Chapter

5.2

Suspended ground floors

This chapter gives guidance on meeting the Technical Requirements for suspended ground floors, including those constructed from:

- **in-situ concrete**
- **precast concrete**
- **timber joists.**

5.2.1	Compliance	01
5.2.2	Provision of information	01
5.2.3	Contaminants	01
5.2.4	Suspended flooring systems	01
5.2.5	Transfer of loads: concrete floors	02
5.2.6	Reinforced concrete	03
5.2.7	Construction of suspended concrete ground floors	03
5.2.8	Transfer of loads: timber floors	03
5.2.9	Thermal insulation and thermal bridging	04
5.2.10	Damp proofing and ventilation	04
5.2.11	Floor finishes	05
5.2.12	Floor decking	05
5.2.13	Further information	05

5.2.1 Compliance

Also see: Chapters 2.1, 4.1, 4.2, 4.5 and 5.1

Suspended ground floors shall comply with the Technical Requirements.

Suspended ground floors that comply with the guidance in this chapter will generally be acceptable.

Ground floors should be constructed as suspended floors where:

- the depth of fill exceeds 600mm
- there is shrinkable soil that could be subject to movement (see Chapter 4.2 Building near trees), expansive materials or other unstable soils
- the ground has been subject to vibratory improvement
- ground or fill is not suitable to support ground-bearing slabs.

For further guidance on the construction of suspended ground floors to garages, see Chapter 10.1 Garages.

5.2.2 Provision of information

Designs and specifications shall be produced in a clearly understandable format, include all relevant information and be distributed to all appropriate personnel.

Design and specification information should be issued to site supervisors, relevant specialist subcontractors and suppliers, and include the following information:

- all necessary plan dimensions and levels related to identified benchmarks
- details of load-bearing walls
- minimum bearing dimensions
- information on all proposed underground services
- points of entry to the building for services
- details of trench backfill, infill and void formers
- details of junctions between DPM, DPC and tanking
- details of underfloor and floor edge insulation and cavity insulation, where relevant
- span and direction of structural members
- details of non load-bearing walls
- details of ground hazards and mitigation measures.

5.2.3 Contaminants

Also see: Chapters 4.1, 10.1 and BRE Report 211

Suspended ground floors shall be designed and constructed to ensure that adequate measures are taken against the adverse effects of ground contaminants, including adequate protection against hazardous gas.

Any contaminants in, or above, the ground should be identified to the satisfaction of NHBC, following the guidance given in the appropriate British Standard, and precautions against health hazards caused by contaminants should be taken.

Precautions acceptable to NHBC may be necessary to reduce the entry of hazardous gas; such conditions should be identified in the site investigation.

5.2.4 Suspended flooring systems

Suspended flooring systems shall have adequate strength and durability. Issues to be taken into account include:

1) proprietary floor systems
2) insulated pre-cast concrete units
3) beam and block floor systems.

5.2.4.1 Proprietary floor systems

Proprietary concrete flooring systems should be designed in accordance with BS EN 1992-1-1. Where a system incorporates elements which cannot be designed to this standard, the floor should be assessed in accordance with Technical Requirement R3.

5.2.4.2 Insulated pre-cast concrete units

Insulated pre-cast concrete units (IPCUs) should be manufactured to BS EN 13224 and designed in accordance with BS EN 1992-1-1. For components or systems which fall outside the scope of BS EN 13224 and/or which cannot be designed to BS EN 1992-1-1, the components or systems should be assessed in accordance with Technical Requirement R3.

5.2.4.3 Beam and block floor systems

Beam and block floor components or systems should be manufactured to BS EN 15037 and designed in accordance with BS EN 1992-1-1. For components or systems which fall outside the scope of BS EN 15037 and/or which cannot be designed to BS EN 1992-1-1, the components or systems should be assessed in accordance with Technical Requirement R3.

