THE Q POLICY

The Blueprint for Structural Warranties

TECHNICAL MANUAL

Contents

SCOPE & REQUIREMENTS

Scope

To satisfy the Requirements of this manual you must comply with:

- The applicable technical requirements of the Building Regulations. This will be dependent upon the location within the United Kingdom (i.e. England and Wales, Scotland and Northern Ireland) and the relevant transitional provisions
- All other statutory technical requirements e.g. Water Regulations, the Gas (Installation and Use) Regulations, etc.
- The additional requirements set by The Q Policy.

Requirements

The Q Technical Standards are divided into several sections corresponding to the various areas of construction.

The Q Requirements and other statutory constructional requirements are shaded for ease of identification. These Requirements are in addition to compliance with Building Regulations and for the avoidance of doubt compliance with the Requirements is mandatory.

All dwellings and commercial buildings covered by a warranty from The Q Policy, shall comply with the Requirements in force at the time that documents for the dwelling were deposited with the relevant authority for the purposes of the Building Regulations. The pages following the Requirements provide guidance on showing compliance.

For the purpose of this Manual, the term *Building Regulation* refers to the equivalent or corresponding statute in the various countries covered by this manual, i.e. England & Wales, Scotland, Northern Ireland.

Building Regulation requirements are described in functional terms (*in italic text*) and reference is made to any corresponding regulation in England & Wales, Scotland and Northern Ireland. Where a Building Regulation requirement is not currently applicable in a particular country then, where noted, it shall be treated as a Q requirement.

When interpreting these Requirements and Guidance the standards of construction achieved shall never fall below the minimum standard set by the controlling Building Regulations.

In determining whether compliance with the Requirements has been achieved:

- It is for the building control body (Local Authority or Approved Inspector) to satisfy themselves on the compliance of plans and work with the Building Regulations. It should be noted that where a dispute arises, Q may delay the issuing of the Insurance Certificate until settled.

- For the avoidance of doubt, when several standards are referred to, the higher standard shall apply

- The decision of Q shall be final in determining these Requirements.

Q Requirements:

The Construction shall comply with the Building Regulations

Paths and drives shall be laid to falls and be adequately drained
Site fill and consolidation of subsoil under paths, drives, outbuildings etc. shall be carried out using non-organic materials and achieve an appropriate level of compaction, due account being taken of the final use of the filled area

Where on-site sewage treatment and disposal systems are included in the warranty and/or soakaways are proposed a porosity test shall be carried out to ensure that the ground conditions are suitable for that form of drainage discharge

Subsoil drainage shall be provided within the vicinity of outbuildings, hardstandings, paths, drives and the like if the ground is liable to waterlogging or if the presence of a water table is likely to affect the stability of the ground

Subsoil drainage shall be provided in garden areas if the ground is liable to constant waterlogging within 4 metres of the dwelling

Garden areas shall be laid to levels and gradients appropriate to the levels of the buildings, adjacent highways and services

An adequate method of rainwater disposal shall be provided to all permanent outbuildings

External doors and windows shall be designed and constructed so as to:

- Not allow moisture through frames
- Be provided with a draught strip
- Shed water from the building in an effective manner
- Provide an adequate deterrent to forced entry into a dwelling

The enveloping walls and floors of a dwelling, including jambs, sills and heads of door and window frames, shall be designed and constructed so as to:

- Prevent build up of excessive condensation within the fabric of the construction
- Prevent cold bridges causing local surface condensation to occur, and prevent the excess flow of air into a dwelling

The width of internal stairways shall be such as to offer safe passage to users of the building

The following accommodation and amenities shall be provided to a dwelling:

- adequate whole house heating and domestic hot water supply
- electrical installation with an adequate number of lighting points and socket outlets
- gas supply to kitchen cooker position (where a mains supply passes adjacent to the dwelling)
- adequate storage space at each floor level
- adequate space with a 13 amp socket outlet for a refrigerator
- TV point in at least one room wired to an accessible connection point

Building service installations shall be designed and constructed so that they:

- operate in a safe manner
- are provided with adequate controls to allow their operation, isolation and drainage
- are provided with adequate means of access where necessary for the purposes of inspection, maintenance and replacement

All service installations requiring periodic attention by the user shall be provided with adequate operating and maintenance instructions

Finishes to walls, floors, fixtures and ceilings in conjunction with levelling and supporting surfaces should provide adequate resistance to impact, wear, water, and light chemical attack, due account being taken of the location of the element. In addition, externally located finishes should have resistance to frost and ultra-violet radiation

Decorative elements shall be completed to adequate basic levels of visual quality (higher standards which may be agreed between the builder/developer and the purchaser are not included in this Requirement)

Adequate vehicular and/or pedestrian access shall be provided:

- from an adjacent street, to an entrance of the dwelling and to any garage or other parking area within the curtilage of the site
- from the dwelling to any garage and outhouse

Detached garages and outbuildings shall be:

- structurally stable and withstand movement of the subsoil, due account being taken of the ground conditions and wind exposure for the site
- reasonably resistant to rain and ground water (however detached garges are not deisgned to form a 'dry' enviornment unless specifically specified)

Retaining walls and garden walls shall be stable, withstand movement of the subsoil and be adequately protected from the adverse effects of ground moisture and freezing. In addition, retaining walls shall be constructed so as not to allow the build-up of ground water

All external ramps and steps providing access to a dwelling shall be safe to use

Garden areas shall be reasonably cleared of builders' materials prior to handover and left suitable for planiting and or turf (including top soil)

Accuracy, quality of finish and protection:

- Any element covered up by another element shall be finished to adequate standards in order to properly receive the covering element and be adequately protected prior to being covered up
- Any element not covered up by another element shall be provided to an adequate basic standard of visual finish and protected prior to handover (Higher standards which may be agreed between the builder/developer and the purchaser are not included in this Requirement)

Q Requirements (continued):

Design and construction:

- Adequate investigations shall be carried out to identify design data which vary from site to site
- Total and differential movement of an element shall be adequately limited or accommodated, such that damage does not occur to itself or to other elements
- Methods of fixing, jointing, bonding, supporting, tying together, surface preparation and sealing of elements shall be adequate, due account being taken of the location and anticipated life of the element
- The design and construction of any element and choice of materials shall be such that a reasonable level of safety to persons is provided
- The method of achieving compliance with any Requirement shall not result in the failure to comply with another Requirement
- Any element which performs the role of more than one element shall comply with the Requirements applicable to each element
- Every dwelling shall be cleared of builders materials and debris and adequately cleaned prior to handover

Durability – Materials and workmanship:

- All materials, with the exception of decorative materials, shall have a minimum life span of not less than 30 years for items affecting structural stability, 15 years for roof coverings and 10 years for non-structural items, due account being taken of their intended location and use
- Materials shall be adequately treated to prevent their premature decay or decomposition and adjacent materials shall be compatible with each other
- Materials shall be stored, protected and properly treated prior to being incorporated into the dwelling
- The Requirements shall be met whilst the building is in service
- If a product has an independent test certificate e.g BBA or BRE, DIN etc and is installed by an "approved installer" [e.g. approved under an industry scheme or by the manufacturer as in the case of Sika render systems] we should not require additional insurance

Q Conversion Requirements

Where deemed necessary the developer/builder should commission a comprehensive survey and report by an Expert for the structure of the building or elements of structure, to indicate the condition and lifespan of those elements

Provision of integral damp-proof course and damp-proof membrane to provide an effective barrier against rising damp. DPC injection to include an insured certificate issued to each property, acceptable to The Q Policy

Independent inspection and treatment of timbers against fungal and insect attack, where necessary, together with replacement of all rotting timbers and associated work necessary to remedy the cause of dampness. Timber treatment to include an insured certificate issued to each property, acceptable to The Q Policy

Historic buildings shall achieve to reasonable as is practicable level of sound insulation. The results of the "test and declare" testing shall be displayed in the building

Where required by Q the developer/builder shall provide an underwritten guarantee for specialist works

Other Statutory Constructional Requirements

All elements of construction covered by this Manual shall comply with any relevant statutory requirements

Services passing through the building envelope shall comply with the requirements of the relevant Gas, Water, Electricity and Drainage Authorities

The protection of building services supplies and installations in waterlogged ground shall satisfy the requirements of the Supply Authority

The method of on-site sewage treatment and disposal shall comply with the requirements of the Sewage / Water Authority / Environment Agency

The method of discharge of a private drain or sewer into a public sewer shall comply with the requirements of the Sewage Authority / Environment Agency

The ventilation of voids under ground floor slabs shall be to the satisfaction of the local Gas Authority

Every dwelling shall be provided with a wholesome supply of drinking water to the satisfaction of the Water Authority

Heating appliances shall comply with the requirements of the Local Authority with regard to the Clean Air Acts (smokeless zone requirements)

The location of services within the finishes shall comply with the requirements of the Gas, Water, Electricity and Drainage Authorities

Low and Zero Carbon Housing

The Building Regulations Approved Documents Part F 2010 & L 2013 for England and Wales regarding the ventilation and energy performance of dwellings requires designers and builders have to ensure that new dwellings minimise uncontrolled air leakage and provide proper ventilation. **Reduced air permeability is recognised as having significant impact on reducing energy consumption and carbon emissions.** Therefore all new dwellings are required to be pressure tested to ensure that their air permeability does not exceed the standards in Approved Document L (also see this section.)

Minimizing air leakage is critical to building performance. It not only saves energy but also improves comfort by eliminating drafts. Equally importantly, reducing draught uncontrolled air leakage enhances durability by allowing rain screen walls to function effectively and prevents moist air from leaking outward and condensing within the building fabric. A continuous sealed air barrier that separates indoor conditioned space from the outdoors must be provided. It can be located anywhere within the building fabric provided the vapour permeability rating of the air barrier will not trap moisture within the wall cavities.

All combustion equipment shall be independently vented and have either sealed direct-vent, induced-draft or forced draft venting systems with electronic ignition. Induced-draft and forced draft vented equipment shall be capable of positive shutdown in the case of venting system blockage. A carbon monoxide detector shall be installed in flats/houses containing either combustion appliances or attached garages.

Low or zero carbon housing should incorporate the principles of occupant health and comfort, affordability, resource conservation and reduced environmental impact. These homes reduce greenhouse gas emissions and minimize the detrimental impacts of housing. The design of these dwellings should be undertaken in the following order and include:

1. Climate specific design
2. Energy and resource-efficient construction
3. Passive solar heating and cooling
4. Natural daylighting
5. Energy-efficient appliances and lighting
6. Renewable energy systems (e.g. photovoltaics, solar thermal and ground source heat pumps, etc.)
7. Water conservation and re-use
8. Land and natural conservation
9. Sustainable community design and green infrastructure practices.

The benefit of good design includes:

- Lower energy bills
- Less concern about disruption to the energy supply or cost escalations
- Healthier living
- Greater comfort
- Reduced carbon emissions and other pollutants
- Improved affordability from a life-cycle cost basis
- Increased opportunities for sustainable redevelopment

Renewable Energy Systems

The following renewable energy systems should be considered when designing low zero carbon dwellings:

a. Combined heat & power
b. Bio-mass heating
c. Solar thermal for space and domestic water heating
d. Solar electricity
e. Solar ventilation air preheat
f. Ground source heat pump
g. Wind

Security

Design – General

The Building Regulations Approved Document Q was introduced in 2015 and was effective from the 1st of October and applys to all new dwellings including those formed by a material Change of use. The regulations go some way to meeting the requirents of the Secure By Design standards however more comprehensive security can be provided to the dwelling and site by following the guidance and objectives of Secured by Design. These standards are designed to encourage the building industry to adopt recommended crime prevention guidelines, in both house and estate design, thus gain approval; to use an official Police approved logo in marketing of new houses.

To gain approval under the Secured by Design initiative, it is important for the designer to consult with the Architectural Liaison Officer of the relevant Police Authority at an early stage of the design Security provisions apply to houses, flats and maisonettes and cover the following matters:

- Passive security measures such as estate layout, landscaping and the design of doors and windows
- Active security measures such as intruder alarms and security lighting (also refer to section regarding External Works).

Further information about Secured by Design can be found at: www.securedbydesign.com

Further information regarding community safety, security and risk solutions can be found at:

Perpetuity Research and Consultancy International (PRCI)
11a High Street, Tunbridge Wells Kent TN1 1UL
Tel: 01892 538 690 Email: prci@perpetuitygroup.com www.perpetuitygroup.com

Customer Services for Home Builders

In today's world, impressing home buyers requires service initiatives. Fortunately, throughout the home buying-building-owning process, you can find hundreds of opportunities to delight and amaze your clients. An emphasis such as those of sales, construction and warranty evolve to a level of sophistication equal to that of the home owners' expectations.

At completion the following should be quality checked:

- **Finishes** – generally check that there is no damage, drips, chips or faults in the appearance of any decorated surface. Ensure that all aspects of the finished home are of a reasonable basic quality standard of visual finish.
- **Services** – generally check that all services, boilers, fires etc. are installed in accordance with the manufacturer's instruction, together with the legislation associated with that appliance. Please note that all operating manuals should be retained and handed over to the purchaser as part of their Customer Information Pack. Always ensure that suitable access for maintenance is provided and the following certificates available for:
    - Gas Safe Certificate
    - Electrical Approved Document Part P certificates
    - RSD or PCT documents
    - EPC
    - Approved Document Part L documents
    - Building Control Final Certificate
    - Warranty Insurance Certificate
    - Operating Instructions for all appliances/equipment fitted
    - White goods guidance in use and warranties
- **Superstructure** – ensure that all finishes are to a reasonable basic visual standards, the brickwork/rendering and roof covering is of a consistent nature in quality of finish and workmanship. All windows and door frames must be reasonably sealed where abutting the external envelope to prevent weather penetration. All rainwater goods must be in place and connected to the drainage system and all timber products are suitably treated / decorated to give a reasonable finish and protection against the elements.
- **Roof space** – the roof space should be accessible, with all insulation in place and, where fitted (in a cold roof the loft hatch must be insulated, draught stripped and secured with a catch. Access must be provided to and round the water storage tanks within the loft space.
- **Ground works and drainage** – generally all external decorations should be complete, boundary walls built, drainage connected and tested, paths and drives complete / serviceable and the plot free from any builder's debris.
- **Miscellaneous** – provide evidence of insured guarantees where applicable. The whole house should be clean, free from builder's material/rubble and be complete prior to handover/conveyance.
- **Insured guarantees are required for:**
    - Timber treatment, materials and workmanship
    - Chemical injection, materials and workmanship
- **Insurance backed guarantees are required for:**
    - Remedial wall tie replacement, materials and workmanship
    - Basement tanking, materials and workmanship
    - Roof covering where applicable

Establishing Fitness of Materials and Workmanship

The following methods exist for establishing the fitness, and assuring the quality of materials and workmanship.

Past experience
Past experience may show that a material is suitable for its intended use or that a method of workmanship is adequate for a particular type of construction.

British Standards or European Standards
Compliance with a British Standard or an equivalent European Standard generally assures the adequacy of a design, method of construction or product where appropriate for a specific use.

Product certification schemes
Product certification schemes operated by independent assessment organisations exist for assuring the conformity of a product to a specific standard, e.g. the Kitemark Scheme operated by the British Standards Institution.

Quality assurance schemes
Various quality assurance certification schemes exist for design, construction and product manufacture. Firms registered under such schemes are considered to have the capability to produce or perform to a consistent level of quality within a defined scope of registration. Quality Assurance schemes registered by the National Accreditation Council for Certification Bodies (NACB) provide assurance as to the integrity of such schemes. Quality Assurance schemes do not, however, certify conformity with a particular product or service standard, or that the standard is adequate for a specific application.

Agrément Certificates
Agrément Certificates issued by the British Board of Agrément (BBA) provide independent certification of the adequacy of a particular product, for a specific use, in cases where a British Standard does not currently exist.

Construction Products Directive
The CE mark is a claim that a product, when properly used, enables the construction works in which it is incorporated to meet the relevant essential Requirements of the EC Construction Products Directive. The claim is normally based on compliance with a harmonised European Standard or European Technical Approval.

The essential Requirements encompass:

- Mechanical resistance and stability
- Safety in case of fire
- Hygiene, health and environment
- Safety in use
- Protection against noise
- Energy economy and heat retention

As with national standards, different classes of performance may be permitted in order to suit varying situations such as climate and required levels of protection. Therefore, products should be carefully selected to ensure that they are fit for their intended purpose.

Tests and calculations
Calculations and destructive or non-destructive tests can show that a design, construction and/or product is adequate for a specific purpose. The NAMAS Accreditation Scheme for Testing Laboratories provides a means of ensuring that tests are conducted in accordance with nationally accepted criteria.

See Appendix C for approved test laboratories.

Tests for reclaimed materials
Reclaimed materials must be subject to a third party test to show suitability (unless specifically seen and accepted on site by Q prior to incorporation of the particular material in the construction).

Expert
Where the appointment of an **Expert** is recommended, the person to be appointed should possess the qualifications, experience and professional indemnity insurance appropriate for the type and complexity of work to be undertaken.

Suitable Experts normally include:

- Registered Architects
- Chartered Civil and Structural Engineers
- Chartered Building Surveyors
- Members of the Chartered Institute of Building
- Members of the Royal Chartered Institute of Surveyors
- Members of the Architects and Surveyors Institute (Building Surveyors)
- Corporate Members of the Association of Building Engineers or Corporate Members of the Incorporated Association of Architects and Surveyors (Architects/Building Surveyors)
- UKAS and ANC members
- Certified Surveyor in Structural Waterproofing (CSSW)

Guidance for Innovative Designs and Construction Methods

In general, designs and construction methods which cannot be shown to meet the Requirements by any of the methods set out in this manual must be approved in advance by Q in writing, generally before commencement on site.

All structural elements should be designed by an Expert when not in accordance with either:

- Approved Document A (England and Wales)
- Technical Standards Part C (Scotland)
- Small Buildings Guide (Scotland)
- BS 8103:1
- This technical manual

Where the structural elements of a building are designed by more than one Expert, then one Expert should be nominated to be responsible for certifying the overall stability of the structure.

To ensure durability, materials should generally be selected as follows to suit the exposure of a particular location:

- BS 5628 – masonry units and mortar
- TRADA Floor Span Tables
- BS 8110 – concrete
- BS 5268 and BS EN 338 – structural timber
- BS 5950 – structural steel.

The findings and recommendations of any site investigation report should be taken into account when selecting masonry, mortar and concrete for below ground use.

Structural elements should not be cut, drilled or notched on site, except in accordance with the recommendations set out in this Manual. Manufactured structural components should not be modified without the express permission of the designer and manufacturer.

If a structural element supports heavy service loads, e.g. a cold water tank, it should be specifically designed for this purpose.

The dimensional accuracy of the completed structure should be within the permissible tolerances specified by the manufacturer of elements to be supported by, or accommodated within, the structure.

Where prefabricated structural components rely on additional site fixed elements or fixings for their own stability, or provide stability to other elements, then a nominated person should be responsible for ensuring that all necessary assembly information is supplied to site and that the completed work complies with the design.

Prefabricated structural components should not be altered on site or any major repair carried out without the specific approval of the Expert responsible for the design.

Prefabricated structural components should be clearly identified by indelible marking.

The rigidity of a framed structure should be sufficient to prevent damage or visual defects occurring to all elements within or supported by the structure.

Workmanship on building sites should comply with BS 8000 and Regulation 7 to the Building Regulations.

Q Warranty Cover for Modern Methods of Construction (MMC)

Ensuring our quick assessment
For all MMC properties, we will need to carry out a technical assessment of your project before we can agree to register it for cover under our warranty policy scheme. MMC is a process in a pre-defined logical sequence, using precise components made under controlled conditions. The result is a building with enhanced performance characteristics in terms of quality, time, waste, value and delivery certainty.

Q defines MMC as:

Panelised – Closed timber, steel framed or concrete panels factory produced and assembled on site, including Structually insulated panels (SIPS) and laminated panel systems.

Volumetric – Lightweight steel, concrete or timber modules and PODs, including services and finishes, factory applied. E.g. Yorkon, Elliots, Terrapin, Rollalong, Buma, Spaceover, etc.

The assessment process is not just a desktop overview of your proposals and specification of the project, but will also include factory audits and site visits. We understand that you need to make quick progress on site. In order to help you do this we set out below how we can help each other to streamline the assessment process.

The flow chart overleaf shows you the stages, from notification of the project to our decision to accept, or unfortunately on some occasions to decline.

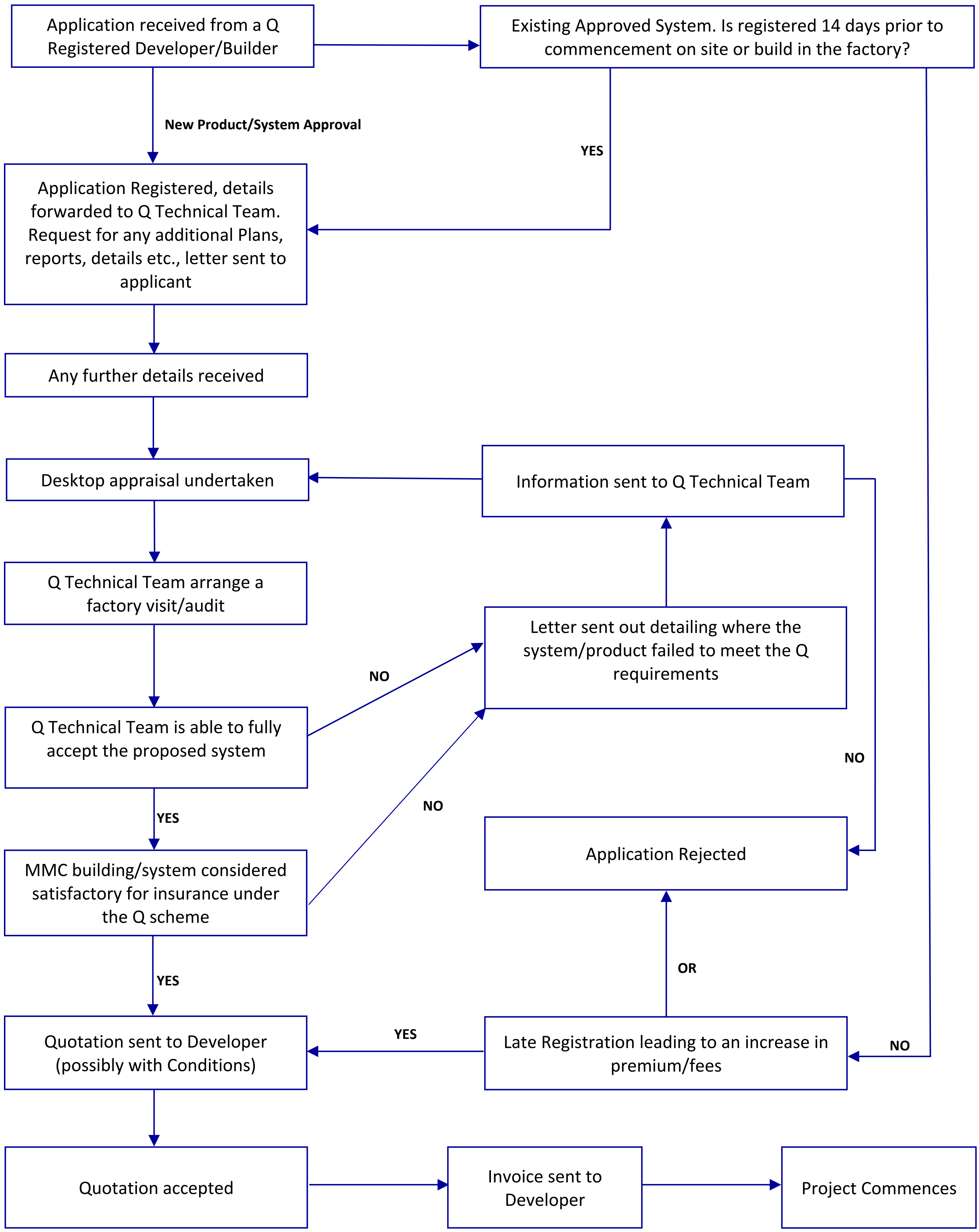
What are we looking for?
In order to understand your project, we need to know as much as possible about it as soon as possible. In particular we need:

- Single point of responsibility for project design co- ordination. The project co-ordinator to be responsible for ensuring compatibility of all individual construction elements.
- Project – Drawings, plans, elevations and specifications.
- Project method statements.
- Erection manuals and confirmation of erection by trained/approved contractors.
- Maintenance requirements.
- Structural Engineer load calculations for all elements of the system and cladding details including fixing calculations.
- Structural Engineer's Report – to comment on structural adequacy of elements and confirm life expectancy of building.
- Experts' reports – these will be in addition to the Structural Engineer's report and should include specialist reports and test evidence data from manufacturers.
- Independent assessment of components or system from BBA, BM TRADA, BRE, WIMLAS, European Technical Approval (ETA) or conformity to International, European and British Standards.
- Best practice guidance from industry bodies, BRE, BM TRADA, CIRIA, ETA, BS etc.
- nformation from manufacturers, builders and clients.
- Past performance of similar systems.
- Third party Manufacturer's Warranties
- Factory audit required if system is not already approved by Q

What we expect

- The project must achieve compliance with Q Technical requirements and the Building regulations.
- The fabric of the building must prevent moisture penetration to the inside of the building.
- Any habitable areas either below or partially below ground level must be provided with a minimum grade 3 tanking system or equivalent and ten year insured certificate.
- Specialist roofing systems and proprietary externally applied weather proofing/insulation systems should have a contractors guarantee and/or ten years insured certificate.
- Windows, doors and internal services should comply with current standards.
- Life of building to be at a minimum of 60 years in accordance with CML requirements

Pleaser refer to the flowchart for MMC projects on the following page.



Flowchart for MMC Project/System Approval

Assessment of MMC Systems, Additional Information

The following provides guidance on the assessment procedure undertaken by the technical department during both the desktop and factory/site inspection stage.

Verification by Desk Study

The durability assessment shall involve a review of the following information supplied by the applicant:

- All materials used in their system shall include specification of any coating finishes for the purpose of corrosion protection, UV protection (i.e. zinc, paint etc).
- The life expectancy of all materials.
- Assessment of long-term performance of materials where relevant.
- Protection from weather during delivery and installation of the various building systems, elements or components.
- Achievement of the weather-tightness of the building by consideration of the following aspects:
- Type of roof covering and method of installation,
- Where relevant, use of drainage cavities in walls,
- Adequate use of damp proof course(s),
- Sealing around windows and doors
- Roof and ground drainage.
- Assessment of the hygrothermal performance of the building system, element or component including thermal transmittance and any associated risk of condensation.
- Effect of different materials in contact (i.e. examination of chemical and physical compatibility).
- Where relevant, provision of movement joints in the system to allow thermal expansion of components without detriment to the weather tightness of the building.
- A schedule, clearly detailing the maintenance requirements including cleaning, re-sealing and replacement of any component or element having life expectancies of less than 60 years.

Product Specification

The manufacturer/supplier shall provide the following:

- Clear identification of the scope of the building system e.g. number of storeys;
- All engineering drawings showing construction details, junction details and connections, with manufacturing tolerances;
- Test reports/calculations relating to performance of the building system/element or component;
- Competency and /or training requirements of installers;
- Full detailed site installation/assembly instructions including any diagrams;
- Critical site assembly checklist for use by on-site inspectors;
- Risk assessments for the installation and construction process;
- Procedures for the adaptation/change of use of the building system, elements or components in response to the following scenarios:
    - Insertion of a 2m x 2m opening for a new patio door;
    - Fixing of heavy items to external walls, ceiling and stairs – e.g. stair lift, ceiling hoist for disabled;
    - Fixing of heavy items to external walls;
    - Adding a conservatory;
    - Removal of internal load bearing walls;
    - Accessibility for modifications to plumbing and electrical services;
    - Cutting or drilling holes through elements to accommodate modifications to service requirements.

Mechanical Resistance and Stability

Evaluation of the structural configuration to identify:

- Clearly defined paths through which the actions are transmitted to the ground.
- Adequate strength, stiffness and stability to resist the applied loads to which the system will be subjected.
- Structural members, the stability of which relies on the assumption that they are restrained in position and their connections to a bracing member are of sufficient strength and stiffness to provide the required restraint.
- Robustness to disproportionate collapse

The building must comply with the following:

The Building Regulations (England & Wales) 2010

- Part A Structure
    - Regulation 7 – Materials & Workmanship

The Building (Scotland) Regulations (2004)

- Section 0 General - Regulation 8 (1) – Fitness and durability of materials and workmanship.
- Section 1 Structure - Regulation 9

The Building Regulations (Northern Ireland) 2012

- Part B Materials & Workmanship
- Part D Structure

Safety in Case of Fire

The minimum fire resistance for compartment walls shall be 60 minutes (REI60) for low and medium rise buildings.

Cavity Barriers/fire stopping shall be fitted at all junctions between individual dwellings, communal areas, and the exterior envelope. For larger buildings follow the guidance in Approved Document B3 (England & Wales), the Technical Handbooks 2.4 (Scotland) and the Technical Standards (N.I).

The building must comply with the following:

The Building Regulations (England & Wales) 2010

- Part B Fire Safety
- Regulation 7 – Materials & Workmanship

The Building (Scotland) Regulations (2004)

- Section 0 General - Regulation 8 (1) – Fitness and durability of materials and workmanship.
- Section 2: Fire - Regulation 9
    - 2.1 Compartmentation
    - 2.2 Separation
    - 2.3 Structural protection
    - 2.4 Cavities
    - 2.5 Internal linings
    - 2.6 Spread to neighbouring buildings
    - 2.7 Spread on external walls
    - 2.8 Spread from neighbouring buildings
    - 2.9 Escape
    - 2.10 Escape lighting
    - 2.11 Communication
    - 2.12 Fire service access
    - 2.13 Fire service water supply
    - 2.14 Fire service facilities
    - 2.15 Automatic life safety fire suppression systems

The Building Regulations (Northern Ireland) 2012

- Part B Materials & Workmanship
- Part E Fire Safety

Hygiene, Health & Environment

The building shall resist the penetration of the building envelope, including driving rain on facades and potential snow penetration.

Basement construction should comply with the provisions of BS 8102.

The risk of interstitial condensation should have been addressed in accordance with EN ISO 13788 and BS 5250.

Approaches, door widths, corridors, circulation and sanitary conveniences should comply with recommendations given in BS 8300.

The building must comply with the following:

The Building Regulations (England & Wales) 2010

- Part K Protection from falling, collision and impact
- Part M Facilities for disabled people
- Regulation 7 – Materials & Workmanship

The Building (Scotland) Regulations (2004)

- Section 0 General - Regulation 8 (1) – Fitness and durability of materials and workmanship.
- Section 4: Safety - Regulation 9
    - 4.1 Access to buildings
    - 4.2 Access within buildings
    - 4.3 Stairs and ramps
    - 4.4 Pedestrian protective barriers
    - 4.7 Aids to communication
    - 4.8 Dangers from accidents

The Building Regulations (Northern Ireland) 2012

- Part B Materials & Workmanship
- Part H Stairs, ramps, guarding and protection from impact
- Part R Access and facilities for disabled people.

Sound Insulation

For England & Wales, Sound insulation performance may be demonstrated by using appropriate Robust Detail (RD) solutions or by solutions similar to them. If no RD solution exists then Pre-Completion Testing (PCT) will be required.

The building must comply with the following:

The Building Regulations (England & Wales) 2010

- Part E Resistance to passage of sound
- Regulation 7 – Materials & Workmanship

The Building (Scotland) Regulations (2004)

- Section 0 General - Regulation 8 (1) – Fitness and durability of materials and workmanship.
- Section 5 Noise - Regulation 9
    - 5.1 Resisting sound transmission to dwellings using appropriate constructions

The Building Regulations (Northern Ireland) 2012

- Part B Materials & Workmanship
- Part G Sound insulation of dwellings

Energy Economy and Heat Retention

The manufacturer should provide details of the thermal performance and air leakage of the building system.

The building must comply with the following:

The Building Regulations (England & Wales) 2010

- Part L Conservation of fuel and power
- Regulation 7 – Materials & Workmanship

The Building (Scotland) Regulations (2004)

- Section 0 General - Regulation 8 (1) – Fitness and durability of materials and workmanship.
- Section 6 Energy - Regulation 9
    - 6.2 Building insulation envelope
    - 6.3 Heating systems
    - 6.4 Insulation of pipes, ducts and vessels
    - 6.5 Artificial and display lighting
    - 6.6 Mechanical ventilation and air conditioning

The Building Regulations (Northern Ireland) 2012

- Part B Materials & Workmanship
- Part F Conservation of fuel and power

Durability, Resilience, Materials and Workmanship

The life expectancy of the structure shall not be less than 60 years. The durability, resilience and repairability of the building shall be similar to that expected from residential construction using more established methods of construction.

The building must comply with the following:

The Building Regulations (England & Wales) 2010

- Regulation 7 – Materials & Workmanship

The Building (Scotland) Regulations (2004)

- Section 0 General - Regulation 8 (1) – Fitness and durability of materials and workmanship.

The Building Regulations (Northern Ireland) 2012

- Part B Materials & Workmanship

References:

Loss Prevention Standard LPS 2020
Approved Documents Building Regulations, England & Wales, Scotland and Northern Ireland.
Barker 33 Cross-Industry Group- Modern Methods of Construction

Guidance on the Party Wall Act 1996

This Act came into force in England and Wales on 1st September 1997. It is important to understand the essential elements although its relevance to a particular site or development will vary according to circumstances.

In any situation it is possible that a number of adjoining owners may be affected, i.e. Freeholder, Head Lessee, Sub Lessees, even a person or organisation under contract to purchase.

Party Walls and Party Structures
The Act gives owners of property, separated by a Party Wall, rights over the whole of that wall and thus beyond title boundary, which is normally, but not always, in the centre of the wall. These rights can be pursued following the service of an appropriate notice. This sometimes produces consent from the adjoining owner but often dissent. Assuming the latter, the Act demands that each owner appoints a surveyor (they can agree on the same surveyor but this is rare) which leads to the delivery of an Award to each owner, signed by the surveyors.

Examples of the rights gained over the Party Wall are:

- Raising or, where appropriate, reducing the height
- Underpinning
- Cutting into
- Removing corbels or footings etc.
- Strengthening/rebuilding

Should you be working in a building which remains part tenanted, the floor between your work and the tenant will almost certainly be defined as a party structure and most works of a significant nature on this floor will require notice.

Simple Fence Or Open Boundary
In these circumstances a notice can be served which gives the right to place a wall immediately adjacent to the boundary with foundations extending on to the adjoining owner's land. By agreement with the adjoining owner it is possible to place the wall astride the boundary.

Excavation and Below Ground Works
Notice also has to be served when carrying out excavation within 3 metres of an adjoining building or structure and to a lower level than the existing foundation. In other circumstances, usually piling, it is necessary to serve notice within 6 metres of the adjoining building or structure.

Summary
Unless you have "in house" expertise in the workings of this Act, you should gain professional advice. Failure to serve appropriate notice, which in most cases is two months prior to the commencement of work, could lead to the delay of a relevant part of the works, or at worst the whole contract.

There are many positive aspects to the Act. In many circumstances you are no longer limited by the laws of property and trespass. The Act lays down a simple timetable for the response to notices and other matters and a procedure for resolving disputes between the appointed surveyors. The intention of the Act is to give certainty in your dealings with the adjoining owner.

Further advice can be found at:
http://www.planningportal.gov.uk   Building Regulations section

Guidance on the CDM Regulations 2015

The new Construction (Design and Management) Regulations 2015 (CDM 2015) came into force on 6 April 2015 and apply to all building and construction projects, regardless of the size, duration and nature of the work. CDM 2015 replaces CDM 2007 from 6 April 2015.

The Regulations are subject to certain transitional provisions which recognise that there will be projects which started before CDM 2015 comes into force.

Details of what the changes are and the implications of the new Regulations can be found together with a number of downloadable guainadnce notes on the Q Assure Build Website using the link below:

http://qassurebuild.co.uk/cdm-and-hs/4576325780

THE Q POLICY - ON-SITE

Inspections

Q inspects new and converted / refurbished homes under construction, with the aim of reducing the possibility of latent defects being incorporated within the new home. Q employs a team of qualified surveyors who target inspection visits to achieve a programme of risk management. Each development will be assessed on its merits, taking into account the complexity of the site, its environment, the type of construction being adopted and the capabilities and expertise of the builder or developer.

When you register a site with us we will give you contact details of one of our Surveyors. When you start your development, please contact your allocated Q Surveyor to arrange a meeting. During this meeting he or she will discuss the development as a whole, your programme of works, the method of construction being used, the site etc. to ensure we have a full understanding of what you want to achieve. Following this pre-planning meeting, your Q Surveyor will agree a risk management programme and will target site inspections to suit the agreed levels of service for your development.

Any programme of risk management inspections cannot eliminate all risks but the Q programme, together with the following stage inspection aide memoirs will endeavour to:-

- reduce uncertainties on difficult sites;
- minimise the risk of defects being undetected;
- help reduce claims e.g. for you in the applicable Developers Guarantee Period and for Q afterwards ensuring that premiums are kept low;
- increase satisfaction for the building user.

The number of inspections made during the construction of your dwelling or refurbishment will normally vary, depending on the initial and ongoing risk management assessments carried out by your Q Surveyor. There follows a series of construction stages identified as areas where inspection can assist in the reduction of latent defects. Not all stages will necessarily need to be inspected by your Q Surveyor, some may be inspected by the local authority building control department or an Approved Inspector and, if so, will not (in the majority of cases) be duplicated.

The local authority (where employed) will normally inspect some or all of stages 1, 2, 3, 4, & 12 and drainage for Building Regulation purposes. Where a local authority or an Approved Inspector does not inspect these stages Q will endeavour to do so. Q will require notice for a stage 02 inspection so that there is an opportunity to inspect foundations. Inspections in the main are planned so that all significant structural and weather penetration elements are checked. Even where the local authority or an Approved Inspector inspects, Q will normally carry out some spot check inspections.

Typical staged inspections are:

Stage 01 - Commencement of work on site
Stage 02 - Excavation of foundations
Stage 03 - Foundation to Ground floor
Stage 04 - Preparation for the over-site of concrete
Stage 05 - Drainage/drain runs and manholes/inspection chambers
Stage 06 - Drain runs, after covering and with a water or air test applied
Stage 07 - Superstructure to upper floor stage
Stage 08 - Superstructure Timbers for roof/floors, whilst still exposed but after first fix
Stage 09 - Roof Structure
Stage 10 - Pre-plaster
Stage 11 - Post-plaster
Stage 12 - Completion & Snagging

Further information as the site develops

Throughout the Build Process, the Developer / Builder will be expected to provide information which becomes available (via the online system or via E-mail).

Please contact your allocated Q surveyor 48 hours prior to commencing a plot's foundation excavation. Final completion inspections should be arranged 5 days in advance. Should the plot not be ready for completion, please cancel the inspection.

To reduce the risk of defects being incorporated in the completed building, the following pages provide details as an aide memoir, covering all stages listed above. Each list indicates the elements of construction that should have been completed satisfactorily by the nominated stage. This allows the Site Manager to check works in progress as well as providing an insight into what aspects of construction Q Surveyors will want to check.

In addition to the aforementioned aide memoirs, Q Surveyors may issue 'best practice sheets'. These highlight areas of concern and are a further guide to assist in reducing the risk of defects. Following an inspection, your Q Surveyor will complete inspection records to indicate plots inspected. If current acceptable building standards are not being met, a printed record for each plot will be issued highlighting areas that require attention.

Work that is not acceptable to Q will require rectification before an insurance certificate can be issued.

Stage 01 - Commencement of work on site

Typically your Q Risk Management Surveyor will carry out an overview of the developement looking at both site wide and specific construction/design issues, discussing opotential hight risk araes with the site management team. The review nand checks will typically comprise of the following which is not intended to be a checklist or exhsuative:

Check that all proposed plots under the current phase have been registered and that the plot numbers on site are as those described under the registered development paperwork.

The Q Surveyor to explain the on site paperwork and inspection recording system, the Q Surveyor will explain the policy type and cover.

The Q Surveyor to outline any conditions and/or endorsements that are known at the outset which will be attached to the insurance cover.

Site wide elements - The Q Surveyor will discuss the type of construction to be adopted together with general observations on the ground conditions, foundation type and site wide elements.

Construction type

- traditional
- non-traditional

Exposure conditions of the site, have they been considered in the design

Are there any rooms to be constructed below ground (habitable or non-habitable) Tanking:

- Are there any walls to be tanked or require tanking
- Are there any basement areas and what is proposed to prevent water ingress, attention to detailing of junctions
- Structural design, wall, floor construction
- Ventilation, fire resistance and means of escape in case of fire
- Services passing through and land drainage around perimeter

Ground conditions:

- Type of subsoil
- Water table level
- Contaminants, gas etc.
- Shrinkability if clay and trees (present or removed)
- Foundation design (standard / engineered)
- Difficult site condition i.e. sloping site
- Land drainage required

Foundations discussed in detail to establish the type and design:

- Strip
- Raft
- Piled
- Other
- Existing ground obstructions
- Sulphates in the ground (cement considerations)

Drainage:
- Mains drainage, foul and surface water
- MH size and location, gradients and protection
- Non-mains drainage
- Septic tank / treatment plant / cesspool
- Size and location - vehicular access required
- Outfalls and porosity tests
- Soakaways - size, location and ground conditions (porosity tests)
- Land drainage

Ground floor type:
- Ground bearing
- Beam and block or similar type
- Cast in-situ concrete
- Timber

External wall type:
- Masonry cavity / solid
- Timber frame
- Steel frame
- Concrete frame / panel
- Other

External wall insulation:
- Exposure level (geographical location & driven rain index)
- Full fill
- Partial fill
- Clear
- Other

Movement joints:
- Location
- Type / design
- Restraint

Internal walls:
- Partition walls
- Type, loadbearing / non loadbearing
- Foundations
- Party walls
- Masonry
- Solid
- Cavity
- Dry lined or dense plaster
- Timber framed
- Metal framed
- Other

Design to comply with Approved Document E - consideration to details, joints, junctions and sound transmission within dwellings and separate rooms

Upper floors:

- Floor type - timber, concrete, other - spans
  - Fire resistance
  - Insulation
  - Restraint

Party Floor:

- Floor type - timber, concrete
- Sound performance
- Density or isolation
- Penetrations
- Restraint

Design to comply with Approved Document E - consideration to details, joints and junctions

Party Walls:

- Wall type - timber, steel, blockwork
- Sound performance
- Density or isolation/separation
- Sockets
- Hangers, joists, steels, penetration etc.

Design to comply with Approved Document E - consideration to details, joints and junctions

Fire Protection & Means of Escape (MOE)

- Travel distances
- Fire doors (smoke seals)
- AOV's and smoke vents
- Protected staircases and areas
- Fire barriers and seals
- Glazed screens
- Access for the Fire Brigade
- Wet and Dry Risers
- Alarms and lobbies

Sound insulation

- Are RSD's to be used, unique numbers req.
- Pre completion testing is this by UKAS or ANC member
- From Approved Doc E pre completion testing required. Is this by UKAS or ANC member

Roof - pitched, flat, mansard, other:

- Timber, steel, other
- Trusses or cut
- Fixing details - zonal fixing method

Roof covering:

- Slates, tiles, thatch, high performance felts, lead, other
- Fixing specification - nailing / clipping, manufacturers details

Roof penetrations:

- Chimneys - stability and trays / flashings
- Parapets / copings (mechanical fixing – sloping copings) - stability and trays / flashings
- Vents - flashings
- Roof lights
  - o Consider design, trimming and weathering

Any other observations / site specific elements / issues:

Stage 02 - Excavation of foundations

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Foundations discussed in detail to establish the type and design:

- Strip
- Raft
- Piled
- Other
- Existing ground obstructions
- Sulphates in the ground (cement considerations)
- Reinforcement required (where)
- Obtain name and contact details of the design engineer for foundation design (if not already known)

Ground conditions:

- Clay (shrinkability)
- Flint
- Sand
- Rock/Stone
- Made Ground
- Sloping Sites
- Other

Water in excavations or soft spots

- Depth
- Width
- Extent of excavations

In Clay soils only:

- Location of trees
- Type distance from foundation
- Mature height/actual (current height if to be removed)
- Trees previously removed (type, height and location)
- Heave precautions required and established / discussed

Stage 03 - Foundation to Ground floor

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Foundations masonry:

- Trench fill foundation / strip concrete in place
- Trench block or cavity blockwork
- Cavity fill in place
- Quality of workmanship
- Service entries and lintels (including bearings and clearance)

Basements:

- ensure that all tanking is correctly installed and linked to the dpc and dpm of the above ground structure

Floors - all floor substructures in place and constructed to comply with the Building Regulations and or the relevant British Standards, checks made for:

- Timber
  - size, centres, spans and grading of joists
  - fixings and bearings
  - multiple and trimming members
  - adequate ventilation
  - restraint straps and noggins
- Concrete
  - size and bearing of units
  - damaged units
  - no cavity obstructions
  - trimming of openings
- Adequate support to internal partitions
- Service entries filled
- All DPCs linked to suitable DPMs

Walls - all walls to be plumb and structurally stable, checks made for:

- Masonry
  - DPCs lapped and bedded on a smooth joint
  - DPCs in place around all openings
  - Wall ties correctly specified and placed
  - Joints filled and consistent in width and height
  - Cavities free of debris
  - Insulation correctly located, secured and clean
  - Lintel bearings and beam supports correct

- Timber / steel frame system
  - sole plate preparation and fixing adequate
  - Plumb
  - Correct specification used in make up
  - Cavity barriers correctly located
  - Damage, notching and drilling of members
  - Wall ties and lintels suitable for purpose
  - breather membrane intact
- Internal walls
  - Built off adequate support
  - Masonry joints filled
  - Bonding adequate
  -
- Lintels and bearings

Other works commenced:

- Over-site;
- Beam & Block
- Drainage
- Roads / paths

Stage 04 - Preparation for the over-site of concrete

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Over-site:

- Ground bearing;
- Beam & Block;
- Insulation;
- Quality of workmanship;
- Heave precautions (Trees).

Detail:

- Depth;
- Stone;
- Suspended;
- Services beneath;
- Service entries and lintels (including rodent protection).

Other works commenced;

- Over-site;
- Beam & Block;
- Drainage;
- Roads / paths.

Discussion points;

- DPM type and application;
- Gas membrane;
- Service entries;
- Drainage;
- Adjacent ground levels/level threshold relationship and air bricks.

Stage 05 - Drainage / drain runs and manholes/inspection chambers

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Foul Drainage:

- Pipe size, layout and chambers as shown on drawings;
- Bedding, line and falls correct;
- Joints good;
- Lintels over;
- Penetrations of floor, walls etc.

Surface Water Drainage:

- Pipe size, layout and chambers as shown on drawings;
- Bedding, line and falls correct;
- Joints good;
- Lintels over;
- Penetrations of floor, walls etc.

Connection to the existing drainage network:

- New connection to main sewer
- Connection to existing run (has drain run been cleaned and surveyed)
- Is connection of appropriate diameter?

Other Aspects;

- Manhole and Chambers;
    - Type;
    - Depth;
    - Size;
    - Haunching;
    - Steps/access.

Installation of septic tanks if they are to be used;

- Discharge consent obtained?
- Distance greater than 7m from dwelling
- Access for emptying vehicles (within 30m)
- Soil porosity for discharge

Discussion points;

- Damage;
- Penetrations/seal;
- Outfall;
- Septic tank/mini pumping station.

Stage 06 - Drain runs, after covering and with a water or air test applied

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Foul Drainage:

- Backfilled and protected;
- Air / Water Test on and successful;
- Manholes / Chambers completed including lids and steps / access;
- Penetrations of floor, walls etc. competed.

Foul Drainage:

- Backfilled and protected;
- Air / Water Test on and successful;
- Manholes / Chambers completed including lids and steps / access;
- Penetrations of floor, walls etc. competed.

Other Aspects;

- Manhole and Chambers;
  - Type;
  - Depth;
  - Size;
  - Haunching;
  - Steps/access.

Discussion points;

- Damage;
- Outfall;
- Septic tank/mini pumping station – warranties/guarantees.

Stage 07 - Superstructure to upper floor stage

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Basements:

- Ensure that all tanking is correctly installed and linked in to the DPC and DPM of the above ground structure

Floors - all floor substructures in place and constructed to comply with the Building Regulations and / or the relevant British Standards, checks made for:

- Timber
  - Size, centres, spans and grading of joists
  - Damaged units
  - Fixings and bearings
  - Multiple and trimming members
  - Restraint straps and noggins

- Concrete
  - Size and bearing of units
  - No cavity obstructions
  - Trimming of openings

- Party floors
  - Joints filled
  - Correct density
  - Junctions detailed

- Adequate support to internal partitions
- Service entries filled
- All DPCs linked to suitable DPMs

Walls - all walls to be plumb and structurally stable, checks made for:

- Masonry
  - Restraint straps and noggins in place
  - DPCs suitably lapped and bedded on a smooth joint
  - DPCs in place to all openings
  - Insulation correctly situated, secured and clean
  - Wall ties correctly specified and placed
  - Joints filled and consistent in width and height
  - Lintel bearings correct and beam supports checked
  - Cavities free of debris

- Timber / steel frame system
  - Sole plate preparation and fixing adequate
  - Plumb
  - Correct specification used in make up
  - Cavity barriers correctly located
  - Damage, notching and drilling of members
  - Wall ties and lintels suitable for purpose
  - Breather membrane intact

Walls - all walls to be plumb and structurally stable, checks made for:

- Internal walls
  - Built off adequate support
  - Masonry joints filled
  - Bonding adequate
  - Lintels and bearings
- Walls, general
  - Movement control
  - Appearance
  - Cladding
  - Thermal insulation and cold bridging
  - Mortar correct specification
  - Services sleeved where necessary
  - Compatible materials used
  - Weep holes, stop ends and cavity trays correctly installed
  - Cavity width acceptable
  - Insulation and cavity type suitable for exposure
- Party walls
  - Density / isolation adequate and maintained
  - Joints filled
  - Junctions detailed
  - Party wall sock to external cavity
  - No mix and match of materials
  - Penetrations
  - Wall ties to correct specification

Stage 08 – Superstructure Timbers for roof/floors, whilst still exposed but after first fix

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Floors - all floor substructures in place and constructed to comply with the Building Regulations and or the relevant British Standards, checks made for.

Timber Floor Joists:

- TJI/Engineered;
- Solid Timber;
  - Sizes (as plans and span tables);
  - Grade – KD C16 / C22/ other;
  - Spacing's - centres;
  - notching and drilling (correct zones and sizes);
- Decking – glued and screwed / fixings;
- Restraint straps;
- Hangers - fixings;
- Trimmers;
- Strutting (spacing/type/number/fixings);
- Damage.

Concrete:

- Size and bearing of units
- No cavity obstructions
- Trimming of openings

Party floors:

- Joints filled
- Correct density
- Floating layer
- Junctions detailed

General:

- Adequate support to internal partitions
- Service entries filled

Walls - all walls to be plumb and structurally stable, checks made for:

Masonry:

- Restraint straps and noggins in place
- Dpcs in place to all openings
- Insulation correctly situated, secured and clean
- Wall ties correctly specified and placed
- Joints filled and consistent in width and height
- Lintel bearings correct and beam supports checked
- Cavity trays and associated weepholes / stop ends in place,
- All cavities free of debris

Party walls:

- Density / isolation adequate and maintained
- Joints filled
- Junctions detailed
- Party wall sock to external cavity
- No mix and match of materials
- Penetrations
- Wall ties to correct specification

Timber / steel frame system:

- Plumb
- Correct specification used in make up
- Damage, notching and drilling of members
- Wall ties and lintels suitable for purpose
- Breather membrane intact

Walls, general:

- Movement control
- Appearance
- Cladding
- Thermal insulation and cold bridging
- Cavity closed at eaves level
- Wallplate bedded and fixed (where applicable)
- Mortar correct specification

Flat roofs/Balconies:

- Product appropriate for use and as specified;
- Membrane fixed as per manufacturers specification;
- Falls sufficient for product;
- Up-stand at edges/openings sufficient;
- Up-stand flashings sufficient overlap with membrane
- Insulation as per design;
- Level threshold?

Pitched roofs:

- Fixings in line with specification;
- Felt supported at eaves;
- Valley/flashing details as per design and technical standards;
- Correct mortar used for pointing;
- Ventilation adequate.

Roof:

- Trusses/Engineered/SIPP/Other;
- Cut roof – solid timbers;
    - Rafters, ceiling joists, purlins, binders/struts/ridge beam;
    - Sizes (as plans and span tables);
    - Grade – KD C16 / C22 / other;
    - Spacing's - centres;
    - notching and drilling (correct zones and sizes);
    - Bracing – pattern and fixings

- Decking – access – tanks – loft hatch trimming;
- Restraint straps;
- Hangers - fixings;
- Roofing felt;
- Blocking for plasterboard below;
- Damage.

Discussion points:

- Steel beams and posts;
- Bearings;
- Sealing of party walls where joist/beams bear;
- Refurb – worm /rot / reports/treatment/guarantees;
- Spring or movement of floor;
- Ventilation of roof;
- Penetrations;
- Roof covering – type and fixing for exposure and pitch;

Look at whilst on site:

- Pluming;
    - Connections;
    - Pipe sizes;
    - Runs – distances, access rodding;
    - Falls;
    - Traps;
- VDPC's to openings;
- Integral garage – separation and fire doors/step;
- AOVs / Lobbies – MOE;
- Staircases – headroom, guarding, pitch, type, width and extension of handrail.

Stage 09 – Roof Structure

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Floors - all floors (including party floors) in place and constructed to comply with the Building Regulations and or the relevant British Standard

Walls - all walls to be plumb and structurally stable, cavities free of debris

Roofs - all roofs to be constructed and structurally stable, checks made for:Trusses/Engineered/SIPP/Other:

- Cut roof – solid timbers;
  - Rafters, ceiling joists, purlins, binders/struts/ridge beam;
  - Sizes (as plans and span tables);
  - Grade – KD C16 / C22 / other;
  - Spacing's - centres;
  - notching and drilling (correct zones and sizes);
  - Bracing – pattern and fixings
  - Valley, hip and dormer roof details
- Decking – access – tanks – loft hatch trimming;
- Restraint straps restraint straps and noggins in place;
- Hangers - fixings;
- Trimming to openings;
- Proximity of timbers to chimneys / flues;
- Party and gable wall cut to profile;
- Penetrations and weathering;
- External wall insulation in place to prevent cold bridging and cavity closed at eaves level;
- Ensure that the batten sizes, spacing and fixings are compatible with the covering and each other;
- Cavity barriers provided where appropriate
- Roofing felt;
- Blocking for plasterboard below;
- Damage and or notching / drilling .

Chimneys and parapets - ensure that:

- All cavity trays and flashings are correctly situated (two number proprietary
- Lead trays dressed up around flue)
- Check liners correctly placed and joints sealed
- The chimney is correctly sized for stability and located the correct height
- Above pitch line the masonry and the flaunching is correctly pointed
- Copings correctly restrained / securely fixed
- Cavity trays (stepped) correctly located and lapped into soakers and flashings
- Mortar mix is suitable

Discussion points:

- Steel beams and posts;
- Bearings;
- Sealing of party walls where joist/beams bear;
- Refurb – worm /rot / reports/treatment/guarantees;
- Spring or movement of floor;
- Ventilation of roof;
- Penetrations;
- Roof covering – type and fixing for exposure and pitch;

Look at whilst on site:

- Pluming;
  - Connections;
  - Pipe sizes;
  - Runs – distances, access rodding;
  - Falls;
  - Traps;
- VDPC's to openings;
- Integral garage – separation and fire doors/step;
- AOVs / Lobbies – MOE;
- Staircases – headroom, guarding, pitch, type, width and extension of handrail.

Stage 10 - Pre-plaster

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

General - all structural items should be in place and completed, namely floors, walls, roof structure, staircases etc. In addition all services, 'first fix', should be undertaken or almost complete.

Floors - all floors in place and constructed to comply with the Building Regulations and or the relevant European Standards, checks made for:

- Holes within floors - fire stopping
- Notching / drilling of joists
- Damaged floor units
- Fixing of boards / floating floors preparation
- Vapour barriers
- Party floors
- Joints filled
- Correct density
- Floating layer
- Junctions detailed
- Adequate support to internal partitions
- Plasterboard / plain edge board supports
- Correct centres and sizes of joists
- Check for sound insulation

Walls - all walls to be plumb and structurally stable, checks made for:

- Dpcs in place at all openings and linked to dpm at floor
- Restraint straps and noggins in place
- Chasing to walls for sockets and fittings
- Party walls
    - Joints filled
    - Junctions detailed
    - No mix and match of materials
    - Bearings to joists, lintels and beams

Roofs (internally) - all roofs to be weathertight and structurally stable, checks made for:

- Centres and sizes of joists, binders, purlins, struts and or trusses
- Fixings of timbers / members
- Trimming to openings
- Proximity of timbers to chimneys / flues
- Damage and or notching / drilling
- Restraint straps and noggins in place
- Bracing - size, location and fixing
- Valley, hip and dormer roof details
- Penetrations and weathering
- Party and gable wall cut to profile and fire stopped (where applicable)
- Flue and vent connections
- Felt condition and laps
- Insulation (if fitted at time) - continuity with external wall insulation
- Cross ventilation / warm roof detail

Services - generally all services and service paths should be fitted in accordance with the appropriate British Standard and/or governing body's guidance.

Electrical - ensure that all works have been installed in accordance with the IEE Regulations. Checks made for:

- Location of cable runs within floor and wall constructions - vertical and horizontal from sockets / switches
- Need for earthed protection
- Socket and switch heights

Gas / solid fuel - ensure that all works have been installed by a Gas Safe registered fitter. Checks made for:

- Location and protection
- Serviceability / access
- Ventilation

Plumbing - ensure all pipes are correctly clipped / fixed and protected.

Check made for:

- Location and sizing of pipes
- Protection passing through walls / floors
- Damage
- Backfalls
- Connections

Miscellaneous:

- Staircases - ensure that the staircase has a minimum suitable width, the correct headroom, pitch, riser and going, together with a correctly located and fixed handrail and balustrading
- First fix carpentry in place, plumb and square
- Fireplaces, hearths and chimneys properly constructed
- Windows - frames appropriately fixed and glazing installed correctly

Conservatories - ensure that they are constructed to the same standard as the remainder of the home and form a weather tight and stable addition to the house. In addition, ensure that cavity trays are installed as per any other abutment.
Integral garage - ensure that it is finished internally to a reasonable, basic level of decoration appropriate for its intended use. It is weathertight (not necessarily watertight, 100mm brick wall) and where abutting the house incorporates a suitable cavity tray and flashing. Ensure fire-stopping is complete.

Basements - ensure that all tanking is correctly installed and linked into the cavity tray, dpc and dpm of the above ground structure.

Structure - ensure that brickwork / rendering and roof covering is of a consistent nature in quality of finish and workmanship. All window and door frames must be reasonably sealed where abutting the external envelope to prevent weather penetration.

External walls:

- Rendering
  - Should be durable to resist the weather and impact
  - Should not bridge the dpc
- Masonry
  - Should be matched in colour and texture providing reasonable aesthetics
  - Joints should be filled / pointed and consistent
  - Mortar should be durable and consistent in colouring
  - Corbelling and or plinths should not be excessive, thus enabling water to collect
- General
  - Movement joints should be suitably located and filled
  - Weep holes should be evident at all locations of cavity projections and at dpc
  - Level within timber frame construction
  - Ensure that surfaces are reasonably plumb and level
  - Lead flashings should be correctly located and fixed
  - Dpc should not be bridged and located a min. 150mm above finished external ground level

Level thresholds - should be suitably constructed to prevent damp ingress and allow adequate entry to the dwelling via a wheelchair

Windows and doors:

- Ensure that all windows and doors are
  - Suitably decorated to a reasonable visual standard and to provide weather protection to the home
  - Designed in such a way to shed water from the external envelope
  - Provided with a suitable deterrent against a forced entry
- Ensure that brickwork and stone cills and heads shed water and are not damaged/cracked

Roofs (externally):

- Ensure that the batten sizes, spacing and fixings are compatible with the covering and each other
- All finishes (tiles, slates, lead or felt) should be free from damage, laid to falls where appropriate and finished to a basic visual standard
- All coverings should be nailed, fixed, clipped to the correct specification in accordance with the relevant British/European Standards or the manufacturers' details coverings and gauge are suitable for pitch
- All flashings and trays are correctly specified and positioned

Chimneys and parapets - ensure that:

- All cavity trays and flashings are correctly situated
- The chimney is correctly sized for stability and located the correct height above pitch line
- The cowling is correctly fitted (where applicable)
- The masonry and the flaunching are correctly pointed

Stage 11 – Post-plaster

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

Ground works and boundary walls - generally all external works should be complete, boundary walls built, drainage connected, paths and drives complete / serviceable and the plot free from any builder's debris. A check of the surrounding area and property curtilage will be made to highlight any possible endorsements from cover.

Drainage:

- For non-mains drainage system, consider access for maintenance and emptying
- Ensure land drainage is present where necessary, i.e. water logging likely within 4m of the dwelling
- Where applicable - boundary, retaining or garden walls - to be complete and structurally stable including any appropriate land drainage
- Where applicable - paths, drives and patios are to be laid to reasonable, self- draining falls and suitable to take their intended loading, i.e. the weight of a tanker if storage or septic tanks are located too far from the highway.
- No path, patio or drive should be within 150mm of the dpc to the external wall of the house or garage except for access to level threshold

Superstructure - ensure that all finishes are to a reasonable basic visual standard, the brickwork / rendering and roof covering is of a consistent nature in quality of finish and workmanship. All window and doorframes must be reasonably sealed where abutting the external envelope to prevent weather penetration.

External walls:

- Rendering
  - – should be durable to resist the weather and impact
  - – should not bridge the dpc
- Masonry
  - Should be matched in colour and texture providing reasonable aesthetics
  - Joints should be filled / pointed and consistent
  - Mortar should be durable and consistent in colouring
  - Corbelling and or plinths should not be excessive, thus enabling water to collect
- General
  - Movement joints should be suitably located and filled
  - Weep holes should be evident at all locations of cavity projections and at dpc level within timber frame construction
  - Dpc should not be bridged and located a min. 150mm above finished external ground level
  - Ensure that surfaces are reasonably plumb and level
- Lead flashings should be correctly located and fixed

Generally - check that there is no damage to pre-decorated surfaces. Ensure that all doors, windows, walls, floors and ceiling are reasonably flat, plumb, and fitted within reasonable tolerances.

Ensure that all dry lining is correctly placed, with continuous dabs to all room perimeters and all openings / fittings

Check double boarding of walls and ceilings to critical area, such as integral garages and separating walls / floors, for fire resistance
Ensure all timber work is suitably prepared, smooth and ready to receive final decoration

Ensure walls, floors and ceilings are level, plumb and within acceptable tolerances.

Check all fixings for adequacy, all nail and screw heads flush and covered

Ensure that floor boarding is correctly fixed, with edge gap tolerance and that floors do not deflect
Ensure that all wall and floor tiling is of the required specification and laid flat or to an appropriate fall. Check for cracked or missing tiles

Where fitted, ensure that all doors and windows are the correct specification for location, free to open, fitted to acceptable tolerances and, where applicable, provide a suitable free area for means of escape in case of a fire. Check glazing for damage / scratches and ensure appropriate materials have been used for bedding and surround to double glazed units. Check all glazed areas in critical locations for safety glass and compliance with BS 6206

Second fix electrics - ensure that all fittings comply with IEE Regulations and are of a suitable quality

Ensure, where fitted, that all other appliances and fuel types are fitted, located and protected to meet current legislation and manufacturers' recommendations

Ventilation:

- Check mechanical and passive ventilators are located and sized correctly
- Check background and rapid ventilation to external windows and patio doors

Disabled facilities:

- Ensure that suitable facilities and access has been provided for disabled persons using / visiting the house

Staircases:

- Ensure that the staircase has a minimum suitable width, the correct headroom, pitch, rise and going, together with a correctly located and fixed handrail and balustrading

Conservatories:

- Ensure that they were constructed to the same standard as the remainder of the home and form a weathertight and stable addition to the house. In addition, ensure cavity trays / flashings are installed as any other abutment

Superstructure - ensure that all finishes are to a reasonable basic visual standard, the brickwork / rendering and roof covering are of a consistent nature in quality of finish and workmanship. All window and door frames must be reasonably sealed where abutting the external envelope to prevent weather penetration.

Windows and Doors:

- Ensure that all windows and doors are suitably decorated to a reasonable visual standard and to provide weather protection to the home
- Are designed in such a way to shed water from the external envelope are provided with a suitable deterrent against a forced entry
- Brickwork and stone cills and heads shed water and are not damaged / cracked

Roofs:

- All finishes (tiles, slates, lead or felt) should be free from damage, laid to falls, where appropriate, and finished to a basic visual standard
- All rainwater goods should be in place, laid to appropriate falls and connected to the drainage system
- All fascia's and soffits should be decorated to a basic visual finish to protect them from the elements

Chimneys and parapets - ensure that:

- All cavity trays and flashings are correctly situated
- The chimney is correctly sized for stability and located the correct height above pitch line
- The cowling is correctly fitted (where applicable)
- The masonry and the flaunching are correctly pointed

Stage 12 - Completion & Snagging

Site: General observations of site:

- Welfare
- Tidiness
- Health & Safety

External:

- Access – level access / disabled;
- Paths / steps/ guarding;
- Guttering and downpipes;
- Windows and sealants;
- Flue outlets;
- Roof ventilation.

Internal Ground Floor:

- Thresholds / Access;
- Background ventilation;
- Extract ventilator – wet rooms and kitchens/utility;
- Widow Openings – Safety glass, MOE etc.;
- Smoke detectors - test;
- Plumbing – traps etc.;
- Boiler and flues;
- Lobbies and Fire doors;
- Air / pressure test pluming /drainage system above ground level.

Internal other floors Floor:

- Staircase – headroom, pitch, width, handrail and guarding;
- Background ventilation;
- Extract ventilator – wet rooms etc.;
- Widow Openings – Guarding, safety glass, MOE etc.;
- Smoke detectors - test;
- Plumbing – traps etc.;
- Lobbies and Fire doors;
- AOV's / Protected lobbies / areas – MOE;
- Fire doors – SC's / type / grade / seals/brushes;
- Boiler and flues.

Roof Space:

- Ventilation;
- Insulation;
- Access / tanks;
- Restraint strapping;
- Bracing;
- SVP and flue connectivity and penetrations;
- Insulated loft hatch;
- Roofing felt – damage etc.;
- Party Wall – damage & gaps / holes / penetrations;
- Room in roof – location and size + Means of Escape from windows including Velux.

Request for information / certification:

- EPC;
- Electrical Certification;
- Gas/Oil Certification;
- Warranties / Guarantees (particularly Refurbishment);
- Man safe system details and guarantees;
- Fire certificate / licensees;
- Lightening Protection details;
- Other.

Partial occupation of multi ownership buildings:

- Have requirements of part B been met or is a partial occupation strategy required;
- If so has this strategy been agreed with Q Building Control and have conditions been met.

Checks:

- Smoke detectors;
- Flue runs and outlets;
- Air / pressure test pluming /drainage system above ground level.

Finishes - generally check that there is no damage, drips, chips or faults in the appearance of any decorated surface. Ensure that all aspects of the finished home are of a reasonable basic quality standard of visual finish.

Ensure all timber work is suitably prepared, smooth and decorated to a reasonable basic standard of finish.

Ensure walls, floors and ceilings are level, plumb and within acceptable tolerances. In addition surfaces should be decorated to a reasonable basic standard of finish.

Ensure that all wall and floor tiling is of the required specification and laid flat or to an appropriate fall. Check for cracked or missing tiles

Kitchen and bathroom fittings and fixtures to be suitable for purpose.

Worktops and fittings to be level, undamaged, well aligned and, where appropriate, installed to avoid water damage to other parts of the home.

Ensure that all doors and windows are the correct specification for location, free to open, fitted to acceptable tolerances and, where applicable, provide a suitable free area for means of escape in case of a fire. Check glazing for damage / scratches and ensure appropriate materials have been used for bedding and surround to double glazed units. Check all glazed areas in critical locations for safety glass compliance with BS 6206

Services - generally check that all services, boilers, fires etc. are installed in accordance with the manufacturers' instructions, together with the legislation associated with that appliance. Please note that all operating manuals should be retained and handed over to the purchaser as part of their Homeowner's fact File (Health & Safety File). Always ensure that suitable access for maintenance is provided.

Electrical - ensure all works comply with the requirements of Part P of the Building Regulations, i.e. and that the installation meets BS 7671:2001 and the relevant safety certificate is available. All bonding (primary and secondary) should be in place.

Gas - ensure that all works have been installed and commissioned by a Gas Safe registered fitter.

Other fuels - ensure that appliances are installed as per manufacturers' instructions and suitably commissioned prior to handover.

Hot and cold water - ensure all controls are accessible, pipes are correctly clipped / fixed and, where applicable, insulated. Check flow rates from all outlets and ensure correct operating pressures

Space heating - ensure that:

- All heating systems have been fully commissioned
- All controls are present and functional
- Adequate combustion ventilation has been provided where applicable
- Fire places and hearths are correctly dimensioned / installed
- Robust notice plates providing information essential to the correct use of hearths, fireplace flues and chimneys are displayed
- Radiators are correctly sized and fully operative

Plumbing - ensure all pipes, traps and fittings are securely fixed, free drain and are of the correct size and overflows discharge as appropriate Ventilation - check mechanical and passive ventilators are located and sized correctly. Check background and rapid ventilation to external windows and patio doors

Roof space - the roof space should be accessible, with all insulation in place and, where fitted (in a cold roof) the loft hatch must be insulated and secured with a catch. Access must be provided to and around the water storage tanks within the loft space.

Miscellaneous - provide evidence of warranty backed insurance guarantees where applicable. The whole house should be clean, free from builder's materials /rubble and be complete prior to handover / conveyance:

Staircases - ensure that the staircase has a minimum suitable width, the correct headroom, pitch, riser and going, together with a correctly located and fixed handrail and balustrading

Conservatories - ensure that they were constructed to the same standard as the remainder of the home and form a weathertight and stable addition to the house.

Integral garage - ensure that it is finished internally to a reasonable basic level of decoration, appropriate for its intended use, it is weathertight (not necessarily watertight, 100mm brick wall) and, where abutting the house incorporates, a suitable cavity tray and flashing. Ensure fire stopping is complete.

Sound insulation

- Are RSD's compliance certificates available
- Pre completion testing reports available from a UKAS or ANC member

The following guarantees should be provided 'where applicable':

- Basement tanking, materials and workmanship insurance-backed 10-year warranty
- Timber treatment, materials and workmanship insured 10-year guarantee.
- An insurance certificate is to be issued to each property chemical injection damp-proofing, materials and workmanship insured 10-year guarantee.
- An insurance certificate is to be issued to each property remedial wall tie replacement, materials and workmanship insurance-backed 10-year warranty

Ground works and drainage - generally all external decorations should be complete, boundary walls built, drainage connected and tested, paths and drives complete / serviceable and the plot free from any builder's debris.

Drainage - all foul and surface water drainage should be connected, tested and fully operational. Where non-mains drainage is incorporated, it should be sited so as to allow suitable maintenance and emptying (as should filling any form of storage tank, i.e. oil). Ensure land drainage is present where necessary, i.e. water logging likely within 4m of the dwelling. Display robust notice plates indicating maintenance and operating requirements for non-mains drainage and oil fuel storage systems.

Boundary, retaining or garden walls - to be complete and structurally stable.

Paths, drives and patios - to be laid to reasonable, self-draining falls and suitable to take their intended loading, i.e. the weight of a tanker if storage or septic tanks are located too far from the highway. No path, patio or drive should be within 150mm of the dpc to the external wall of the house or garage.

Level thresholds - should be suitably constructed to prevent damp ingress and allow adequate entry to the dwelling via a wheelchair.

Planting - ensure that any planting scheme introduced has been designed to suit the foundations already constructed

Superstructure - Ensure that all finishes are to a reasonable basic visual standard, the brickwork / rendering and roof covering is of a consistent nature in quality of finish and workmanship. All windows and door frames must be reasonably sealed where abutting the external envelope to prevent weather penetration. All rainwater goods must be in place and connected to the drainage system and all timber products are suitably treated / decorated to give a reasonable finish and protection against the elements.

External Walls:

- Rendering
    - Should be durable and decorated to resist the weather and impact
    - Should not bridge the dpc
- Masonry
    - Should be matched in colour and texture providing reasonable aesthetics
    - Joints should be filled / pointed and consistent
    - Mortar should be durable and consistent in colouring
    - Corbelling and / or plinths should not be excessive, thus enabling water to collect
- General
    - Movement joints should be suitably located and filled
    - Weep holes should be evident at all locations of cavity projections and at dpc
    - Level within timber frame construction
    - Ensure that surfaces are reasonably plumb and level
    - Lead flashings should be correctly located and fixed
    - Dpc should not be bridged and located a min. 150mm above finished external ground level

Superstructure - ensure that all finishes are to a reasonable basic visual standard, the brickwork / rendering and roof covering is of a consistent nature in quality of finish and workmanship. All window and door frames must be reasonably sealed where abutting the external envelope to prevent weather penetration. All rainwater goods must be in place and connected to the drainage system and all timber products are suitably treated / decorated to give a reasonable finish and protection against the elements.

Windows and Doors:

- Ensure that all windows and doors are:
  - Suitably decorated to a reasonable visual standard and to provide weather protection to the home
  - Designed in such a way to shed water from the external envelope
  - Provided with a suitable deterrent against a forced entry
- Ensure that brickwork and stone cills and heads shed water and are not damaged / cracked

Roofs:

- All finishes (tiles, slates, lead or felt) should be free from damage, laid to falls, where appropriate, and finished to a basic visual standard
- All rainwater goods should be in place laid to appropriate falls and connected to the drainage system
- All fascia's and soffits should be decorated to a basic visual finish and to protect them from the elements
-

Chimneys and parapets - ensure that:

- All cavity trays and flashings are correctly situated
- The chimney is correctly sized for stability and located the correct height above pitch line
- The cowling is correctly fitted (where applicable)
- The masonry and the flaunching are correctly pointed

SUBSTRUCTURE

General

Ways of Achieving Compliance with the Requirements

The building should be designed and constructed in accordance with the guidance contained in the following appropriate documents:

England & Wales

- Approved Document A - Structure
- Approved Document B – Fire safety
- Approved Document C – Site preparation and resistance to moisture
- Approved Document H – Drainage
- Approved Document J – Combustion appliances and fuel storage systems
- Approved Document K – Protection from falling, collision & impact
- Approved Document 7 – Materials and workmanship

Scotland

- Section 0: General
- Section 1; Structure
- Section 3: Environment
- Section 4: Safety
- Section 6: Energy

Northern Ireland

- Part A: Interpretation and general
- Part B: Materials and workmanship
- Part D: Structure
- Part E: Fire safety
- Part F: Conservation of fuel and power
- Part N: Drainage

In addition to the following guidance, reference shall also be made to the Scope & Requirements section.

Site Investigation – General

All Q registered sites should have a full site investigation report as outlined in this section. If the site is contaminated then Site Preparation Insurance (SPI) is required.
NB. Q will not be able to offer Warranty cover on contaminated Custom Build sites.

Additional guidance is also contained in the following current design and construction standards or guides:

BS 5930 Code of Practice for Site Investigation

Building Research Establishment

- Report 211 Radon: Guidance on protective measures for new dwellings
- Report 212 Construction of new buildings on contaminated land
- Digest 318 Site Investigation for low-rise building: Desk study
- Digest 348 Site Investigation for low-rise building: The walkover survey
- Digest 363 Sulphate and acid resistance of concrete in the ground
- Digest 383 Site Investigation for low-rise building: Soil description
- Digest 414 Protective measures for housing on gas contaminated land

DETR [Department of the Environment, Transport and the Regions]

- Waste Management Paper 27: Landfill gas
- Planning Policy Guidance: Planning and Pollution Control, PPG 23
- CLR Report No 12: A quality approach for contaminated land consultancy
- TBA Report from Parkman Environment "Housing Development on Contaminated Land"

DETR Welsh Office

- Schedules of Industrial Uses and Potential Contaminants
- Planning Policy Guidance: Development of Unstable Land PPG 14

DETR Welsh Office, Scottish Office

- Special Waste Regulations The Controls on Special Waste, How they affect you

The investigation of the geology and previous use of any site is fundamental to best practice.

Site investigation is often carried out to facilitate the design of roads, drainage provisions etc. However it can also provide information to allow for a suitable and cost effective design for substructure works.

Before the substructure is designed a site investigation must be undertaken by a competent Geotechnical expert. Copies of which should be made available to the Q Surveyor prior to commencement of work.

The purpose of the investigation is to identify the character and variability of the underlying strata of the site and the adjoining land (which may also affect the performance of the substructure). See diagram 1.01. This will enable the design of all the elements of the substructure to be best suited to the conditions particular to a site.

- Reducing extra construction costs through an economic foundation design
- Reducing the risk of unacceptable whole or differential settlement
- Reducing the risk of contractual disputes because of unforeseen design changes
- Ensuring the safety of site personnel
- Designing "in" a construction that will suitably eliminate potential health hazards from contaminated land and determine how much unsuitable material should be removed.

Site Investigation Procedures

The level of investigation required is generally obtained after carrying out:

- Preliminary desk top study
- Site walk over study

This will then determine the following:

- The design of a suitable ground investigation programme - e.g. by trial pits and/or boreholes
- Soil and rock classification including identification of fill materials or made ground
- Identification of groundwater levels
- Laboratory testing to determine physical and chemical characteristics
- Report and recommendations

Ground Investigation may include:

- Cable percussion boring
- Rotary drilling
- Trial pits – a minimum of two per plot is advised
- In situ testing
- Dynamic probing
- Rock discontinuity surveying
- Plate bearing testing
- Percolation testing-for soakaway drainage design
- Assessment of slope stability

Reports should show that the following has been considered:

- The risks of general subsidence or land-slip (e.g. caused by geological faults, excessive slopes, current and past mineral workings etc.),
- The effect of the proposed construction operations on the overall ground stability,
- The risks caused by excessive vibration from adjacent sources,
- The effect of ground water conditions, including level and flow,
- The effect of flooding of the site, both before and upon completion of the construction,
- The presence of existing substructures, sewers, drains and service runs and the effect they will have on the foundation design,
- The extent to which ground water and subsoil contains or is contaminated with:
  - chemicals aggressive to concrete and other materials used below ground (e.g. sulphates, acids or strong alkaline substances).
  - materials which by expansion may disrupt the substructure
  - materials which might affect the health or safety of occupants in or near buildings on the site
  - the level of radon risk and the precautions required.

Contamination Assessment

This is needed to ensure legislation regarding health hazards is complied with. Potential chemical attack to substructure work can be determined. An assessment of possible groundwater contamination can be made.

This will include an assessment/testing of the following:

- Soils
- Groundwaters
- Radiological
- Biological

Environmental Risk Assessment of Land

Introduction

In order to build, appropriate local authority approvals are always required. When development is planned on previously used sites or land adjacent to a site containing a risk to the built environment, additional precautions are needed. This section provides guidance on the research and precautions needed in order to obtain Q protection against liabilities imposed by statute on the developer or land owner. This applies to development on land ranging from green fields to sites with known contaminants present. This now also applies to buildings that are being converted for residential use. Diagram 1.02 outlines the process involved in site investigation and risk assessment for any contaminated site, it will also assist in achieving insurance cover for the land and development.

