TECHNICAL MANUAL

PART 5

SUBSTRUCTURE
AND
GROUND FLOORS

Version 1: 24/07/2017

Part 5 – Substructure & Ground floors

5.1 Walls

CONSTRUCTION FROM FOUNDATION TO DPC

Bricks and Blocks Below DPC

Bricks and blocks may be used below DPC where there are no soil borne sulphates. Bricks should be selected in accordance with table 5.52 and BS EN 772-3:1998, BS EN 772-7:1998 & BS EN 771-1:2003.

Where sulphates in soils and/or groundwater are present, suitability of brickwork and blockwork below DPC should be confirmed with the manufacturer.

Sulphate resisting cement may be necessary.

Suitable blocks have:

- Blocks of density greater than 1500 kg/m^3
- A compressive strength greater than or equal to 7 N/mm^2
- Some autoclaved aerated blocks

In association with Table 5.01 below, 'F' quality bricks are considered suitable for use in all building situations, whilst 'M' quality bricks are considered to be durable except in situations where they may remain saturated and subject to repeated freezing and thawing. Whilst not noted on the table, 'O' quality bricks have no frost resistant qualities and are generally for internal use only.

Designation	Frost Resistance	Soluble Salt content
FL	Frost Resistant (F)	Low (L)
FN	Frost Resistant (F)	Normal (N)
ML	Moderately frost resistant (M)	Low(L)
MN	Moderately frost resistant (M)	Normal (N)
OL	Not frost resistant (O)	Low (L)
ON	Not frost resistant (O)	Normal (N)
Note: calcium silicate and concrete bricks contain no soluble salts		

Table 5.01: Durability designations of clay bricks

Use	Brick Type			Notes on Mortar (for mortar designation see Mixing of Mortar in Part 6)
	Clay	Calcium Silicate*	Concrete	
Foundation to DPC	FL, FN, ML, MN**	Class 3	Strength > 20 N/mm^2	
Foundation to DPC sulphates in soils	FL, FN, ML, MN**	Class 3	Strength > 20 N/mm^2 All Class 1 sulphates and some in Class 2 (consult manufacturers). Engineering quality concrete bricks up to Class 3 sulphates	Where sulphate levels are Class 3 or higher use sulphate resisting Portland Cement
Unrendered external walls protected from saturation	FL, FN, ML,MN	Class 3	Strength > 7 N/mm^2	
Unrendered external walls not protected from saturation	FL, FN	Class 3	Strength > 15 N/mm^2	Use sulphate resisting cement in mortar with Type N clay bricks
Rendered external walls	FL, FN, ML, MN	Class 3	Strength > 7 N/mm^2	Use sulphate resisting cement in mortar and base coat of render with Type N clay bricks
Copings, cappings, sills etc	FL, FN	Class 4	Strength > 30 N/mm^2	
Internal	FL, FN, ML, MN, OL, ON	Class 3	All	
Notes: *Minimum Class indicated: a higher class (eg up to 7) is equally acceptable. ** If the site is wet or the masonry at or near ground level may be subject to saturation use FL bricks with sulphate resisting cement				

Table 5.02: Selection of Bricks

DAMP-PROOF MEMBRANES AND DAMP-PROOF COURSES

Resistance to Ingress of Moisture

Damp-Proof Membrane (DPM) and Damp-Proof Course (DPC):

A DPC should:

- Be laid in a smooth mortar bed and lapped at junctions
- Not obstruct or bridge cavities unless specifically designed to do so, e.g. cavity trays

A DPM should:

- Be provided under all ground supported slabs and made continuous with the DPC in the wall by the use of 100 mm laps (See diagram 5.03).
- Be laid on a smooth blinded surface in such a manner so as to avoid accidental perforation
- Be installed in ground supported slabs of integral garages

A DPC and DPM should be protected during storage and construction operations such as power-floating or tamping so as to avoid perforation. Unavoidable perforations of DPM's by services should be fully sealed to maintain the integrity of the membrane.

Workmanship should comply with BS 8000-4:1989.
Damp-Proof Membranes should be either:

- A minimum 1200 g (300µm) polythene (laid on sand blinding when located below the slab) or
- Specialist liquid applied membranes, applied to manufacturers recommendations. or
- Hot applied mastic asphalt (laid beneath or over a screed).

Other Damp-Proof Membranes possessing current independent Third Party testing and certification may be acceptable to Build-Zone.

AVOIDING MOISTURE INGRESS IN STEPPED CONCRETE FLOORS

Ensure that vertical Damp-Proof Membranes are located behind the wall and provided with suitable protection against damage (See diagram 5.03).

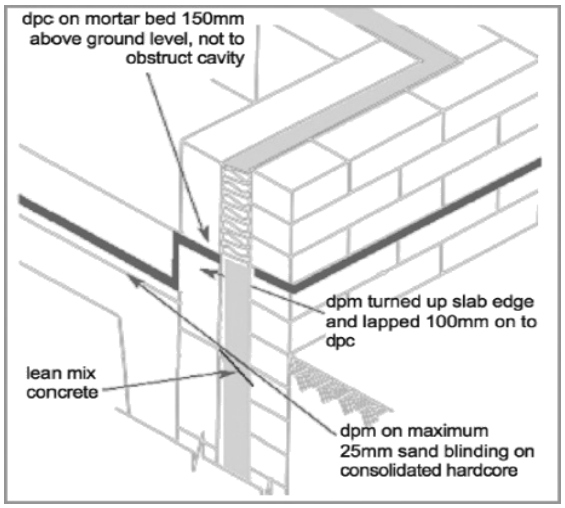

Diagram 5.03: Damp Proof course and membrane

5.2 Floors

INTRODUCTION

Subjects covered in this section include:

- Traditional ground supported concrete floors
- Precast concrete beam and block floors
- Thermal insulation to floors
- Suspended reinforced in-situ slabs
- Suspended timber floors

The moisture content of structural timber should not exceed 20% (ideally 18%) at the time of stress grading and at the time of erection. All structural timber for use within the building fabric should be stress graded marked 'KD' (Kiln Dry) or 'Dry'.

Level of Floor

Maximum of 4mm out of level per metre for floors up to 6m across, and maximum 25mm overall in any other case.

Flatness of Floor

Max ± 5mm deviation from a 2m straight edge with equal offsets.

Skirting to Floor Gap

A gap of up to 5mm can be expected between the finished floor screed/floor board (without covering) and bottom of skirting in a new house.

The gap between floor finish and skirting may increase because of drying out shrinkage and deflection, particularly on timber floors. A gap of 10mm, exceptionally 15mm may be seen on floors with long spans or heavy items of furniture on the floor.

Timber Floors and Staircases

These are made of materials which naturally shrink as they dry. It may result in squeaking of components as they move against each other. This is natural and to be expected. It is noted that some squeaking is to be expected and cannot be totally eliminated.

Choice of Ground Floor

The Developer is to use a ground floor construction which is appropriate for the site conditions.

Traditional ground supported concrete floors provide a convenient and economical solution for normal sites.

Suspended floors may be appropriate when building in the following situations:

- Oversite fill depth exceeding 600 mm
- Sloping ground
- Shrinkable clay soils
- Soils of low bearing capacity or filled sites
- High water table
- Aggressive sub-soils
- Presence of trees

GROUND SUPPORTED CONCRETE FLOORS

Do not commence site filling until all topsoil, tree roots and other organic matter have been removed.

Use well graded inert hardcore e.g. crushed limestone, granite, washed river gravel, clean and suitably graded concrete rubble, etc. maximum size not exceeding 100 mm and free from organic materials, sulphates, or other deleterious matter. Do not use materials such as expanding colliery shales, slag, etc. Generally demolition materials should not be used unless specifically agreed by Build-Zone.

On dry sites selected broken bricks (excluding refractory bricks) may be acceptable providing they are firm and free from plaster. A 1200 g (300µm) polythene barrier should be placed between the blinded brick fill and the concrete slab.

Fill should be at least 100 mm thick, laid in layers not exceeding 150 mm and be fully consolidated by a mechanical compactor, e.g. 8 passes with a 65 kg vibro tamper or 8 passes of a 2000 kg/m^2 vibrating plate. The total depth of compacted layers should not exceed 600mm.

Where the fill exceeds 600mm a suspended floor supported on load bearing walls is necessary e.g. beam and block.

To ensure optimum compaction, the fill should not be excessively wet.

The trench excavations located beneath slabs should be backfilled with hardcore and consolidated without damaging the brickwork below DPC level.

Unreinforced ground supported slabs should be in accordance with BS EN 206-1:2000, BS 8500-1:2002 & BS8500-2:2002/ST3 mix grade concrete at least 100 mm thick. The concrete should be well tamped.

