Chapter 5.2

Suspended ground floors

5.2 Suspended ground floors

CONTENTS

SCOPE

This Chapter gives guidance on meeting the Technical Requirements and recommendations for suspended ground floors of in-situ and precast concrete and timber joists.

DESIGN STANDARDS

5.2 - D1 Design shall meet the Technical Requirements

Design that follows the guidance below will be acceptable for suspended ground floors.

STATUTORY AND OTHER REQUIREMENTS

5.2 - D2 Design of suspended ground floors shall comply with all relevant statutory and other requirements

Design should be in accordance with relevant Building Regulations and other statutory requirements.

NHBC requires ground floors to be constructed as suspended floors in the following situations:

- where the depth of fill exceeds 600mm, as described in Chapter 5.1 'Substructure and ground bearing floors' (Design)
- where soil swelling may occur, as described in Chapter 4.2 'Building near trees'
- on sites which have been subject to vibratory ground improvement, as described in Chapter 4.6 'Vibratory ground improvement techniques'
- where ground or fill is not suitable to support ground bearing slabs. For suitable fill providing temporary support to suspended floors, refer to Chapter 5.1 'Substructure and ground bearing floors' Appendix 5.1-A.

RESISTANCE TO GROUND CONTAMINANTS

5.2 - D3 Design shall ensure that adequate measures are taken against adverse effects of ground contaminants and radioactive materials

Any contaminants in or above the ground should be identified to the satisfaction of NHBC, following the guidance given in the appropriate British Standard.

Where necessary, precautions against danger to health caused by contaminants should be taken, as described in the Appendix 'Introduction to remedial measures' to Approved Document C1/2/3 and other Building Regulation documents.

5.2 - D4 Design shall provide adequate protection against radon gas

In certain parts of the country, special precautions may be necessary to reduce the entry of radon gas. Areas in England and Wales where special precautions are necessary are detailed in BRE Report 211.

When precautions are necessary, they should be acceptable to NHBC.

In-situ concrete

STRUCTURAL STABILITY

5.2 - D5 In-situ concrete suspended ground floors shall be designed to transmit all loads safely to the supporting structure without undue movement

Items to be taken into account include:

(a) dead and imposed loads
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 Part 4.

(b) end bearings
Bearings on supporting walls should be designed either:

- by an Engineer in accordance with Technical Requirement R5, or
- in accordance with BS 8103 Part 4.

RESISTANCE TO MOISTURE

5.2 - D6 In-situ concrete suspended ground floors shall be designed to resist the passage of moisture to the inside of the building

Items to be taken into account include:

(a) damp-proofing
Dampness from the ground and supporting structure should be prevented from reaching the floor by use of dpms and dpcs.

(b) linking dpm with dpc
Damp-proofing of suspended ground floors should be linked with any damp-proofing of the supporting structure in order to provide continuous protection.

Where there is a risk of sulfate attack, a polyethylene sheet dpm, not less than 1200 gauge (0.3mm) (or 1000 gauge (0.25mm) if assessed in accordance with Technical Requirement R3) should be used, properly lapped.

THERMAL INSULATION

5.2 - D7 Thermal insulation of in-situ concrete suspended ground floors shall be designed to comply with statutory requirements

The BRE report 'Thermal insulation: avoiding risks' discusses aspects of insulation relevant to suspended ground floors. In England and Wales account should be taken of Accredited Details.

Items to be taken into account include:

(a) insulation placed below the floor slab
Insulation below the ground floor slab should:

- be placed on a suitable compacted and even substrate
- have low water absorption
- be resistant to ground contaminants
- be strong enough to support wet construction loads
- be compatible with any dpm.

Suitable insulating materials are described in the Materials section.

(b) insulation placed above the floor slab
For guidance on insulation above the floor slab, reference should be made to Chapter 8.3 'Floor finishes' (Design and Materials).