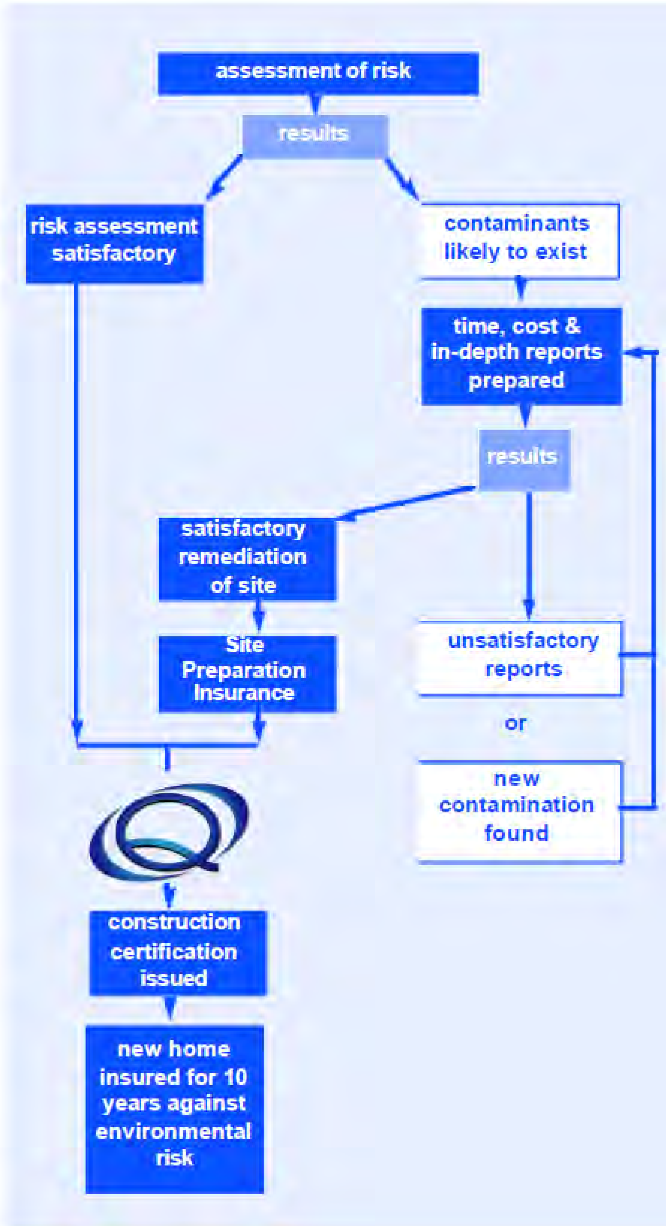


Diagram 1.02

Contaminated Sites

It is a condition of Q providing cover on contaminated sites that Site Preparation Insurance (SPI) cover is taken out by the developer and is approved by Q.

Where SPI cover is being sought then the following information will be required:

- A4 site plan with site outlined in red
- Copies of the site remediation reports
- Environment Agencies Approval

Historic buildings

The aim is to improve the resistance to contaminants and moisture as much as possible but it has been recognized that this is not always practical. In arriving at an appropriate balance between historic building conservation and improving resistance to contaminants and moisture the advice of the Local Planning authority's conservation officer should be sought at an early stage in the design process.

Further information can be found within the following documents:

- BS 7913 Guide to the principles of the conservation of historic buildings
- SPAB Information Sheet 4 The need for old buildings to breathe.
- BRE Report BR 267 Major alterations and conversions
- BRE GBG 25 Buildings and radon

An assessment is required in all cases. The level and depth of the assessment will be determined by the historic knowledge of the site. A suitably qualified consultant should carry out the assessment.

Appointment of consultants

Specialists and consultants must have:

- experience of similar projects
- detailed understanding of current legislation
- detailed understanding of and access to the relevant skills and expertise necessary for the project
- the ability to prepare comprehensive reports identifying hazards, risk assessment and conclusions drawn
- adequate professional indemnity insurance for the works undertaken

Definition of contamination

The "Registers of Land Subject to Contaminated Uses" identify the following eight uses:

- Manufacture of gas, coke or bituminous material from coal
- Manufacture or refining of lead, steel or an alloy of lead or steel
- Manufacture of asbestos or asbestos products
- Manufacture, refining or recovery of petroleum or its derivatives, other than extraction from petroleum bearing ground
- Manufacture, refining or recovery of other chemicals, excluding minerals
- Final deposit in or on land of household, commercial or industrial waste other than waste consisting of ash, slag, clinker, rock, wood, gypsum, railway ballast, peat, bricks, tiles, concrete, glass, other minerals or dredging spoil; or where the waste is used as fertiliser or in order to condition the land in some beneficial manner
- Treatment at a fixed installation of household, commercial or industrial waste by chemical or thermal means
- Use as a scrap metal store, within the meaning of section 9(2) of the Scrap Metal Dealers Act

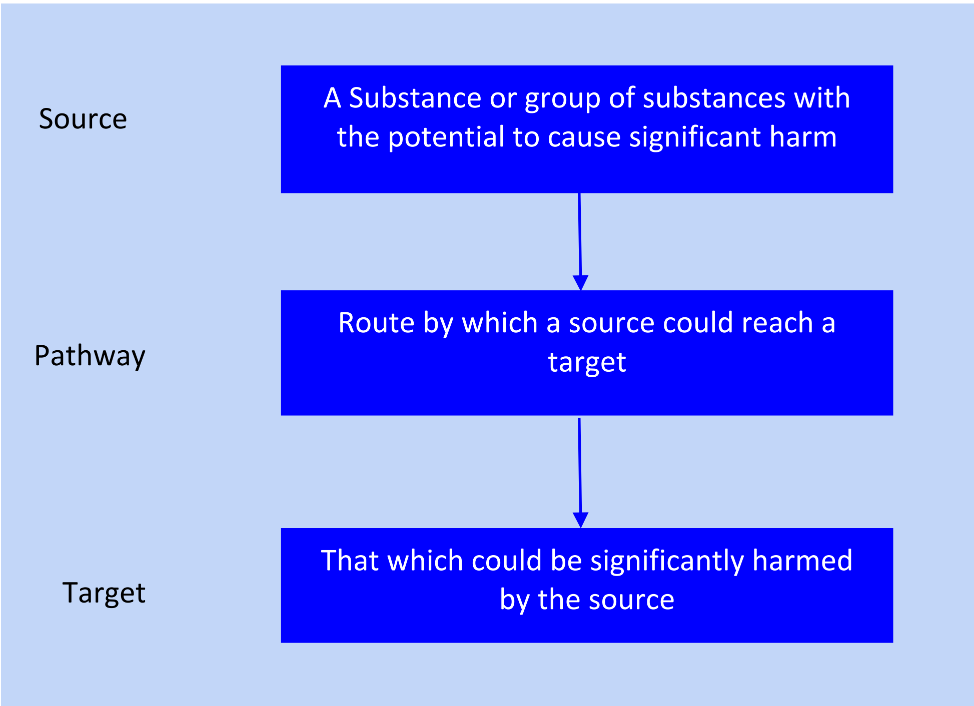
The risk of other potential contaminants which might affect the insurability of the site should be researched to identify whether they occur on, or adjacent to the land. A classification of potentially contaminating industries was published by the then DoE in 1991. The classification is a useful guide and is reproduced in table 1.01.

Desk top assessment

- timing – normally during purchase negotiations, valuation or development planning. The initial phase of the assessment should be completed as part of the feasibility study and prior to any decision to insure the environmental risk.
- scope – the site and surrounding area up to at least 250m or 500m where there is a known risk of contamination and free draining soils.
- key elements – investigation of the soils and underlying geology including ground and surface water drainage.
- land usage – current and previous land usage of the site and surrounding areas. See "definition of contamination".
- existing site information – from the vendor of the land, current or past monitoring and previous knowledge.
- current legislation and the role of regulatory bodies.

Assessment of geotechnical & contamination

Contaminated land should be assessed using the following framework:



DoE Classification of Contaminating Industries – Table 1.01

DoE classification of contaminating industries category	profile	risk
Agriculture: Burial of diseased livestock		Not applicable
Extractive industry: Extracting, handling and storage of carbonaceous materials such as coal, lignite, petroleum, natural gas, or bituminous shale (not including the underground workings).	Coal mines and coal preparation plants: petrochemicals; Oil refineries and bulk storage of crude oil and petroleum products.	High
Extracting, handling and storage of ores and their constituents.	Mineral workings; mineral processing works. Note: Handling includes loading, transport, sorting, forming and packaging, and similar operations. Ore means any mineral, including non-metal bearing, except fuels.	High
Energy industry: Producing gas from coal, lignite, oil and other carbonaceous material (other than from sewage or other waste), or from mixtures of those materials.	Gas works, coke works and other coal carbonisation plants; Oil refineries and bulk storage of crude oil and petroleum products.	High
Reforming, refining, purifying and odourising natural gas or any product of the processes outlined above.	Gas works, coke works and other coal carbonisation plants; Oil refineries and bulk storage of crude oil and petroleum products.	High
Pyrolysis, carbonisation, distillation, liquifaction, partial oxidation, other heat treatment, conversion, purification, or refining of coal, lignite, oil, other carbonaceous material or mixtures and products thereof, other than with a view to gasification or making of charcoal.	Gas works, coke works and other coal carbonisation plants; Coal mines and preparation plants; Oil refineries and bulk storage of crude oil and petroleum products.	High
A thermal power station (including nuclear power stations and production, enrichment and reprocessing of nuclear fuels).	Power stations (excluding nuclear power stations); Radioactive materials; Asbestos manufacturing works.	High
Electricity and sub-station.	Engineering works: Electrical and electronic equipment manufacturing equipment containing PCBs); Power stations.	High
Production of Metals: Production, refining and recovery of metals by physical, chemical, thermal or electrolytic or other extracting process.	Metal manufacturing, refining and finishing works; Electroplating and other metal finishing works; Iron and steelworks; Non-ferrous metal works (excluding lead-works); Precious metal recovery works; Lead-works; Heavy engineering.	High
Heating, melting or casting metals as part of an intermediate or final manufacturing process (including annealing, tempering or similar processes).	Metal processing; Heavy engineering; Miscellaneous (High Street) trades.	High
Old forming processes (including pressing, rolling, extruding, stamping, forming or similar processes).	Metal processing; Heavy engineering; Shipbuilding, repair and shipbreaking (including naval shipyards).	High to Moderate
Finishing treatments, including anodising, pickling, coating, and plating or similar processes.	Metal processing; Heavy engineering; Miscellaneous (High Street) trades; Metal manufacturing, refining and finishing works; Electroplating and other metal finishing works. Note: Metals are taken to include metal scrap.	High

DoE classification of contaminating industries category	profile	risk
Production of Non-metals and their Product: Production or refining of non-metals by treatment of the ore.	Mineral processing works.	High
Production or processing of mineral fibres by treatment of the ore.	Mineral processing works; Asbestos manufacturing works.	High
Cement, lime and gypsum manufacture, brickworks and associated processes.	Mineral processing works.	Moderate
Glass Making and Ceramics: Manufacture of glass and products based on glass.	Glass manufacturing.	High to Moderate
Manufacture of ceramics and products based on ceramics, including glazes and vitreous enamel.	Ceramics, cement and asphalt manufacturing works.	High to Moderate
Production and Use of Chemicals: Production, refining, recovery or storage of petroleum or petrochemicals, or their by-products, including tar and bitumen processes and manufacture of asphalt.	Oil refineries and bulk storage of crude oil and petroleum products; Mineral processing works; Waste recycling, treatment and disposal sites; Drum and tank cleaning and recycling plants.	High to Moderate
Production, refining and bulk storage of organic or inorganic chemicals, including fertilisers, pesticides, pharmaceuticals, soaps, detergents, cosmetics, toiletries, dyestuffs, inks, paints, fireworks, pyrotechnic materials or recovered chemicals.	Chemical Works – Coatings (paints & printing inks) manufacturing works; Cosmetics and toiletries manufacturing works; Disinfectants manufacturing works; Fertiliser manufacturing works; Explosives, propellants and pyrotechnics (fireworks) manufacturing; Sealants, adhesives and roofing felt manufacturing works; Fine chemicals manufacturing works; Inorganic chemicals manufacturing works; Pesticides manufacturing works; Organic chemicals manufacturing works; Soap and detergent manufacturing works; Textile works and dye works; Pharmaceuticals; Miscellaneous (High Street) trades.	High to moderate
Production, refining and bulk storage of industrial gases not otherwise covered.	Chemical works; Fine chemicals manufacturing works.	High
Engineering and Manufacturing Processes: Manufacture of metal goods, including mechanical engineering industrial plant or steel works, motor vehicles, ships, railway or tramway vehicles, aircraft, aerospace equipment or similar equipment.	Engineering works: Mechanical engineering and ordnance works; Vehicle manufacturing: Aircraft manufacturing works; Shipbuilding, repair and shipbreaking (including naval shipyards); Railway engineering works; Heavy engineering works.	Moderate
Storage, manufacture or testing of explosives, propellants, ordnance, small arms or ammunition.	Chemical works; Explosives, propellants and pyrotechnics manufacturing works.	High to Moderate
Manufacture and repair of electrical and electronic components and equipment.	Miscellaneous (High Street) trades; Electrical and electronic equipment manufacturing works (including works manufacturing equipment containing PCBS).	High to Low
Food Processing Industry: Manufacture of pet foods or animal foodstuffs.	Food preparation and processing.	Moderate
Processing of animal by-products (including rendering or maggot farming, but excluding slaughterhouses, butchering).	Animal and animal products processing works; Miscellaneous (High Street) trades.	Low

DoE classification of contaminating industries category	profile	risk
Paper, Pulp and Printing Industry: Making of paper pulp, paper or board, or paper or board products, including printing or de-inking.	Pulp and paper manufacturing works; Printing works; Miscellaneous (High Street) trades.	High to Low
Timber and Timber Products Industry: Chemical treatment and coating of timber and timber products.	Timber treatment works; Miscellaneous (High Street) trades: Timber products manufacturing.	High
Textile Industry: Tanning, dressing, fellmongering or other processes for preparing, treating or working leather.	Animal processing works; Miscellaneous (High Street) trades.	High to Moderate
Fulling, bleaching, dyeing or finishing fabrics or fibres.	Textile works and dye works: Miscellaneous (High Street) trades.	Moderate
Manufacture of carpets or other textile floor coverings (including linoleum works).	Chemical works; Linoleum, vinyl and bitumen-based floor covering manufacturing work; Textile works and dye works.	Moderate
Rubber Industry: Processing of natural or synthetic rubber (including tyre manufacture or retreading).	Chemical works: Fine chemicals manufacturing works; Rubber processing works (including works manufacturing tyres or other rubber products).	High to Moderate
Infrastructure: Marshalling, dismantling, repairing or maintenance of railway rolling stock.	Heavy engineering; Dockyards and dockland; Railway land; Engineering works; Railway engineering works.	Moderate
Dismantling, repairing or maintenance of marine vessels, including hovercraft.	Shipbuilding, repair and shipbreaking (including naval shipyards), Dockyards and dockland.	Moderate
Dismantling, repairing or maintenance of road transport and road haulage; Garages and filling stations.	Road vehicle fuelling, service and repair: garages and filling stations; Transport and haulage centres.	Moderate
Dismantling, repairing or maintenance of air or space transport systems.	Engineering works; Aircraft manufacturing works.	Moderate
Waste Disposal: Treating of sewage or other effluent.	Sewage works and sewage farms.	High
Storage, treatment or disposal of sludge including sludge from water treatment works.		High
Treating, keeping, depositing or disposing of waste, including scrap (to include infilled canal basins, docks or river courses).	Landfills and other waste treatment and disposal sites: Scrap yards; Waste recycling, treatment and disposal sites: Drum and tank cleaning and recycling plants; Hazardous waste treatment plants; Landfills and other waste treatment or waste disposal sites; Metal recycling sites; Solvent recovery works.	High
Storage or disposal of radioactive materials.	Radioactive materials.	High
Miscellaneous: Premises housing dry-cleaning operations.	Miscellaneous (High Street) trades; Profile of miscellaneous industries.	High to Moderate
Laboratories for educational or research purposes	Research laboratories; Miscellaneous (High Street) trades.	Moderate to Low
Demolition of buildings, plant or equipment used for any of the activities in this schedule.	Demolition.works.	Moderate

Research Sources

All of the following sources can be researched and a comprehensive report obtained from the SiteCheck service available from:

Landmark Information Group Limited
7 Abbey Court, Eagle Way, Sowton, Exeter EX2 7HY
Tel: 01392 441700 Fax: 01392 441709 www.landmarkinfo.co.uk

- Thompsons Trade Directories – potentially contaminative industrial uses
- Local Authorities – Air Pollution Control, local nature reserves, Planning Applications, Planning Hazardous Substance Consents and Enforcements
- Ordnance Survey
- British Geological Survey – Land Fill Survey, Mines Quarries and Minerals, Solid Geology.
- Environment Agency England and Wales – Discharge Consents, Red List Discharge Consents, Water Abstractions, Substantiated Pollution Incidents Relating to Controlled Waters, Prosecutions Related to Controlled Waters, Groundwater Vulnerability Mapping, Integrated Pollution Control (IPC), IPC Enforcements and Prosecutions, Landfill Sites, Waste Transfer, Treatment or Disposal Sites, River Quality Data, Registered Radioactive Substances.
- Scottish Environment Protection Agency – Discharge Consents, Groundwater Vulnerability Mapping, Integrated Pollution Control (IPC), IPC Enforcements and Prosecutions, Air Pollution Control, Landfill Sites, Waste Transfer, Treatment or Disposal Sites, Prosecutions Relating to Controlled Waters, Registered Radioactive Substances, River Quality Data, Substantiated Pollution Incidents Relating to Controlled Waters.
- English Nature, Countryside Council for Wales, Scottish Natural Heritage – Sites of Special Scientific Interest (SSSI), Marine Nature Reserve (MNR), National Nature Reserve (NNR)
- Department of the Environment Transport and the Regions – Area of Outstanding Natural Beauty, Planning Hazardous Substance Consents and Enforcements.
- Department of Agriculture Fisheries and Food – Environmentally Sensitive Areas (Scotland).
- Scottish Office – Public Water Abstractions
- Welsh Office – Planning Hazardous Substance Consents and Enforcements.
- Farming and Rural Conservation Council – Nitrate Vulnerability Areas, Nitrate Sensitive Areas, Environmentally Sensitive Areas (England and Wales)
- Forest Enterprise – Forest Parks
- National Radiological Protection Board – Radon Affected Areas
- Institute of Hydrology – River Network, Flood Plain

Site assessment

An appropriately qualified person must carry out a walkover inspection of the site and adjacent areas. The purpose is to assess and correlate the information from the desk top assessment with the physical evidence on site. A walkover inspection will assess:

- The surface ground conditions
- Site and adjacent area topography
- Any residues in stores, tanks or pipes
- Any evidence of contamination
- Any surface or sub-surface impediments to development
- The extent and location of any trial excavations, boreholes, samples or other physical investigation required.

Introduction

Evidence from the desk top assessment and the walkover inspection will determine if further ground investigation is necessary. The preliminary information gathered will be used to establish the ground investigation requirements and to identify:

- Any necessary safety precautions.
- Location and extent of boreholes, trial pits etc.
- Samples or other physical investigation required.

Health and safety
All work must comply with the Health and Safety at Work Act. Before any work starts a COSHH (Control of Substances Hazardous to Health) assessment must be made and a safety plan prepared to cover all the works including those of any sub-contractors. The Construction (Design and Management) Regulations 2015, (CDM Regs) impose a responsibility to ensure safety regulations are met.

Preparation for ground investigation
Where it is necessary, buildings, structures or rubble may have to be removed. Care must be taken not to spread contamination during site clearance works. Where contaminants are suspected, tests to identify them will be necessary. If rubble, wastes, residues etc. are likely to interfere with the investigation they should either be removed or safely contained. This work will normally be carried out by specialists.

Remote sensing
Techniques such as ground penetrating radar, infra red photography or thermography can be used to detect unusual ground conditions caused by geotechnical or chemical conditions. The benefits of remote sensing should be considered.

Trial pits and trenches
BS 5930 gives guidance. Trial pits and trenches are most useful for shallow depth investigation up to 3m to 4m. They allow good visual inspection, particularly in areas of fill or where the strata has been disturbed. Samples may be taken from any location in the trial pit or trench but the location must be accurately recorded and annotated as a disturbed sample.

Boreholes
BS 5930 gives guidance on drilling techniques in various ground conditions e.g:

- Rotary drilling – boulder clay and rock
- Shell and auger – soils and weak rock
- Continuous flight auger – soils

Boreholes are normally used when the ground to be investigated is below 4m to 5m. Useful for:

- Confirming deep geological conditions
- Taking disturbed and undisturbed samples
- Establishing the location of groundwater
- Groundwater sampling and monitoring
- Determining the hydrology and water permeabilities
- Gas monitoring.

Spike tests
Spike tests are for detecting ground gases and should be used where the desk top assessment suggests:

- There is fill material on the site
- There is a landfill site within 250m
- There are pathways for gas migration.

If spike test surveys reveal methane levels > 1.0% v/v or carbon dioxide levels > 1.5% v/v further investigation will be needed. Spiking surveys are straight forward but if gas is not detected it cannot be assumed that none is present.

As with all tests, results should be analysed by a suitably qualified experienced person.

Probe tests
Used to determine the density of the soil, also for sampling and monitoring environmental hazards e.g. chemicals, gases, liquids etc.

Sampling
BS 5930 and BS 10175 give guidance on the spacing of samples (see table 1.02 below). The strategy must be to ensure that areas of contamination are not missed. The purpose is to determine the range of chemicals in the ground and groundwater and the geotechnical properties. The pattern of sampling must be dependent on the findings of the preliminary investigations and will be most frequent in areas of known or suspected contamination. An accurate plot of all sampling points is essential.

AREA IN HECTARES	MINIMUM SAMPLING POINTS
0.5	15
1.0	25
5.0	85
Spacing between points: 10m to 30m (BS 5930)	

Table 1.02: Sampling for Contamination Assessment (BS10175)

Sample handling, analysis and testing
Packaging and handling of samples for analysis must be undertaken using appropriate methods. Analysis must be carried out by properly qualified and accredited laboratories that can demonstrate their experience in testing environmental samples, e.g. the National Measurement Accreditation Service (NAMAS) scheme or UKAS.

- In-situ testing – e.g. simple physical, geological and soil bearing capacity test.
- Laboratory testing – chemical testing of rocks, soils, gases and groundwater. Physical testing of strength, relative density, consolidation properties, permeability, etc.
- Analysis – Testing should include tests for, water soluble boron, total sulphates, phenols and cyanide, sulphide, solvent extractable material, pH levels and total metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.

Risk assessment

Following the site investigation, an assessment which includes the identification of health and environmental risks will be required. If a risk has been identified the assessment must be followed by evaluation and management through a remediation scheme.

Risk management

Land risk management includes the identification and control of:

- Sources of potential hazards
- Receptor at risk or target e.g. adjacent river, agricultural land, house foundations and structure, people living or working on the land, workers during remediation, construction and future maintenance.
- Critical pathway – the route by which the hazard can gain contact with the receptor.

Hazard identification

A hazard can be identified at any stage of the site assessment and can be defined as a situation with the potential to cause harm to the receptor and can be geotechnical, biological, chemical and physical. Hazards, critical pathways and receptors can be identified from the desk top assessment and will be confirmed and quantified (or not) by the ground investigation.

Hazard assessment

Factors involved in the assessment are:

- The nature and intensity of the hazard
- The critical pathway between the source and the receptor.
- The nature of the pathway, as a barrier or partial barrier or the potential to increase the intensity of the hazard.

Construction Details
Radon is generally drawn into buildings because of small "gaps" within the construction in the same way that air is drawn into buildings. This is mainly through floors.

Low Level Precautions

- **Ground-bearing Slabs**
  Generally a 1200 gauge (300 micrometre) certified membrane is laid under the 100mm concrete slab and carried over the external cavity wall to form a cavity tray. To eliminate the risk of a structural slip plane it is recommended that the membrane is taken below the horizontal dpc in the external leaf.
  Weepholes should be provided to drain the tray.

- **Insitu Suspended Slabs**
  Generally a 1200gauge (300 micrometre) certified membrane is laid above the structural slab (this reduces the risk of damage to the membrane should the structural slab move) and carried over the external cavity wall to form a cavity tray. To eliminate the risk of a structural slip plane it is recommended that the membrane is taken below the horizontal dpc in the external leaf. Weepholes should be provided to drain the tray.

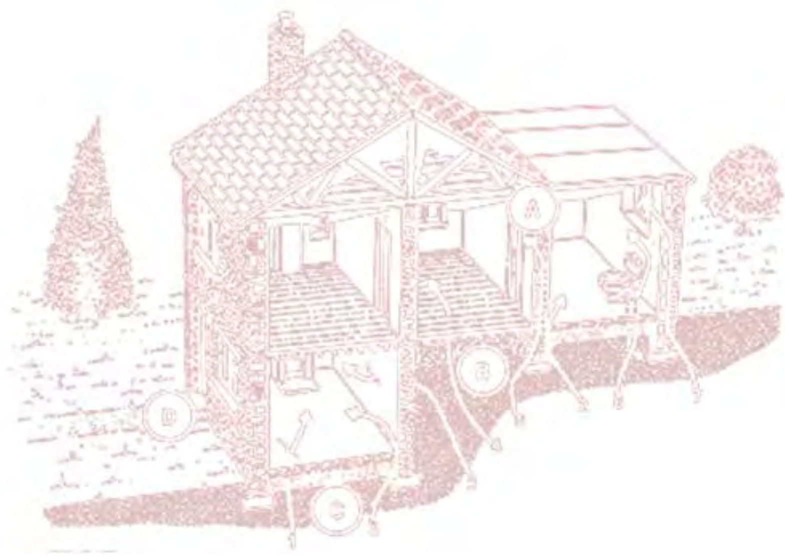


Diagram 1.03: Gas entry into buildings

Key to Ingress Routes

1. Through cracks in solid floors
2. Through construction joints
3. Through cracks in walls below ground level
4. Through gaps in suspended floors
5. Through cracks in walls
6. Through gaps around service pipes
7. Through cavities in walls

Possible locations for gas accumulation:

A Wall cavities and roof voids
B Beneath suspended floors
C Within voids caused by settlement or subsidence
D Drains & soakaways

Remedial Action

Remedial Works
If it is suspected or known that there are contaminated gases below the proposed building or that the ground covered by the building is within 250m of a landfill site, further studies will be required to determine if any further remedial actions are necessary.

The following should be considered for buildings near landfill sites:
- Methane levels below 1% – suspended concrete floor (ventilated) will be adequate.
- Carbon dioxide levels of 1% – possible measures to prevent ingress to building. Carbon dioxide levels of 5% (or more) – specific design measures to be taken.
- Passive protection is the most viable method of ensuring that contamination levels remain at an
- acceptable level.

In other cases, the advice of an Expert should be obtained. The research plus the Expert's recommendations should be used to assess the current and future risks posed by the gases. The design of measures to protect the building and its occupants should be included within the design of the building. Arrangements should also be made for monitoring and maintenance.

Remedial Measures
If only moderate contamination has taken place, handling of the fill materials should comply with both the "Health and Safety at Work Act" and the "Control of Pollution Act". The main contractor will also be required to produce a construction stage health and safety plan, detailing their management structure, method of working and information provided to the workforce as per the Construction Design and Management (CDM) Regulations 2015.

All contaminated materials should be removed to a licensed tip.

Any service trenches, in only moderately contaminated ground, should be excavated and filled with clean stone so that site operatives do not become endangered during future maintenance.

Fill
Site fill and consolidation of subsoil under paths, drives and outbuildings etc. shall be carried out using non-organic materials and achieve an appropriate level of compaction, due account being taken of the final use of the filled area.

Solid Contaminants
There are several possible courses of action, these include:
- Sealing: this is achieved via the use of an imperforate material laid between the building and the contaminant. This must be sealed at joints, service entries and the edges etc.
- Removal: all of the contaminated ground should be removed to a depth of 1.0 m below the level of contamination – unless the Local Authority agrees to less. This should be removed from site to a licensed tip.
- Filling: the ground covered by the building should be covered to a depth of 1.0m with materials which will not react with any remaining contaminant.

Hazardous Conditions
Only the total removal of the contaminants will provide a complete remedy. Such procedures should only take place with the benefit of Expert advice.

Further guidance may be obtained from the BS Draft for Development BS 10175: Code of Practice for the Identification of Potentially Contaminated Land and its investigation and BS 5930: Code of Practice for site investigations.

Japanese Knotweed

General
Japanese Knotweed is a vigorously growing and hardy plant, which will cause damage to buildings if left untreated. It was introduced in this country in the early part of the last century to stabilise railway embankments and as ornamental shrubs. It is more evident in some parts of the country.

Japanese Knotweed can spread rapidly from a clump to adjacent uninfested land by lateral growth of rhizomes. Knotweed spread to non-adjacent uninfested areas by a number of means. These are principally through the transport of soil containing knotweed rhizomes during earthworks, by flytipping, the dumping of cut knotweed on rubbish tips and by rhizomes being washed downstream after being eroded from riverbanks.

Control Strategy
Control of existing Knotweed will only be achieved by a planned programme which includes:

- A survey of the area of Knotweed to be controlled
- Liaison with interested and affected parties.
- Informing land owners and users, including those adjacent to the control area, that the area is to be subject to Knotweed control.
- Implementation of control.
- Monitoring of the effectiveness of control and any modification of the control strategy which is appropriate.
- Logging of all control measures and their effectiveness to give a databank for future control efforts.

Control Guidelines
Approved personnel, in compliance with The Control of Pesticides Regulations 1986, shall carry out control. A control strategy shall consider the whole of the area infested and should not be restricted by field boundaries. Knotweed can re-infest an adjacent area in spite of the presence of a partitioning boundary such as a hedge or wall.

A method statement should be provided on the chosen form of control. The control method selected may be chemical, mechanical, removal or a combination of some or all.

Great care shall be taken adjacent or near to watercourses. In these areas the Environment Agency should be consulted prior to the use of herbicidal treatments to avoid contamination of the watercourse.

www.environment-agency.gov.uk

In areas of drives, paving or other hard surfaces, removal may be the only course of action.

Complete Removal
Strands of Knotweed may be excavated and removed with the surrounding soil to be burned or deep buried in a landfill at least 10m deep. This is a very expensive and time consuming solution for large stands. It is only effective with complete removal of all the underground parts of the Knotweed plant. Under no circumstances should shallow burial of Knotweed infested soil be carried out. It is advised that if this method of control is used that the site is revisited at least once a year to remove any re-growth of the plant.

More detailed guidance on Japanese Knotweed can be found at:
www.ex.ac.uk/knotweed
www.environment-agency.gov.uk

Foundations

General

Foundation stability
Every dwelling should be designed and constructed in accordance with the guidance contained in the following appropriate documents:

- Approved Document A – Structure (England & Wales)
- Technical Standards Part C – Structure (Scotland)

Additional guidance is also provided in the following current design and construction standards:

- BS 5950:3.1 Structural use of steelwork in building
- BS 6399 Loadings for buildings
- BS 8004 Code of practice for foundations
- BS 8103 Structural design of low rise buildings
- BS 8110 Structural use of concrete
- CP 3, Chapter V, Part 2
- The Small Buildings Guide, (Scotland)

The Building Control Authority and Q should be consulted at the design stage in order to agree variable design data such as the safe loadbearing capacity of the ground on problem sites.

The Building Control Authority and Q should be informed if deviations from the approved plans are made during the course of the works, or if unforeseen variations in the ground conditions are encountered.

Construction works associated with this Section should be approved before being covered up. Sufficient notice, in accordance with current Q procedures, shall be given in order to allow for satisfactory inspections to take place.

Foundation work
Foundations and ground consolidation works should be designed and supervised by an Expert when not in accordance with either:

- Approved Document A (England & Wales)
- Technical Standards C (Scotland)
- Small Buildings Guide (Scotland)

Generally, foundation work should comply with: BS 8000:1, 2 & 5, and BS 8004.

Further guidance is available in Building Research Establishment Publication AP34, Foundations for low rise buildings, which provides guidance on:

- Site investigation
- Foundations and soils
- Trees
- Fill and hardcore
- Shrinkable clay soils
- Mini-piles

For minimum width of foundation and dimension see Table 1.03 & 1.04 Both reproduced from Building Regulations Approved Document Part A.

Concrete for foundations should be selected in accordance with BS 8110, BS 5328 or Table 1.05.

Hand mixing of concrete on site for structural elements is not acceptable to Q unless it is a quality controlled mix, produced under BS EN ISO 9001 conditions.

Specialist Foundations
These include vibratory ground improvement, piles and rafts (and associated ground beams).

These foundations should be designed by a suitable Expert (Structural Engineer) and installed by a specialist contractor. The work on site shall be supervised by an Expert that is independent of the persons carrying out the specialist foundations unless specifically agreed with Q. The Expert should be satisfied that the design is suitable for the site conditions and the work on site is as designed.

It should be noted that copies of specialist installers piling logs and associated test reports may be requested by Q.

Dimensional accuracy
The dimensional accuracy of the completed foundations should be appropriate to the type of superstructure construction. In particular, the accuracy should be within the tolerances specified by the designer of the superstructure.

Minimum width of strip foundations

			Total loads of load-bearing wall not more than (kN/linear metre)					
			20	30	40	50	60	70
Type of subsoil	**Condition of subsoil**	**Field test application**	**Minimum width of strip foundation (mm)**					
I rock	not inferior to sandstone, limestone or firm chalk	requires at least a pneumatic or other mechanically operated pick for excavation	in each case equal to the width of wall					
II gravel sand	compact compact	requires pick for excavation. Wooden peg 50mm squares in cross section hard to drive beyond 150mm	250	300	400	500	600	650
IV clay sandy clay	firm firm	can be moulded by substantial pressure with the fingers and be excavated with graft or spade	300	350	450	600	750	850
V sand silty sand clayey sand	loose loose loose	can be excavated with a spade. Wooden peg 50mm square in cross section can be easily driven	400	600	Note In relation to types V, VI and VII foundation do not fall within the provisions of this section if the total load exceeds 30kN/m.			
VI silt clay sandy clay silty clay	soft soft soft soft	fairly easily moulded in the fingers and readily excavated	450	650				
VII silt clay sandy clay silty clay	very soft very soft very soft very soft	natural sample in winter conditions exudes between fingers when sqeezed in fist	600	850				

Table 1.03 – Minimum Width of Foundations

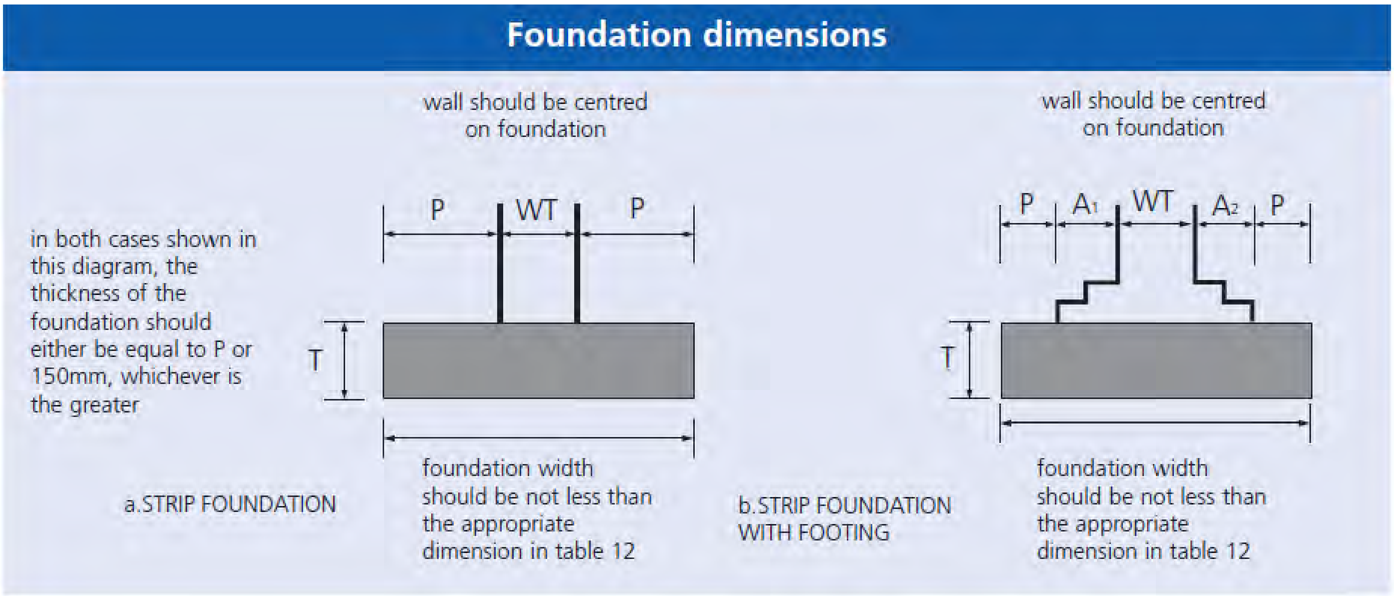


Table 1.04 – Foundation Dimensions

Concrete

Specifying concrete mixes for various uses:

Application	Standard Mix	Designated Mix	Compressive strength @ 28 days N/mm^2 (MPa)	Suggested workability slump (mm)	Suggested method of compaction
Foundations					
Blinding and mass concrete fill	ST2	GEN I	10.0	75	Poker or
Strip footings[1]	ST2	GEN I	10.0	75	beam vibration
Mass concrete foundations[1]	ST2	GEN I	10.0	75	and/or tamping
Trench fill foundations[1]	ST2	GEN I	10.0	125	Self compacting
Reinforced foundations[1]	N/A	RC 35	35.0	75	Poker
Foundations in Class 2 sulphate conditions[2]	N/A	FND 2	35.0	75	Poker
Foundations in Class 3 sulphate conditions[2]	N/A	FND 3	35.0	75	Poker
Foundations in Class 4A sulphate conditions[2]	N/A	FND 4A	35.0	75	Poker
Foundations in Class 4B sulphate conditions[2]	N/A	FND 4B	35.0	75	Poker
Other reinforced and pre-stressed concrete applications					
Reinforced or pre-stressed concrete: mild exposure	N/A	RC 30	30.0	75	Poker
Reinforced or pre-stressed concrete: moderate exposure	N/A	RC 35	35.0	75	Poker

1 In non – aggressive soils i.e. Class I sulphate conditions as given in table 7a BS 5328: 1
2 see table 7a BS 5328: 1 for all sulphate conditions

Table 1.05 – Selection Guide to the Use & Specification of Standard & Designated Concrete Mixes

Definitions

STANDARD MIX (ST)	DESIGNATED MIX (GEN, FND, RC, PAV)
A standard mix is a concrete designed using the materials and mix proportions given in BS 5328: 1 Section 4 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.	Designated mixes are designed and specified in accordance with BS 5328: 1 Section 5. It is a quality controlled mix, produced under BS EN ISO 9001 conditions. The purchaser orders the mix by specifying its required strength and its intended use i.e: RC to be used for reinforced concrete and GEN for general usage.

Strip and Mass Fill Foundations

There are a number of different types of foundations, the most common of which are shown in diagrams 1.04 – 1.10.

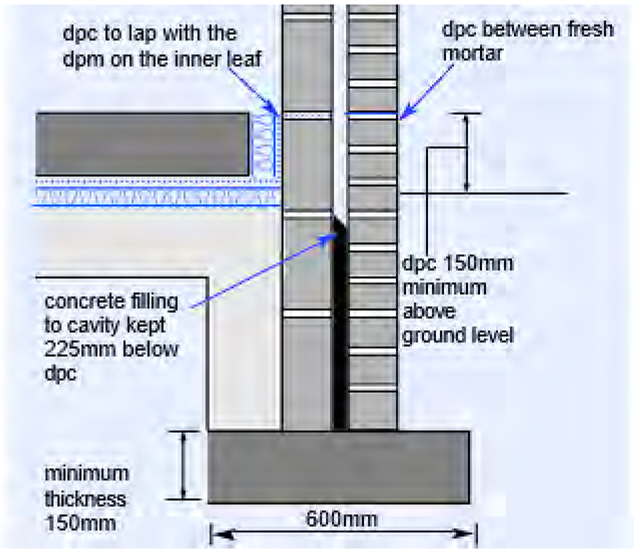


Diagram 1.04 – Strip Foundations

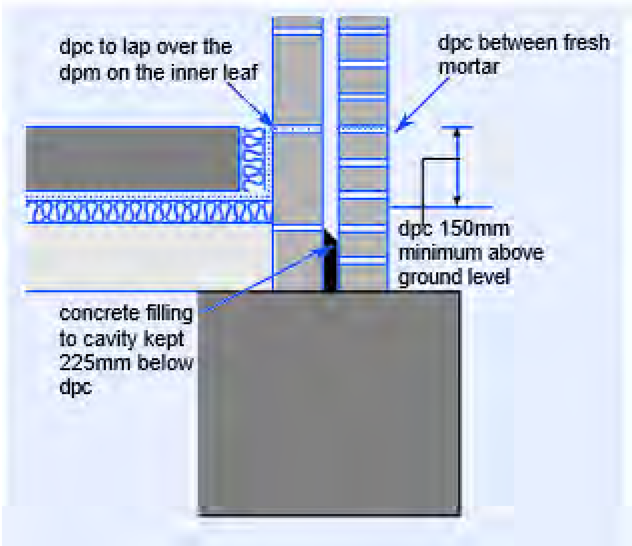


Diagram 1.05 – Mass Fill Foundation

Subsoil conditions

The subsoil should not:

- Impair the stability of the structure by being a weaker type of soil at foundation level.
- Be “made up” ground.

Design

The following provisions should be taken into account:

- Strip foundations should be 600mm minimum width.
- Foundations should be situated centrally below the wall.
- Minimum thickness of strip foundations should be 150mm.
- Steps in foundations must not be of a greater dimension than the thickness of the foundation.
- Where foundations are stepped (on elevation) they should overlap by twice the height of the step, by the dimension of the foundation, or 300mm – whichever is the greater.

Depth

The depth of all foundations will be determined by specific site conditions. All foundations must bear onto virgin stable sub-soil. Except where strip foundations are founded on rock, the strip foundation should have a minimum depth of 450mm, measured from finished ground level, to their underside to avoid the action of frost. This depth however, will commonly need to be increased in areas subject to long periods of frost or in order that loads are transferred to suitable ground. Where trees are situated close to a proposed building founded on a clay soil, the foundation depth/design will be affected, see the following page for the depths and precautions necessary.

In clay soils with a plasticity index greater than or equal to 10%, strip foundations should be taken to a depth where anticipated ground movement will not impair the stability of any part of the building taking into account of the influence of vegetation and trees on or adjacent to the site.

The depth to the underside of foundations on clay soils should not be less than 750mm measured from finished ground level, depths may need to be increased in order that loads are transferred to suitable ground.

Proposed shrub planting

The planting of shrubs can have an effect on foundations in particular Cotoneaster, Ivy, Pyracantha and Wisteria can have a detrimental effect on foundations. Where the planting of shrubs is proposed the foundations should be designed to take account of the possible effect these may have on the foundations. It is recommended that shrub planting is no nearer the foundations than given in the table below: (From nearest foundation)

PLASTICITY INDEX %		MIN. DISTANCE FROM FOUNDATIONS IN METRES
High	40 %	3.0
Medium	20 – 40 %	2.5
Low	0 – 20 %	2.0

Raft Foundations

Raft foundations should be designed by a suitable Expert i.e. a structural engineer.

Where a party wall is to be built attention must be given at an early stage as to the construction of the party wall. Not all wall constructions are acceptable when a raft is being used.

Cost comparisons between raft and other types of foundation are only feasible when related to specific cases but some influencing factors are mentioned. The edge treatment of a raft provides the main problems of structural design, building details and visual effect.

Advantages

- Simple machine excavation without trenching
- Excavation less liable than trenches to become waterlogged or damaged in bad weather
- Less interference with subsoil water movements
- May eliminate need for awkward below-ground walling by bricklayers
- In poor sites, they avoid penetrating poor bearing materials just below the surface

Disadvantages

- May not be acceptable for some loading and soil conditions. For example, where because of the proximity of trees and the nature of the subsoil, it would require a strip foundation excavation depth in excess of the distance from the tree/4 then a raft design is not acceptable
- Ducts and pipe chases in the floor present problems
- Precautions usually need to be taken against drying, shrinkage or frost heave of the ground beneath the raft perimeter
- Unequal load distribution, e.g. piers, may cause problems
- In these conditions a raft design is not acceptable
- Rafts are seldom worth considering unless the site is substantially level
- The quality of material beneath the raft, of the raft concrete and the correct positioning of its reinforcement, are more important than in strip foundations

Edge of raft detail

In determining the type of edge treatment for rafts the following points should be considered:

- Provision of reasonable support for perimeter wall loads
- Prevention of either frost heave or drying shrinkage of the ground beneath the edge of the raft, the top of the concrete of the raft edge should be a minimum 450mm below finished ground level
- Simple and efficient damp-proofing
- Accommodation of minor variations in ground levels
- Appearance
- Permanence of satisfactory support conditions
- Protection of steel and durability of reinforced concrete

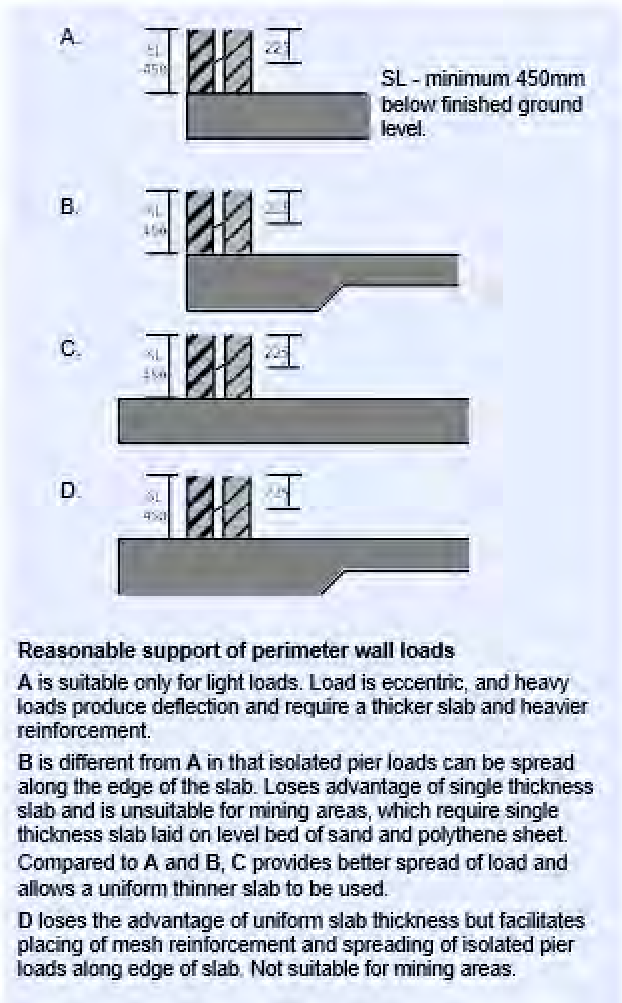


Diagram 1.06 – Edge of Raft Detail

Reasonable support of perimeter wall loads

A is suitable only for light loads. Load is eccentric, and heavy loads produce deflection and require a thicker slab and heavier reinforcement.

B is different from **A** in that isolated pier loads can be spread along the edge of the slab. Loses advantage of single thickness slab and is unsuitable for mining areas, which require single thickness slab laid on level bed of sand and polythene sheet.

Compared to **A** and **B, C** provides better spread of load and allows a uniform thinner slab to be used.

D loses the advantage of uniform slab thickness but facilitates placing of mesh reinforcement and spreading of isolated pier loads along edge of slab. Not suitable for mining areas.

Piled Foundations & Floors

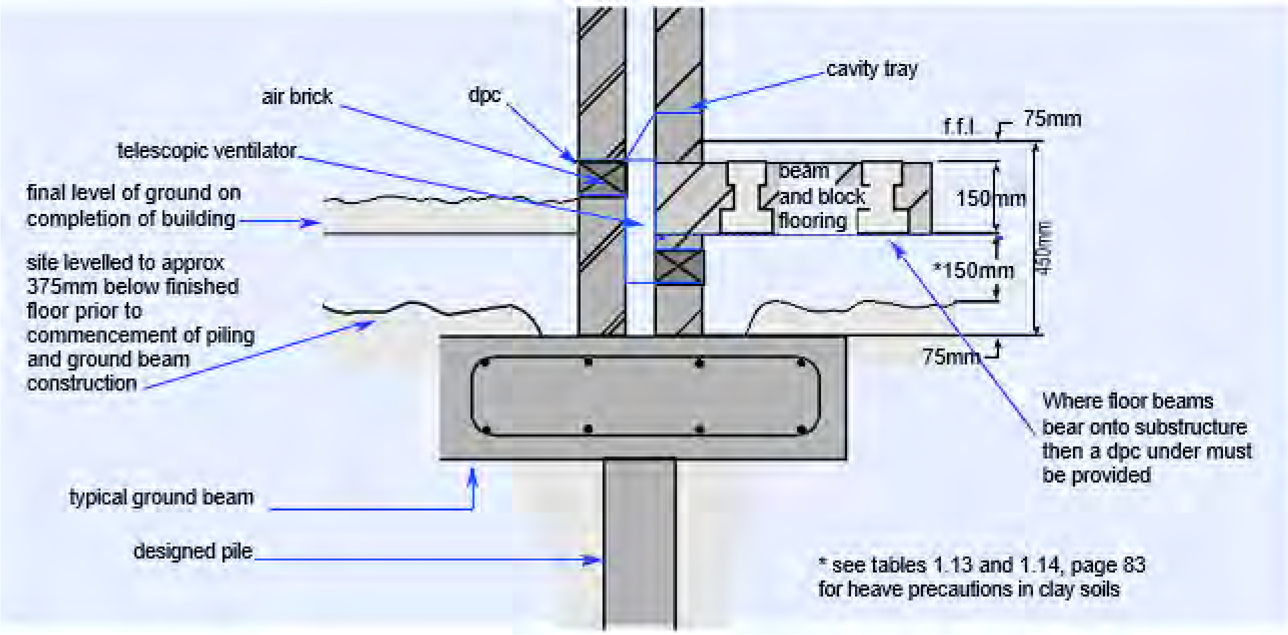


Diagram 1.07 – Typical Reinforced Pile Cap Detail

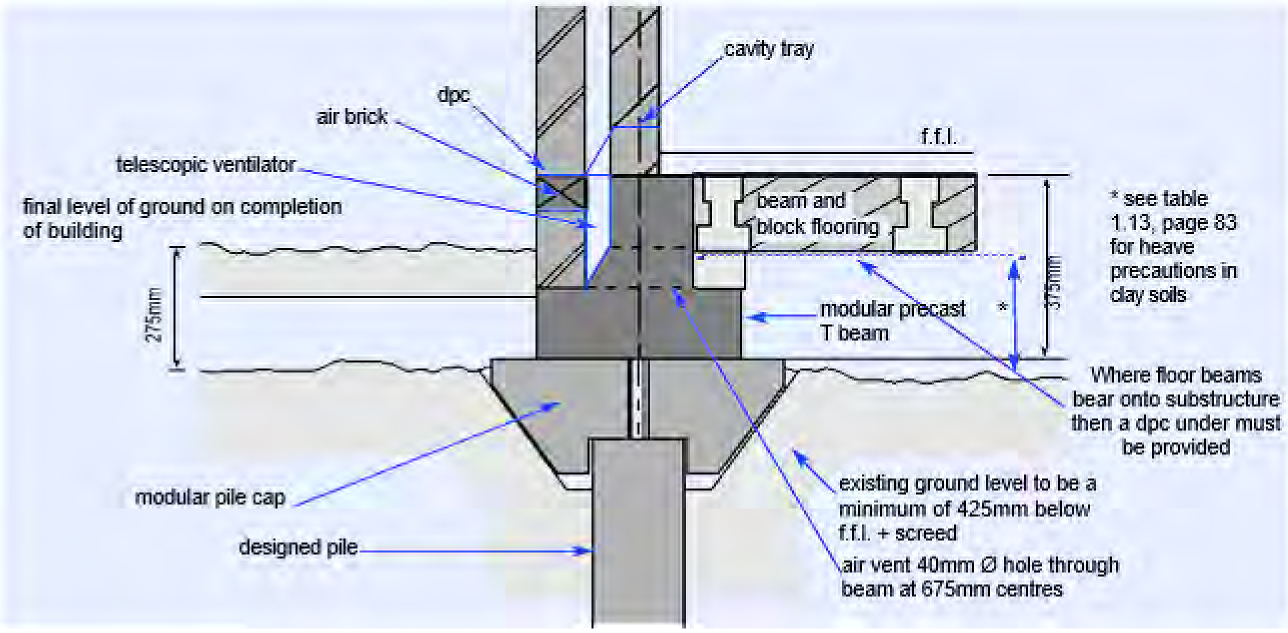


Diagram 1.08 – Modular Foundation System

Short Bored Piles

The Plate

The Tee Beam System comprises inverted Tee shaped precast reinforced concrete ground beams designed to carry wall and floor loadings and supported on pile caps which may be either standard precast components or in-situ concrete depending upon loadings and layouts. (See diagram 1.08).

The system may be used in clay heave susceptible conditions, leaving voids or void formers beneath the beams and caps, and applying heave precautions to the piles.

All external, internal, partition and party walls can be accommodated using this system.

Delivery and installation should all be carried out in accordance with the manufacturer's instructions.

Why use piles

It negates the use of deep uneconomic trenches together with the safety implications of excavating such foundations:

- Deep trenches involve high excavation and cart away costs
- Deep trenches require shuttering for safety at work measures, as a result making the provision of slip membranes and heave precautions (void formers) difficult to place with confidence and accuracy
- Labour savings (skilled and unskilled)
- Material savings (concrete and void formers etc.)

Piles are particularly appropriate for heave sites (trees removed) for which they are strongly recommended.

Pile layout

Pile layouts can be readily designed to accommodate an individual plot. A good design will seek to achieve cost savings in foundation excavation and materials by the incorporation of large ground beam spans between piles, and a small number of piles.

A typical pile layout is indicated in diagram 1.09 below.

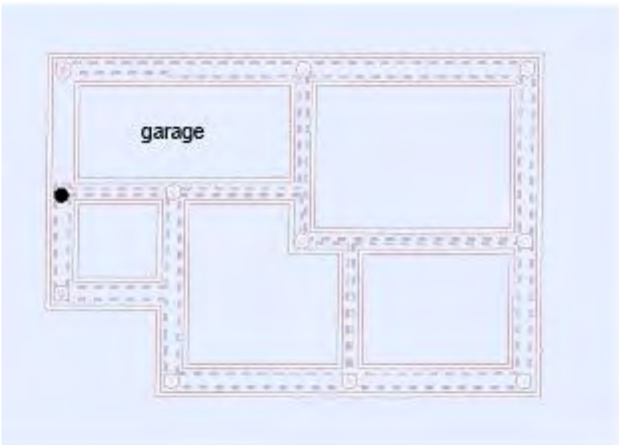


Diagram 1.09 – Typical Pile Layout

Floor construction

- Suspended floors with provision for adequate ventilation
- Beam and block may be better than timber flooring to accommodate large spans designed for economies

Ground beams

- Precast RC beams can be installed and over-excavation beneath the beam undertaken to accommodate any potential heave – use of precast beam may be beneficial in difficult ground conditions
- Cast in-situ beams will require provision of void formers and a minimum cover to reinforcement (i.e. 75mm when cast in the ground with no shuttering)

Typical pile design

Pile foundations should be designed by an Expert and include the following criteria (See diagram 1.10):

- Design to length for bored piles (or set for driven piles where these are recommended following ground investigations)
- Precautions to resist uplift
- Provision of sleeving to top section
- Preference is for installing longer piles designed to balance uplift
- Tension reinforcement required

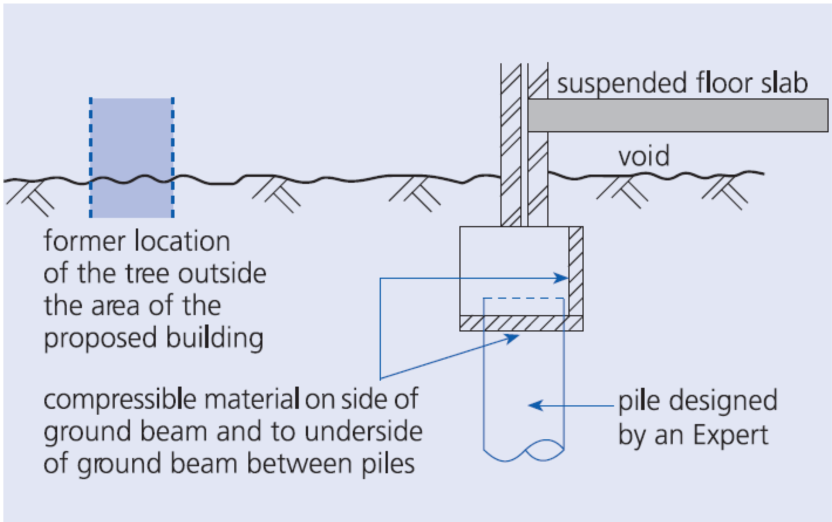


Diagram 1.10 – Typical Pile Beam Design for Heave Conditions

Proximity of Trees in Clay Soils

Introduction
The methods suggested below will be accepted by Q as meeting the requirements. Builders and designers should note that other equally acceptable solutions may exist. These details provide guidance relating to precautions which should be undertaken in shrinkable clay soils, particularly where trees are present or have been felled.

The following relates to conventional strip or trench fill foundations, although general comments are given on the potential benefits of other foundations in shrinkable clay soils.

Additional guidance on foundations in swelling and shrinkable clays is available in:
- BS 8004 Code of Practice for Foundations together with aspects of design and construction.
- BS 5837 Guide for trees in relation to construction.

These guidelines are written with a view to indicating good practice for a typical combination of conditions. However, each site has its own specific characteristics and where conditions do not clearly fall within the guidance given; seek clarification from Q or a suitably qualified and experienced Expert.

Identification and classification of clay soils

Damaging Effect of Clay
Changes in moisture contents of clays can cause heave or shrinkage which, in turn, can cause cracking and movement of foundations, floor slabs and hence whole structures. Clay shrinkage is caused during dry spells generally from moisture abstraction by vegetation, whereas clay heave is often caused by the removal of trees and hedgerows or alternatively due to substantial wetting after prolonged dry spells. The extent of movement may be determined from a number of factors, e.g. clay type, vegetation and tree type, the distance from the foundation excavation to the tree and / or geographical location.

The effects of clay shrinkage and clay heave on structures can be seen in diagrams 1.11 and 1.12 respectively.

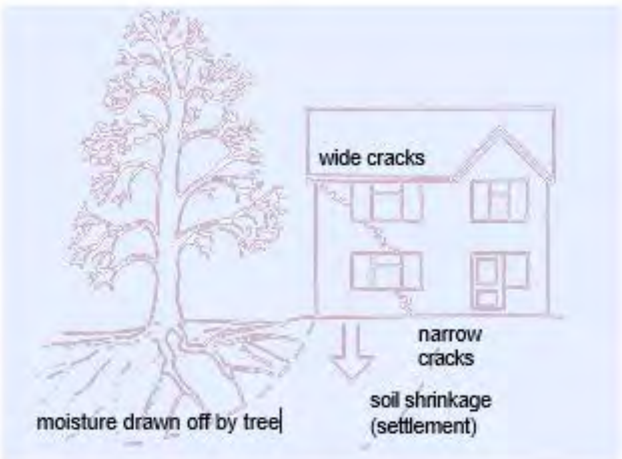


Diagram 1.11 – Damaging Effect of Clay Shrinkage

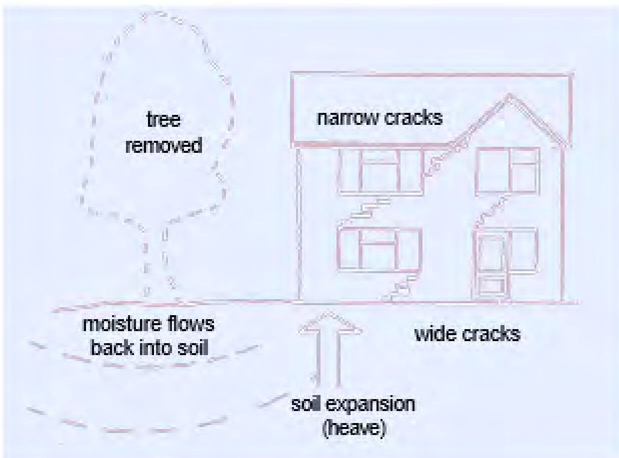


Diagram 1.12 – Damaging Effect of Clay Heave

Climatic effects
Different climatic effects for different parts of the country influence the degree to which shrinkable clays cause movement of foundations. This is generally thought of in terms of soil moisture deficit. Locations in the south east of England have a relatively warmer and drier climate than the rest of the British Isles, hence have corresponding higher soil moisture deficit values; locations in the north have a colder and wetter climate with lower soil moisture deficit values (See diagrams 1.13, 1.14 and 1.15).

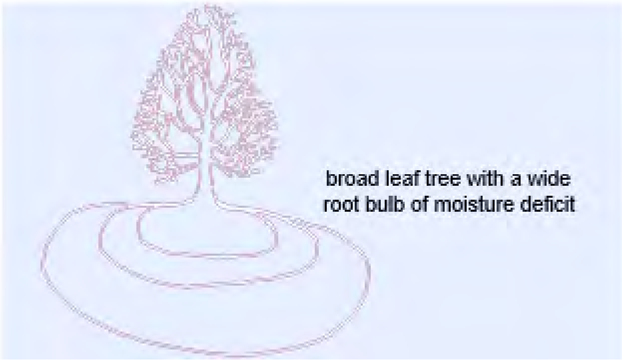


Diagram 1.13 –
Soil Moisture Deficit of Broad Leaf Tree

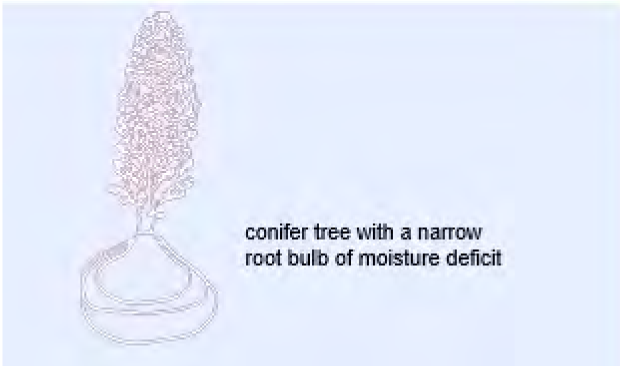


Diagram 1.14 –
Soil Moisture Deficit of a Coniferous Tree

Assessing Foundation Depths

Location of shrinkable clay soils
Clay soils may be found nationwide. All are shrinkable to varying degrees, although clays of most concern are found within an area south east of a line drawn between Exeter and Hull (See diagram 1.15). Clays situated south east of this line are likely to be classified as medium to highly shrinkable, with those to the north west of this line in general having a medium to low shrinkability potential.

Guidance on the probable soil conditions in a locality can be obtained from geological survey maps, available from British Geological Survey at Keyworth near Nottingham, (maps may be available for inspection at local libraries and from the local Building Control Authority). Local variations are common and additional guidance should be sought by undertaking ground investigations. The interaction of trees and clay soils should be borne in mind when considering appropriate ground investigations.

All clays require an assessment of shrinkage to be made to assist in foundation design. The most accurate way of achieving this is via a soil sample analysis in a laboratory.

Site identification of clay types
A clay can be recognised as being smooth and silky to touch with no grains visible to the naked eye. A clay may also contain silt sized particles (barely visible to the naked eye) together with sand (which will be visible and would give a more gritty feel).

The shrinkage potential of clay soils may be classified according to their plasticity. In general, the finer the soil (more clay particles and less silt or sand sized particles), the greater its shrinkage potential.

In order to accurately determine the shrinkability of clay soils, laboratory tests need to be carried out, such tests being:

- Determination of natural moisture content;
- Of the liquid limit
- Of the plastic limit
- Of the plasticity index (PI)

Tests should be undertaken in accordance BS 1377 – Methods of test for soils for civil engineering purposes.

Although recommended, laboratory tests are not always necessary. Where local knowledge is available regarding the soil type or from visual inspection (the soil has a high sand and or stone content) it is evident that the clay type would not fall within the category of high shrinkability.

Where the soil type cannot be readily identified and in the absence of laboratory testing a high shrinkage potential should be assumed.

Shrinkage classification

Soils which have a large potential range of moisture content within which the clay remains plastic (i.e. has a high plasticity index percentage) are more susceptible to shrinkage and swelling than those soils with a low PI.

There are no precise limits for PI which correspond to an amount of shrinkage. However, it is conventional practice to classify shrinkage potential (or swelling potential) with PI values.

A commonly adopted classification is as follows:

SHRINKAGE POTENTIAL	'PI' VALUE (%)
Low	0% - 20%
Medium	20% - 40%
High	40% +

Diagram 1.15 – Guidance on the Location of Highly Shrinkable Clay Soils

Table 1.06: Mature Heights of broad leaved trees and moisture demand					
high water demand		moderate water demand		low water demand	
Tree type (species)	H - Mature height (m)	Tree type (species)	H - Mature height (m)	Tree type (species)	H - Mature height (m)
Elm, English	24 - 30	Alder	18 – 22	Birch	15 – 25
Elm, Wheatly	22 - 30	Apple	8 – 10	Hornbeam	16 - 20
Elm, Wych	20 - 30	Ash	22 – 30	Elder	8 - 10
Eucalyptus	17 - 25	Bay Laurel	10 – 14	Fig	3 - 4
Hawthorn	9 - 14	Beech	20 – 28	Hazel	10 - 12
Oak English	20 - 25	Blackthorn	8 – 15	Honey Locust	8 - 15
Oak Holm	18 - 25	Cherry Domestic	14 – 16	Hornbeam	16 - 20
Oak Red	24 - 26	Cherry Japanese	10 – 15	Laburnum	10 - 12
Oak Turkey	24 - 30	Cherry Laurel	8 – 15	Magnolia	8 - 12
Poplar Aspen	20 - 25	Cherry Wild	16 – 25	Mulberry	12 - 14
Poplar Hybrid black	27 - 30	False Acacia	18 – 25	Tulip Tree	10 - 20
Poplar Lombardy	25 - 30	Horse Chestnut	20 – 26		
Poplar White	18 - 20	Judas Tree	7 – 10		
Willow Crack	23 - 25	Laurel	12 – 14		
Willow Weeping	16 - 20	Lime	22 – 30		
Willow White	22 - 24	Maple Japanese	8 – 12		
		Maple Norway	20 – 26		
		Mountain Ash	12 – 16		
		Pear	10 – 12		
		Plane	25 – 30		
		Plum	11 – 14		
		Sweet Chestnut	18 – 28		
		Sycamore	20 – 28		
		Tree of Heaven	18 – 25		
		Walnut	18 – 24		

Table 1.06 – Mature Heights of Broad Leaved Trees & Moisture Demand
Notes: In the majority of urban area developments the lower of the two mature heights specified can be adopted in determining the recommended depth of foundation required. (H within the D/H ratio, refer to tables 1.08, 1.09, 1.10 and 1.11).

Table 1.07: Mature Heights of conifer trees and moisture demand					
high water demand		moderate water demand		low water demand	
Tree type (species)	H - Mature height (m)	Tree type (species)	H - Mature height (m)	Tree type (species)	H - Mature height (m)
Cypress Lawson	18 - 30	Cedar	20 – 30	Holly	12 - 20
Cypress Leyland	20 - 30	Douglas fir	20 – 40		
Cypress Monterey	20 - 30	Larch	22 – 30		
		Monkey Puzzle	16 – 20		
		Corsican Pine	20 – 30		
		Scots Pine	20 – 30		
		Spruce	16 – 28		
		Western Hemlock	18 – 30		
		Yew	12 – 16		

Table 1.07 – Mature Heights of Conifer Trees & Moisture Demand
Notes: In the majority of urban area developments the lower of the two mature heights specified can be adopted in determining the recommended depth of foundation required. (H within the D/H ratio, refer to tables 1.08, 1.09, 1.10 and 1.11).

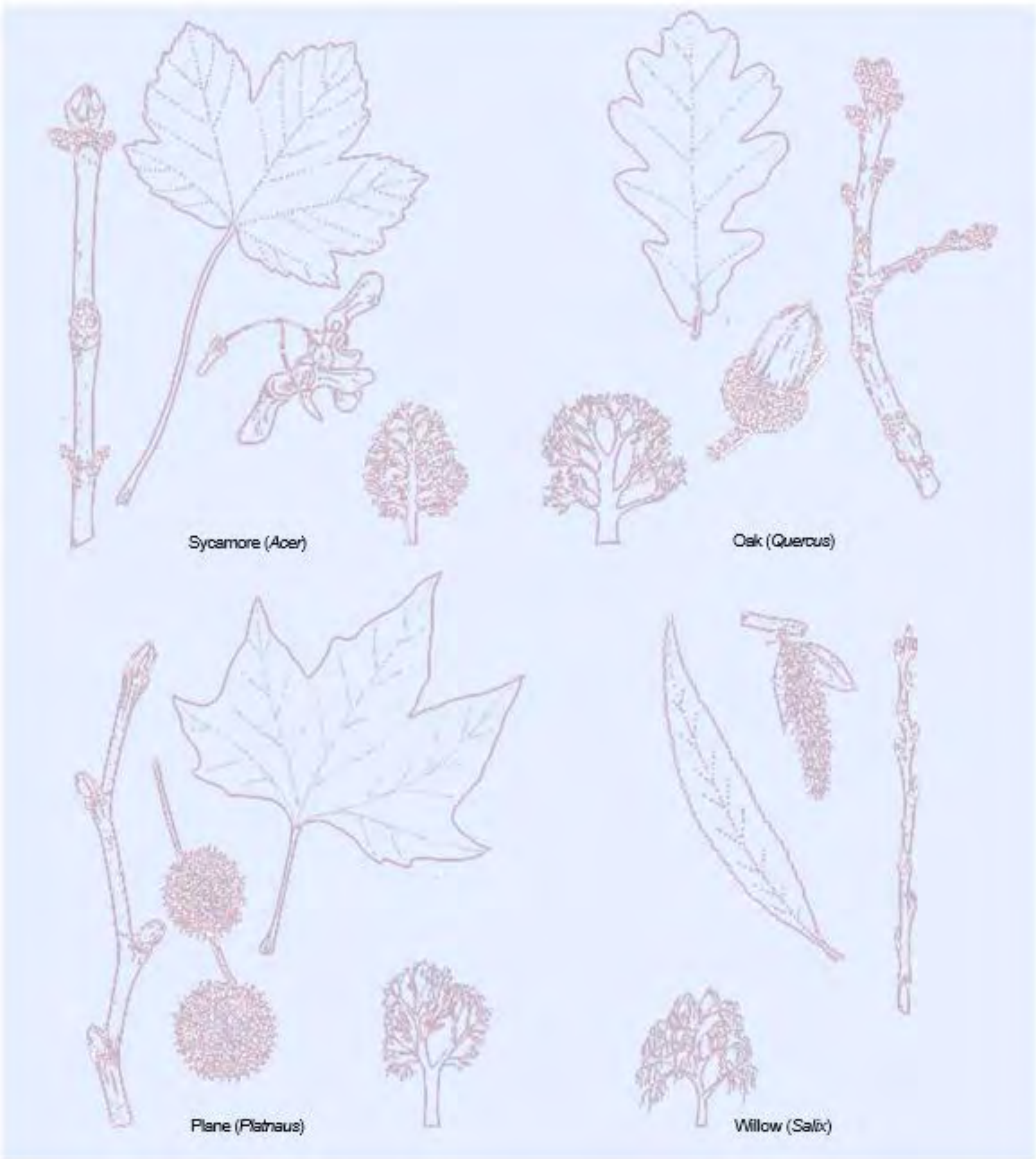


Diagram 1.16 – Tree Leaves 1
Drawings reproduced from Tree Recognition – A Pocket Manual (Richardson's Botanical Identifications, Reading) – Dr Ian Richardson and Rowena Gale - 1994

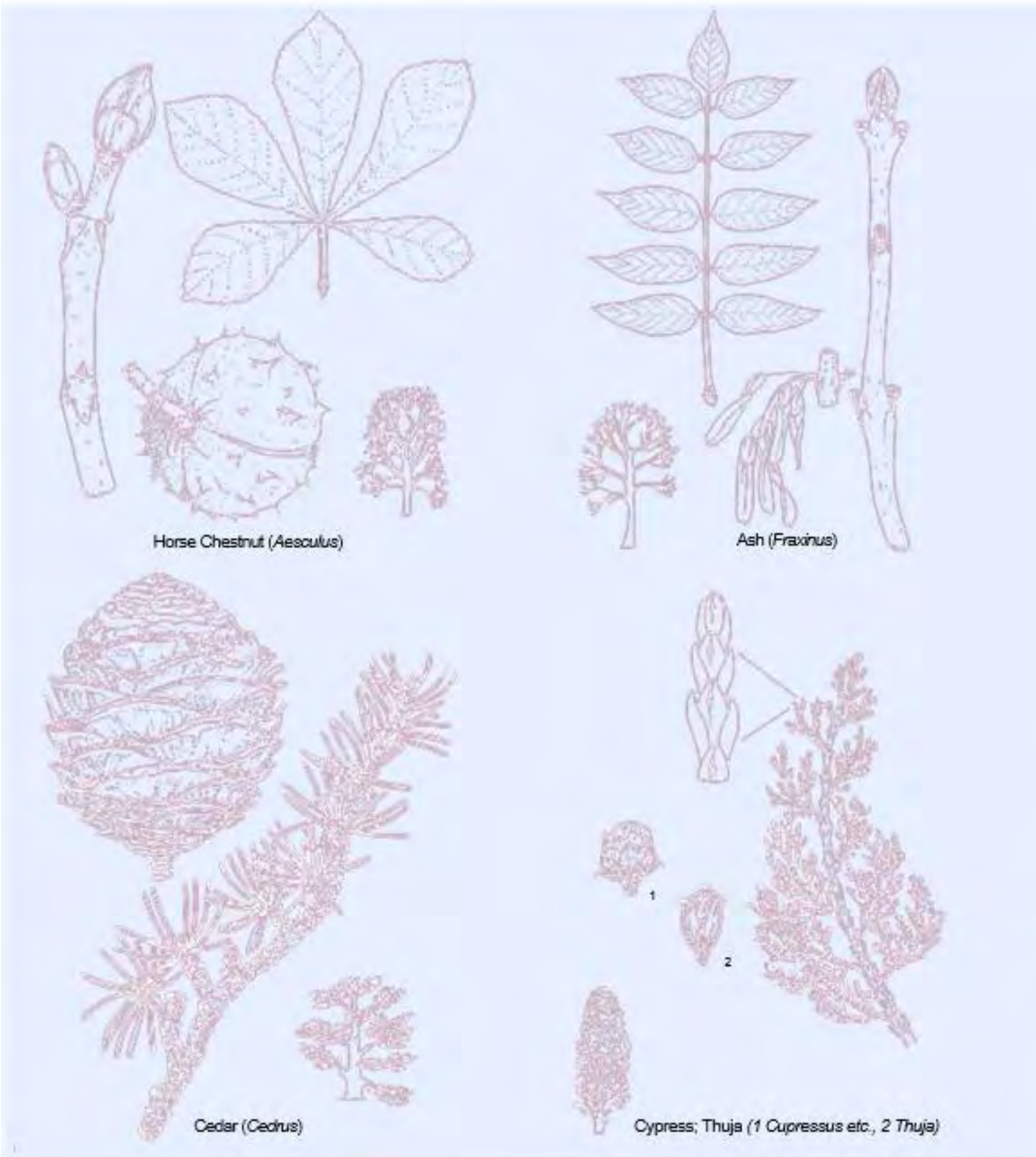


Diagram 1.16 – Tree Leaves 3
Drawings reproduced from Tree Recognition – A Pocket Manual (Richardson's Botanical Identifications, Reading) – Dr Ian Richardson and Rowena Gale - 1994

Assessing likely water demand of trees
The presence of trees and other vegetation affects the moisture content considerably. Careful assessment of the trees in close proximity to the proposed dwelling, together with the moisture demand on the clay is therefore essential. As a general guide, buildings constructed nearer to existing trees than a distance equal to their mature height – the so called ‘1H’ rule will be influenced by the moisture demand of that tree. Where applied the ‘1H’ rule should reduce the risk to the foundations but should not be regarded as an all-encompassing rule of safety. Builders and designers should follow the guidance given in this Manual and use the information together with tables 1.09 – 1.11 provided, to determine the actual depth of foundations relative to the tree type and location.

The degree to which a soil will change in volume will depend greatly on the amount of moisture which is drawn from or returned to it. Different trees have different water demand, and it is important to determine the particular tree type under consideration (See diagrams 1.13 and 1.14).

It is important to consider and identify trees on adjacent sites, where the soil type has a shrinkable potential. Some trees up to 30m away from the proposed dwelling may still abstract moisture from the soil at the dwelling’s location.

Tree identification
Trees may be identified using the tree leaf and bud pictures shown in diagrams 1.16, 1.17 and 1.18. If in doubt, consult a suitably qualified Expert.

Mature heights and water demand
Details of typical mature heights and water demands, for the most commonly found trees within the British Isles are included in table 1.06 and 1.07.

Distance between the structure and the tree
When considering the factors in relation to a tree’s proximity, the shrinkage effects of the clay soil is not the only consideration. The physical size of a tree can dominate a building and give rise to concern about the tree’s safety. BS 5837 gives guidance on the proximity of trees to structures to assist the planning of developments. In particular, the British Standard gives specific guidance on minimum distances to avoid damage to the root system and direct damage to a structure from the future growth of the trunk and roots. Guidance should be sought from a suitably qualified Expert where a structure is proposed within a distance from the tree equal to one tenth of the mature height (i.e. within D/H = 0. 1).

The British Standard also gives general guidance on the depth of foundations based on clay soils, however, more specific guidance is provided in the following pages.

No trees present
The minimum depth for a foundation on a clay soil, where no trees are present or have been removed within the last three years, is:

- 0.9m (900m) for low to medium volume change potential soils (PI value of 0-40%) and
- 1.0m (1000mm) for high volume change potential soils (PI value > 40%), or
- in accordance with the Building Control Policy whichever is the greater.

This minimum depth is required to ensure that the natural climatic affects i.e. drying and frost, do not affect the stability of the proposed foundation.

The results of the site investigation report must confirm that no desiccation is evident.

Trees present
Guidance on minimum depths of foundations for different clay soils and different moisture demands is presented in tabular form (see tables 1.09-1.11).

Attention is drawn to the fact that mature tree heights need to be applied when using these tables, rather than the actual height (unless the tree is being removed before construction commences) at the time of construction.

If any factors are unknown or unable to be established at the time of construction, the worst case scenario should be assumed. i.e. A high shrinkability soil together with a high water demand broad leaf tree type.

Trees removed
Where trees have been removed from clay soils the moisture extracted by the tree will find its way back into the soil, resulting in the soil swelling, commonly known as heave.

Previous text has discussed the effects of soil moisture deficit bulbs. The greater the depth below ground level the less soil moisture is abstracted from the soil by the tree and hence the less likelihood of structural damage occurring to the foundation.

