Introduction

This section provides guidance on meeting the performance requirements for the following types of concrete upper floors:

- Beam and block
- Concrete plank

Throughout this section, both beam and block, and concrete plank floors will collectively be referred to as concrete upper floors.

10.2.1 Compliance

The design, specification and installation of concrete upper floors shall satisfy the performance requirements of this section.

10.2.2 Information to be provided

The Designer shall provide sufficient design details to demonstrate it meets the requirements of this section.

A full set of design drawings and specifications shall be made available to the Warranty provider and all other interested parties prior to the associated works starting on site. This may include:

1. Manufacturer's floor layout drawings and calculations.
2. Plan details showing dimensions, levels and locations of incoming service penetrations.
3. Details indicating the locations of all load and non-load bearing walls.
4. The manufacturer's third party product conformity certificate for the proposed insulation to be used within the floor.
5. Details of underfloor heating systems where being used.
6. A third party product conformity certificate for non-standard beam & block flooring.
7. Details of proposed floor screeds including thickness and mix.
8. Details of substrates to which the screeds will be laid upon.
9. Details of proposed curing times and environmental constraints.
10. Details of services within the floor, including underfloor-heating.
11. Details of suspended ceilings and manufacturer's fixing instructions.
12. The following should be provided for the proposed plasterboard to be used:
    a. Details of proposed plasterboards to be used; type of board, thickness, number of boards to create the layer.
    b. Details of mechanical fixings of plasterboards.

The Warranty surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

10.2.3 Structural design

Concrete upper floors shall be durable and safely support and transmit intended loads to the supporting structure without undue movement.

Concrete upper floors are proprietary products, which the design and construction are specific to the manufacturer of the product. Projects incorporating precast beams or planks must be provided with full manufacturers design, structural calculations and specifications including fixings specific for the project in accordance with BS EN 1992-1-1.

Concrete upper floors should have loads calculated in accordance with BS EN 1991-1-1.

Deflection

For concrete upper floors, designers and Engineers must observe our tolerance requirements for levelness and deflection limits of floors. Please refer to the 'Tolerances' section for further guidance.

There may be an instance where a joist might be designed to meet permissible deflections within a relevant British Standard; however, our tolerance requirements will take precedence.

10.2.4 Storage and protection against damage

Concrete upper floors shall be carefully stored and handled on-site, preventing damage occurring before, during and after incorporation into the structure.

10.2.5 Installation and workmanship

Concrete upper floors shall:

- Be installed in a manner which does not effect their durability or performance.
- Be in accordance with the manufacturer's recommendations and the site specific specification.
- Have all workmanship satisfy the 'Tolerances' section.

Concreting shall not take place during cold weather periods where the working temperature is below 2°C or where ground conditions are frozen.

General

- The installation of concrete upper floors must follow the manufacturer's guidance and specification for the project.
- Concrete upper floors should be fully supported by load-bearing walls.
- The bearing surface of walls, beams and other supports to receive precast units are to be smooth and level.
- Infill blocks and slabs should fully bear onto supporting beams and walls.
- Holes for service pipes are properly filled by laying non-timber formwork between PC joists and filling with good quality concrete (ST2 mix) prior to screeding.
- Beams and planks should bear onto masonry with a minimum 90mm bearing, and steelwork with a minimum 75mm bearing.
- Similar beams/planks of the same size may have differing strength properties because of their varying reinforcement size, so it is important to check unit reference numbers and their layout.