Avoiding Ingress of Moisture at Junction of DPC and DPM

Ensure that:

- Damp-Proof Membranes located below concrete floors are continued up the edge of the slab and lapped onto the wall DPC. Where the slab is power-floated, ensure that the projecting Damp-Proof Membrane is not damaged.
- In cases where a sheet type Damp-Proof Membrane is laid after the construction of the walls, an extra wide damp-proof course should be provided in the wall and lapped onto the Damp-Proof Membrane (e.g. where located between the screed and the concrete slab, see diagram 5.04).

Avoiding Debonding and Cracking of Screeds

Prior to laying the screed ensure the floor slab is properly cleared of rubble and dust.

Use a 1:3 to 1:41/2 cement/sand mix for up to 50 mm thickness (65 mm thick with light reinforcing on insulation).

It is recommended that pipes are located in purpose made ducts.
Ensure that screeding is carried out in a frost-free environment, protect or cure screeds from rapid drying out (e.g., floor areas adjacent to south facing patio doors) and lay as per the manufacturer's instructions where applicable.

Avoiding Clay Heave or Shrinkage Damaging Concrete Floors

Changes in the moisture content of cohesive soils (clays) can cause heave or shrinkage which in turn can cause cracking and movement of ground supported floors. "Clay heave" is often caused by removal of trees and hedgerows and insufficient time is given to allow the supporting subsoil to return to its natural equilibrium. "Clay shrinkage" is caused during long dry spells and the influence of vegetation which remains in influencing distance.

The extent of the movement depends upon the plasticity of the clay and requires a detailed site investigation and report performed by an Expert.

Damage to floors caused by clay heave or shrinkage is avoided by using suspended floors with a void below that will accommodate any ground movement.

See later in this section for suspended floor details and dimensions of associated voids.

Preventing Settlement of Ground Supported Slabs

Fill beneath concrete floors should generally not be used on sloping sites greater than 1 in 15, nor exceed 600 mm in depth. Suitable and approved fill material should be compacted in layers of a maximum thickness of 150mm unless a suspended reinforced floor is constructed.

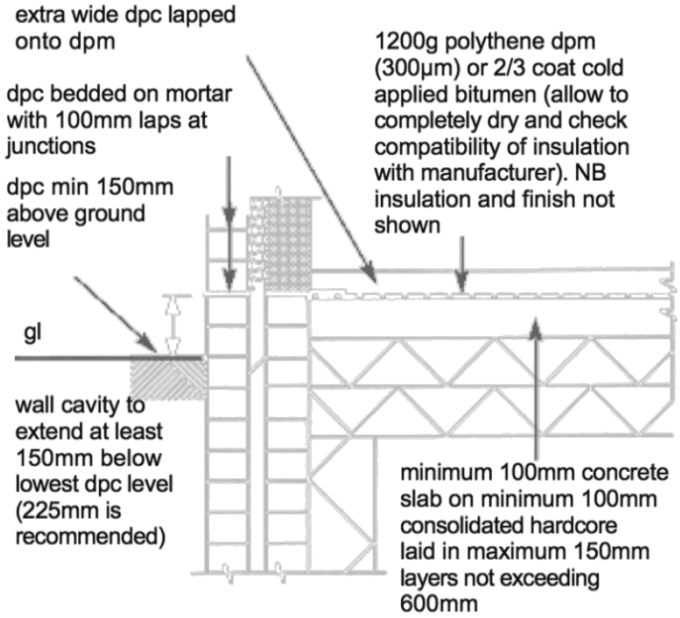

Diagram 5.04: Ground supported concrete slab with DPM above slab

PRECAST BEAM AND BLOCK FLOOR

Site Preparation

The ground beneath the floor should be free from topsoil and vegetable matter. Where necessary, ground level beneath the beam and block floor should be raised to that of the external ground to prevent water ponding (unless the ground is free draining and the perimeter wall is capable of acting as a retaining wall). Alternatively provide a suitable DPM linked to a DPC.

In Scotland it is common practice to bring the solum area beneath all suspended floors up to ground level except where a Damp-Proof Membrane is linked to a Damp-Proof Course.

Avoiding Deflection of Floors and Cracking of Screeds

Ensure that precast (PC) beam and block floors possess current independent Third Party certification acceptable to Build-Zone and that:

- They are fully supported by loadbearing walls
- They are laid as specified by the designer and independent Third Party certificates acceptable to Build-Zone
- The beam reference numbers have been checked, as similar beams of the same size may have varying strength characteristics because of different sized reinforcement
- Suitable infill bricks or blocks, properly bedded on mortar, are provided between PC beams where bearing onto supporting walls
- Beams and blocks are grouted together with a 1:6 cement/sand mix in accordance with the manufacturer's instructions
- Loadbearing walls continue through the beam and block floor
- Holes for service pipes are properly filled by laying non-timber form work between PC joists and gaps filled with good quality concrete (ST3 mix) prior to screeding
- Screeds in garages are reinforced with minimum A98 steel mesh to distribute car loads

Avoiding Ingress of Ground Moisture

There are two methods for preventing ground moisture in precast beam and block floors:

NO DAMP PROOF MEMBRANE REQUIRED

Locate the beams and blocks above DPC level and provide 600mm^2/m run of ventilation to the void under the floor. A minimum gap of 75mm should be maintained between the underside of the floor and solum area (see diagram 5.05).

The void should be increased to 150mm when:

- Venting to remove gas
- In Scotland
- There is a risk of "clay heave"

Where a gas supply passes through this void or an occurrence of natural gas is possible (landfill, radon, etc.) the ventilation provided should be increased to 1500mm^2/m run.

Provide perimeter ventilation in two opposite external walls. Maintain continuity of ventilation through internal walls by honeycomb walling or airbricks.

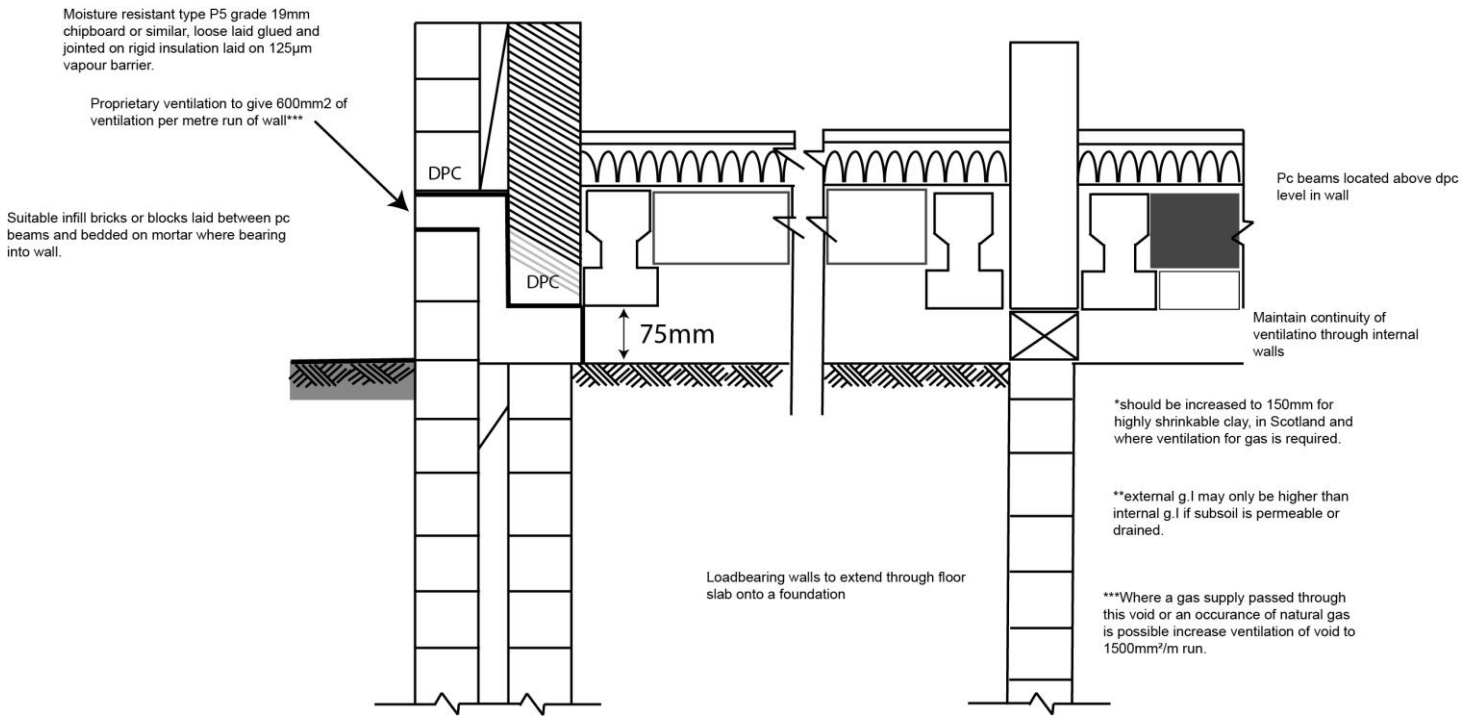

Diagram 5.05: Precast concrete ground floor

DAMP-PROOF MEMBRANE REQUIRED

Where beams and/or blocks are located below DPC level, provide a Damp-Proof Membrane laid over the beams and blocks, lapped onto the DPC in the wall (a void below the floor is still required in this case in order to minimise the exposure condition of the precast concrete beams). The void should be ventilated where a gas supply passes through this void or the presence of naturally occurring gases is expected (e.g. methane or radon).