Predicting a safe depth at which to construct the foundations, where the moisture content can be considered relatively stable in shrinkable clay soils near trees, requires account to be taken of a number of major factors. Such factors are:

- Soil type
- Shrinkage potential of the clay soil
- Potential water demand of the tree
- Potential mature height of the tree
- The influence of removed trees
- Distance of the tree(s) from the proposed foundation (measured on site in metres)
- Climatic factors (geographical location)

All of the above considerations are dealt with in detail within the text, except the actual distance of the tree from the proposed foundation, which will be determined from accurate measurement on site. The use of root barriers is not an acceptable alternative to this guidance.

Choosing the foundation type
Conventional strip foundations may be constructed practically and economically to a maximum depth of approximately 1.5m, hence where trees are present on clay soil sites, strip foundations would be unsuitable in the majority of cases.

Trench fill foundations are likely to be most economic for low and moderate moisture demand trees. This type of foundation is best suited at depths below 1.5m but can be economic to depths of 2.5-3.0m. Trench fill foundations exceeding 2.5m should have expert design input, and should consider slip membranes and heave precautions.

For foundation depths in excess of 2.0m, short bored piles with ground beams are recommended and may well prove to be a more economical form of construction. **Short bored piles are an essential requirement for depths in excess of 3.0m. The use of root barriers is not an acceptable alternative to this guidance.**

All pile design should be undertaken by an Expert i.e. a structural engineer. This may well be the supplier and installer.

NOTE:

If a tree cannot be readily identified, then assume the tree has a HIGH MOISTURE DEMAND for a BROADLEAF tree.

If in doubt consult a suitably qualified expert. For further information:

- **Arboricultural Association**
  01794 368717 www.trees.org.uk

- **Arboricultural Advisory and Information Service**
  01420 22022

- **Tree Helpline**
  0906 526 1147 (premium rates charged) www.treehelp.info

If the volume change potential of the soil cannot be confirmed then assume a HIGH PI of >40%

For trees removed within the footprint of the proposed dwelling/structure, see precautions against heave (also see this section).

Step by Step Guide

1. Identify the tree type from site observation and reference to diagrams 1.16-1.18 or other suitable reference data.
2. Note the anticipated mature height (H), the tree's moisture demand and its category i.e. broad leaf or coniferous.
3. Measure the actual distance (D) on site from the tree trunk to the face of the proposed foundation.
4. Calculate the D/H ratio, using a calculator or by reference to table 1.08:

   Actual Distance (D)

   Mature Height (H)
5. Establish the shrinkage potential of the soil, either from local or expert knowledge, laboratory tests or by assuming the safeguard of a high Plasticity Index (PI).
6. Using the appropriate table 1.09-1.11 for high, moderate or low moisture demand for the tree(s) in question, and using the D/H and PI established earlier, read off the proposed foundation depth
7. Apply a reduction factor (where applicable) in foundation depth for geographical location see diagram 1.20.
8. Depending upon the established depth required, determine the most suitable foundation type for the structure.

Table 1.08: Calculation of D/H ratio

Distance of tree (D) away from face of foundations in metres (columns); Mature height (h) of tree in metres (see table s1 & 2) (rows)

	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
30	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53	0.60	0.67	0.73	0.80	0.87	0.93	1.00	1.07	1.13	1.20
29	0.07	0.14	0.21	0.28	0.34	0.41	0.48	0.55	0.62	0.69	0.76	0.83	0.90	0.97	1.03	1.10	1.17	1.24
28	0.07	0.14	0.21	0.29	0.36	0.43	0.50	0.57	0.64	0.71	0.79	0.86	0.93	1.00	1.07	1.14	1.21	1.29
27	0.07	0.15	0.22	0.30	0.37	0.44	0.52	0.59	0.67	0.74	0.81	0.89	0.96	1.04	1.11	1.19	1.26	1.33
26	0.08	0.15	0.23	0.31	0.38	0.46	0.54	0.62	0.69	0.77	0.85	0.92	1.00	1.08	1.15	1.23	1.31	1.38
25	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	1.12	1.20	1.28	1.36	1.44
24	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.83	0.92	1.00	1.08	1.17	1.25	1.33	1.42	1.50
23	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.70	0.78	0.87	0.96	1.04	1.13	1.22	1.30	1.39	1.48	1.57
22	0.09	0.18	0.27	0.36	0.45	0.55	0.64	0.73	0.82	0.91	1.00	1.09	1.18	1.27	1.36	1.45	1.55	1.64
21	0.10	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.05	1.14	1.24	1.33	1.43	1.52	1.62	1.71
20	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80
19	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84	0.95	1.05	1.16	1.26	1.37	1.47	1.58	1.68	1.79	1.89
18	0.11	0.22	0.33	0.44	0.56	0.67	0.78	0.89	1.00	1.11	1.22	1.33	1.44	1.56	1.67	1.78	1.89	2.00
17	0.12	0.24	0.35	0.47	0.59	0.71	0.82	0.94	1.06	1.18	1.29	1.41	1.53	1.65	1.76	1.88	2.00	
16	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00		
15	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07	1.20	1.33	1.47	1.60	1.73	1.87	2.00			
14	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.29	1.43	1.57	1.71	1.86	2.00				
13	0.15	0.31	0.46	0.62	0.77	0.92	1.08	1.23	1.38	1.54	1.69	1.85	2.00					
12	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00						
11	0.18	0.36	0.55	0.73	0.91	1.09	1.27	1.45	1.64	1.82	2.00							
10	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00								
9	0.22	0.44	0.67	0.89	1.11	1.33	1.56	1.78	2.00									
8	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00										
7	0.29	0.57	0.86	1.14	1.43	1.71	2.00											
6	0.33	0.67	1.00	1.33	1.67	2.00												
5	0.40	0.80	1.20	1.60	2.00													

Table 1.08 – Calculation of D/H Ration

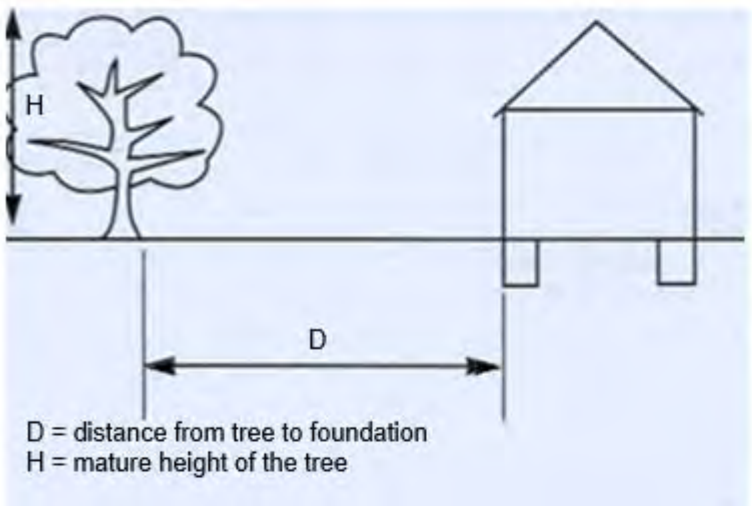


Diagram 1.19 – Calculation of D/H Ration

trees with high moisture demand

shrinkage potential of clay	P.I. %	tree type	distance from tree/height of tree (D/H)																					
			<0.1	0.10	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	>1.2
high	>40	broadleaf	NR	3.00	3.00	3.00	3.00	2.90	2.75	2.65	2.50	2.40	2.30	2.15	2.05	1.95	1.90	1.80	1.70	1.55	1.40	1.30	1.20	1.05	0.90
		coniferous	NR	2.80	2.80	2.50	2.25	2.00	1.80	1.60	1.35	1.15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
medium	20-40	broadleaf	NR	2.60	2.60	2.60	2.60	2.45	2.30	2.15	2.00	1.95	1.85	1.80	1.70	1.65	1.55	1.50	1.40	1.30	1.20	1.15	1.10	1.00	0.90
		coniferous	NR	2.40	2.40	2.20	2.00	1.80	1.60	1.45	1.30	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
low	<20	broadleaf	NR	2.30	2.30	2.30	2.30	2.05	1.90	1.65	1.50	1.45	1.40	1.38	1.35	1.30	1.25	1.20	1.15	1.10	1.05	1.00	0.95	0.90	0.90
		coniferous	NR	2.00	2.00	1.85	1.70	1.60	1.45	1.35	1.20	1.05	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90

foundation depth (m) below GL where trees are present

Table 1.09 – High Moisture Demand

trees with moderate moisture demand

shrinkage potential of clay	P.I. %	tree type	distance from tree/height of tree (D/H)																					
			<0.1	0.10	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	>1.2
high	>40	broadleaf	NR	2.00	2.00	2.00	2.00	1.85	1.70	1.55	1.45	1.35	1.20	1.05	1.00										
		coniferous	NR	1.75	1.75	1.45	1.20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00										
medium	20-40	broadleaf	NR	1.60	1.60	1.60	1.60	1.55	1.45	1.40	1.30	1.20	1.10	1.00	0.90										
		coniferous	NR	1.45	1.45	1.25	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90										
low	<20	broadleaf	NR	1.30	1.30	1.30	1.30	1.25	1.20	1.15	1.10	1.05	1.00	0.95	0.90										
		coniferous	NR	1.20	1.20	1.10	1.00	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90										

Minimum foundation depths are:

0.9m (900mm) for low to medium volume change potential soils (PI value of 0-40%) and 1.0m (1000mm for high volume change potential soils (PI value > 40%) or in accordance with the Building Control Policy whichever is the greater

foundation depth (m) below GL where trees are present

Table 1.10 – Moderate Moisture Demand

trees with low moisture demand

shrinkage potential of clay	P.I. %	tree type	distance from tree/height of tree (D/H)																					
			<0.1	0.10	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	>1.2
high	>40	broadleaf	NR	1.40	1.40	1.40	1.40	1.32	1.24	1.16	1.08	1.00	1.00												
		coniferous																							
medium	20-40	broadleaf	NR	1.20	1.20	1.20	1.20	1.15	1.10	1.05	1.00	0.95	0.90												
		coniferous																							
low	<20	broadleaf	NR	1.00	1.00	1.00	1.00	0.98	0.96	0.94	0.92	0.91	0.90												
		coniferous																							

Minimum foundation depths are:

0.9m (900mm) for low to medium volume change potential soils (PI value of 0-40%) and 1.0m (1000mm for high volume change potential soils (PI value > 40%) or in accordance with the Building Control Policy whichever is the greater

foundation depth (m) below GL where trees are present

Table 1.11 – Low Moisture Demand

Key to Tables 1.09, 1.10 and 1.11

NR	Not recommended (to provide protection to the tree)
<	Less Than
>	More Than

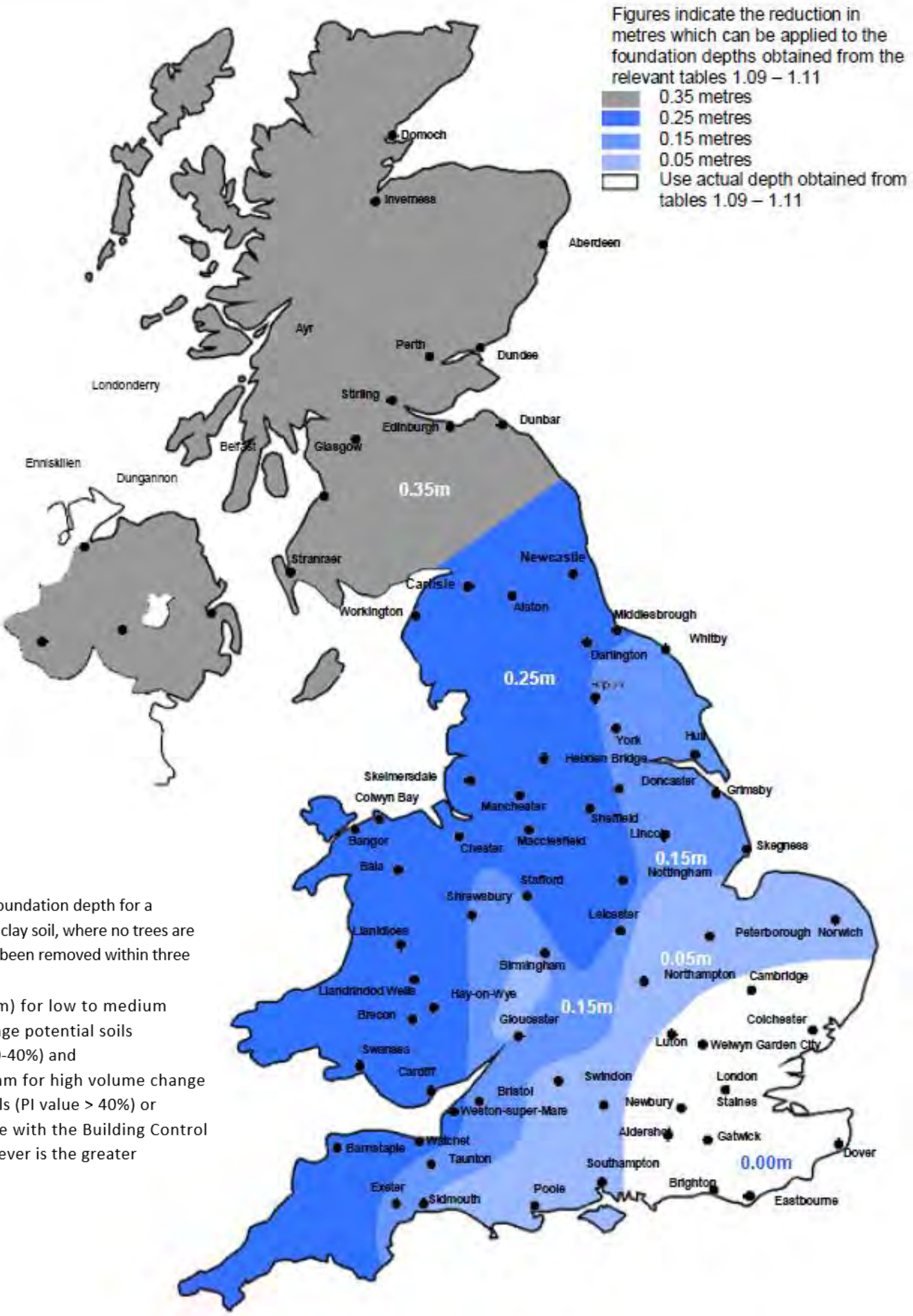
Any foundations greater than 2.5m require design by a suitably qualified and experienced expert

Short boared piles are recommended for depths greater than 2.0m

Short bored piles are a requirement for depths greater than 3.0m

Notes:

1. For D/H between stated values foundations depths may be determined by interpolation
2. A reduction in foundation depth may be applied based on climatic factor (see diagram 1.20)
3. Data is for single trees
4. Where tress have been removed, refer to Table 1.12
5. Foundations may need protection using compressible material (even where trees are not removed. See Tables 1.13 & 1.14)



NOTE:
The minimum foundation depth for a foundation on a clay soil, where no trees are present or have been removed within three years is:

- 0.9m (900mm) for low to medium volume change potential soils (PI value of 0-40%) and
- 1.0m (1000mm for high volume change potential soils (PI value > 40%) or
- in accordance with the Building Control Policy whichever is the greater

Diagram 1.20 Climatic Factors

Reduction in Depths

Climatic conditions (geographical area) can have a significant effect on the proposed depth of the foundation. Areas of relatively warmer and drier climate i.e. the south east of the country will have a higher soil moisture deficit than those areas with somewhat wetter and colder climate. As a result the proposed foundation depth can be adjusted to suit the part of the country in which it is being excavated (See diagram 1.20).

As the excavation of the proposed foundation trench moves away from the tree in question the foundation depth can be reduced accordingly, i.e. as the D/H ratio increases the required depth of the foundation decreases and steps can be introduced within the foundation dig.

General

Clays will heave or swell as a result of an increased moisture content. This will take place during the winter season when there is likely to be a surplus of moisture compared to the demand of the tree's root system. In particular, heave will occur where trees have been removed since there is no longer a moisture demand on the soil by those trees.

As with sites when considering trees for shrinkage of clay soils, foundation depths when assessing heave need to be taken to a suitable level beyond the influence of the soil recovery. i.e. The height of the tree on removal should be taken when using tables 1.09 – 1.11, for determining the depth of the proposed foundation excavation.

Trees outside the proposed building

Where trees are removed from outside the footprint of the proposed dwelling, the actual height of the tree at time of removal can be taken for the D/H ratio in calculating the required depth of the proposed foundations.

The height at time of removal shall be taken as the height prior to any recent crown reduction or pollarding.

Such precautions are required up to D/H ratios of 0.6, 0.7 and 1.2 for low, moderate and high moisture demands respectively. At greater D/H ratios standard (minimum) foundation depths can be adopted.

In highly shrinkable clays, consideration should be given to taking foundations beyond the depths required by this guidance, further reducing the risk of long term heave effects. The advice of a suitably qualified and experienced Expert should be sought in these instances.

The Effect of Heave

Building over the former location of trees
Where buildings are proposed directly over the former location of trees it may be prudent to consult a suitably experienced and qualified Expert. However, the recommended minimum depth of foundation excavation where mature trees have been removed within the building's footprint are set out in table 1.12.

tree type removed	shrinkage potential	minimum foundation depth broadleaf/conifer
high moisture demand	high medium low	3.0m/2.8m 2.6m/2.4m 2.3m/2.0m
moderate moisture demand	high medium low	2.0m/1.8m 1.6m/1.5m 1.3m/1.2m
low moisture demand	high medium low	1.4m 1.2m 1.0m

1 For young trees, the recommended depths are the same unless otherwise assessed by a suitably qualified Expert.
2 In these circumstances it is strongly recommended to use short bored piles, adequately designed by an Expert to resist heave.

Table 1.12 – Foundation Depths When Building over the Location of Trees

If, when excavating to the recommended foundation depths, vegetation / fibrous roots are still being encountered, then the foundation depth shall be increased to 500mm below the level of the existing roots. The need for heave precautions should be considered.

Heave precautions
Not only do the foundations have to penetrate to a depth which is outside the influence of the soil movement, additional precautions need to be provided to the face of the foundations and the underside of ground beams and floor slabs.

Compressible materials such as low density expanded polystyrene (or proprietary heave systems) may need to be provided to the face of foundation excavations prior to the concrete being placed (See diagrams 1.21 and 1.22). Voids or proprietary void formers may be required to the underside of ground beams and floor slabs (See table 1.14).

These precautions are essential where the clay soil is susceptible to heave (whether trees remain or are removed).

Compressible Materials/Void Formers

The materials used for void formers (either compressible boards or proprietary systems) should be those assessed and possess independent third party certification acceptable to Q and installed in accordance with the manufacturers instructions.

In the majority of cases where trees are removed outside the footprint of the proposed dwelling, compressible boards need only be used on the internal face of the foundation. For trees removed from within the proposed building area, compressible material (in accordance with table 1.13) will be required to both faces of external foundation trenches. If in doubt regarding a particular site or precautions required consult a suitable qualified Expert (or Q).

Note: Fast construction of the building after tree removal is desirable to avoid clay heave due to the ingress of moisture from rainfall, prior to the superstructure loads being applied. Damage to either strip or trench filled foundations can occur at this early stage, where moisture ingress is allowed to occur.

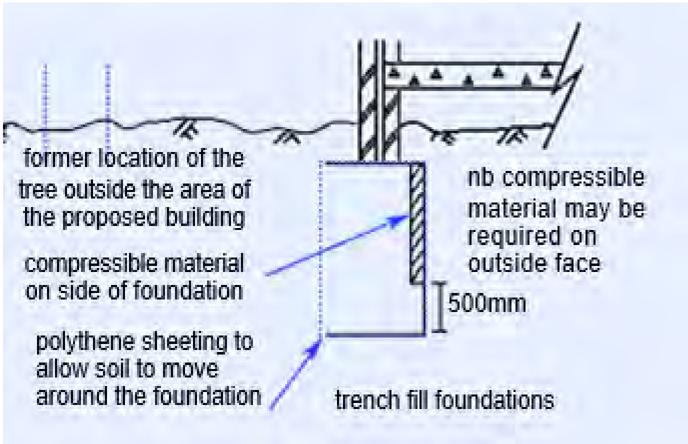


Diagram 1.21 – Heave Precautions Where a Tree is removed outside the Footprint of the Proposed Dwelling

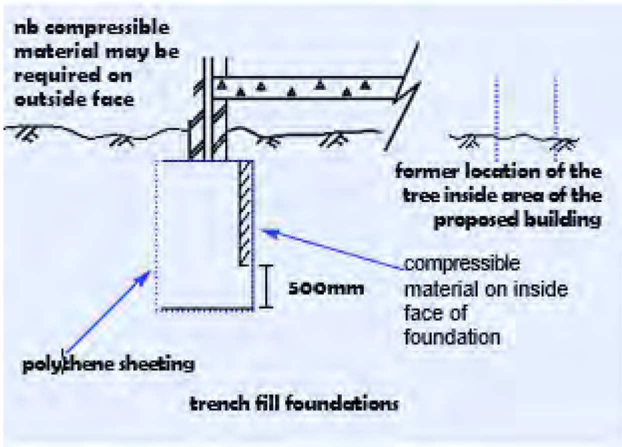


Diagram 1.22 – Heave Precaution Where a Tree is removed within the Footprint of the Proposed Dwelling

	external walls		internal walls
existing trees	outside faces	inside faces	both faces
where D>2d	–	✓	–
where Dδ2d	✓	✓	–
removed trees	outside faces	inside faces	both faces
where D>2d	–	✓	–
where Dδ2d	✓	✓	–
trees in building area	✓	✓	–

1 Compressible material is required to counter any out of balance forces resulting from swelling (see table 1.12).
2 Where a tree (or tree removed) is (was) present/very close or beneath the house, compressible materials are required on both faces.
3 > = more than δ = equal to or less than
2d = 2 times foundation depth
D = distance from tree to foundation face

Table 1.13 – Guidance for Location of Compressible Material

element	void former /void	Soil heave potential (dimensions in mm) high	medium	low
underside of ground beam	void former	150-200	100-150	50-100
underside of in-situ floor slab	void former	150-200	100-150	50-100
against side of foundation	void former	35-50	25-40	0-25
pre-cast concrete floor (beam & block)	void	225-250	175-200	125-150
timber suspended floor	void	300-350	250-300	200-250

In the majority of cases the lower limits will be acceptable for each soil type

Table 1.14 – Minimum Void Dimensions to Facilitate Heave against Foundations, Ground Beams and Floors

Aspects Unique to Some Clay Sites

There will be a number of unique aspects (not appropriate to all clay soil sites) which will require particular consideration when determining suitable foundation types and formation levels. Consideration of the following aspects are generally outside the scope of this guidance and Expert advice may be necessary, however some general information is given below:

Sloping Ground
Allow for the vertical change in height between ground level at the building and ground level at the tree position. For a higher ground level at the building, the vertical difference should be added to the recommended foundation depth and vice – versa. (See diagrams 1.23 and 1.24)

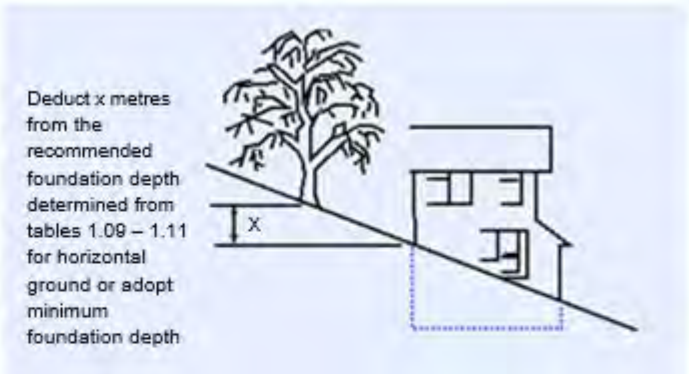


Diagram 1.23 – Allowance for Sloping Ground 1

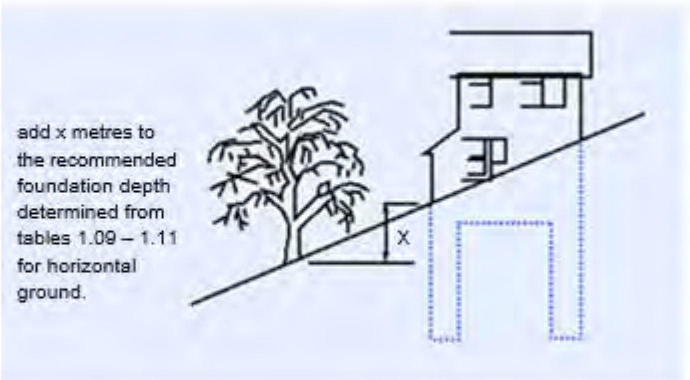


Diagram 1.24 – Allowance for Sloping Ground 2

Example
The ground level at the base of the tree is higher than that of the proposed dwelling by 0.75m. The site conditions dictate that the foundation depth required is 3.0m, as the tree is situated above the dwelling the actual depth of dig required is 3.0 – 0.75 = 2.25m.

Multiple Trees
In certain circumstances multiple trees can extract moisture to a greater depth than that of a single tree of the same species. However, mature heights may not be realised due to competition for moisture between adjacent trees. Expert technical advice on the effect of multiple trees should be sought. Particular caution is advised for rows of closely spaced trees of the Poplar and Cypress species.

Stepped Foundations
Steps may be introduced for economy where the distance away from the tree increases along the foundation line.

Soft Ground at Foundation Level
Foundations should be taken down to a depth which provides an adequate and safe bearing capacity. Appropriate investigations and a knowledge of overcoming local problems (e.g. a stiff crust over a soft underlying strata or isolated soft spots) must be fully considered. This may necessitate seeking advice from an Expert.

Planting of Trees
The planting of trees and shrubs should not influence the stability of the building. Landscaping should be agreed with local planning authorities prior to foundation excavation on site. Consultation with an arboriculturalist is also advised.

Where a planting schedule is known in advance of a building project, adopt the foundation suitable for the location, type and mature height of those trees and shrubs proposed. Otherwise, restrict the planting of trees and shrubs within the designated distance from the existing structure. This distance can be determined by reference to table 1.08, thus avoiding future damage to the foundations.

It should be noted that there are no additional requirements for heave precaution when considering new planting. Heave is unlikely, as the soil has not been desiccated.

Drainage
All drainage should, wherever possible, be located away from trees to minimise the potential for breakage from root action. Generally the threat of root damage can be avoided or lessened by providing flexible jointed pipe runs or concrete surround incorporating flexible joints. Alternatively adopt a deeper invert level (subject to constraints on falls and connections). Construction advice is given in BS 5837.

Boundary Walls
Foundation depths for dwellings apply equally to detached garages and other associated structures, such as brick or concrete boundary walls. On shrinkable clay sites it may be more prudent and possibly more economic to adopt concrete/timber post together with a timber fencing system (subject to planning constraints).

Non-shrinkable soils over shrinkable clays
It is not uncommon for a sand and gravel formation to overlie a shrinkable clay, in which case a site investigation is required to determine the extent of the overlying material. An assessment of the type and depth of foundation proposed should be made by a suitably experienced and qualified Expert. For general guidance in these circumstances (See diagram 1.25).

The thickness (d1) of the non-shrinkable soil beneath the foundation should be greater than the width of the proposed foundation (W), **and** the depth (d2) to the base of that overlying material is greater than 0.8 times the depth of the foundation assuming it was to be excavated in a clay soil (d3). (depth established from tables 1.09 – 1.11 for clay soils).

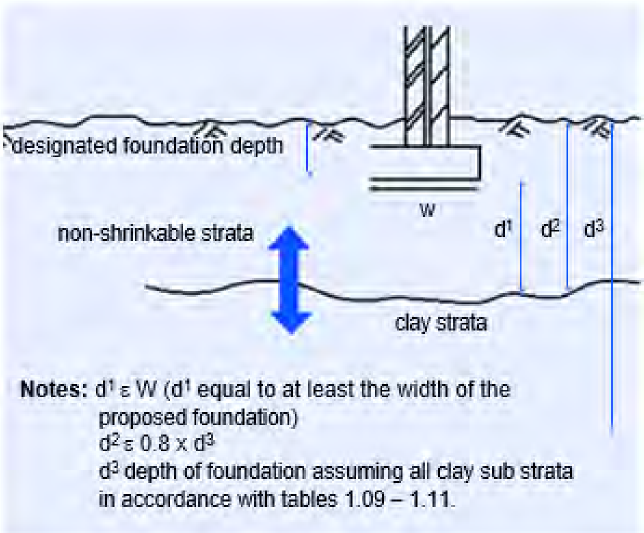


Diagram 1.25 – Non-shrinkable soils over shrinkable trays

Drainage – General

Foul and stormwater drainage
Every drainage system should be designed and constructed in accordance with the guidance contained in the following appropriate document:

England & Wales:	Approved Document H – Drainage and waste disposal
Scotland:	Technical Standards Section 3 – Environment
N.Ireland:	Part N – Drainage

Additional guidance is also provided in the following current design and construction standards:
- BS EN 12056-2 Sanitary pipework
- BS 6367 Drainage of roofs and paved areas
- BS 6297 Design and installation of small sewage works
- BS EN 752 Building drainage

The relevant Building Control body and Q should approve the construction of the drainage system. In the absence of an inspection and / or final test by the Approved Inspector, Q will need to be consulted.

The following clauses provide guidance on the interpretation of the Q Requirements with regard to individual elements covered in this Manual and where appropriate, propose guidance on ways to meet these requirements.

Drainage – General
Where impervious surfaces such as drives, paths, hard-standings, etc. drain to a rainwater drainage system, a trapped gully should be provided. Impervious surfaces may drain to a permeable area of the garden provided that it is free draining.

Proprietary drainage systems should be designed and laid in accordance with the manufacturer’s specification.

The drainage system, including manholes, gullies, pipe connections, etc. should be protected from damage throughout the course of the construction works.

Prior to handover, the drainage system should be rodded clean and its efficient operation checked.

Workmanship should comply with BS 8000:14.

Rainwater should discharge into a rainwater drainage system, or a soakaway located at least 5.0m from any building or watercourse. The soakaway should have a minimum capacity of $1m^3$. For soakaway design, refer to BRE Digest 365.

Pipework
Flexible drainage systems should be provided where ground movement is likely to occur, e.g. filled sites, mining areas and sites with shrinkable clay.

Drain runs should, wherever possible, avoid passing adjacent to tree roots. Where this cannot be avoided, adequate precautions should be taken in accordance with the recommendations of the relevant Building Control body and the pipe manufacturer.

Drainage trench excavations should be taken down to solid ground or where this is not possible, the drainage system should be designed to accommodate any movement and made up with a well compacted backfill to the required formation levels. Quality of backfill should be in accordance with the manufacturer's recommendations.

The depth of drains and the protection provided over the drain should be adapted to the traffic normal for the location in accordance with the recommendations of the relevant Building Control body and the pipe manufacturer.

Pipes should be laid in accordance with the manufacturer's instructions and any independent third party certification acceptable to Q.

Pipes should be securely stored so as to avoid damage occurring. Plastic pipes and fittings should be stored away from direct sunlight.

Manholes, access chambers, gullies and rodding eyes
The cover level of manholes, access chambers, gullies and rodding eyes should suit the adjacent finished ground levels and be provided with covers capable of withstanding the traffic normal for the location.

Covers should be finished level with any adjacent paving or building and bedded so as to accommodate the adjacent finished surface of the ground.

Manholes should be of a suitable size so as to permit access for inspection and maintenance. In sealed systems narrow shaft type accesses should generally not be deeper than 600mm, or be in accordance with the manufacturer's instructions and any independent third party certification acceptable to Q.

Inspection chambers and manholes within buildings should have mechanically fixed airtight covers unless the drain itself has watertight access covers.

Manholes deeper than 1m should have metal step irons or fixed ladders.

Catchpits should be provided to all land drainage systems which connect to a drain or sewer.

Quality of backfilling under drives, garages, paths, etc.
Backfill to trenches under drives, garages and paths should be carried out using non-organic matter which should be fully compacted. Where drains have less than 600mm cover they should be protected by either encasing in concrete or by a reinforced concrete raft cast over the drain which may form part of the drive, garage, path, etc.

Planning drainage
The design and layout of a drainage system should be kept as simple as possible and be capable of conveying and discharging its contents, without causing nuisance or danger to health and safety from leakage, blockage or surcharge throughout its anticipated lifetime.

There may be technical and economic advantages in providing a drainage system to serve more than one property but such an arrangement may cause difficulties in conveyancing or apportionment of maintenance costs. Designers should consider this when preparing drainage layouts.

Sewers serving more than 1 property should normally have a minimum diameter of 100mm. For more than 10 dwellings the minimum diameter should be 150mm. For housing it is preferable for drains to be laid externally where provision can be made for ready detection of blockages and their removal. A drain trench should not impair the stability of a building. When drains are laid parallel to the foundation, care should be taken that the foundations are not undermined.

Written permission is required from the Water and Highway authority before any work in connection with drains is started.

The authority's requirements vary but will be either:

- A separate system – separate sewers are provided for foul and surface water

OR

- A combined system – both foul and surface water use the same pipeline. In rural areas where no public sewer is readily available, special consent may be given for foul water to be discharged into a cesspool or septic tank and surface water to a soakaway, ditch or natural watercourse or lake.

Provision of access to drains
As the majority of drainage is underground it is necessary to provide access to the system to allow rodding and the removal of debris. BS EN 752 and Approved Document H (Technical Standards for Scotland : Section 3, N.I. Part N) detail recommendations for the siting and sizing of access fittings.

Guidance on access to drains includes:
- Every drain length should be accessible for maintenance and rodding without the need to enter the building
- Access should be provided at the head of a drain run
- Access should be provided within 22m of every junction with another drain, unless there is an inspection chamber at the junction
- Access should be provided at changes of direction, pipe size or gradient
- Every soil and vent and WC pan connection must discharge into an inspection chamber
- Access should be provided at suitable locations to aid the testing of pipe runs
- Each drain length must be roddable from at least one point.

Table 1.15, 1.16 and 1.17 provide guidance on access to drainage.

Special protection – rodent control
Where the site has been previously developed, the Local Authority should be consulted to decide whether special precautions are necessary for the control of rodents. These measures can include:
- Sealed drainage – secondary access covers to pipework within inspection chambers.
- Intercepting traps – regular maintenance of these will be required to prevent blockages. They should only be installed in chambers where maintenance can be carried out from the surface.
- Rodent barriers fitted within discharge pipes or the drainage system.
- Metal cages on ventilator stack terminals to discourage rodents from exiting the drainage system.
- Fixed metal or plastic gratings to gullies in order to prevent dislodging by rodents.

Other requirements

- Pipes should be laid to an even gradient and any change in gradient should be combined with an access point
- Pipes should be laid in straight lines but may be laid to slight curves if these can be effectively rodded
- Connections should be to inspection chambers or manholes, but connections to junctions are acceptable if access is provided to clear blockages. In all cases discharge should be in the direction of flow
- Bends should be positioned in or adjacent to terminal fittings, inspection chambers or manholes and at the foot of discharge stacks. Bends should have as large a radius as practicable
- The system should be ventilated at or near the head of each main drain to allow free passage of air throughout, the maximum length of any branch serving a single appliance being 6m and for a group of appliances 12m
- Where appliances are not fitted with integral traps at the point of discharge a trap must be provided using either a trapped gully or low back trap

to:	Access fitting small	Access fitting large	to junction branch	to inspection chamber	to manhole
start of external drain (from stack or ground floor appliance)	12m	12m	–	22m	45m
rodding eye	22m	22m	22m	45m	45m
access fitting small. 150mm x 100mm or 150mmø	–	–	12m	22m	22m
access fitting large. 225mm x 100mm		–	45m	22m	45m
inspection chamber	22m	45m	22m	45m	45m
manhole	–	–		45m	90m*

Table 1.15 – Maximum Spacing Between Access Points

type of access	depth to invert (m)	min. internal dimensions (mm) rectangular	min. internal dimensions (mm) circular	min. nominal cover size (mm) rectangular	min. nominal cover size (mm) circular	remarks
access fitting	0.6 or less	(1) 150 x100 (2) 225 x100	150 225	150 x100 225 x100	150 same size as access fitting	the depth restriction is imposed because of the limited access afforded by these items
inspection chamber	0.6 or less	225 x100	190 dia for drains up to 150mm dia	-	190	the depth restriction is imposed as for the access fitting
	1.2 or less	450 x 450	450	min 430 x 430	430	
	> 1.2	450 x 450	450	max 300 x 300	350	
rodding eye			not less than 100 dia		same size as pipework	

Other requirements

(1) **Gradient** – Pipes should be laid to even gradients and any change in gradient should be combined with an access point

(2) **Direction** – Pipes should be laid in straight lines but may be laid to slight curves if these can be cleared of blockages

(3) **Junctions** – Connections should be to inspection chambers or manholes but connections to junctions are acceptable if access is provided to clear blockages. In all cases discharge to be in the direction of flow

(4) **Bends** – Bends should be positioned in or adjacent to terminal fittings, inspection chambers or manholes and at the foot of discharge stacks. Bends should have as large a radius as practicable

Table 1.16 – Minimum Dimensions for Rodding Eyes, Access Fittings and Inspection Chambers

type	size of largest pipe	min. internal dimensions(mm)	diameter (mm)	min clear opening size	diameter
<1.5m deep to soffit of pipe	<150 225 300 >300	750 x 675 1200 x 675 1200 x 750 1800 x (DN+450)	1000 1200 1200 The larger of 1800 or (DN+450)	750 x 675 1200 x 675	N/A
>1.5m deep to soffit of pipe	<225 300 375-450 >450	1200 x 1000 1200 x 1075 1350 x 1225 1800 x (DN+775)	1200 1200 1200 The larger of 1800 or (DN+775)	600 x 600	600

Notes
(1) Larger sizes maybe required for manholes on bends or where there are junctions
(2) The minimum size of a manhole serving any drain from more than 1 property should be 1200mm x 675mm or 1200mm diameter
(3) Further guidance is available for manhole shafts > 3.0m deep

Table 1.17 – Minimum Dimensions for Manholes

Foul Water

Foul water drainage is permitted to discharge to one of the following systems listed in order of priority:

1. A public sewer; or where this is not reasonably practicable,
2. A private sewer communicating with a public sewer; or where this is not reasonably practicable,
3. Either a septic tank which has an appropriate form of secondary treatment or another wastewater management system; or where that is not reasonably practicable,
4. A cesspool

Main drainage
The drainage system will be deemed to be acceptable to Q if compliance with Building Regulation requirements – foul and surface water drainage is achieved.

Testing and inspection
After laying gravity drains and private sewers they should be tested for water tightness using either a suitable:

- Air test or;
- Water test

Where separate drainage systems are provided connections should be proven to ensure that they are connected to the correct system.

No. of Residents	4	9	13
Capacity in litres	2700	3600	4500
Capacity in gallons	600	800	1000

Time taken to fall	Overall length of drain run required for capacity tanks (in metres)					
250mm	2800 litres	3600 litres	4500 litres	6000 litres	7500 litres	9000 litres
Up to 30 minutes	15	30	50	80	120	140
Up to 1 hour	30	60	90	150	225	280
Up to 2 hours	60	120	180	300	-	-
Up to 3 hours	90	200	360	-	-	-
For drain runs in excess of 100m, the trench may be widened to 1m and the length halved from the above figures						

Septic tanks

General Description

- They are designed to separate and settle solids which are present in sewage, leaving the resultant liquids to be absorbed in the soil. Dispersal is via a sub-surface looped irrigation system of rigid perforated land drains laid in excavated trenches with gravel fill
- All septic tank installations must possess independent third party certificates acceptable to Q and / or comply with BS 6297 Design and installation of small sewage treatment works and cesspools
- Sizing of tank depends on the number of residents served by the development (As an indication see table 1.18)

Design
The following design considerations should be taken into account:

- Legal requirements to obtain "Consent to Discharge" from the Environment Agency.
- Siting should be no closer than 7m from any habitable parts of the building, preferably downslope.
- The dispersal system should be a minimum of 10m from the nearest watercourse and a minimum of 1m above the local water table.
- Emptying vehicles should have access to within 30m of the tank.
- Prevent leakage and ingress of sub-soil water.
- Have adequate ventilation to comply with the manufacturers recommendations
- Dry site – 150mm level base of concrete required (with pea gravel fill)
- Wet site – 200mm layers of hardcore/concrete is required (with concrete back fill). The tank should be filled with water to avoid flotation during installation.
- The drainage system should be lengths of perforated pipe (except for the first 3m) laid to falls of approximately 1 in 200. Do not use corrugated land drain pipework.
- Due consideration of changes in water table levels should be considered for outfall drainage.
- Use 30 – 50mm gravel to surround the pipes. Lay a polythene membrane between any topsoil and gravel to avoid contamination.

Foul Water
Soil porosity tests should be carried out in accordance with BS 6297 section 15.3.2.

The test involves:
- Excavating a hole 300 x 300mm to a depth of 250mm BELOW the proposed invert of the land drain.
- Fill the hole with water up to 250mm deep, allow to drain overnight.
- Refill to a depth of 250mm and note the time taken to drain away. Repeat twice.
- Use table 1.19 to calculate length of outfall drainage for capacity of tank.
- A notice should be fixed within the property describing necessary maintenance and occupier’s responsibilities.

Cesspools

The following items should be considered when choosing a site for a cesspool:

- Should have sufficient capacity below the level of the inlet of at least 18,000 litres for 2 users. This size should be increased by 6800 litres for each additional user.
- Should have no openings except for the inlet, access for emptying and ventilation.
- Siting should be no closer than 7m from any habitable parts of the building, preferably downslope.
- Emptying vehicles should have access to within 30m.
- Traffic loadings should be avoided.
- Due to the tendency of cesspits to become buoyant they should be surrounded by concrete.
- Dry sites – they can be backfilled with pea gravel with a concrete base.
- Wet sites – should be bedded onto pea gravel, which is laid on a 150mm concrete base. Backfill with concrete should occur with the tank being filled with water to avoid flotation during installation.
- A notice should be fixed within the property describing necessary maintenance and occupier’s responsibilities.

Sewage treatment plants

Biotec sewage treatment plants employ a development of the aerobic biological process for the purification of sewage and waste water. There are 4 stages:

- Initial stage – retention of coarse solids for subsequent breakdown
- Reduction stage – pollutants removed by presenting the sewage to the micro-organisms in the presence of oxygen
- Additional treatment to provide nitrification
- Treated effluent is discharged via the outlet. The discharge should be at least 10m from a watercourse and any habitable building

Prior to installation there is a legal requirement to obtain a “Consent to Discharge” from the Environment Agency.

Installation

The following should be considered prior to installation:

- Siting should be no closer than 7m from any habitable parts of the building, preferably downslope.
- The tank should be vented
- If the packaged treatment plant requires power to operate it should be able to adequately function without power for up to 6 hours or have an uninterruptable power supply.
- Periodic emptying to prevent excessive build up of surplus sludge is required. It is therefore recommended that emptying vehicles should have access to within 30m.
- A notice should be fixed within the property describing necessary maintenance and occupier’s responsibilities.

Pump systems

There are 2 basic types of standard pumpsets:

- The Septic Tank and Integral Pumpset.
- The Domestic Sewage Pumpset.

Where gravity drainage is impracticable, or protection against flooding due to surcharge in downstream sewers is required, a pumping installation should be installed. Where foul water drainage from a building is to be pumped, the effluent receiving chamber should be sized to contain 24-hour inflow for disruption in service.

Design Consideration for location of pumps

- Units should be installed below ground
- Mains supply of 230 volt, single phase 50Hz is recommended
- Dry site – 150mm concrete base with pea gravel backfill
- Wet site – 150mm layers of hardcore concrete base with backfilling of concrete

Surface Water

Surface water drainage is permitted by the use of one of the following systems listed in order of priority:

1. An adequate soakaway or some other adequate infiltration system; or where this is not reasonably practicable,
2. A watercourse; or where this is not reasonably practicable,
3. It should be noted that this 'priority' is the reverse, previously described for foul drainage. It should help to minimise surface water entering the foul drainage system, which can often overload the capacity of the sewer and cause flooding.

Mains drainage

BS EN 752 adopts the "flat rate of rainfall" method for assessing the peak discharge of surface water and is suitable for drains that do not exceed 200m in length. (See table 1.20) It assumes a flat rate of rainfall of 50mm/hour. This rainfall intensity is regarded as satisfactory by most regulatory bodies, however some areas of the country are susceptible to heavy rainfall so 75mm/hour may be required by the authority. All of the rainfall on impervious areas should be assumed to reach the drain, whilst all pervious areas should be disregarded from the equation.

TYPE OF SURFACE	EFFECTIVE DESIGN AREA (m^2)
Paved Areas	Plan Area
Flat Roof Plan	Area of Roof
30° roof pitch plan	Area x 1.29
45° roof pitch plan	Area x 1.5
60° roof pitch plan	Area x 1.87
75° roof pitch elevational	Area x 0.5

Soakaways

Soakaways can only be considered in permeable ground conditions and should be positioned in areas where stability and support to foundations of adjacent structures can be maintained. Where any doubt exists as to the suitability of the ground, it may be necessary to obtain permeability figures by ground investigation. This should be carried out by a recognised Soils Engineer or Geologist who will then recommend on the suitability of soakaways. Further information is given in BRE Digest 365 and BS 6297.

Modern soakaways are generally constructed of perforated pre-cast concrete rings to allow water to percolate away. Other soakaways may take the form of land drains, traditional brick built pits jointed in honeycomb bond, or a combination of the above.

Soakaways and other forms of infiltration drainage may not be possible. Infiltration devices should not be built:

- Within 5m of a building or road or in areas of unstable land;
- In ground where the water table reaches the bottom of the device at any time of the year;
- Close enough to other filtration devices such that the overall capacity of the ground is not exceeded and the effectiveness is not impaired.
- Where the presence of any contamination in the runoff could result in pollution of the groundwater source or resource.

Percolation tests should be carried to confirm the suitability of an infiltration system.

Soakaways should be designed in accordance with BS EN 752-4 or BRE Digest 365 Soakaway design.

Combined systems
It may be necessary to install surface and foul water drains separately even where a site is being served by an existing combined sewer. This should be confirmed with relevant authorities prior to designing the drainage.

When a one pipe system is installed, it is important that all surface water fittings have an integral trap so that foul gases do not cause nuisance.

BS EN 752 states that a combined drain should be capable of accepting peak surface and foul water flows. It is also good design practice to ensure that self cleansing velocity (0.75l/s) is achieved when only foul water flow is entering the drain (i.e. when there is no rain).

Separate systems
Separate systems of drains should be provided for foul water and rainwater where:

- The rainwater is not contaminated; and
- The drainage is to be connected either directly or indirectly to the public sewer system and either –
    1. The public sewer in the area comprises separate systems for foul water and surface water; or
    2. A system of sewers, which provides separate conveyance of surface water, is under construction or is proposed.

Subsoil drainage of gardens
Avoid flooding of garden areas

Subsoil drainage may be necessary in garden areas where:
- Site works have affected the natural flow of ground water within 4m of the dwelling e.g. exposing of underground springs (See diagram 1.26)
- Ground water table rises to within 250mm of the finished ground within 4m of the dwelling (See diagram 1.27)
- The drainage of the subsoil is poor and the ground contours make the site prone to waterlogging within 4m of the dwelling (See diagram 1.28).

Layout of land drains
On sloping sites drain runs should be located perpendicular to the fall of the site.

Land drains should be located adjacent to paths, drives and outbuildings. The pipe soffit should be located at least 400mm below the finished ground level and the backfill consolidated to the same degree of compaction as the adjacent soil.

Where retaining walls are provided, a land drain should be provided on the retained soil side of the wall, adjacent to the foundations.

Where required, land drains should be laid across the site in a regular pattern. The spacing between each drain will depend upon the permeability of the subsoil, varying from 3m for heavy clays to 18m for permeable soils (See diagrams 1.29 and 1.31).

Subsoil Drainage

Diagram 1.26: Ground Water Exposed by Site

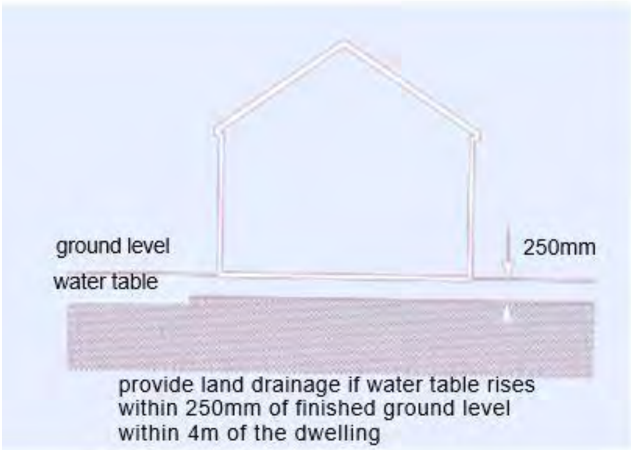


Diagram 1.27: Ground Water – High Water Table

Diagram 1.28: Ground Water – Waterlogged Site

Construction of land drains

Drain materials should comply with either:

- BS 1194 Concrete porous pipes
- BS 65 or BS 1196 Clayware pipes
- BS 4962 Plastic pipes
- Or possess independent third party certificates acceptable to Q

Land drains should be laid to a uniform gradient with falls of not less than 1:200 and as recommended by the pipe manufacturer.

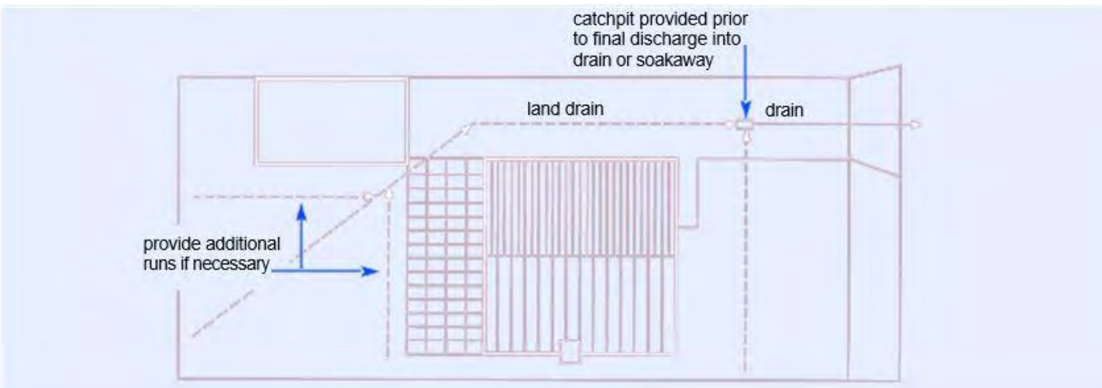


Diagram 1.29: Ground Water – High Water Table

Generally the minimum pipe diameters currently available for each land drain material provide adequate drainage capacity for individual plots. On multiple plot sites (where collector land drains are used), or very wet sites, larger diameter pipes may be necessary and should be sized in accordance with manufacturer's design data.

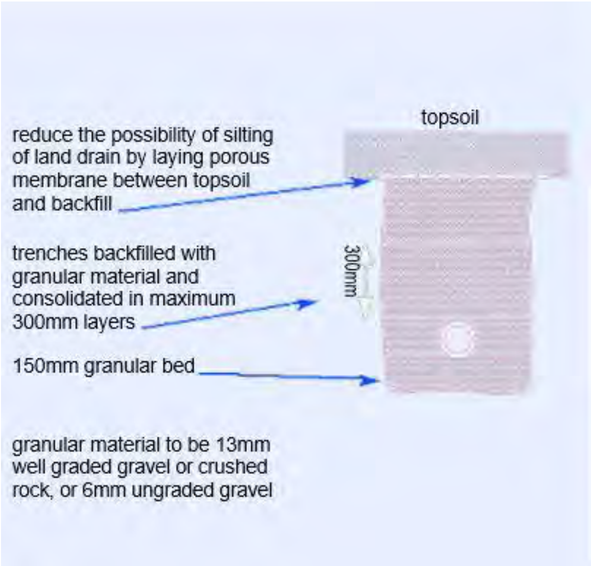


Diagram 1.30: Backfilling of Trenches

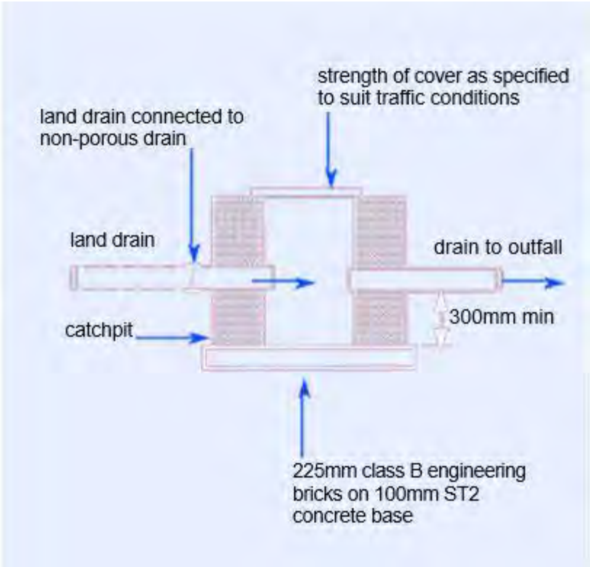


Diagram 1.31 Catchpit Detail

Land drains should be jointed in accordance with manufacturer's instructions with perforations laid uppermost where appropriate.

Diagram 1.29 and 1.32 show typical subsoil drainage schemes for single and multiple plot sites.

Land drains should be bedded and backfilled with either:

- 13mm well graded gravel or crushed rock, or
- 6mm ungraded gravel (pea shingle)

It is recommended that a membrane is laid over the granular backfill to prevent silting of the drain (See diagram 1.30).

Ensure proper drainage of groundwater away from the site.

Land drains should discharge into either:

- A soakaway located in porous ground located at least 5m from any building. For soakaway design refer to BRE Digest 365
- A watercourse (subject to approval of the Water Authority)
- A storm drain
- A foul drain (subject to the approval of the Water Authority).

Where final discharge is into a drain or soakaway, a catchpit should be provided (See diagram 1.31 and 1.32).

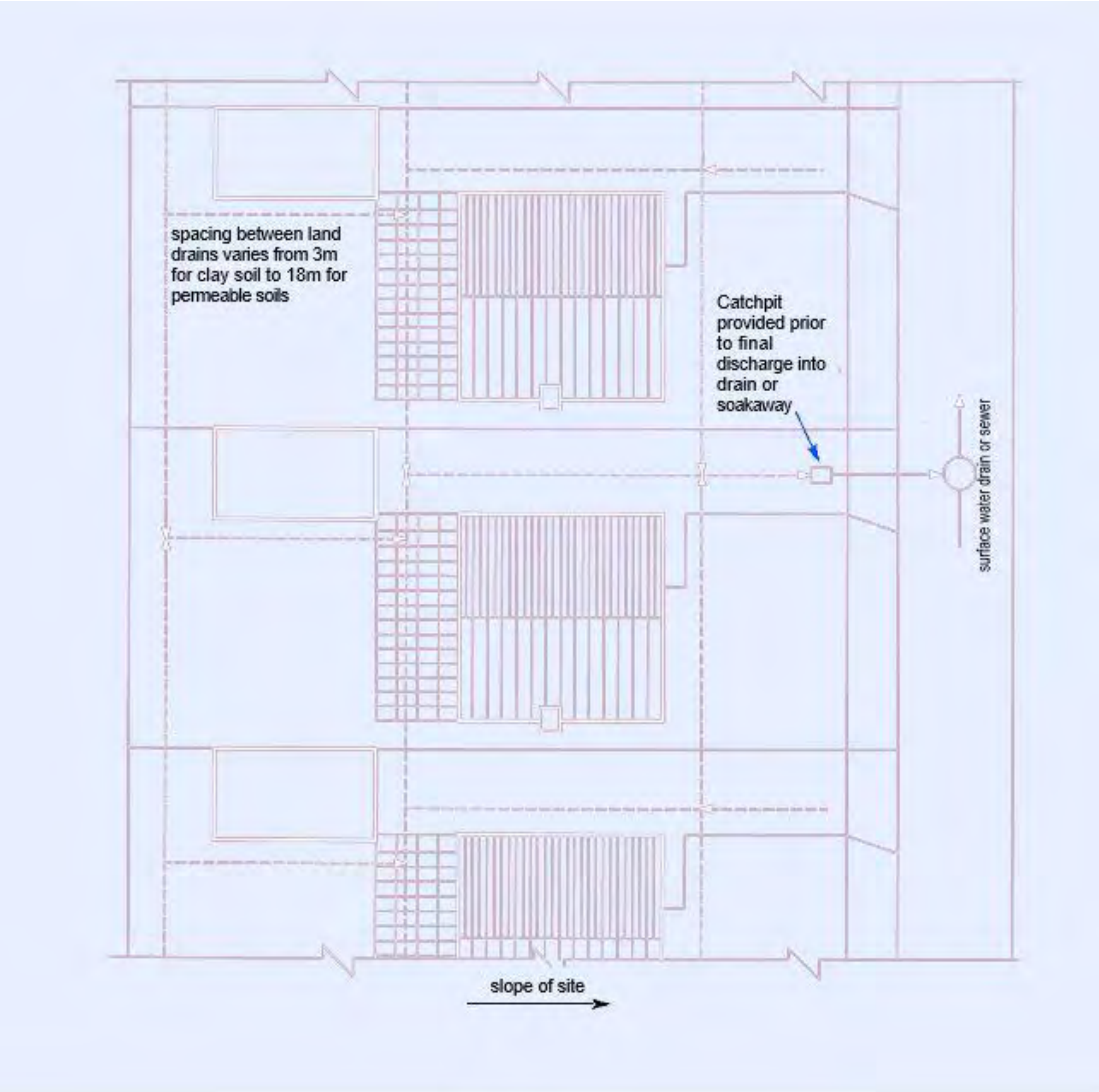


Diagram 1.32 Typical Subsoil Drainage for Multiple Plots

Basements

General

Ways of achieving compliance with the requirements
The basement should be designed and constructed in accordance with the guidance contained in the following appropriate document:

England & Wales: Approved Document C – Site Preparation and resistance to moisture

Scotland: Section 3 – Environment

N.Ireland: Part C – Resistance to moisture

Q strongly recommends that waterproofing systems should be designed by a waterproofing design specialist. Designers who have successfully completed the Certified Surveyor in Structural Waterproofing (CSSW) qualification available from the Property Care Association (PCA) would generally be acceptable to Q. Additionally, a 10-year insurance backed warranty for workmanship and material is advised in most cases.

It should be noted that a 10-year insurance backed warranty for workmanship and materials is a requirement of Q. This is also highlighted on the selfbuild application form.

Amongst others the following companies are acceptable to Q:

- Rentokil Environmental Services Ltd
- Guarantee Protection Insurance

This is not an exhaustive list and other companies are acceptable provided their products/system can be shown to be suitable by third party accreditation.

Site Investigation
Before starting any design or construction work, a site investigation should be made to establish the ground conditions (including the type of subsoil), the level of the water table (including the provision for natural drainage), the location of any existing drains or other services, the presence of contaminants and whether there is a risk from radon and other gases.

Contaminants
If the site investigation indicates the presence in the ground of solid or liquid contaminants, natural gases (e.g. radon) or landfill gases, then appropriate measures should be taken to limit their effect on the basement and on the remainder of the dwelling.

In addition to complying with the provisions of Approved Document C, the possible effects of contaminants on the materials used in basement construction should be considered (please also see Site Investigations).

Underground Services and Drainage

With the agreement of the appropriate statutory authority, any services which are affected by the construction work should be re-routed around the building, or the building and the services should be designed to enable the services to run under the building, again with their agreement.

The building should be orientated and designed to avoid the risk of increasing hydrostatic pressure. Where this is not practicable, the waterproofing system should be designed to withstand a full hydrostatic head. Provision should be made for maintainable sub-ground drainage to control or maintain the external environment for which the waterproofing system was designed.

Exclusion of Moisture
Walls and floors below external ground level and the junctions between them should:

- Provide resistance to ground moisture reaching the internal surface of the wall or upper surface of the floor so that the environmental conditions in the basement are appropriate to the intended use
- Not be adversely affected by moisture from the ground.

Key to levels of protection

Grade 1	Allows some seepage and damp patches
Grade 2	Allows no water penetration but moisture penetration is acceptable
Grade 3	No water penetration and provides dry environment
Grade 4	Grade 4 Protection catergory has been removed from BS 8104

Grade 2 is recommended as a minimum for garages, Grade 3 is required as a minimum for habitable accommodation.

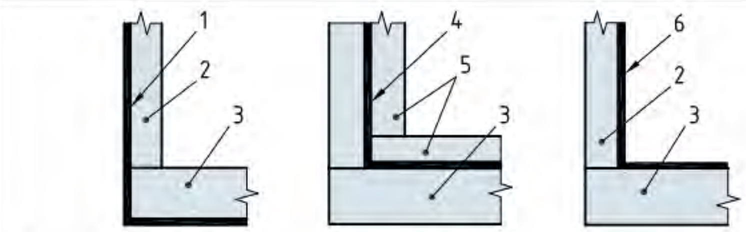
BS 8102 Specifies three types of waterproof protection

Type A - Internal or external tanking

Type B - Structurally integral protection

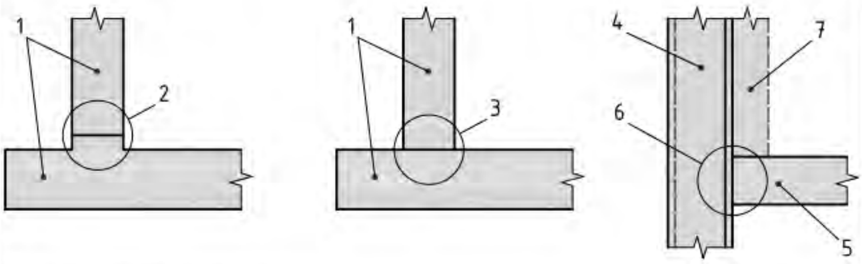
Type C - Internal drained cavity protection with a sump and pump for removal of water or its disposal by gravity

Combined systems should be used where Grade 3 protection is required, and the below ground wall retains more than 600mm measured from the top of the retained ground to the lowest finished floor level.



a) Type A (barrier) protection

Key
1 External waterproofing
2 Masonry or concrete wall, as appropriate (see Table 1)
3 Concrete floor slab
4 Sandwiched waterproofing
5 Loading coat
6 Internal waterproofing



b) Type B (structurally integral) protection

Key
1 Water-resistant reinforced concrete wall and slab
2 External or internal (within wall) waterstop, as required
3 Waterstop required at junction between wall and slab and at all construction joints
4 Concrete/steel piled wall
5 Water-resistant reinforced concrete floor slab or slab with added barrier
6 Waterstop at junction to follow profile of wall
7 Piled wall might need to be faced to achieve desired water resistance (see Table 1)

NOTE Seek the manufacturer's advice with respect to waterstops to suit the specific construction.

Tanking

Similar wall constructions can be used for Grades 2, 3 and 4 with improvements in dryness being obtained by the degree of heating, ventilation and moisture control.

It is advisable to provide ventilation to all basements (heated or unheated) so that any moisture vapour either generated within the dwelling, or brought in through the structure, is adequately controlled.

General

Combined systems should be used where Grade 3 protection is required, and the below ground wall retains more than 600mm measured from the top of the retained ground to the lowest finished floor level.

Alternatively, where the builder has demonstrated that the water table is permanently below the underside of the lowest floor slab, a Type B structurally integral concrete system is acceptable without further protection from a combined system.

Tanking to basements should be properly connected to and made continuous with wall dpcs
(See diagrams 1.33 – 1.38).

Perforations of the tanking membrane, e.g. by service entry pipes should be avoided.

Suitable tanking systems include mastic asphalt, combined bitumen/polythene membranes and proprietary tanking systems possessing independent third party certificates acceptable to Q. All tanking systems should be installed in accordance with the manufacturer's instructions.

SHEET MATERIALS SUCH AS POLYTHENE ARE NOT DEEMED SUITABLE FOR TANKING.

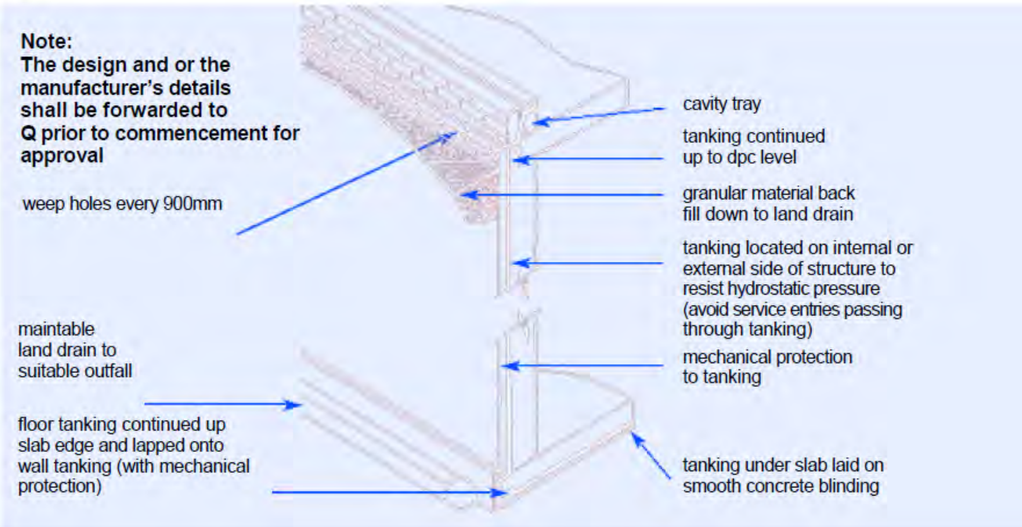


Diagram 1.33: Tanking to basements

Tanking should be designed to resist mechanical damage and the effects of hydrostatic pressure. The tanking system can be provided to the internal (a loading coat should be provided to prevent accidental damage to the water proofing membrane) or external face of the basement wall, alternatively the wall itself can be designed to resist the passage of moisture and the forces applied (See diagrams 1.34 and 1.35).

All basements should be designed by an Expert to be structurally stable and resist the passage of moisture. A high level of workmanship and site supervision is essential, particularly when incorporating a reinforced concrete design in accordance with BS 8110.

Whichever system or design is proposed, it is essential that the specification and/or the manufacturer's details shall be forwarded to Q prior to commencement and preferably at design stage, for approval.

A maintainable land drain should be provided around the perimeter of the basement at low level and the side of the basement wall back filled with granular material.

Workmanship should comply with BS 8000:4.

The following criteria should be considered in the selection of the waterproofing system to be adopted:

- Establish the position of the water table with respect to the underside of the lowest floor level according to the classification as follows
    - HIGH – The water table is above the underside of the lowest basement floor slab level (where because of insufficient permeability of the soil, percolating water is held above the underside of the lowest floor level, resulting in hydrostatic pressure)
    - LOW – The water table is permanently below the underside of the proposed basement floor level
    - VARIABLE – The water table varies between the two levels described above. The duration of this condition will dictate design requirements
- Establish the drainage capabilities of the soil (usually via soil analysis)
- Establish whether or not the tanking should be continuous:
    - NO – Where the water table is below the lowest floor level and the drainage characteristics of the soil are good, and will confidently remain so
    - YES – In all other cases (preferred option). In all situations a maintainable land drain should be provided at the base of the retaining wall (basement wall)
- Choose a suitable construction method to meet the tanking/waterproofing requirements. Typical tanking details are shown in diagrams 1.34 – 1.38
- Consider the type of foundation and its suitability for providing a continuous waterproofing structure
- Establish the most suitable form of tanking system to suit the site conditions. In considering which system, it is important to take account of any aggressive materials found in the soil or ground moisture. All systems whether cementitous, a liquid applied or sheet membrane should have third party accreditation and be installed in accordance with the manufacturer's instructions (preferably by an approved installer)
- The designer of a basement must ensure that all necessary details (service penetrations, change of level or direction, window/door reveals etc.) are shown
- A high level of workmanship and supervision is essential for all tanking systems

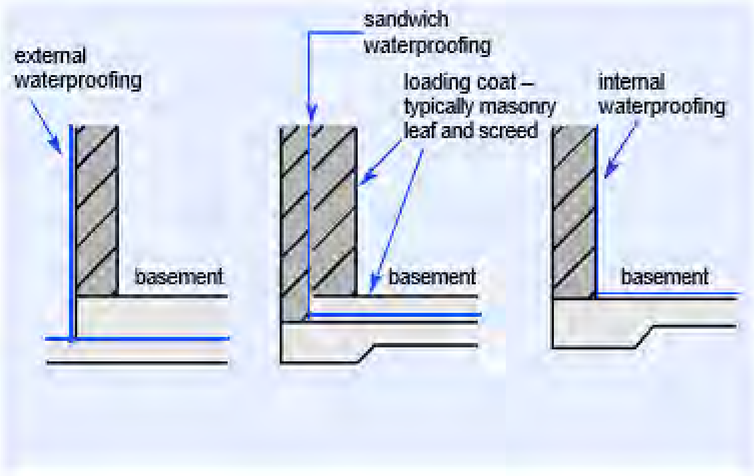


Diagram 1.34: Types of tanking protection to basement construction

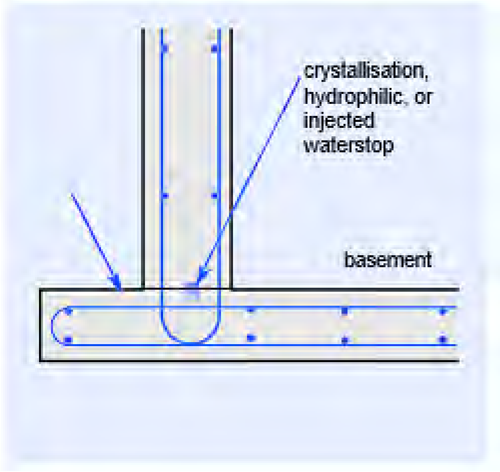


Diagram 1.35: Structurally integral basement construction

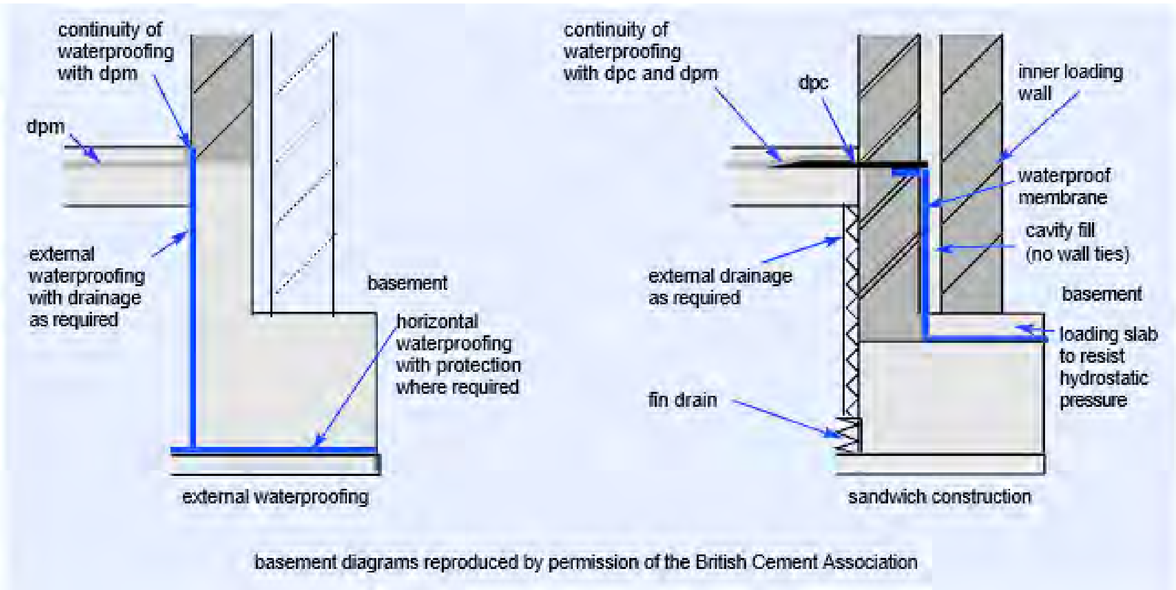


Diagram 1.36: Maintain continuity of waterproofing

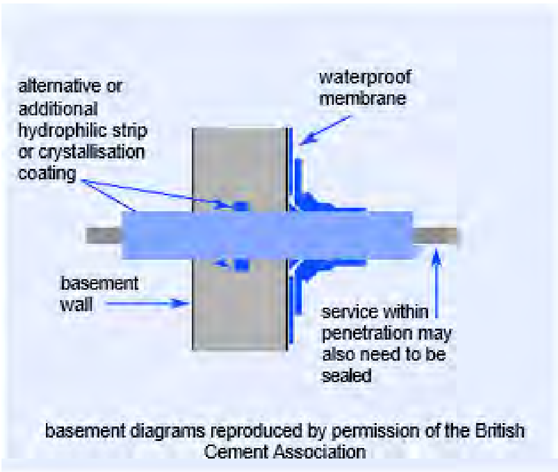


Diagram 1.37: Penetration of services through waterproofing

Detailing

Once the type of wall construction and the location of the tanking system have been established, consideration must be given to the detailing, particularly the continuity of the damp-proofing system to prevent any potential ingress of moisture. Diagrams 1.36 – 1.38 provide typical guidance on how to overcome linking details to achieve continuity.

These diagrams are only to be used as a guide, the principles will remain but specific details may change depending upon the tanking system and wall type adopted.

Ventilation & Drainage

Ventilation to basements
Habitable rooms including kitchens, utility rooms, bathrooms and non-habitable rooms (such as store rooms and workshops) located within a basement should meet the requirements of Approved Document F.

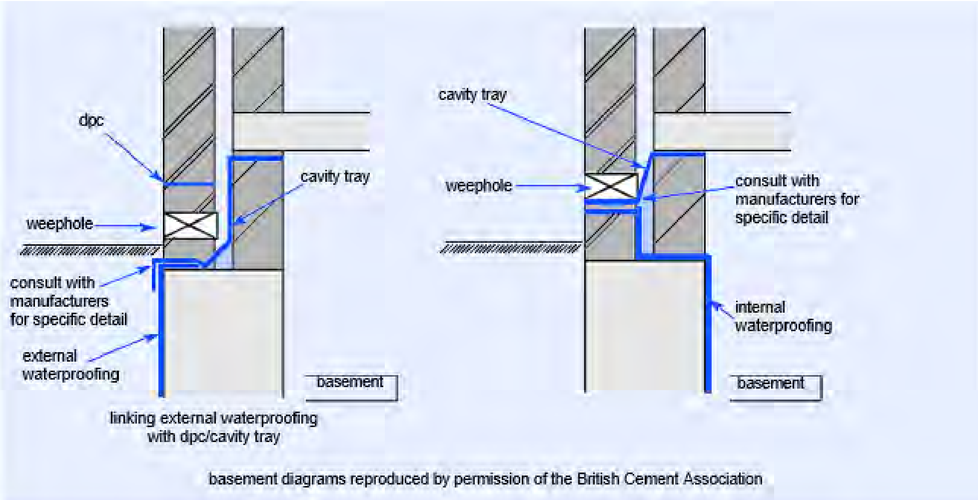


Diagram 1.38: Continuity of waterproofing – linking with superstructure

Drainage
All penetrations through a basement wall should be avoided wherever possible.

All pipework and drainage within a basement should comply with the requirements of BS EN 752.

Wherever possible the soil and vent pipe (SVP), serving the dwelling should be located on the outside of the basement construction. SVP's can be located externally even where there are drainage connections within the basement, however the system must be designed to reduce waterproofing penetrations to a minimum. The use of proprietary mini pumped systems can be adopted to overcome the need for such service installations.

Where service connections through basement walls cannot be avoided by design and/or layout, they should be designed along the guidance given in diagram 1.37. Where drainage connections pass through the basement wall, allowance should be made for future potential movement. Provide a rocker pipe having a maximum length of 600mm, positioned not more than 150mm from the external face of the basement wall. All other service entries should be designed to allow tolerance for movement of the ground and/or the structure (consult the supply company for further guidance on suitable tolerances).

Surface water drainage should comply with the requirements of Approved Document H and BS EN 752. Access areas of basement level and lightwells to windows should be provided with suitable surface water drainage to prevent flooding.

Means of escape
There is a risk that in the event of a fire in a basement or ground storey, a single stairway may become blocked by smoke. If the basement contains any habitable room an alternative means of escape shall be provided.

Additional guidance
- British Cement Association - Basement waterproofing: Design guide.
- British Cement Association - Basement waterproofing: Site guide.

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 1.26. and BS 3921.

Where sulphates in soils and/or ground-water 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 1500kg/m^3. A compressive strength greater than or equal to 7N/mm^2
- Some autoclaved aerated blocks.

Use	Brick type			Notes on Mortar (for mortar designation see table 2.04 page 131)
	Clay	Calcium Silicate*	Concrete	
Foundation to dpc	FL, FN, ML, MN**	Class 3	Strength > 20 N/mm2	
Foundation to dpc sulphates in soils	FL, FN, ML, MN**	Class 3	Strength > 20 N/mm2 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/mm2	
Unrendered external walls not protected from saturation	FL, FN	Class 3	Strength > 15 N/mm2	Use sulphate resisting cement in mortar with Type N clay bricks
Rendered external walls	FL, FN, ML, MN	Class 3	Strength > 7 N/mm2	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/mm2	
Internal	FL, FN, ML, MN, OL, ON	Class 3	All	

Notes: *Minimum Class indicated: a higher class (e.g. 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 or FN bricks with sulphate resisiting cement

Table 1.26: Selection of bricks

DPC & DPM

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 100mm laps (See diagram 1.39)
- 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 dpms by services should be fully sealed to maintain the integrity of the membrane.

Workmanship should comply with BS 8000:4.

Suitable damp-proof membranes

Damp-proof membranes should be either:

- Minimum 1200g (300µm) polythene (laid on sand blinding when located below the slab).
- Cold applied bitumen or coal tar, minimum 2/3 coats laid beneath screed (see manufacturers details for the appropriate number of coats).
- Hot applied mastic asphalt (laid beneath or over a screed).

Other damp-proof membranes should possess current independent third party certificates acceptable to Q.

Avoid 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 1.40).

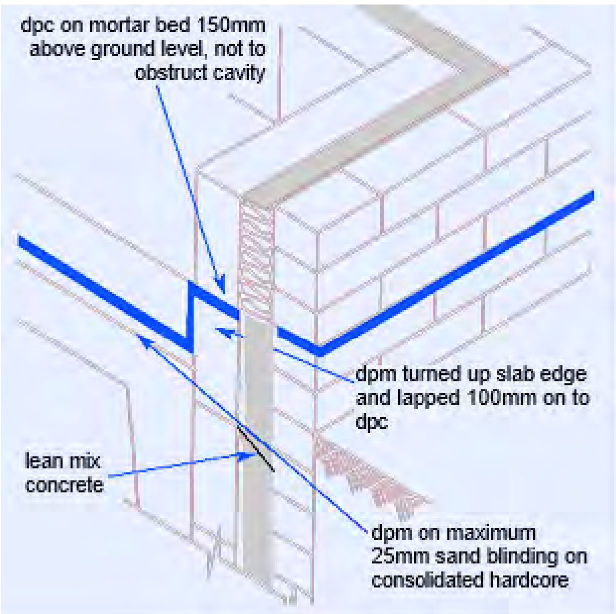


Diagram 1.39: Damp proof course and membrane

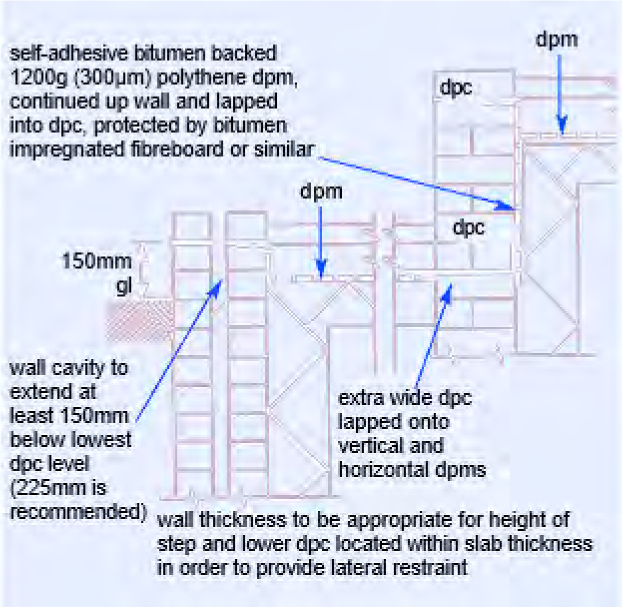


Diagram 1.40: Stepped ground floor slab

Floors

Introduction

Subjects covered in this section include:

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

The moisture content of structural timber should not exceed 20% 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 up to 5mm can be expected between floor covering (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. Some squeaking is to be expected and cannot be totally eliminated.