Beam and block

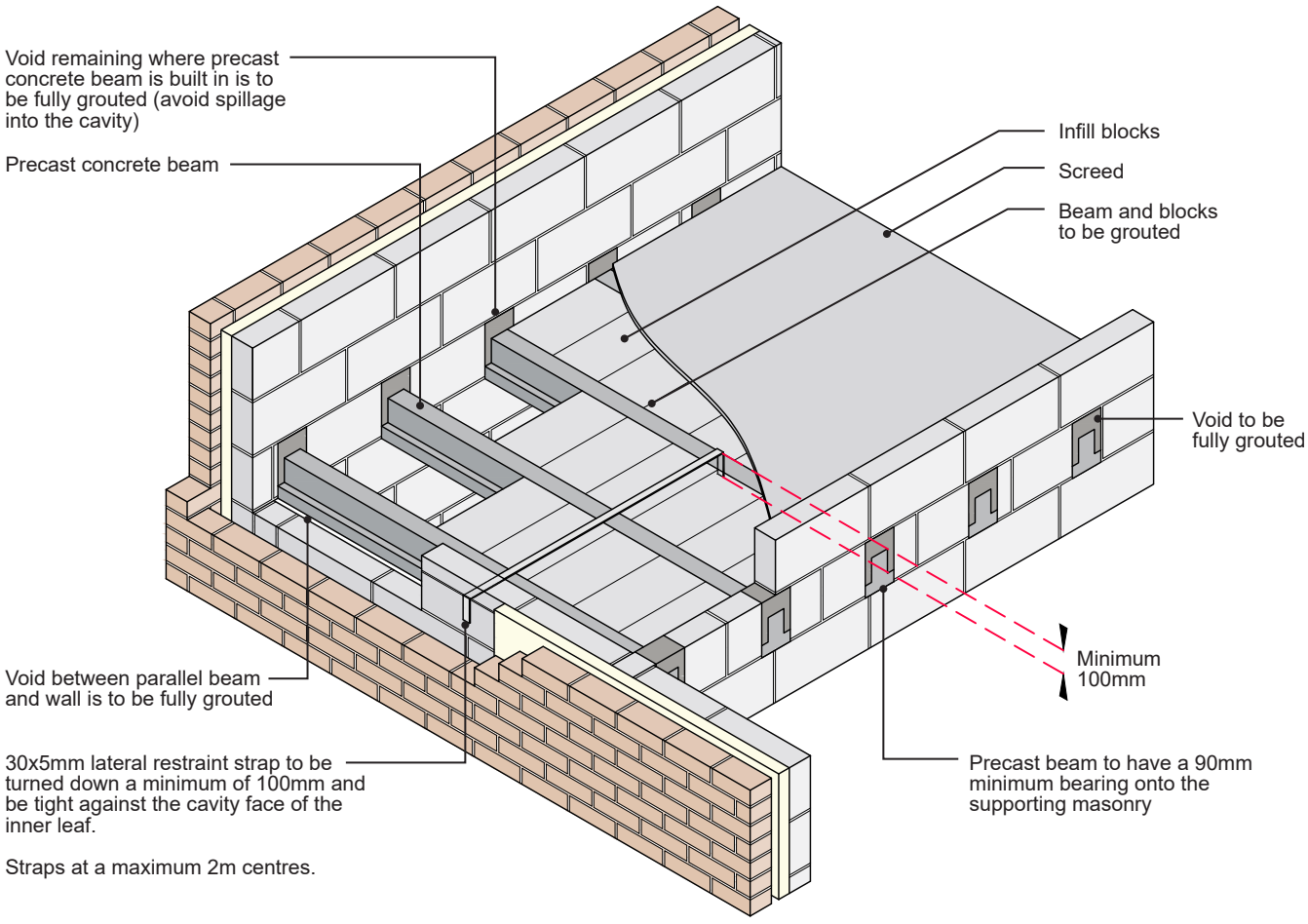
Precast beams or beam and block floor constructions must be laid reasonably level and onto suitable solid and level bearings.

It is essential sometimes to provide two or more beams adjacent to each other where spans are excessive or in heavily loaded areas. Suitable infill bricks or blocks are to be properly bedded on mortar and provided between pre cast (PC) beams where bearing onto supporting walls.

Beams and blocks are to be grouted together with a 1:6 cement to sand mix in accordance with the manufacturer's instructions.

Load-bearing walls are to continue through the beam and block floor.