Where beam and block floor systems utilise non-structural infill blocks (such as lightweight concrete or insulation blocks), a structural screed/topping will be needed to transfer loads. Structural screeds/toppings should be reinforced with either:

- steel mesh reinforcement, or
- steel fibres to BS EN 14889-1, or
- Class II polypropylene macro fibres to BS EN 14889-2.

Class I polypropylene micro fibres to BS EN 14889-2 are not acceptable to NHBC for use in structural applications; however, they may be used as reinforcement only to assist in controlling shrinkage.

Table 1 provides guidance on the use of reinforcement to concrete screeds/toppings above beam and block floors for either structural or crack control purposes.

Table 1: Reinforcement of concrete screeds/toppings to beam and block floor systems in residential dwellings[4]

Infill block type[1]	Screed/topping reinforcement[2]			
	Micro fibre (BS EN 14889-2 Class I)	Macro fibre (BS EN 14889-2 Class II)	Steel fibre (BS EN 14889-1)	Steel mesh
Non-structural/finishing screed				
Loadbearing concrete infill block with compressive strength ≥ 7.3N/mm², or Type SR or Type RR to BS EN 15037-2	✔	✔	✔	✔
Loadbearing EPS infill block Type R2 to BS EN 15037-4				
Structural screed/topping				
Non-loadbearing concrete infill block	✗	✔[3]	✔[3]	✔
Non-loadbearing EPS/XPS infill block (eg Type R1 to BS EN 15037-4)				

Notes

✔ Acceptable to NHBC when used in accordance with the manufacturers' literature, and relevant design and product specification standards. Independent technical approval may be required – see note [3].

✗ Not acceptable to NHBC. The structural capacity of concrete screeds/toppings reinforced with micro fibres has not been verified to the satisfaction of NHBC.

1. Infill block to the relevant harmonised standard and/or as declared by the product manufacturer.
2. This guidance is applicable to structural screeds/toppings and finishing screeds that are applied above beam and block floors, or where the beam and block floor is overlaid with insulation.
3. Flooring systems which use polypropylene macro fibre or steel fibre reinforcement in structural screeds/toppings should hold satisfactory assessment from an independent technical approvals authority accepted by NHBC.
4. This table applies to habitable areas only, and not to garages. For reinforcement of toppings to garages, see Clause 10.1.4.

5.2.5 Transfer of loads: concrete floors

Also see: Chapters 4.1, 4.2, 5.2 and BRE Report 211

Suspended ground floors shall be designed and constructed to transmit all loads safely to the supporting structure without undue movement. Issues to be taken into account include:

1) dead and imposed loads

2) end bearings.

5.2.5.1 Dead and imposed loads

In-situ:

Loads should be calculated in accordance with BS EN 1991-1-1.

Suspended in-situ concrete ground floors should be designed either:

- by an engineer in accordance with Technical Requirement R5, or
- in accordance with BS 8103-1.

Precast:
Loads should be calculated in accordance with BS EN 1991-1-1.

Precast concrete suspended ground floors should be:

- designed by an engineer in accordance with Technical Requirement R5
- proprietary systems which have been assessed in accordance with Technical Requirement R3, or
- chosen from the manufacturer's details, which are based on recognised standards and codes of practice.

5.2.5.2 End bearings

In-situ:
Bearings on supporting walls should be designed either:

- by an engineer in accordance with Technical Requirement R5, or
- in accordance with BS 8103-1.

Precast:
Bearings on supporting walls should be as recommended by the manufacturer, and in no case less than 90mm.

5.2.6 Reinforced concrete

Also see: Chapter 3.1

Suspended ground floors shall use suitably mixed and reinforced concrete, which will achieve sufficient strength to support floor loads safely and be sufficiently durable to remain unaffected by chemical or frost action.

Guidance for the specification and use of in-situ concrete, additives and reinforcement is contained in Chapter 3.1 Concrete and its reinforcement.

5.2.7 Construction of suspended concrete ground floors

Also see: Chapter 6.4

Suspended ground floors shall be designed and constructed to ensure the safe support of the intended loads and be reasonably level.