Damp-Proof Membranes should be either:

- A minimum 1200 g (300µm) polythene (laid on sand blinding when located below the slab) or
- Specialist liquid applied membranes, applied to manufacturers recommendations. or
- Hot applied mastic asphalt (laid beneath or over a screed).

All the above Damp Proof Membranes should link to the Damp Proof Course.

Ensure that PC beams bear fully onto the inner leaf of the cavity wall without projecting into and obstructing the cavity. The minimum bearing for precast beams should be 90mm.

THERMAL INSULATION OF FLOORS

Provide an effective and durable layer of thermal insulation to ground floors.

Where required, thermal insulation should be provided to ground floors to achieve a U-value of not greater than 0.25w/m^{2}K.

Insulation Located Below a Ground Bearing Slab

Where thermal insulation is located below ground floor slabs it is essential that the insulation material possesses a current independent Third Party certificate acceptable to Build-Zone. Use of an unsuitable material may lead to subsidence of the floor.

The hardcore must be sand blinded prior to placing the insulation.

Where the Damp-Proof Membrane is positioned below the concrete floor slab it should be located over the insulation board. Provide vertical edge insulation to the perimeter of the slab to avoid a cold bridge (See diagram 5.06).

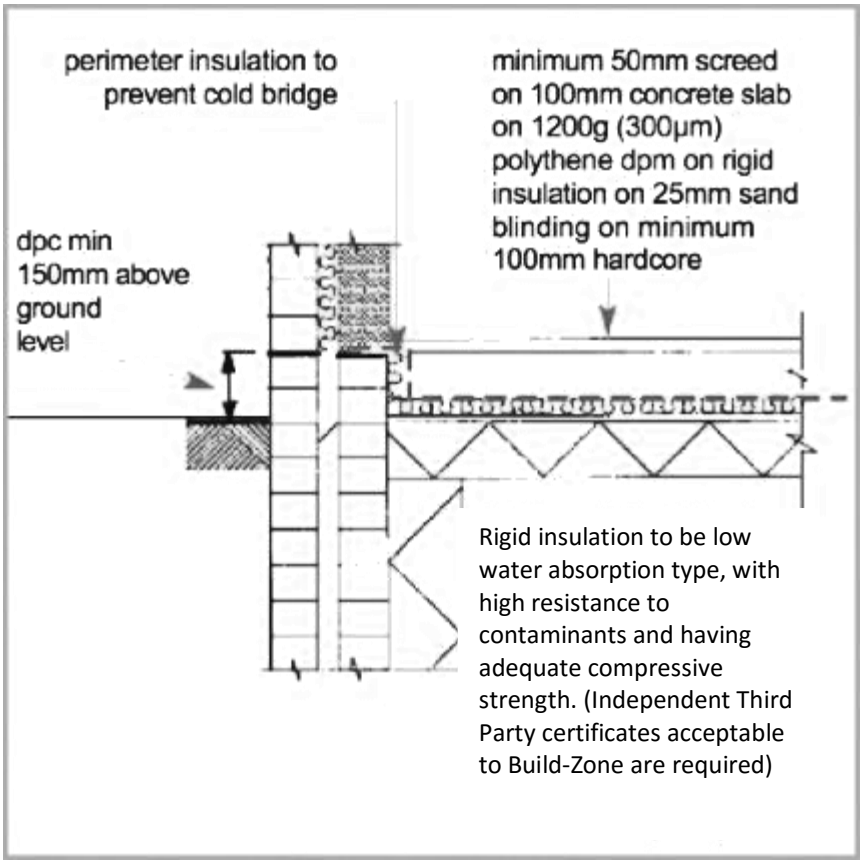

Diagram 5.06: Ground supported concrete slab with insulation located below the slab

Insulation Located Above a Ground Bearing Slab - Screed Finish

A Damp-Proof Membrane should be located above the slab linked to the DPC, 1200 gauge (300µm) polythene DPM is recommended in this situation linked to an extra wide DPC. The joints of the rigid insulation should be closely butted and taped or the insulation should be protected by a separating layer e.g. 500 gauge (125µm) polythene or building paper to prevent the wet screed penetrating the joints between the boards (See diagram 5.07).

The insulation should be turned up at the edges to prevent cold bridging through the screed/wall junction. Screeds laid over insulation should be at least 65 mm thick and incorporate a layer of either D49, D98 or chicken mesh reinforcement located centrally in the screed if the floor area of the room exceeds 15m^2.

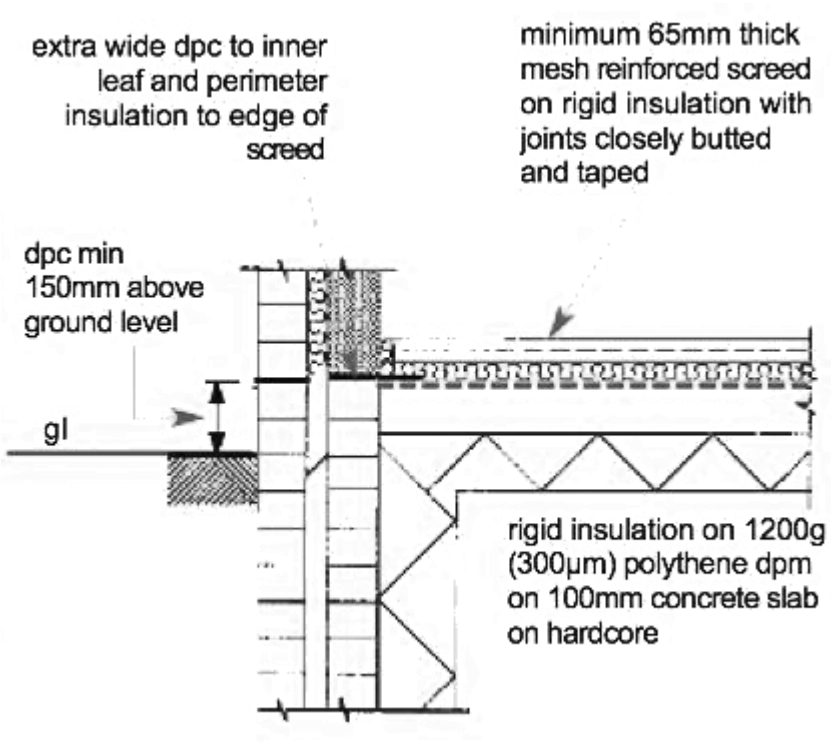

Diagram 5.07: Ground supported concrete slab with insulation located below the screed

Timber Board Loose Laid System

A loose laid system is where T & G panels of chipboard or plywood and rigid insulation are laid separately. The Damp-Proof Membrane should be laid above the floor slab linked to the DPC. Pressure impregnated timber battens are used at door openings to support non T & G board joints and elsewhere to support heavy partitions.

A 500 g (125µm) polythene vapour barrier is then laid over the insulation with 150 mm laps or taped joints and lapped 100 mm up walls (See diagram 5.08).

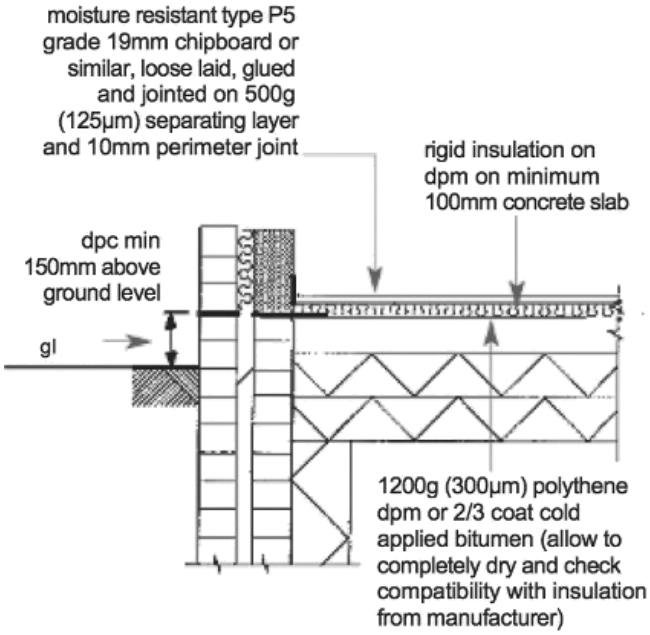

Diagram 5.08: Ground supported concrete slab finished with separate timber boarding and loose laid insulation system

Type P5 or P7 chipboard or similar, with all joints glued with PVA adhesive or similar, is then laid over the vapour barrier. Allow for a 10 mm gap or 2 mm gap per metre run of floor (whichever is the greater) at all abutments between walls and floors to accommodate possible expansion of the floor decking. Temporary wedges should be used to facilitate fixing and gluing the boards, which must be removed prior to fixing the skirting board.