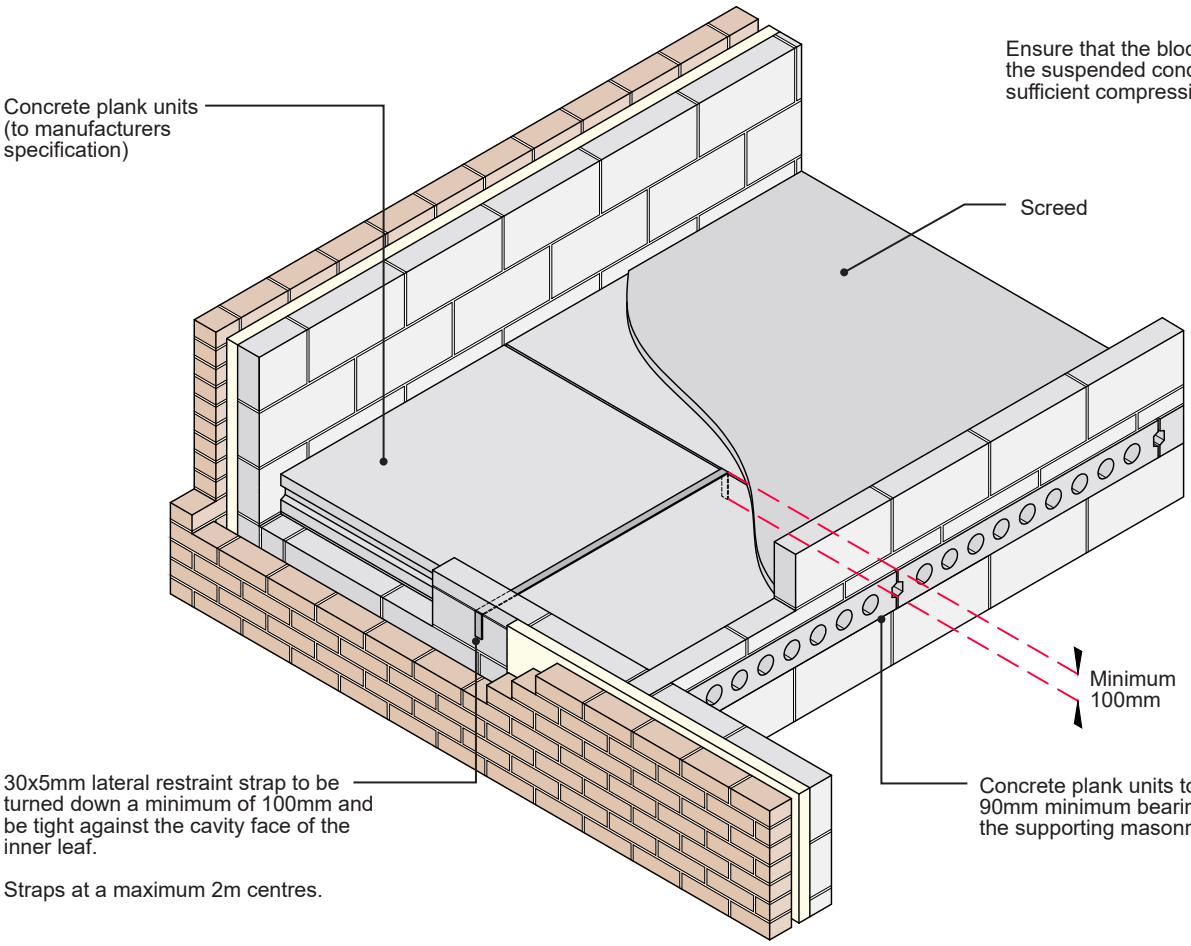
Ensure that the blockwork carrying the beam and block flooring has sufficient compressive strength.



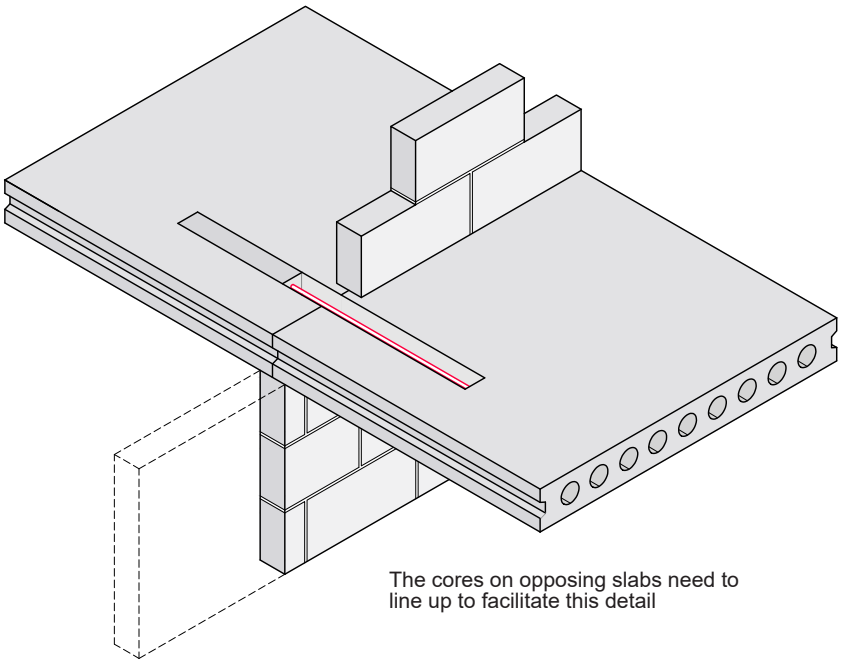
Concrete plank

Suspended concrete planks should be grouted in accordance with the manufacturer's instructions ensuring the correct strength and aggregate size is used.