In-situ:
Concreting should be carried out in accordance with:

- the design information
- relevant parts of NHBC guidance for concrete, including Chapter 3.1 Concrete and its reinforcement.

Precast:
Care should be taken to ensure that DPCs are not damaged or displaced. All sitework for precast concrete floors should be carried out in accordance with the manufacturer's recommendations.

5.2.8 Transfer of loads: timber floors

Also see: Chapters 4.3 and 6.4

Timber suspended ground floors, including the decking material, shall be designed and constructed to be suitable for their intended use. Issues to be taken into account include the:

1) support of self-weight, dead and imposed loads and limited deflection
2) safe transmission of loads to the supporting structure
3) adverse effects of shrinkage and movement.

5.2.8.1 Support of self-weight, dead and imposed loads and limited deflection

Structural timber grades and sizes should be adequate for the spans and imposed loads. Where trimming is necessary, adequately sized timbers should be used.

Structural timber components should be of a suitable strength class as specified by the designer to BS EN 338. Solid structural timber should be:

- machine graded to BS EN 14081, or visually graded to BS 4978 for softwoods or BS 5756 for hardwoods
- assigned a strength class based on BS EN 1912 when visually graded
- dry graded
- marked in accordance with BS EN 14081.

Further guidance on strength classes for certain timber species can be found in PD 6693.

Engineered wood products such as I-section or metal-web joists should be assessed in accordance with Technical Requirement R3.

For guidance on floor joist deflection limits, see Clause 6.4.9.

5.2.8.2 Safe transmission of loads to the supporting structure

Joist hangers should be suitable for:

- the joist width and depth
- the strength of masonry
- the loading
- providing adequate end bearings to joists.

Sleeper walls should adequately support the floor joists, and joists should be correctly supported at masonry separating walls. Sleeper walls should not limit ventilation.

5.2.8.3 Shrinkage and movement

Strutting should be provided where required following the guidance in Clause 6.4.15.

5.2.9 Thermal insulation and thermal bridging

Also see: Chapter 9.3 and BRE Report BR 262

Suspended ground floors shall be insulated in accordance with relevant Building Regulations to minimise thermal transmission through the floor, using materials suitable for the location and intended use.

Insulation should be installed to ensure that any risk of thermal bridging is minimised, especially at junctions between floors and external walls. Thermal bridging precautions include:

- extending cavity wall insulation below floor level
- providing perimeter insulation to floors.

Insulation below cast in-situ suspended ground floor slabs should be:

- placed on a suitable, compacted and even substrate
- of a material with low water absorption
- resistant to ground contaminants
- strong enough to support wet construction loads
- compatible with any DPM.

Insulation for timber floors may be either insulation quilt or rigid insulation.

Cavity wall insulation should extend below the floor insulation level.

Insulation for use above suspended concrete floors should be in accordance with Chapter 9.3 Floor finishes.

Particular attention should be paid to ensuring thermal bridging is addressed at door openings.

5.2.10 Damp proofing and ventilation

Also see: Chapters 4.2, 5.1, 5.4, 6.1, 6.3 and 9.3

Suspended ground floors shall be designed and constructed to resist the passage of moisture into the building. Issues to be taken into account include:

1) damp proofing

2) ventilation.

5.2.10.1 Damp proofing

Where DPMs are required, they should be linked with any DPCs in the supporting structure, in order to provide continuous protection from moisture from the ground or through the supporting structure.

DPMs should be properly lapped in accordance with Chapter 5.1 Substructure and ground-bearing floors.

In-situ concrete:
Dampness from the ground and supporting structure should be prevented from reaching the floor by using linked DPMs and DPCs to provide continuous protection.

Where there is a risk of sulfate attack, in-situ or oversite concrete should be protected with polyethylene sheet that is a minimum:

- 1,200 gauge (0.3mm), or
- 1,000 gauge (0.25mm) if assessed in accordance with Technical Requirement R3.