Choice of Ground Floor

Use a ground floor construction 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 soils
- Presence of trees

Avoid clay heave or shrinkage damaging concrete floor

Changes in moisture content of 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, whereas clay shrinkage is caused during long dry spells.

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

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 Suspended Floor details and table 1.14 for dimensions of associated voids.

Prevent settlement of ground supported slabs
Fill beneath concrete floors should generally not be used on sloping sites greater than 1 in 15, nor exceed 600mm in depth compacted in layers of a maximum thickness of 150mm unless a suspended reinforced floor is constructed.

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 100mm 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 Q.

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

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

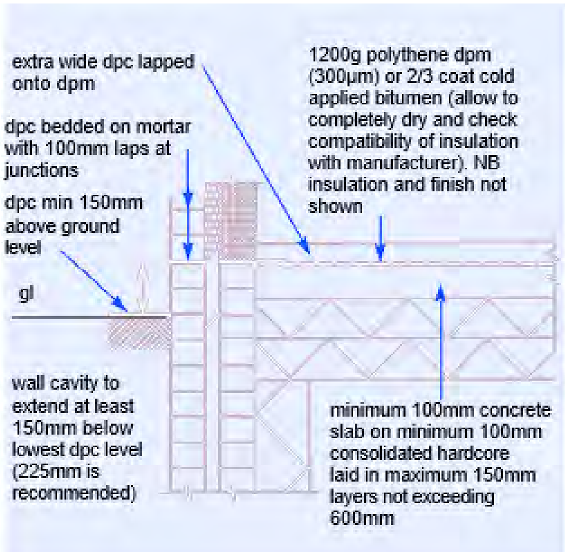


Diagram 1.41: Ground supported concrete slab with dpm above slab

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 minimum BS 5328/ST3 mix grade concrete at least 100mm thick. The concrete should be well tamped.

Avoid 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 1.41)

Avoid 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 50mm thickness (65mm 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 and protect or cure screeds from rapid drying out e.g., floor areas adjacent to south facing patio doors. Additional guidance is available in this section.

Suspended Timber Floors

Avoid 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 1.42)

Avoid 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. See table 1.20 for net areas of airbricks and ventilators.

For guidance on ventilating in areas of radon, refer to BRE report 211 Radon: Guidance on protective measures for new dwellings.

Avoid ingress of ground moisture into the building
Provide beneath all suspended timber floors either:

- A 100mm BS 5328/STI mix concrete oversite on hardcore, or:
- A 50mm concrete oversite and minimum 1000g (250µm) damp-proof membrane on sand blinding

Avoid 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 wallplates 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 is taken down to a suitable loadbearing strata is provided and its location clearly marked.

TYPE	SIZE (mm)	NET AREA (mm²)
Squared Holed Clay Air Brick	225 x 75	1400
	225 x 150	4300
	225 x 225	6400
Louvred Clay Air Brick	225 x 150	2000
	225 x 225	6400
PVC (Typical Values)	225 x 75	4645

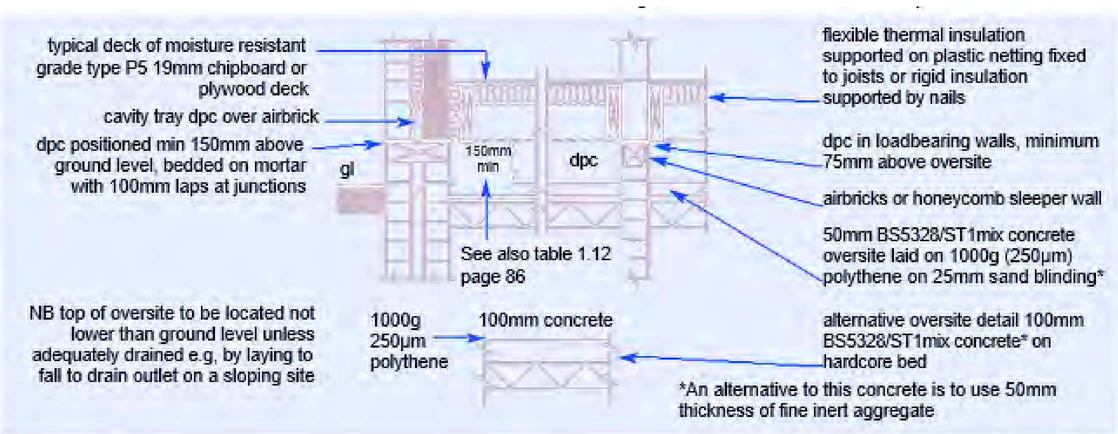


Diagram 1.42: Suspended timber ground floor

Avoid 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, and
- 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 1.28 below provide 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/m²
Dead load more than 0.25 but not more than 0.50kN/m²

Sizes with no partitions							Sizes with light weight partitions						
size of joist mm x mm	spacing of joists (mm) C16[1] 400	C16[1] 450	C16[1] 600	C24[2] 400	C24[2] 450	C24[2] 600	size of joist mm x mm	spacing of joists (mm) C16[1] 400	C16[1] 450	C16[1] 600	C24[2] 400	C24[2] 450	C24[2] 600
	Maximum clear span of floor joist (m)							Maximum clear span of floor joist (m)					
47 x 72	1.27	1.15	0.89	1.35	1.27	1.10	47 x 72	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	47 x 97	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	47 x 122	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	47 x 147	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	47 x 170	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	47 x 195	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	47 x 220	4.09	3.92	3.41	4.24	4.10	3.73
63 x 97	2.19	2.08	1.82	2.31	2.19	1.93	63 x 97	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	63 x 122	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	63 x 147	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	63 x 170	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	63 x 195	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	63 x 220	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. Non loadbearing lightweight partitions (loading not greater than 0.8kN/m run

Joists should be doubled up beneath baths and any other point of concentrated load
Non loadbearing partitions should be supported as shown in diagram 3.07, page 281

Table 1.28: Floor joist spans

Precast Beam & 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.

Avoid deflection of floors and cracking of screeds
Ensure that precast (PC) beam and block floors possess current independent third party certificates acceptable to Q and are:
• Fully supported by loadbearing walls
• Laid as specified by the designer and independent third party certificates acceptable to Q. Similar beams of the same size may have varying strength characteristics because of different size of reinforcement, therefore check the beam reference numbers
• 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

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

1. No damp proof membrane required
Locate the beams and blocks above dpc level and provide 600mm2/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 1.43)

The void should be increased to 150mm when:
• Venting to remove gas
• In Scotland
• A risk of clay heave exits

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.

2. 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 are expected (i.e. Methane or Radon).

Damp-proof membranes should be either:

- Cold applied bitumen or coal tar, minimum 2/3 coats laid beneath screed
- Hot applied mastic asphalt (laid beneath or over screed)
- 300µm polythene.

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.

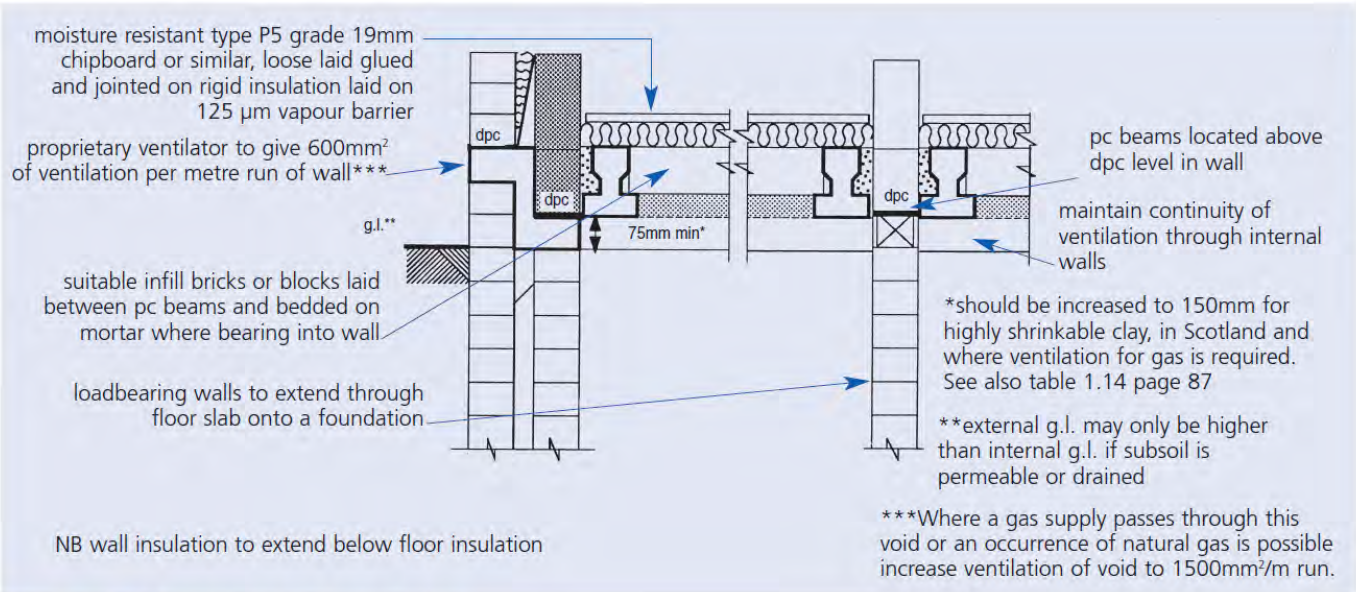


Diagram 1.43: Precast concrete ground floor

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 Q. 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 1.44).

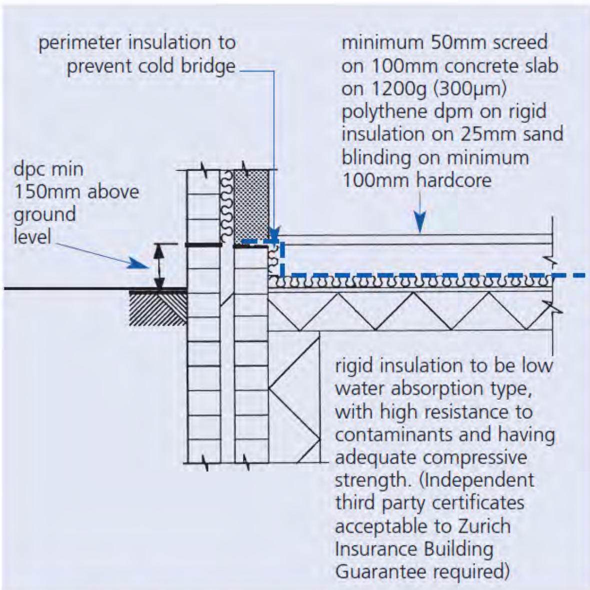


Diagram 1.44: Ground supported concrete slab with insulation located below the slab

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 1.45). 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 15m2.

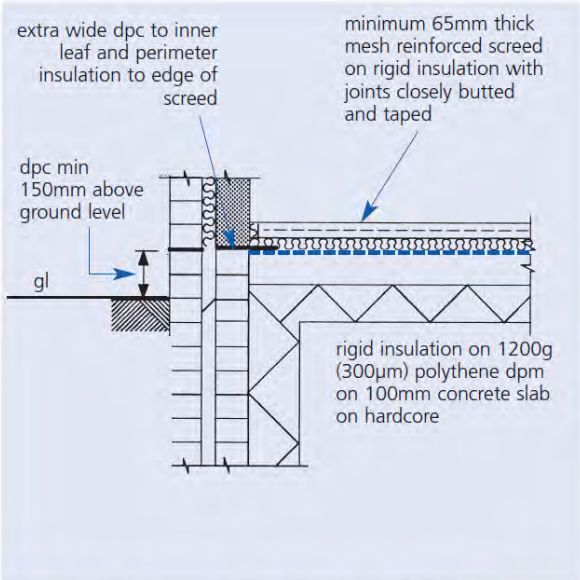


Diagram 1.45: Ground supported concrete slab with insulation located below the screed

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 1.46).

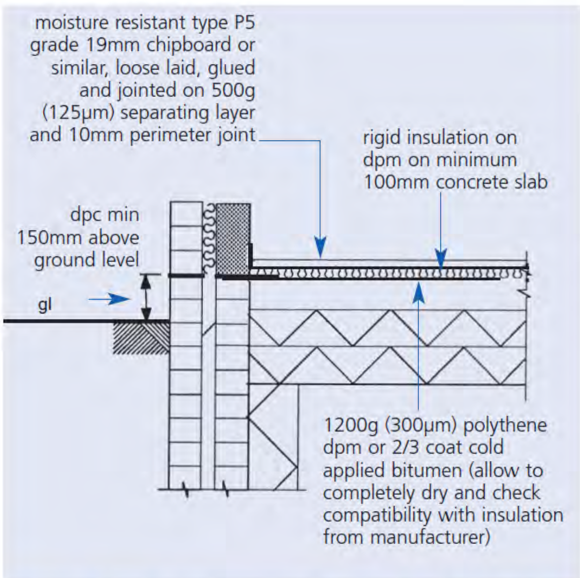


Diagram 1.46: Ground supported concrete slab finished with separate timber boarding and loose laid insulation system

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 10mm gap or 2mm 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 glueing 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 1.47).

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 600mm or by battens nailed to the side of the joists (See diagram 1.48)

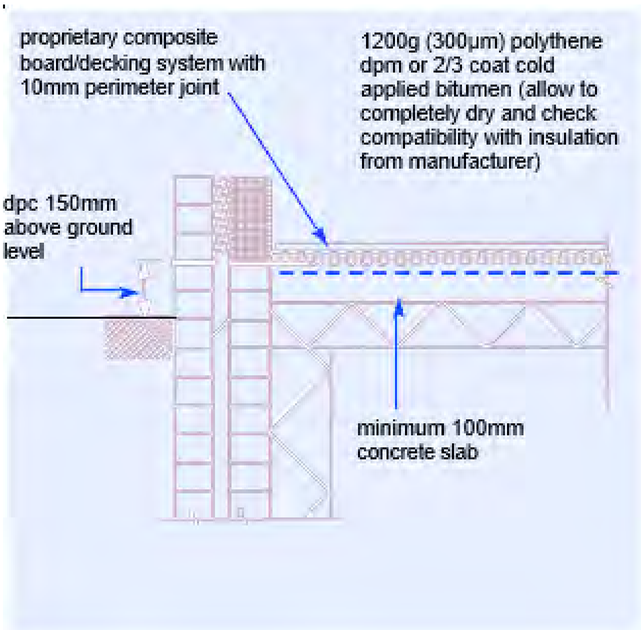


Diagram 1.47: Ground supported concrete slab finished with composite board/decking system

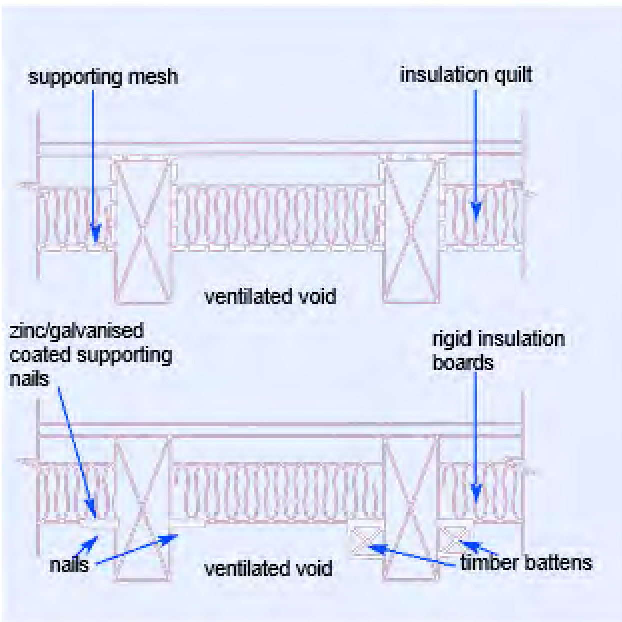


Diagram 1.48: Suspended timber floors – supporting of insulation over ventilated void

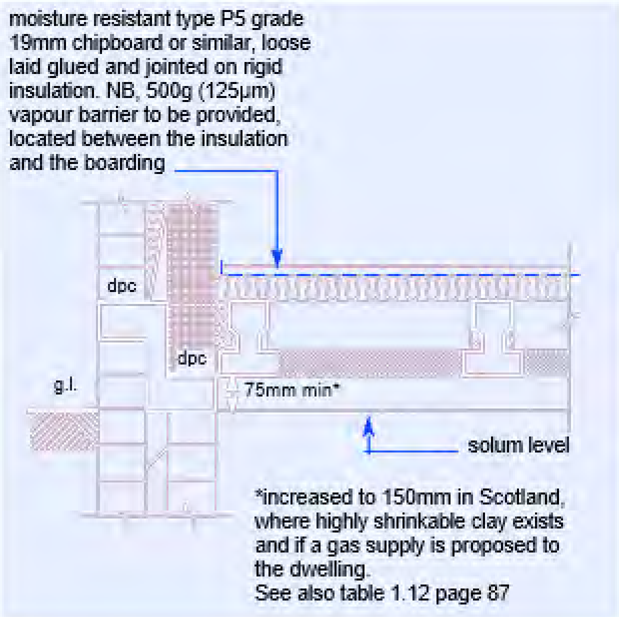


Diagram 1.49: Precast concrete ground floor with timber decking and insulation

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 1.49)

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 of 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 Slabs

Subjects covered in this section include:

- Using the Design Tables
- Site preparation
- Damp-proof membrane
- Site construction methods
- Design load/Span tables

This guidance mainly relates to work on site and is intended to provide simple slab design tables.

It may be more economical for the slab to be designed by a Structural Engineer using BS 8110. 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

Tables 1.32 – 1.35 provide simple details to select fabric reinforcement and concrete slab thicknesses for various spans and loading situations.

There are four loading situations:

- **Table 1.32:** No partitions, a domestic living area with a floor finish of up to 65mm sand cement screed.
- **Table 1.33:** Timber studwork and plasterboard partitions, a domestic living area with a floor finish of up to 65mm sand cement screed.
- **Table 1.34:** 100mm lightweight blockwork partitions, a domestic living area with a floor finish of up to 65mm sand cement screed.
- **Table 1.35:** 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 1.50)

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 1.51). If the builder wishes to lay the damp proof membrance under the slab the following must be complied with:

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

Damp-proof membranes should be either:

- 2/3 coats (min) of cold applied bitumen or cold tar, brushed onto the slab before screed is laid. (See manufacturers detail for the appropriate number of coats.)
- 1200g (300µm) polythene (laid on top of the slab).
- Hot applied mastic asphalt (laid beneath or over screed).
- Any other damp proof membranes possessing a current independent third party certificate acceptable to Q

In cases where a sheet-type damp proof membrane is laid above the slab an extra wide damp proof course should be provided in the wall and lapped onto the damp-proof membrane.

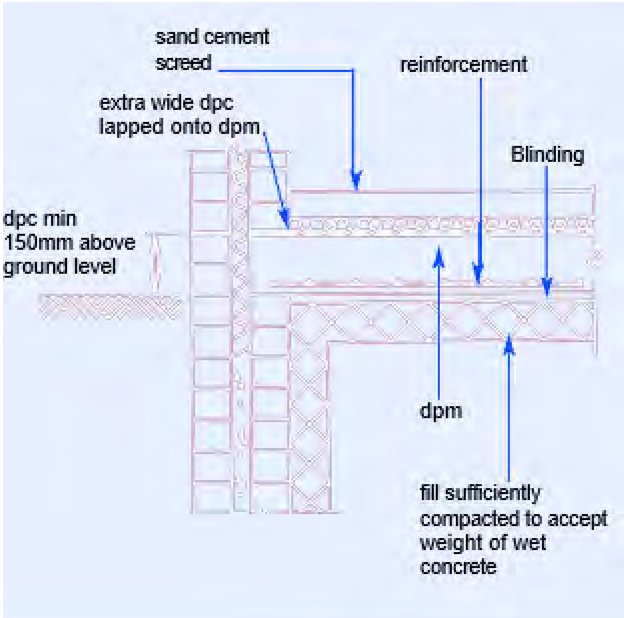


Diagram 150: Suspended R.C. slab after construction

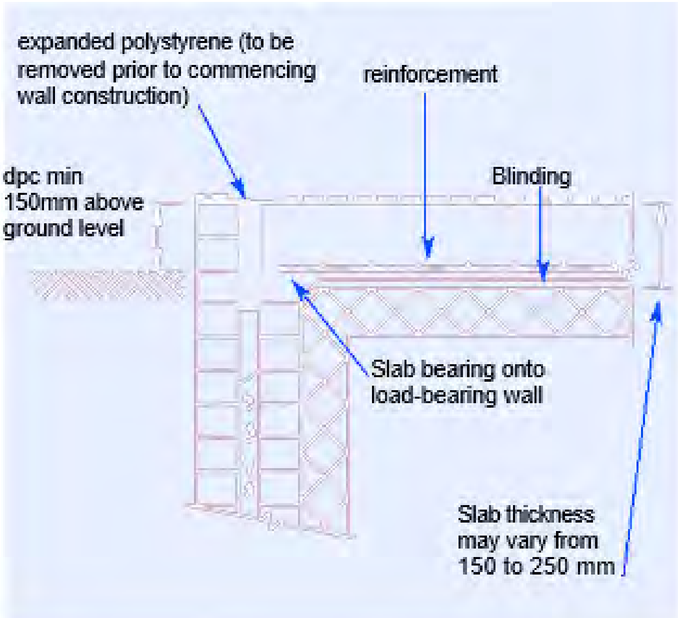


Diagram 1.51: Suspended concrete slab

Site construction

The purpose of a suspended reinforced in situ slab is to be independent of any fill material and transmit loads to foundations via walls. The slab must therefore bear onto load-bearing walls.

(Note: Diagrams shown are notional and may not indicate other details such as damp proof membranes, insulations or finishes).

The thickness of the slab will vary according to its span between walls (See diagram 1.51).

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.

Concrete Mix

The concrete in a reinforced slab must meet the requirements of BS 5328 and be a prescribed, designed or designated mix to provide a characteristic cube strength at 28 days of $35N/mm^2$.

The concrete should have a minimum cement content of $300kg/m^3$ with a maximum free water/cement ratio of 0.60. Slump for medium workability should be around 75mm and concrete should be placed within 30 minutes of mixing. Ready mixed concrete will be supplied to this specification.

Standard mixes are not considered suitable for suspended reinforced in situ slabs. Site mixing is not considered appropriate for this grade of concrete either. See table 1.29 for suitable concrete mix specification.

application	standard mix	designated mix	compressive strength @ 28 days N/mm^2 (MPa)	suggested workability slump (mm)	suggested method of compaction
Floors –					
house floors with no embedded metal:					
permanent finish to be added e.g. screed	ST2	GEN 1	10.0	75	poker or
no permanent finish to be added e.g. carpeted	ST3	GEN 2	15.0	75	beam vibration
garage floors with no embedded material	ST4	GEN 3	20.0	75	and/or tamping
Other reinforced and pre-stressed concrete applications					
reinforced or pre-stressed concrete:mild exposure	N/A	RC30	30.0	75	poker
reinforced or pre-stressed concrete: moderate exposure	N/A	RC35	35.0	75	poker

Table 1.29: Selection guide to the use and specification of standard and designed concrete mixes

Definitions

STANDARD MIX (ST)	DESIGNATED MIX (GEN, FND, RC, PAV)
A standard mix is a concrete designed using the materials and mix proportions given in BS 5328: 1 Section 4 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.	Designated mixes are designed and specified in accordance with BS 5328: 1 Section 5. It is a quality controlled mix, produced under BS EN ISO 9001 conditions. The purchaser orders the mix by specifying its required strength and its intended use i.e: RC to be used for reinforced concrete and GEN for general usage.

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 1.52).

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

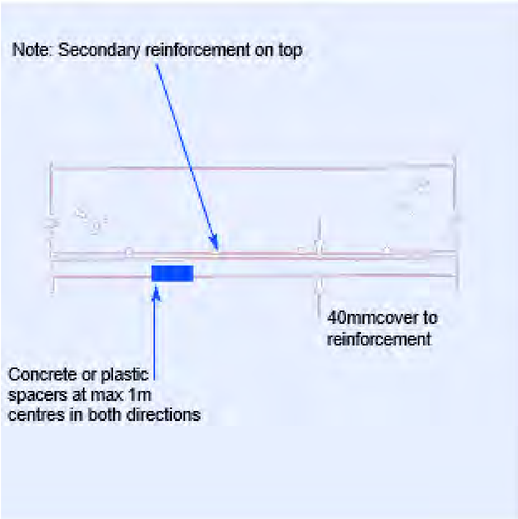


Diagram 1.52: Cover to reinforcement

Laying steel reinforcement
The fabric wires must be laid so that the main wires are parallel to the span (See diagram 1.53).

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.

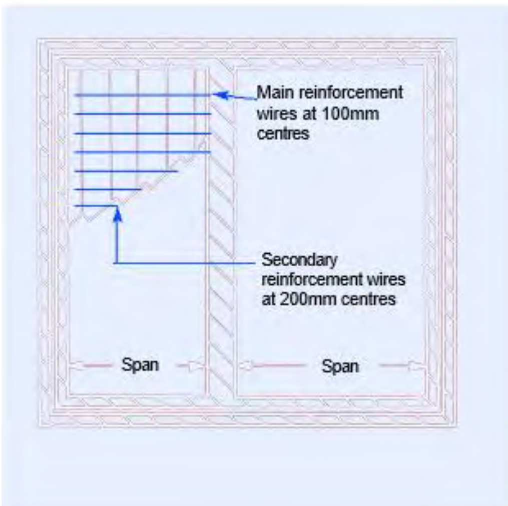


Diagram 1.53: The placing of reinforcement in slab

Lapping (where applicable)

Ensure the reinforcement is lapped and tied. Laps in secondary wires to be 300mm (See diagram 1.54 and table 1.30).

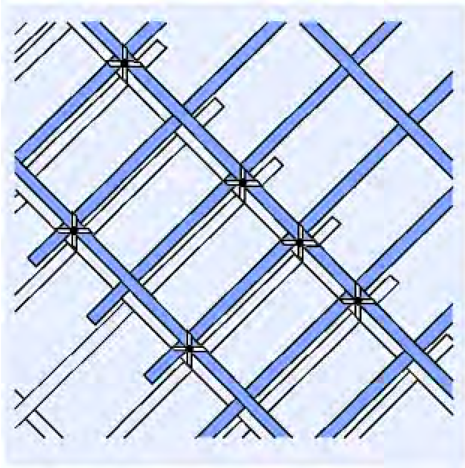


Diagram 1.54: End laps of fabric

MAIN WIRE LAPS	
FABRIC TYPE	**LAP LENGTH**
B1131	550
B785	450
B503	400
B385	350
B283	300
B196	250

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.

British Standard reference	size mm	main wires pitch mm	main wires area mm²/m	secondary wires size mm	secondary wires pitch mm	secondary wires 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

Diagram 1.31: Sizes of B mesh

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 1.55).

Where the slab is not continuous over an internal support, bottom fabrics should extend a minimum 75mm onto the wall (See diagram 1.56).

Where slabs bear on cavity walls the bearing width should be at least 90mm and 20mm end cover to reinforcement is recommended (See diagram 1.57).

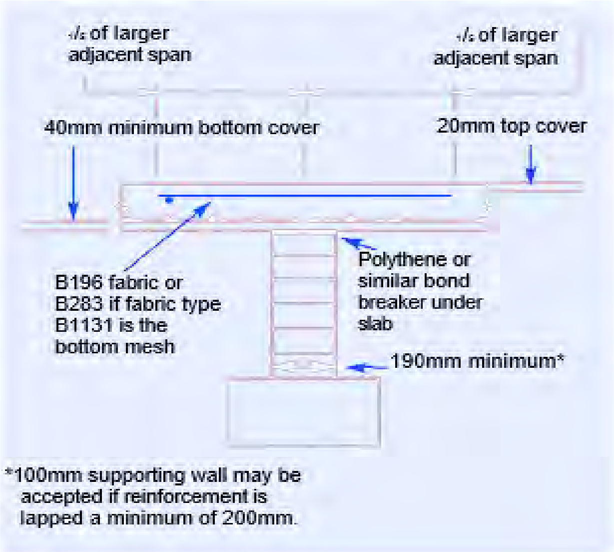


Diagram 1.55: Slab continuous over a support

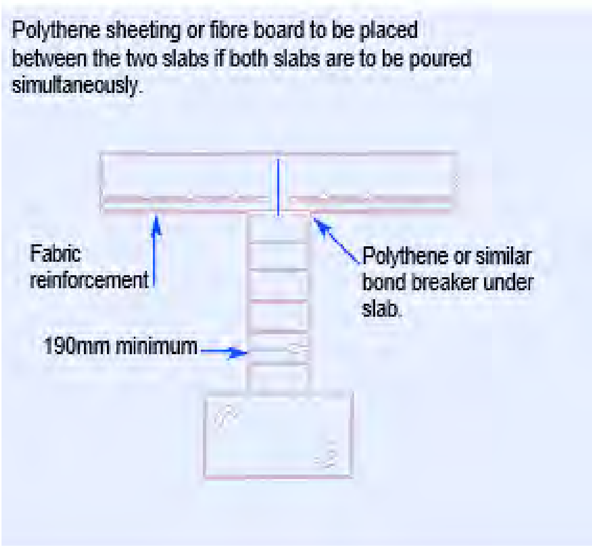


Diagram 1.56: Two slabs adjoining at support

Slab thickness

The thickness of slabs should be neither more, nor less than shown in load case tables 1.32, 1.33, 1.34, 1.35 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 diagram 1.57).

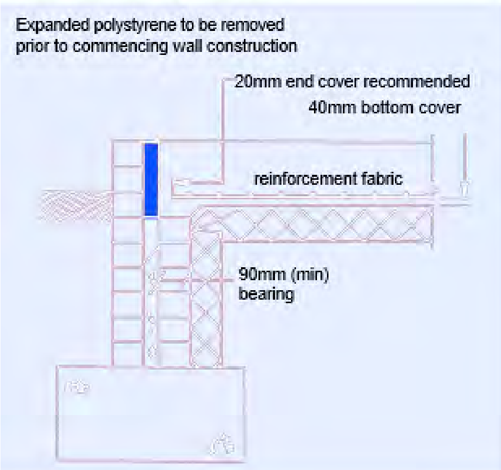


Diagram 1.57: Slab bearing on a cavity wall

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 1.58).

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 60m² and as square in shape as possible to reduce the possibility of shrinkage cracking.

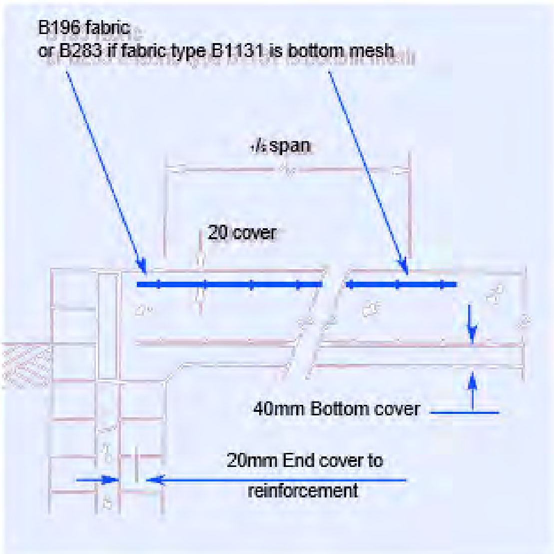


Diagram 1.58: Prevention of cracking

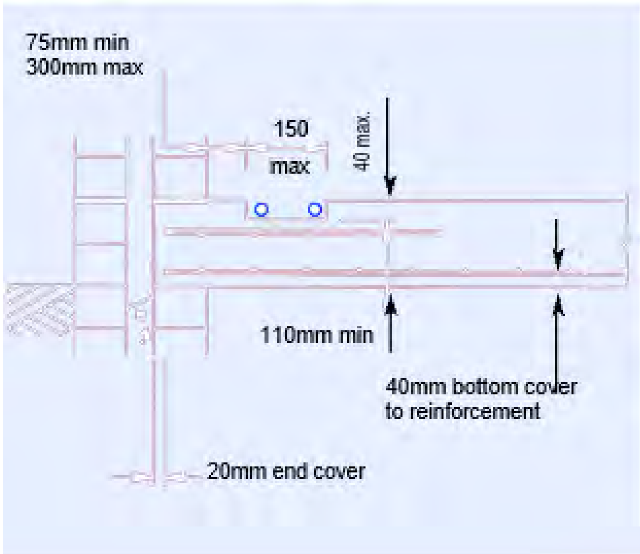


Diagram 1.59: Forming of recesses for pipes around perimeter of slab

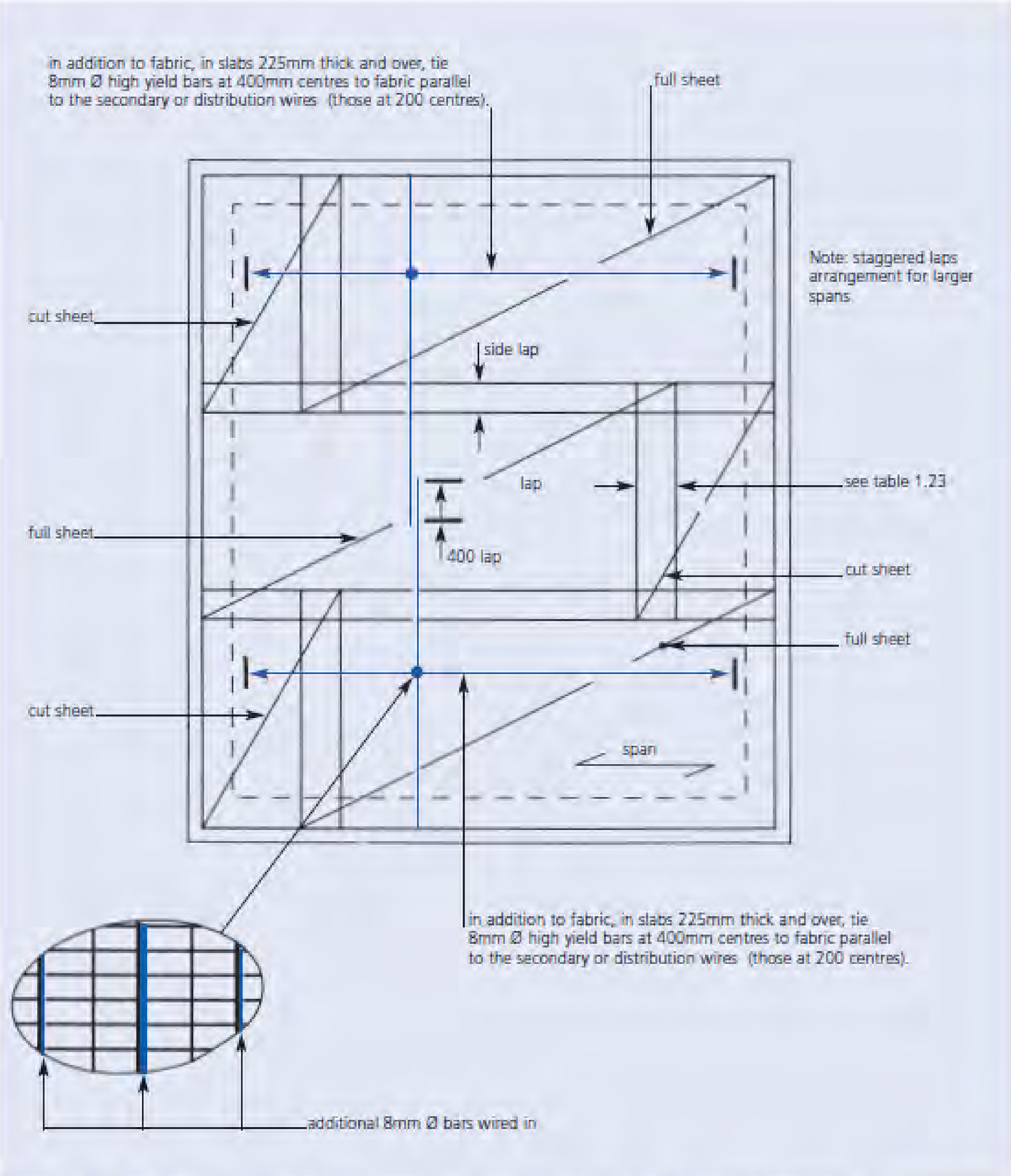


Diagram 1.60: Plan showing additional reinforcement to bottom fabric in slabs of 225mm in thickness and over

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 1.59).

clear span (m)	loading conditions: no partitions + domestic living area 65mm screed finish slab thicknesss (mm)				
	150	175	200	225[8]	250[8]
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	–	B785	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 6399 :1
2. 65 mm sand cement screed weighing not more than 155kg/m^2, assumed in 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: 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.
8. See diagram 1.60 page 122.

Table 1.32: Load case 1 reinforcement specification tables

clear span (m)	timber stud + plasterboard partitions domestic living area + 65mm screed finish slab thickness (mm) 150	175	200	225^9	250^9
2.00	B196	B283	B283	B385	B385
2.25	B283	B283	B283	B385	B385
2.50	B283	B283	B283	B385	B385
2.75	B385	B283	B283	B385	B385
3.00	B503	B385	B283	B385	B385
3.25	B785	B385	B385	B385	B385
3.50	–	B503	B385	B385	B385
3.75	–	B785	B503	B385	B385
4.00	–	B1131	B503	B503	B503
4.25	–	–	B785	B503	B503
4.50	–	–	B1131	B785	B503
4.75	–	–	–	B785	B785
5.00	–	–	–	B1131	B785
5.25	–	–	–	B1131	B785
5.50	–	–	–	–	B1131

Notes
1. The live load quoted caters for nominal domestic loading within the living area of a domestic dwelling in accordance with BS 6399 :1
2. 65mm sand cement screed weighing not more than 155kg/m^2, assumed in design.
3. Partition construction allows up to 100mm x 50mm studs with skin plaster board of thickness 12.5mm, to a height not exceeding 2.5 metres.
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: 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 above. Never go below.
8. Fabric to be side lapped a minimum of 300mm.
9. See diagram 1.60 page 122.

Table 1.33: Load case 2 reinforcement specification tables

clear span (m)	loading conditions: 100mm lightweight block partitions domestic living area + 65mm screed finish slab thicknesss (mm) 150	175	200	225^9	250^9
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 6399 :1.
2. 65mm sand cement screed weighing not more than 155kg/m^2, assumed in design.
3. Partition loading includes for lightweight block weighing 127kg/m^2 (1267kg/m^3) with 2 coat plaster both sides, not exceeding 2.5m 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: 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 above. Never go below.
8. Fabric to be side lapped a minimum of 300mm.
9. See diagram 1.60 page 122.

Table 1.34: Load case 3 reinforcement specification tables

clear span (m)	loading conditions: garage area with no applied finishes or partitions 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	B196	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	B785	B385	B385	B385	B385
3.75	–	B503	B385	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 6399 :1.
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: 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 above. Never go below.
6. Fabric to be side lapped a minimum of 300mm.
7. See diagram 1.60 page 122.

Table 1.35: Load case 4 reinforcement specification tables

SUPERSTRUCTURE

General

Ways of Achieving Compliance with the Requirements

The building should be designed and constructed in accordance with the guidance contained in the following appropriate documents:

England & Wales

- Approved Document A - Structure
- Approved Document B – Fire safety
- Approved Document C – Resistance to Contaminents and Moisture
- Approved Document D – Cavity insulation
- Approved Document E – Resistance to passage of sound
- Approved Document F - Ventilation
- Approved Document G – Sanitation, hot water safety and Water Efficiency
- Approved Document H – Drainage
- Approved Document J – Combustion appliances and fuel storage systems
- Approved Document K – Protection from falling, collision & impact
- Approved Document L – Conservation of fuel and power
- Approved Document M – Access facilities for disabled people
- Approved Document P – Electrical safety
- Approved Document Q – Security
- Approved Document 7 – Materials and workmanship

Scotland

- Section 0: General
- Section 1: Structure
- Section 2: Fire
- Section 3: Environment
- Section 4: Safety
- Section 5: Noise
- Section 6: Energy
- Section 7: Sustainability

Northern Ireland

- Part A: Interpretation and general
- Part B: Materials and workmanship
- Part C: Resitence to Contamination and Moisture
- Part D: Structure
- Part E: Fire safety
- Part F: Conservation of fuel and power
- Part G: Sound insulation of dwellings
- Part H: Stairs, ramps, guarding and protection from impact
- Part J: Solid waste in buildings
- Part K: Ventilation
- Part L: Combustion appliances and fuel storage systems
- Part N: Drainage
- Part P: Unvented hot water storage systems
- Part R: Access to and use of buildings
- Part V: Glazing

In addition to the following guidance, reference shall also be made to the <u>Scope & Requirements</u> section.

Materials

Storage & Use

Position storage areas for maximum accessibility, ease of working and security. It is helpful to keep materials in delivery packaging until required, thereby reducing the risk of units being used in the wrong location or for the wrong purpose and to help keep them dry and secure.

Use mechanical off-loading where possible as this will reduce the risk of handling damage and enable units to remain protected in identifiable packs.

Facing quality bricks and blocks should be handled carefully to avoid damage. Damaged bricks or blocks should not be built into facing work since cracks, chips and other defects will detract from the final visual quality of the wall.

Torn or split damp-proof course (dpc) materials and cavity trays must not be used as water may be allowed into the construction causing problems of dampness and possibly affecting the durability of some components.

Ensure that:

- Materials are stored on a dry and firm level site and to a safe handling height
- Bricks and blocks are carefully stacked and covered to prevent them becoming saturated (diagram 2.01)
- Different types of cement, bricks and blocks are stored separately and are clearly identified
- The use of materials such as cement are rotated so that the 'oldest' bags are used first
- Sand is placed on polythene or a similar membrane to avoid contamination. Barrier boards can be used to limit wastage
- Sands are stored separately according to type and premixed lime-sand (coarse stuff) is clearly identified. Tarpaulin or polythene protection against rain is advised.

Avoid:

- Tipping units i.e. from a dump truck
- Stacking units on wet or uneven ground
- Breaking open protective wrappings prior to use.

Diagram 2.01: Keep bricks and blocks dry by storing on a suitable base and covering them

Materials should be selected so that corrosive deterioration is minimised. If different metals are used in combination, particularly in humid locations, they should be chosen to be as near as possible in the electro-chemical series of metals so that galvanic action is unlikely to occur (not more than two metals apart in the list) e.g. use copper or galvanised nails with copper containing preservative treated timber. Some typical metals in the order they appear in the series are:

- Stainless steel
- Copper/Cupro-nickel
- Brass/Gunmetal
- Steel
- Aluminium
- Galvanized iron
- Zinc

If metals remote from each other in the series have to be used, adequate precautions should be taken to prevent their corrosive interaction.

All materials and equipment should be installed and commissioned as specified by the manufacturer.

Where indicated elsewhere in this Manual, materials and equipment should be type tested and approved by the mentioned independent authority.

Appliances and equipment should be selected that are suitable for the designed thermal loads, fluid flow rates and fluid pressures.

Bricks & Blocks

Selection
Bricks and blocks should be selected for their intended use, position and exposure depending upon:

- Durability
- Type
- Mortar

Sulphates
Sulphates can be present in the ground and carried to the construction by ground water or they can be present in certain types of brick.

The type of brick to be used will affect the specification of the mortar where there is a risk of saturation due to the lack of protection from roofs, copings, overhanging sills to openings and for elevations exposed to exceptionally severe wind driven rain.

Due to the presence of sulphates in designation N clay bricks to BS EN 771 (see table 2.01 for classification). Sulphate Resisting Portland Cement (SRPC) should be specified for the mortar when subject to saturation as described above.

See table 2.02 for selection of bricks and notes on mortar in sulphate bearing soils.

Designation S2 clay bricks have sufficiently limited sulphate content so that SRPC is not necessary.

Clay bricks are not affected by sulphate bearing soils.

Calcium silicate bricks and concrete bricks will not contribute to sulphate attack and Ordinary Portland Cement (OPC) is therefore satisfactory for the mortar above dpc level.

Durability	Frost resistance	Soluble salts content
FL FN	Frost resistance (F) Durable in all uses	Limits of soluble salts defined by test Low (L) Normal (N)
ML MN	Moderately frost resistant (M). Durable except when saturated and subject to repeated freezing and thawing.	
OL ON	Not frost resistant (O). Bricks liable to be damaged by repeated freezing and thawing. (internal use only)	
Note: calcium silicate and concrete bricks contain no soluble salts		

Table 2.01: Durability designations of clay bricks

BS 3921 Durability Designation	Practical Equivalents of Durability Designations	
	EN 771 - 1	
	Freeze Thaw Resistance	Active Soluble Salts Content
FL	F2	S2
FN	F2	S1
ML	F1	S2
MN	F1	S1
OL	F0	S2
ON	F0	S1

Table 2.021: Equivalent Durability Classification
The above table gives the practicle equivalents of the durability designations given in BS 3921:1985

Durability
See table 2.02 for selection of bricks for different uses.

Clay Bricks
BS EN 771 classifies clay bricks according to their frost resistance and soluble salt content (see table 2.01 for durability designation).

Use designation F2 clay bricks to BS EN 771 where brickwork may be saturated and subject to freezing and thawing. e.g: parapets, sills and very exposed sites shown on table 2.02.

Use designation F1 clay bricks to BS EN 772 in the external wall providing measures, such as roof overhang or copings, have been taken into account by the designer to prevent saturation.

Do not use designation F0 clay bricks to BS EN 772 in external walls.

use	brick type			notes on mortar
	Clay	Calcium Silicate*	Concrete	(see table 2.04)
Foundation to dpc	FL, FN, ML, MN**	Class 3	Strength > 20 N/mm²	
Foundation to dpc Sulphates in Soils	FL, FN, ML, MN**	Class 3	Strength > 20 N/mm² 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/mm²	
Unrendered external walls not protected from saturation	FL, FN	Class 3	Strength > 15 N/mm²	Use sulphate resisting cement in mortar with Type N clay bricks
Rendered external walls	FL, FN, ML, MN	Class 3	Strength > 7 N/mm²	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/mm²	
Internal	FL, FN, ML, MN, OL, ON	Class 3	All	

Notes: *Minimum Class indicated: a higher class (e.g. 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 designation FL bricks or FN bricks with sulphate resisting cement

Table 2.02: Selection of bricks

Concrete Bricks
The frost resistance of concrete bricks is related to their compressive strength. Concrete bricks of not less than 7N/mm^2 may be used in external walling protected from saturation.

Concrete bricks with a strength of not less than 15N/mm^2 are required if the work is subjected to saturation and freezing.

A strength of not less than 20N/mm^2 is required for concrete bricks used below dpc.

Concrete bricks of not less than 30N/mm^2 should be specified for a capping course.

Calcium Silicate Bricks
Use Class 3 calcium silicate bricks in external walls except for sills and brick-on-edge copings, when a Class 4 or higher should be used.

Concrete Blocks
Where concrete blocks are to be used externally without a rendered finish or placed below dpc level reference should be made to the manufacturer for their suitability. Blocks should have been tested for their use in such locations.

Most blocks may also be used in the outer leaf above dpc when rendered – check with the manufacturer to ensure that the material is adequately durable. Low density aircrete units (usually less than 480 kg/m^3) are not usually suitable for use in the external leaf.

Colour variation
Mix facing units from a minimum of three different packs to prevent colour banding of brickwork. On large schemes liaise with the manufacturer or supplier to ensure consistent colour/texture quality.

Use only fresh mortar mixed in the correct proportions and do not vary mix proportions as this will lead to incorrect strengths and colour variations. Changes in the supply of mortar materials may also lead to colour variation.

Avoid the use of pigments in mortar unless you are confident of consistent batching. As an alternative a coloured sand may avoid the need for pigments.

Ensure a consistent joint width is used – normally 10mm (nominal) and that the bed joints and cross joints (perps) are completely filled.

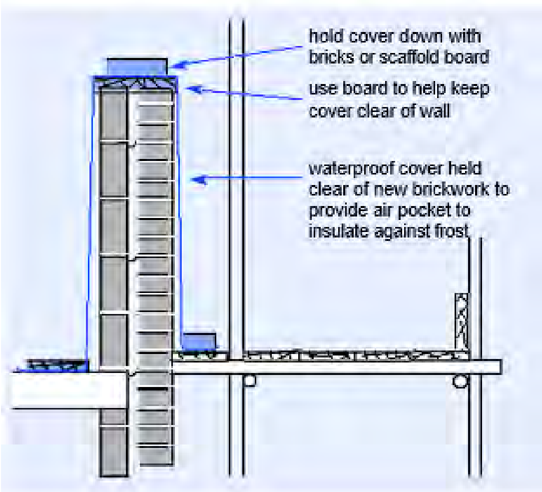
Joints
Perpends should be a minimum 5mm and a maximum 20mm. Bed joints a minimum 7mm and a maximum 13mm.

Frogs
Frogged bricks have a depression in the face of the brick. Normally they should be laid with the major depression or frog facing up so that it is fully filled with mortar during laying. This ensures optimum strength and helps to increase the mass of the wall (to give good sound insulation) and prevents the possibility of standing water within the structure which could freeze. Bricks with a directional surface texture are intended to be laid frog up. Bricks should only be laid frog down when specified and with the consent of Q.

Perforated Bricks
Care should be taken with the use of perforated bricks where the exposure rating of the wall is high, as water retention/collection has been found to exist in the perforations.

Efflorescence
Efflorescence is a white deposit on the face of masonry brought about by water moving through the wall dissolving soluble salts and depositing them when the water evaporates during drying out.

Efflorescence is best prevented by:
- Keeping all units dry prior to use.
- Protecting the head of newly constructed work with some form of cover to prevent saturation - see diagram 2.02 below:



Diagam 2.02: Cover newly constructed walls

Protection during construction
All new masonry work should be protected during construction by covering, so that walls are not allowed to become saturated by rainwater, dry out too quickly in hot weather and to protect against frost attack. (See diagram 2.02) Unnecessary wetting will increase the risk of efflorescence, line staining and movement problems. Care will need to be taken to ensure that any cover does not drape into fresh mortar or disturb the bond of the units.

It may be necessary to provide temporary propping to gable walls etc. prior to roof construction.

When a floor or roof slab of a building is used for the temporary storage of building materials the loading should not exceed the design loading for the element.

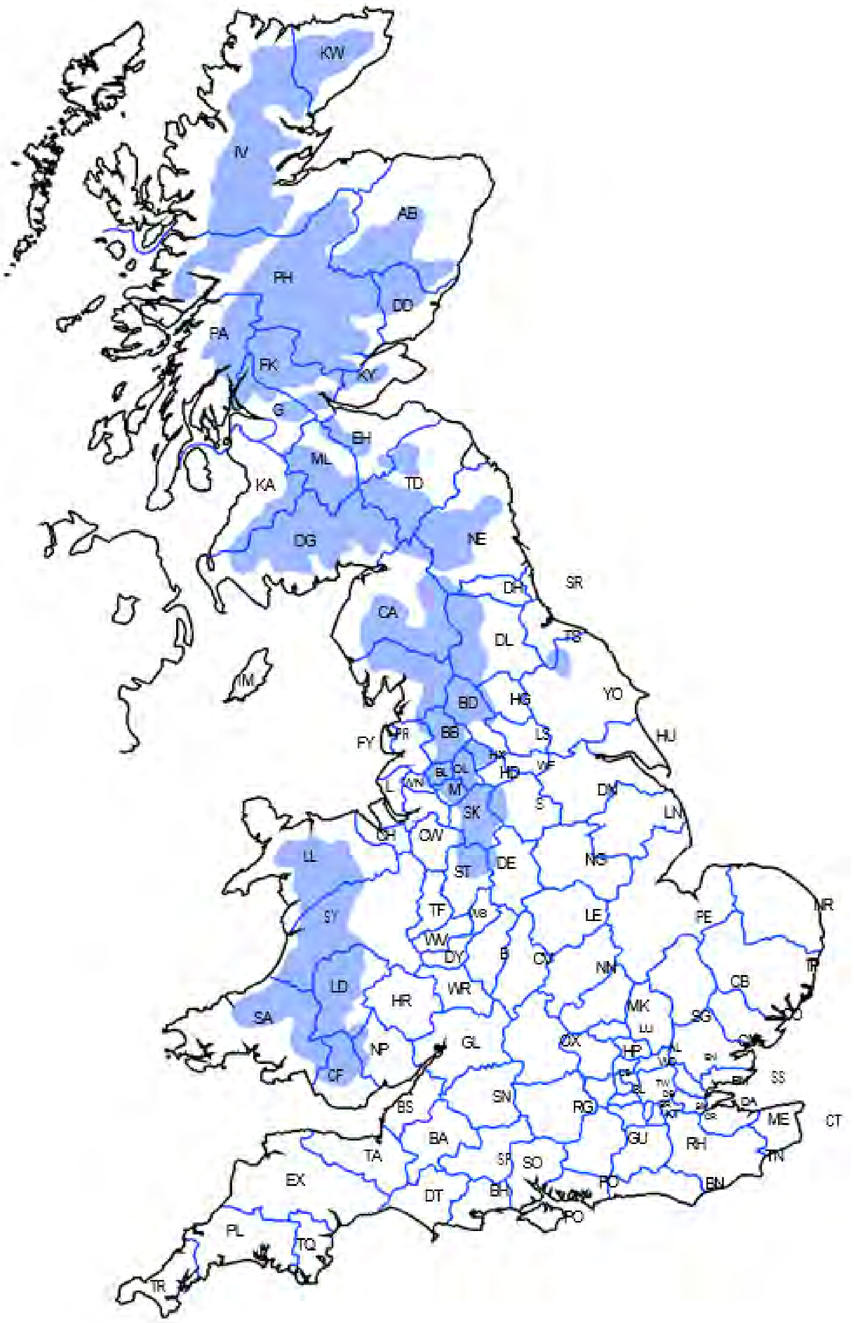


Diagram 2.03: Map showing areas where there is a risk of severe exposure to frost attack.
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The shaded areas meet the meteorological criteria for severe exposure. For identification of these areas by postcode district, see table 2.03 on the following page.

Buildings within these areas which are situated on top of, or on the slopes of, locally high ground or on a locally high plateau, and have an open aspect with no protection from adjacent trees, buildings or topographical features are subject to exceptionally severe exposure to frost conditions and require frost resistant brick work.

Note: Northern Ireland has been assessed as an area of normal exposure to frost attack. As such domestic buildings in Northern Ireland will not require frost restraint brickwork.

AB	BB	BD	BL	CA	CF	CH	DD	DE	DG	DH	DL	EH	FK	G	HD	HG	HR	HX	IV	KA
3	1	13	0	5	8	7	6	4	1	8	8	14	1	62	3	3	2	2	1	1
5	2	15	1	6	37		9	6	2		11	23	8	63	4		3	4	3	3
	3	20	2	7	39				3		12	26	11	64	7		5	6	4	4
	4	21	7	8	40				4		13	27	12	65	8			7	6	5
	5	22	8	9	41				6			28	13	72					7	6
	6	23	9	10	42				7			43	14	74					12	16
	7	24		11	43				8			44	15	75					13	17
	8			12	44				10			45	16	76					14	18
	9			13	45				11			46	17	77					15	19
	10			16	46				12			47	18	81					16	26
	11			17	47				13			48	19	82					17	
	12			19	48				14			55	20	83					18	
				20									21	84					19	
				22									47						22	
				23															23	
																			24	
																			25	
																			26	
																			27	
																			28	
																			40	
																			54	

partly within

wholly within

KW	KY	LA	LD	LL	MM	ML	NE	NP	OL	PA	PH		S	SA	SK	ST	SY	TD	TS	YO
3	13	2	1	11	24	1	19	1	1	23	1	30	6	9	6	10	10	1	9	6
5		6	2	15		2	46	2	2	24	2	31	10	10	10	13	16	2		7
6		8	3	16		3	47	3	3	25	3	32	11	11	11		17	5		18
7		9	4	20		6	48	4	4	26	4	33	30	13	12		18	8		21
8		10	5	21		7	49	5	5	27	5	34		19	13		19	11		22
9		12	6	22		8	66	6	6	32	6	35		20	14		20	71		
10		20	7	23		9	71	7	7	33	7	36		32	15		21			
11		21	8	24		10		8	8	34	8	37		33	16		22			
12		22		25		11		44	9	35	9	38		39	17		23			
13		23		26		12			10	36	10	39		40			24			
14				27					11	37	11	41		44			25			
				28					12	38	15			48						
				32					13	41	16									
				33					14		17									
				40					15		18									
				41					16		19									
				54							20									
				55							21									
				57							22									
											23									
											25									
											26									

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Table 2.03: Showing postcode districts wholly or partly within the severe Exposure from map on the previous page

External Walls - Masonry

Bricks & Blocks

Straightness on plan
± 10mm maximum deviation in any length of wall up to 5m

Level of bed joint
± 10mm maximum deviation for walls 5m long
± 15mm maximum deviation for walls 5-10m long
± 25mm for walls over 10m long

Thickness of bed joint
± 5mm (average over 8 joints)

Plumb of wall
Maximum 8mm out of plumb for walls up to 5m in height, limited to 8mm in a storey height (approx 2.5m).
Maximum 12mm out of plumb for walls over 5m in height, limited to 8mm in a storey height (approx 2.5m).

Straightness in section
± 8mm max deviation in any 2.5m height of wall

Mortar
Mortar type above dpc should be chosen in accordance with guidance given in table 2.04, or otherwise as recommended by the brick or block manufacturer.

The addition of lime and/or air entraining plasticizers to cement or the use of masonry cement produces mortars with the correct balance of workability, strength and durability. Cement and sand alone should not be used unless a strong mix is specifically required by the design.

Batching
Keep batching and mixing equipment clean to avoid contamination with materials used previously. Mortar should be mixed by machine (e.g. tilting drum mixer) or use ready-mixed retarded mortars. Accurately proportion materials using a gauge box or buckets.

Add water with care – start with about 1/4 of estimated quantity of water needed.

When mixing by machine load about 3/4 of the sand or premixed lime/sand and water. Continue mixing and gradually add cement and/or lime if appropriate. Then load the remainder of sand or premixed lime/sand and further water to achieve required workability.

Mixing of mortar
Mortar should be carefully and consistently proportioned then thoroughly mixed using a mechanical mixer, except for very small quantities. Accurately proportion materials using a gauge box or bucket. Do not use a shovel.

Ensure that mortar proportions are in accordance with the manufacturer’s recommendations for the type of masonry unit to be laid and the degree of exposure.

Following initial production, nothing should be added to mortar except for clean water to maintain consistency.

Mortar should not be 'knocked up' after it has started to set.

Air-entraining or other admixtures should be used only when approved by the designer and then according to manufacturers instructions.

Do not use strong mortar for blockwork above dpc level (1:4 cement:sand or equivalent is too strong) (See table 2.04).

General purpose mortar (see BRE Digest 362) can be used internally and externally regardless of sand type. A mortar mix by volume of 1:1:51/2 (portland cement/lime/sand) with an air-entraining plasticiser is deemed suitable. Sulphate resisting cement should be used where groundwater sulphate can reach the masonry or where clay bricks with a sulphate content (N designation BS EN 772) are used externally and are likely to be subject to a high risk of saturation.

Cold weather working
Precautions should be taken when necessary to maintain the temperature of bricks, blocks and mortar above 3° C. The use of anti-freeze as a frost resistant additive in mortar is not permitted.

Hot weather working
During prolonged periods of hot weather when masonry units can become very dry, absorbent clay bricks may be wetted to reduce suction. Low absorption bricks (i.e. engineering bricks) should not be wetted. For calcium silicate and concrete units the mortar specification may need to be changed in order to incorporate an admixture to assist with water retention. On no account should masonry units or completed work be saturated with water.

Use	Designation	Proportions by Volume			Minimum Compressive Strength of site-mixed mortars at 28 days in N/mm^2 (CEN standards in brackets)
		Portland cement:lime: sand	Air-entrained Portland cement:sand	Masonry cement:sand	
Mortar for internal and external use above dpc	(iii)	1:1:5-6	1:5-6	1:4-5	2.5 (M 2.5)
General Purpose Mortar to BRE Digest 362		Air entrained with plasticiser Portland cement: lime: sand 1:1:5½ by volume			2.5 (M 2.5)
High Durability Mortar for: a use below or near external ground level b in parapets & chimneys c external walls with a high risk of saturation due to severe exposure	(ii)**	1*:½:4-4½	1*:3-4	1*:2½ − 3½	5.0 (M 5)
	If Type N clay bricks are used, or for all chimneys, use sulphate-resisting cement				
Low Permeability Jointing Mortar for: a coping, cappings and sills b jointing impervious ceramic units in drainage systems	(i)***	1: ¼:3 Use a Type S sand to BS 1200	–	–	10.0 (M)
Loadbearing Masonry designed to BS 5628:1		Air entrained with plasticiser Portland cement: lime: sand 1:1:5½ by volume			As specified

Notes: * Where soil or ground-water sulphate levels are appreciable (Class 3 or higher) use sulphate resisting Portland cement.
** For concrete or calcium silicate bricks use a designation (iii) mortar and refer to *.
*** For concrete or calcium silicate bricks use a designation (ii) mortar.

Table 2.04: Recommended mortars for different uses

Structural Design of External, Separating & Compartment Walls

The design of an external, separating or compartment wall depends upon a number of criteria, including the following:

- Construction
- Location
- Height
- Length
- Thickness
- Strength

Construction	Location	Height	Length	Thickness	Strength (min)***
Cavity* (Brick/Block)	External, separating and compartment walls	≯ 3.5m	> 12m	< 190mm	**2 storey dwelling****: all walls brick 5N/mm², block 2.8N/mm² **3 storey dwelling****: external walls: (foundations to eaves – outer leaf) – brick 7N/mm², block 7N/mm² external walls: (foundations to u/s of first floor – inner leaf) – brick 15N/mm², block 7N/mm² internal load bearing walls: (foundations to u/s of first floor) – brick 7N/mm², block 7N/mm²
		> 3.5m ≯ 9m	≯ 9m	≮ 190mm	
			> 9m ≯ 12m	≮ 290mm from the base for the full height of the storey and then ≮ 190mm onwards	
		> 9m ≯ 12m	> 9m	≮ 290mm from the base for the full height of two storeys and then ≮ 190mm onwards	
			> 9m ≯ 12m	≮ 290mm from the base for the full height of the storey and then ≮ 190mm onwards	
(Brick/Block)	Internal load bearing walls			[(thickness as above)/2] – 5mm BUT a minimum of 140mm on the lowest storey of a three storey house	All other load bearing walls first floor and above – brick 5N/mm², block 2.8N/mm²
Solid (coursed)				as above but at least 1/16 (0.0625) of storey height	
Solid (uncoursed) stone, flint, etc.				at least 1.33 x thickness given for cavity walls, OR at least 1.33 x thickness given for solid walls above	**2 storey dwelling****: all walls brick 5N/mm², block 2.8N/mm² **3 storey dwelling****: external walls: (foundations to u/s of first floor) – brick 15N/mm², block 7N/mm² Above first floor level – brick 7N/mm², block 7N/mm² internal load bearing walls: (foundations to u/s of first floor) – brick 7N/mm², block 7N/mm²

Notes: 1. The minimum thickness of any leaf or single skin wall to be 90mm
2. For restrictions on openings in walls see diagram 17 Approved Document A1/2 Building Regulations.
> greater than ≯ not greater than < not less than
* Cavity wall width is given by the combined thickness of the two leaves plus 10mm
** Where storey heights (u/s of floor to ceiling above) exceeds 2.7m the brick/block strength shall be a minimum 7N/mm²
*** Where the roof is of timber construction

Table 2.05: Reference guide for use of masonry in domestic situations up to 3 storeys in height

Table 2.05 provides a reference guide for use of masonry in domestic situations up to 3 storeys in height.
(This table is based on an interpretation of Approved Document A.)

Further guidance for wall design may be obtained from Approved Document A of Building Regulations and BS 8103:2.

Detached garages and similar outbuildings

The following guidance applies in the following circumstances:

- The floor area is more than 10m² but does not exceed 36m²
- The walls are at least 90mm thick, solidly constructed of brick or blockwork having a mass of at least 130kg/m².
- The maximum length or width of the building does not exceed 9m
- Access to the roof is only for repair and maintenance
- The only lateral loads are wind loads.
- The height of the building does not exceed the dimensions shown on diagram 2.04
- The roof is braced at rafter level, horizontally at eaves level and at the base of any gable by roof decking, rigid sarking or diagonal bracing
- Walls should be tied to the roof structure (See diagram 2.05 and 2.08)
- One or two major openings not more than 2.1m in height are permitted in one wall only. The width of a single opening or the combined width of two openings should not exceed 5m. The only other opening permitted is for windows and single leaf doors. (See diagram 2.06)

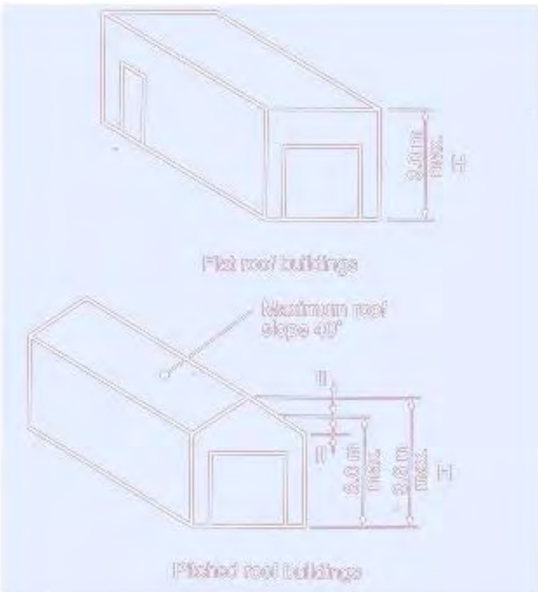


Diagram 2.04

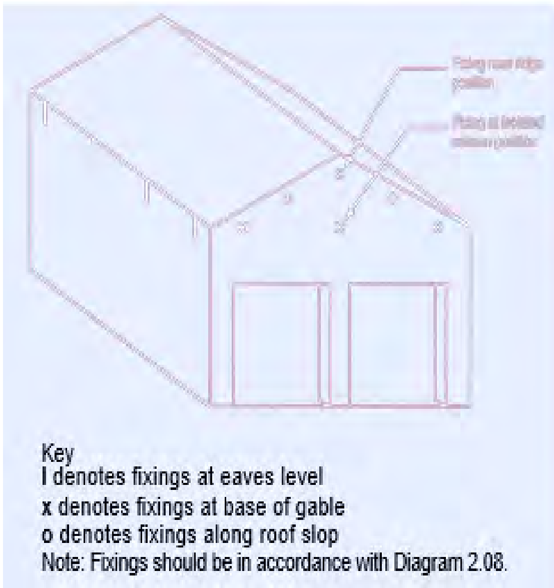


Diagram 2.05

Building classification can be determined from table 2.05.

The following should also be noted:

Disproportionate Collapse
Buildings should be sufficiently robust to sustain a limited and proportionate level of damage in the event of accident or failure without causing collapse. (See diagram 2.07). The extent and limitations that should be designed for are defined by the classification and/or building type and use.

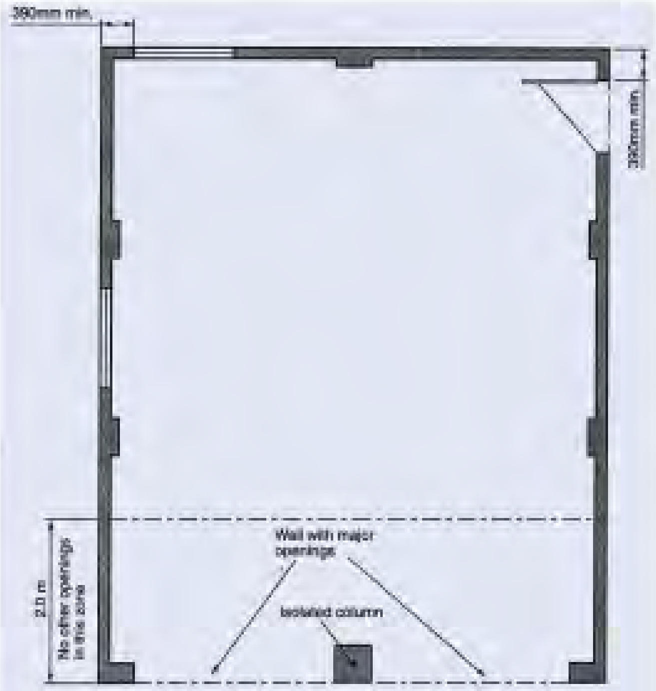
a. Determine the building class from Table 2.06.
b. For Class 1 buildings – Provided the building has been designed and constructed in accordance with the rules given in this Approved Document, or other guidance referenced under Section 1, for meeting compliance with requirement A1 and A2 in normal use, no additional measures are likely to be necessary.
c. For Class 2A buildings – Provide effective horizontal ties, or effective anchorage of suspended floors to walls, as described in the Codes and Standards listed under paragraph 5.2 for framed and load-bearing wall construction; the latter being defined in paragraph 5.3 (See Building Regulations AD A3 pages 42 & 43).
d. For Class 2B buildings – Provide effective horizontal ties, as described in the Codes and Standards listed under paragraph 5.2 for framed and load-bearing wall construction; the latter being defined in paragraph 5.3 (See Building Regulations AD A3 pages 42 & 43) together with:
    a. effective vertical ties, as defined in the Codes and Standards listed under paragraph 5.2, in all supporting columns and walls, or alternatively,
    b. check that upon the notional removal of each supporting column and each beam supporting one or more columns, or any nominal length of load-bearing wall (one at a time in each storey of the building) that the building remains stable and that the area of floor at any storey at risk or collapse does not exceed 15% of the floor area of that storey or 70m², whichever is smaller, and does not extend further than the immediate adjacent storeys (See diagram 2.07).
    c. Where the notional removal of such columns and lengths of walls would result in an extent of damage in excess of the above limit, then such elements should be designed as a "key element" as defined in paragraph 5.3. See Building Regulation AD, A3 pages 42 & 43
e. For Class 3 buildings – A systematic risk assessment of the building should be undertaken taking into account all the normal hazards that may reasonably be foreseen, together with any abnormal hazards.

Critical situations for design should be selected that reflect the conditions that can reasonably be foreseen as possible during the life of the building. The structural form and concept and any protective measures should then be chosen and the detailed design of the structure and its elements undertaken in accordance with the recommendations given in the Codes and Standards given in paragraph 5.2. See Building Regulation AD, A3 pages 42 & 43.

CLASS	BUILDING TYPE & OCCUPANCY
1	Houses not exceeding 4 storeys Agricultural buildings Buildings into which people rarely go, provided no part of the building is closer to another building, or area where people do go, than a distance of 1.5 times the building height
2A	5 storey occupancy houses Hotels not exceeding 4 storeys Flats, apartments and other residential buildings not exceeding 4 storeys Offices not exceeding 4 storeys Industrial buildings not exceeding 3 storeys Retailing premises not exceeding 3 storeys of less than 2000m² floor area in each storey Single storey educational buildings All buildings not exceeding 2 storeys to which members of the public are admitted and which contain floor areas not exceeding 2000m² at each storey
2B	Hotels, flats, apartments and other residential buildings greater than 4 storeys but not exceeding 15 storeys Educational buildings greater than 1 storey but not exceeding 15 storeys Retailing premises greater than 3 storeys but not exceeding 15 storeys Hospitals not exceeding 3 storeys Offices greater than 4 storeys but not exceeding 15 storeys All buildings to which members of the public are admitted which contain floor areas exceeding 2000m² but less than 5000m² at each storey Car parking not exceeding 6 storeys
3	All buildings defined above as Class 2A and 2B that exceed the limits on area and/or number of storeys Grandstands accommodating more than 5000 spectators Buildings containing hazardous substances and/or processes
NOTE 1:	For buildings intended for more than one type of use, the class should be that pertaining to the most onerous type.
NOTE 2:	In determining the number of storeys in a building, basement storeys may be excluded provided such basement storeys fulfil the robustness requirements of Class 2B buildings.

Table 2.06

Structural Design of External, Separating and Compartment Walls



Notes
1 Major opening should be restricted to one wall only. Their aggregate width should not exceed 5.0m and their height should not be greater than 2.1m
2 There should be no other openings within 2.0m of a wall containing a major opening
3 The aggregate size of openings in a wall not containing a major opening should not exceed 2.4m²
4 There should not be more than one opening between piers
5 Unless there is a corner pier the distance from a window or a door to a corner should not be less than 390mm

Diagram 2.06: Size and location of openings

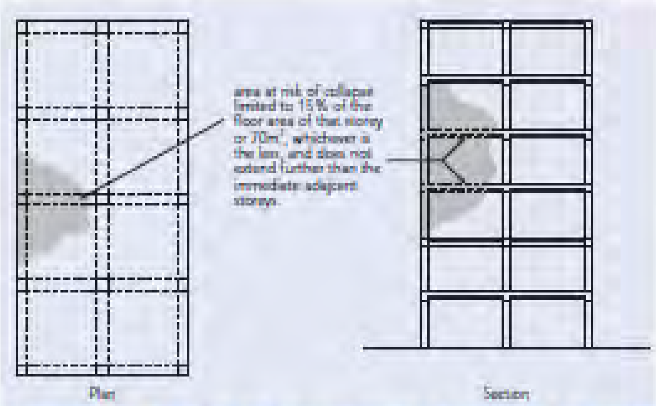


Diagram 2.07: Area at risk of collapse in the event of an accident

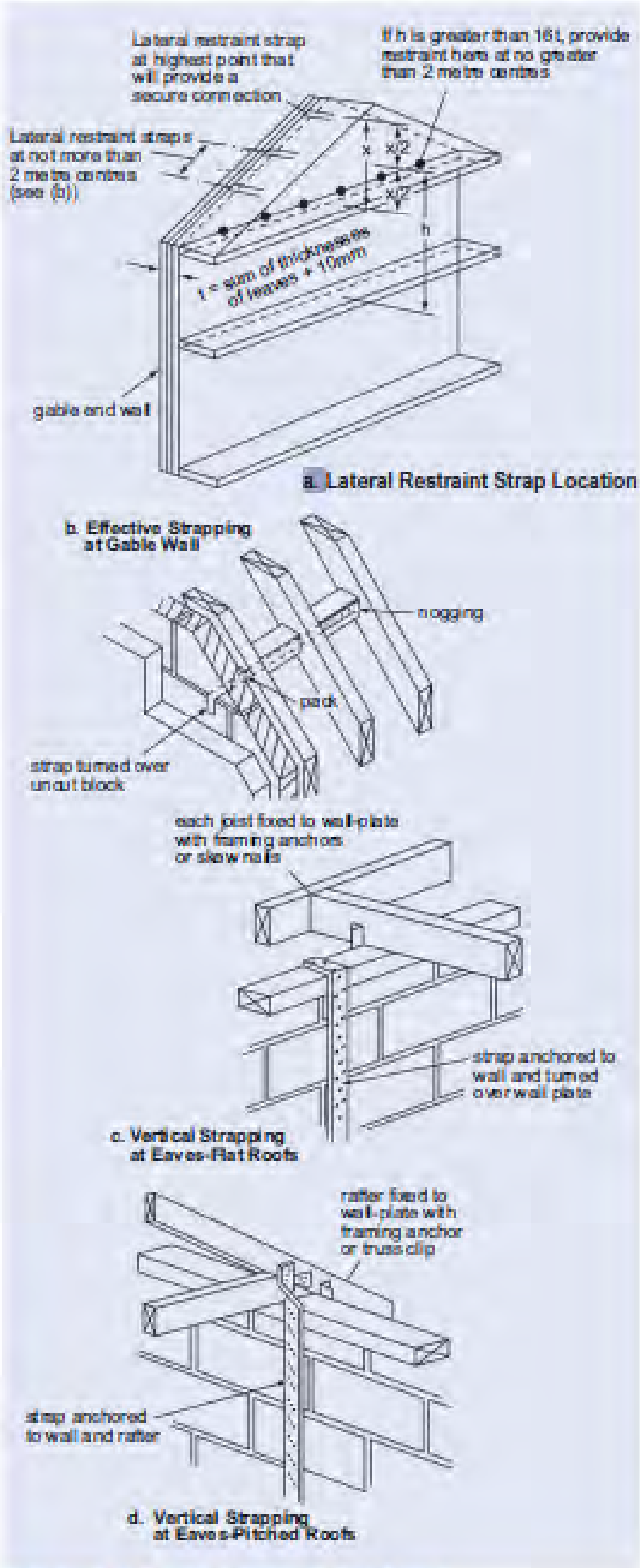


Diagram 2.08: Lateral support at roof level

Corbelling

The extent of corbelling of masonry should not exceed that indicated in diagrams 2.09 and 2.10 unless supported or reinforced.

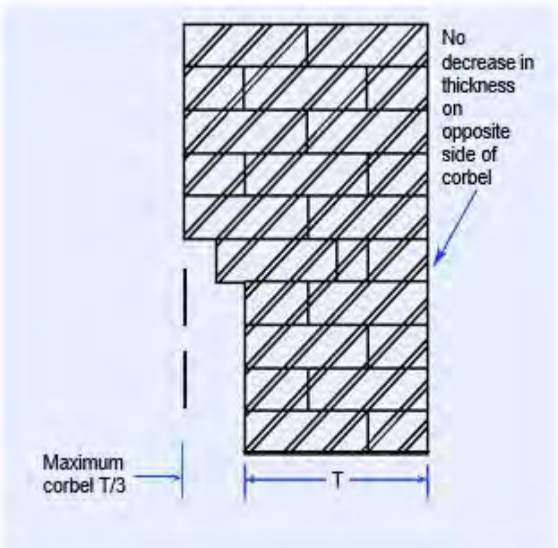


Diagram 2.09: Corbelling section through solid walling

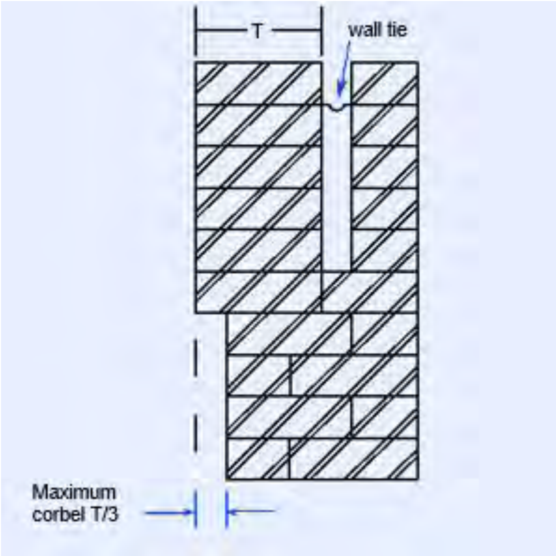


Diagram 2.10: Corbelling section through cavity walling

Bonding at Internal Wall

Bonded walls in brickwork are comparatively easy to construct but with blockwork this can be more difficult.