(c) cold bridging
The design should ensure that any risk of cold bridging is minimised, giving particular attention to junctions between floor and external walls.

Precautions include:

- extending cavity insulation below floor slab level
- linking floor and wall insulation
- providing perimeter insulation to floors
- facing the supporting substructure with insulation.

FLOOR FINISHES AND DECKING

5.2 - D8 Finishes and decking to in-situ concrete suspended ground floors shall be suitable for their intended use

Details of finishes and decking are given in Chapter 8.3 'Floor finishes' (each section) and Chapter 6.4 'Timber and concrete upper floors'.

Precast concrete

STRUCTURAL STABILITY

5.2 - D9 Precast concrete suspended ground floors shall be designed to transmit all loads safely to the supporting structure without undue movement

Items to be taken into account include:

(a) dead and imposed loads
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, or
- proprietary systems which have been assessed in accordance with Technical Requirement R3, or
- chosen from manufacturers' details which are based on recognised Standards and Codes of Practice.

(b) end bearings
Bearings on supporting walls should be as recommended by the manufacturer, and in no case less than 90mm.

RESISTANCE TO MOISTURE

5.2 - D10 Precast concrete suspended ground floors shall be designed to resist the passage of moisture to the inside of the building

Items to be taken into account include:

(a) damp-proofing

The supporting structure should, wherever necessary, incorporate adequate damp-proofing measures to prevent dampness from reaching the floor as described in the following Chapters:
5.1 'Substructure and ground bearing floors' (each section)
6.1 'External masonry walls' (each section).

(b) ventilation of underfloor voids

A minimum void of not less than 150mm should be provided below the underside of floor slabs and beams.

On shrinkable soil where heave could take place, allowance should be made for the void to accommodate the following movements according to the shrinkage potential of the soil:

- high potential - 150mm
- medium potential - 100mm
- low potential - 50mm.

Voids should be ventilated by openings providing not less than 1500mm^2 per metre run of external wall or 500mm^2 per m^2 of floor area, whichever gives the greater opening area.

Ventilation openings should be provided on at least two opposite sides. Where this is not possible, effective cross ventilation from opposite sides should be provided by a combination of openings and air ducts.

Where the finished level below the floor is lower than the finished adjoining ground level, appropriate drainage should be provided.

(c) damp-proofing of suspended floors

It may not be necessary to provide additional damp-proofing where the:

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

Vapour control layers may be necessary to protect floor finishes and should be positioned in accordance with the manufacturer's recommendations (reference should be made to Chapter 8.3 'Floor finishes' (each section)).

(d) linking dpm with dpc

Where provided, damp-proofing of suspended ground floors should be linked with any damp-proofing of the supporting structure in order to provide continuous protection.

THERMAL INSULATION

5.2 - D11 Thermal insulation of precast concrete suspended ground floors shall be designed to comply with statutory requirements

The BRE report 'Thermal insulation: avoiding risks' discusses aspects of insulation relevant to suspended ground floors. In England and Wales account should be taken of Accredited Details.

Items to be taken into account include:

(a) insulation above floor slab

For guidance on insulation above a floor slab, reference should be made to Chapter 8.3 'Floor finishes' (each section).

(b) cold bridging

The design should ensure that any risk of cold bridging is minimised, giving particular attention to junctions between floor and external walls.

Precautions include:

- extending cavity insulation below floor slab level
- linking floor and wall insulation
- providing perimeter insulation to floors
- facing the supporting structure with insulation.

FLOOR FINISHES AND DECKING

5.2 - D12 Finishes and decking to precast concrete suspended ground floors shall be suitable for their intended use

Details of finishes and decking are given in Chapter 6.4 'Timber and concrete upper floors' and Chapter 8.3 'Floor finishes' (each section).

Timber

STRUCTURAL STABILITY

5.2 - D13 Timber suspended ground floors, including the decking material, shall be designed to:
(a) support self weight, dead loads and imposed loads
(b) transmit loads safely to the supporting structure
(c) not deflect unduly
(d) take account of the adverse effects of shrinkage and movement

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design).