General detailing



Narrow wall bearing



Generally for walls narrower than 190mm the slabs should be tied together in accordance with the manufacturer's instructions.

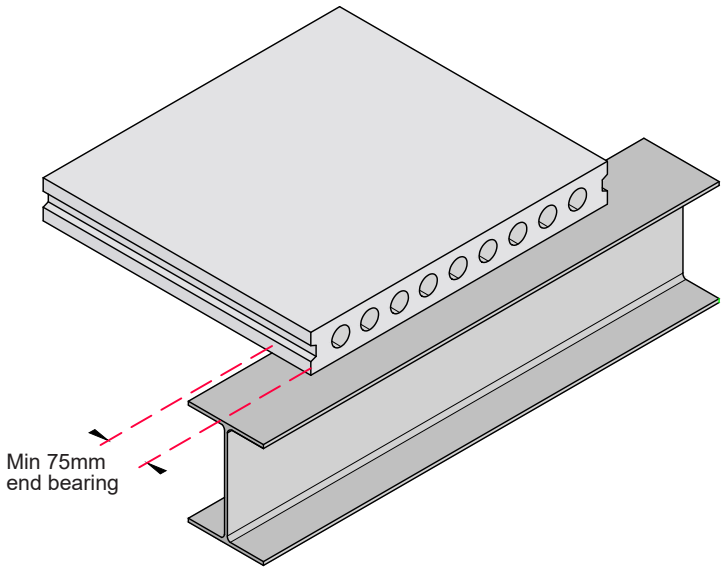
Typically this is achieved by two cores per 1200mm wide slab are formed open so that a reinforcement bar can be inserted across to form the tie detail, however this should be constructed in accordance with the manufacturers site specific design.

Bearing on top of steelwork

A minimum of 75mm bearing should be provided on steel beams. Planks may require mechanical restraint to the steel beam in accordance with the manufactures specification.

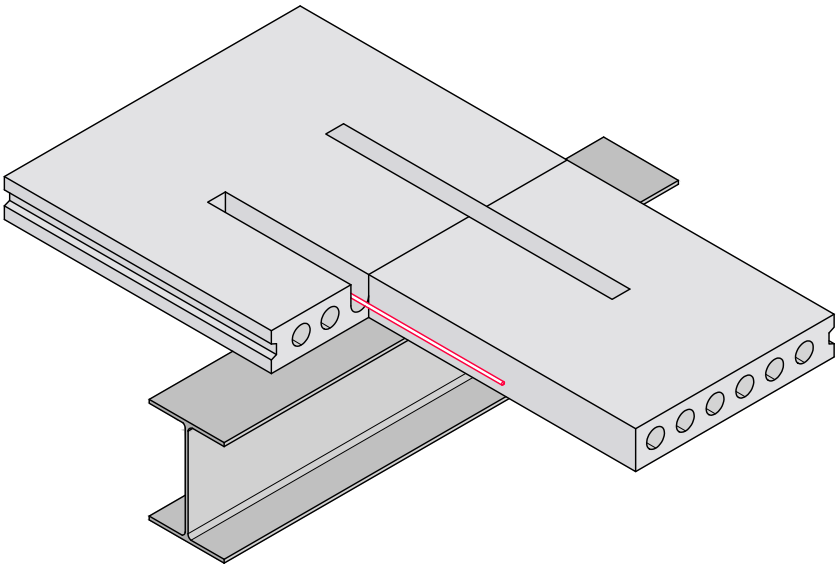
Steel beams should be designed by the Engineer and should have appropriate fire resistance to meet the requirements of the relevant Building Regulations.

Where steel beams and columns are used to support the upper floor construction on a project in a coastal location, and maybe exposed to an aggressive external environment (e.g. under croft), please follow the requirements for additional corrosion protection in ‘Appendix B - Coastal Locations’ and ‘Appendix C - Materials, Products, and Building Systems’.