Either:

- Tooth every alternative course (See diagram 2.11) or
- butt and tie (See diagram 2.12)

Where blocks are of a different density a butted joint should always be used (on party walls carry the separating wall through and butt up the inner leaf using a proprietary bed joint reinforcement or suitable ties at each block course).

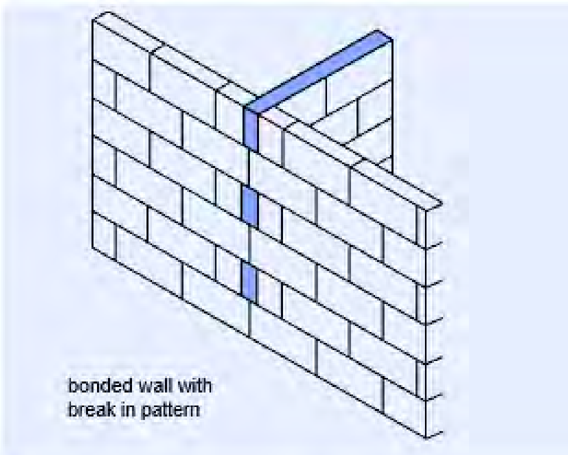


Diagram 2.11: Bonded walls

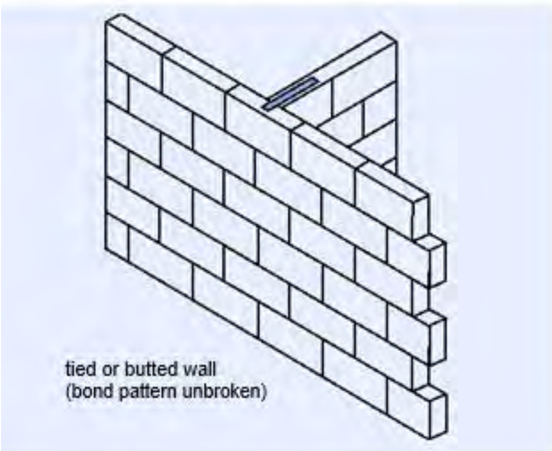


Diagram 2.12: Butted and tied walls

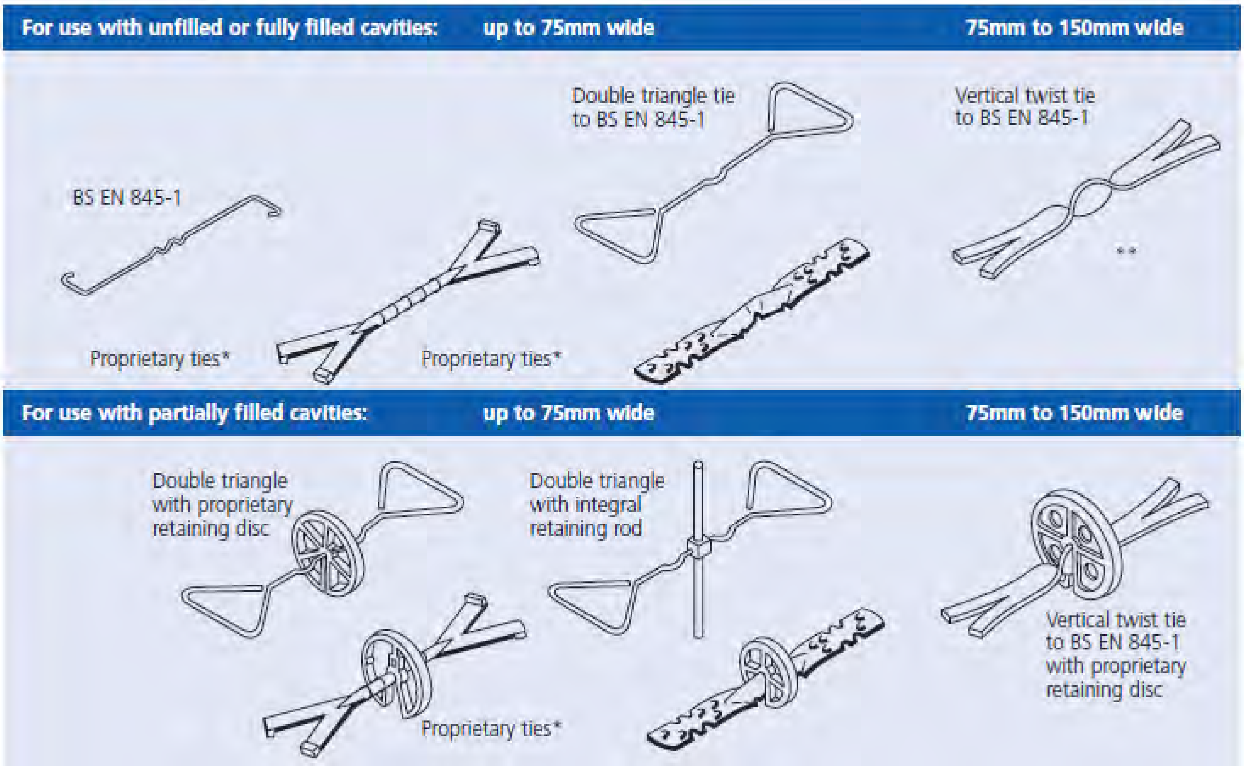
Wall Ties

Types
It is important to use ties to BS EN 845-1 or to provide independent third party certificates acceptable to Q, so that the ties used have adequate durability. Normally it is the structural requirements of the cavity wall, the cavity width and any insulant to be used, which dictates the type of tie to be used. The main types are shown in diagram 2.13. All ties should have a minimum embedment of 50mm, ensure that the drip is in the centre of any clear cavity and the tie is laid to a slight fall to the outer leaf (See table 2.07).

Ties fitted with retained discs or rods are used to hold partial fill insulation in place within the cavity.

It is important to note that only BS EN 845-1 type wall ties or specifically manufactured (and tested) party wall ties are permitted in cavity separating walls between dwellings to reduce the transfer of sound.

Durability
Stainless steel wall ties should always be used.



Note: *Proprietary ties should have independent third party certificates acceptable to Q – some may be suitable for use with cavities up to 150mm.
**** BS EN 845-1 or proprietary party wall ties only, to be used in sound resisting walls**

Diagram 2.13: Main types of wall tie

Permissible type of tie			
Normal cavity width mm (note 1)	Tie length mm (note 2)	Tie shape in accordance with BS EN 845-1*	BS EN 845-1 tie (note 4)
50 to 75	200	Double triangle or vertical twist	Types 1,2,3 or 4 to DD 140-2* and selected on the basis of the design loading and design cavity width
76 to 90	225	Double triangle or vertical twist	
91 to 100	225	Double triangle (note 3) or vertical twist	
101 to 125	250	Vertical twist	BS 1243 and DD 140-2 was withdrawn on 1 February 2005. The tie user classes (types) given in Tables 1 and 3 of the document can be used
126 to 150	275	Vertical twist	
151 to 175	300	Vertical twist	
176 to 300	(see note 2)	Vertical twist style	

Table 2.07: Cavity wall ties

Rigidity

Where lightweight aggregate or autoclaved aerated concrete blocks are used in one leaf, do not use a rigid tie which will inhibit differential movement. A butterfly tie or a double triangle tie will usually be suitable in a cavity up to 75mm (a heavier grade of double triangular tie is available for cavities up to 100mm). A vertical twist tie can be used for a cavity between 75-150mm. Other ties may also be acceptable subject to the provision of independent third party certificates acceptable to Q.

Spacing

For walls with a structural cavity between 50 and 150mm (where neither leaf is less than 90mm thick), ties should be spaced not more than 900*mm horizontally and 450mm centres vertically and evenly distributed. Ties are placed at maximum 300mm centres vertically at reveals and movement joints. See diagram 2.13 for wall tie types and cavity width limitations.

***Note the Building Regulations require a reduced spacing of 750mm centres horizontally where cavity width exceeds 75mm.**

Where a partial fill insulation system is being employed a regular pattern as shown in diagram 2.14 may be necessary, depending upon the system used. Place ties in a staggered pattern as shown in diagram 2.15.

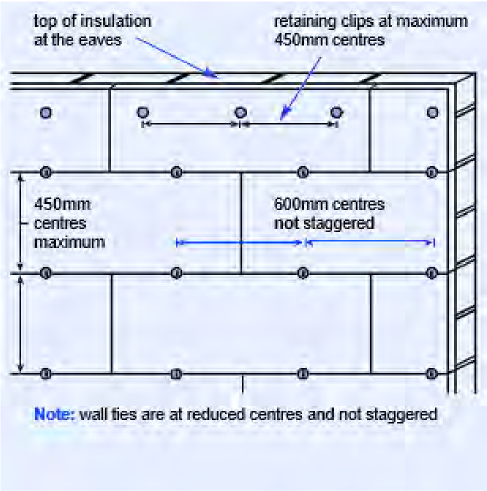


Diagram 2.14: Wall tie positions for a partial fill insulation board

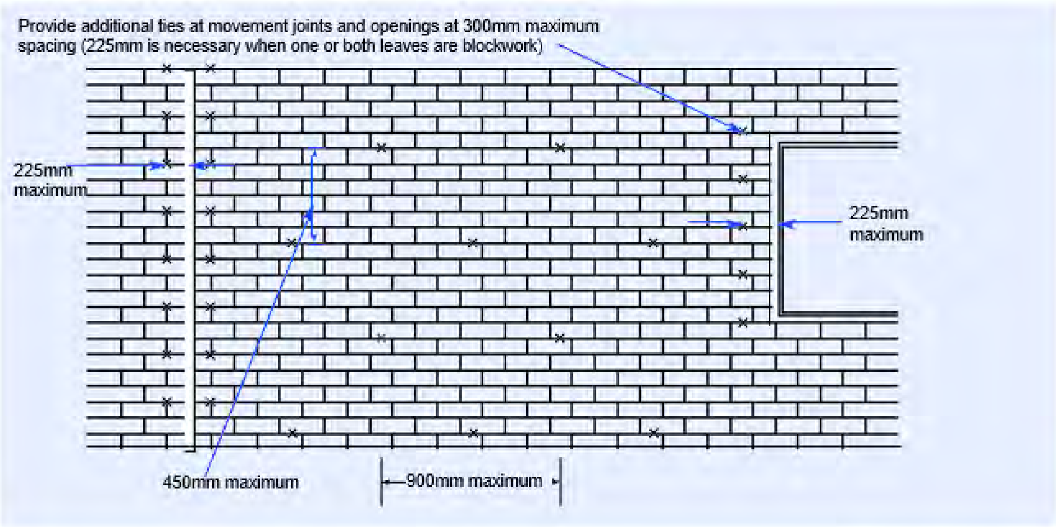


Diagram 2.15: Normal positioning of wall ties

Restraint

Structural connections

Joist hangers should be appropriate for the strength of the masonry, the size of the joist and the load to be supported.

Joist hangers

Joist hangers may be either of the standard joint fixing type (See diagram 2.16) or of the restraint type (See diagram 2.17).

Always support the hanger on a full masonry block not on a cut block.

Do not use hangers marked for use with a particular strength of block on a block of a lower strength. The joist width should be equal to the width of the hanger and not more than 10mm deeper than the hanger. Do not cut down the width of the joist to fit a hanger. (See diagram 2.18)

If the coursing requires adjustment to achieve the designed joist height make the adjustment at the course below the one supporting the hanger. The adjustment block must be of similar strength and thermal performance. Do not pack up between the joist and it's bearing surface on the hanger. (See diagram 2.19)

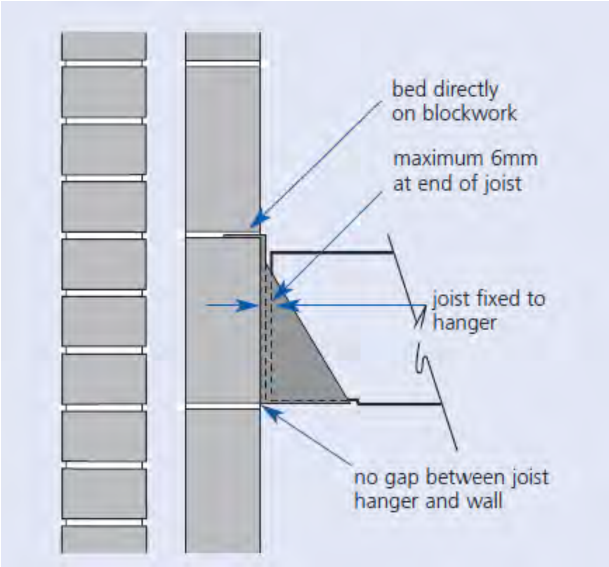


Diagram 2.16: Standard joist hanger

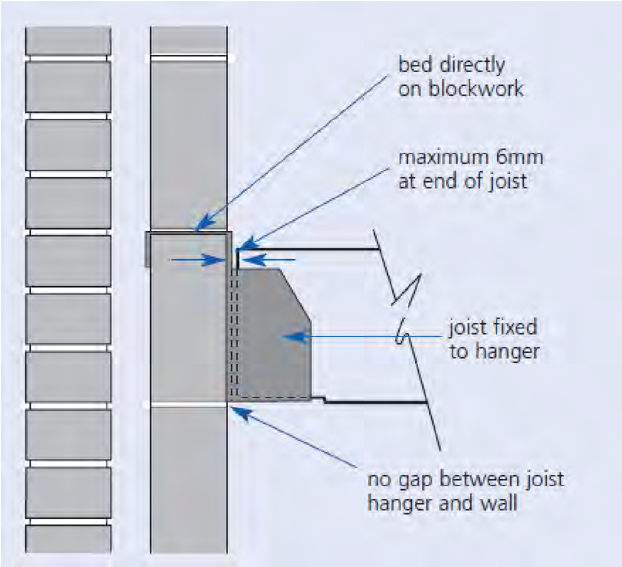


Diagram 2.17: Restraint type joist hanger

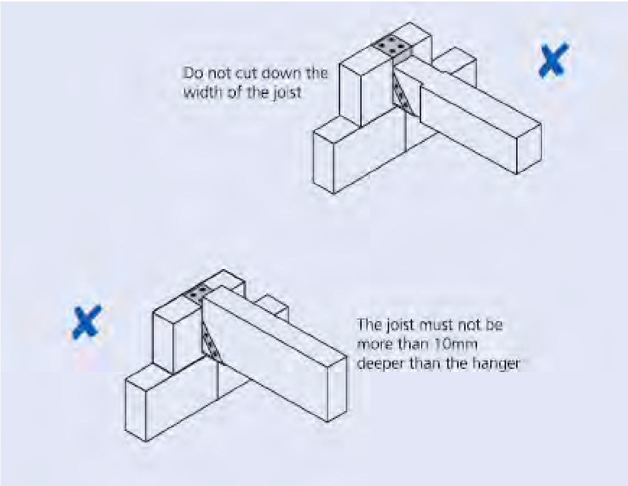


Diagram 2.18: Correct us of joist hangers

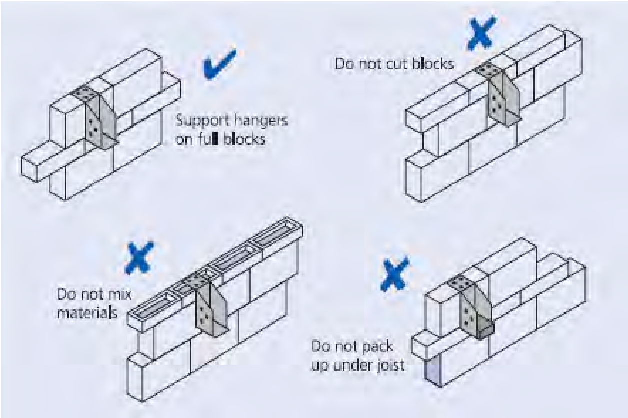


Diagram 2.19: Correct use of joist hangers

Ensure that:

- The hanger is bedded directly on the masonry and there is no gap between the hanger back-plate and the face of the masonry
- At least 450mm of masonry should be provided above the hanger
- Hangers are spaced at centres of floor joists included in the design
- The hanger is suitable for the loadings and masonry strength.

Do not:

- Apply load while the mortar is still green and has not gained sufficient strength
- Use brick courses in block walls under joist hangers – the thermal insulation of the wall may be reduced unless similar units to the blocks are used

The guidance on connections given in this Manual relates to work on site and should be used in addition to guidance given in this section.

Floors including timber, block and beam, and roofs should provide lateral restraint to all walls running parallel to them, by means of 30 x 5mm galvanized or stainless steel restraint straps at 2.0m centres (See diagrams 2.24 and 2.25).

Straps need not be provided to floors at, or about, the same level on each side of a supported wall and at the following locations:

- Timber floors in 2 storey dwellings where:
    i. Joists are at maximum 1.2m centres and have at least 90mm bearing on supported walls or 75mm bearing on a timber wall plate
    ii. Carried by the supported wall by restraint type joist hangers as described in BS 5268:7.1 (See diagram 2.17)
- Concrete floors with minimum 90mm bearing on supported wall.

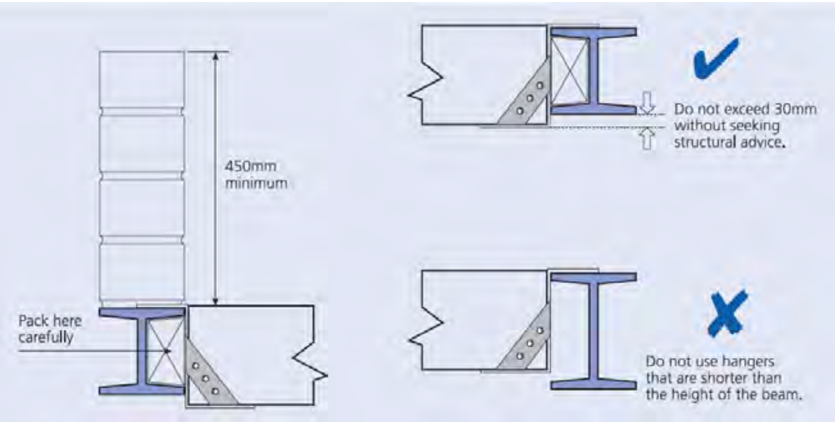


Diagram 2.20: Correct use of joist hangers

Joist hangers on steel beams

Use only heavy-duty hangers.

If standard or restraint hangers are to be used, there must be at least 450mm of masonry above. Joists can be hung up to half their depth below the beams lower flange provided they are packed as shown. Ensure shrinkage will not cause the packing to become dislodged. (See diagram 2.20)

Stirrup hangers can be used where the load on either side is approximately equal. Masonry above is not generally required.

Vertical strapping securely fixed to a suitable wall plate at least 1.0m in length should be provided at maximum 2.0m centres at eaves level to roofs except where the roof:
• has a pitch of 15° or more and
• is tiled or slated and
• is of a type known to resist wind gusts and
• has main timber members spanning on to it at maximum 1.2m centres.

Wall straps should be corrosion resistant, correctly positioned, blocked out and built into the masonry as the work proceeds (See diagram 2.25).

Where a standard hanger is used as shown in Diagram 2.16 and lateral restraint is required to this wall then a strap should be installed at max 2m centres (See diagram 2.24). Where timber engineered joists are used then the strap should be fixed to the sides of the flanges (See diagram 2.22).

Straps that are only 1.2mm can be fitted to the top of joists without the need to notch (See diagram 2.23).

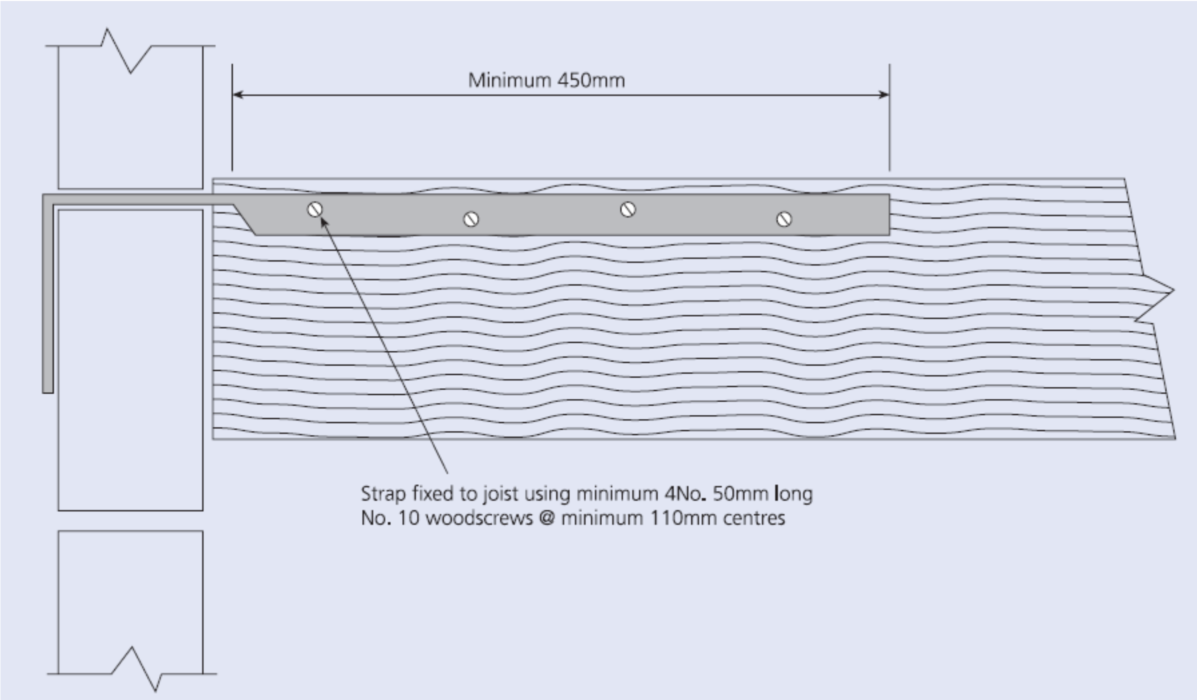


Diagram 2.21: 30mm x 5mm bent and twisted galvanised mild steel straps – for solid timber joists

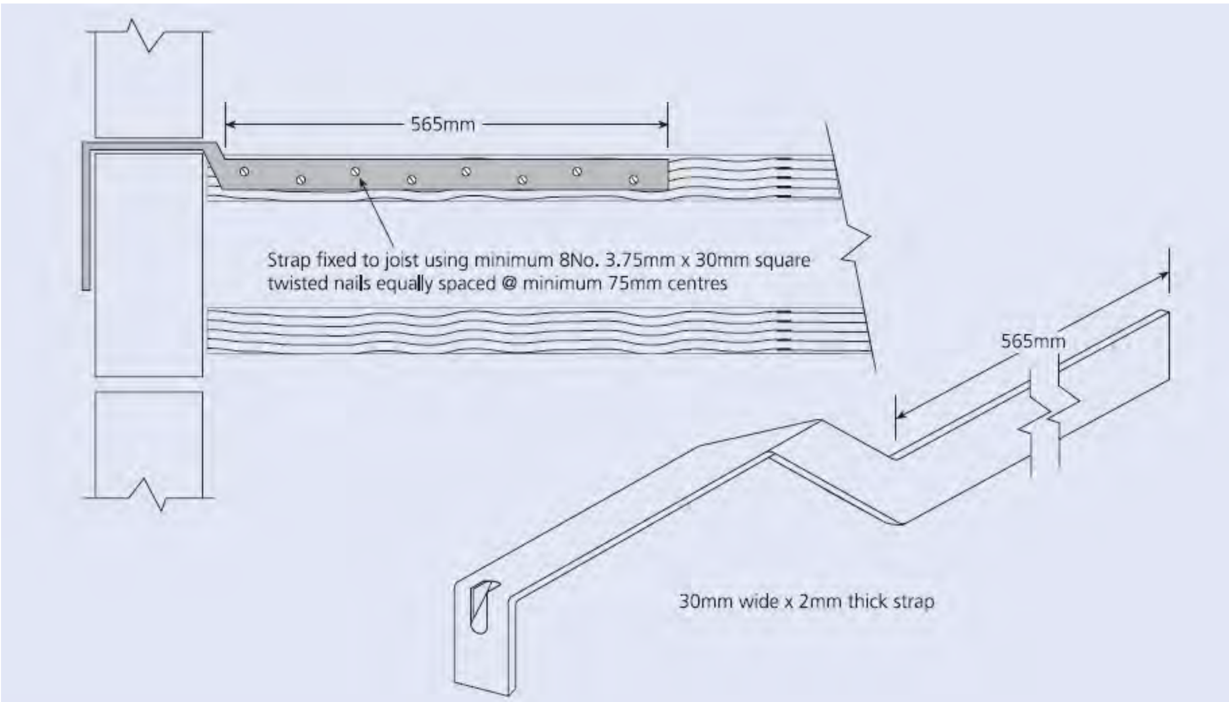


Diagram 2.22: Cullen PST (parallel Strap Top) longitudinal strap – for engineered or solid timber joists

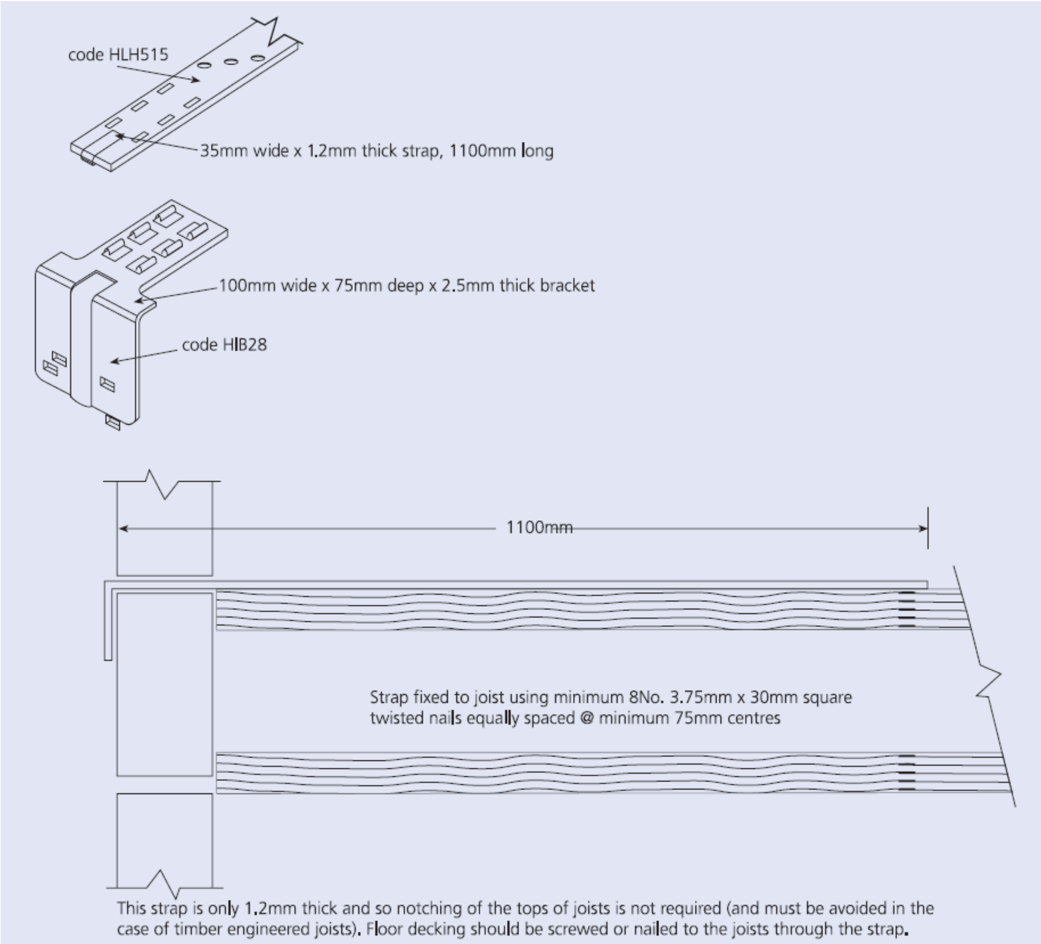


Diagram 2.23: Simpson Strong Tie 'Hi-Load' two part strap – for engineered or solid timber joists

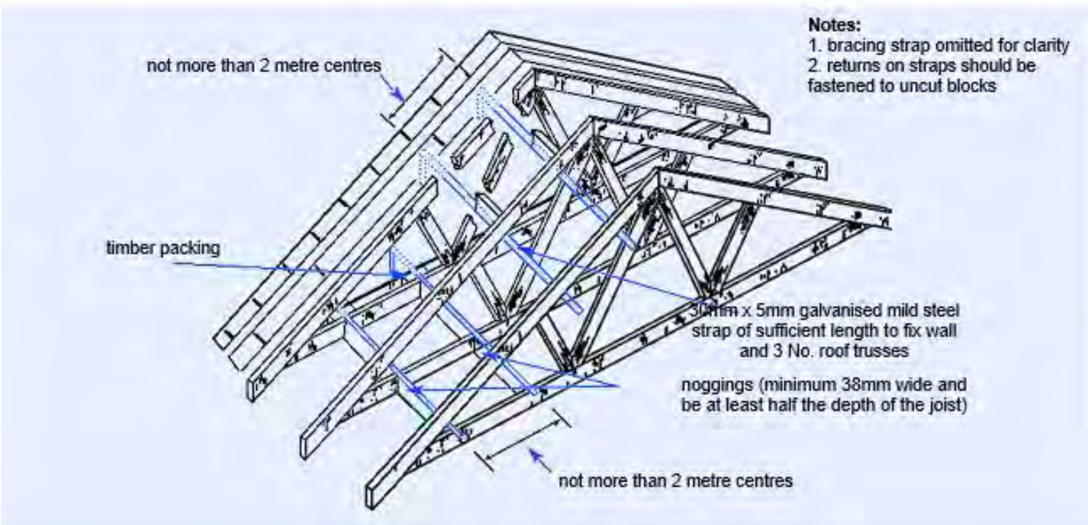


Diagram 2.24: Lateral restraint to gable and separating wall

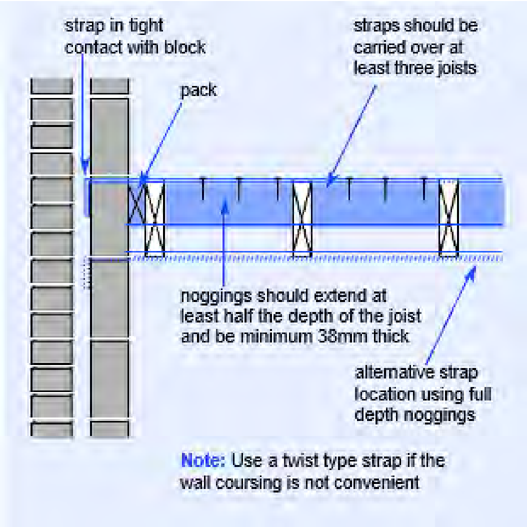


Diagram 2.25: Lateral restraint strap detail at floor or ceiling joist level

Movement Control

Vertical movement joints should be provided to the outer leaf of cavity walls as indicated in table 2.08. Where the finished ground level is 600mm or greater below the horizontal dpc then the movement joint should be continued within the external leaf of the substructure.

The dpc should be lapped a minimum 100mm to accommodate any movement.

Movement joints below the dpc should also be provided at major changes in foundation levels and at changes in foundation design.

Wall ties at maximum 300mm centres should be provided each side of movement joints (also see Wall Ties.)

Slip ties in the outer leaf are not required.

A compressible filler such as polyurethane foam should be used to form the joint and be sealed to prevent water penetration.

Fibreboard or cork are not acceptable materials for forming movement joints in masonry.

Bed joint reinforcement
Tramline or similar bed joint reinforcement can be used in calcium silicate brick, concrete brick and blockwork external walls to control the risk of shrinkage cracking to resist stresses around window openings if required by design (See diagram 2.26).

Stainless steel or other materials approved by Q should be used for bed joint reinforcement.

To ensure suitability of the product contact the manufacturer.

Elastic sealants (type E) are suitable as they allow for reversible movement.

Where a back-up material is used to control the sealant depth it will also provide a compressible space into which the sealant can deform. The following must be considered:

- The material is compatible with the sealant
- It will not adhere to the sealant thus preventing cracking within the sealant.
- Provides sufficient density to allow the sealant to be applied
- Allows sufficient flexibility so as to not impede lateral movement (compressible to about 50% of its original thickness) Fibreboard is not acceptable.

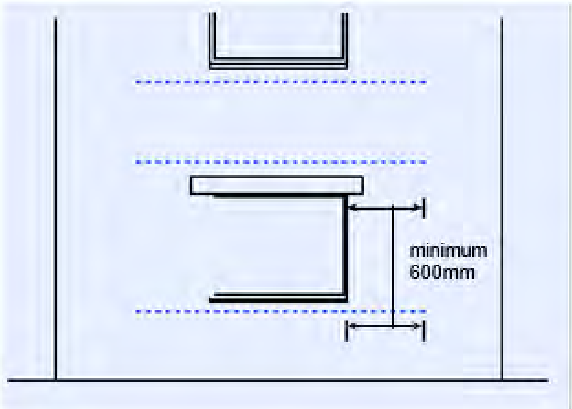


Diagram 2.26: Use of bed joint reinforcement around openings
in calcium silicate and concrete masonry

Lintels & Beams

Bearing length
Use the correct length and width of lintel for the opening and cavity width. The bearing length should be at least 150mm (this may be reduced to 100mm with some concrete lintels – check with designer/manufacturer).

Do not let masonry overhang lintels by more than 25mm (See diagram 2.27).

Continuity of masonry bond should be maintained at supports to beams and lintels (See diagram 2.28).

Ensure adequate end and intermediate (if applicable) support to hollow pressed steel lintels. This can be a problem where narrow or slender piers are proposed (See BS 5628:2 for further guidance).

Concrete prestressed lintels may need temporary strutting in the centre. Use correct size and type of padstones to spread the load if specified in the design.

Do not:
- Support lintels and beams on short lengths of cut block and make up pieces.
- Apply load to the lintels or beam before the masonry supporting it has hardened.

Timber lintels
The use of timber lintels is not acceptable unless a structural lintel is provided above. To prevent the possibility of moisture ingress when the timber shrinks please refer to diagram 2.29.

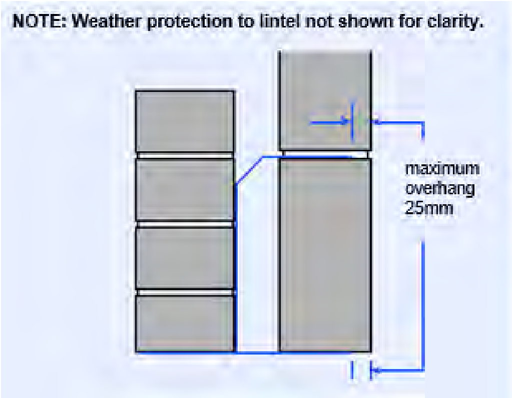


Diagram 2.27: Do not let blocks overhang lintels more than 25mm

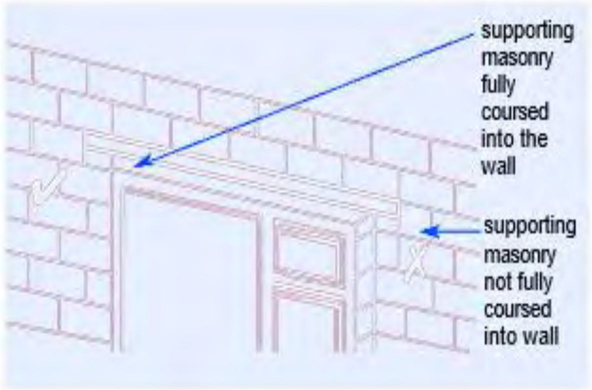


Diagram 2.28: Lintels bearing onto masonry

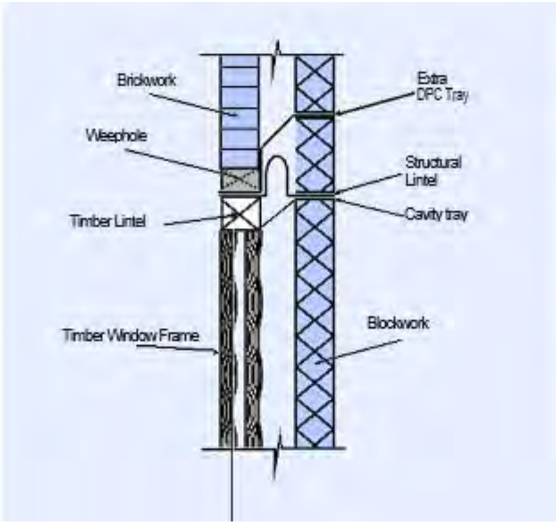


Diagram 2.29: Structural lintel above timber lintel

Cavity Trays

Cavity trays, associated weepholes and stop ends prevent the build up of water within a cavity wall thus allowing water to escape through the outer leaf. They are used in conjunction with lintels above openings, to protect the top surface of cavity insulation, at horizontal cavity barriers and where the cavity is bridged e.g. by projecting concrete floor units (See diagram 2.30).

- Cavity trays are to be provided:
    - at all interruptions which are likely to direct rainwater across the cavity, such as rectangular ducts, lintels and recessed meter boxes,
    - above cavity insulation which is not taken to the top of the wall, unless that area of wall is protected by impervious cladding (See diagram 2.31).
    - above lintels in walls in exposure zones (exposure zones shown on diagram 2.03 in the previous section) 4 and 3 and in zones 2 and 1 where the lintel is not corrosion-resistant and not intended to function as its own cavity tray,
    - continuously above lintels where openings are separated by short piers (See diagram 2.33).
    - above openings where the Lintel supports a brick soldier course.
- Cavity trays to rise at least 150 mm from the outer to the inner leaf, be self-supporting or fully supported, and have joints lapped and sealed. See diagram 2.32 and 2.37).

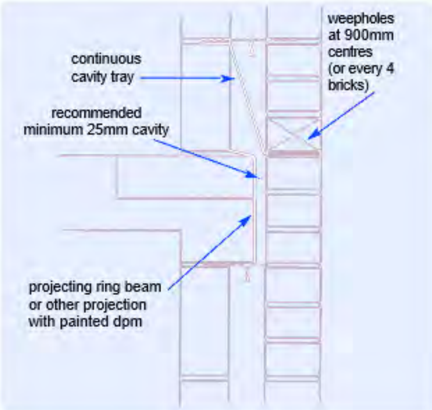


Diagram 2.30: Use of cavity tray to protect ring beam which protrudes into cavity

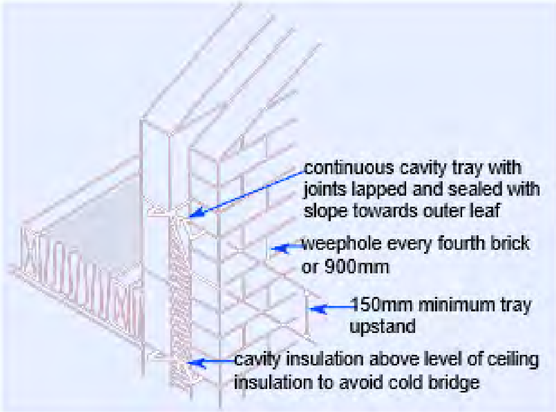


Diagram 2.31: Cavity trays – above insulation

Weepholes

- Weepholes to be installed at not more than 900 mm centres to drain water from cavity trays and from the concrete cavity infill at ground level. When the wall is to be cavity filled, it is advisable to reduce this spacing.
- At least two weepholes to be provided to drain cavity trays above openings.
- Provide means of restricting the entry of wind driven rain through weepholes in walls in exposure zones 3 and 4, including at ground level.

Stopends

Cavity trays should have watertight stopends to prevent water from running into the adjacent cavity (See diagrams 2.33 and 2.34).

Stopends need to be bonded to the cavity tray material or clipped to the lintel such that a stop to the structural cavity of at least 75mm high is provided. Normally the stop-end is located to coincide with the perpend nearest to the end of the cavity tray. Stop ends can be formed by sufficiently turning up the end of a dpc tray into the perpend joint.

Surplus mortar should be removed from cavities and wall ties cleared of mortar droppings and debris as the work proceeds.

Ring beams or floor slabs which partially bridge the cavity (e.g. when dimensional accuracy cannot be guaranteed) should be protected by a continuous cavity tray, especially when full cavity insulation is employed (See diagram 2.30).

Steps and staggers

Particular care is needed in adequately preventing the ingress of water in a terrace of dwellings with steps and staggers. A proprietary cavity tray system should be used, or alternatively a suitable tanking system.

Stepped cavity trays are required at all pitched (stepped) roof abutments with external cavity walls e.g. attached garages or staggered terraces. The bottom (last) cavity tray must be supplied with two stopends and an associated weephole, allowing all water to escape over the lower roof covering (See diagram 2.35).

For brickwork, blockwork and stonework, lead coverflashings should be linked into the cavity tray (lapped in below). Small gables should be constructed with a cavity. It may be impractical to build the inner leaf in masonry. In these cases it is acceptable to provide a "timber frame" construction (See diagram 2.38 for details). With blockwork, in particular rendered blockwork, and stonework this is more difficult and care must be taken in detailing and construction to avoid a path for water ingress.

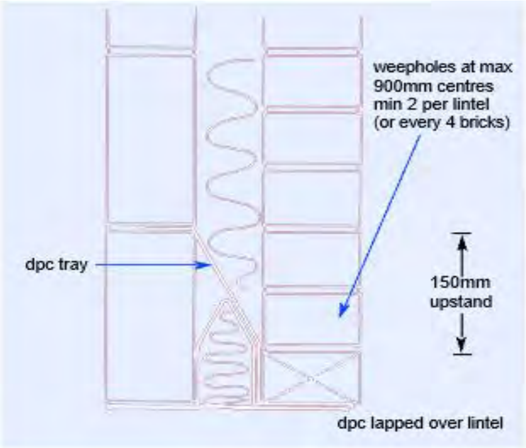


Diagram 2.32: Typical cavity tray installation

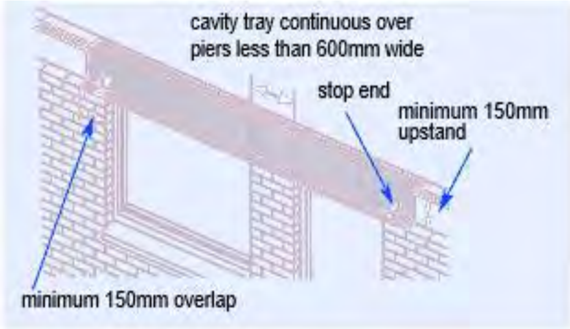


Diagram 2.33: Cavity Tray continuous over a pier

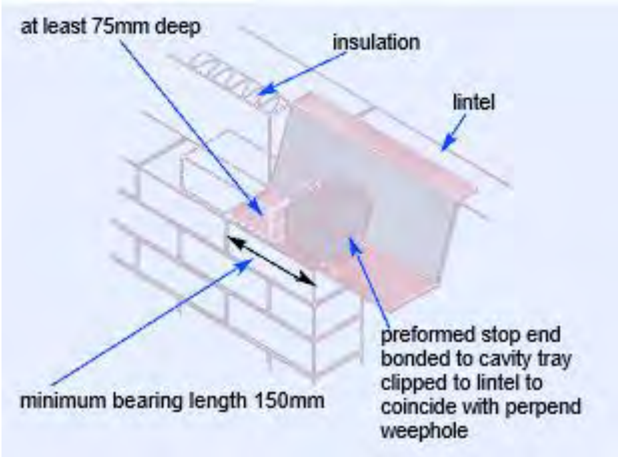


Diagram 2.34: Stop end

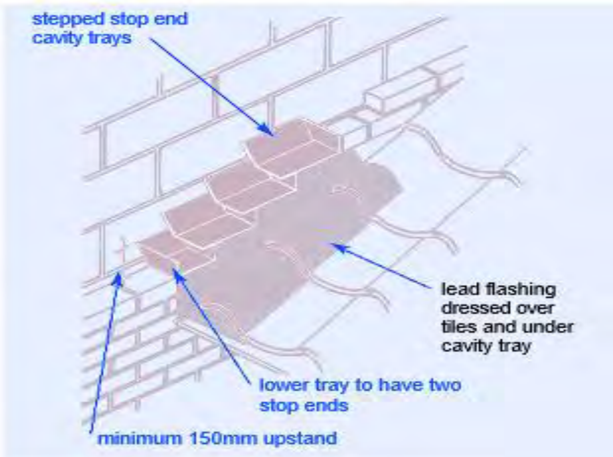


Diagram 2.35: Stepped cavity tray detail at roof/cavity wall abutment (brick/blockwork but equally applied to stone work)

Other perforations of the building envelope

Proprietary elements such as ventilators, soil pipes, etc. which perforate the building envelope should be installed and sealed to prevent ingress of moisture or vermin in accordance with the manufacturer's instructions.

External meter boxes should be of a type approved by the service supply authority and provided with a cavity tray and a vertical dpc between the back of the box and the wall.

Small Gables

Small gables should be constructed with a cavity. It may be impractical to build the inner leaf in masonry. In these cases it is acceptable to provide a "timber frame" construction. See diagram 2.38 for details.

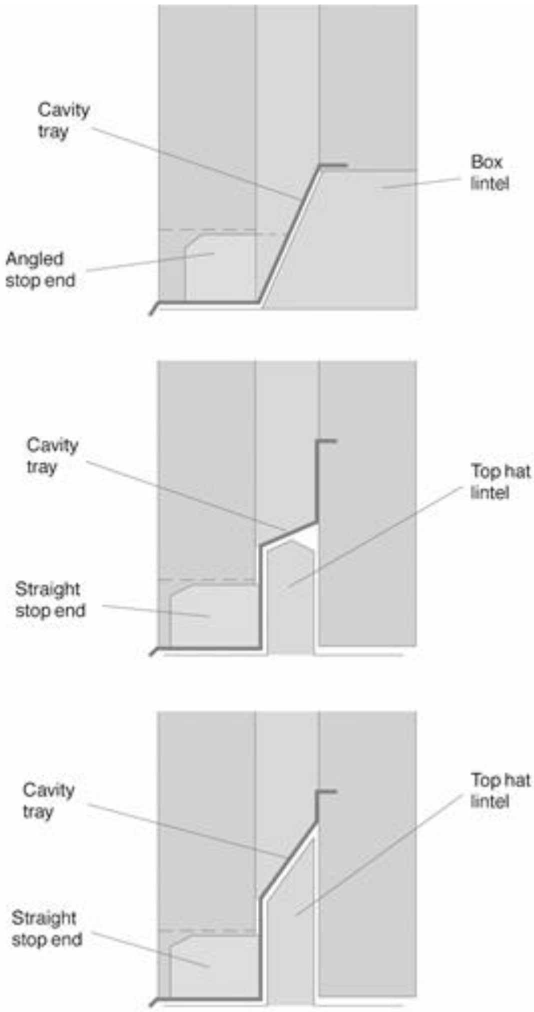


Diagram 2.36: Cavity tray and stop end profiles above lintels

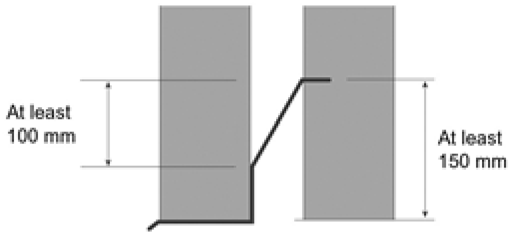


Diagram 2.37: Minimum dimensions for cavity trays

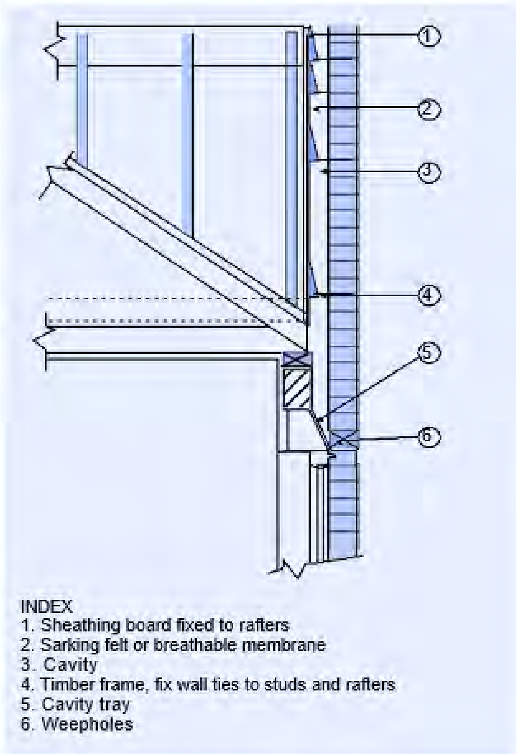


Diagram 2.38: Small gable timber frame

External Wall - Chimneys

If a chimney is not provided with adequate support by ties or securely restrained, its height (measured to the top of the chimney) should not exceed 4.5 x its least horizontal dimension, when measured from the highest point of intersection with the roof surface (density of masonry must be minimum 1500kg/m^3) - see diagram 2.45.

Chimneys and flues
Ensure that all gas flues terminate to the open air i.e. flue blocks must terminate at an appropriate ridge vent or similar even where no appliance is fitted prior to the sale/occupancy of the property. To demonstrate that flues comply with Building Regulations, reports showing flues have passed appropriate tests need to be drawn up and made available to the building control body and Q surveyor. A suggested checklist for these reports is given in Appendix A of Approved Document J and detailed guidance on testing is given in Appendix E.

Special blocks are made to accommodate gas fire flues which tend to be slightly thicker than normal units. When used in external walls, care should be taken not to reduce the clear cavity width below 50mm.

Typical chimney positions, dpc and flashing details are shown in diagrams 2.39-2.47.

Ensure that:

- If the chimney is in a severe exposure zone the cavity should extend around the outside of the stack and be continuous up to roof level as per BS5628. Part 3: 2001. Where the chimney breast is gathered in, the lower projecting masonry should be protected with a suitable capping and cavity trays.
- A 50mm cavity at the back of the chimney breast is maintained to prevent rainwater penetration
- Flue liners are used as specified with sockets upper most and jointed with fire resisting mortar and flue liners should:
    - be non-combustible
    - be reasonably smooth internally
    - be correctly jointed with mortar with the space between the liners and the brickwork filled with weak insulating concrete unless the manufacturer recommends an alternative specification
    - be properly jointed at the junctions with the starter block or lintel and outlet terminal
- A notice plate containing safety information about any hearths and flues should be securely fixed in an unobtrusive but obvious position within the home.
- Where a chimney forms part of a wall, the foundation should project at least 100mm wider than the chimney base and should be the same depth as the adjacent wall foundation.
- Factory made insulated chimneys should have a life of at least 30 years and be designed in accordance with BS4543, BS EN 1859 and installed in accordance with BS 7566.
- Where a chimney is not directly over an appliance or opening, a soot box accessible for emptying should be formed.
- Flue pipes should be equal to the cross section of the outlet of the appliance
- Flue pipes for solid fuel appliances should be vertical or inclined at 45º or less from vertical. A 150mm long horizontal section may be used to connect a back outlet appliance to a flue.
- Combustible materials close to a chimney should be:
    - At least 200mm from the inside surface of a flue, or
    - In all areas except Scotland, 40mm from the face of the chimney. This does not apply to floorboard, dado rail, mantelshelf or architrave.
    - Metal fixings in contact with combustible materials should be at least 50mm from a flue.

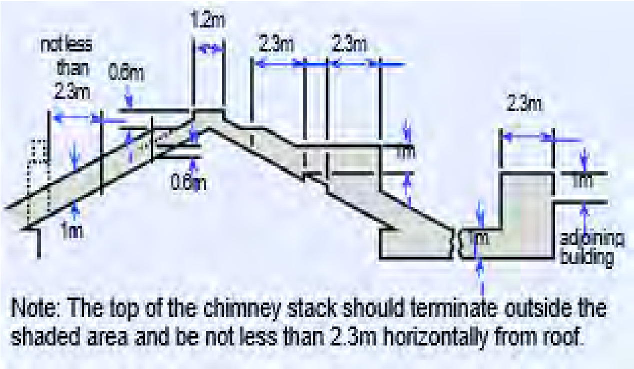


Diagram 2.39: Minimum chimney heights

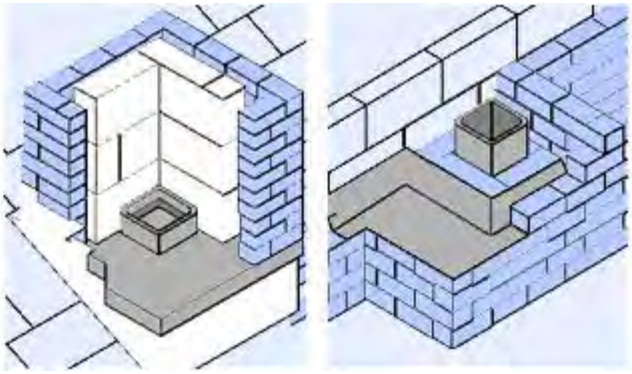


Diagram 2.40: Chimney Tray High and Low Level

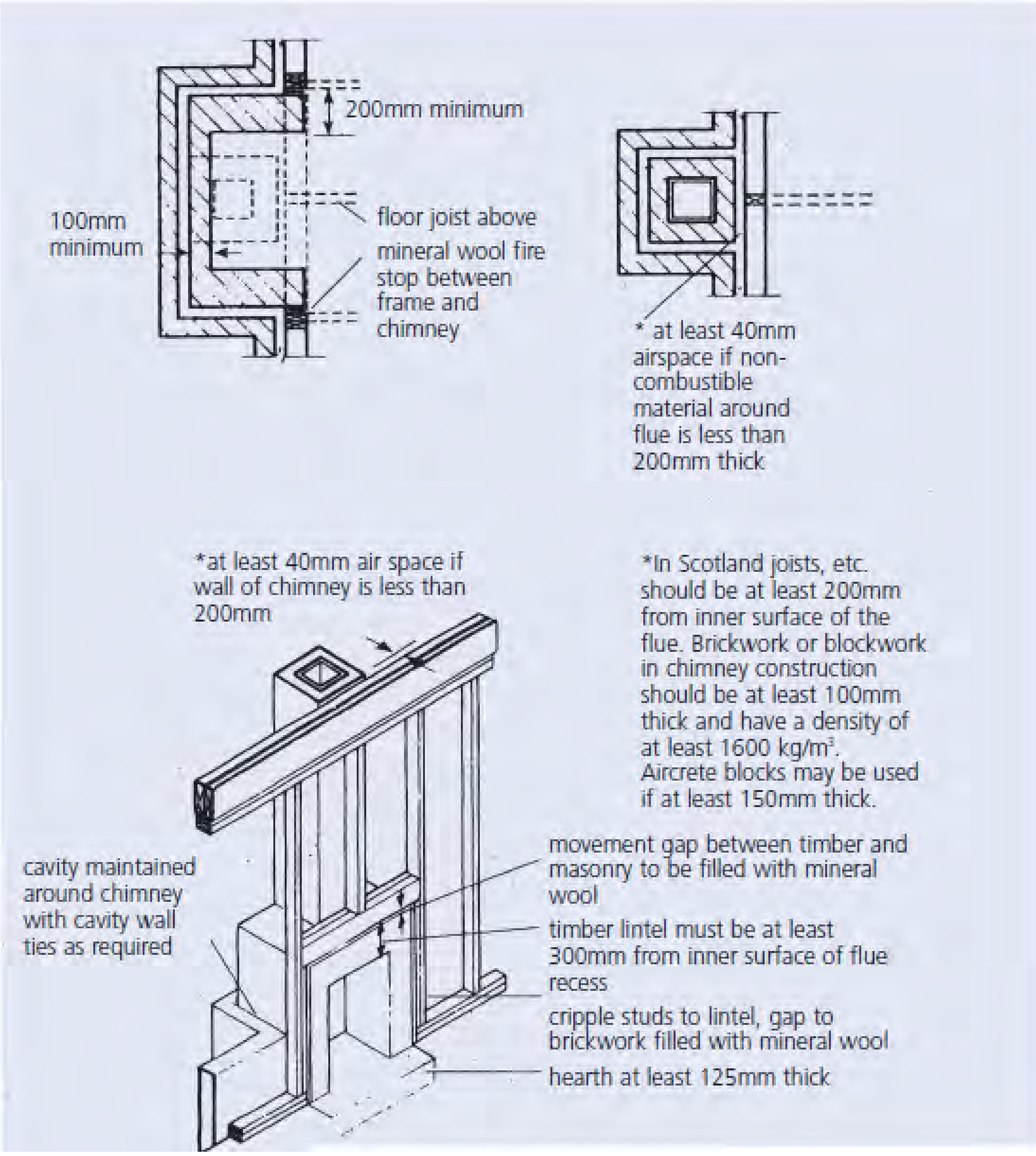


Diagram 2.41: Typical external fireplace recess and chimney -Timber frame construction

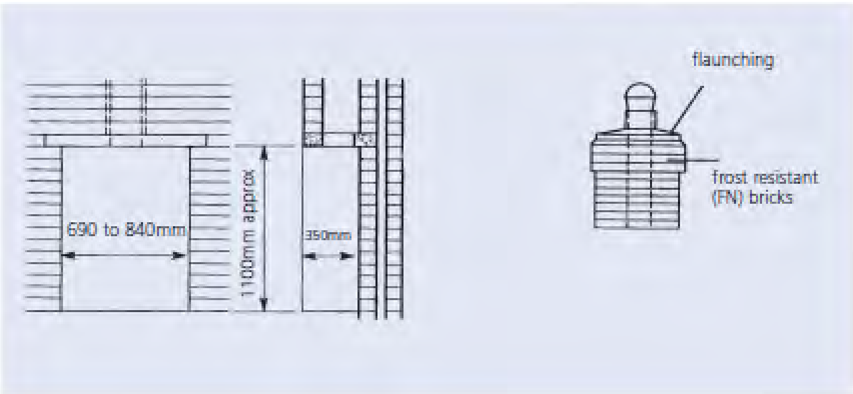


Diagram 2.42: Appliance Recess

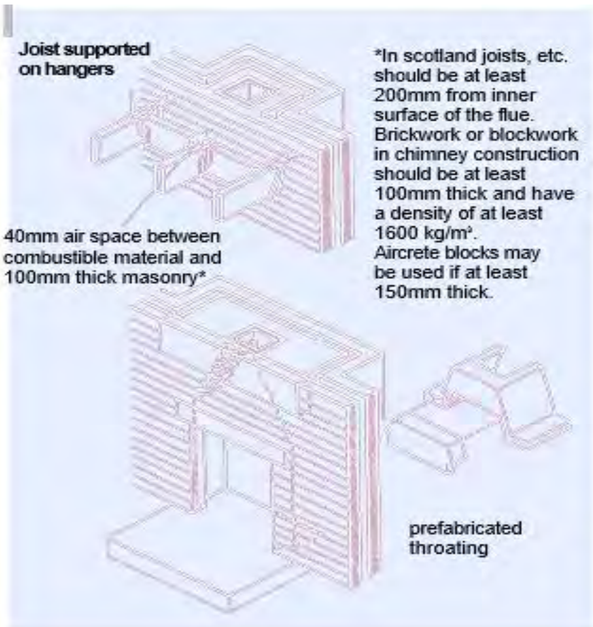


Diagram 2.43: Chimney breast details

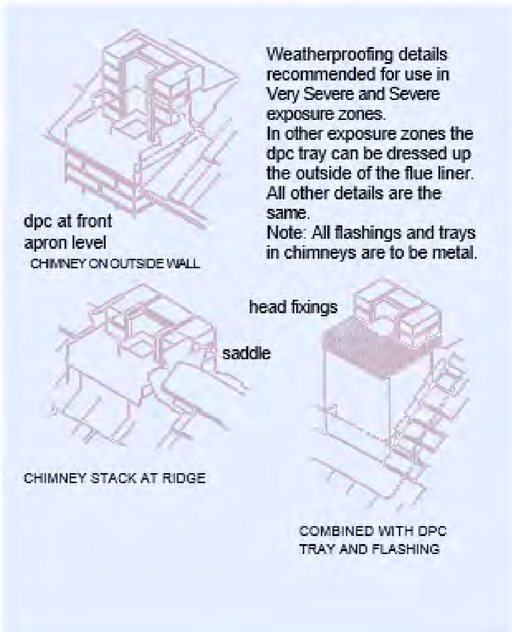


Diagram 2.44: Details of external chimney breast with masonry inner leaf

Corrosion of Lead Work

When free lime from mortar comes into contact with lead trays or flashings, (due mainly to the continual saturation of the brickwork) in areas such as chimneys, the lead should be protected from corrosion by the use of a thick coat of bitumen paint covering the faces likely to be in contact with the mortar. The protection against corrosion of lead work buried in mortar is suggested in guidance issued by the Lead Sheet Association. This treatment can also reduce staining of lead and brickwork. It is unnecessary to treat flashings buried only 40 – 50mm into mortar joints (cover flashings), as this close to the drying surface carbonation of free lime is rapid and there is no risk of corrosion in such circumstances.

Chimney Tray, Low Level

Required at low level where a cavity-walled chimney with brick shoulders is built on to an external wall; the tray prevents water which may enter the shoulders from penetrating to the inner leaf of the wall. (See diagram 2.40) Material: 1mm aluminium alloy sheet to BS EN 485-2: 1995 ‘Aluminium and aluminium alloys. Sheet strip and plate. Mechanical properties’. This has a higher melting point than lead, so is suitable for installation close to a heat source.

Chimney Tray, High Level

Required to prevent the entry of water at high level where a chimney rises through a pitched roof; suitable for new-build or remedial work. Minimises disturbance to surrounding construction in remedial work.

Material: Lead sheet to BS 1178: 1982 ‘Specification for milled lead sheet for building purposes’. Code 4 as standard. Standard sizes: 800 x 800mm, 900 x 900mm, 950 x 950mm. To suit either 195mm square or 195mm diameter circular flue.

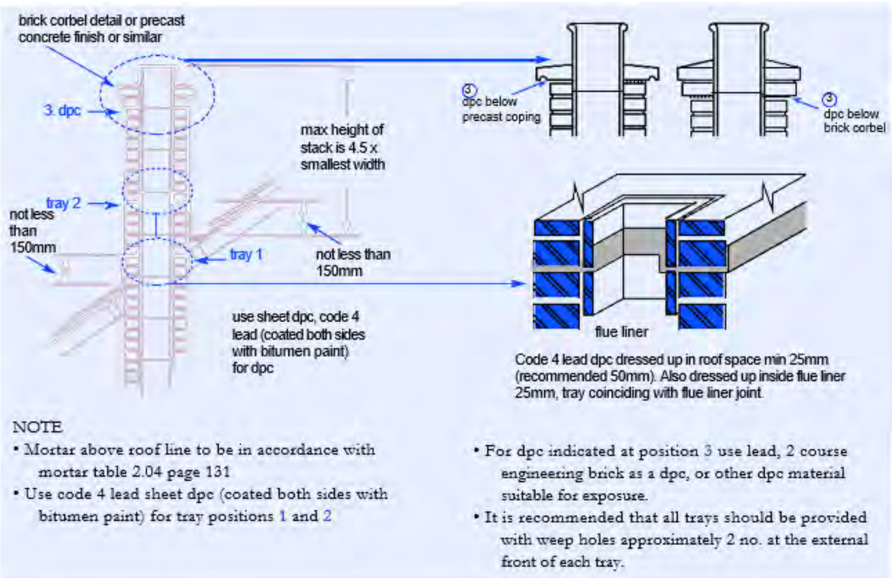


Diagram 2.45: Position of dpcs in a typical chimney

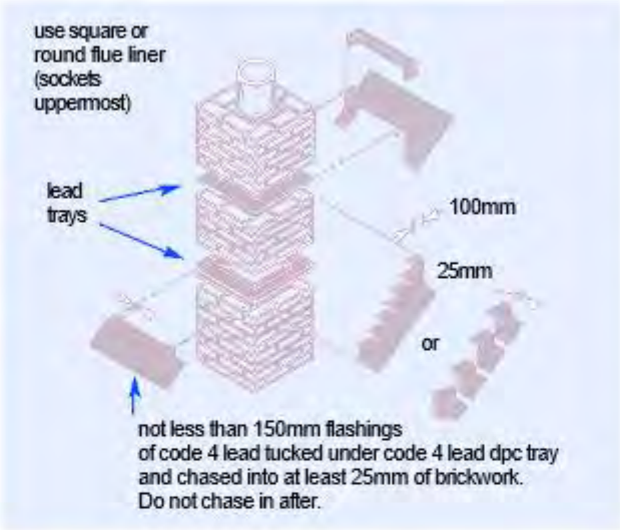


Diagram 2.46: Typical chimney flashing detail

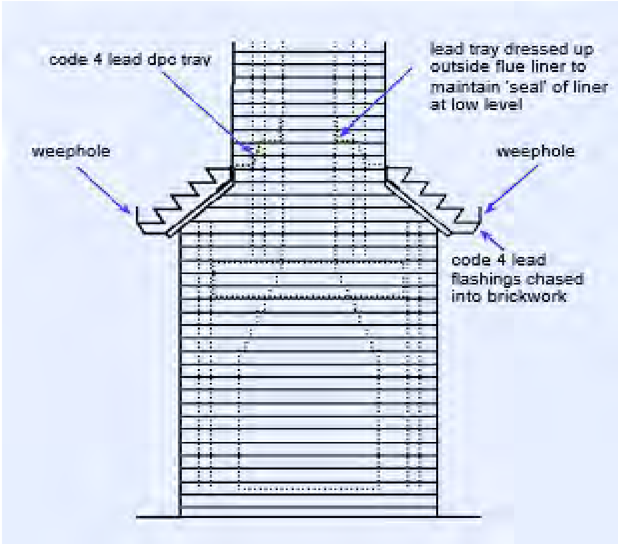


Diagram 2.47: Typical detail for external chimney breasts

External Walls - Parapets

The minimum thickness and maximum height of parapet walls should be as given in diagram 2.48 and table 2.09.

The materials used in the construction of parapet details should be suitable for the location and exposure.

Where possible, the use of raking parapets should be avoided due to the need for high standards of detailing and workmanship required to prevent the ingress of moisture. In very severe exposure zones it is recommended that a parapet construction is avoided altogether. Where these details cannot be avoided it is essential to provide a high level of supervision and workmanship whilst following the general guidance given in diagrams 2.50 – 2.53.

It is recommended that in moderate and severe exposures any full fill cavity insulation should be stopped at the upper level of the ceiling insulation, providing a suitable cavity tray in accordance with diagram 2.49.

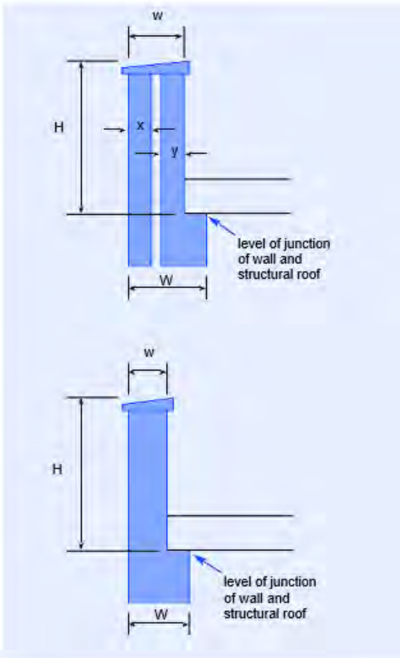


Diagram 2.48: Parapet walls – height

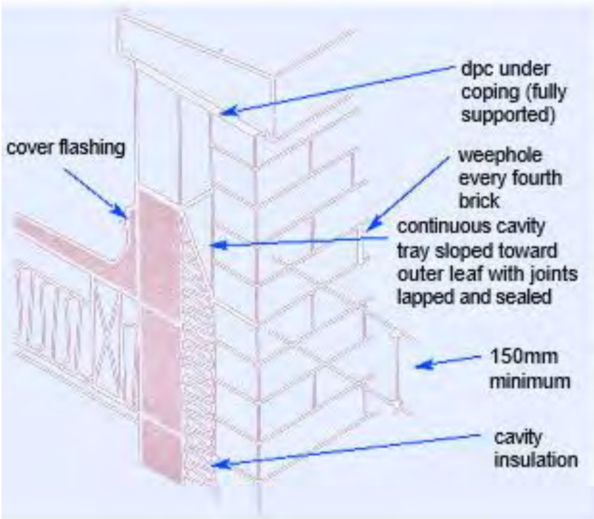


Diagram 2.49: Cavity trays - parapets

Wall type	Thickness (mm)	Parapet height H to be not more than (mm)
Cavity wall	x + y equal or less than 200	600
	x + y greater than 200 equal or less than 250	860
Solid wall	w = 150 w = 190 w = 215	600 760 860
Note: w should be less than W		

Table 2.09: Parapet walls/height ratios

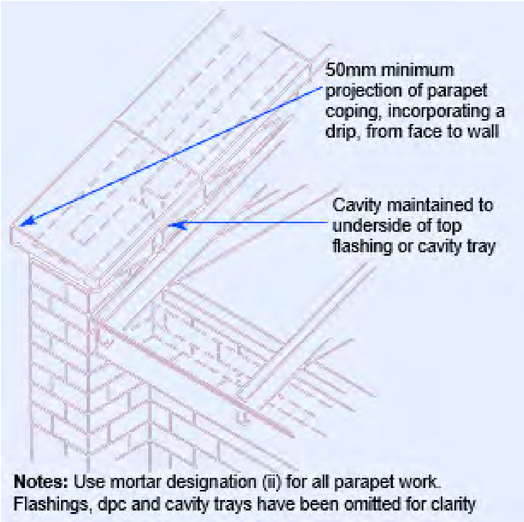


Diagram 2.50: Raked parapet detail - coping

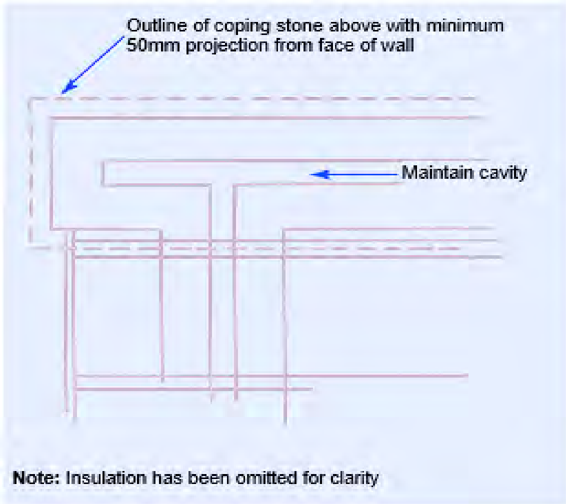


Diagram 2.51: Parapet detail – continuous cavity

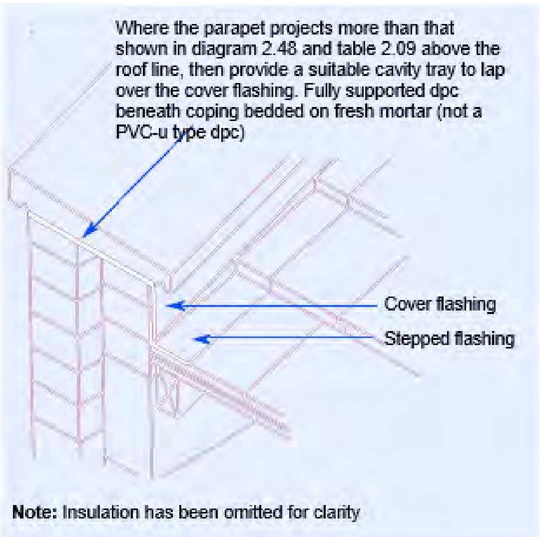


Diagram 2.52: Section of a raked parapet detail – flashings

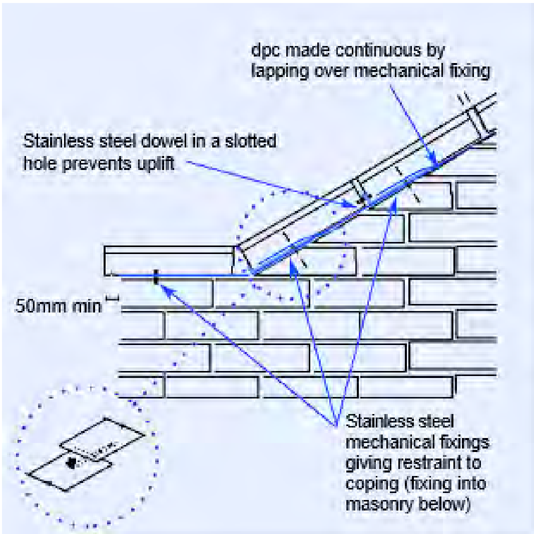


Diagram 2.53: Parapet detail – coping fixings

External Walls - Natural Stone

General

The following additional guidance for natural stone shall be used in conjunction with any other information in this manual.

When selecting stone for cavity wall house building it is important to consider the exposure rating for the area. Clearly it is not recommended to use a soft, porous type stone in a severe exposure zone.

Consideration should also be given to the compatibility of different stone to prevent staining and premature decay. Limestones and sandstones should not be mixed together. It is also advisable to use a stone that has been quarried within a reasonable location of the development thus ensuring both weathering qualities and the visual blending with existing buildings.

Natural stone has a grain or natural bed, which is determined during its formation in the strata of the quarry.

It is important that the stone is laid with the grain running horizontal to the bed. In the case of jambs and mullions the grain should be vertical.

Walls constructed with a cavity are essential where the location is likely to be of moderate exposure or worse.

A sawn bed of 100mm minimum thickness to be used as the outer leaf of a cavity wall although Q recommends 150mm.

Where dressed stone is used and the bed falls below 90mm due to the irregularities of the stone, then the stone should be backed with either a brick or 50mm min thick block wall to maintain the structural stability (see diagram 2.54).

It is not acceptable for the stone to be packed or wedged to maintain line and level without the backing wall being in place.

Mortar

The mortar for use with stone should comply with the relevant British Standards for sand, lime and cement as set out in BS 5390.
This can vary in strength from 1:1:6 to 1:3:12 depending on the softness of the stone. It is important to use correct mortar to allow for movement and associated shrinkage.

Wall ties

Ensure that the ties are stainless steel and of sufficient length to maintain a 50mm embedment. It may be necessary to double up the wall ties where the coursing is out of line due to the varying thickness of natural stone at the reveals i.e. every other course. Also ensure that wall ties do not slope inwards.

Insulation

Full fill cavity insulation should only be considered where the outer leaf is backed by brick/blockwork, although this is still dependent on exposure.
Either partial fill, leaving a residual cavity of 50mm or a clear cavity should always be the preferred option.

Movement control

Where sealants are used it is important to select a non-oil-based sealant to help to prevent any staining to the stone.

Cavity trays

In addition to the previous guidance for cavity trays the following shall apply:

- When stone heads are being used it is advisable to double up the cavity trays one below and one above the stone head.
- Provide stop ends and weep holes.

Jambs and mullions

Stone jambs and mullions should be fixed at the top and the bottom with stainless steel pins. Stainless steel frame type cramps can also be used to give extra stability at jambs.

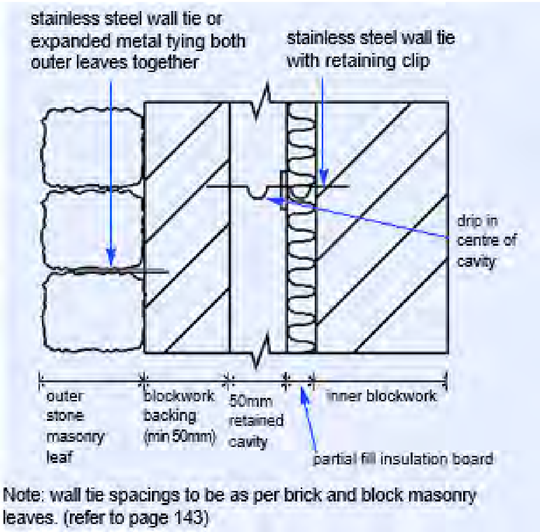


Diagram 2.54: Block backing to natural stone masonry

External Walls - Thermal Insulation

The following text provides some guidance and an interpretation of the Approved Document (L1 2006) covering the thermal efficiency of dwellings.

Part L Conservation of fuel and power

L1. Reasonable provision shall be made for the conservation of fuel and power in buildings by:

a. limiting heat gains and losses:
   i. through thermal elements and other parts of the building fabric; and
   ii. from pipes, ducts and vessels used for space heating, space cooling and hot water services;
b. providing and commissioning energy efficient fixed building services with effective controls: and
c. providing to the owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

External walls should be designed to provide the required standard of thermal insulation and the correct use of insulation material to meet the requirements of the Building Regulations.

Design should avoid cold bridging at openings and at junctions of external walls with roofs, floors and internal walls.

Full cavity insulation
In Northern Ireland, it is not permissible to fill cavities with pumped thermal insulants at the time of construction.

In Scotland, it is not permissible to fill the full width of the cavity with any thermal insulant at the time of construction.

Note: Render on an external leaf of clay bricks in Severe or Very Severe exposures is not permitted where the cavity is to be fully filled with insulation (Diagram 2.55 to be used when calculating the elemental method for conversions).

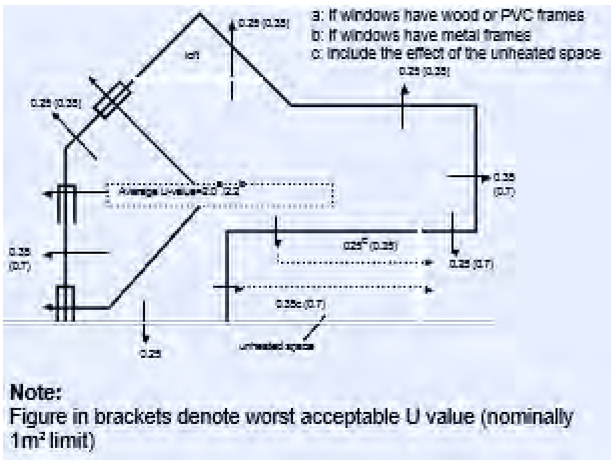


Diagram 2.55: Summary of elemental method

SAP rating (SAP 2005)

The Approved Document sets out the Standard Assessment Procedure for calculating energy ratings. As well as producing guidance on the insulation values of the fabric, compliance with the following energy saving methods are required.

- The central heating programmer should control heating and hot water separately
- When both heating and hot water thermostats are satisfied the boiler should switch off (boiler interlock)
- All rooms shall be provided with a means of controlling heating output*
- The HWS cylinder shall be insulated and fitted with a thermostat
- All pipework outside the heated space including primary connections to the HWS cylinder for a distance of 1 metre should be insulated

* i.e. Provide zone control or thermostatic radiator valves in addition to the room thermostat.