Precast concrete:
Additional damp proofing may not be necessary where:

- the underfloor void is ventilated in accordance with CP 102, and DPCs are provided under bearings of precast floors
- ground below the floor is effectively drained, if excavated below the level of the surrounding ground.

Where proprietary floor systems are used, adequate moisture-resistant membranes should be installed in accordance with the manufacturer's recommendations.

Vapour control layers may be necessary to protect floor finishes and, where used, should be positioned in accordance with the manufacturer's recommendations.

Timber ground floors:
Timber used for suspended ground floors should either have adequate natural durability or be preservative treated in accordance with Chapter 3.3 Timber preservation (natural solid timber), and the ground below the floor covered with:

- 50mm concrete or fine aggregate on a polyethylene membrane laid on 50mm sand blinding, or
- 100mm concrete.

To prevent water collecting on the ground below the floor, the top of the covering should be entirely above the highest level of adjoining ground, and the underside of the suspended timber ground floor joists or panels should be at least 150mm above the external finished ground level. See Clause 6.2.10 for guidance on the position of any sole plates below suspended timber ground floors when used in conjunction with timber frame external walls.

5.2.10.2 Ventilation

Ventilation should be provided to precast and timber suspended floors. This is generally provided by ventilators on at least two opposite external walls, with air bricks properly ducted in accordance with Chapter 6.1 External masonry walls. Where this is not possible, suitable cross ventilation should be provided by a combination of openings and air ducts. Ventilation should not be obtained through a garage.

Sleeper walls and partitions should be constructed with sufficient openings to ensure adequate through ventilation. If necessary, pipe ducts should be incorporated in adjoining solid floors, separating walls or other obstructions. Where underfloor voids adjoin ground-bearing floors, ventilation ducts should be installed.

Void ventilation should be provided to whichever gives the greater opening area:

- 1,500mm^2 per metre run of external wall
- 500mm^2 per m^2 of floor area.

In the case of timber floors, ventilators should be spaced at no more than 2m centres and within 450mm of the corner of the floor.

A minimum ventilation void of 150mm should be provided below the underside of precast concrete and timber suspended floors. On shrinkable soil where heave could take place, a larger void is required to allow for movement according to the volume change potential:

- high volume change potential — 150mm (300mm total void)
- medium volume change potential — 100mm (250mm total void)
- low volume change potential — 50mm (200mm total void).

Where precast concrete floor planks are used over a DPM laid directly on fill on non-shrinkable soil, the fill should be inert and non-expansive, raised up to the underside of the floor slab and well compacted. Where this is carried out, a ventilated void below the floor is not necessary.

5.2.11 Floor finishes

Finishes to suspended ground floors shall be protected where necessary, against damp, condensation or spillage.

Guidance for suitable floor finishes is given in Chapter 9.3 Floor finishes. Care should be taken to prevent trapping any water spillage below timber floors.

Other floor decking should be assessed in accordance with Technical Requirement R3 and installed in accordance with manufacturers' recommendations.

5.2.12 Floor decking

Floor decking shall be suitable for the intended purpose and be correctly installed.

Acceptable installation details and materials used for decking are detailed in Clause 6.4.19.

5.2.13 Further information

- *BRE Report BR 262 Thermal insulation: avoiding risks. 3rd Edition*
- *BRE Report BR 211 Radon: Guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishment projects). 2023 Edition*

Technical Disclaimer

The NHBC Standards are produced by NHBC as guidance solely for our builder customers as to how to interpret the technical requirements in relation to the warranty cover provided by NHBC under its Buildmark, Buildmark Choice, Buildmark Link, Buildmark Solo, Buildmark Connect or any similar product from time to time. It has not been created or intended for distribution or use outside of that purpose. The information contained in the NHBC Standards do not constitute advice and is not to be relied upon by any third party. Nothing in the NHBC Standards is intended to, nor should it be taken to, create any legal or contractual relationship. Any third party who chooses to rely upon the information contained in the NHBC Standards shall do so entirely at their own risk and NHBC accepts no duty of care or liability, however caused, in connection with its use or reliance by any third party.