Timber Board/Insulation Composite System

A composite system is where the board and insulation are one element and laid together. The Damp-Proof Membrane must be laid above the slab and linked to the DPC (this is to prevent any residual moisture in the slab affecting the chipboard). The jointing and expansion gaps at walls are as the loose laid system (See diagram 5.09).

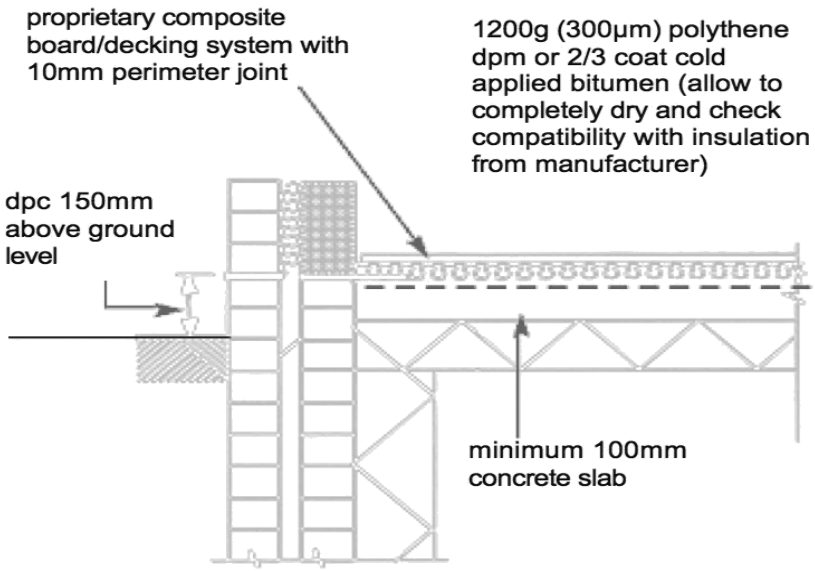

Diagram 5.09: Ground supported concrete slab finished with composite board/decking system

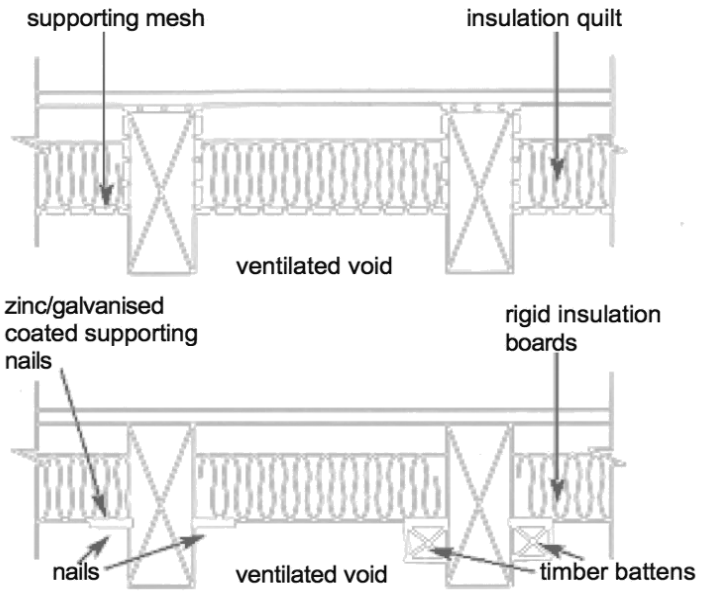

Diagram 5.10: Suspended timber floors – support of insulation over ventilated floor

Insulation Located Below a Timber Suspended Floor

Flexible quilt insulation is supported between joists by plastic mesh. Care should be taken to ensure that the insulation does not fall below the underside of the joists and block the ventilation gap.

Rigid insulation boards can be supported between the joists by use of supporting nails every 600 mm or by battens nailed to the side of the joists (See diagram 5.10).

Insulation Located Above a Precast Concrete Suspended Floor

Providing the precast concrete floor is located above the Damp-Proof Course and has a ventilated void, a Damp-Proof Membrane is not usually required. If there is a high water table or the possibility of water ponding under the floor a DPM should be installed. The insulation and finish should be constructed as shown for insulation located above a ground bearing slab. A 500g (125µm) polythene vapour barrier located beneath the timber boarding should be provided. (See diagram 5.11).

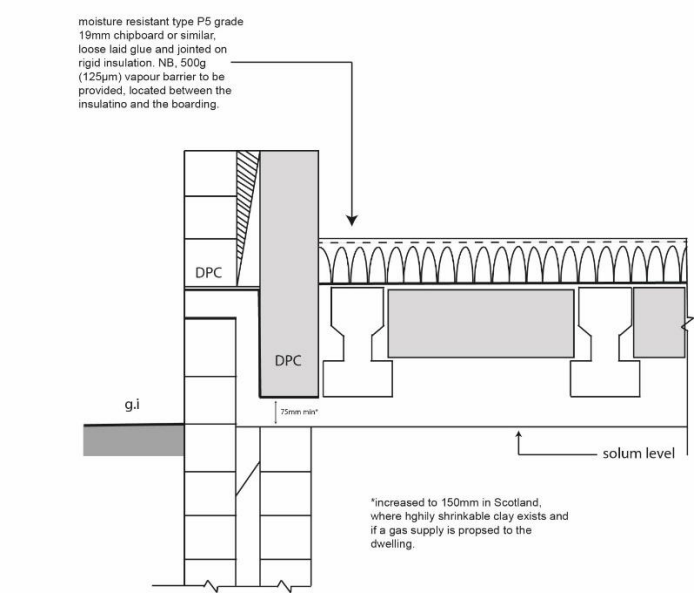

Diagram 5.11: Precast concrete ground floor with timber decking and insulation

Other Points to Remember

The floor slab must be smooth and level prior to laying the insulation. Irregularities up to 10mm may be removed by lean mix screed adequately compacted.

Concrete slabs should be left as long as possible to dry out prior to laying the insulation.

Non T & G board joints should be screw fixed to battens e.g. at door openings and at perimeters of rooms. Protect thermal insulation from damage whilst laying floor screed or deck.

Special care should be taken to ensure that where timber boarding is used as a finish it is laid in dry conditions in a weather tight building after all wet site operations have been completed.

Insulate water pipes located in voids below suspended floor slabs.

SUSPENDED REINFORCED IN-SITU

Subjects covered in this section include:

- Using the Design Tables
- Site preparation
- Damp-Proof Membrane
- Site construction methods
- Design load/Span tables

This guidance relates to work on site and is intended to provide simple slab design tables and is provided as a guide only. All slab designs should be checked by a suitably insured and qualified Building Professional. Therefore it may be more economical for the slab to be designed by a Structural Engineer using BS EN 1992-1-1:2004. This is especially relevant if a two way spanning or continuously supported slab is proposed.

It should be noted that a solid reinforced in situ slab cast in contact with the ground for temporary support is considered inappropriate where "clay heave" conditions are likely to occur. A suspended floor above a minimum 150mm deep void is recommended where these conditions exist.

Using the Design Tables

The following pages provide simple tables to select fabric reinforcement and concrete slab thicknesses for various spans and loading situations.

There are four loading situations:

1. Table 5.26: No partitions, a domestic living area with a floor finish of up to 65mm sand cement screed.
2. Table 5.27: Timber studwork and plasterboard partitions, a domestic living area with a floor finish of up to 65mm sand cement screed.
3. Table 5.28: 100mm lightweight blockwork partitions, a domestic living area with a floor finish of up to 65mm sand cement screed.
4. Table 5.29: Garage slab with no partitions or additional floor finish.

The tables assume that all partitions are non-loadbearing and are positioned anywhere on the slab.

The tables can only be used for a maximum of 100mm lightweight blockwork (1267 kg/m^3) plus 2 coat plaster up to a height of 2.5m. Should the partitions be heavier than this e.g. brick or dense block then the slab should be designed by a structural engineer.

The floor finish assumes 65mm of sand cement screed used with insulation on the slab. This allows the tables to be used for other floor finishes that may be lighter e.g. insulation and timber boarding or with no finishes (i.e. a power-floated slab).

Site Preparation

The fill material must be compacted sufficiently in order to provide temporary support to the slab during construction and until it has gained its design strength.

The fill material must not contain topsoil or organic matter. It must not be susceptible to swelling (e.g. do not use colliery shales) or contain materials which may affect the concrete (e.g. plaster, blast furnace slag, ash, etc.).