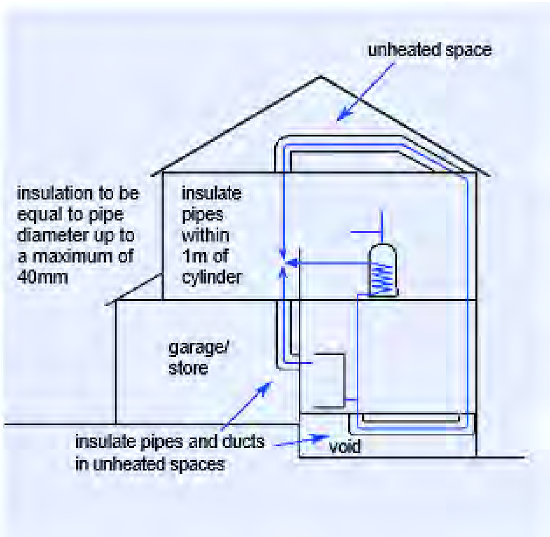


Diagram 2.56: Adequate insulation of water pipes

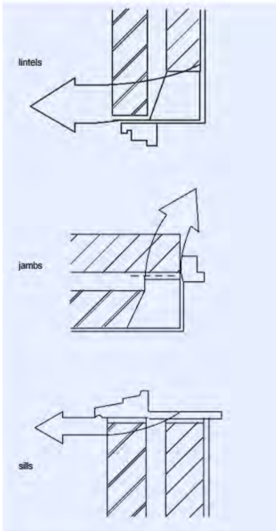


Diagram 2.57: Thermal bridging and heat loss paths

Positive measures to prevent infiltration should include:

- all windows and doors to be draught stripped
- likewise loft hatches
- service entries and dry linings to external walls should all have continuous seals.

Care must also be taken to ensure that water pipes are adequately insulated (See diagram 2.56).

Provision must be made to prevent thermal bridging around windows and doors to avoid heat loss and condensation problems (See diagram 2.57).

When considering the energy efficiency of a dwelling care must be taken in the detailing at lintels, jambs and sills.

The Building Control Authority and Q should be consulted at the design stage to agree variable design data such as the driving rain index for the site and be consulted if deviations from the approved plans are made during the course of the works.

Compliance with Q Technical Requirements

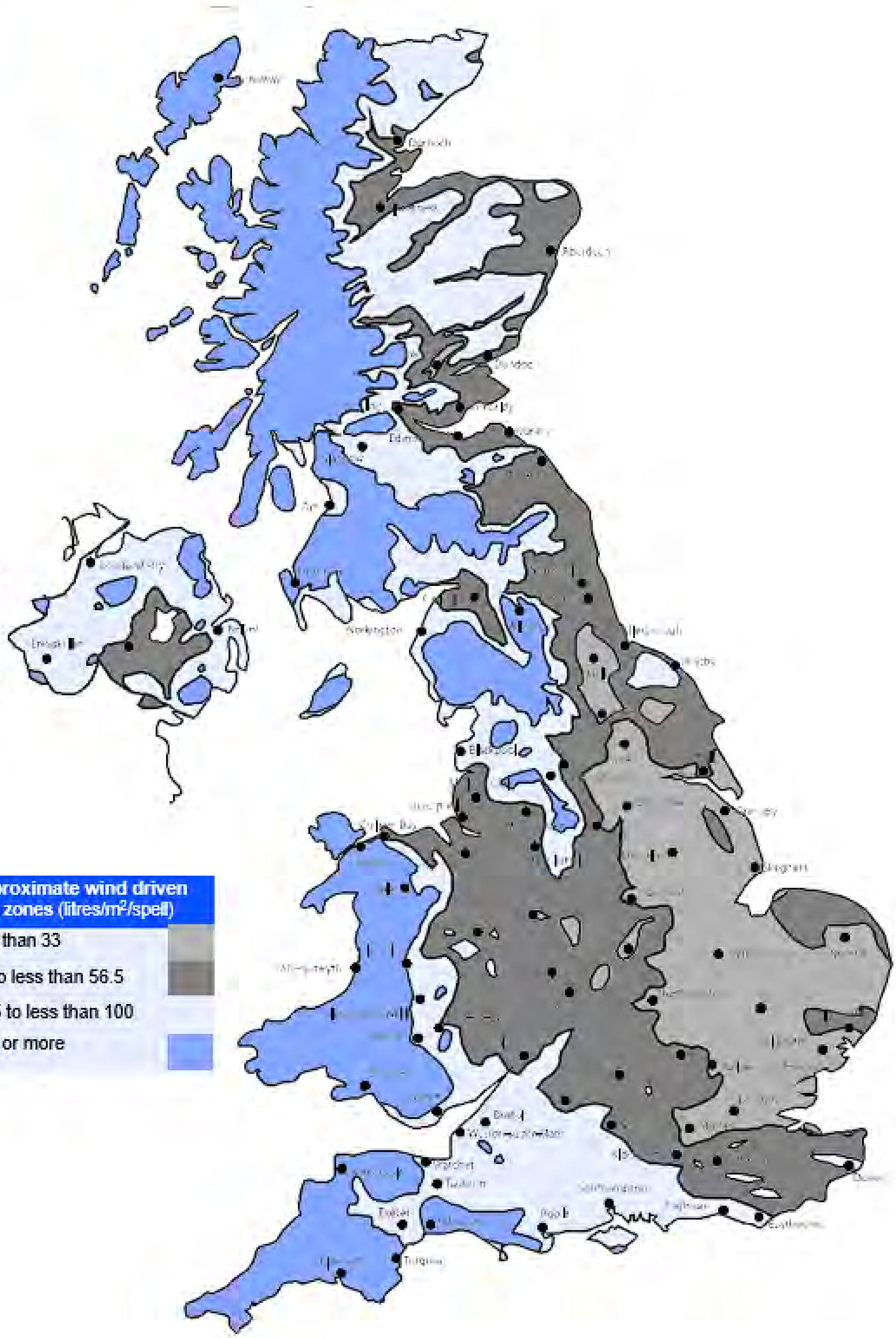
The following provides guidance on the interpretation of the Requirements with regard to individual elements covered in this section and where appropriate, propose performance or specific standards which meet these Requirements.

Where reference is made to the exposure rating of a site, these are as defined in BS 5628:3 and should be determined by reference to the map showing categories of exposure to wind driven rain. Diagram 2.69 represents the average case situation.

Where local knowledge or features dictate, a modification to the rating should be made:

- Where there is concern over the increased incidence of wind-driven rain, particularly with full or partial cavity fill, consider increasing the map zone value by one category, i.e. a location currently assessed as zone 3 (Severely exposed) could be considered as zone 4 (Very severely exposed). This modification should only be considered where there is increased local exposure, e.g. hillside location, urban fringe or multi- storey construction. Alternatively, provide additional protection in the form of rainscreen cladding to the outer face of the wall.
- Decrease the exposure rating by one where the building does not face a prevailing wind and all walls are well protected by local features i.e. tall evergreen trees or other buildings of similar height within a close proximity.
- The contour lines shown on the map represent an approximate division between zones. For a more detailed analysis using larger maps, reference can be made to BS 8104
- It is recommended that stainless steel wall ties should always be used, to all houses regardless of their location.

Diagram 2.69: Map showing categories of exposure to wind driven rain



	Exposure zones	Approximate wind driven rain zones (litres/m²/spell)
1	Sheltered	less than 33
2	Moderate	33 to less than 56.5
3	Severe	56.5 to less than 100
4	Very Severe	100 or more

Maximum recommended exposure zones for insulated masonry walls.								
Wall construction	Maximum recommended exposure zone for each construction							
Insulation method	Min. width of filled cavity or clear cavity (mm)	Impervious cladding: Full height of wall	Impervious cladding: Above facing masonry	Rendered finish: Full height of wall	Rendered finish: Above facing masonry	Facing masonry: Tooled flush joints	Facing masonry: Recessed mortar joints	Facing masonry: Flush sills and copings
Built-in full fill	50	4	3	3	3	2	1	1
	75	4	3	4	3	3	1	1
	100	4	4	4	3	3	1	2
	125	4	4	4	3	3	1	2
	150	4	4	4	4	4	1	2
Injected fill *not* UF foam	50	4	2	3	2	2	1	1
	75	4	3	4	3	3	1	1
	100	4	3	4	3	3	1	1
	125	4	4	4	3	3	1	2
	150	4	4	4	4	4	1	2
Injected fill UF foam	50	4	2	3	2	1	1	1
	75	4	2	3	2	2	1	1
	100	4	2	3	2	2	1	1
Partial fill								
Residual 50 mm cavity	50	4	4	4	4	3	1	1
Residual 75 mm cavity	50	4	4	4	4	4	1	1
Residual 100 mm cavity	50	4	4	4	4	4	2	1
Internal insulation								
Clear cavity 50 mm	50	4	3	4	3	3	1	1
Clear cavity 100 mm	100	4	4	4	4	4	2	2
Fully Filled								
Cavity 50 mm	50	4	3	3	3	2	1	1
Cavity 100 mm	100	4	4	4	3	3	1	2

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Table 2.11: Refer to diagram 2.70 for interpretation of cladding and render above facing masonry

External insulation

- External insulation systems, which incorporate 65mm or more of insulation or incorporate a 50mm clear cavity and an effective external cladding, are generally suitable in all exposure categories. However, they should only be installed in exposure categories as stated by suitable third party accreditation acceptable to Q and in accordance with manufacturer's recommendations.

Cavities

- Cavities to be not less than the stated width and free of obstructions which may transmit water towards the inner leaf.

Solid masonry

- Internally insulated masonry walls to be at least 328mm thick if of brickwork, 250mm if of aggregate blockwork and 215mm if of autoclaved aerated concrete blockwork with a notional cavity between the masonry and the insulation.

Mortar and render

- A mortar mix whose strength is compatible with the strength and type of masonry unit must be specified to minimise cracking, especially for concrete and calcium silicate units. (See table 2.04).
- Tooled mortar joints, either bucket handle or weathered, to be used. Recessed or raked joints to be used only in exposure zone 1 with 50mm clear cavity, or zone 2 with 100mm clear cavity. (See table 2.11)
- Render to be appropriately specified and applied to the correct backing material to minimise cracking (See Render section for further guidance).

Overhangs

- Overhangs at eaves and verges to be at least 350mm and incorporate a throating. The greater the overhang, the greater the protection (diagram 2.70). Sills, copings, string courses and drips below cladding or render to project at least 50mm and incorporate a throating (diagram 2.71). Flush sills and copings give no protection to the wall below.

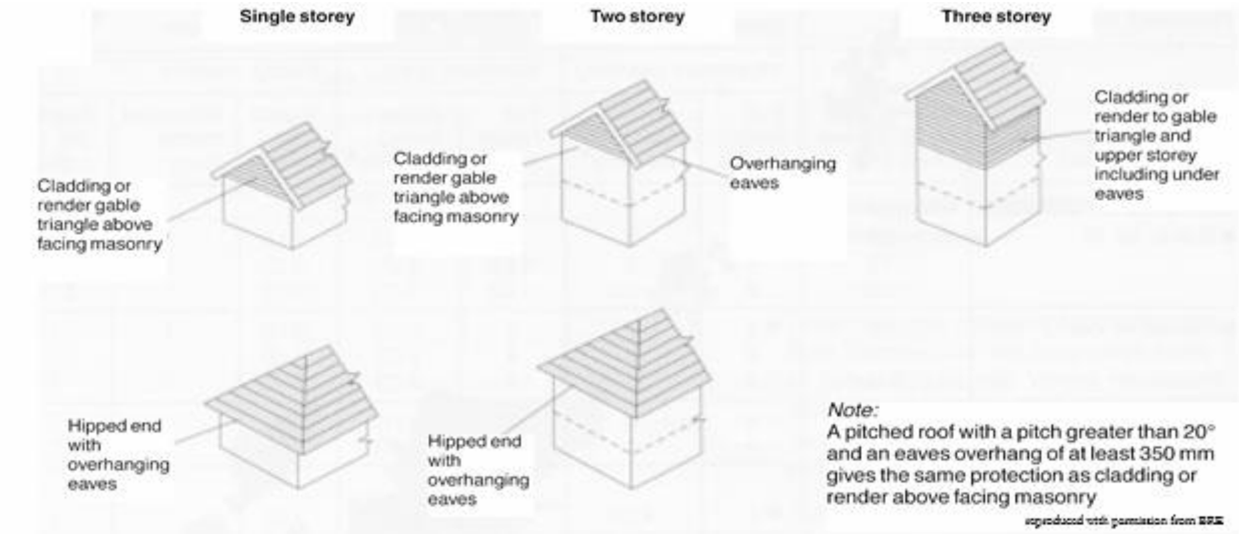


Diagram 2.70: Interpretation of walls and impervious cladding or render above facing masonry

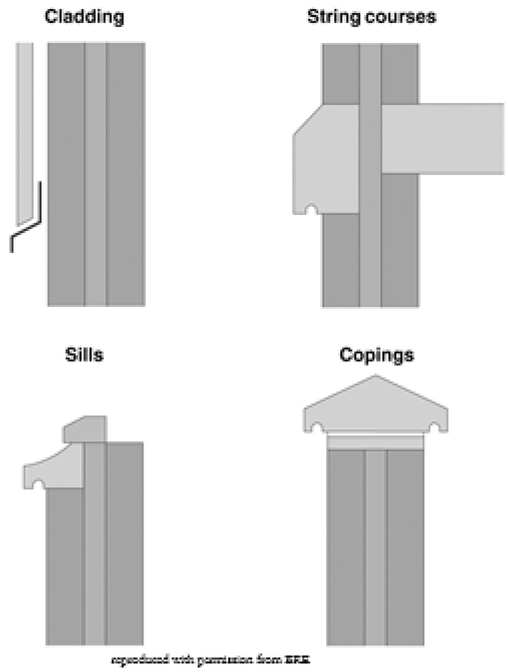


Diagram 2.71: Masonry protected by overhangs

General (including cavity insulation and durability)
The following provisions apply when cavity fill insulation is used:

- Ensure that a clear cavity width of 50mm is maintained when partial cavity fill is used
- Full cavity fill should be the minimum thickness for the given exposure as set out in table 2.11.
- Full cavity fill insulation should not be used in walls of rendered clay bricks of N category soluble salts content, unless sulphate resisting cement is used in mortar for jointing and backing coat for render
- Full cavity fill should not be used in moderate exposure or worse where painted fair-face masonry is proposed unless the masonry outer leaf is frost resistant
- Full cavity fill insulation should not generally be used with random stonework unless backed up by a skin of brick or blockwork although this is still dependent on the exposure category.
- The two cavity leaves should be raised together, unless insulation comprising built-in batts is to be used, in which case it should be installed in accordance with the manufacturers instructions
- Wall ties should be positioned so as to support full or partial cavity insulation batts below the dpc where this is permitted by independent third party certificates acceptable to Q. (See Wall Ties section.)

Third-party certification

- Built-in cavity fill must have third-party certification and be installed in accordance with manufacturers' instructions.
- Injected cavity fill must have third-party certification and be installed under an approved surveillance scheme.
- External insulation must have third-party certification for use on solid walls in specified exposure zones.

Ensure that:

- All batts butt closely
- Batts are kept free from mortar droppings
- The orientation of batts is retained, e.g. vertical laminations in mineral wool allow water to drain downwards not across the cavity (See diagram 2.72-2.75)
- Batts or injected fill are taken right up to the verge of a gable unless a cavity tray is fitted where the insulation finishes
- All vents are sleeved and all openings sealed when an injected insulation system is to be used
- No gaps are left – insulation materials can be cut to fit with a sharp knife or the edge of a trowel
- All new work is covered after construction (See diagram 2.02).
- Wall insulation is to be taken up high enough to link with loft insulation without blocking any cross ventilation provision.

Partial fill insulation

The insulation material can be either mineral wool or foamed plastics installed so that they are held against the supporting inner masonry leaf.

Fixing the insulation against the inner leaf does not hinder the progress of any water draining down the cavity, allows air movement to dry out the outer leaf and keeps cold air in the residual air space outside of the insulation layer (See diagrams 2.76-2.79)

The minimum design width of the residual air space in the cavity is 50mm ie. if using 25mm thick insulation provide a total cavity width of 75mm.

Wall ties need to be provided with an appropriate retaining disc or system to keep the insulation in place. Follow the installation procedure in the previous section. Mortar droppings should be cleaned off the top of batts before the next batt is placed.

Do not:

- Fix damaged boards
- Leave gaps in insulation (cut boards where required)
- Stop short of the verge in a gable wall without providing a cavity tray

It is recommended that cavity insulation is continued to the top of a gable wall. Where it is not, it should be protected by a cavity tray, unless otherwise permitted by independent third party certificates acceptable to Q.

Cavity trays should be lapped and sealed at joints. A cavity tray should be provided immediately below parapets, being located above any insulation and with a step down towards the outer leaf (See diagram 2.49).

A dpc should also be provided beneath the coping.

Cavity trays should be laid on a mortar bed of fresh mortar and extend across the full width of any opening including circular or arched openings.

Full fill cavity insulation

The following design points should be noted:

- stop ends should be provided to cavity trays or combined lintels
- weepholes should be provided at 450mm (maximum) centres with at least two per opening
- mortar should not be recessed
- paint finishes on brick or render are not acceptable if they are likely to cause frost damage or sulphate attack or other damage.

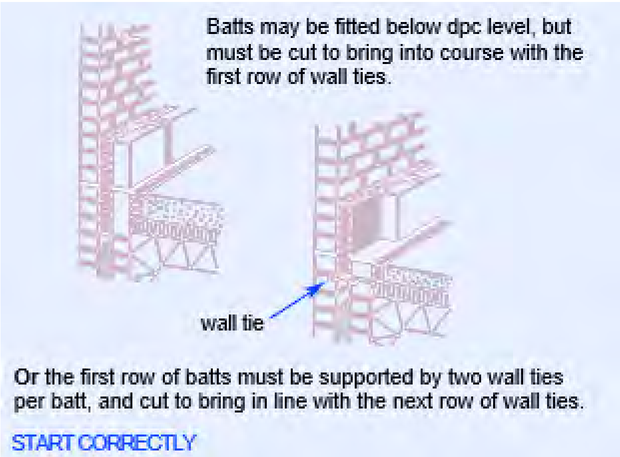


Diagram 2.72: Installation of full fill insulation batts – start correctly

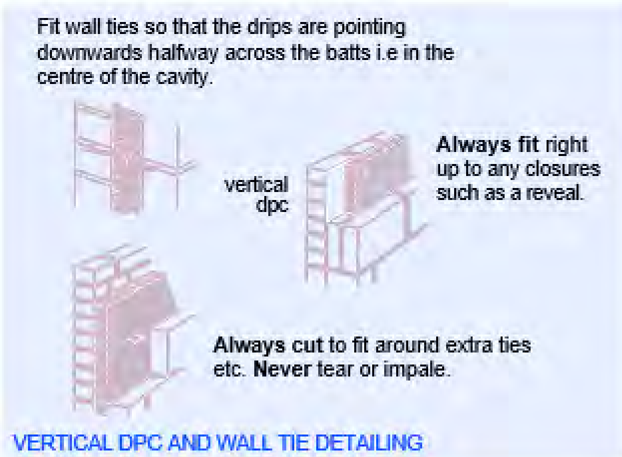


Diagram 2.73: Installation of full fill insulation batts – vertical dpc and wall tie detailing

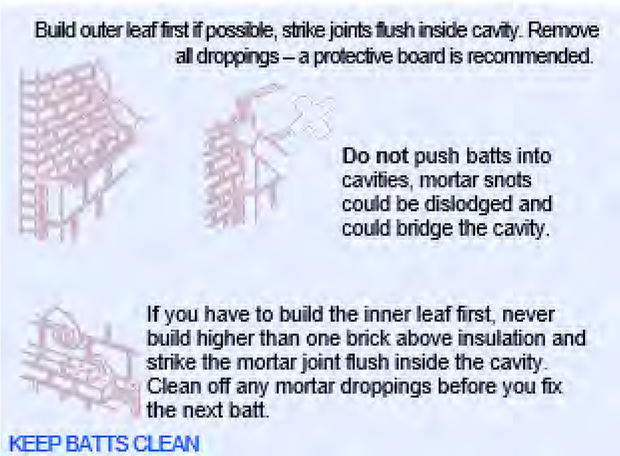


Diagram 2.74: Installation of full fill insulation batts – keep batts clean

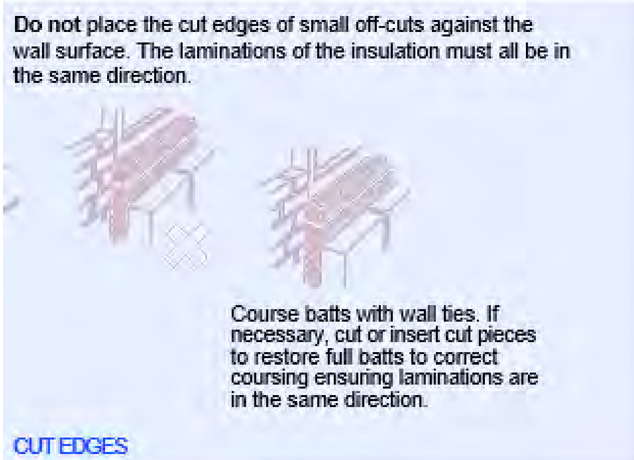


Diagram 2.75: Installation of full fill insulation batts – cut edges

Partial fill cavity insulation

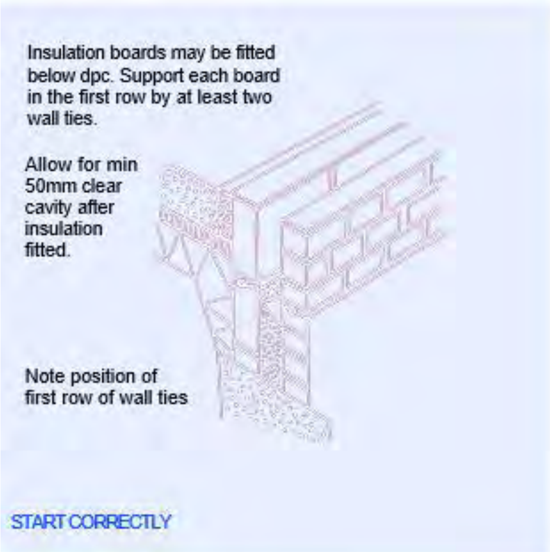


Diagram 2.76: Installation of partial fill insulation boards – start correctly

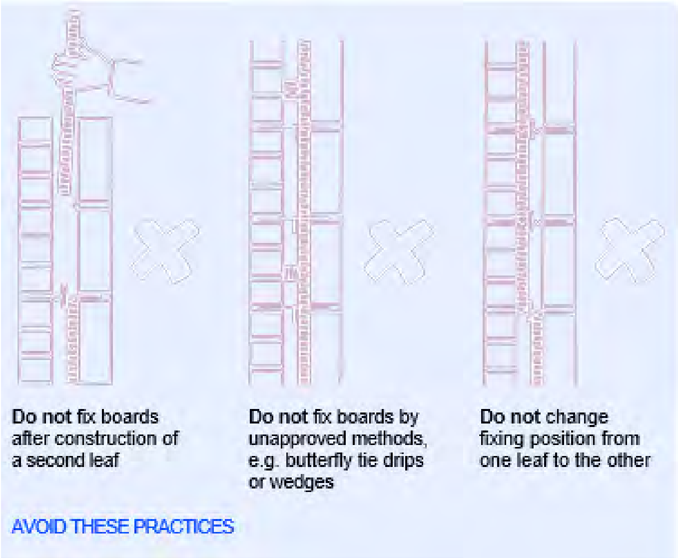


Diagram 2.77: Installation of partial fill insulation boards – avoid these practices

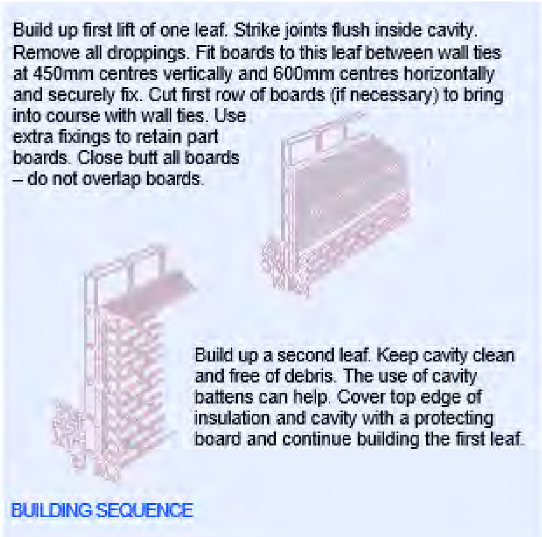


Diagram 2.78: Installation of partial fill insulation boards – building sequence

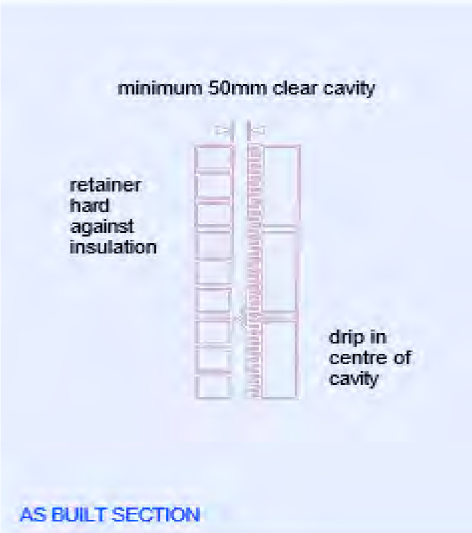


Diagram 2.79: Installation of partial fill insulation boards – as built section

Air Permeability & Pressure Testing

In accordance with Part L and Regulation 7, the building fabric should be constructed to a reasonable quality of construction so that:

a. the insulation is reasonably continuous over the whole building envelope; and
b. the air permeability is within reasonable limits.

Pressure testing is a requirement for newly built dwellings, but not for dwellings created by conversion, for extensions or alterations etc.

Extent of testing is affected by-

- Number of dwellings involved; and
- The use of "approved construction details"

New Dwellings
Sites using accredited construction details:

- A test must be carried out on one example of each type of dwelling type
- Dwelling to be tested to be selected by Building Control (in reality is likely to be the first completed)
- Where development includes several blocks of flats, at least one flat from each block should be tested

Sites not using accredited details:

- On sites of up to 4 dwellings, one unit of each dwelling type
- On sites of 5 -40 dwellings, two units of each type
- Over 40 dwellings, 5% of each type of dwelling, however, if the first five dwellings are satisfactory, the sample rate can be reduced to 2%
- Dwellings select by Building Control body
- Where development includes several blocks of flats, at least two flats from each block should be tested

Small sites (1 or 2 dwellings)

- Carry out a pressure test
- Use information from a pressure test carried out on same house type (on a different site) within past 12 months
- Use an air permeability value of $15m^3/(h.m^2)$ when calculating the design
- CO^2 emissions

Other new buildings
All new buildings other than dwellings need to be pressure tested on completion.

- There is a dispensation for buildings less than $500m^2$ floor area, use air permeability rate of $15m^3(h.\ m^2)$
- A similar dispensation applies to factory made modular buildings where no site assembly work is required; it can be assumed that the standard of airtightness for module type has been achieved, provided a 3rd party accreditation had demonstrated through site based testing, that the design air permeability is routinely achieved
- Special requirements for extremely large or complex buildings, where it would be impossible to pressure test the whole building
- Until the end of October 2007, dwellings and other buildings under 1000 m^2 which fail a pressure test will not be required to meet the full standard when re-tested.

In connection with air leakage detection the builder can also use thermal imaging technology to detect energy loss from buildings if a building fails an air test. A thermal survey before the air leakage test allows the builder to seal any poor detail therefore avoiding a second air leakage test had the building failed. Air leakage paths can be seen in red and white in thermal images.

Further guidance and information can be obtained from:

IRT surveys
Unit D Software Media Centre
Prospect House
Dundee Technology Park
Dundee, DD2 1TY
Tel: 01382 598 510
Fax: 0182 598 533
info@irtsurveys.co.uk
www.irtsurveys.co.uk

External Walls - Doors, Windows & Roof Lights

General

Timber used for external joinery should be of a species classified as suitable in BS EN 942 and preservative treated if not a moderately durable species or better (with sapwood excluded). Guidance on selection is provided in BM TRADA Wood Information Sheets 3.10 and 4.16. Workmanship should follow the recommendations of BS 1186:2.

Preservative treated joinery which is cut or adjusted on site should be liberally brushed with an appropriate and coloured preservative. Where the colour of the preservative will adversley affect the final appearance of the joinery then an appropriate clear preservative should be used.

Bay, oriel and dormer windows require particular care in detailing and fitting so that they are stable, weather-tight and reasonably airtight.

Rooflights should be proprietary components, fixed within prepared openings in accordance with manufacturer's instructions, and have effective weather-sealing.

Non-timber components should comply with the following British Standards (as appropriate) and be installed and fixed in accordance with manufacturer's recommendations:

- BS 4873 Aluminium windows
- BS 5286 Specification for aluminium framed sliding glass doors
- BS 6510 Steel windows and doors
- BS 7412 PVC-u windows
- BS EN 514 PVC-u windows

PVC-u windows and doors should also be subject to independent third party certificates acceptable to Q.

Windows should comply with the current Building Regulations taking into consideration:

- Means of escape in the event of a fire
- Thermal insulation
- Ventilation
- Safety

Thresholds and sills should be at least 150mm above ground level. Where the top of a threshold is more than 225mm above ground level, steps are necessary.

Where level (threshold) access is required builders can follow the general guidance given in diagrams 2.80, 2.81, and 2.82 ensuring a high level of supervision and workmanship, together with the correct specification of materials, with consideration given to design, location and exposure.
Wherever possible locate the entrance door away from the prevailing weather and provide a storm porch.

It is recommended that a matwell be constructed within the entrance hall to accommodate the swing of the door without fouling the carpet and/or the proprietary door seal, thus maintaining the integrity of the seal.

External doors and opening lights to windows should be reasonably airtight by ensuring that effective draught seals are fitted.

External joinery should be designed and constructed in accordance with the requirements of the following British Standards:

- BS 4787:1 Internal and external wood door sets, door leaves and frames
- BS 6262 Code of practice for glazing for building
- BS 6375:1 Performance of windows
- BS 644:1 Wood windows
- BS 8213:1 Windows, doors and roof lights

Security

External door leaves should be of a robust construction. Timber doors should be not less than 44mm thick (or equivalent strength for other materials). Flush doors should be of solid core construction. Door stiles to which locks are fitted should be of sufficient width so as not to create a weak point in the general robustness of the door (119mm minimum width recommended for timber). Non-glazed panels should be sufficiently small to prevent access to within the dwelling. See diagram 2.83 in the following pages for hardware to main entrance door.
The "throw" of the lock into the frame should be 20mm.

Additional security may be provided within the design and further guidance is given in this section.

Protection from falling

For houses and flats, the guidance in Approved Document K2 specifies a minimum guard height of 800mm to window openings in the external wall. This would normally be achieved by forming window openings at least 800mm above finished floor level. The wall beneath the opening is therefore considered to be the barrier to falling.

Where window openings are formed less than 900mm from the finished floor level permanent guarding should be provided to the opening in accordance with the design requirements specified in Approved Document K2, section 3, para 3.2 and 3.3.

The use of a restrictor stay in this situation is unlikely to be acceptable as guarding, because:

- It is unlikely to resist the loads of someone falling against the window
- It is releasable and therefore not considered to be permanent guarding
- The glazing, frame and fixings would need to be designed to provide containment.

Where Q Building Control is carrying out the building control, our building control surveyors will be pleased to advise on specific proposals.

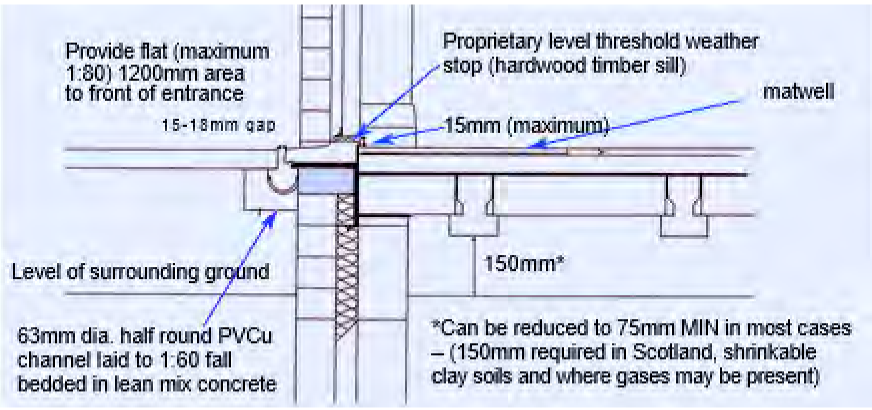


Diagram 2.80: Level threshold with approach rising towards property

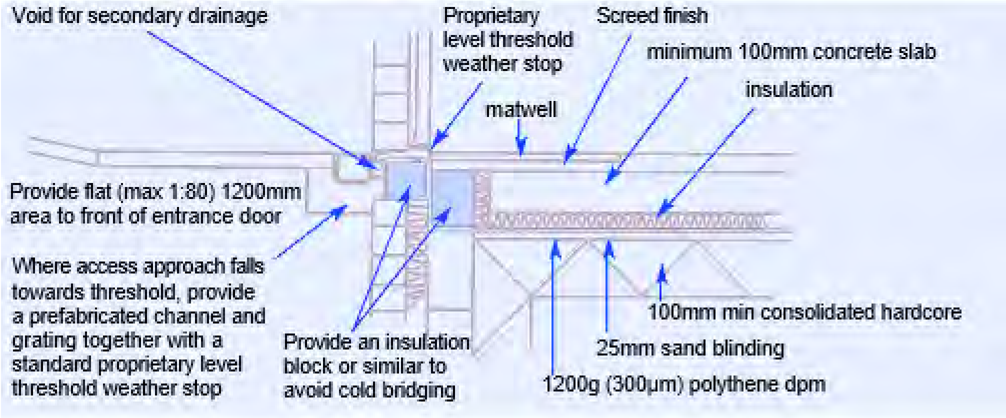


Diagram 2.81: Level threshold with approach falling towards property

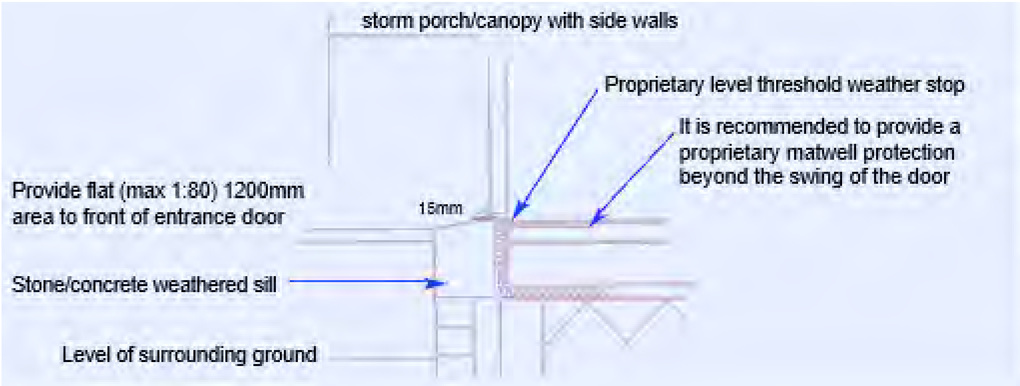


Diagram 2.82: Level threshold with porch/canopy protection

Control of condensation

Minimise the effects of condensation on glazing and frames by:

- using insulated metal frames
- using details which prevent condensation running on to walls or floors
- housing window boards into frames to prevent condensation entering the joint and
- providing thermal insulation to walls at lintels, sills and jambs (see diagram 2.57).

Guidance on this subject is provided in BRE report, "Thermal Insulation: Avoiding Risks".

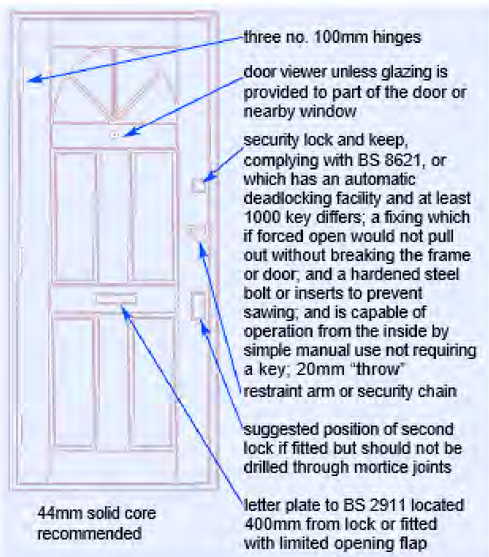


Diagram 2.83: Main entrance door

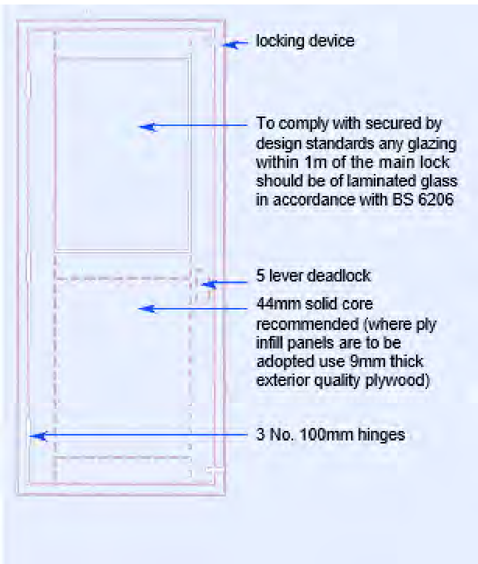


Diagram 2.84: Other entrance doors

Security
Door frames should be securely fixed and the rebate formed preferably from a solid section. Where planted stops are used, they should be glued, screwed and pelleted.

Door and window frames should be fixed to vertical reveals with corrosion-resistant fixings at a minimum of 600mm centres, the end fixings being located within 150mm of the top and bottom of the frame.

External doors should be hung on 3no. 100mm hinges. A restraint arm or security chain should be provided to main entrance doors.

Main entrance doors should be provided with at least one security lock and keep. (See diagram 2.83 for lock specification). If a second lock is fitted it is suggested that this is positioned 600mm away.

A 5 lever deadlock should be provided to other external doors, including patio doors. The lock should comply with BS 8621 (and Euro Norm - 12209) or be of a similar performance standard. Locks to entrance doors of flats should not operate automatically and the deadlock mechanism on the dwelling side of the door should be non-key operated (this is a fire precaution requirement).

On the ground floor, with the exception of kitchens, all habitable rooms should either open directly onto a hall leading to the entrance or other suitable exit or be provided with a suitable window (or door).

External doors (except main entrance doors) and sliding patio doors should be provided with robust bolts at the top and bottom of the closing edge of the door (e.g. 100mm barrel bolts fixed with 30mm No. 8 screws - See diagram 2.84). Where espagnolette multi locking points are provided the bolts can be omitted.

Sliding doors should be designed so that they cannot be lifted out of the frame from the outside.

Letter plates should comply with BS 2911 and either be located not closer than 400mm from the door lock or be fitted with a limited opening flap. Where fitted to a fire resistant door (e.g. flats), the letterplate should not adversely affect the fire resistance of the door.

Windows should be provided with a securing device which cannot be sprung by levering the casement or sash from the outside of the building when in a closed position. A key operated lock should also be provided to all ground floor windows and others which are readily accessible from the outside, either as part of the securing device or as a separate unit (See diagram 2.85).

Rooflights should not be used on single storey or other accessible roofs unless they are specifically designed to provide a deterrent against forced entry and can be locked with a removable key.

Externally located hinge pins should be non-demountable (e.g. welded or disturbed ends).

Emergency Egress Windows in Two Storey Dwellings
With the exception of kitchens, all habitable rooms in the upper storey served by one stairway shall be provided with a window:

- Which has an unobstructed openable area of at least $0.33m^2$;
- Be at least 450 mm high x 450 mm wide in either width or height.
- The bottom of the openable area should not be more than 1100 mm above the floor.

Installation of doors and windows

Window and door frames should be installed so that:

- they do not carry loads unless designed to do so
- the face of the frame is set back at least 38mm from the masonry face. Masonry on the external side of a vertical dpc should not be in contact with internal finishes
- the window head is set back behind the edge of the cavity tray
- the frame to wall junction is weather-tight and reasonably airtight
- in areas of severe/very severe exposure checked rebates should be provided. The frame should be set back behind the outer leaf and should overlap it as shown in diagram 2.86. Alternatively an insulated finned cavity closer may be used that has third party accreditation for use in this location (See diagram 2.87 moderate exposure).
- distortion is minimised by not locating radiators or other heaters close to doors.
- the water drip to window and door sills projects beyond the wall or subsill by at least 10mm and the sill edge by at least 25mm.

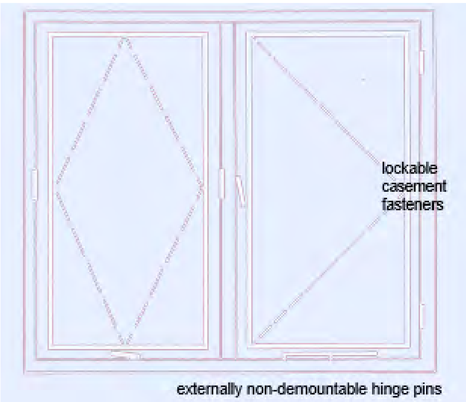


Diagram 2.85: Securing the windows

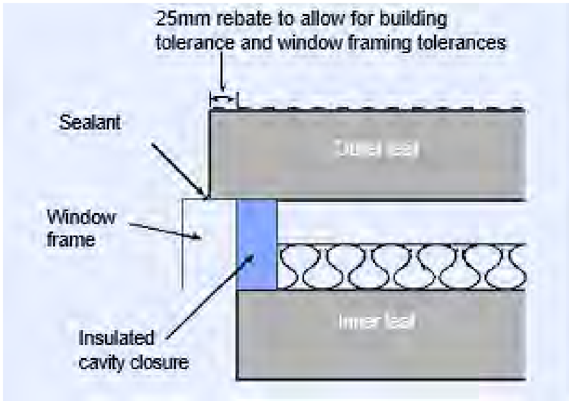


Diagram 2.86: Typical detail for severe/very severe exposure

Fire safety

Fire resisting doors should be fitted with a positive self-closing device.

Any door between a dwelling and an attached or integral garage should be a half hour fire resisting door and frame.

Bay windows

The vertical dpc and cavity closer should be installed as shown in diagram 2.88.

Window and door frames should be installed either by building in tightly as work proceeds, or by fitting into preformed openings, suitably dimensioned to provide an accurate fit for the frame plus the perimeter weather-tight joint.

Timber frame windows and doors can be installed so they abut the masonry. Any gap provided should not exceed 10mm. For gaps less than 5mm the sealant must cover both the frame and the masonry by 6mm. For gaps greater than 5mm a backing strip should be provided behind the sealant. The sealant should have a minimum depth of 6mm.

PVC-U frame windows and doors should be installed with a gap of between 5mm and 10mm to allow for thermal expansion. For large framed units such as patio doors then the gap can be up to 15mm.

Frames should be fixed in accordance with the manufacturer's recommendations or, if no instructions are given, with the following guidance:

- fixings should be at 600mm maximum centres and within 150mm of corners of the frame
- frames should be fixed either by galvanized steel cramps or by non-corrodible screw fixings to the surrounding wall

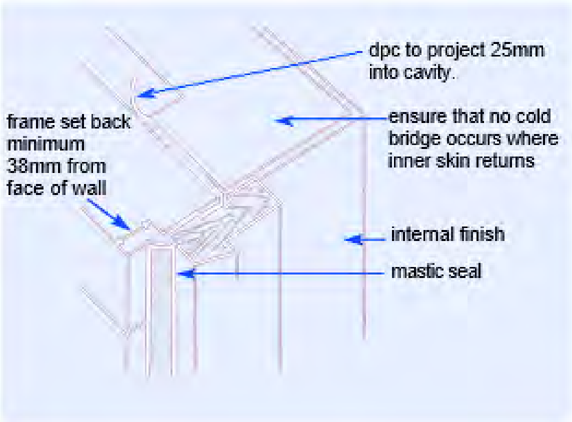


Diagram 2.87: Typical detail for moderate exposure

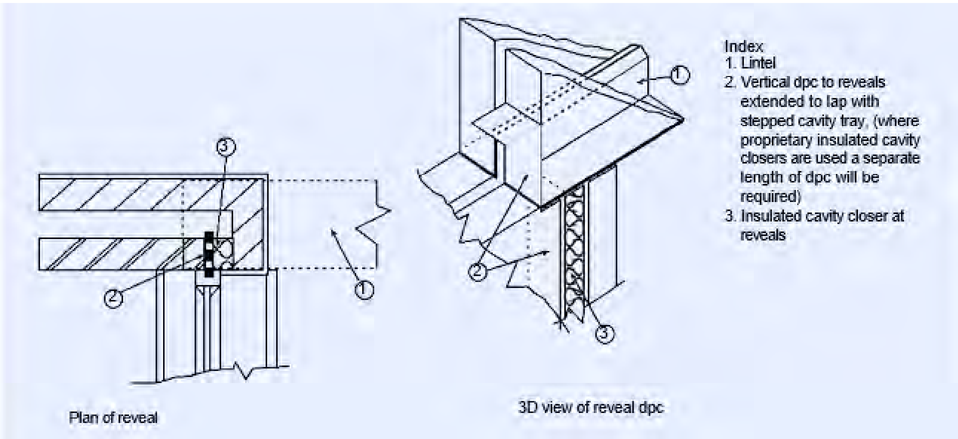


Diagram 2.88: Typical reveal detail showing vertical dpc and cavity closure at bay windows

Glazing

Proprietary materials, possessing third party accreditation acceptable to Q, should be used to close cavities at window and door openings. They should also be installed in accordance with the manufacturer's recommendations.

Critical Locations
Glazing in doors and windows in areas known as "critical locations" need to be given special consideration in order to prevent potential injury to people within or around the building. Limits for annealed glass can be seen in diagram 2.89.

These "critical locations" are as follows (See diagram 2.90)
- in a door or a side panel within 300mm of it between floor level and a height of 1500mm
- in an internal or external wall or partition between floor level and a height of 800mm

It is important that any glazing within these "critical locations" should be either:
- provided with permanent protection, or
- be of small panes, or
- be robust, or
- break safely.

If permanent protection is provided (See diagram 2.91) then there is no requirement for the glazing itself to be of a special type. The permanent protection may take the form of railing or barriers and should:
- be designed to be robust
- have a maximum opening or gap in any railing of 75mm or less
- be 800mm high minimum
- be non-climbable (especially where floor acting as a balcony).

Small panes, either an isolated pane within glazing bars or copper or lead lights, should be restricted in size so that any breakage would be strictly limited.

Small panes should:
- be not more than 0.5m^2 in area, and
- be not wider than 250mm, and
- where concealed glass is used be min 6mm thick (4mm for lead or copper lights).

Some materials are inherently strong such as glass blocks or polycarbonates whereas concealed glass will require to be of an increased thickness as the area of the panel increases to be considered 'safe' (See diagram 2.89).

As an alternative to any of the above solutions it is possible for the material to break 'safely' when tested to BS 6206 which would mean that:
- only a small opening was created with a limited size of detached particles, or
- the balance would create only small pieces that are not sharp or pointed, or
- the pane disintegrates with only small detached particles.

Detailed guidance on this aspect of glazing can be found in Approved Document N to the Building Regulations.

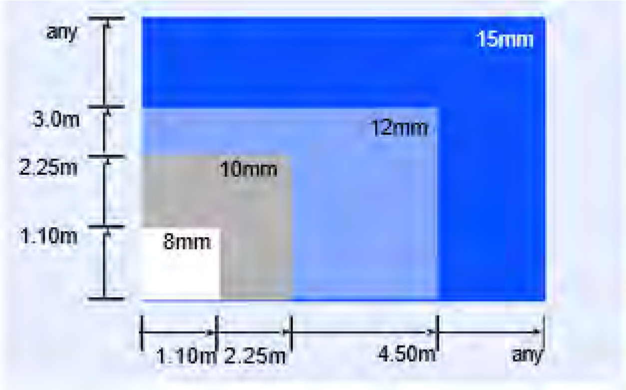


Diagram 2.89: Limits for annealed glass thickness/dimension

Glazing
Glazing should be in accordance with BS 6262.

Insulated glass units should meet requirements of BS EN 1279-Glass in building-insulating glass units. IGU's should carry third party accreditation. This includes windows in possession of a BBA certificate and timber windows.

- they should have dual seals; single seal units are not acceptable
- desiccant should be provided to every spacer bar
- any glazing on site must have a drained and ventilated bottom bead
- any glazing with an area greater than $1m^2$ must have a drained and ventilated bottom bead
- glazing with an area less than $1m^2$ may be solid bedded
- all spacer bars should be stamped with BS EN 1279
- PVC-U frames and spacer bars should be stamped with BS 7412, 7413 & 7414

Linseed oil putty glazing should not be used when the joinery is finished with vapour permeable paint or stain, putty glazing should also not be used with organic solvent based stains. Putty should be neatly finished to receive a protective paint coat.

Putty is not suitable for double glazed units.

Workmanship should be in accordance with BS 8000:7.

To ensure compatibility of the whole glazing system together with a high level of workmanship and control, it is recommended that factory pre-glazed systems be installed in all external openings.

External glazing beads should be pinned at maximum 150mm centres (maximum 50mm from corners) or screwed at 200mm centres (maximum 50mm from corners).

The preferred method of installation for double glazed units is either;

- drained and ventilated frames as recommended by the Glass and Glazing Federation (GGF). Where possible this method should be adopted for external glazing. (See diagram 2.92), or
- solid bedding of units in 16-18mm deep frame rebates. 18mm rebates are recommended by the GGF to allow for tolerances. Use bedding methods suggested in diagrams 2.93, 2.94 and 2.95 or another method recommended by the GGF or BS 8000:7.

In all cases, sealants should not be sensitive to ultra-violet light.

External glazing beads should be fixed at maximum 150mm centres and the glazing bedded in a non-setting putty. Louvred windows should not be used. Double glazing should be fixed and bedded as recommended by the Glass and Glazing Federation.

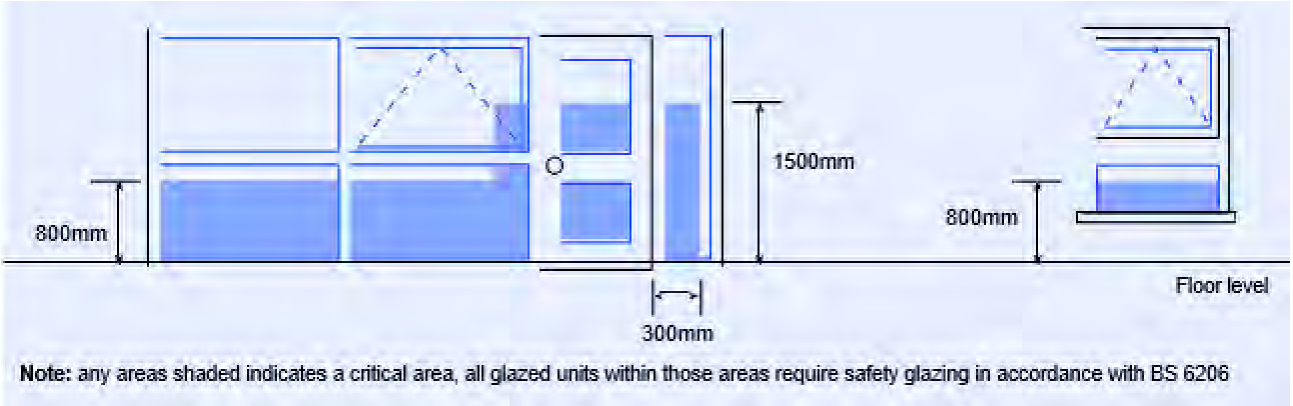


Diagram 2.90: Critical locations for glazed panels

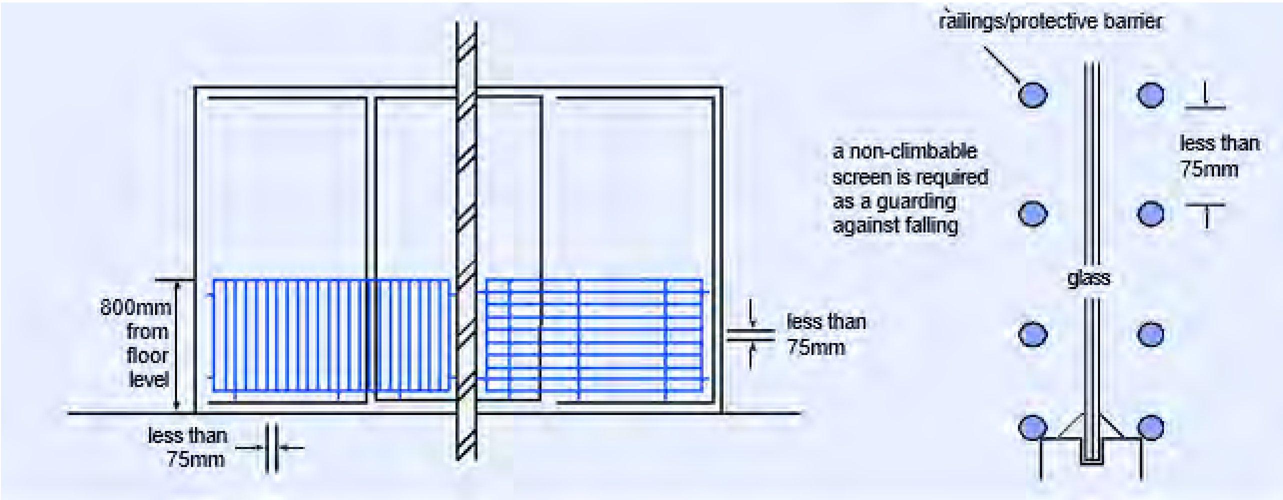


Diagram 2.91: Protection – railings and barriers

Control of condensation

Minimise the effects of condensation on glazing and frames by:

- Using insulated metal frames
- Using details which prevent condensation running on walls or floors
- Housing window boards into frames to prevent condensation entering the joint
- Providing thermal insulation to walls at lintels, sills and jambs.
- Trickle ventilators, or similar, should be used to provide background ventilation where required by the Building Regulations. (Avoid the use of louvered windows).

Further guidance on this subject is provided in BRE report, BR262 Thermal Insulation: Avoiding Risks 2002 edition.

Glazing

When viewed in daylight from within the room and at least 2m from the panes (3m for toughened, laminated or coated glass) and looking at right angles through the glass, the following are acceptable if they are neither obtrusive nor bunched:

- bubbles or blisters
- hairlines or blobs
- fine scratches not more than 25mm long
- minute particles

Note: The above does not apply within 6mm of the edge of the pane, where minor scratching is acceptable.

Scratches on doors, windows and frames

Factory finished door and window components should not have conspicuous abrasions or scratches when viewed from a distance of 0.5m

- Surface abrasions caused during the building-in process should be removed in accordance with manufacturers instructions which may include polishing out, re-spraying or painting
- In rooms where there is no daylight, scratches should be viewed in artificial light fixed wall or ceiling outlets and not from portable equipment.

Notes to diagrams 2.92, 2.93, 2.94 and 2.95:

1. Ensure the frame, unit and glazing systems are compatible.
2. Ensure that the frame and rebates are clean, dry and sound prior to installation.
3. When using Butyl based hand applied compounds, the timber frame will require a proprietary sealer to be applied or recoated with a second primer coat.
4. Hand applied Butyls are sensitive to ultra-violet hence their use should be restricted to an internal bedding material only (if required)
5. When using silicones and/or non-setting compounds, distance pieces as well as setting blocks are required.
6. Silicone sealants will not take paint or stain finishes.

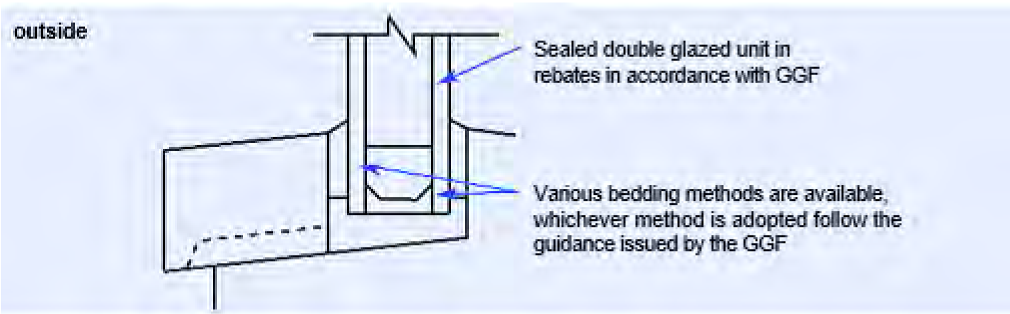


Diagram 2.92: Typical drained and ventilated method for timber frames

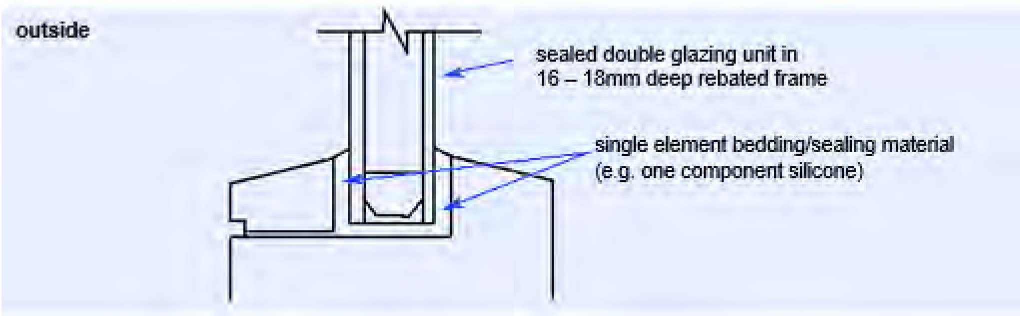


Diagram 2.93: Installation ofdouble glazed window units with solid bedding (timber joinery)

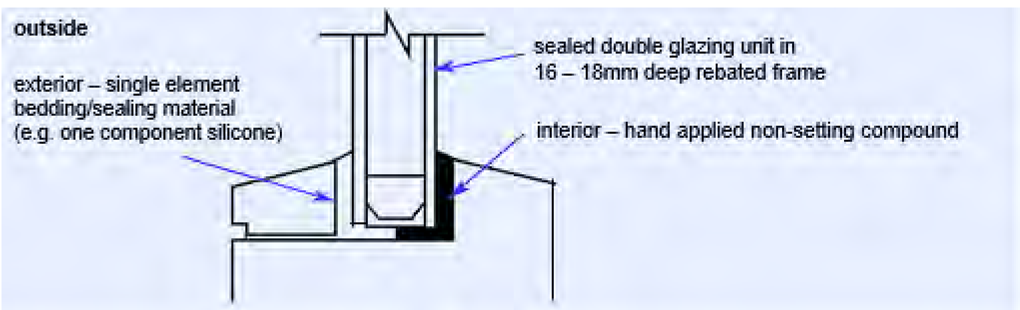


Diagram 2.94: Installation of double glazed window units with solid bedding (timber joinery)

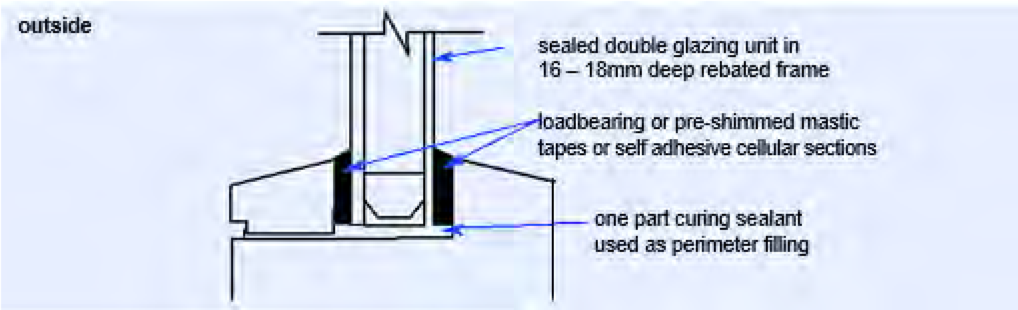


Diagram 2.95: Installation of double glazed window units with solid bedding (timber joinery)

Cast Stone Jambs and Mullions

Stainless steel dowels in the sides of the jambs should be bedded into adjacent mortar joints as the masonry is constructed. (See diagram 2.96–2.98)

Cast Stone Heads

A cavity tray must be provided above all heads as this discharges water to the outside face of the masonry but also acts as a slip plane.

A slip plane will be required at the end of the cast stone head as well as a soft joint between the top of the head and the steel support lintel. (See diagram 2.99–2.100).

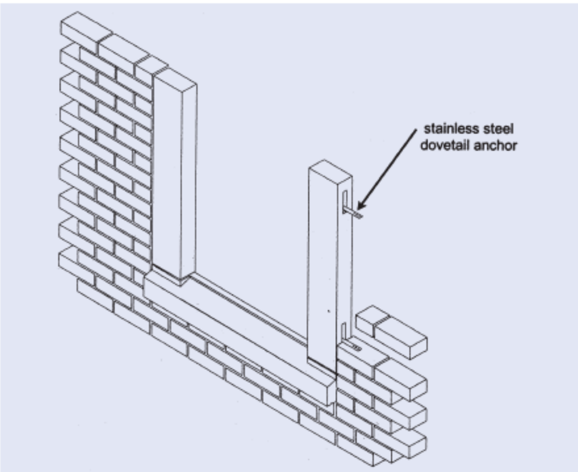


Diagram 2.96: Typical Cast Stone Jambs and Mullions detail

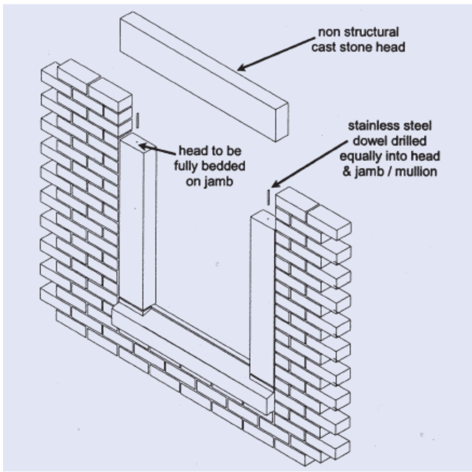


Diagram 2.97: Typical Cast Stone jambs and Mullions detail

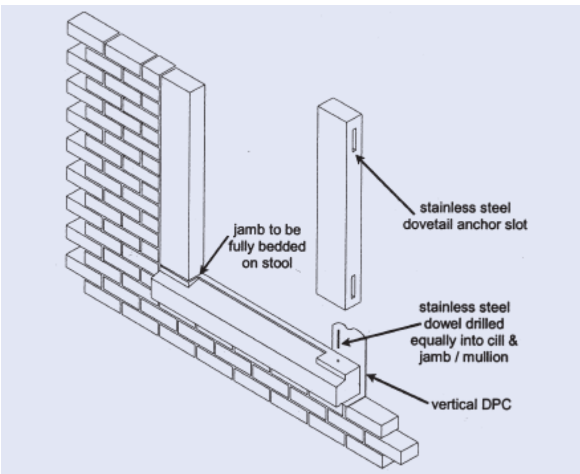


Diagram 2.98: Cast Stone Jambs and Mullions detail

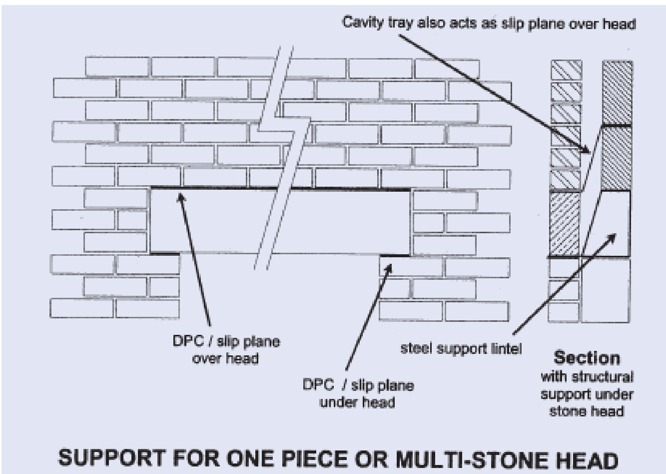


Diagram 2.99: Typical Cast Stone head detail

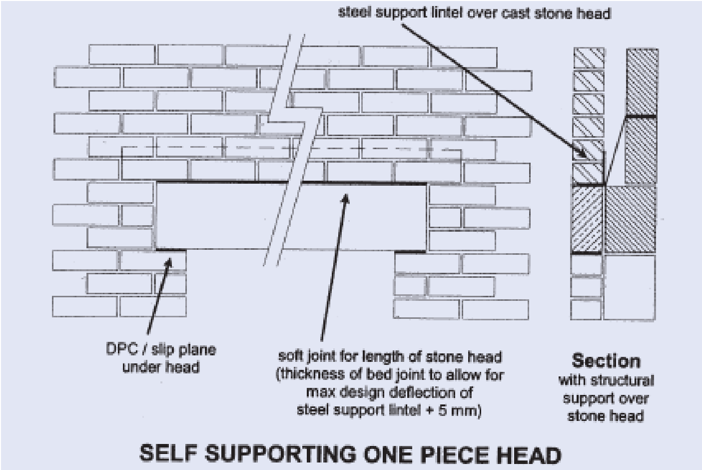


Diagram 2.100: Typical Cast Stone Head detail

Cast stone window/door surrounds

Where cast stone butts up to other materials allowance must be made to accommodate differential movement. E.g. where cast stone abuts clay brickwork a slip surface between the two materials must be incorporated or the cast stone should be flexibly jointed.

Sills

The dpc should be overlapped by the vertical dpc at the jambs and should be turned up at the back and ends for the full depth of the sill. (See diagram 2.101)

The mortar bed below sills should be trowelled smooth, allowed to set, cleaned off and then a dpc laid over. The open section below the sill should be sealed with a flexible material only at completion of the structure. (See diagram 2.102)

To control water penetration through joints in window surrounds (e.g. at junctions between jambs and mullions and sills) rectangular and T shaped water bars should be provided.

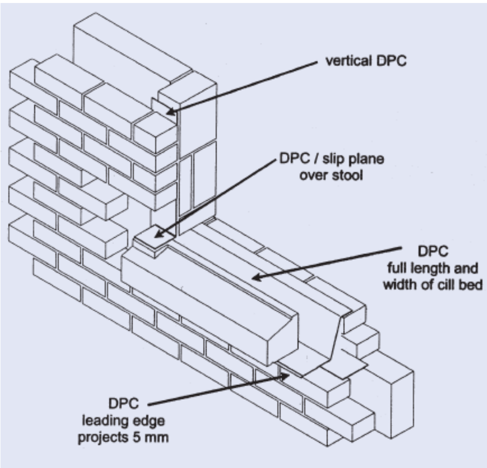


Diagram 2.101: Typical Cast Stone Sill detail

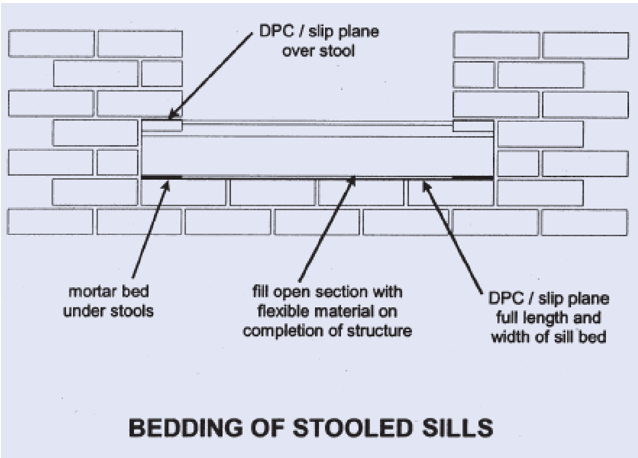


Diagram 2.102: Typical Cast Stone Sill detail

External Walls – Timber Frame

Design and Certification

All timber frames must be designed in accordance with BS EN 1995-1-1 and should be independantly certified by either

- An industry recognised third party timber product approval scheme such as EXOVA BM TRADA Q-Mark Timber Frame Elements Certification Scheme - or
- A Suitably Qualified Structural Engineer with a minimum of three years experience in timber frame.

In either case the certifier should not be the designer of the timber frame and should provide a signed certificate confirming the structural assessment and adequacy of the design for the specific project.

Off site manufactirers of timber frame should belong to a suitable trade body such as the UK Timber Frame Assosiation and employ a recognised quality management system.

Site manufactured timber frame should also provide an independantly certified as built frame check for each property.

Design Information

Adequate design information should be available on site and also be provided to Q for their records and shodl nclude

- A full set of drawings
- Materials specifications
- Fixing and nailing schedules detailing size and type of fixings

Sole Plates

The moisture content of structural timber should not exceed 20% 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'.

Where elements are designed as stressed skin panels, notching, drilling and other perforations through the stressed skin should be designed by an Expert. All timber elements should be fixed with durable fixings or otherwise restrained in a manner capable of resisting excessive movement caused by drying out. Workmanship should comply with BS 8000:5.

Once timber frames have been erected, it is essential that the cladding and roof covering are installed as soon as possible. In no circumstances should the timber frame be left exposed for a period greater than specified by the manufacturers of either the frame or the breather membrane.

Setting out

It is essential that the accuracy of setting out of the foundations is checked well in advance of delivery of materials to site. Design changes should be approved by the designer.

Ensure sole plates are properly located and fixed to the substructure.

The sole plates or the lowermost timber plate should be set level, accurately set out, and fixed as specified in the design. Deviation in level should not be greater than 10 mm per 5m run. Particular care is required where the camber on a block and beam floor results in difficulties supporting the sole plate adequately.

Sole plates should not overhang the substructure by more than 12 mm, nor be set back from the edge of the substructure forming a ledge for mortar and debris to collect. Should a ledge be unavoidable then install a dampproof tray.

Packings where necessary should:
• Be non-compressible
• Be durable and corrosion resistant
• Not exceed 20 mm
• Be as wide as the timber frame
• Be located below the vertical studs positions

Sole plates with dpc under should be mechanically fixed to the substructure masonry. Holding down anchors, straps or shoes to be of either stainless steel, phosphor bronze, silcon bronze or galvanized mild steel (940 g/m2) at suitable centres. Mechanical fixing points are to be as specified in the design. It is preferable to use straps or shoes, but where specified care should be taken with shot fixings so as not to damage the supporting masonry or split timber members.

Green Timber/Ungraded Timbers

- The use of green timber/ungraded timbers are not permitted as structural members e.g. lintels, beams, joists, rafters, purlins etc., nor where they are aesthetic elements but are "fixed" to the structure, as the extent of their shrinkage is unknown and can lead to structural damage of the property.
- They can be used as lintels providing the detail on diagram 4.29 is followed and allowance is made for any possible shrinkage and/ or swelling of the timber.

Sole plates should not be fixed to infill blocks of proprietary masonry flooring systems i.e. block and beam floors. Suitable anchoring straps must be fixed to the substructure masonry to provide adequate fixings.
With masonry, special density nailable blockwork is required and generally with concrete the fixings should not be closer than 75mm from the edge of the slab.

Protect sole plates from damp

Sole plates should have a Hazard class 2 treatment in accordance with BS8417: 2003 or equivalent and be laid on a dpc which is lapped onto the slab dpm. Wall panels should be skew-nailed to sole plates without perforating the dpc.

Breather membrane should extend over the sole plate (See diagram 2.103).

It is recommended that the inner leaf dpc is turned up approximately 30mm above screed to protect sole plate and bottom rails from construction moisture and spillage.

Cavity fill should be ST1 concrete and terminate no closer than 225mm below the dpc (See diagram 2.103).

Drain cavities below dpc level at 1.35m centres. e.g. open perpend mortar joints.

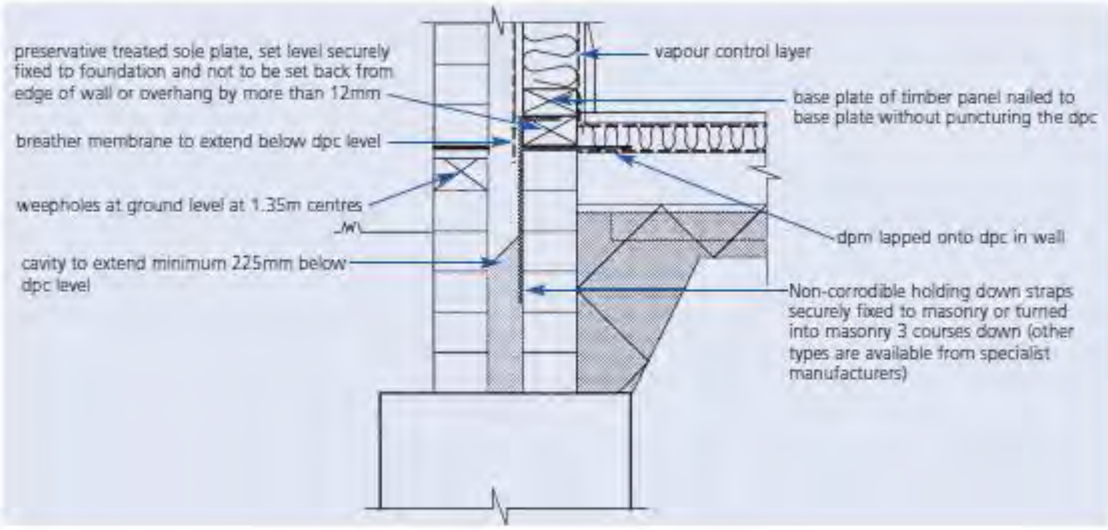


Diagram 2.103: Timber frame, typical ground floor detail

Timber stud framework

Avoid the following defects:

- Gaps between panels and nails missing at panel to panel connection
- Bottom rails not securely fixed to sole plates
- Plates, rails and studs cut away for services and holes drilled for electrical services near edge of stud
- Use of damaged wall panels
- Upper-deck wall panels nailed to floor decking only and not to joists
- Inadequate packing under upper storey panels
- Studs out of plumb
- Studs missing or overloaded
- Split timbers caused by nailing too close to edge of timber

Timber element	Process
Timber studs and rails, header joists, lintels and binders, cavity barriers and sole plates above screed level, including any timber or plywood packing pieces.	Hazard class 2 treatment in accordance with BS8417:2003, or equivalent, for a 60 year anticipated service life. See note 1.
Sole plates below screed level.	As above, but vacuum pressure impregnation process required
Note 1: The preservative treatment should conform to the treatment recommendations specified in BS8417:2003 for CCA, organic solvent (O/S), micro-emulsions or copper-organic treatments according to the requirements for hazard class 2 for a 60 year anticipated service life. Treatments with micro-emulsion, those organic solvent preservatives not complying with BS 5707:1997 and copper organic preservatives should meet the recommendations in Table 9 of BS 8417 for treatments for which an appropriate critical value as described in BS EN 599-1 is available. The supplement to the BWPDA Manual lists preservatives for which an appropriate CV as described in BS EN599-1 has been audited. For other preservatives, interim critical values may have been declared by BSI. CCB and CC may also be used. Note 2: From 30 June 2004, the use of CCA treated timber in the UK will be prohibited in residential or domestic constructions, whatever the purpose (this does not apply to CCA treated timber already in place). Its continued professional use will only be permitted in structural timber in public buildings, offices and industrial premises where human contact during service life is prevented provided skin contact by the general public during its service life is unlikely (Directive 1976/769/EEC, point 20).	

Table 2.12: Treatment of external timber frame

Materials and fixings

Timber elements should be regularised, bear a stress grade stamp and the moisture content should not exceed 20% at time of erection. All structural timber to be used within dwellings must be clearly marked ‘DRY’ or ‘KD’.

The moisture content of timber can be checked by the use of an electrical resistance moisture meter. The type with insulated probes is recommended which can be driven into the timber.

Timbers forming part of the external timber frame should be treated, see table 2.12.

Where elements are designed as stressed skin panels, notching, drilling and other perforations through the stressed skin should be designed by an Expert.

All timber elements should be fixed with durable fixings or otherwise restrained in a manner capable of resisting excessive movement caused by drying out.

Workmanship should comply with BS 8000:5.

Framed walls should be accurately aligned, plumb, level, without twist and securely fixed to adjacent elements using durable fixings suited to the location of the element.

Bedding under frames to accommodate variations in level should be made with a durable non-compressible material of full frame width. The maximum depth of the bedding should not exceed 20mm.

Lateral restraint

The gable panels of timber frame buildings need to be laterally restrained to the roof construction in the same way a masonry construction is restrained. Refer to this section for spacing etc.

It is acceptable to provide this lateral restraint by fixing the wind bracing of a trussed roof construction to the studs of the gable frame (See diagram 2.104).

Unless designed by an Expert, holes for electrical services may only be drilled on the centre line of timber studs between 0.25 and 0.40 of height. Maximum hole size is 0.25 of stud depth (See diagram 2.105). Timber studs should not be notched.

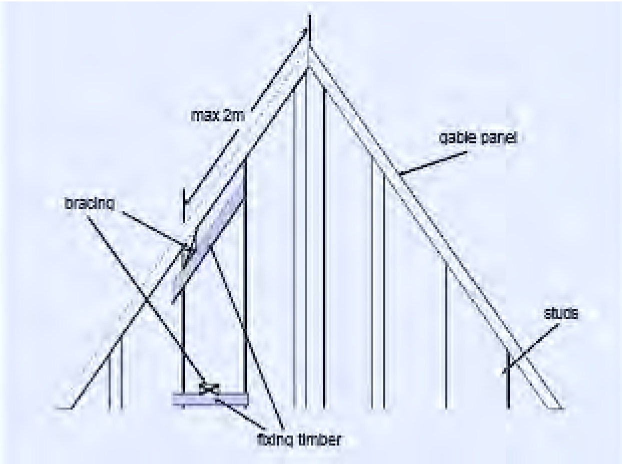


Diagram 2.104: Lateral restraint

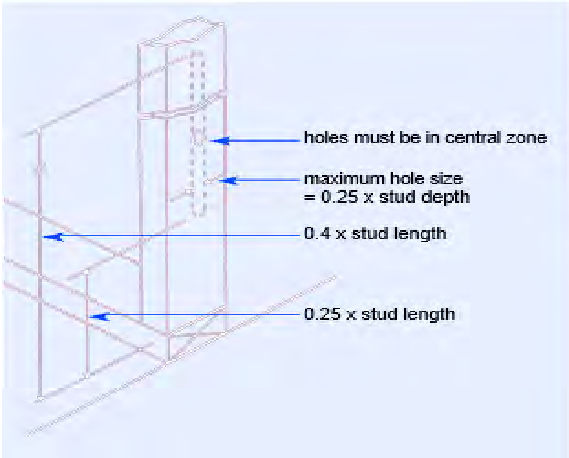


Diagram 2.105: Holes in studs or posts

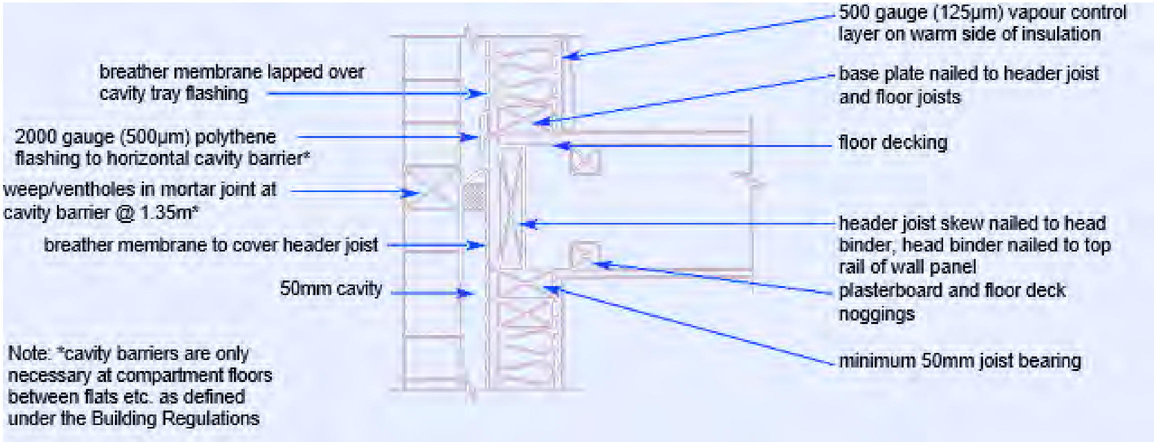


Diagram 2.106: Timber frame, first floor detail

Standard Durability Sheathings
• Canadian Douglas fir and softwood plywoods, Finnish conifer plywood and Swedish softwood plywood as specified in BS 5268:2, which meet the BS 5268:6 requirements for plywood sheathing and have a WBP (weather and boil proof) bond as specified in BS EN 314 & 636. In addition, plywoods constructed throughout of softwood, which meet the BS 5268:6.1 requirements for plywood sheathing and have a WBP bond as specified in BS EN 314 & 636.
• Impregnated softboard type SBS which meets the requirements specified for sheathing in BS EN 622.
• High-density medium board type HME which meets the requirements specified for sheathing in BS EN 622.
• Wood chipboard of moisture-resistant types P5, P6 and P7 which meet the requirements specified for sheathing in BS EN 312.
• Oriented Strand Board (OSB) type OSB/3 and OSB/4 which meets the requirements specified in EN 300 and at least 8mm thick.
• Any board (treated or untreated) that has been certified by independent third party certificates acceptable to Q as suitable for sheathing according to MOAT 26.
• Any board included in table 2.14

Note : * These sheathings have a high moisture vapour resistance and designers should check that there is no risk of interstitial condensation in accordance with BS 5250.