Continuity over steelwork

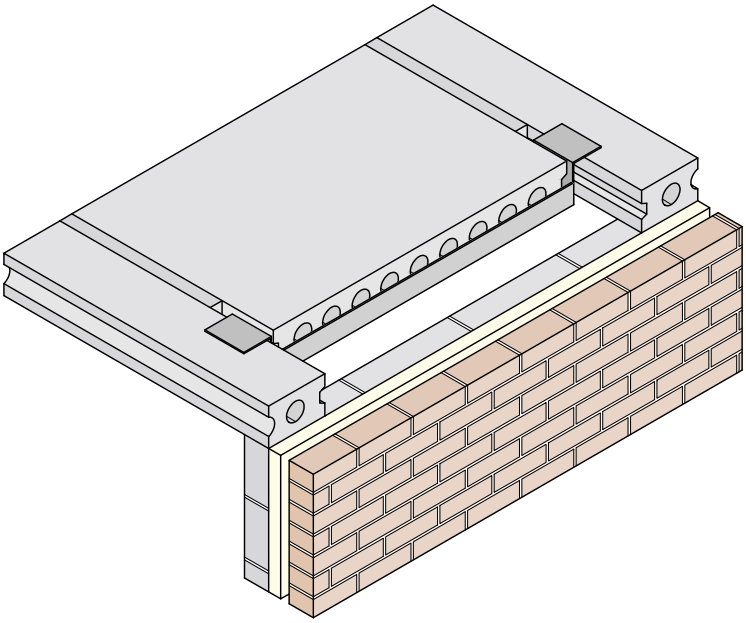
When continuing over steel work the slabs may also require tying together in accordance with the manufacturers recommendations.



Holes and notches

Openings to accommodate service voids and column notches should be preformed. Large openings may require steel trimming supports. Holes of less than 100mm can be formed on site in accordance with the manufactures design.

All holes/openings should be in accordance with the manufacturers design.



10.2.6 Lateral restraint of walls

Concrete upper floors shall provide adequate lateral restraint in accordance with the design.

Walls should be adequately restrained at floors, ceilings and verges in accordance with the relevant Building Regulations.

Restraint can be provided by:

- Lateral restraint straps.
- Other forms of restraint proven by the Engineer.

Please refer to the 'External Walls' section for further guidance.

10.2.7 Sound resistance

Internal separating floors shall, where necessary, meet the requirements for the resistance of sound in the relevant Building Regulations.

Internal separating floors shall, where necessary, meet the requirements of the relevant Building Regulations in relation to the resistance of sound and sound testing requirements.

10.2.8 Background surface for screeds

Background surfaces shall be suitably prepared to receive a screed.

Background surfaces where screeds are being supported should meet the following requirements:

Bond

Background surfaces for bonded screeds should provide an adequate mechanical key. If necessary, cement grouting or a bonding agent should be specified to provide adequate adhesion. Where bonded screeds are used, mechanical means of preparing the concrete should be used to create an adequate bond between the substrate and the screed.

Adequate support

Substrate structures must be adequately constructed to provide adequate support to the screed (note: Timber floor constructions are not suitable to support screeded finishes).

Substrates must be level with no pockets or high spots to ensure the thickness of the screed remains even.

Where screeds are laid over insulation; the insulation must be tightly butted together and level.

Additional steps where constructing screeds over concrete substrates

Where a concrete slab is insulated from below and a finishing screed is required to the top surface:

- The concrete substrate slab must be of the correct thickness and not less than 100mm thick.
- Concrete substrate must be adequately dried out and not wet.
- Surfaces of hardened in situ concrete bases for bonded screeds should be roughened (scrabbled) and cleaned to remove laitance and to expose cleanly, but not loosen, the coarse aggregate particles.
- Brushing to remove laitance from a fresh concrete base is inadequate preparation before laying a bonded screed and is not recommended.
- Remove all loose debris, dirt and dust by appropriate means, preferably with vacuum equipment.
- Carry out the preparation of the surface with as little delay as is practicable before the screed is laid so as to reduce the risk of contamination.
- The surface of the prepared slab must be reasonably level to avoid deviations in thickness's of the screed.

10.2.9 Screed specification

Non-structural floor screeds shall be of an adequate specification for the intended use and location. The screed shall also provide a suitable background for the desired floor finish.

Traditional floor screeds consist of sand and cement. If the ratios and properties of these screeds are not correctly controlled; cracking, peeling or collapse of the screed will occur (due to being too strong/weak).

Proprietary screeds typically are pre-blended to achieve greater consistency and strength and more suitable over larger areas. Where the floor area exceeds 50m^2 only a proprietary screed installed by the screed manufacturers trained installers will be accepted.

Screeds should be fit for purpose, have a suitable finish and be of an appropriate thickness and provide a reasonably level surface.

Screed mix

Cement and sand screeds should have a mix ratio of between 1:3 and 1:4½.

Proprietary additives should have been assessed and have a third party product conformity certificate.