In many cases well compacted sub-soil (excluding topsoil) already excavated can be used as a temporary support.

The fill should then be covered by 50mm blinding (i.e. sand, lean-mix concrete, etc.) to provide a level but firm working surface. (See diagram 5.12).

Damp-Proof Membrane (DPM)

Damp Proof Membranes located below the slab are often punctured by the reinforcement. It is therefore recommended that Damp Proof Membranes are located above the slab. (See diagram 5.13). If the builder wishes to lay the DPM under the slab the following must be complied with:

- DPM must be laid on a 50mm layer of sand blinding.
- Reinforcement must be cut correctly to minimise damage.
- Slab edge must be protected by wrapping the DPM up and locating under 1st course of blockwork.
- Joints must be lapped at least 300mm and DPM must be linked with the DPC to provide a continuous impervious barrier.

Damp-Proof Membranes should be either:

- A minimum 1200 g (300µm) polythene (laid on sand blinding when located below the slab) or
- Specialist liquid applied membranes, applied to manufacturers recommendations. Or
- Hot applied mastic asphalt (laid beneath or over a screed).
- Any other Damp Proof Membranes possessing a current Independent Third Party certification acceptable to Build-Zone.
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In cases where a sheet-type DPM is laid above the slab an extra wide DPC should be provided in the wall and lapped onto the Damp-Proof Membrane.

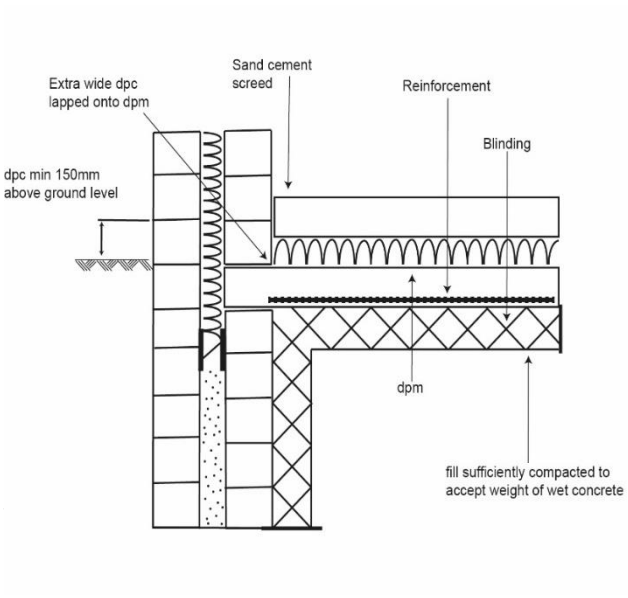


Diagram 5.12: Suspended R.C. slab after construction

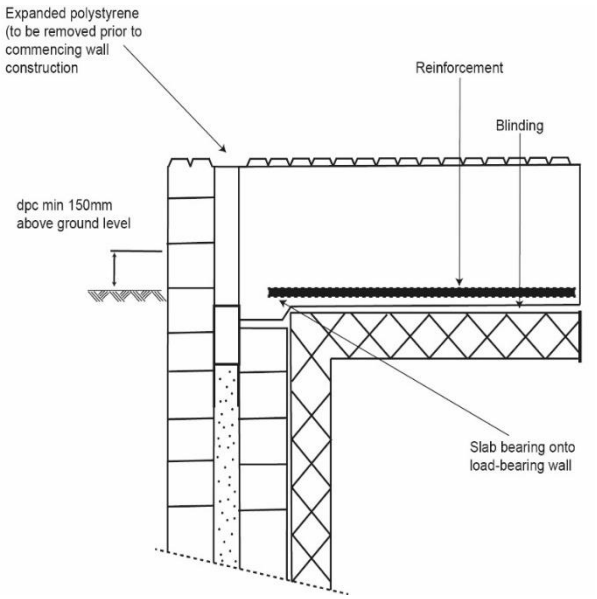


Diagram 5.13: Suspended concrete slab

The thickness of the slab will vary according to its span between walls. (See diagram 5.13).

The extra load imposed by the slab may also have an effect on the foundation design. It is advisable to check this with the foundation designer and/or Building Control Authority.

Definitions - Standard Mix (ST)

A standard mix is a concrete designed using the materials and mix proportions given in BS EN 206-1:2000 and is suitable for most house construction activities.

Note: Standard mixes should not be used in aggressive soil conditions where the soil, the ground water or any adjacent material contains sulphates or other aggressive chemicals.

Application	Standard designated 28 days M/mm^2 mix	(MPa)	Suggested slump (mm)	Suggested method of compaction
Floors house floors with no embedded metal: Permanent finish to be added eg screed no permanent finish to be added eg carpet garage floors with no embedded material	 ST2 ST3 ST4	 10.0 15.0 20.0	 75 75 75	 Poker or beam vibration and/or tamping
Other reinforced and pre-stressed concrete applications reinforced or pre-stressed concrete: mild exposure reinforced or pre-stressed concrete moderate exposure	 N/A N/A	 30.0 35.0	 75 75	 Poker poker

Table 5.14: Selection guide to the use and specification of standard and designated concrete mixes

Reinforcement

COVER TO STEEL-WORK

Main reinforcement must be 40mm from the underside of the slab subject only to normal building tolerances. This is achieved by placing the fabric on spacers prior to pouring concrete (See diagram 5.15).

Chairs or stools should be provided as spacers to ensure correct placement of top reinforcement in relation to bottom reinforcement ensuring adequate cover.

LAYING STEEL REINFORCEMENT

The fabric wires must be laid so that the main wires are parallel to the span (See diagram 5.16).

The bottom mesh should be laid so that the main reinforcement wires are below the secondary reinforcement wires, i.e. the main wires are on the bottom and the secondary wires on top. This is to allow the correct positioning of the main wires in the slab when providing the cover.

LAPPING (WHERE APPLICABLE)

Ensure the reinforcement is lapped and tied. Laps in secondary wires to be 300mm (See table 5.17 and diagram 5.18).

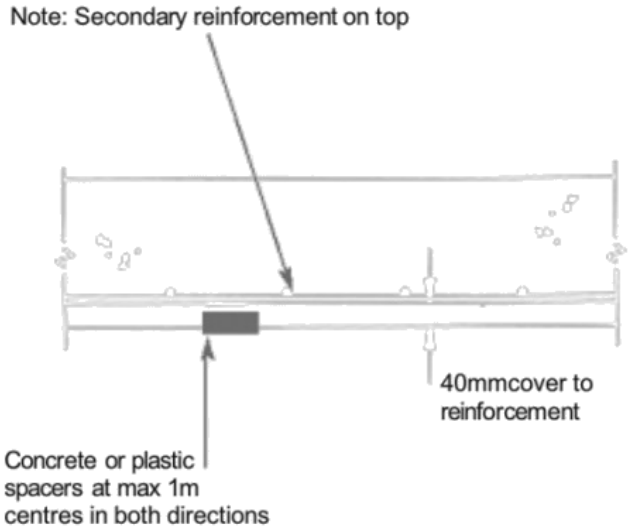


Diagram 5.15: Cover to reinforcement

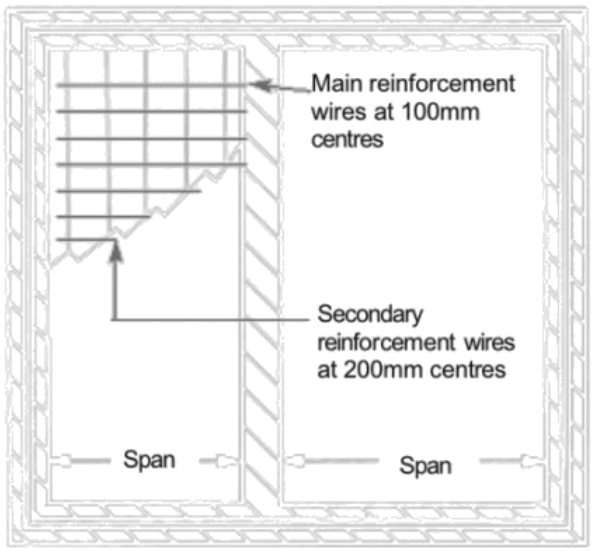


Diagram 5.16: The placing of reinforcement in slab

SITE CHECKING OF MESH

'B' mesh can be identified by the size of the main and secondary bars, main and secondary bars being at 100 and 200mm centres respectively. (See table 5.19).

main wire laps	
Fabric type	Lap length (mm)
B1131	550
B785	450
B503	400
B385	350
B283	300
B196	250