Table 2.13: Standard durability sheathings

1 Improved protection of the sheathing using either:	2 An enhanced level of sheathing durability using the following:
• high performance breather membranes as specified in the TRADA Wood Information Section 1, Sheet 35. • a 50mm cavity wall with a rendered finish or with cladding of metal, plastics, slate, tile hanging, timber boarding or similar materials.	• Tempered hardboard* type THE which meets the requirements specified for sheathing in BS EN 622 (also defined as type TE in BS 5268:6.1) • Cement-bonded particleboard* which meets the requirements specified for sheathing in BS EN 634:2. • Plywood that has been treated with: i) an organic solvent preservative complying with type F/N of BS5707:1997. ii) Any preservative conforming to the requirements of BS EN 599-1 for hazard class 3. iii) Disodium octaborate in aqueous solution according to the BWPDA Manual iv) CCA, CCB or CC (see note below) so that the outer veneers are completely penetrated. In addition the plywood should meet the requirements for sheathing specified in BS 5268:6 and have a WBP bond as specified in BS EN 314 & 636. • Any board (treated or untreated) that has been certified by BBA as suitable for sheathing according to MOAT 26, and which in the associated BS 1982:1 test has a durability at least equivalent to a plywood manufactured entirely from moderately durable timber.

Note: * These sheathings have a high moisture vapour resistance and designers should check that there is no risk of interstitial condensation in accordance with BS 5250.

From 30 June 2004, the use of CCA treated timber in the UK will be prohibited in residential or domestic constructions, whatever the purpose (this does not apply to CCA treated timber already in place). Its continued professional use will only be permitted in structural timber in public buildings, offices and industrial premises where human contact during service life is prevented provided skin contact by the general public during its service life is unlikely (Directive 1976/769/EEC, point 20) See also exposure to wind driven rain map on page 166

Diagram 2.14: Sheathing for very severely expostsed sites

Sheathing
Sheathing is usually provided to timber framed walls to provide increased strength to the structure or simply to protect the building from the elements prior to fixing the external cladding. Where sheathing provides racking resistance to wind and other lateral loads, the edge distance and spacing of the fixings are critical.

When fixed on site, sheathing should be nailed to stud members with galvanised, sherardised, stainless steel, phosphor or silicon bronze nails at centres as the approved design. Nails must not be overdriven.

Sheathing should achieve standard durability level and be of the type shown in table 2.13.

Sheathings for dwellings that are subject to extreme exposure conditions on sites located in areas defined as 'very severely exposed' (see diagram 2.69 within this section) should use either improved protection of standard durability see (1) in table 2.14, or alternatively, an enhanced level of sheathing durability, see (2) in table 2.14. Such dwellings would not be sheltered by local features, including surrounding buildings and trees, and therefore would not qualify for the reductions of exposure category permitted.

Breather Membrane
Avoid the following defects:

- Breather membrane torn at service entrance points
- Laps too small
- Breather membrane damaged by site work or wind
- Laps in breather membrane in wrong direction allowing ingress of water
- Breather membrane not extended to protect sole plate
- Marker tapes, or identification marks, for stud locations inaccurate or absent
- Breather membrane not lapped over lintels.

Suitable breather membranes
Breather membranes are normally provided to the face of sheathing as an additional waterproof barrier in cases where rainwater entering the cavity can come in contact with the timber frame construction (See diagram 2.106).

Suitable breather membranes can be identified by reference to BS 4016 noted on each roll and TRADA publication TBL 64: Test methods for breather membranes for timber frame walls. It should be noted that in areas designated as ‘very severe’, only ‘high performance’ breather membranes can be used. Impervious roofing felts are not suitable as breather membranes.

Where no breather membrane is required (e.g. where bitumen impregnated fibreboard is used) the joints between sheets should be taped to prevent draughts.

Fixing of breather membranes
Breather membranes are normally fixed with stainless steel staples and should be continuous, lap onto cavity trays and extend below sole plates and dpcs (See diagram 2.103).

Laps should be minimum 100mm horizontal and 150mm vertical (See diagram 2.107).

Breather membrane should be fixed in horizontal bands starting at the bottom of the building and working up so that upper layer overlaps the lower layer (See table 2.15).

Repair any damage to breather membrane before fixing of cladding (See diagram 2.108).

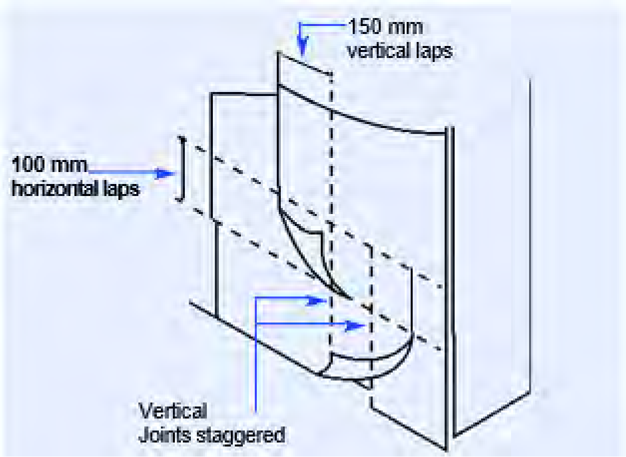


Diagram 2.107: Lapping breather membranes

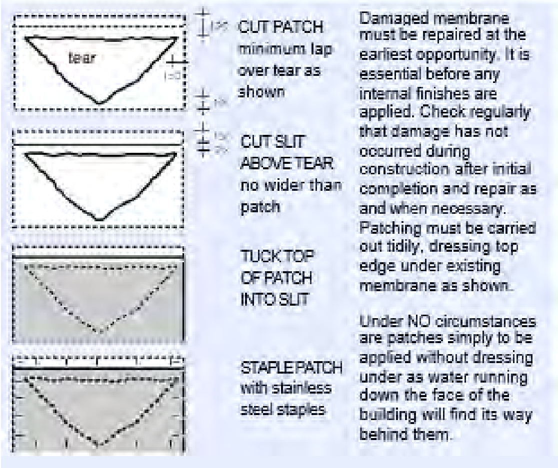


Diagram 2.108: Repairing breather membranes

Fixing of breather membranes	
	Fixing centres (mm)
Vertical	
at stud position	300
at sides of opening	150
at vertical membrane joints	150
at end of panel*	150
Horizontal	
at eaves	300
at sole plate or bottom rail	150
at horizontal membrane joint	150
at head and base of openings	150
at head and base of panels`*	
* required when membrane is fixed to panels in the factory	

Table 2.15: Fixing of breather membranes

Thermal Insulation

Avoid the following defects:

- Thermal insulation quilt missing
- Thermal insulation not continuous above lintels and at junctions with other walls
- Paper backing on thermal insulation not stapled to studs
- Sagging thermal insulation (cold bridges)
- Thermal insulation squashed (reduced efficiency)

Fixing of thermal insulation
Generally flexible quilts should be mechanically fixed between studs to avoid sagging (e.g. by stapling).

Particular attention is required to avoid cold bridges at internal/external wall junctions where it is difficult to fix insulation between closely spaced studs.

Insulation should extend down to floor insulation (or provide perimeter insulation to slab edge).

Vapour control
Avoid the following defects:

- Vapour control layer with gaps at joints
- Holes in vapour check plasterboard and tears in polythene vapour control layer

Suitable vapour control layers
Suitable vapour control layers include 500 gauge (125µm) sheet polythene (manufactured from virgin polymer) or metalised polyester backed plasterboard (not foil backed plasterboard). Sheet polythene is preferred to plasterboard due to the problem of sealing board joints.

Where metalised polyester backed plasterboard is used as a vapour control layer, it should be fixed in strict accordance with the manufacturer's instructions, in particular ensuring that joints occur at studs and noggings, and are filled and taped.

Fixing of vapour control layers
Condensation can cause timber decay and reduced efficiency of thermal insulation.

The vapour control layer should have at least 5 times the vapour resistance of the breather membrane. Vapour control layers should be provided to timber framed external walls on the warm side of the insulation (See diagram 2.109).

"Warm wall" constructions (thermal insulation located outside sheathing) normally do not require a vapour control layer. Such systems need to be approved by an independent assessment authority (See diagram 2.110). The moisture content of the timber frame should be below 20% before the vapour control layer is fitted.

In practice it is very difficult to achieve a perfect vapour barrier and consequently a combination of vapour check and ventilation of the fabric is often used.

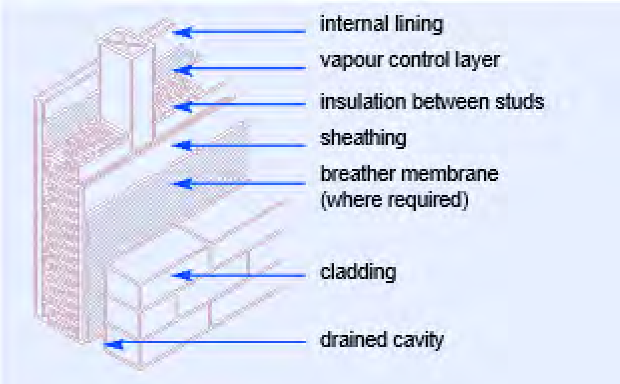


Diagram 2.109: Timber frame external wall construction

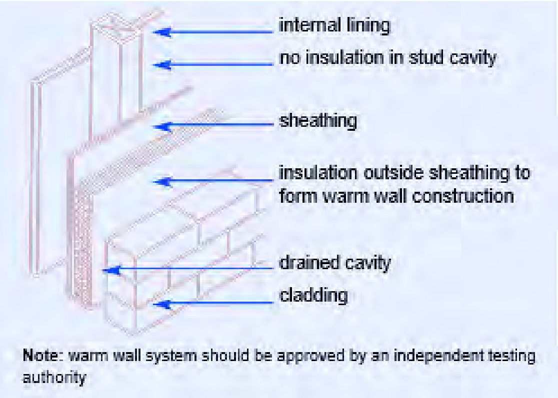


Diagram 2.110: Timber frame warm wall construction

Fixing of frames
Make allowance for the shrinkage of the timber frame, see the following sections on movement control: Movement Control - Masonry and Movement Control - Timber Frame. Support masonry over openings with lintels having minimum 150mm bearing, ensuring that no weight is transferred to timber frame structure.

Window and door frames should normally be screw fixed to the timber frame, unless specifically designed otherwise.

Provide vertical damp-proof courses to jambs which should be tacked to frames and dressed around cavity barriers. Ensure breather membrane laps over cavity trays over openings.

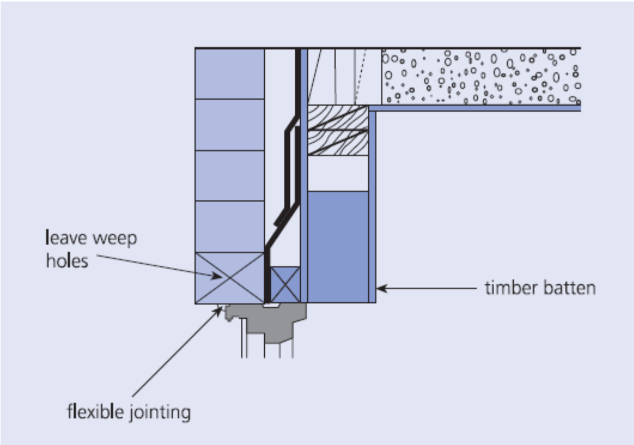


Diagram 2.111: Single element lintel over window in timber frame construction (pinch batten is essential)

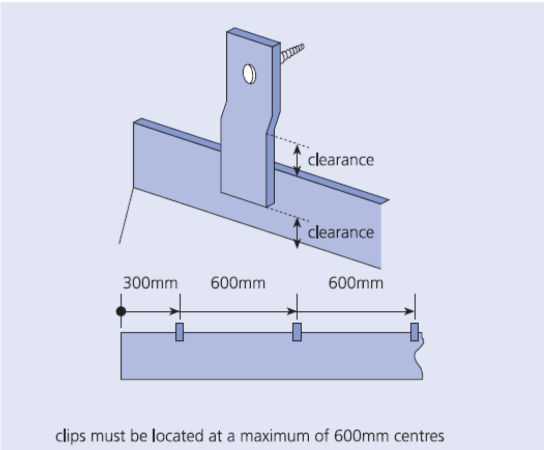


Diagram 2.112: Lintel restraint clips fixing recommendations

Vapour Control

Venting of Cavities
It is considered unnecessary to provide weepholes to the base and head of a timber-framed building, provided an equilibrium of moisture and air within the cavity behind the external masonry cladding can be achieved.

Weepholes are therefore only required at the foot of the wall, usually at dpc level, therefore eliminating the need to vent the cavity (See diagram 2.113).

The exception to the provision of one set of weepholes is where the cavity is bridged by lintels etc. in the normal way or where a fire barrier is provided at a floor level in accordance with Approved Document B, in which case weepholes are required directly above the fire break to allow any moisture entering the cavity to be readily drained away.

The use of a vent/weephole ventilator incorporating an insect resistant grille is recommended.

Cavity widths should be:
- Masonry, 50mm
- Render, 25mm when the mesh or metal lathing is backed by a breather membrane
- Render, 50mm when the mesh or metal lathing is unbacked
- Other claddings, 19mm

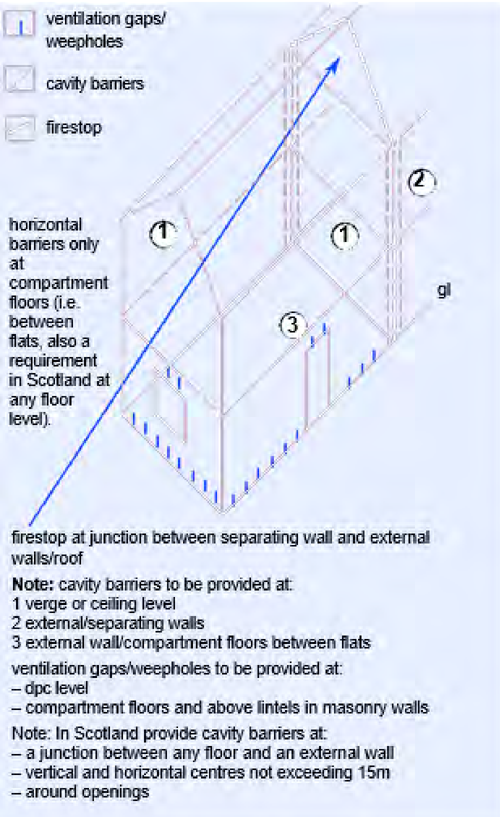


Diagram 2.113: Cavity barriers and venting of cavities

Wall Ties

Avoid the following defects:

- Wall ties nailed to sheathing only, instead of the studs
- Wall ties not sufficiently embedded in brickwork
- Prefixed wall ties not coinciding with masonry mortar joints
- Mortar droppings on cavity wall ties
- Wall ties sloping backwards to the internal wall
- Rigid wall ties used instead of flexible ties

Fixing of wall ties
Wall ties should be fixed to studs with stainless steel, phosphor bronze or silicon bronze nails.

Wall ties should be flexible stainless steel or equally durable.

Ties should be fixed to studs, not the sheathing, at the following spacing:

- For studs at 600mm centres the vertical spacing is maximum 375mm
- For studs at 450mm centres the vertical spacing is maximum 525mm.

In all cases the vertical spacing should be 300mm at reveals (See diagram 2.114).

Wall ties should be embedded in mortar joints to a minimum depth of 50mm with a slight fall towards the external brickwork.

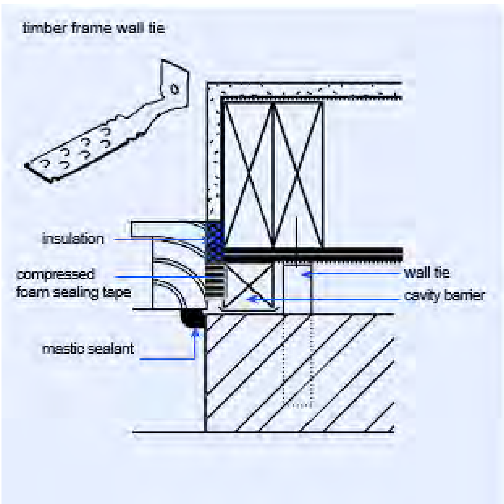


Diagram 2.114: Timber frame, window reveal detail

Movement Control

Avoid the following defects:

- Insufficient allowance for shrinkage of timber frame relative to masonry at eaves, verges, windows and door sills
- Cracking of cladding due to absence of a movement joint between different types of cladding
- Absence of movement joint where timber or render cladding bridges intermediate floor zones
- Failure of weather-tight joint at window jambs due to shear from movement

Masonry

Ensure that differential movement between timber frame and independently supported claddings such as masonry can take place, particularly at:

- Eaves and verges (See diagram 2.115)
- Window and door sills (See diagram 2.116)
- Balconies
- Service entries
- The junction of the timber frame and any other type of construction where cladding is fixed to the timber frame

Movement gaps should be in accordance with table 2.151 and should be constructed to provide a wether resistant Flexible joint

Make allowance for vertical sliding of masonry against side of openings by providing a flexible mastic joint between reveals and frames.

Where cladding horizontally abuts masonry, provide a movement joint to allow for differential movement (See diagram 2.117).

Where cladding vertically abuts masonry, provide a movement joint with drainage channel discharging onto a cavity tray dpc (See diagram 2.117).

Timber cladding

Where timber cladding spans across a floor zone, provide a movement joint to accommodate timber shrinkage (See diagram 2.118).

Cement render

Where cement render on lath fixed to the frame spans across an intermediate floor zone in timber frame construction, allow for differential movement due to timber shrinkage by incorporating a weather-tight movement joint using a proprietary render stop.

Vertical movement joints should also be provided at maximum 5m horizontal centres to render panels. A movement gap must be maintained below any horizontal render stop bead on masonry below.

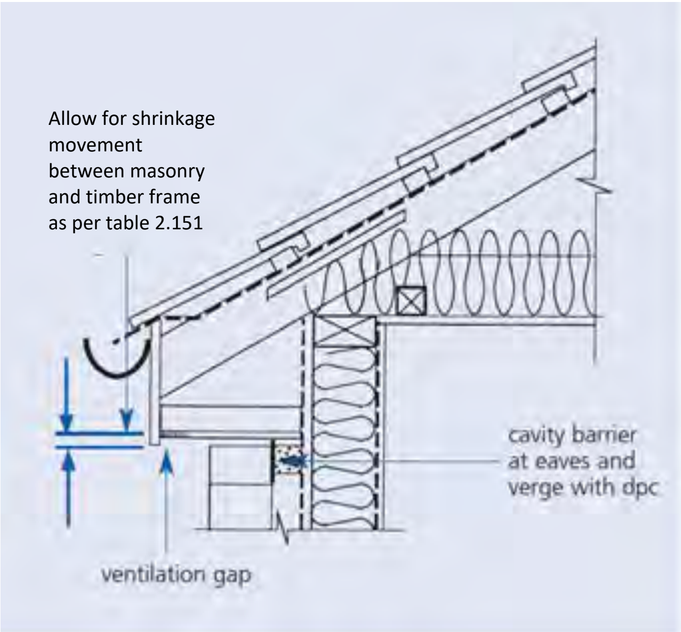


Diagram 2.115: Timber frame, movement control at eaves

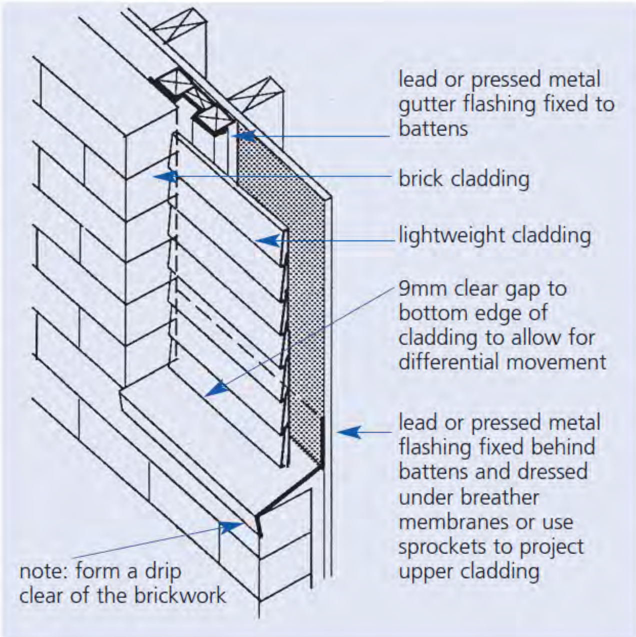


Diagram 2.117: Typical movement joint between different claddings at first floor level

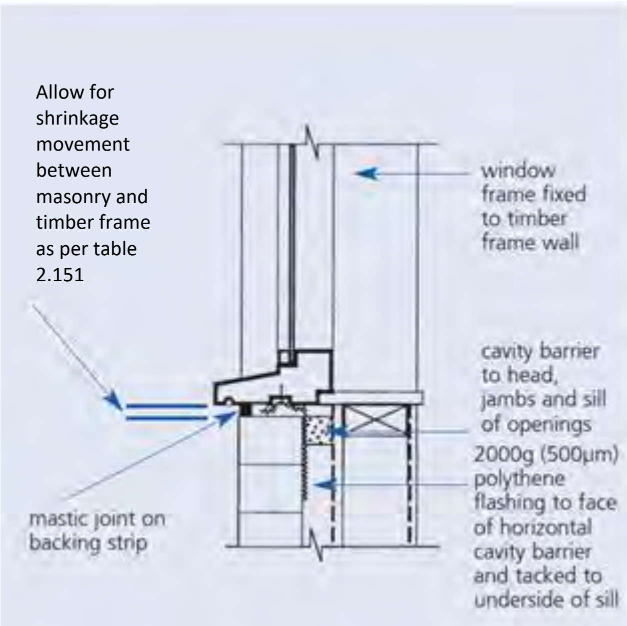


Diagram 2.116: Timber frame, movement control at window sill

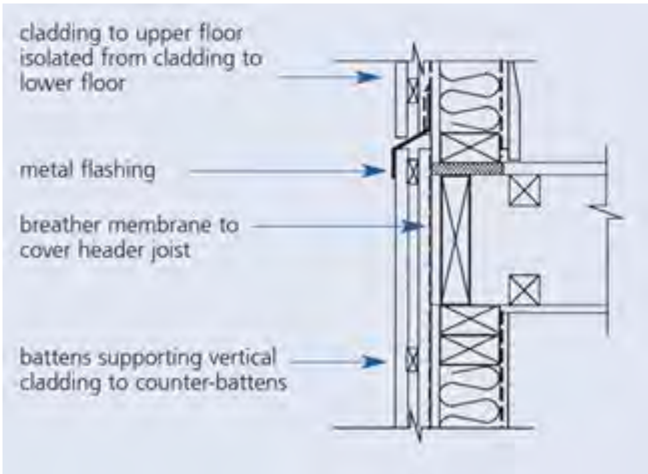


Diagram 2.118: Timber frame intermediate floor movement joint

Movement Gap Location	Gap Size (mm)	
	Joist Type	
	Solid Timber	Engineered I Joist
Eaves Verge		
6th Floor	Specialist Calculations required based on BS EN 1995-1-	61
5th Floor		53
4th Floor		45
3rd Floor		35
2nd Floor		25
1st Floor		15
Ground Floor		5

Table 2.151

The gap sizes in Table 2.151 assume the following

- Timber componants have a moisture content of less than 20%
- Timber joists have a maximum depth of 240mm
- Single binder plates at eaves and no more than double sole plates each with a maximum cross sectional depth of 45mm
- Ground floors are of concrete construction. For timber ground floors add 15mm for solid timber and 10mm for engineered I joists

For light weight claddings fixed to the timber frame allow floor level joints of 15mm for solid timber and 10mm for engineered I joists

Cladding

Claddings fixed directly to frame

Avoid the following defects:

- Insufficient overhang of roof at verges to protect render
- Battens fixed directly to sheathing
- Mesh for render inadequately fixed to timber frame
- Mesh for render damaged or deformed
- Movement or slipping of timber cladding

Timber

Boarding to be preservative treated, minimum 16mm thick and sufficient tongues or overlaps provided to permit shrinkage and expansion of the timber.

Timber boarding should be battened off the sheathing to provide a minimum 19mm cavity for draining and venting (See diagram 2.119).

Battens should be a minimum 38mm wide, preservative treated or equivalent hazard class 2 and at maximum 600mm centres. Battens should be fixed to each stud (and not to sheathing) with annular ring nails of length at least twice the batten thickness plus the sheathing thickness or plain nails of length at least 2.5 times the batten thickness plus the sheathing thickness. All nails to be fixed at 600mm centres.

Counter battens should be used for vertical cladding (See diagram 2.120).

Boards should be fixed to battens by face or secret nailing with annular ring nails at least twice the board thickness or plain shank nails at least 2.5 times the board thickness. Butt joints at board ends should occur at battens. Nails should be either hot dipped galvanised, stainless steel or equally durable. Aluminium nails should not be used with copper containing preservative treated timber and galvanised nails should not be used with Western Red Cedar.

Corners and reveals should be formed to provide a weather-tight construction (See diagram 2.121).

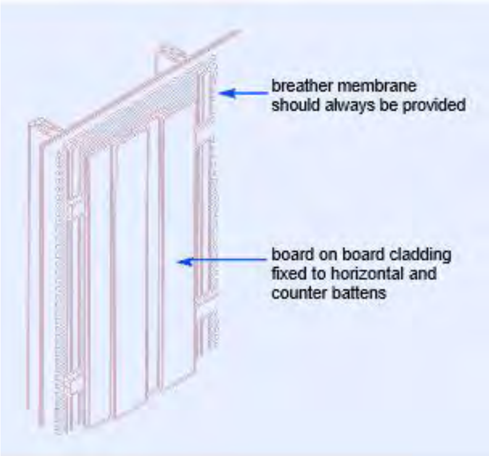


Diagram 2.119: Vertical timber cladding

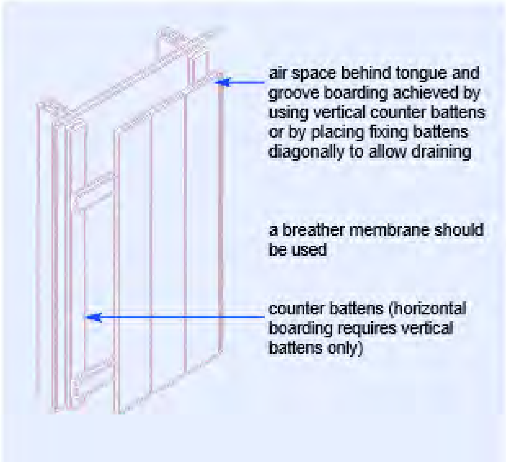


Diagram 2.120: Vertical timber cladding

Plywood
Plywood sheets used as cladding should be pressure preservative treated, a minimum 12mm thick and bonded with WBP or equal quality exterior adhesive and marked accordingly. Battens should be vertical and treated. Joints between sheets should be made resistant to excessive water penetration by fixing cover battens or flashings (See diagram 2.122).

Render
Battens should be either 25 x 38mm or 50 x 50mm, preservative treated.

Battens should be fixed to each stud with annular ring nails of length at least twice the batten thickness plus the sheathing thickness or plain nails of length at least 2.5 times the batten thickness plus the sheathing thickness.

Horizontal battens must be drilled or notched to maintain ventilation requirements. Nails should be hot dipped galvanised, stainless steel or equally durable. Mesh or metal lathing should be stainless steel or assessed by an independent authority and fixed to vertical battens at maximum 600mm centres with stainless steel staples. Laps in the lathing should be wired together at 150mm centres.

A damp-proof course should be provided between unbacked rendered lath and timber battens.

Render should not bridge the dpc and should be finished onto a durable render stop.

Three coat work is essential, at least 16mm thick. First and second coats should be 1:1/2:4 (cement: lime: sand) or 1:3 (cement: sand with plasticiser) or 1:3 (masonry cement: sand). Final coat should be 1:1:6 (cement: lime: sand) or 1:6 (cement: sand with plasticiser) or 1:41/2 (masonry cement: sand). More detailed guidance on render selection and mixes is given in table 2.16.

See this section on movement control for location of movement joints in render.

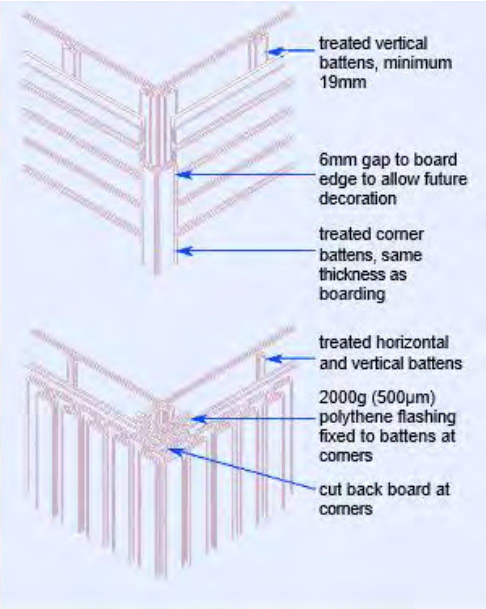


Diagram 2.121: Timber cladding – corner details

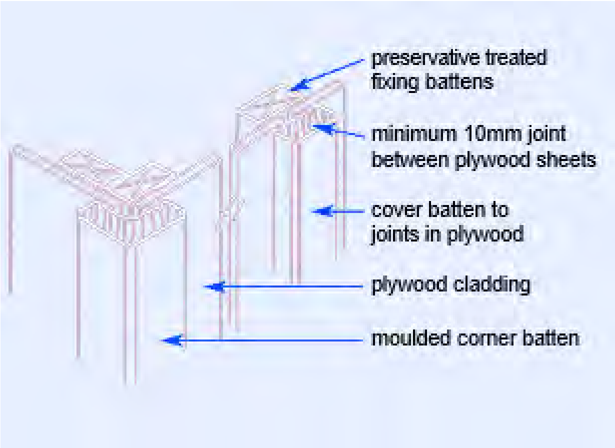


Diagram 2.122: Plywood Cladding

Tile and slate cladding
Tile or slate cladding should be fixed in accordance with the manufacturer's recommendations.

Battens should be a minimum 38 x 25mm for stud centres up to 600mm, and should be preservative treated (BS 8417, or equivalent, hazard class 2). 38 x 19mm counterbattens should be provided on severely exposed sites. Severely exposed sites are those shown on the wind driven exposure map , provided previously on diagram 2.03.

Battens should be level and fixed to each stud (not to sheathing) with annular ring nails of length at least twice the batten thickness plus sheathing thickness or plain nails of length at least 2.5 times the batten thickness plus the sheathing thickness.

Battens should not normally be less than 1200mm in length and span across at least 3 supports. Nails should be either hot dipped galvanised, stainless steel or equally durable.

A breather membrane (not a roof underlay) should normally be fixed to the sheathing behind the battens. Edge of hanging tiles should be cloaked at the jambs of all openings with purpose made corner tiles or by butting against a timber reveal with drainage channel behind.

Other claddings
Other cladding should only be used if they either:

- Conform with a British Standard and, where appropriate, are detailed for use with timber frame construction by the manufacturer
- Approved as being suitable by an independent assessment authority
- In addition they should be approved by Q

Cavity barriers & Fire-stops
Materials used for cavity barriers and fire-stops shall, be capable of providing adequate resistance to fire and smoke.

Cladding systems incorporating proprietary intumescent materials should follow the guidance provided by The Intumescent Fire Seals Association (IFSA) and the association for Specialist Fire Protection (ASFP).

Cavity barriers and fire-stops should be installed in positions detailed by the design and relevant Building regulations. Service penetrations in floors between dwellings should be fire-stopped. There should no holes or gaps for smoke to penetrate once the fire-stopping has been installed.

Installation of services
Avoid the following defects:

- Insecurely fixed socket outlets, switches, cooker point boxes, etc
- Electric power cables not de-rated where they run in or beside thermal insulation
- Loadbearing studs cut away to accommodate meter boxes, flues, etc
- Holes in vapour barriers around service pipes not sealed
- Timber damaged by plumber's blow torch.
- Metal sleeves not provided to flues.
- External and internal load bearing studs drilled or notched excessively

Cables running in, or covered by, thermal insulation should be derated to reduce the risk of overheating. The current carrying capacity should be reduced by 50% when the cable is fully surrounded or by 25% when the insulation is on one side.

Provide noggings to support heavy fixtures and fittings.

Holes in vapour control layers for services should be cut close and neat and sealed around the pipe or cable.

Provide fire protection around flue pipes (e.g. metal sleeve extending through the wall thickness and a 25mm air gap between the pipe and sleeve).

Plumbing runs should not be located in external walls to avoid inaccessibility and the risk of condensation occurring on the pipes.

Holes in studs for services should be sized and positioned in accordance with diagram 2.105.

Compatibility of fixings
Structural timber in timber framed walls and cavity barriers should be preservative treated.

When copper containing preservative treated timber is used, aluminium fixings should not be used.

In order to avoid corrosion of ferrous fixings, timber treated with water borne preservative should not be fixed until the timber has dried out to its required moisture content.

External Walls – Steel Frame

General
Galvanised strip steel should be designated either grade S280GD or 350GD to BSEN 10326.

Structural design should be in accordance with BS 5950 – 5 and the building should be designed to resist loadings in accordance with BS 6399 including:

- dead loads
- imposed loads
- wind loads.

Steel and fixings should be suitable for the design and adequately protected against corrosion.

Load bearing walls should be designed to support and transfer loads to foundations safely and without undue movement.

Wall panels may provide resistance to racking forces using one or more of the following techniques:

- internal bracing
- cross flat bracing
- external sheathing board
- internal sheathing board
- rigid frame action.

The design should detail how joints between the wall panels and other elements are to be securely fixed:

- to the structure
- to adjacent panels
- to the floor and roof.

The design should ensure that the structure is adequately protected from the effects of moisture. Exterior claddings should be compatible with the steel frame.

Suspended floors should be designed to support and transmit loads safely to the supporting structure without undue deflection. Services should be adequately protected from damage. Walls and floors should resist the spread of fire. Internal walls and floors should be designed to adequately resist the passage of sound.

A COPY OF THE MANUFACTURERS SPECIFICATION AND FIXING METHOD STATEMENT SHOULD BE MADE AVAILABLE TO YOUR Q SITE SURVEYOR PRIOR TO THE ERECTION OF THE STEEL FRAME SYSTEM AND THE CLADDING.

Site tolerances
It is essential that the accuracy of setting out of foundations and ground beams are checked well in advance of delivery of materials to site.

For accurate erection of the frame, the following tolerances are required at the level of the base of the wall frame:

- Length of wall frame +/- 10mm in 10m
- Line of wall frame +/- 5mm from outer face of plate
- Level of base of wall frame +/- 5mm over complete wall line.

Some packing may be required to achieve the required tolerances and may be as follows:

- Less than 10mm – pack under each steel with pre-galvanised steel shims
- 10-20mm – pack under each steel with steel shims and grout over length of sole plate
- over 20mm – refer to frame designer.

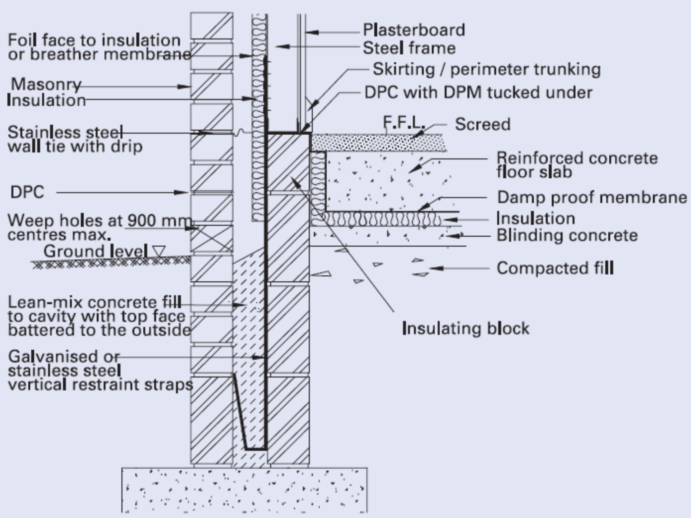


Diagram 2.130: Steel frame at ground floor level

Fixing of frames to substructures

The oversite dpm should be attached to the side of the slab and returned under the dpc on which the frame is placed.

The dpc/dpm detail requires careful attention to prevent the cavity being bridged and providing a ledge for mortar droppings.

Holding down anchors may be galvanised or preferably stainless steel straps fixed to the stud wall and attached to masonry supports or concrete foundation or holding down bolts fixed to the concrete slab (See diagram 2.130).

If stainless steel straps are used then they should be grade 1.4301 steel to BS EN 10088 and isolated from the studs with neoprene gaskets or similar. Non-stainless connections should be isolated from the straps with suitable grommets and washers.

Resin or expanding anchors should be used in an in-situ concrete raft of min C20/GEN3 grade concrete.

If required steel frames can be fixed to timber sole plates. For guidance on fixing sole plates refer to timber frame section in this manual.

The metal frame should be located entirely above dpc level. Where this is not possible Z460 galvanising or equivalent or a suitable bituminous coating should be applied to all components below dpc level. It is recommended that the inner leaf dpc is turned up approx. 30mm above the screed to protect the bottom of the studs from construction moisture and spillage.

Provide weep holes at 900 mm centres to drain cavities at ground level.

Metal stud framework

The wall panel usually consists of a head rail, a base rail (sole plate) and possibly horizontal noggins at mid height together with vertical wall studs.

- Recommended site connections include self-drilling, self-tapping screws or 10-12mm diameter grade 4.6 bolts. Welding is not recommended on site.
- Workmanship should comply with BS 8000:5.
- Framed walls should be accurately aligned, plumb, level without twist and securely fixed to adjacent elements.

Vertical tolerances are:
- +/- 15mm in overall height of wall 3 storey or,
- +/- 10mm in overall height of wall 2 storey or,
- +/- 5mm in storey height (approx. 2.5m).

A lintel should be provided where one or more studs is cut or displaced to form an opening. A lintel is not required where an opening falls between studs.
Non-load bearing walls should have adequate strength and support.

Non-load bearing walls should not bridge movement joints in the main structure.

A movement joint should be constructed between the frame and any chimney flue, lift shaft to prevent load transfer.

Cavity barriers and fire stops should be provided in accordance with relevant Building Regulations. Steel joists should be spaced at centres not greater than 600mm.

Cutting holes for services on site is not recommended but where essential, should be carried out with specialist tools. Max size of rectangular holes should not exceed 40% of overall section and length should not exceed 60% of overall section or be the depth of the section apart. No holes should be closer than 1.5x the depth of the section to the end of the member. Notches are not acceptable.

Thermal insulation
Rigid thermal insulation material should be fixed to the outside face of the steel studs to create a 'warm frame' construction.
Where the condensation risk has been assessed, and shown to be negligible, additional insulation may be placed between the studs. The additional insulation should be placed in contact with the studs to minimise air gaps and to prevent local condensation.

The following are acceptable:
- mineral wool to BS EN 13162
- FR (flame retardant) grade expanded polystyrene to BS EN 13163
- FR (flame retardant) grade extruded polystyrene to BS EN 13164
- rigid polyurethane foam and polyisocyanurate to BS EN 13166
- cellular glass to BS EN 13167.

Breather Membranes
Breather membranes should be capable of allowing water vapour from within the frame to pass out into the cavity and protect the sheathing and frame from external moisture and should be:
- vapour resistant to less than 0.6MNs/g when calculated from the results of tests carried out in accordance with BS 3177 at 25°C and relative humidity of 75%
- capable of resisting water penetration
- self-extinguishing
- durable
- adequately strong when wet to resist site damage
- Type 1 to BS 4016 in areas of Very Severe.

If foil faced insulation is not used then an independent breather membrane should be provided to the 'cold side' of the insulation. **See notes regarding breather membranes in previous section**

Vapour Control Layers

Vapour control layers should resist the passage of water vapour from within the dwelling and should be:

- Minimum 500 guage polyethylene sheet or vapour control plasterboard should be used.
- Products manufactured from recycled materials should be approved by the Q Technical Department.

Plasterboard

Plasterboard should be to BS 1230 and not less than:

- 9.5mm for stud spacing up to 450mm
- 12.5mm for stud spacing up to 600mm

To provide fire resistance, fire rated boards should be used and installed in accordance with the manufacturer's instructions.

Masonry cladding

- Cavity trays must be provided above all cavity barriers and windows and door openings etc.
- Cavity trays should extend 150mm either side of the door or window openings and have stopped ends.
- A continuous cavity tray should be provided where intermediate floors meet the external wall.
- External skin of brickwork should be attached to the metal frame with either epoxy coated galvanised ties or austenitic stainless steel ties (to DD140, BS1243, BS5268, BS8200)
- Ties are normally fixed in vertical channels. These channels are then fixed directly to sheathing boards or attached through insulation boards with stand off screws. (Screws should be isolated from the channels with neoprene or similar washers).
- Ties should be spaced at jambs of openings, a maximum of 300mm vertically within 225mm of the masonry reveal. Additional studs may be needed to achieve this.
- Ties should be inclined away from the frame.
- Ties should be fixed to the studs, not the sheathing.
- Ties should accommodate differential movement
- between the frame and the cladding.
- Soft joints should be provided to allow for differential movement. A gap of 1mm per metre of masonry should be provided at openings and soffits.
- All brick support angles should be installed by the manufacturer or specialist contractor.

Claddings

More traditional claddings can include amongst others timber boarding, plywood and tile hanging. These types of cladding should be fixed to battens, suitably attached at stud positions (See diagram 2.131). For further details refer to the timber frame section of this manual and the manufacturers' recommendations.

Render on metal lath combined with a breather membrane should also be fixed to battens attached to studs. Breather membranes should be provided in areas of severe exposure or worse. Other claddings should only be used if they are provided with an acceptable third party accreditation certificate.

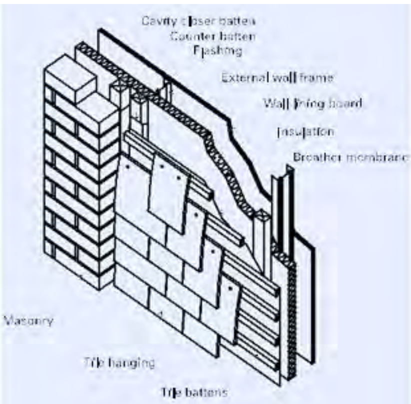


Diagram 2.131: Typical cladding detail

Internal Walls

Metal partitions
Head rail should be fixed to structure above either directly with a channel or with noggins.

Purpose made sections or special corner studs should be used to connect the partition walls to the external or separating walls.

Plasterboard linings should be attached to partitions using bugle-headed self-drilling, self-tapping screws to minimise the risk of popping fixings. Maximum spacing of fixing should not exceed 300mm.

Vertical edges require secondary supports.

Metal floors

Upper Floors
The cutting of holes in steel webs on site is not recommended but, where necessary, should be formed with specialist tools and subject to the designers approval.

The maximum depth of unstiffened rectangular holes should not exceed 40% of the overall depth of the member and its length should not be more than 3 x the depth of the hole.

Circular holes should not be more than 60% of the depth of the member, at least the depth of the member apart and a min. 1.5 x the depth away from the end of the member.

Rubber or polythene grommets should be used to line the holes etc.

Plasterboard and other ceiling linings may be fixed directly to the bottom flanges of joists or perimeter Z sections provided the maximum centres are 600mm. Where joists exceed 600mm resilient bars should be fixed to the joists and the ceiling fixed directly to them.

Noggins are required to unsupported edges of plasterboard. Joists may be built into walls or supported by joist hangers or cleats (See diagram 2.132).

- Steel joists should be spaced at centres not greater than 600mm.
- The maximum deflection for a single joist due to imposed load should be limited to span/450
- The maximum deflection for a single joist due to dead and imposed load should be limited to the lesser of span/350 or 15mm.
- Where the floor construction span is greater than 3.5m for 'C' joists or 4.2m for sigma joists the prevention of roll is required and can be by one of the following:
- A continuous line (or lines) of proprietary steel herringbone struts provided between the joists
- Solid blocking provided to every third pair of joists with ties between them
- Joists alternately reversed and tied together in pairs Joist alternately reversed and continuous ties (e.g. resilient bar) fixed to the joist flanges.

Bridging and blocking are necessary to provide lateral stability but as different profiles require different solutions advice from the manufacturer should be sought on the exact requirements.

Decking requirements are as detailed for timber floors (see tables 2.26 - 2.27) but fixed with self-drilling, self-tapping screws.

The following materials are acceptable for decking:

- Moisture resistant particleboard Type P5 to BS EN 312
- Oriented strand board Type OSB3 to BS EN 300
- Plywood in accordance with BS EN 636.

Fixings and supports should be as recommended by the manufacturer.

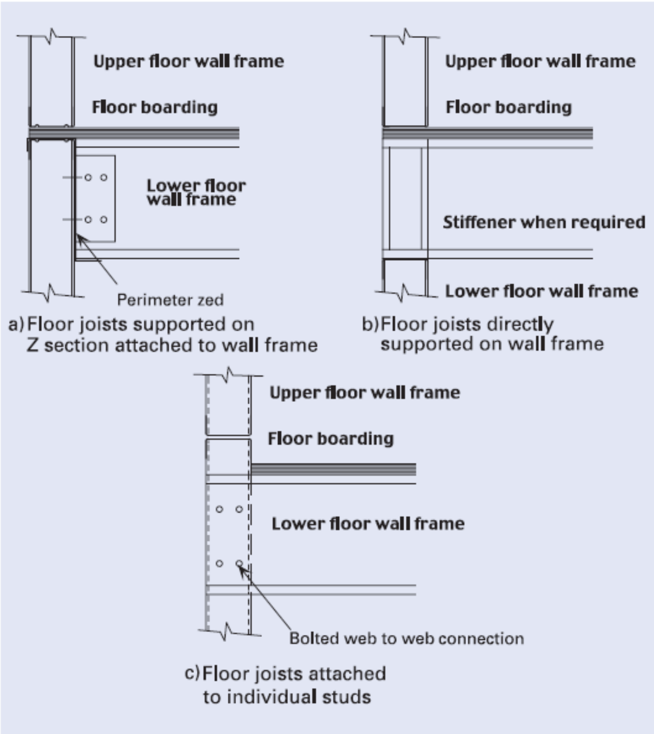


Diagram 2.132: First floor junctions

External Walls - Render

Rendering should be in accordance with BS5262 and workmanship in accordance with BS8000. In particular the following should be considered:

- Abutments between cement render and other cladding materials or components should be weather-tight and allow for differential movement.
- Any joints in the wall where movement may occur should be continued through the rendering.
- Render should not bridge the dpc and be finished onto a durable render stop.
- External rendering should comply with BS 5262. Guidance on mixes and uses is given in tables 2.16 and 2.17.
- Sand for rendering should be stored separately from other building and concreting sands.
- For bellcasts a galvanised steel bead is acceptable
- For other beads and stops an epoxy or PVC coated galvanised steel is acceptable

Timber frame background
A drained and vented cavity should be provided behind render on timber framed construction. Mesh or metal lathing should be one approved by an independent authority and fixed to vertical battens at stud centres. The minimum size of the cavity should be 19mm when the mesh or metal lathing is backed by a water-resistant membrane and 50mm when the mesh or metal lathing is unbacked. A dpc should be provided between unbacked render and timber battens.

Battens should be either 25 x 38mm or 50 x 50mm, preservative treated (BS 8417, or equivalent, hazard class 2) and fixed at spacings recommended in BS 5262. Fixings and preservatives should be compatible.

Battens should be fixed to each stud with annular ring nails of length at least twice the batten thickness plus the sheathing thickness. Nails should be hot dipped galvanised, stainless steel or equally durable.

Where cavity barriers are required, they should be correctly fitted without gaps, fill the cavity and be fixed with stainless steel staples or equally durable fixings.

Maintain settlement joints below external frames and soffits.

Where cement render spans across an intermediate floor zone in timber frame construction, allow for differential movement due to timber shrinkage by incorporating a movement joint. Vertical movement joints should also be provided at maximum 5m horizontal centres.

Masonry background
Walls should be examined for excessive moisture content prior to rendering. This is particularly important where the masonry background has no upper limit on its soluble salts content. (e.g. N designation clay bricks).

Parapets, chimneys, retaining walls and walls below dpc level with this background should employ sulphate resisting cement in the render and mortar.

Chimneys, parapets, retaining walls and walls below dpc level

- Pay special attention to the render mix specification and use sulphate resisting cement.
- It is recommended that the backs and exposed horizontal surfaces of parapets are not rendered.
- Throats or drips to copings of parapets and chimneys should project beyond the finished faces to throw water clear.
- Rendering to chimneys should only be carried out where brickwork contains little or no sulphates. Splatterdash treatment should be used.
- As before horizontal dpcs and dpms must not be bridged.
- It is recommended that rendering is not used below dpc. However where this is not practical, the render must still not be allowed to bridge the dpc. A bellcast must be formed in the render above the dpc.

Other construction detailing

- Ensure that drips and throating to sills, coping etc. project beyond the face of the finished render above the dpc.
- Notwithstanding wind loadings, the larger the eaves overhang the better. This will provide protection to the top joint and prevent rainwater percolating behind the render.

Angles, stop beads and jointing sections should be secured with drilled or shot-fired fixings and not with gypsum plaster.

Check whether the rendering can be applied directly onto the wall or whether any preparatory treatment is required in accordance with the manufacturer's instructions.

The surface should be checked for suction by dampening the wall with clean water.

Vertical and horizontal flatness

Rendering should have a maximum vertical and horizontal deviation from flatness of ± 10mm in 5m and is measured in a similar way to straightness on plan and plumb of masonry. See diagram 2.133a.

uses	designation	proportions by volume		
		portland cement: lime:sand	air-entrained portland cement:sand	masonry cement: sand
To produce a strong relatively impervious finish but with high drying shrinkage, hence susceptible to cracking. Restrict its use to first base for metal lathing.	I	1:1/4:3	–	–
To provide a suitable render for finishing and base coats in the majority of cases. More permeable than designation 1 and hence has lower drying shrinkage problems.	II	1:1/2:4-4 1/2	1:3-4	1:2 1/2-3 1/2
	III	1:1:5-6	1:5-6	1:4-5
	IV	1:2:8-9	1:7-8	1:5 1/2-6 1/2
Only suitable for work in sheltered locations with weak backgrounds. Ideal for use in remedial works to weak lime based renders	V	1:3:10-12	–	–
Follow the guidance given regarding batching, admixtures, working life and cold weather working for mortars. Ensure the render coat does not bridge the dpc.				

Table 2.16: Recommended mortar mixes for use in render finishes

background	exposure*	first basecoat designation	first basecoat thickness (mm)	second basecoat designation	second basecoat thickness (mm)	final coat finish	final coat type	final coat designation **
metal lathing	very severe/ severe	I	3 – 6	II	10 – 14	–	roughcast buttercoat for drydash tyrolean	$1:\frac{1}{2}:3:1\frac{1}{2}$ II II
	moderate/ sheltered					thrown	roughcast buttercoat for drydash tyrolean	1:1:3:2 III II
						troweled	woodfloat scraped patterned tooled	IV
strong to moderate	very severe/ severe	II	8 – 12	II	6 – 10	–	roughcast buttercoat for drydash tyrolean	$1:\frac{1}{2}:3:1\frac{1}{2}$ II II
	moderate/ sheltered	II	8 – 12	–	–	thrown	roughcast buttercoat for drydash tyrolean	1:1:3:2 III II
		III	8 – 12	–	–	troweled	woodfloat scraped patterned tooled	IV
moderate to weak	very severe/ severe	III	8 – 12	III	6 – 10	–	roughcast buttercoat for drydash tyrolean	1:1:4:2 III II
	moderate/ sheltered	III	8 – 12	–	–	thrown	roughcast buttercoat for drydash tyrolean	1:1:3:2 III II
						troweled	woodfloat scraped patterned tooled	IV
weak	sheltered only	IV	8 – 12	–	–	troweled	woodfloat patterned	V

* reference to the map on page 166 with regard to wind driven rain index and exposure ratings.

** where (designation) a mix is specified it is by volume using cement: lime: sand: coarse aggregate.

The mix for each successive coat should never be stronger than the previous coat or background.

A strong background is deemed to be a dense concrete block, lightweight blocks are classified as moderate, with bricks being moderate to weak depending on type and condition (always check with the manufacturer prior to rendering).

Nominal overall thickness expected for three coat applications is 20mm and 16mm for two coat applications.

For very severe and severe exposures and when the background is metal lathing it is recommended to provide two base coats thus providing an enhanced resistance to rain penetration.

Refer to table 2.16 for mixes relative to designation.

Table 2.17: Mortar specification for background exposure and finish

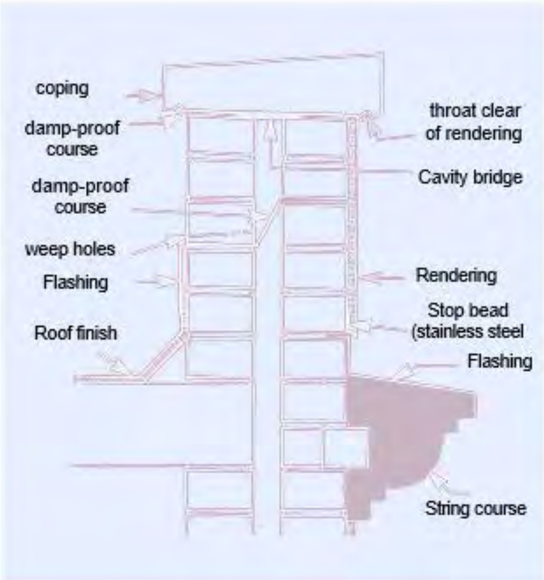


Diagram 2.13: Parapet and string course detail

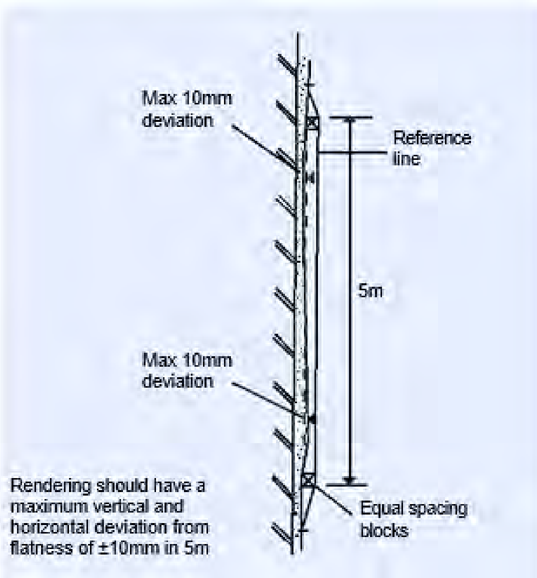


Diagram 2.13a: Plan & Plumb of rendering

External Walls - Curtain Walling

General
Curtain walling systems should have third party certification confirming satisfactory assessment in accordance with the CWCT Standard for Curtain Walling. The CWCT Standard provides detailed guidance on performance and testing.

Dead and live loads should be transferred safely to the building structure without undue permanent deformation or deflection of any component.

Imposed loads should be calculated in accordance with BS 6399.

Movement should be accommodated without any reduction in performance.

Fixings and supports should be designed to accommodate specified loads and take account of product manufacturer's recommendations.

Pull-out or destructive testing of anchors should be carried out in accordance with BS 5080 and the construction Fixings Association Guidance Note 'Procedure for Site Testing and should be carried out at a rate agreed by Q.

Packing of brackets to achieve surface tolerance should be permitted only in accordance with the manufacturer's recommendations.

It should resist the passage of water to the inside of the building, allowing free drainage and not trap water and should have:

- External and internal air and water seals, and
- Drained and ventilated glazing rebates

Sealants should be specified in accordance with BS 6213 and the manufacturer's recommendations.

It should be designed to minimise the risk of surface and interstitial condensation by the use of thermal breaks and a continuous vapour control layer.

The system should be designed to resist the passage of airborne and impact sound within the building, particular attention should be given to flanking transmission at:

- The edges of separating floors
- The outer edges of separating walls
- The outer edges of partition walls
- The junctions with roof constructions and parapets.

It should comply with BS 7671 'Requirements for Electrical Installations' for electrical continuity and earth bonding.

The risk of bimetallic corrosion should be avoided by isolation of dissimilar metals.

The curtain wall system should not include materials liable to infestation attack by micro-organisms, fungi, insects or vermin.

Design should allow for the line, level, plumb and plane of the completed curtain wall to be within the acceptable tolerances of:

- +/- 2mm in any one storey height or structural bay width and
- +/- 5mm overall.

Insulated render systems
These are systems which are applied to the exterior walls of existing or new buildings, comprising of an insulant and a weather protective finish, or which there are three main types:

- Traditional renders and finishes;
- Thin coat renders and synthetic finishes;
- Preformed cladding materials.

Only approved installers supplying a 10 year insurance backed warranty are acceptable to Q.

For further information www.inca-ltd.org.uk

Dead and live loads should be transferred safely to the building structure without undue permanent deformation or deflection of any component.

Imposed loads should be calculated in accordance with BS 6399.

Movement within the insulated render system should be accommodated without any reduction in performance.

Movement joints in the backing wall should be continued through the insulated render system and formed in accordance with the manufacturer's recommendations.

Fixings rails, frames and supports should be designed to accommodate specified loads and take account of product manufacturer's recommendations. Pull-out or destructive testing of anchors should be carried out in accordance with BS 5080 and the construction Fixings Association Guidance Note 'Procedure for Site Testing' and should be carried out at a rate agreed by Q.

Insulated render systems together with the backing wall to which they are applied should satisfactorily resist the passage of moisture to the inside of the building.

Particular attention should be given to the interfaces between the insulated render system and the walls, roof, doors, windows etc., and sealants and tapes should be in accordance with BS 6213 and the manufacturer's recommendations.

The insulated render system should be securely fixed to the support frame or backing wall with the appropriate fixings/adhesive in accordance with the manufacturer's recommendations.

A minimum of one non-combustible fixing per square metre or per insulation batt, whichever provides the greater number should be used in addition to other fixings. Reference should be made to BRE document BR 135-2003 'Fire performance of external thermal insulation for walls of multi-storey buildings' when specifying type of insulation system to be installed.

Insulation should be returned into window and door openings and be continuous around penetrations through the wall (See diagram 2.135).

A condensation risk analysis in accordance with BS 5250 should be carried out. Unless it shows otherwise, a vapour control layer should be provided. The vapour control layer should be fixed on the warm side of the building. Reinforcement mesh is to be provided and additional should be provided where there is likelihood of increased stress in the render system, e.g. at the corners of window or door openings (See diagram 2.134).

Corners, returns and features should be formed with appropriate trims in accordance with the manufacturer's recommendations.

Fixings and brackets should be stainless steel, suitable non-ferrous metal or suitable plastics.

The risk of bimetallic corrosion should be avoided by isolation of dissimilar metals.

The insulated render system should not include materials liable to infestation attack by micro-organisms, fungi, insects or vermin.

Acceptable tolerance for an insulated render system would normally be a maximum horizontal or vertical deviation from flatness of +/- 10mm in 5m.

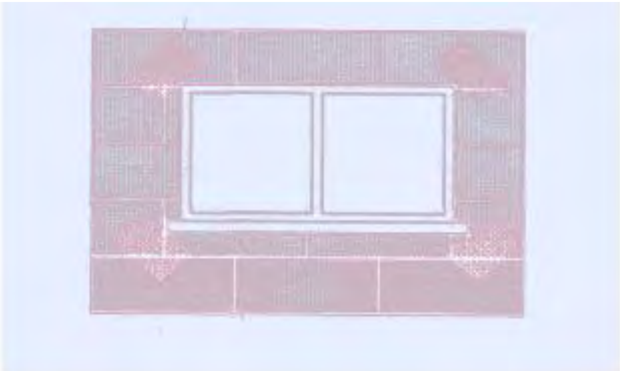


Diagram 2.134: Reinforcement continuous across face of insulation

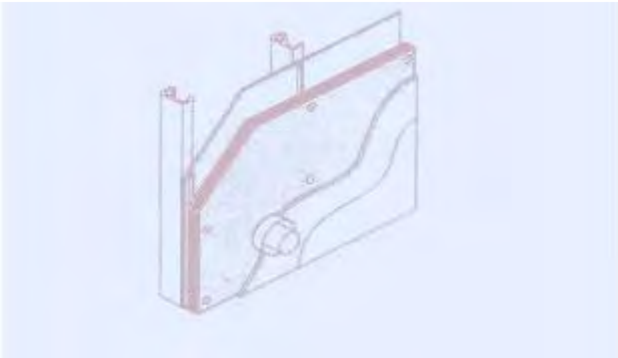


Diagram 2.135: All layers neatly cut around flue outlet

Render Application for Thin Coat

The undercoat should be built up to the correct thickness in two or more stages without any appreciable delay and ruled off with a straight edge between the grounds.

The undercoat should be finished with a wood or plastic float and, unless otherwise required, combed to divide the surface into small areas to provide a key for the final coat.

The undercoat should be allowed to dry before application of the next coat.

The final coat should be applied in a single, continuous operation over each wall. The position of any joints in the final coat should be determined in advance.

Where adhesives are used, the recommendations of the manufacturer should be followed.

Metal lathing should be fixed in accordance with the manufacturer's instructions.

Precautions should be taken to prevent rapid drying out of wet applied materials by:

- Dampening porous supporting surfaces
- Providing sun screens across window openings in hot weather.

Renders should (unless specifically intended otherwise) be finished to a reasonable plane, visually uniform surface in order that trims, paints, and other surface finishes may be applied without the need to carry out any excessive preparatory work such as levelling, stopping up or rubbing down.

Textured finishes should be uniform and neatly finished at perimeter edges.

Renders should not bridge any dpc or dpm (See diagram 2.136).

Work on site should be in accordance with BS 8000:9/10.

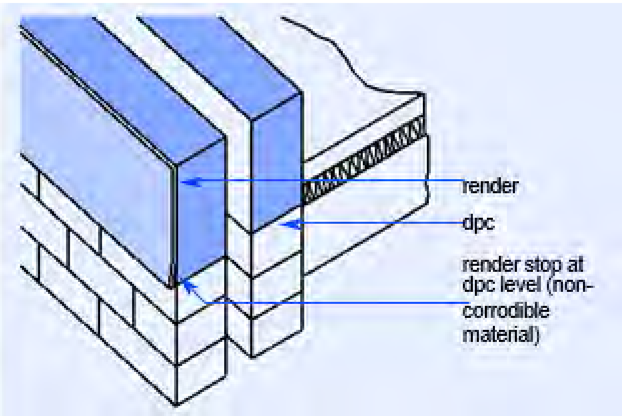


Diagram 2.136: Render finish at dpc level

Protection of render

Renders are vulnerable to damage through exposure to extremes of temperature during the first few days. Therefore the following appropriate precautions should be arranged in advance:

- In hot weather, the wall should be shaded from the direct heat of the sun or the work programmed to be carried out in the shade
- In cold weather, rendering should not be attempted when there is a risk of frost occurring during the day or the following night
- Air temperature should be at least 5˚C at the time of application
- When rendering has been applied, it should be prevented from drying out for two or three days until the mortar has hardened
- In drying winds it may need to be kept damp by gentle spraying.
- Rendering should not be carried out when rainfall exceeds the lightest of showers.

External Walls - Cladding

General
Timber and boards for exterior use should be of a durable species, with sapwood excluded, or preservative treated by pressure impregnation using preservatives suitable for use in hazard class 3 in compliance with BS8417:2003, or equivalent, (see table 2.18).

Ends cut on site should be dipped or liberally brushed with preservatives.

Where timber boarding or plywood spans across an intermediate floor zone in timber frame construction, allow for differential movement caused through timber shrinkage, by incorporating a movement joint (See diagram 2.137).

Where cavity barriers are required they should be correctly fitted without gaps, fill the cavity and be fixed with stainless steel staples or equally durable fixings.

Abutments between cladding and other weather-resisting elements should be neatly made, be weather-tight and allow for differential movement (See diagram 2.138).

Workmanship should comply with BS 8000:5.

Timber boarding
Timber boarding should be at least 16mm thick and allowance for moisture movement in boarding should be made by making tongues, joints or overlaps at least 10% of the board width.

Timber boarding should be battened off the supporting background to provide a minimum 19mm cavity for draining and venting. (See diagrams 2.139 and 2.140). Battens should be a minimum 38mm wide, preservative treated and at maximum 600mm centres. A breather membrane should always be installed when horizontal battens are located against the sheathing.

Battens on timber frame should be fixed to each stud (and not to the sheathing) with annular ring nails of length at least twice the batten thickness plus the sheathing thickness (or plain shank nails of length 2.5 times the batten thickness plus the sheathing thickness).

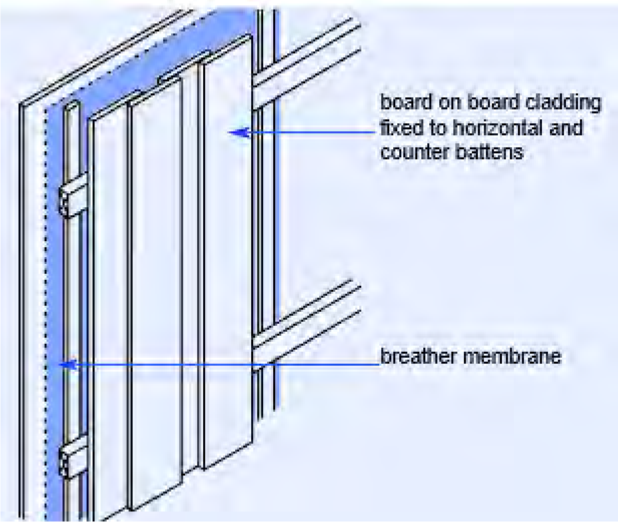


Diagram 2.139: Vertical timber cladding

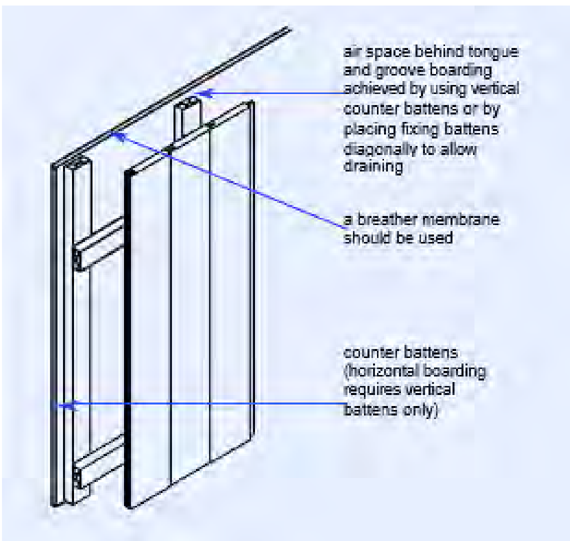


Diagram 2.140: Vertical timber cladding

Boards should be fixed to battens by face or secret nailing with annular ring nails at least twice the board thickness or plain shank nails at least 2.5 times the board thickness. Butt joints at board ends should occur at battens.

Nails should be either hot dipped galvanised, stainless steel or equally durable. Aluminium nails should not be used with copper containing preservative treated timber and galvanised nails should not be used with Western Red Cedar.

Tile and slate cladding

Tile and slate cladding should comply with BS 8000:6 and be fixed in accordance with the manufacturer's recommendations.

All battens should be minimum 38 x 25mm for double lap Clay or Concrete tiles or 50mm X 25mm for Single Lap Clay & Concrete tiles or Slates In accordance with BS 5534

Battens should be level and, if timber frame, fixed to each stud (not to sheathing) with annular ring nails of length at least twice the batten thickness plus sheathing thickness. Battens should not be less than 1200mm in length and span across at least 3 supports. Nails should be either hot dipped galvanised, stainless steel or equally durable.

A breather membrane (not a roof underlay) should always be fixed to sheathing behind the battens.

Other claddings

Other claddings should only be used if they conform with independent third party certificates acceptable to Q.

Flint, stone or cobble cladding must be a non-loadbearing element of the wall, backed up by a masonry skin and secured by stainless steel ties at 450mm centres horizontally and vertically. Expanded metal is recommended as it is easily adjusted to suit the stonework.

A minimum 50mm cavity and inner skin are then constructed in the usual way.

Upper Floors

Timber

Timber floors
The moisture content of structural timber should not exceed 20% 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'.

Joists should be regularised to enable floor and ceiling finishes to be laid to a level and smooth finish. Notching and drilling of joists should be as shown in diagram 2.142, unless designed by an Expert.

Reference can be made to tables 2.19 and 2.20 which translates diagram 2.142 drilling and notching zones into actual dimensions for a number of typical depths and spans.

- Adjacent holes must not be closer than 3 times the diameter of the largest hole permitted (See table 2.20)
- A notch and a hole within the same joist must be at least 100mm apart measured horizontally along the centre of the joist
- Where the joist depth is greater than 250mm, then the dimensions of the shaded zones given in diagram 2.142 should be calculated using d = 250mm

Clear span of joist* (m)	Holes to be drilled only within the zones of A–B (distance given is taken from either supporting wall in mm)		Notches to be taken out only within the zones C–D (distance given is taken from either supporting wall in mm)	
	A	B	C	D
1.50	375	600	105	375
2.00	500	800	140	500
2.50	625	1000	175	625
3.00	750	1200	210	750
3.50	875	1400	245	875
4.00	1000	1600	280	1000
4.50	1125	1800	315	1125
5.00	1250	2000	350	1250
5.50	1375	2200	385	1375
6.00	1500	2400	420	1500

Notes:
*Clear span is the distance between supports
A = 0.25 x clear span B = 0.40 x clear span
C = 0.07 x clear span D = 0.25 x clear span

Table 2.19: Permitted locations for notching and drilling joists

depth of joist 'd' (mm)	max. depth of notch 0.125d (mm)	max. diameter of holes 0.25d (mm)	min. distance between holes* (mm)
100	12.5	25	75
125	16	31	93
150	19	37.5	112.5
175	22	44	132
200	25	50	150
225	28	56	168
250	31	62.5	187.5

Notes: *distance given is when using maximum permissible hole size.
If the joist depth is greater than 250mm, notch and hole sizes should not exceed those given for 250mm deep joists.

Table 2.20: Maximum depth of notches and diameter of holes in joists

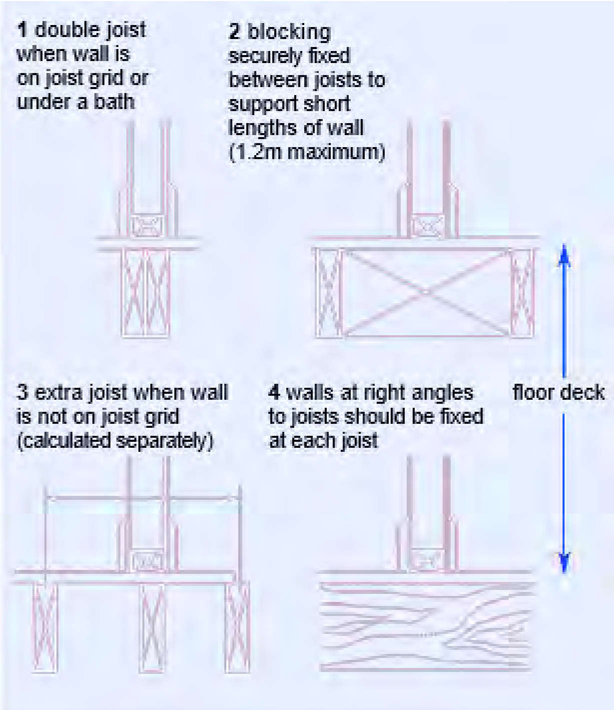


Diagram 2.141: Supporting of non loadbearing internal studwork and plasterboard wall

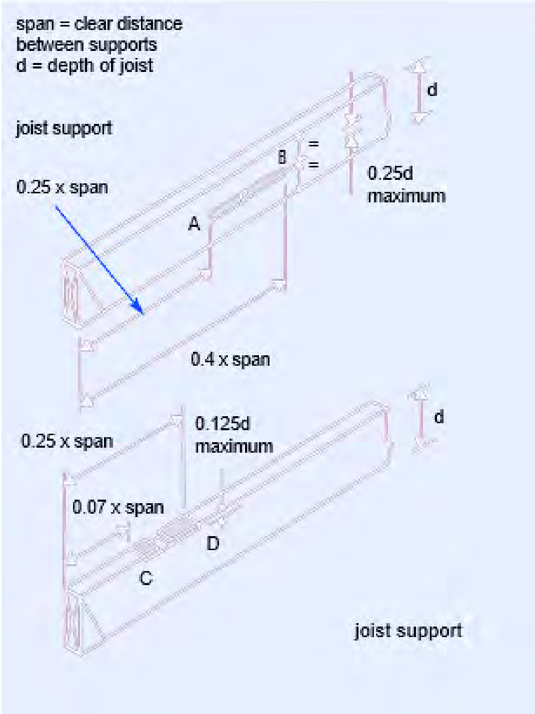


Diagram 2.142: Notching and drilling joists

Joists

Internal partitions should be supported so as not to cause excessive floor deflection. Non-loadbearing lightweight partitions (up to 0.7KN/m run) such as timber stud partitions or plasterboard lined honeycomb partitions may be supported by timber floors as shown in diagram 2.141.

To prevent cold bridging, reduce air leakage and avoid the risks of moisture penetration ends of joists should not be built into external masonry walls unless proprietary joist end caps are used, alternatively the use of suitable proprietary joist hangers are also recommended. Further information can be found in 'RobustDetails' and BR262 "Thermal Insulation: avoiding the risks", 2002 edition.

To avoid distortion of finishes, joists should be prevented from twisting over supports and provision made to accommodate up to 10mm drying shrinkage in floor joists supported by steel beams (See diagram 2.143).

Joists should not be overloaded during construction. Joints in joists, rafters and purlins should only occur over a loadbearing support, or the joint be designed by an Expert.

Joists should be restrained at supports and along the span as shown in table 2.21, using tightly fitted strutting.

Joists should have a minimum end bearing of 90mm. Joists should have a minimum 35mm bearing onto joist hangers. Double joists should be pattern nailed at 450mm centres, nails maximum 20mm from top and bottom. Projecting nails ends should be bent over. Bolting of double joists recommended at 1m centres along centre line of joist – bolting should always be used on double stair trimmers.

Trimmer and trimming joist sizes should not be less than as shown in tables 2.22 – 2.25 unless the size is specifically calculated by an Expert.

Joist span	Rows of strutting
Up to 2.5m	None
2.5m to 4.5m	1 (located at mid-span)
Over 4.5m	2 (located at third points)

Notes:
Solid strutting should be used instead of herringbone strutting where the distance between joists is greater than three times the depth of the joists. In all other instances the use of herringbone strutting is recommended to reduce the risk of creaking floors due to shrinkage.
Timber for herringbone strutting should be at least 38 x 38mm.
Solid strutting should be at least 38mm thick and at least three quarters of the joist depth.
Strutting should be blocked solidly to perimeter walls.
Strutting or blocking should not block the ventilation space in cold deck flat roofs.

Table 2.21: Strutting to joist

Table 2.22	Floor joists													
Permissible clear span between supports with imposed loads of 1.5kN/m². Dead load more than 0.25 but not more than 0.50kN/m²														
sizes with no partitions							sizes with l/w[3] partitions							
size of joist mm x mm	spacing of joists (mm)						size of joist mm x mm	spacing of joists (mm)						
	C16[1]			C24[2]				C16[1]			C24[2]			
	400	450	600	400	450	600		400	450	600	400	450	600
	Maximum clear span of floor joist (m)							Maximum clear span of floor joist (m)						
47 x 72	1.27	1.15	0.89	1.35	1.27	1.10	47 x 72	1.15	1.04	0.80	1.21	1.14	0.99
47 x 97	1.92	1.82	1.46	1.03	1.92	1.68	47 x 97	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	47 x 122	2.29	2.21	1.88	2.39	2.29	2.06
47 x 147	3.06	2.95	2.61	3.18	3.06	2.78	47 x 147	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	47 x 170	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	47 x 195	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	47 x 220	4.09	3.92	3.41	4.24	4.10	3.73
63 x 97	2.19	2.08	1.82	2.31	2.19	1.93	63 x 97	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	63 x 122	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	63 x 147	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	63 x 170	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	63 x 195	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	63 x 220	4.42	4.29	3.93	4.54	4.42	4.10

Table 2.22: Floor joists

Table 2.23	Loaded length (m) L on diagram 2.144											
	1.0	2.0	3.0	4.0	5.0	6.0	1.0	2.0	3.0	4.0	5.0	6.0
	Clear span (m) s on diagram 2.83											
Trimmer size (mm)	C16[1] timber						C24[2] timber					
2 x 47 x 147	2.55	2.14	1.78	1.54	1.36	1.23	2.67	2.25	1.99	1.81	1.67	1.36
170	2.96	2.50	2.09	1.81	1.61	1.45	3.10	2.62	2.33	2.12	1.96	1.68
195	3.41	2.88	2.41	2.10	1.87	1.69	3.56	3.02	2.69	2.45	2.27	2.02
220	3.85	3.25	2.73	2.38	2.13	1.93	4.03	3.42	3.05	2.78	2.58	2.36
2 x 63 x 147	2.83	2.39	2.11	1.83	1.63	1.48	2.96	2.50	2.22	2.03	1.88	1.76
170	3.28	2.78	2.46	2.14	1.91	1.73	3.43	2.91	2.59	2.37	2.20	2.06
195	3.76	3.20	2.83	2.47	2.21	2.01	3.93	3.36	2.99	2.74	2.54	2.39
220	4.25	3.63	3.20	2.80	2.51	2.29	4.44	3.80	3.39	3.11	2.89	2.72
2 x 75 x 147	3.00	2.54	2.26	2.03	1.81	1.64	3.13	2.66	2.37	2.17	2.01	1.89
170	3.47	2.96	2.64	2.36	2.11	1.92	3.63	3.10	2.76	2.53	2.35	2.21
195	3.99	3.41	3.04	2.73	2.44	2.23	4.17	3.56	3.19	2.92	2.72	2.56
220	4.50	3.85	3.45	3.08	2.77	2.53	4.70	4.03	3.61	3.31	3.09	2.90

Key:
1. C16 timber is approximately equivalent to SC3 grade timber
2. C24 timber is approximately equivalent to SC4 grade timber
3. Non loadbearing lightweight partitions (loading not greater than 0.8kN/m² run)

Notes: Joists should be doubled up beneath baths and any other point of concentrated load
Maximum partition load 0.8kN/m² (e.g. timber framed stud partition).
Non loadbearing partitions should be supported as shown in diagram 2.141
No notches in trimmer beam unless designed by an Expert.