The minimum thicknesses of screeds are as follows:

Surface	Minimum thickness at any point
Laid monolithically with base	12mm
Laid and bonded to a set and hardened base	20mm
Laid on a separating membrane (e.g. 1000g polyethylene)	50mm
Laid on resilient slabs or quilts (screed reinforced with galvanised wire mesh)	65mm

Where service pipes are bedded in the screed, the screed should be deep enough to provide at least 25mm of screed cover over service pipes, insulation and reinforcing.

Maximum areas of screed

Screeds should be laid room by room. Unreinforced screeds should have a maximum area of 40m^2. Expansion joints should be provided and consistent with joints in the floor slab below.

Finishing of screeds

Screed should provide an even surface as appropriate, as defined in the 'Tolerances' section. Concrete floor slabs may be suitably finished to serve directly as a wearing surface without the need for an additional topping, in accordance with the recommendations of BS 8204. If required, surface sealers or hardeners should only be used in accordance with the manufacturer's instructions.

Anhydrite (liquid) screeds

If an anhydrite screed is used, it must be sealed before the application of any cement based floor finish adhesive is proposed. Anhydrite screeds can be difficult to identify once laid, if the screed type cannot be identified the screed should be fully sealed as a precaution to prevent the possibility of the floor finish adhesive de-bonding from the screed.

The floor screed should be fully dry before the sealant is applied. The screed drying time will depend on the thickness and type of screed.

A decoupling membrane is also recommended as this can reduce the stress on the fixed floor finish layer.

Dry times and curing

Drying times

- With cementitious levelling screeds, one day should be allowed for each millimetre of thickness for the first 50 mm, followed by an increasing time for each millimetre above this thickness (BS 8204).
- Polymer modified screeds: strictly follow the manufacturer's specifications and recommendations.
- The developer should keep an accurate record of the screed drying times elapsed before any fixed floor finish is constructed on top is laid and the Warranty surveyor may ask for this information.

Note: The moisture contents of levelling screeds onto which particular floorings are to be laid and methods for measuring moisture content are given in BS 5325, BS 8201, BS 8203 and BS 8425.

Curing

Movement joints will be required in the screed in accordance with the design. The following should also be taken into account:

- Movement joints will be required across door thresholds.
- Movement joints are required if bay sizes exceed 40m² with a maximum of 8m on any one side.
- Movement joints are also required where joints exist or a change of span occurs e.g. beam and block floors.

Installation

Where screeds are being installed they should be correctly mixed, not be walked on during the drying period and shouldn't be constructed during cold periods (below 5ºC).

10.2.10 Insulation

Insulation materials shall minimise thermal transmission through the floor and be suitable for their intended purpose and location.

Insulation below screeds should have enough compressive strength to support the screed. DPMs should be installed in the correct positions, as indicated by the insulation manufacturer's instructions. Sound insulation should be installed in accordance with the manufacturer's instructions.

10.2.11 Building services

Where building services pass through the screed, there shall be consideration for compatibility between the floor screed and the services.

Pipes should be protected against chemical attack (with the use of sleeves for example).

10.2.12 Screeds and underfloor heating systems

Where underfloor heating systems are specified under a screed there should be suitable movement joint and perimeter expansion joint provision.

General requirements

Where underfloor heating systems are bedded into the screed:

- There should be a minimum 25mm cover over the highest point of the pipe or insulation.
- There should be consideration for thermal movement of water pipes.

Provision and construction of movement joints

Movement joints should be provided in the floor screed / fixed floor finish where floor heating is provided in the following places:

- Between independently controlled heating zones.
- Between heated and unheated areas of screed.
- Additional joints should be considered in areas of high thermal gain e.g. large conservatories or glass atria.
- Across door thresholds.
- If bay sizes exceed 40m² with a maximum of 8m on any one side.

Bay joints should be formed using rigid joint formers where possible, which can be placed during the preparation phase and will remain in place during operation. The joint former should be 5mm lower than the finished screed depth to allow a smooth transition in height between bays:

- All joints in the screed should extend through to any subsequent bonded floor covering.
- Joint positions should be specified prior to the installation of the screed and full consultation between all parties including the main contractor, underfloor heating installer, finished flooring installer and the screed installer should take place to determine appropriate locations.
- Movement joints should be carried through the subfloor to the floor finish and all applied layers terminated either side of the joint.
- The joint should be filled with a suitable flexible filler and a proprietary cover strip applied to cover the joint. Grout must not be used.
- Movement joints should not be bridged by any resilient, textile or other adhered floor finish.
- Movement joint covers may be flush, surface mounted or bedded in mortar and metal, metal with a rubber insert or PVC.