STRUCTURAL TIMBER

5.2 - D14 Structural timber grades and sizes shall be adequate for the spans and imposed loads

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Materials).

TRIMMERS

5.2 - D15 Where trimming is necessary, adequately sized timbers shall be used

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Sitework).

STRUTTING

5.2 - D16 Strutting shall be adequate to limit the twisting of joists

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Sitework).

JOIST HANGERS

5.2 - D17 Joist hangers shall be suitable for the joist width and depth, the strength of masonry and the required load

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (each section).

5.2 - D18 Adequate end bearings shall be provided for joists and joist hangers

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Sitework).

JOIST SUPPORT AT SEPARATING WALLS

5.2 - D19 Joists shall be correctly supported at masonry separating walls

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Sitework).

INTERMEDIATE SUPPORT

5.2 - D20 Sleeper walls shall adequately support the floor joists

For guidance, reference should be made to Chapter 4.4 'Strip and trench fill foundations' (Design and Sitework).

FLOOR DECKING

5.2 - D21 Appropriate materials for floor decking shall be used

Items to be taken into account include:

(a) decking and joist centres

(b) resistance to moisture

(c) fixing

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (each section).

DAMP-PROOFING

5.2 - D22 Design of timber suspended ground floors shall ensure that the floors are not adversely affected by moisture

Items to be taken into account include:

(a) damp-proofing of supporting structure

The supporting structure should include damp-proofing to prevent moisture penetrating to the suspended floor, as described in Chapter 6.1 'External masonry walls' (each section).

Where the finished level below the floor is lower than the finished adjoining ground level:

- appropriate drainage should be provided, or
- the structure should be tanked.

(b) resistance to ground moisture

Provision should be made to prevent ground moisture affecting timber floor construction.

This can be achieved by either:

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

In Scotland, the deemed-to-satisfy specification of the statutory regulations should be followed.

Where necessary, oversite concrete should be protected against sulfate attack by the use of a polyethylene sheet dpm, not less than 1200 gauge (0.3mm) (or 1000 gauge (0.25mm) if assessed in accordance with Technical Requirement R3) properly lapped.

(c) ventilation of underfloor voids

A minimum ventilation void of 150mm should be provided below floor joists or 75mm below any wall plate.

On shrinkable soil where heave could take place, an allowance for movement should be added to the underfloor ventilation requirement to determine the minimum dimension of the underfloor void. The allowance for movement relates to the shrinkage potential of the soil as follows:

- high potential - 150mm
- medium potential - 100mm
- low potential - 50mm.

Voids should be ventilated by openings providing not less than 1500mm^2 per metre run of external wall or 500mm^2 per m^2 of floor area, whichever gives the greater opening area.

Ventilators should be spaced at not more than 2m centres and within 450mm of each end of any wall. Air bricks should be ducted through cavities and be unobstructed.

Every part of the void under a timber suspended ground floor should be thoroughly ventilated through openings on at least two opposite sides. Where this is not possible, effective cross ventilation from opposite sides should be provided by a combination of openings and air ducts.

Provision should be made for ventilation through partitions and sleeper walls. If necessary, pipe ducts should be incorporated in adjoining solid floors, separating walls or other obstructions. Ventilation should not be obtained through a garage.

THERMAL INSULATION

5.2 - D23 Thermal insulation of timber suspended ground floors shall be designed to comply with statutory requirements

The BRE report 'Thermal insulation: avoiding risks' discusses aspects of insulation relevant to suspended ground floors. In England and Wales account should be taken of Accredited Details.

Items to be taken into account include:

(a) positioning of insulation

Insulation may be:

- insulation quilt, or
- rigid insulation.

Insulation quilt should be supported between joists.

Rigid insulation boards should be adequately supported on battens fixed to the sides of joists.

