters: should be located above predicted flood level.

Electrical services: electrical sockets should be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation (see Figure 6.13. Note a dado rail which provides a limit for replacement of any wall covering). Electric ring mains should be installed at first floor level with drops to ground floor sockets and switches.

Heating systems: boiler units and ancillary devices should be installed above predicted flood level and preferably on the first floor of two-storey properties. Underfloor heating should be avoided on ground floors and controls such as thermostats should be placed above flood level. Conventional heating systems, e.g. hot water pipes are unlikely to be significantly affected by flood water unless it contains a large amount of salts. The less common, hot air duct heating would remain effective provided it is installed above the design flood level.

Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.

General advice for resilient design

The main principle is to use durable fittings that are not significantly affected by water and can be easily cleaned (e.g. use of plastic materials or stainless steel for kitchen units). The cost of these units may need to be balanced against the predicted frequency of flooding.

Place fittings (e.g. electrical appliances, gas oven) on plinths as high as practicable above floor so that they are out of reach of flood water.

Ensure adequate sealing of joints between kitchen units and surfaces to prevent any penetration of water behind fittings.

Ensure high quality workmanship in the application of fittings.