Provision of edge strip perimeter expansion joint

When incorporating under floor heating (UFH):

- Screeds should be isolated at all edges, abutments and columns to allow for movement due to thermal loadings.
- The floor screed and finished floor manufacturers guidance to be followed particularly when incorporating under-floor heating to determine the minimum thickness of edge strip required to allow for expansion. Typically, between 6-15mm may be required.
- The joint can be concealed by the skirting.
- These joints must be left empty, or else filled with a compressible material.
- Movement joints must not be filled with grout.

Screed drying time

- The drying time allowed must be calculated for the proposed depth of screed, taking account of the environmental conditions present e.g. temperature and humidity. Where polymer modified type screeds are being used the manufacturer's requirements must be strictly followed for the actual depth of screed. Surface finishes placed on a screed too early will fail.
- Drying times for polymer modified screeds could potentially be different to cementitious screeds.
- All subcontractors involved with the screed and floor finishes (including installation of underfloor heating systems) must follow the installation requirements and not deviate or change materials.
- The screed should not be walked on until fully cured.

UFH testing and commissioning

- Ensure there are no joints in the heating system loops.
- UFH systems should be commissioned before floor finishes are applied. This will add to the total time before any floor finish can be applied. If floor finishes are installed prior to the UFH being turned on and commissioned, any residual moisture in the floor is driven to the surface of the screed and can potentially cause delamination of the floor finish.
- Pressure testing of the system does not constitute commissioning of the system. The heat source has to be in place and operating in order to deliver the correct temperatures.
- The UFH system must be commissioned in accordance with the manufacturer's recommendations by their approved installers. A commissioning certificate will be required.

Moisture testing of the screed where floor finishes are proposed

- Moisture testing should be carried out after the commissioning of the UFH system but before any floor finishes are laid.
- Where UFH is not installed, moisture testing of the screed should still be carried out before floor finishes are installed.
- Moisture testing is carried out using a suitable approved method such as a flooring hygrometer or carbide bomb test. Due to the potential inaccuracies of using hygrometers at high humidity levels, a direct measurement should be used such as Carbide Bomb or oven dried sample.
- The base is deemed to be sufficiently dry when the relative humidity, as measured by a surface mounted flooring hygrometer/probe is 75% RH or less. For the use of a flooring hygrometer, reference should be made to dampness testing in BS 5325, BS 8203, BS 8425 and BS 8201.
- If underfloor heating is present in the base, the heating must be switched off 96 hours prior to any hygrometer test being carried out.
- The hygrometer must be allowed to remain in position until full equilibrium has been established. This is generally considered to be 72 hours but could be longer over thick sections and considerably longer on power floated concrete.

Screed preparation for finishes

- The top surface of screeds may require to be scored, sanded or keyed in preparation to accept the primer and floor finish.
- Sanding, keying etc. of the screed surface allows the penetration of primers. It also provides a "key" for the adhesive to grip onto.
- The surface must then be cleared of dirt and debris prior to primers being applied.
- Any primers and adhesives must not be applied until the screed has fully hardened and dried out. Drying times vary depending on the type of screed.
- Surfaces to receive fixed floor finishes should be rigid, dimensionally stable, flat with no dips and rises, sound, clean and free from laitance, paints, salts, grease, dust and any contamination which may prevent adhesion.

Adhering to the manufacturer's process during the installation of the flooring finish

All the relevant manufacturers recommendations should be followed which will identify timelines to adhere i.e:

- Removing the laitance by sanding to provide a key for the primer and/or adhesive.
- Commissioning the underfloor heating before installing the fixed floor finish.
- Allowing the UFH system to cool down for at least 48 hours before installing the fixed floor finish.
- Moisture testing to confirm the dryness of the screed before installing the fixed floor finish.
- Ensuring the time from screed completion to installing the fixed floor finish commencement is calculated and adhered to.
- Ensure the fixing of the finished floor finish has stabilized before walking on. Some finishes require typically 12 -24 hours dependent on environmental conditions.
- Ensure the UFH system is not turned on for at least 48 hours after any adhered floor finish is completed.
- If an anhydrite screed is used, it must be sealed before the application of a cement based floor finish adhesive if proposed in conjunction with a finished floor surface covering.

Exceeding the maximum 27°C floor temperature

The underfloor heating system must be correctly commissioned to ensure temperature fluctuations are avoided and potential damage to the floor finishes.

BS 8203 Code of Practice for the Installation of Resilient Floor Coverings states: When used with many flooring materials underfloor heating can cause problems if the temperature at the interface between the subfloor and flooring exceeds 27°C, or is subject to rapid fluctuations in temperature.