(b) cold bridging

The design should ensure that any risk of cold bridging is minimised, giving particular attention to junctions between floor and external walls.

Precautions include:

- extending cavity insulation below floor level
- linking floor and wall insulation
- providing perimeter insulation to floors
- facing the supporting substructure with insulation.

Information

PROVISION OF INFORMATION

5.2 - D24 Designs and specifications shall be produced in a clearly understandable format and include all relevant information

Clear and fully detailed drawings should be available on site to enable work to be carried out in accordance with the design.

Design drawings should include:

- all necessary plan dimensions and levels related to identified benchmarks
- details of loadbearing walls
- minimum bearing dimensions
- information on all proposed underground services
- points of entry to the building for services
- penetration of services through the substructure, including support of the structure above
- details of trench backfill, infill and void formers
- the required sequence of trench backfill if this is relevant to the design of the walls below dpc
- work required to maintain the integrity of dpcs and dpms
- details of junctions between dpm, dpc and tanking
- details of underfloor and floor edge insulation and cavity insulation, where relevant.

5.2 - D25 All relevant information shall be distributed to appropriate personnel

Ensure that design and specification information is issued to site supervisors and relevant specialist subcontractors and/or suppliers.

MATERIALS STANDARDS

5.2 - M1 All materials shall:
(a) meet the Technical Requirements
(b) take account of the design

Materials that comply with the design and the guidance below will be acceptable for suspended ground floors.

Materials for suspended ground floors should comply with all relevant standards, including those listed below. Where no standard exists, Technical Requirement R3 applies (see Chapter 1.1 'Introduction to the Standards and Technical Requirements').

References to British Standards and Codes of Practice include those made under the Construction Products Directive (89/106/EEC) and, in particular, appropriate European Technical Specifications approved by a European Committee for Standardisation (CEN).

CONCRETE AND REINFORCEMENT

5.2 - M2 Concrete shall have appropriate reinforcement and be of a mix design that will:
(a) achieve sufficient strength to support floor loads safely
(b) be sufficiently durable to remain unaffected by chemical or frost action

For guidance on the specification and use of in-situ concrete, additives and reinforcement, reference should be made to Chapter 2.1 'Concrete and its reinforcement' (each section).

PROPRIETARY SYSTEMS

5.2 - M3 Proprietary flooring systems shall have adequate strength and durability

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, eg polystyrene infill blocks, the floor should be assessed in accordance with Technical Requirement R3.

TIMBER

5.2 - M4 Structural timber, decking and related materials shall be suitable for their location and intended use

Materials should be selected in accordance with the relevant parts of Chapter 6.4 'Timber and concrete upper floors' (Design and Materials).

DAMP-PROOFING AND THERMAL INSULATION MATERIALS

5.2 - M5 Materials shall be suitable for their location and intended use

Items to be taken into account include:

(a) damp-proofing materials
Damp-proofing materials should be selected in accordance with Chapter 5.1 'Substructure and ground bearing floors' (Design and Materials).

(b) thermal insulation materials
Thermal insulating materials used below cast in-situ suspended floor slabs should be selected in accordance with the relevant recommendations given in Chapter 5.1 'Substructure and ground bearing floors' (each section).

Thermal insulating materials for use with timber floors should be:
- expanded polystyrene boards (grade EPS 70) to BS EN 13163
- mineral wool to BS 5803 : Part 1
- other materials which have been assessed in accordance with Technical Requirement R3.

For thermal insulation used above concrete floor slabs, materials should be selected in accordance with Chapter 8.3 'Floor finishes' (Design and Materials).

SITEWORK STANDARDS

5.2 - S1 All sitework shall:
(a) meet the Technical Requirements
(b) take account of the design
(c) follow established good practice and workmanship

Sitework that complies with the design and the guidance below will be acceptable for suspended ground floors.