Table 5.17: Minimum laps for main wires

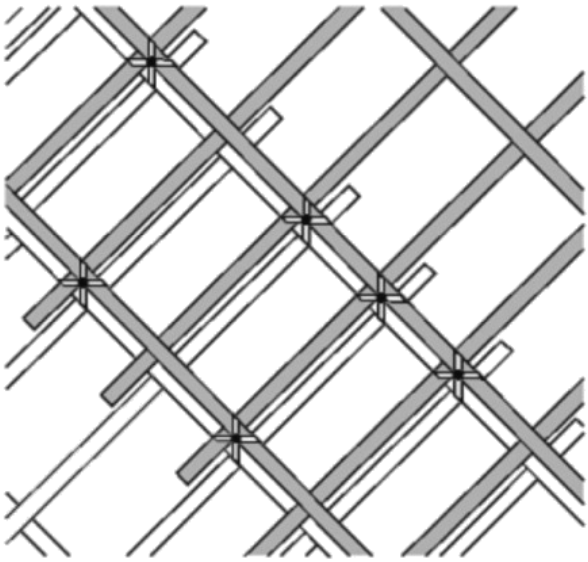


Diagram 5.18: End laps of fabric

British Standard reference	main wires size mm	pitch mm	area mm²/m	secondary wires size mm	pitch mm	area mm²/m
structural fabric						
B1131	12	100	1131	8	200	252
B785	10	100	785	8	200	252
B503	8	100	503	8	200	252
B385	7	100	385	7	200	193
B283	6	100	283	7	200	193
B196	5	100	196	7	200	193

Table 5.19: Minimum laps for main wires

CONCRETE SLAB SUPPORT

Where the slab is continuous over a support, the bottom fabric is to extend a minimum 75mm onto the support and top fabric provided as indicated (See diagram 5.20).

Where the slab is not continuous over an internal support, bottom fabrics should extend a minimum 75mm onto the wall (See diagram 5.21).

Where slabs bear on cavity walls the bearing width should be at least 90mm and 20mm end cover to reinforcement is recommended (See diagram 5.22).

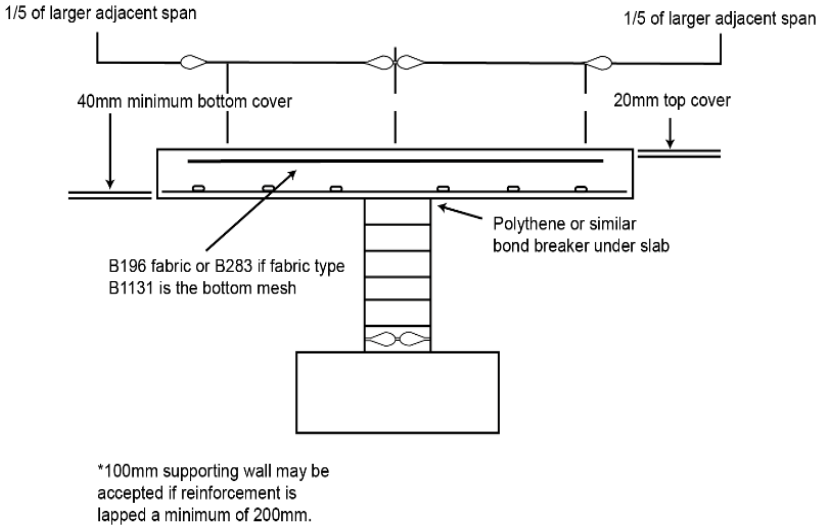


Diagram 5.20: Slab continuous over a support

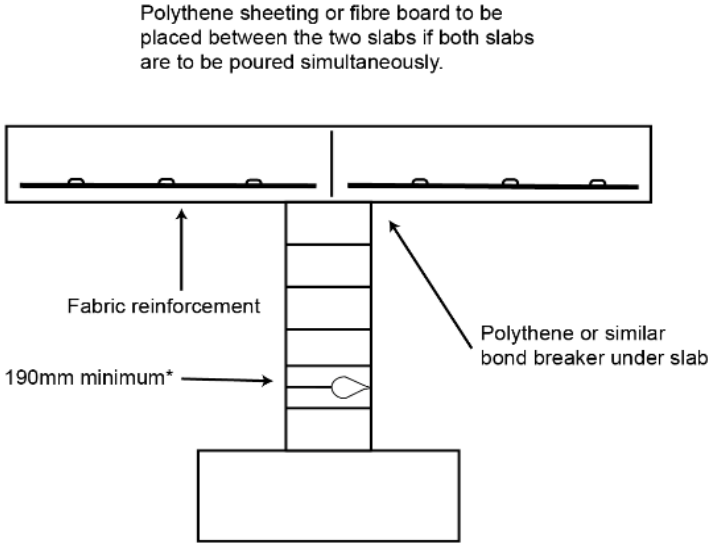


Diagram 5.21: Two slabs adjoining at support

Slab Thickness

The thickness of slabs should be neither more, nor less than shown in load case tables 5.26, 5.27, 5.28, 5.29 subject to normal building tolerances. The thickness of the concrete slab where bearing on the walls must not be reduced and is usually sized to suit brick courses e.g. if a 175mm or 200mm thick slab has been chosen then the thickness of the concrete where bearing on the load bearing walls will be increased to 225mm (See diagrams 5.22 & 5.23).

Edge Shuttering

Shuttering to form the edge of the slab where bearing on the inner skin must be used to maintain a clear cavity in the wall. Expanded polystyrene or vertical boards with spacers against the outer leaf can be used. Both are to be removed prior to laying the DPC.

To minimise any risk of cracking to the slab and screed finish, additional reinforcement may be placed in the top of slabs at the outer edges and particularly at corners (See diagram 5.23).

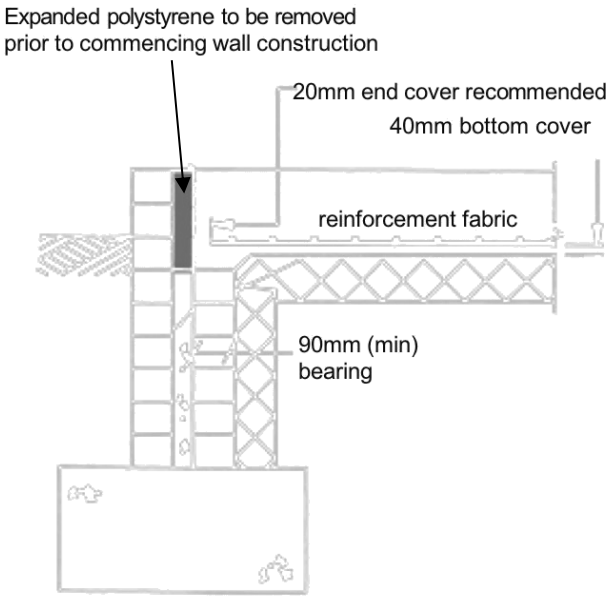


Diagram 5.22: Slab bearing on a cavity wall

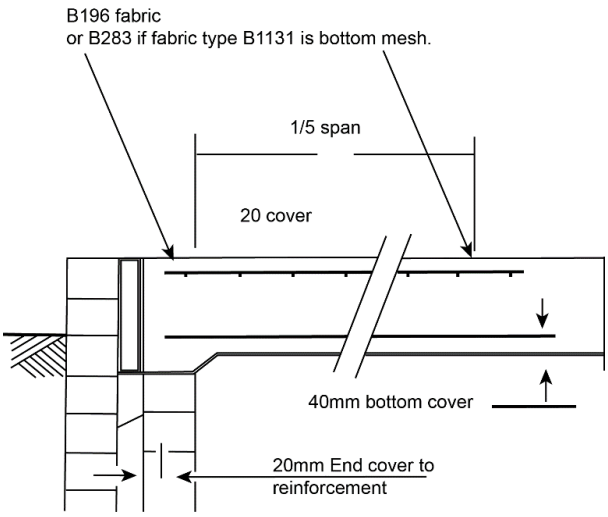


Diagram 5.23: Prevention of cracking

Concreting

Before concreting, reinforcement must be free from mud, oil, grease, release agents, paint, retarders, loose flaky rust, loose mill scale, snow, ice, or any substance that will affect the concrete or steel chemically or reduce the bond between the two materials. The concrete after pouring should be lightly vibrated and well tamped to the finished level.

Where large areas of concrete are to be laid it is recommended that the total area cast in any one operation is not larger than 60m^2 and as square in shape as possible to reduce the possibility of shrinkage cracking.