Where a resilient floor covering is proposed, the temperature should never exceed the agreed maximum of 27°C at the underside of the floor covering (the adhesive line).

Notes:

- UFH designers may refer to this as the 'interface' temperature.
- BS EN 1264 - 2 refers to a max 29°C however for Warranty purposes a maximum 27°C is to be followed.

End user information

End users must be aware of how to use an UFH system, as these need to be operated differently than other heating systems both for in use and to avoid damage to screeds and finishes.

10.2.13 Plasterboard requirements

Plasterboards shall:

- Be adequately supported and fixed in accordance with the manufacturer's instructions.
- Provide an adequate surface to receive the intended finish required by the design.
- Supporting test evidence will be required where the plasterboard is intended to perform additional functions (e.g. fire or acoustic resistance).

Support of plasterboard

Supports for plasterboard should be designed so that the following span limits are not exceeded:

Board thickness	Support centres	Intermediate supports required	Perimeter supports required
9.5mm	400mm	No	Yes
	450mm	Yes	Yes
12.5mm	400mm	No	Yes
	450mm	No	Yes
	600mm	Yes	Yes
15mm	600mm	No	No

Fixing of plasterboards

When fixing plaster boarding:

- Fix boards with decorative side out to receive joint treatment or a skim plaster finish.
- Lightly butt boards together and never force boards into position.
- Install fixings no closer than 13mm from cut edges and 10mm from bound edges.
- Position cut edges to internal angles whenever possible, removing paper burrs with fine sandpaper.
- Stagger horizontal and vertical board joints between layers by a minimum of 600mm.
- Locate boards to the centre line of framing where this supports board edges or ends.

Gaps between boards should not exceed 3mm and consideration should be given to sealing all gaps to improve building air tightness.

10.2.14 Plastering

Plastering shall provide an adequate surface to receive the intended finish as required by the design.

Plastered finishes

Workmanship of plastered finishes to ceilings should be applied to a certain standard to receive a suitable decorative finish. It should be durable enough to prevent surface cracking and, if applicable as part of the whole element, meet the required levels of fire and sound insulation in accordance with current Building Regulations.

Substrate and background

Plasterwork should be applied to suitable substrates. The substrate may also require additional sealing or bonding agents, in accordance with the requirements set out in BS 8481.

Plaster mixes

Plaster mix ratios should be in accordance with manufacturer's recommendations and be appropriate for the intended use.

Minimum plaster thicknesses

The thickness of plaster will vary depending on the evenness of the substrate. The finished element must meet the tolerances identified in this Technical Manual, and be of a suitable quality so that a decorative finish can be applied. Minimum thickness should be in accordance with the following table.

Element	Minimum number of coats	Typical thickness
Ceiling – plasterboard	1	Skim to provide suitable and durable finish

10.2.15 Suspended ceilings

Suspended ceilings shall be specified and installed to be suitable for the site specific conditions. The following shall be taken into account:

- Fixing requirements.
- High humidity and external environments.
- Fire resistance.

Fixing requirements

Fixings should be appropriate for the site conditions and the loads to be supported. They must also be installed in accordance with the manufacturer's specifications. Fixings to the floor construction should be at the correct designated centres using the correct wires/brackets that are compatible with the suspended ceiling (and the intended environmental conditions - see below). Pull tests should be carried out on ceilings with an area exceeding 100m² and a factor of safety of 2 is applicable.

Ceiling grid layouts and fixing schedule and method of fixing to soffit, should be provided.

Confirmation that the weight of the ceiling construction and any additional fire/sound insulation loads has been taken account of in the supporting structure design calculations.

Where there is any doubt regarding the adequacy or installation or variation from the initial design a manufacturer's inspection and certification will be required.

High humidity or external environment

Where the ceiling is above a high humidity area or is an external suspended ceiling; a third party product conformity certificate should be provided to demonstrate the product is suitable for the specified environment.

Fire resistance

Where suspended ceilings are designed to give a minimum period of fire resistance, fire test certification will be required to confirm the periods of fire resistance given. This should also take into account any recessed light fittings which may bypass the fire resistant layer. Consideration should also be given to the quality of workmanship in these installations, and a manufacturer approved installer be used.

The additional weight of materials used to achieve fire resistant specifications or where sound insulation requirements occur must also be taken account of in the structural design of the supporting structure and the fixings of the ceiling construction.

Typical detail for suspended ceilings

Suspended ceilings should be designed and constructed in accordance with BS EN 13964.