VENTILATION AND DAMP-PROOFING

5.2 - S2 Construction of suspended ground floors shall ensure adequate damp-proofing

Masonry supporting suspended ground floors should have been damp-proofed using dpm, dpc or tanking in accordance with the guidance given in the following Chapters:
5.1 'Substructure and ground bearing floors' (each section)
6.1 'External masonry walls' (each section).

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

5.2 - S3 Construction of suspended ground floors shall ensure adequate ventilation

Ventilation should be provided in accordance with the design. This is normally provided by ventilators on at least two opposite external walls.

Air bricks in cavity walls should be properly ducted as detailed in Chapter 6.1 'External masonry walls' (Design and Sitework).

Sleeper walls should be constructed with sufficient openings to ensure adequate through ventilation. Where underfloor voids adjoin ground bearing floors, ventilation ducts should be installed.

Ventilation should not be obtained through a garage.

CONSTRUCTION OF FLOORS

5.2 - S4 Construction of suspended floors shall ensure that they safely support the intended loads and are reasonably level

Items to be taken into account include:

(a) in-situ concrete floors
Concreting should be carried out in accordance with:
- the design
- relevant parts of Chapter 2.1 'Concrete and its reinforcement' (each section)
- relevant parts of Chapter 6.4 'Timber and concrete upper floors' (each section).

(b) precast concrete floors
All sitework for precast concrete floors should be carried out in accordance with the manufacturer's recommendations.

Care should be taken to ensure that dpcs are not damaged or displaced.

(c) timber floors
All sitework for timber floors should be carried out in accordance with the relevant parts of Chapter 6.4 'Timber and concrete upper floors' (Sitework).

THERMAL INSULATION

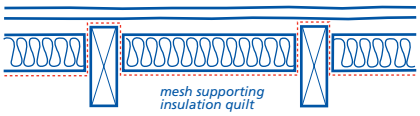
5.2 - S5 Thermal insulation shall be installed to minimise thermal transmission through the floor

The BRE report 'Thermal insulation: avoiding risks' discusses aspects of insulation relevant to suspended ground floors. In England and Wales account should be taken of Accredited Details.

Items to be taken into account include:

(a) floor insulation methods

TIMBER FLOORS
Insulation quilts should be supported, eg by draping plastic mesh across the joists and stapling it to joist sides so that the quilt can be laid to the full thickness. Insulation draped over the joists is not acceptable.



Rigid insulation boards should be supported on battens or fillets nailed to the sides of joists.

CONCRETE FLOORS
For guidance on insulating concrete floors, reference should be made to Chapter 8.3 'Floor finishes' (each section).

(b) cold bridging
The design should be followed to ensure that any risk of cold bridging is minimised. Pay particular attention to junctions between floor and external walls.

FLOOR FINISHES

5.2 - S6 Finishes to concrete suspended ground floors shall be protected, where necessary, against damp, condensation or spillage

For guidance, reference should be made to Chapter 8.3 'Floor finishes' (Design and Sitework).

FLOOR DECKING : GENERAL

5.2 - S7 Flooring shall be fixed only when the dwelling is substantially weathertight

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Sitework).

5.2 - S8 Completed floor decking shall not be overloaded and shall be protected against damage

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Sitework).

Care should be taken to prevent trapping any water spillage below timber floors.

SOFTWOOD BOARDING

5.2 - S9 Softwood boarding shall be securely fixed

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Sitework).

CHIPBOARD FLOORING

5.2 - S10 Chipboard flooring shall be of the type and thickness specified and shall be fixed securely

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (each section).

ORIENTED STRAND BOARD FLOORING

5.2 - S11 Oriented strand board flooring shall be of the type and thickness specified and shall be fixed securely

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (each section).

OTHER FLOOR DECKING

5.2 - S12 Plywood decking shall be fixed securely

For guidance, reference should be made to Chapter 6.4 'Timber and concrete upper floors' (Design and Sitework).

5.2 - S13 Proprietary materials shall be fixed in accordance with manufacturers' recommendations

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

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