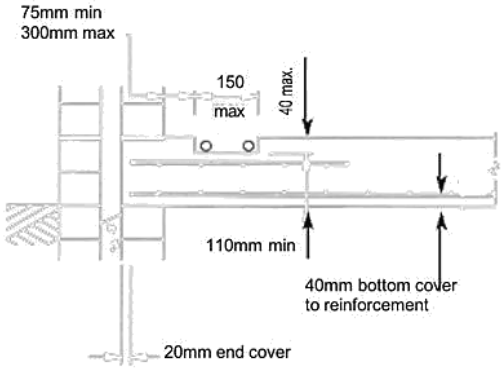


Diagram 5.24: Forming of recesses for pipes around perimeter of slab

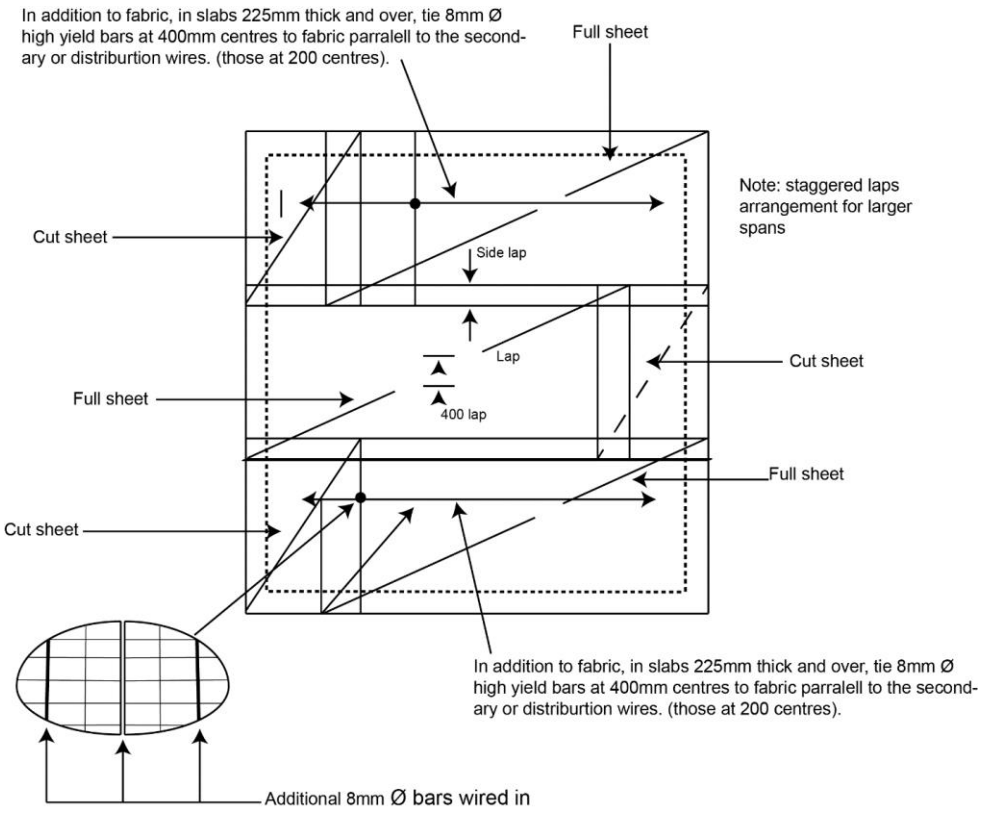


Diagram 5.25: Plan showing additional reinforcement to bottom fabric in slabs of 225mm in thickness and over

Where greater areas of concrete are required to be cast in one operation expert advice should be sought

To obtain a good quality concrete it is essential to cure freshly laid concrete for 7 days. This is achieved by covering with a polythene membrane to prevent rapid drying out and in periods of cold weather may also require covering with an insulation mat. Alternatively, a sprayed curing membrane could be used. Such a membrane should not be used on floors which are to receive a screed or other similar finishing as bonding may be affected.

The slabs should not be loaded with brick stacks etc., until initial strength has been acquired. Allow 10 - 14 days.

Slabs should not, at any time, be loaded at mid-span.

Service Pipes

Recesses for pipes may only be formed in the perimeter of the slabs (See diagram 5.26).

Clear span (m)	Loading conditions: no partitions + domestic living area 65mm screed finish Slab thickness (mm)				
	150	175	200	225[7]	250[7]
2.00	B196	B283	B283	B385	B385
2.25	B196	B283	B283	B385	B385
2.50	B283	B283	B283	B385	B385
2.75	B283	B283	B283	B385	B385
3.00	B385	B283	B283	B385	B385
3.25	B503	B385	B283	B385	B385
3.50	B1131	B385	B385	B385	B385
3.75	--	B503	B385	B385	B385
4.00	--	B783	B503	B385	B385
4.25	--	B1131	B503	B503	B503
4.50	--	--	B785	B503	B503
4.75	--	--	B1131	B785	B503
5.00	--	--	--	B785	B785
5.25	--	--	--	B1131	B785
5.50	--	--	--	--	B785

Notes:
1. The live load quoted caters for nominal domestic loading within the living area of a domestic dwelling in accordance with BS EN 1991-1-1:2002 & BS EN 1991-1-7:2006.
2. 65mm sand cement screed weighing not more than 155kg/m^2, assumed in the design.
3. Clear span = clear distance between supports.
4. Concrete to have a specified works cube strength at 28 days of 35N/mm^2.
5. Fabric reinforcement shall comply with the requirements of BS 4483:2005 Steel fabric for reinforcement of concrete.
6. If the actual span or load in any particular situation is not shown in the table, always use the next span or load allowance next above. Never go below.
7. Fabric to be side lapped a minimum of 300mm.

Table 5.26: Load Case 1 reinforcement specification tablets

Clear span (m)	Loading conditions: 100mm lightweight block partitions domestic living area + 65mm screed finish Slab thickness (mm)				
	150	175	200	225[8]	250[8]
2.00	B196	B283	B283	B385	B385
2.25	B283	B283	B283	B385	B385
2.50	B385	B283	B283	B385	B385
2.75	B385	B385	B283	B385	B385
3.00	B785	B385	B385	B385	B385
3.25	--	B503	B385	B385	B385
3.50	--	B785	B503	B503	B503
3.75	--	B1131	B503	B503	B503
4.00	--	--	B785	B785	B503
4.25	--	--	B1131	B785	B785
4.50	--	--	--	B785	B785
4.75	--	--	--	B1131	B785
5.00	--	--	--	--	B785
5.25	--	--	--	--	B1131
5.50	--	--	--	--	--

Notes:
1. The live load quoted caters for nominal domestic loading within the living area of a domestic dwelling in accordance with BS EN 1991-1-1:2002 & BS EN 1991-1-7:2006.
2. 65mm sand cement screed weighing not more than 155kg/m^2, assumed in the design.
3. Partition loading includes for lightweight block weighing 127 kg/m^2 (1267kg/m^3 with 2 coat plaster both sides, not exceeding2.5m in height
4. Clear span = clear distance between supports.
5. Concrete to have a specified works cube strength at 28 days of 35N/mm^2.
6. Fabric reinforcement shall comply with the requirements of BS 4483:2005 Steel fabric for reinforcement of concrete.
7. If the actual span or load in any particular situation is not shown in the table, always use the next span or load allowance next above. Never go below.
8. Fabric to be side lapped a minimum of 300mm.

Table 5.27: Load Case 2 reinforcement specification tablets

Clear span (m)	Loading conditions: 100mm lightweight block partitions domestic living area + 65mm screed finish Slab thickness (mm) 150	175	200	225[8]	250[8]
2.00	B196	B283	B283	B385	B385
2.25	B283	B283	B283	B385	B385
2.50	B385	B283	B283	B385	B385
2.75	B385	B385	B283	B385	B385
3.00	B785	B385	B385	B385	B385
3.25	--	B503	B385	B385	B385
3.50	--	B785	B503	B503	B503
3.75	--	B1131	B503	B503	B503
4.00	--	--	B785	B785	B503
4.25	--	--	B1131	B785	B785
4.50	--	--	--	B785	B785
4.75	--	--	--	B1131	B785
5.00	--	--	--	--	B785
5.25	--	--	--	--	B1131
5.50	--	--	--	--	--

Notes:
1. The live load quoted caters for nominal domestic loading within the living area of a domestic dwelling in accordance with BS EN 1991-1-1:2002 & BS EN 1991-1-7:2006.
2. 65mm sand cement screed weighing not more than 155kg/m^2, assumed in the design.
3. Partition loading includes for lightweight block weighing 127 kg/m^2 (1267kg/m^3 with 2 coat plaster both sides, not exceeding2.5m in height
4. Clear span = clear distance between supports.
5. Concrete to have a specified works cube strength at 28 days of 35N/mm^2.
6. Fabric reinforcement shall comply with the requirements of BS 4483:2005 Steel fabric for reinforcement of concrete.
7. If the actual span or load in any particular situation is not shown in the table, always use the next span or load allowance next above. Never go below.
8. Fabric to be side lapped a minimum of 300mm.

Table 5.28: Load Case 3 reinforcement specification tablets

Clear span (m)	Loading conditions: garage area with no applied finishes or partitions Slab thickness (mm) 150	175	200	225[6]	250[6]
2.00	B196	B283	B283	B385	B385
2.25	B196	B283	B283	B385	B385
2.50	B196	B283	B283	B385	B385
2.75	B283	B283	B283	B385	B385
3.00	B385	B283	B283	B385	B385
3.25	B505	B385	B283	B385	B385
3.50	B785	B385	B385	B385	B385
3.75	--	B503	B503	B385	B385
4.00	--	B785	B503	B385	B385
4.25	--	B1131	B503	B503	B385
4.50	--	--	B785	B503	B503
4.75	--	--	B785	B785	B503
5.00	--	--	--	B785	B785
5.25	--	--	--	B785	B785
5.50	--	--	--	B1131	B785

Notes:
1. The live load quoted caters for nominal vehicle loading within the garage area of a domestic dwelling in accordance with BS EN 1991-1-1:2002 & BS EN 1991-1-7:2006.
2. Clear span = clear distance between supports.
3. Concrete to have a specified works cube strength at 28 days of 35N/mm^2.
4. Fabric reinforcement shall comply with the requirements of BS 4483:2005 Steel fabric for reinforcement of concrete.
5. If the actual span or load in any particular situation is not shown in the table, always use the next span or load allowance next above. Never go below.
6. Fabric to be side lapped a minimum of 300mm.

Table 5.29: Load Case 4 reinforcement specification tablets

SUSPENDED TIMBER FLOORS

Avoiding Timber Decay

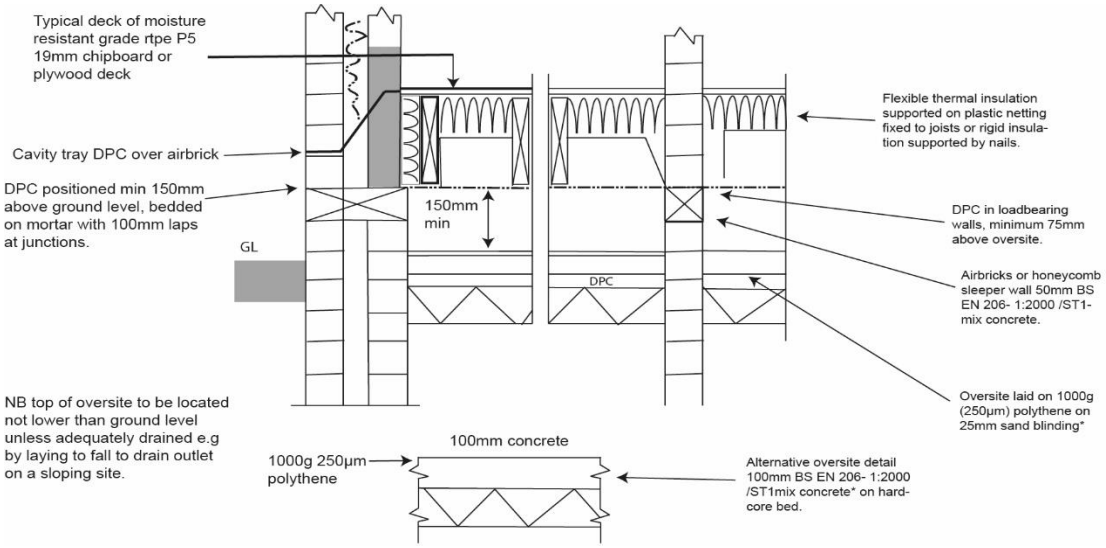
Ensure that:

- Floor joists and any wall plates are located above DPC level in walls
- A minimum 150mm gap is provided between underside of joists and the oversite
- Air bricks are located at least one course above ground level
- Joists bear fully onto the inner leaf of a cavity wall without projecting into the cavity and that cut ends are preservative treated

Ensure that the floor void below the joists is adequately cross ventilated. (See diagram 5.31).

Type	Size (mm)	net area (mm^2)
squared holed clay brick	225 x 75	1400
	225 x 150	4300
	225 x 225	6400
louvered clay brick	225 x 150	2000
	225 x 225	6400
PVC (typical values)	225 x 75	4645

Table 5.30: Net areas of air bricks and ventilators



Note:
*An alternative to this concrete is to use 50mm thickness of fine inert aggregate

Diagram 5.31: Suspended timber ground floor

Avoiding Build-Up of Gases and Moisture in the Floor Void

Provide perimeter ventilation in two opposite external walls @ $1500mm^2$ per metre run of wall or $500mm^2$ per square metre of floor area (whichever is the greater) and maintain continuity of this ventilation through internal walls by honeycomb walling or air bricks. Any pipes carrying ventilating air should have a diameter of at least 100mm. For guidance on ventilating in areas of radon, refer to BRE report 211 Radon: Guidance on protective measures for new dwellings.

Avoiding Ingress of Ground Moisture Into The Building

Provide beneath all suspended timber floors either:

- A 100mm BS EN 206-1:2000, BS8500-1:2002 & BS 8500-2:2002/STI mix concrete oversite on hardcore, or
- A 50mm concrete oversite and minimum 1000g (250µm) Damp-Proof Membrane on sand blinding

Avoiding Springing and Unlevel Floors

Ensure that floor joists are:

- Dry/KD stamped
- Correctly sized, stress graded and laid at specified centres as indicated on the plans
- Regularised
- Fully supported by supporting walls
- Securely nailed to timber wall plates where bearing onto sleeper walls
- Properly built-in to loadbearing walls without timber packing pieces
- Bedded in correct size joist hangers
- Adequately strutted

NB. Sleeper walls should be built off appropriate foundations and not on the concrete oversite unless a thickened slab taken down to a suitable loadbearing strata is provided and its location clearly marked.

Avoiding Poor Sound Insulation Through Separating Walls

Sound insulation performance is greatly reduced when timber joists are built into masonry separating walls. Even when joists are properly built-in, timber shrinkage can create air paths along which sound can travel.

Timber joists should be supported on joist hangers on masonry separating walls on at least one side.

Ventilation of Subfloor Voids

Voids beneath suspended ground floors should be ventilated by a through draught in order to:

- maintain an atmosphere in the void of sufficiently low moisture content so as to prevent damage to any timber or other susceptible materials in the floor
- prevent the build-up of gases, whether natural or from leaking pipes, which could cause a risk of explosion
- prevent the build-up of gases of any kind which could penetrate the habitable areas of the building and cause a danger to health.

Continuity of underfloor ventilation should be maintained by providing internal sleeper walls and similar obstructions with the same degree of ventilation as provided to perimeter walls.

Table 5.32 provides timber floor joist design for C16 and C24 grade timbers for normal domestic uses.

Floor joists
Permissible clear span between supports with imposed loads of 1.5kN/m^2
Dead load more than 0.25 kN/m^2 but more than 0.50kN/m^2

Size of joist mm x mm	Sizes with no partitions: Spacing of joists (mm)						Sizes with light weight partitions: Spacing of joists (mm)					
	C16[1]			C24[2]			C16[1]			C24[2]		
	400	450	600	400	450	600	400	450	600	400	450	600
47 x 72	1.27	1.15	0.89	1.35	1.27	1.10	1.15	1.04	0.80	1.21	1.14	0.99
47 x 97	1.92	1.82	1.46	2.03	1.92	1.68	1.73	1.64	1.31	1.82	1.73	1.51
47 x 122	2.55	2.45	2.09	2.65	2.55	2.29	2.29	2.21	1.88	2.39	2.29	2.06
47 x 147	3.06	2.95	2.61	3.19	3.06	2.78	2.76	2.65	2.35	2.87	2.76	2.50
47 x 170	3.53	3.40	2.99	3.67	3.54	3.21	3.18	3.06	2.69	3.31	3.18	2.89
47 x 195	4.04	3.89	3.39	4.20	4.05	3.68	3.64	3.50	3.05	3.78	3.64	3.31
47 x 220	4.55	4.35	3.79	4.71	4.55	4.14	4.09	3.92	3.41	4.24	4.10	3.73
62 x 97	2.19	2.08	1.82	2.31	2.19	1.93	1.97	1.87	1.64	2.08	1.97	1.73
63 x 122	2.81	2.70	2.45	2.92	2.81	2.55	2.53	2.43	2.21	2.63	2.53	2.30
63 x 147	3.37	3.24	2.95	3.50	3.37	3.07	3.03	2.92	2.66	3.15	3.04	2.76
63 x 170	3.89	3.74	3.40	4.04	3.89	3.54	3.50	3.37	3.06	3.63	3.50	3.19
63 x 195	4.44	4.28	3.90	4.61	4.45	4.05	4.00	3.85	3.51	4.15	4.00	3.65
63 x 220	4.91	4.77	4.36	5.05	4.91	4.56	4.42	4.29	3.93	4.54	4.42	4.10

Key
1. C16 Timber is approximately equivalent to SC3 grade timber
2. C24 Timber is approximately equivalent to SC4 grade timber
3. No loadbearing lightweight partitions (loading not greater than 0.8kN/m run
4. Joists should be doubled up beneath baths and any other point of concentration load
5. Non load bearing partitions should be supported eg. doubled up joists

Table 5.32: Floor joist spans