Table 2.23: Loaded length (m) L on diagram 2.144

Table 2.25	See diagram 2.145 for positions of d1, d2, d3 and S								C24[2]
	For ratios of d1/d2 up to 0.25			For ratios of d1/d2 between 0.26 and 0.49					
	1.0	2.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0
Trimmer size (mm)	Clear span S (m)								
2 x 47 x 147	3.39	3.12	2.91	2.88	2.56	2.33	2.76	2.51	2.32
170	3.93	3.64	3.40	3.35	2.99	2.73	3.20	2.92	2.71
195	4.51	4.19	3.94	3.85	3.45	3.17	3.67	3.36	3.12
220	5.08	4.75	4.47	4.35	3.92	3.60	4.14	3.80	3.54
2 x 63 x 147	3.73	3.45	3.23	3.18	2.85	2.61	3.05	2.78	2.58
170	4.31	4.01	3.77	3.69	3.32	3.05	3.52	3.23	3.01
195	4.94	4.62	4.35	4.24	3.83	3.52	4.04	3.72	3.46
220	5.56	5.21	4.93	4.78	4.33	4.00	4.56	4.20	3.92
2 x 75 x 147	3.94	3.66	3.43	3.38	3.03	2.78	3.23	2.95	2.75
170	4.55	4.25	4.00	3.91	3.52	3.24	3.73	3.43	3.19
195	5.21	4.88	4.61	4.48	4.06	3.74	4.28	3.94	3.68
220	5.85	5.50	5.21	5.05	4.59	4.25	4.82	4.45	4.16

Key: 1. C16 timber is approximately equivalent to SC3 grade timber
2. C24 timber is approximately equivalent to SC4 grade timber

Notes: Maximum partition load 0.8 KN/m^2 (e.g. timber framed stud partition).
No notches in trimmer beam unless designed by an Expert.

Table 2.25

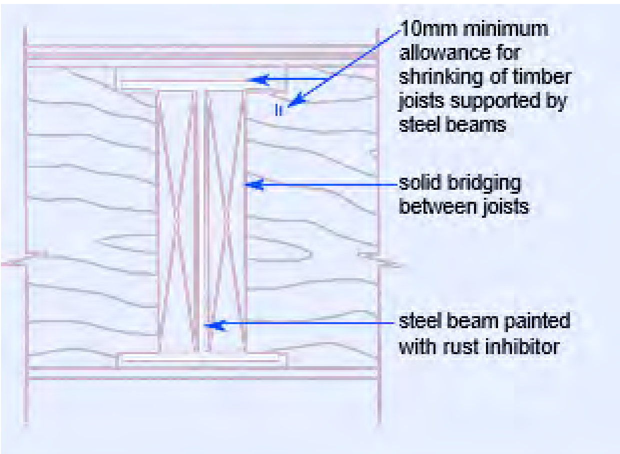


Diagram 2.143: Allowance for joist movement

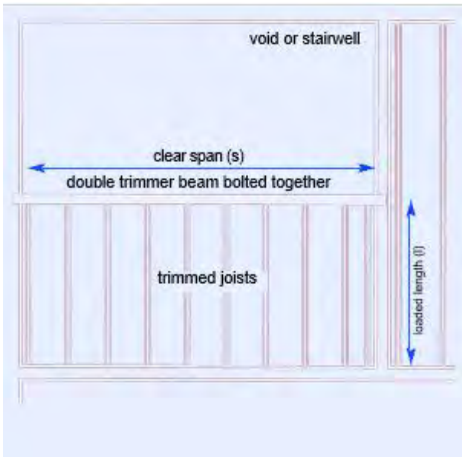


Diagram 2.144: Trimmer beam (See table 2.22)

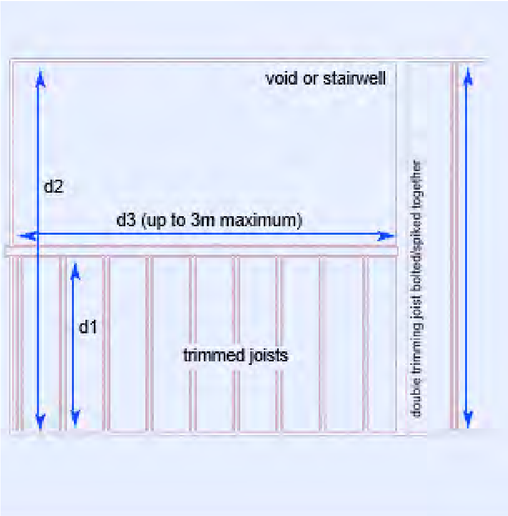


Diagram 2.145: Trimming joist (See tables 2.23 and 2.24)

Floor joist sizes should not be less than as shown in table 2.22 unless the size and spacing are specifically designed by an Expert.

Decking

The type and thickness of floor decking should not be less than as set out in tables 2.26, 2.27 and 2.28.

Other board types and thicknesses than those shown in tables 2.26 to 2.28, should be assessed as suitable by an independent testing authority and laid in accordance with the recommendations of the supplier or importer's association.

To achieve adequate sound resistance to internal floors the particleboard may need to be increased to 22mm to achieve the required density.

All square cut edges and all boards at room perimeters should have solid timber edge support, ensure that the short edge of tongued and grooved boards meet over a joist.

Deck fixings should be as set out in tables 2.26 – 2.28 or as specified by the board manufacturer.

Floor decking should not generally be laid until the building is weather-tight, unless fully protected. Other types of proprietary timber floor construction, such as web beams, may be used if independent third party certificates acceptable to Q are available, or subject to a satisfactory appraisal by Q. All such systems should be installed in accordance with the manufacturers instructions.

Table 2.26: T & G softwood boarding for flooring

Finished board thickness (mm)	Maximum span (mm) centre to centre
15	up to 450
18	450 – 600

Note:
Softwood floor boarding should comply with BS 1297 and have a moisture content of 16 - 20% at the time of laying. Boards should be double nailed or secret nailed to each joist. Use nails 2.5 times the thickness of the board and punch well below board surface.

Table 2.26: T & G softwood boarding for flooring

Table 2.27: Flooring grade particleboard and oriented strand board		
thickness (mm) particle board	thickness (mm) OSB	Maximum span (mm) centre to centre
18 & 19mm	15mm	450
22mm	18 & 19mm	600

Note:

Softwood floor boarding should comply with BS 1297 and Chipboard flooring should be moisture resistant flooring grade type P5 or P7 to BS EN 312.

Particleboard may be square edged or tongued and grooved. Square edged boards should have all edges supported and are normally laid parallel to the joists and short ends supported on noggings. Tongued and grooved chipboard is normally laid across the joists with short ends occurring on joists.

Oriented Strand Board (OSB) should be type 3 or 4 to BS EN 300. OSB should be laid with its major axis at right angles to the supporting joists. (The major axis is indicated by a series of arrows on the face of the board).

Screw or nail chipboard and OSB at 200mm to 300mm (or closer) centres along the edges and elsewhere along the joist.
Nails should be annular ringed shank (improved) of length 2.5 times the thickness of the board. Use 10 gauge nails positioned at least 9mm from the edge of the panel.

A minimum 10mm expansion gap should be provided where chipboard and OSB flooring abuts a wall.

Glueing of tongue and grooved panels is recommended to reduce squeaking. Glueing is essential where panels are over insulation as a floating floor.

Table 2.27: Flooring grade particleboard and oriented strand board

Table 2.28: Plywood for flooring		
	Recommended thickness (mm)	Max span, multi-support (mm)
American Plywood		
	15-16	Up to 450
	18-19	Up to 600
Canadian Plywood		
	15-16 (Douglas Fir)	450 - 600
	15-16 (Softwood)	450
	18-19 (Softwood)	600
Swedish Plywood		
	16 (Softwood)	450 - 600
Finnish Plywoods - sanded		
	15-16	450
	18-19	600

Notes:

Thickness and spans are recommended and not minimum.
Recommendations for specific plywood grades issued by the American Plywood Association, Council of Forest Industries or Finnish Plywood International may allow greater spans. In all cases, fixing and other recommendations of these associations should be followed.

Plywood may be square edged or tongued and grooved. Square edged boards and cut edges should be supported on all edges. Boards are normally laid so that the face grain is at right angles to the joists.
If narrow sheets of plywood are used which span only between one pair of joists, the allowable span may be less than that given for multi-support. The recommendations of the above associations should be followed.

Nail or screw the ply panels at 150mm centres along the edges and at 300mm elsewhere along the joist.
Nails should be 10 gauge annular ringed shank (improved) nails 2.5 x decking thickness long positioned at least 10mm from the panel edge.

Table 2.28: Plywood for flooring

Engineered Timber I Joists

General
Engineered Timber I joists comprise a timber flange (typically solid timber or LVL – laminated veneer lumber) and a panel product web (usually OSB – oriented strand board). They are manufactured in a variety of depths and flange widths under carefully controlled factory conditions to low and uniform moisture contents.

Joists should be protected from the elements supported on suitable bearers over a free-draining surface. Levels of exposure that are more severe than those encountered during a normal continuous build programme should be avoided or addressed by the provision of suitable protection.

Large areas of floor joists can be assembled using these products due to their light weight and availability in long lengths. It is extremely important, though, that adequate safety bracing is provided to ensure that the joists remain stable during the construction phase. Joist manufacturers provide simple guide recommendations to allow the installer to facilitate this process quickly and easily.

Do not allow workers to walk on un-braced joist layouts. Ensure that floors do not become overloaded during construction.

Design
The design of these members should be undertaken in accordance with BS5268: Part 2 using design values obtained from the relevant third party product certification for service classes I and II only. These products are proprietary and cannot be substituted without design verification.

Notching and drilling
Notching and drilling of these products is restricted and should be undertaken in accordance with the reference charts and tables provided by the joist manufacturer.
Under no circumstances should the flanges of the I-joist be cut, notched or drilled.

Standard Details
Components are assembled using standard details, connectors and fixings. Two important details are shown below (See diagrams 2.146 and 2.147) that illustrate the different approach that is utilised when detailing Engineered I-Joists.

Permanent rows of intermediate strutting are not required.

Support
Where any doubt exists relating to the design, specification or installation of these products, then contact should be made with the technical department of the respective manufacturer. Further guidance is also available from Timber Research and Development Association (TRADA). www.trada.co.uk

Space Joist
Space joist is designed by Gang-Nail Systems and are distributed via licensed specialist manufacturers.
It consists of parallel stress graded timber flanges joined together with V shaped galvanised steel webs. The webs are fixed to the flanges via nailplates. The open web design gives great flexibility to run services through. All damage should always be referred back to the manufacturer

Building in of joists over internal walls

The mortar should be sufficiently dry to reduce the likelihood of shrinkage and should be solidly packed in but should not be packed up tight to the underside of the top flange. All continuous joists must be packed down to the intermediate bearing wall before the floor decking is fixed. (See diagram 2.148)

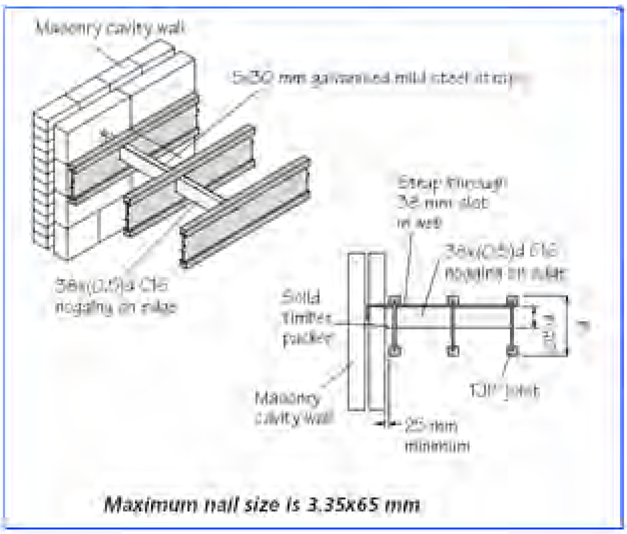


Diagram 2.146: Masonry wall restraint

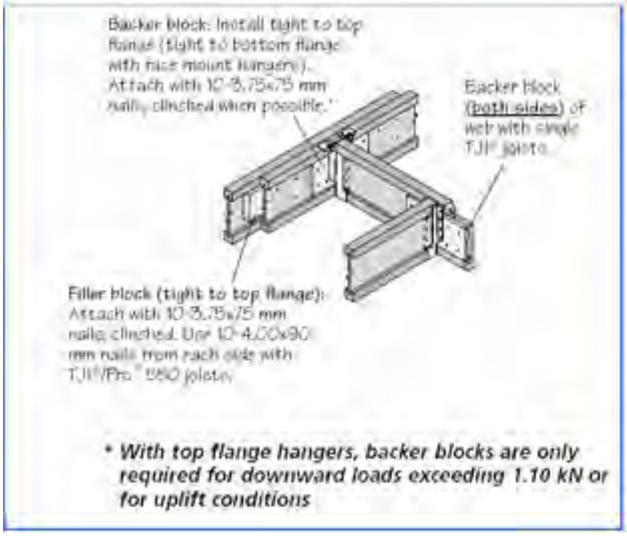


Diagram 2.147: Joist to joist connections

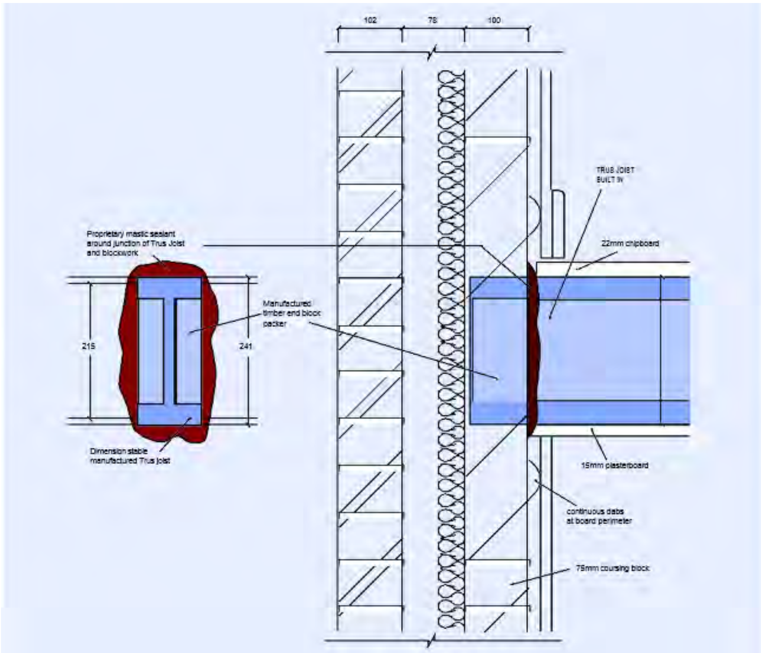


Diagram 2.148: Building in joists

Concrete

Please see following section relating to Floor Insulation.

General
The quality and type of finish for in situ concrete should be to the standards as set out in BS 8110.

- class 1 finish should be used where surfaces are exposed to view
- class 2 finish should be used where surfaces are to be exposed to view but where appearance is not critical and
- special finish relates to the highest standards of finish where appearance is critical

Finishes for precast products are normally specified by reference to an agreed sample which should be kept on site for comparison with delivered items prior to acceptance.

In situ slabs and beams should be fully propped until the element has achieved its design strength.

Movement joints in large ground floor slabs should be provided in accordance with the recommendations of the British Cement Association publication, “Concrete Ground Floors”.

Directly finished in situ concrete floor surfaces should be produced to a level and smooth finish, and to a porosity and texture appropriate for the specified covering.

The maximum permissible movement due to combined shrinkage, creep and deflection of concrete beams, floors and slabs should be as determined in accordance with BS 8110.

Columns, beams and slabs should be constructed level, square and plumb, and without excessive twist.

Precast concrete floor units
Precast or insitu concrete floors should be designed to BS 8110.

Proprietary concrete units of elements will be acceptable if supported by independent third party certificates acceptable to Q or subject to appraisal by Q.

Reinforced concrete upper floors should be constructed in accordance with the designers details without deviations unless specifically agreed with the designer.

Precast concrete units and infill blocks should be carefully stored and handled on site so as to avoid damage occurring before, during and after incorporation into the structure. Units should be lifted as near as possible to their ends.

The bearing surface of walls, beams and other supports to receive precast units should be smooth and level.

Infill blocks and slabs should fully bear onto supporting beams and walls.

Materials should be stored and protected so as to prevent damage by frost.

Reinforcement should be stored so as to keep it free from grease, oil, mud, excessive rust, loose concrete and ice.

Mixing of concrete
Concrete, including ready-mixed concrete, should be produced and specified in accordance with BS 5328.

Concrete should be mixed so that every batch is produced with the required workability, batch quantities, strength (where specified), uniform consistency, uniformity of colour and at the correct rate for the placing method used.

A mechanical mixer should be used except for very small quantities. Mixing water should be of drinking water quality. Typical mixes used in house building are referenced in table 2.29.

Compaction and placing
Concrete may be placed and compacted at any time after mixing provided that it is still workable, due account being taken of the compacting method used.

Mechanical compaction methods should be used where appropriate to ensure thorough compaction of the concrete. Transport and placing methods should be used which minimise segregation of the concrete and do not damage or displace formwork or reinforcement.

Formwork
Formwork should be erected to tolerances appropriate for the required degree of accuracy of the completed structure and be strong enough to support the pressure and weight of fresh concrete and any other loads without distortion, deflection or grout leakage.

Formwork should be designed and fabricated so as to be easily struck without causing damage to the concrete.

Reinforcement
Reinforcement should be designed and fixed in the detailed positions with the designed minimum cover. Reinforcement should be securely tied together and using spacers and chairs so as to allow normal concreting methods to be used without displacement of the reinforcement.

Reinforcement should be cleaned of all loose rust, grease and dirt prior to concreting.

Daywork joints in concrete members
Any daywork joints in concrete members should be located at suitable positions to suit design requirements. Generally, daywork joints, if required in continuous slabs and beams, should be located at approximately one-quarter points of their span.

Cold weather working
Special precautions should be taken if concreting work is to be carried out when the air temperature is below 2°C or when the overnight temperature is likely to fall below 0°C. The concrete temperature should be prevented from falling below 5°C for several days after placing. Freshly placed concrete and screed mortar should be protected from freezing wind by covering with insulating mats, tarpaulins or other sheeting.

Heated concrete may be supplied and used in cold weather conditions. Mixing water should not be heated to more than 80°C.

Application	Standard Mix	Designated Mix	Compressive strength @ 28 days N/mm² (MPa)	Suggested workability slump (mm)	Suggested method of compaction
Floors					
House floors with no embedded metal					
permanent finish to be added e.g. screed	ST2	GEN I	10.0	75	Poker or beam vibration and/or tamping
no permanent finish to be added e.g. carpeted	ST3	GEN 2	15.0	75	
Garage floors with no embedded metal	ST4	GEN 3	20.0	75	
Other reinforced and prestressed concrete applications					
Reinforced or prestressed concrete: mild exposure	N/A	RC 30	30.0	75	Poker
Reinforced or prestressed concrete: moderate exposure	N/A	RC 35	35.0	75	Poker

Definitions

Standard Mix (ST)	Designated Mix (GEN, FND, RC, PAV)
A standard mix is a concrete designed using the materials and mix proportions given in BS 5328:1.4 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.	Designated mixes are designed and specified in accordance with BS 5328:1.5. It is a quality controlled mix, produced under BS EN ISO 9001 conditions. The purchaser orders the mix by specifying its required strength and is intended use i.e. RC to be used for reinforced concrete and GEN for general usage.

Table 2.29: Selection guide to the use and specification of Standard and Designated concrete mixes

Admixtures

Admixtures should be used only when approved by the designer and then only in accordance with the manufacturer's recommendations.

Curing

Concrete should be continuously cured for at least 7 days.

Curing should be carried out by:

- either closely and completely covering the concrete with impermeable plastic sheeting, or
- applying a complete coating of a proprietary liquid curing membrane material, provided that this will not affect subsequent coatings or applied materials, or
- covering the concrete with hessian or other absorbent sheeting which should be kept continuously wet.

Concrete containing pulverised fuel ash or ground blast furnace slag cement replacement achieves its strength over a longer period than ordinary cements, particularly in cold weather. When these materials are used, an extended period of curing should be carried out in accordance with the cement manufacturer's instructions.

Sampling, testing and production of concrete

Sampling and testing of fresh or hardened concrete should be carried out in accordance with BS EN 12350 or as otherwise allowed in BS 5328.

Precast Beam and Block floors

Ensure that PC beam and block floors possess current independent third party certificates acceptable to Q or equivalent and are:

- Fully supported by loadbearing walls
- Laid as specified by the designer and independent third party certificates acceptable to Q

NB. similar beams of the same size may have varying strength characteristics because of different size of reinforcement, therefore it is important to check beam reference numbers and their layout. Also, it is sometimes necessary to provide two or more beams adjacent to each other where spans are excessive or in heavily loaded areas.

Ensure that:
- 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 formwork between PC joists and filling with good quality concrete (ST2 mix) prior to screeding

Beams should bear onto masonry minimum 90mm and steelwork minimum 70mm. Restraint straps should be provided to walls where the beams run parallel (see diagram 2.149).

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

Non-traditional construction
Non-traditional or proprietary forms of floor construction may be used if independent third party certificates acceptable to Q are available, or subject to satisfactory appraisal by Q.

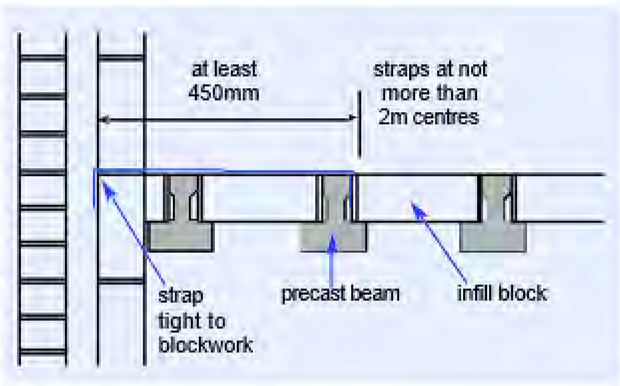


Diagram 2.149: Restraint staps
(Note: mechanical fixing required or turn down block.
If over 3 storeys refer to BS5328)

Sound Insulation

General

To achieve a standard of construction that is considered to be acceptable two different routes are available:

- The use of the guidance given within Approved Document E of the Building Regulations. This route requires the use of Pre-completion testing.
- The use of Robust Details

Pre Completion Testing

Pre Completion Testing (PCT) is required in the following circumstances:

- To all new build domestic properties (including rooms for residential purposes), unless the developer has registered and built in accordance with Robust Standard Details. (See below)
- Where the sound insulation construction is in accordance with the guidance given in Approved Document E of the Building Regulations.
- Where the building is not built in accordance with the Approved Document E of the Building Regulations.
- The requirements of the Robust Details system have not been met.
- Sound testing is required in conversions, for more guidance see the following section.
- The building is considered as an historic building or within a conservation area (also see this section)

Where pre completion testing is carried out the construction needs to achieve the sound levels as specified in Tables 2.30 & 2.31.

Only a test body with appropriate third party accreditation can carry out testing. Such bodies should have either UKAS accreditation or be members of the ANC registration scheme.

www.associationofnoiseconsultants.co.uk
Tel: 01763 852958
Fax: 01763 853252
E-mail: mail@anc

www.ukas.org/testing
Tel: 020 8917 8400
E-mail: info@ukas.com

The extent of pre completion testing should be agreed with your Q surveyor to ensure an adequate number of tests are carried out. Guidance on the extent and number of tests is provided on pages 12-14 of Approved Document E of the Building Regulations. Please note you must also contact the Building Control Officer to discuss this. In certain cases Q may require more or additional tests than Building Control.

We will require that you supply a copy of the sound tests confirming compliance with Table 1a & 1b of Approved Document E of the Building Regulations prior to any completion/insurance certificate being authorised by Q.

Note in the event of a failed set of tests appropriate remedial treatment should be applied to the rooms that failed the test. A failed set of tests raises the questions over the sound insulation between rooms sharing the same separating element. The developer should demonstrate that these rooms meet the performance standards. Normally this would be done by additional testing, and/or applying the appropriate remedial treatment to the other rooms and/or demonstrating that the cause of failure does not occur in other rooms.

Q must be consulted in order to agree the test regime in addition to the Building Control body.

Robust Details
The use of robust details as a means of providing adequate sound insulation applies only to party walls and floors between different dwellings or flats. It is approved by Robust Details Ltd.

The robust design details are available in a handbook, which may be purchased from:

Robust Details Ltd.
PO Box 7289
Milton Keynes
Bucks MK14 6ZQ
Tel 0870 240 8210.
www.robustdetails.com

Robust Details Ltd will undertake monitoring to check on performance achieved in practice.

Their use in building work is NOT authorised unless the builder has registered the particular use of the relevant design details with Robust Details Ltd. (RSD) and obtained a unique number or numbers from the company. Each unique number identifies a house or flat in which one or more of the design details are being used.

Where the use of Robust Details is proposed then the Building Control Authority must be notified before the start of building work on the site.

Where inadequate notice is given or the work is not carried out in accordance with the design details then the relevant structures become subject to Pre-Completion testing.

All RSD's will have a checklist, which the builder must sign off for the Building Control Authority. A Compliance Certificate must also be completed. The builder must complete the RSD checklist as work proceeds on the party floors/walls. A checklist is required for each party floor/wall which is registered with RSD. Failure to complete these could result in Q asking for PCT to show compliance.

Approved Document E aims to ensure that the construction of a dwelling should be such that the noise from normal domestic activities in an adjoining dwelling, within a dwelling or other building is kept down to a level that will not threaten the health of the occupants of the dwelling and will allow them to sleep, rest and engage in normal domestic activities in satisfactory conditions.

This applies to houses and flats, residential hostels, boarding houses, halls of residence and residential homes. Schools are also included.

The areas of construction which the standards cover are:
- All separating walls and floors including between non-habitable areas and common areas
- Within dwellings between walls to bedrooms or a room containing a WC and any other room and to all internal floors (see following section)

Early consideration of the design/layout of the dwelling/building is important, particularly
- Wherever possible avoid having rooms of dis-similar uses on either side of a separating wall
- Steps and staggers between dwellings can improve sound insulation
- Avoid placing mechanical equipment such as cooker hoods, boilers and pumps directly onto separating walls. Where this is unavoidable fix such equipment on acoustic mountings
- Movement joints should not be built into separating walls
- Services should not be chased into separating walls
- Quality control on levels of workmanship should be maintained throughout the build

Where a suspended ceiling is continuous over adjoining rooms, provision should be made to maintain an adequate degree of sound insulation between WC's and other parts of a dwelling.

Wall ties
Suitable wall ties for use in masonry cavity walls are either type A or B. Type B should only be used in external masonry cavity walls where type A does not satisfy the requirements of Building Regulation Part A - Structure.

Corridor walls and doors
Doors between corridors and rooms in flats should have good perimeter sealing and a minimum mass of 25kg/m² or a minimum sound reduction index of 29dB Rw.

Refuse chutes
A wall separating a habitable room or kitchen and a refuse chute should have a mass of at least 1320kg/m². Walls separating a non-habitable room from a refuse chute should have a mass of at least 220kg/m².

Using the Approved Document Route

The following performance standards have been given.

	Airborne sound insulation sound insulation $D_{nT,w} + C_{tr}$ dB (Minimum values)	Impact sound insulation $L'_{nT,w}$ dB (Maximum values)
Purpose built dwelling-houses and flats		
Walls	45	-
Floors and stairs	45	62
Dwelling-houses and flats formed by material change of use		
Walls	43	-
Floors and stairs	43	64

Table 2.30: Dwelling-houses and flats – performance standards for separating walls, separating floors, and stairs that have a separating function

	Airborne sound insulation sound insulation $D_{nT,w} + C_{tr}$ dB (Minimum values)	Impact sound insulation $L'_{nT,w}$ dB (Maximum values)
Purpose built rooms for residential purposes		
Walls	43	-
Floors and stairs	45	62
Rooms for residential purposes formed by material change of use		
Walls	43	-
Floors and stairs	43	64

Table 2.31: Rooms for residential purposes – performance standards for separating walls, separating floors, and stairs that have a separating function

Separating Walls

The following construction details are ways of achieving adequate standards. The list is not exhaustive and other designs, materials or products may be suitable. Advice should be sought from the manufacturer or other appropriate expert. The walls are grouped into four main types. (See Diagram 2.150).

Wall type 1: Solid masonry
The resistance to airborne sound depends mainly on the mass per unit area of the wall.

Wall type 2: Cavity masonry
The resistance to airborne sound depends on the mass per unit area of the leaves and on the degree of isolation achieved. The isolation is affected by connections (such as wall ties and foundations) between the wall leaves and by the cavity width.

Wall type 3: Masonry between independent panels
The resistance to airborne sound depends partly on the type and mass per unit area of the core, and partly on the isolation and mass per unit area of the independent panels.

Wall type 4: Framed walls with absorbent material
The resistance to airborne sound depends on the mass per unit area of the leaves, the isolation of the frames, and the absorption in the cavity between the frames.

Junctions between separating walls and other building elements

In order for the construction to be fully effective, care should be taken to correctly detail the junctions between the separating wall and other elements, such as floors, roofs, external walls and internal walls. Recommendations are also given for the construction of these elements, where it is necessary to control flanking transmission.

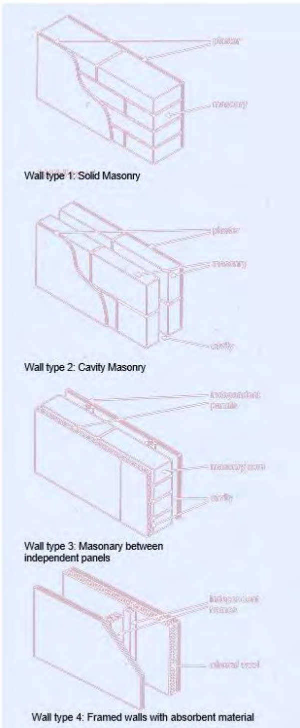


Diagram 2.150: Types of separating wall

Separating Walls (Junctions)

Table 2.32 indicates the availability of guidance on the junctions that may occur between each of the four separating wall types and various attached building elements.

Building element attached to separating wall	Separating wall type Type 1	Type 2	Type 3	Type 4
External cavity wall with masonry inner leaf	GGGN			
External cavity wall with timber frame inner leaf	GGGG			
External solid masonry wall	NNNN			
Internal wall – framed	GGGG			
Internal walls – masonry	G	G	X	G
Internal floor – timber	GGGG			
Internal floor – concrete	GGGN			
Ground floor – timber	GGGG			
e	GGGG			
Ceiling and roof space	GGGG			
For flats the following may also apply: Separating floor type 1 – concrete base with ceiling and soft floor covering Separating floor type 2 – concrete base with ceiling and floating floor Separating floor type 3 – timber frame base with ceiling and platform floor	See Guidance in Section 3 of Approved Document E, Separating floors and associated flanking construction for new buildings			
Key: G = guidance available; N = no guidance available (seek specialist advice); X = do not build				
Note: Where any building element functions as a separating element (e.g. a ground floor that is also a separating floor for a basement flat) then the separating element requirements should take precedence.				

Table 2.32: Separating wall junctions reference table

		Weight Kg/m2						
Manufacturer	Plasterboard Type	6.0mm	9.5mm	12.5mm	15mm	19mm	25mm	Remarks
British Gypsum	Gyproc WallBoard		6.5 Kg/m2	8 Kg/m2	9.8 Kg/m2			
	Gyproc WallBoard Duplex		6.5 Kg/m2	8 Kg/m2	9.8 Kg/m2			With vapour barrier
	Gyproc Plank					14.5 Kg/m2		
	Gyproc HandiBoard		6.5 Kg/m2	8 Kg/m2				Ivory face
	Gyproc HandiBoard Duplex		6.5 Kg/m2	8 Kg/m2				With vapour barrier
	Gyproc FireLine			9.5 Kg/m2	11.5 Kg/m2			Pink coloured
	Gyproc FireLine Duplex			9.5 Kg/m2				Pink coloured /vapour barrier
	Gyproc FireLine MR			9.5 Kg/m2	11.5 Kg/m2			Pink coloured / black bar marks
	Glasroc MultiBoard	6 Kg/m2	8.5Kg/m2(10mm)	10.63 Kg/m2				Glass reinforced
	Gyproc Moisture Resistant			8.5 Kg/m2	10 kg/m2			Green face
	Gyproc SoundBloc			10.5 Kg/m2	12.5 Kg/m2			Pale blue
	Gyproc SoundBloc MR			10.5 Kg/m2	12.5 Kg/m2			Pale blue but water repellant
	Gyproc SoundBloc RAPID			10.5 Kg/m2	12.5 Kg/m2			
	Gyproc SoundBloc RAPID MR				12.5 Kg/m2			
	Gyproc DuraLine			11.5Kg/m2(13mm)				
Knauf	Wallboard		6.2 Kg/m2	8.3 kg/m2	10.2 kg/m2			Ivory face
	Baseboard		6.2 Kg/m2					Grey face
	Plank					13.2 Kg/m2		Ivory face
	Vapourshield		6.2 Kg/m2	8.3 kg/m2	10.2 kg/m2			Ivory face / foil back
	Vapourshield baseboard		6.2 Kg/m2					Grey face / foil back
	Fireshield			9 Kg/m2	10.7 kg/m2			Pink face
	Moistureshield			10 Kg/m2				Green face
	Sound Moistureshield			12 kg/m2	13.8 kg/m2			Blue face
	Fire Moistureshield			10 Kg/m2	12 kg/m2			Green face
	Denseshield			11.6 kg/m2	13.9 kg/m2			Mustard face
	Soundshield			12 kg/m2	13.8 kg/m2			Blue face
	Coreboard					16 kg/m2		Green face
Lafarge	Standard wallboard		6.3 Kg/m2	8.0 Kg/m2	10 Kg/m2	14 Kg/m2		Ivory face
	E-Check			10 kg/m2				Sky blue
	Baseboard and lath		6.0 Kg/m2	7.8 Kg/m2				Grey faces
	Moisturecheck			8.0 Kg/m2	10 kg/m2			Green
	Firecheck			10.2 Kg/m2	12.3 Kg/m2			Pink
	Megodeco			11 kg/m2	13 kg/m2			White
	Toughcheck			13 Kg/m2				Mustard
	MR Firecheck			10.2 Kg/m2	12.3 Kg/m2			Pink / Green
	dBcheck			11 kg/m2	13 kg/m2			Blue
	MR dBcheck			11 kg/m2	13 kg/m2			Blue
	Coreboard						21 Kg/m2	Green
	Contour	5.4 Kg/m2						Ivory

Table 2.33: Plasterboard weights

Wall Type	Coursing Height (mm)	Width excuding finishes (mm)	Min Mass required kg/m^2	Finishes	Material (density) kg/m^3	Cavity (mm)
1.1	110	215 block	415 * laid flat	A	1840	No
1.2	N/a	190	415*	A	2200	No
1.3	75	215	375*	A	1610	No

* including finishes to both sides
A 13mm lightweight plaster (minimum mass per unit area $10kg/m^2$

Table 2.34: Junction requirements for Wall type 1

Table 2.33 gives guidance on plasterboard weights. The information on plasterboards is correct as at 21 July 2003 but it is the user's responsibility to ensure it remains current prior to use. Approved Document E generally requires $10kg/m^2$ per layer.

Table 2.34 indicates the junction requirements for Wall type 1.

Junctions with an external cavity wall with masonry inner leaf
Where the external wall is a cavity wall:
a) the outer leaf of the wall may be of any construction, and
b) the cavity should be stopped with a flexible closer (See Diagram 2.151) unless the cavity is fully filled with mineral wool or expanded polystyrene beads (seek manufacturer's advice for other suitable materials).

The separating wall should be joined to the inner leaf of the external cavity wall by one of the following methods:
a) Bonded. The separating wall should be bonded to the external wall in such a way that the separating wall contributes at least 50% of the bond at the junction. (See Diagram 2.152).
b) Tied. The external wall should abut the separating wall and be tied to it. (See Diagram 2.153).

The masonry inner leaf should have a mass per unit area of at least 120 kg/m^2 excluding finish. However, there is no minimum mass requirement where there are openings in the external wall see Diagram 2.154 that are:
a) not less than 1 metre high, and
b) on both sides of the separating wall at every storey, and
c) not more than 700mm from the face of the separating wall on both sides.

Where there is also a separating floor then the requirement for a minimum mass per unit area of 120 kg/m^2 excluding finish should always apply, irrespective of the presence or absence of openings.

Wall Type	Coursing Height (mm)	Width excuding finishes (mm)	Min Mass required kg/m^2	Finishes	Material (density) kg/m^3	Cavity (mm)
1.1	110	215 block	415 * laid flat	A	1840	No
1.2	N/a	190	415*	A	2200	No
1.3	75	215	375*	A	1610	No

* including finishes to both sides
A 13mm lightweight plaster (minimum mass per unit area $10kg/m^2$

Table 2.34: Junction requirements for Wall type 1

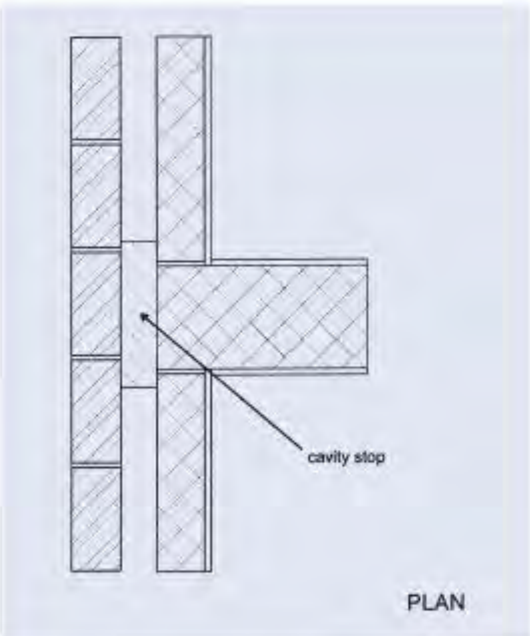


Diagram 2.151: Wall type 1 – external cavity wall with masonry inner leaf

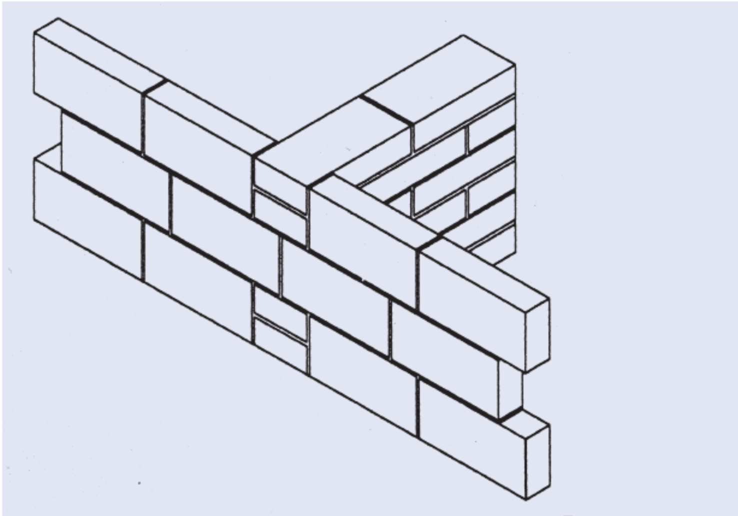


Diagram 2.152: Wall type 1 - bonded junction - masonry inner leaf of external cavity wall with solid separating wall

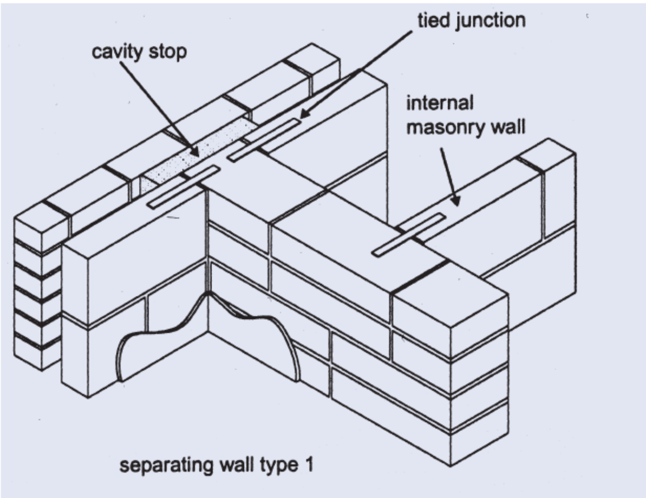


Diagram 2.153: Wall type 1 - tied junction - external cavity wall with internal masonry wall

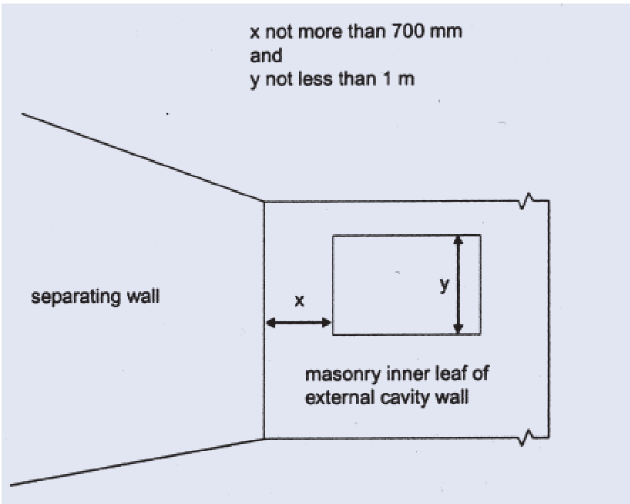


Diagram 2.154: Wall type 1 - position of openings in masonry inner leaf of external cavity wall

Junctions with an external cavity wall with timber frame inner leaf

Where the external wall is a cavity wall:

(a) the outer leaf of the wall may be of any construction, and
(b) the cavity should be stopped with a flexible closer. (See Diagram 2.155).

Where the inner leaf of an external cavity wall is of framed construction, the framed inner leaf should:

(a) abut the separating wall, and
(b) be tied to it with ties at no more than 300 mm centres vertically.

The wall finish of the framed inner leaf of the external wall should be:

(a) one layer of plasterboard, or
(b) two layers of plasterboard where there is a separating floor
(c) each sheet of plasterboard to be of minimum mass per unit area 10 kg/m2, see table 2.33 on page 232.
(d) all joints should be sealed with tape or caulked with sealant.

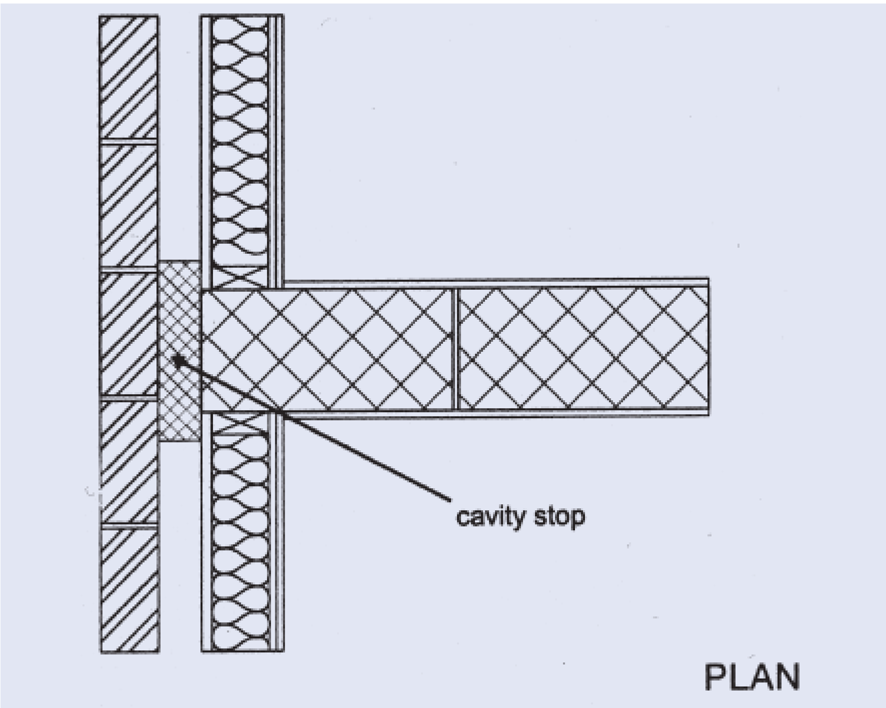


Diagram 2.155: Wall type 1 - junction between an external cavity wall and timber frame inner leaf

Junctions with an external solid masonry wall
No guidance available (seek specialist advice).

Junctions with internal framed walls
There are no restrictions on internal framed walls meeting a type 1 separating wall.

Junctions with internal masonry walls
Internal masonry walls that abut a type 1 separating wall should have a mass per unit area of at least 120 kg/m² excluding finish.

Junctions with internal timber floors
If the floor joists are to be supported on a type 1 separating wall then they should be supported on hangers and should not be built in. (See Diagram 2.156).

Junctions with internal concrete floors
An internal concrete floor slab may only be carried through a type 1 separating wall if the floor base has a mass per unit area of at least 365 kg/m² (See Diagram 2.157).

Internal hollow-core concrete plank floors and concrete beams with infilling block floors should not be continuous through a type 1 separating wall.

For internal floors of concrete beams with infilling blocks, avoid beams built in to the separating wall unless the blocks in the floor fill the space between the beams where they penetrate the wall.

Junctions with timber ground floors
If the floor joists are to be supported on a type 1 separating wall then they should be supported on hangers and should not be built in.

Junctions with concrete ground floors
The ground floor may be a solid slab, laid on the ground, or a suspended concrete floor. A concrete slab floor on the ground may be continuous under a type 1 separating wall (See Diagram 2.158).

A suspended concrete floor may only pass under a type 1 separating wall if the floor has a mass of at least 365 kg/m².

Hollow core concrete plank and concrete beams with infilling block floors should not be continuous under a type 1 separating wall.

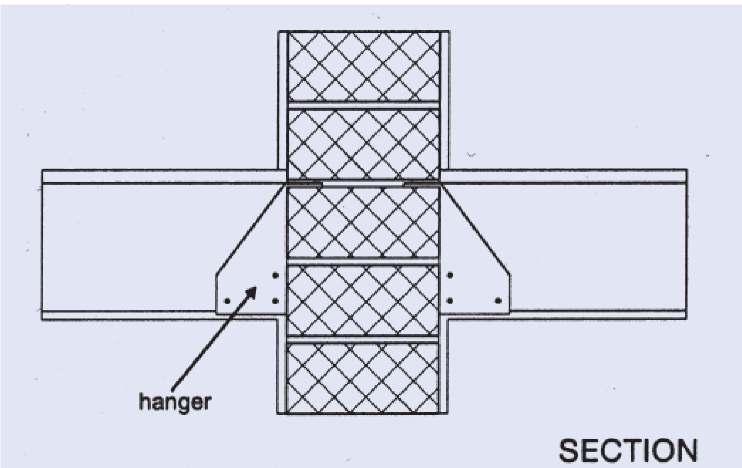


Diagram 2.156: Wall type 1 – Internal timber floor

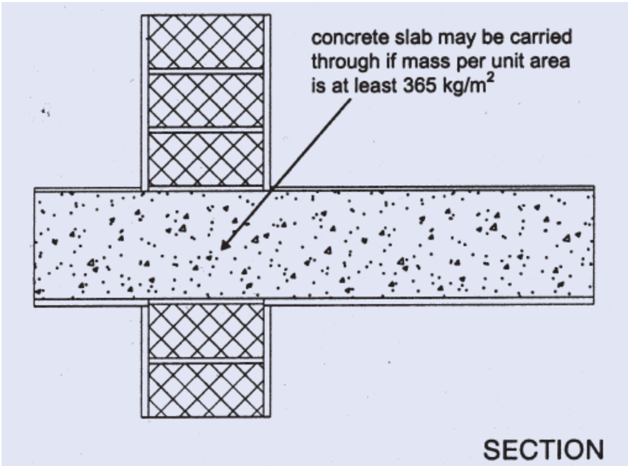


Diagram 2.157: Wall type 1 – Internal concrete floor

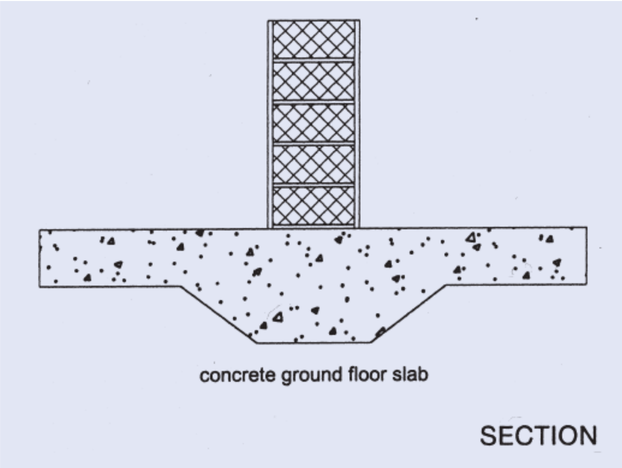


Diagram 2.158: Wall type 1 – Concrete ground floor

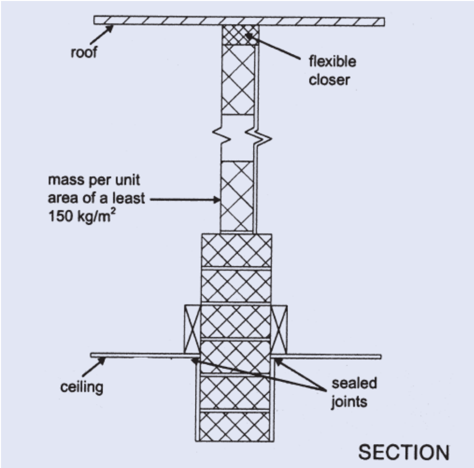


Diagram 2.159: Wall type 1 – Ceiling and roof junction

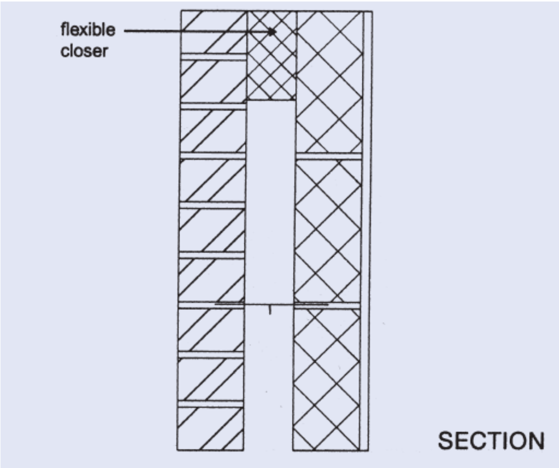


Diagram 2.160: External cavity wall at eaves level

Junctions with ceiling and roof

Where a type 1 separating wall is used it should be continuous to the underside of the roof.

The junction between the separating wall and the roof should be filled with a flexible closer which is also suitable as a fire stop (See Diagram 2.159).

Where the roof or loft space is not a habitable room and there is a ceiling with a minimum mass per unit area of 10kg/m² with sealed joints, then the mass per unit area of the separating wall above the ceiling may be reduced to 150 kg/m² (See Diagram 2.159).

If lightweight aggregate blocks of density less than 1200 kg/m² are used above ceiling level, then one side should be sealed with cement paint or plaster skim.

Where there is an external cavity wall, the cavity should be closed at eaves level with a suitable flexible material (e.g. mineral wool) (See Diagram 2.160).

Note: A rigid connection between the inner and external wall leaves should be avoided. If a rigid material is used, then it should only be rigidly bonded to one leaf. See BRE BR 262, Thermal Insulation: avoiding risks, section 2.3.

Junctions with separating floors

There are important details in Section 3 of Approved Document E concerning junctions between wall type 1 and separating floors.

Wall Type	Coursing Height (mm)	Width excuding finishes (mm)	Min Mass required kg/m^2	Finishes	Material (density) kg/m^3	Cavity (mm)
2.1	225	250	415 *	A	1990	50
2.2	225	275	300*	A	1375	75
2.3**	225	275	290*	B	1350 -1600	75

* including finishes to both sides
** Only acceptable where there is a step and/or stagger of at least 300mm
A 13mm lightweight plaster (minimum mass per unit area $10kg/m^2$)
B plasterboard, minimum mass per unit area of $10kg/m^2$ to both sides

Table 2.35: Junction requirements for Wall type 2

Wall Type	Coursing Height (mm)	Width excuding finishes (mm)	Min Mass required kg/m_2		Finishes	Material (density) kg/m_3
3.1	110	140	300*	C	2200	50
3.2	225	140	150*	C	1400	50
3.3**	225	250	Any	C	1350 -1600	50

* of core only
** Recommended cavity widths are minimum values
** Core width only. The minimum core width is determined by structural requirements.
C independent panels, each panel of mass per unit area $20kg/m^2$, to be two sheets of plasterboard with staggered joints

Table 2.36: Junction requirements for Wall type 3

Detailing

Gas Flue Blocks in Separating Walls

Gas flue blocks must be positioned within separating walls so as not to reduce the effectiveness of the sound reduction factor across the wall.

Attention must be paid to the minimum cavity width of the wall and the density of the blockwork. (See diagrams 2.161 and 2.162) Note. Where this minimum cavity width cannot be maintained, the cavity must include a proprietary cavity slab between the back to back flue liners.

The flue blocks must be installed on a suitable bedding compound, care must be taken to ensure all perpend joints are fully filled with mortar.

Back to back services in separating walls should be avoided. In particular, switches, socket outlets and chasing installed in blockwork and holes cut in plasterboard separating walls need particular attention to detail in order to avoid problems associated with sound transmission. The detail below indicates guidance for sockets and switches in timber frame separating walls.

Holes in ceilings

Downlighters and other flush fitting attachments should not be installed through a ceiling if the ceiling is providing part of the required, necessary sound insulation or fire resistant properties to the dwelling. An additional suspended ceiling, light box or proprietary fittings must be installed to maintain the integrity of the ceiling construction.

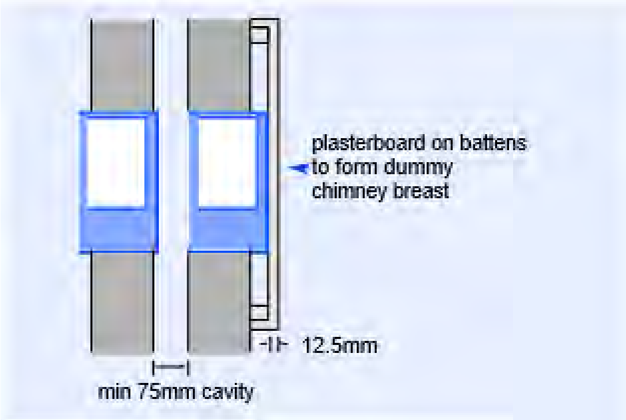
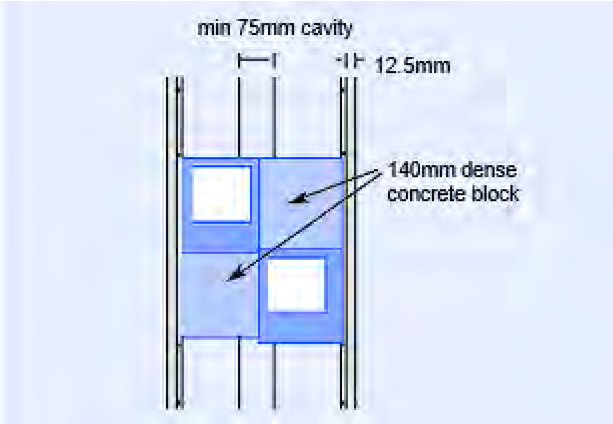


Diagram 2.161: Gas flue blocks in separating walls



2.162: Gas flue blocks in separating walls

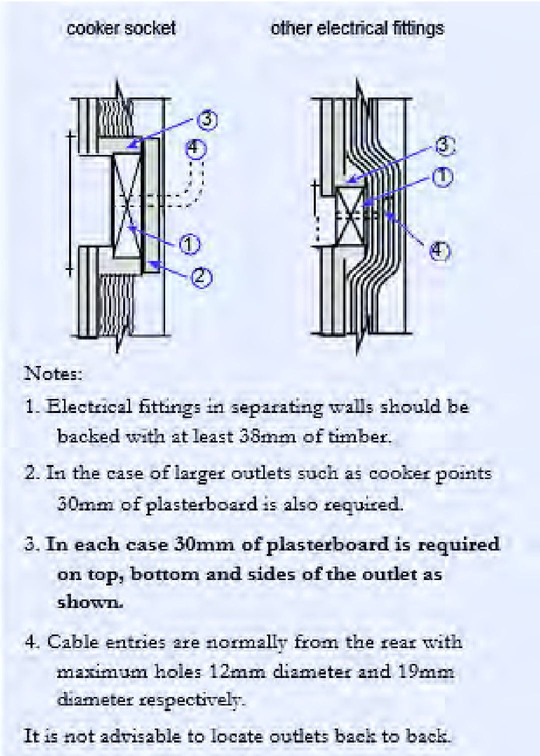


Diagram 2.163: Electrical fittings in timber frame walls

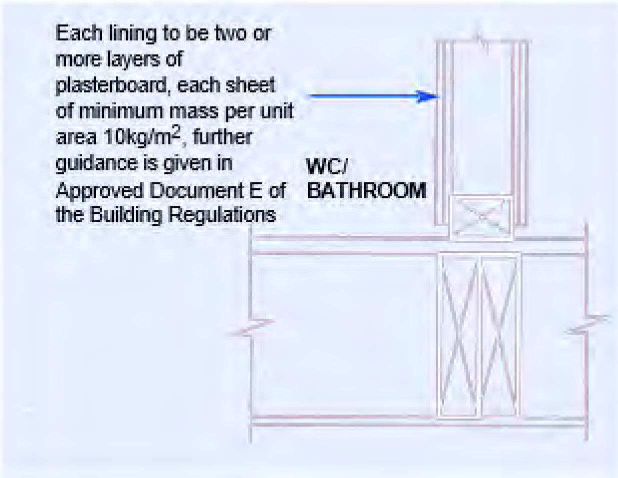


Diagram 2.164: Sound insulation of partitions

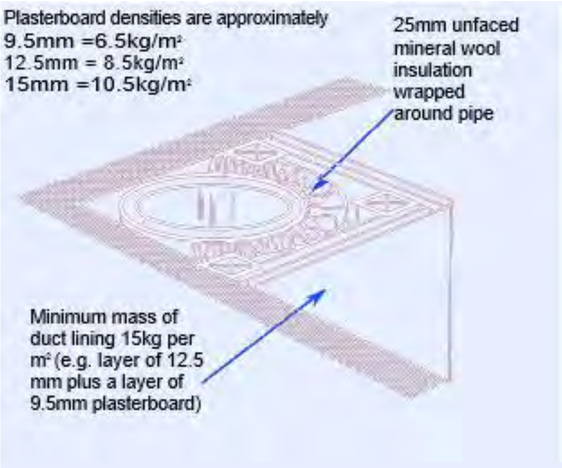


Diagram 2.165: Sound insulation of service ducts

Partitions

To improve modern living standards there is a requirement to provide protection against sound within dwellings. It is good practice to consider the layout of rooms at an early design stage to avoid placing noise sensitive rooms next to rooms which tend to generate noise. (See diagram 2.164).

This applies to:

- Internal walls between a bedroom and another room
- Internal walls between a room containing a WC and another room (NOT including the wall between an en-suite WC and its associated bedroom)
- Internal floors
- The requirement does not apply to an internal wall which contains a door.

Information is also given on data for the more common materials available. This information is based on manufacturers' literature. Material and specifications alter continuously so you should confirm that the product proposed meets the requisite performance.

Ducts

Provide adequate sound insulation to ducts around soil and waste pipes penetrating separating floors within all rooms of the dwelling (See diagram 2.165):

- The material of the enclosure should have a mass of at least 15 kg/m².
- The enclosure should be lined or wrap the duct with a minimum of 25mm unfaced mineral wool.
- Leave a nominal gap between the enclosure and floor and seal with acrylic caulking or neoprene.

Adequate sound insulation should be provided to soil and waste pipes not penetrating separating floors but still situated within rooms of the dwelling.

Penetrations through a separating floor by ducts and pipes should have fire protection in accordance with Approved Document B (Technical Standard for Scotland: Part D). The fire stopping should be flexible and prevent rigid contact between the pipe and the floor.

Gas Safety Regulations require ventilation for ducts at each floor containing gas pipes. Gas pipes may be contained in a separate ventilated duct or they can remain unducted.

Pitched Roofs

General Requirements for Timber Pitched Roofs

Statutory Requirements
All structural timber used in a conventional cut roof (i.e. rafters, purlins, ceiling joists, binders and other timber elements) should be stress graded. All such timber must be either stamped as ‘DRY’ or 'KD' (Kiln Dry).

The use of ungraded or “green” timber is not acceptable.

Allowances for Wind Loading
The need for a roof to withstand wind pressure and suction will be met if the proposed roof is braced effectively as discussed elsewhere in this Manual and secured to the structure as detailed below with walls adequately restrained.

Securing of Roofs to the Supporting Structure
Roof timbers are normally supported on a timber wall plate or similar which should be levelled using a spirit level so that loadings from the roof are directed perpendicularly down the supporting wall. The wall plate may as good practice, be fixed to ensure correct positioning when roof timbers or trusses are being installed, by means of galvanised mild steel holding down straps (30mm x 5mm x 1000mm long at maximum 2.0 metres centres) nailed to the wall plate and securely fixed to the inner surface of the wall with compatible fixings. Ensure that holding down straps are provided in areas of severe wind exposure where required by the roof design.

Treatment of Timber
Preservative treatment of roof timbers is normally unnecessary except where specifically required under relevant standards and codes of practice, and in the following circumstances:

- Roof timbers should be preservative treated where the insulation and ceiling line follow the roof pitch (See diagram 2.166)
- The Approved Document of Regulation 7 of the Building Regulations for England and Wales requires that in certain geographical areas, all softwood roof timbers should be treated against attack by the House Longhorn Beetle. The areas at risk are:
- The District of Bracknell Forest
- The Borough of Elmbridge
- The Borough of Guildford (other than the area of the former borough of Guildford)
- The District of Hart (other than the area of the former urban district of Fleet)
- The District of Runnymede
- The Borough of Spelthorne
- The Borough of Surrey Heath
- In the Borough of Rushmoor, the area of the former district of Farnborough
- The District of Waverley (other than the parishes of Godalming and Haslemere)
- In the Royal Borough of Windsor and Maidenhead, the parishes of Old Windsor, Sunningdale and Sunninghill
- The Borough of Woking

The treatment should be impregnation with a preservative suitable for use in hazard class 2 in accordance with BS8417, or equivalent, for a 60 year anticipated service life. Cut ends must be liberally brushed or dipped with an end-grain preservative. It is strongly recommended that where punched metal fasteners are proposed to roof trusses, only micro-emulsion or organic solvent preservatives should be used for timber treatment to limit the possibility of corrosion of the fasteners and so as not to adversely affect glued joints.

Trussed Rafter Roofs

Information and design criteria necessary for ordering BS 5268:3 provides a comprehensive list of criteria that should be supplied by the building designer or site supervisor to the trussed rafter designer/fabricator to enable a design to be prepared. This includes:

- Span of the trussed rafter, wall plate to wall plate plus the width of wall plate at each end
- Pitch of the roof
- Method of support
- Position of support
- Anticipated loading of the roof structure, i.e. the weight of the roof tiles and the exposure of the site should it attract excessive wind loads (See diagram 2.174)
- Position and size of water tanks
- Position and size of openings (i.e. loft hatches, roof windows, chimneys)
- Due to the site locality, any particular preservative treatment necessary for the timber (e.g. to protect against House Longhorn Beetle)
- Eaves details (i.e. overhang required, etc.) (See diagram 2.166).

In return the trussed rafter designer should supply the following details for site use:

- Position, bearing and spacing of trussed rafters
- Position, fixings and sizes of lateral supports to prevent buckling of compression members such as rafters and struts
- Deviations from standard spacings, etc. to accommodate openings
- Support details for water tanks
- Any special handling equipment.

Site storage
The delivery of trussed rafters should be planned so as to minimise the period of storage necessary on site.

When delivered, the trusses should, at all times, be kept clear of the ground and vegetation and be supported by level bearers sited under or adjacent to the points of support assumed by the design.

Ensure that, to prevent any distortion, the trusses are stored in a vertical position as in diagram 2.167.

Horizontal storage is sometimes possible as in diagram 2.168. In both cases stacks of trusses should be covered with a weatherproof cover, whilst maintaining adequate ventilation to prevent the occurrence of condensation. Trusses should be checked visually upon arrival at site for damage occurring during transportation and again before site use to check for damage occurring during storage. Trusses where moisture content exceeds 20% should not be installed.

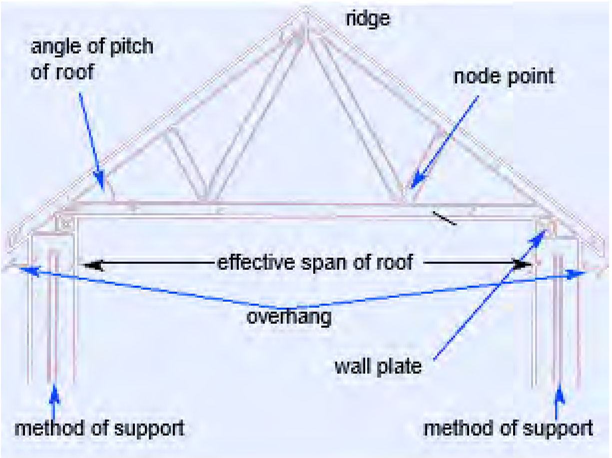


Diagram 2.166: Explanation of terms

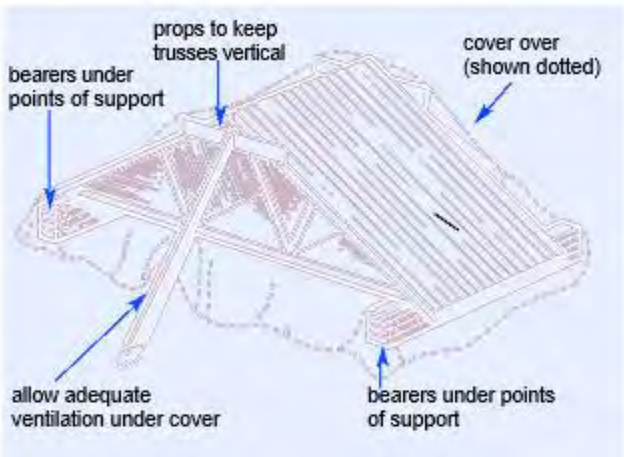


Diagram 2.167: Truss storage

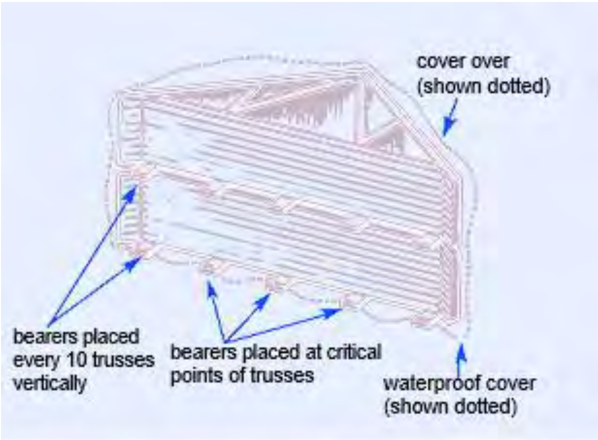


Diagram 2.168: Truss Storage

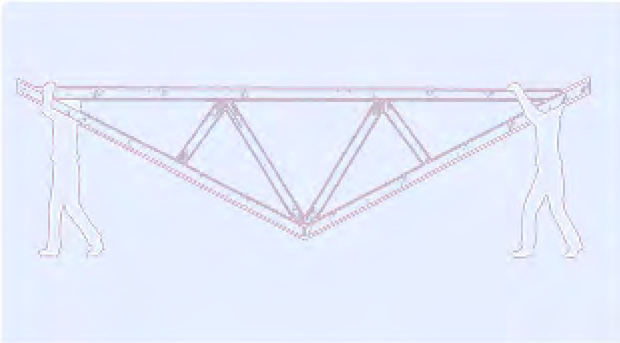


Diagram 2.169: manual lifting

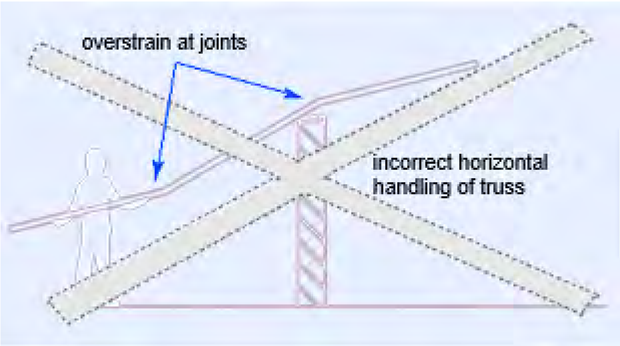


Diagram 2.170: Incrorect manual lifting

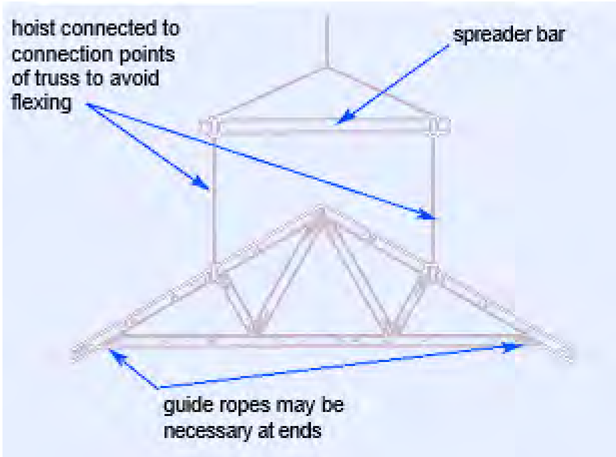


Diagram 2.171: Mechanical handling

Handling and transportation
When transporting and handling trussed rafters, sagging and flexing should be avoided at all times. Whether handling is manual or by using mechanical equipment, trusses should be moved in a vertical position unless support can be provided to every joint.

Manual lifting
On long span trusses it may be necessary to employ additional labour at intermediate positions. If required the truss may be inverted so that the apex hangs down (See diagram 2.169).

See-sawing the truss across walls and scaffolding must be avoided (See diagram 2.170). Individual designs and site conditions may dictate different requirements in order to install trusses in their final position.

Mechanical lifting
Ideally where mechanical lifting is used, the trusses should be lifted in banded sets and lowered onto suitable supports. Lifting points should be rafter or ceiling intersections or node points (See diagram 2.171).

Lifting trusses singly should be avoided but where unavoidable a suitable spreader bar should be used to withstand the sling force (See diagram 2.171).

Erection

It is essential when erecting a trussed rafter roof to ensure that the first trussed rafter is erected and braced rigidly in the correct vertical position so that it provides a base model against which all the other trusses can be set out (See diagram 2.172).

Any temporary bracing should not be removed until permanent bracing has been installed. Immediately prior to the fixing of permanent bracing the trussed rafters should be checked again for alignment and verticality.

Procedure for erection using diagram 2.172:

- Before placing first truss, mark required position of trussed rafters on opposing wall plates
- Erect and brace first trussed rafter (A), using brace B as temporary support (only one shown but fix others as necessary)
- Erect next adjacent trussed rafter (C) and brace back to A using brace D
- Erect other trussed rafters as with (C)
- When the final accurate positioning of the trussed rafters has been confirmed, the rafter feet can be fixed in position (See diagram 2.173)
- Fix permanent diagonal bracing (E) (only one brace shown for clarity)
- Fix longitudinal bracing (F). (Only 3 shown for clarity)
- Fix all remaining bracing (see following section)
- Remove all temporary bracing.

The International Truss Plate Association Technical Handbook, available from trussed rafter suppliers, provides additional advice on trussed rafter erection.

Bracing to duo-pitched roofs
This deals with duo-pitched (double pitched) trusses.

Fixing
To achieve a stable and wind resistant roof and gable wall structure, the roof must be secured to the gable wall, if applicable, and fully braced by 100 x 25mm timber twice nailed to roof timbers using 65mm long, 3.35mm diameter galvanised wire nails. Where nail guns are used 3.1mm x 75mm long annular ring-shank nails are allowed. They do not need to be galvanised.

Limitations
The details given relate to standard bracing for trussed rafters.

They do not apply in the following circumstances, when advice from the roof designer should be sought:

- When the height of the building exceeds 8.4 metres to plate level (3 storeys) or where the building is in a particularly exposed position such as open land in exposed areas (e.g. West Coast of Scotland etc.)
- When the building is non-rectangular in shape
- When the trussed rafter spacing exceeds 600mm
- When the maximum span of the roof is greater than that given in the tables 2.37 – 2.39

Maximum spans of roofs using standard bracing in relation to location.

The wind zones referred to are illustrated in diagram 2.174.

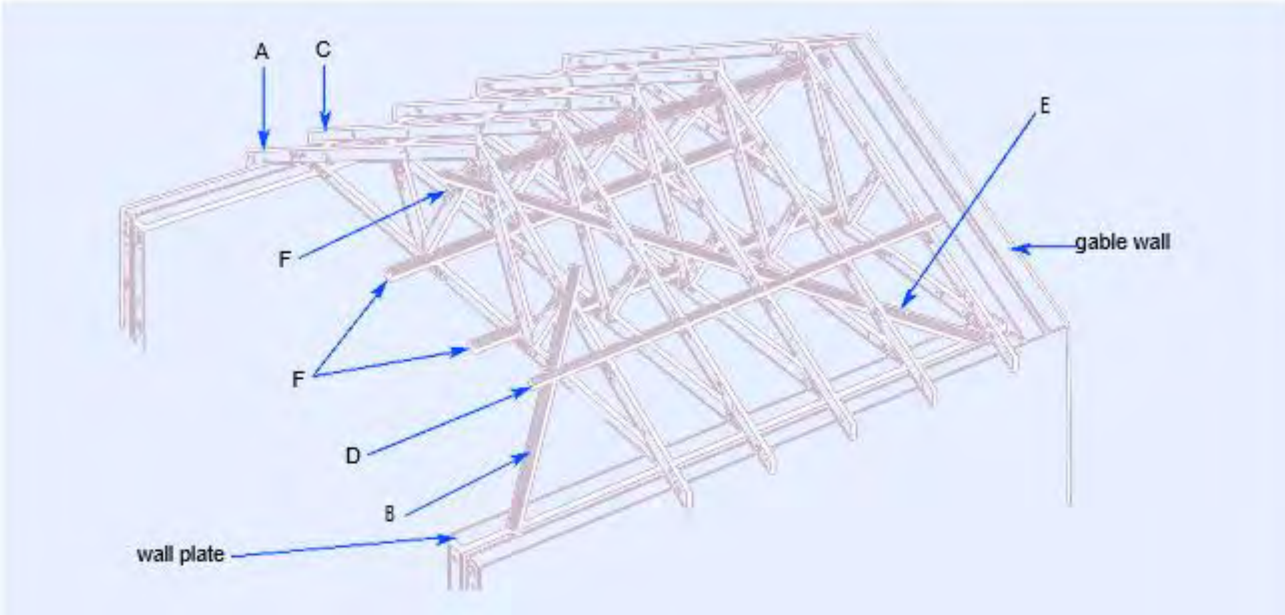


Diagram 2.172: Wind bracing to truss rafter roofs

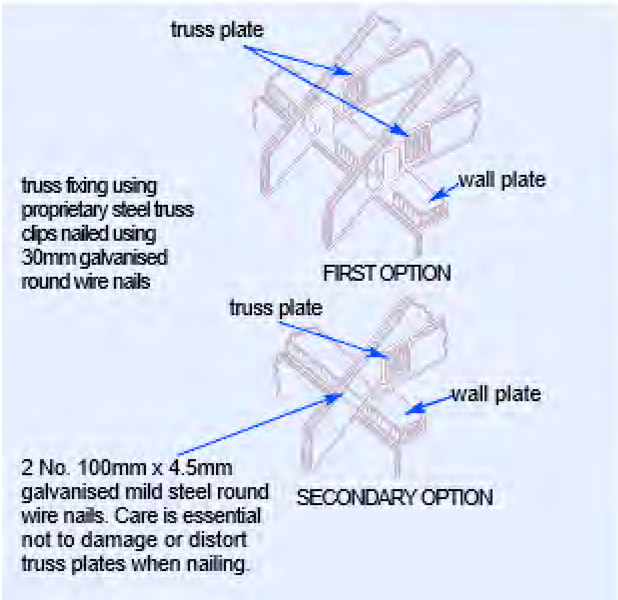


Diagram 2.173: Fixing of trusses to a wall plate area should be designed by an Expert.

Maximum height to underside of ceiling tie in metres	Pitch of roof	Maximum span of roof in metres	
		duo-pitched	mono-pitched
3.0	30°	12	7.8
5.7		12	6.6
8.4		11.8	5.9
3.0	35°	12	6.4
5.7		10.5	5.6
8.4		10	5.0

Table 2.37: Wind zone A – refer to Diagram 2.174

Maximum height to underside of ceiling tie in metres	Pitch of roof	Maximum span of roof in metres	
		duo-pitched	mono-pitched
3.0	30°	12	6.6
5.7		11.5	5.8
8.4		10.2	5.1
3.0	35°	10.6	5.6
5.7		9.1	4.5
8.4		8.5	4.3

Table 2.38: Wind zone B – refer to Diagram 2.174

Maximum height to underside of ceiling tie in metres	Pitch of roof	Maximum span of roof in metres duo-pitched	mono-pitched
3.0	30°	11.6	5.8
5.7		10	5.0
8.4		8.8	4.4
3.0	35°	9.8	4.9
5.7		7.7	4.2
8.4		7.2	3.6

Table 2.39: Wine zone C – refer to Diagram 2.174

Diagram 2.174: Wind zones – British Isles.
Parts of Scotland are outside Zone C and as such, roofs in this

Types of bracing
There are three main types of wind bracing, which should be fixed:

- Diagonal rafter bracing
- Longitudinal bracing
- Chevron bracing (only necessary on trussed rafter spans over eight metres).

Diagonal and longitudinal bracing are required in all trussed rafter roofs.

Bracing for wind loads can also be enhanced by adequately fixed tiling battens and/or sarking boards. The ceiling plasterboard (12.5mm thickness) or a similar rigid material will also contribute to the bracing process.

Sarking boards such as moisture resistant plywood (minimum thickness 9mm) and moisture resistant chipboard (minimum thickness 12mm) may provide adequate bracing without the need for additional wind bracing to the roof. Sarking boards should be laid with staggered joints and nailed at 200mm centres on every truss with 50mm long x 3mm diameter galvanised round wire nails.

Sarking boards are commonly used in Scotland.

Diagonal bracing
Diagonal braces should be fixed at an angle of about 45° (but not less than 35° or greater than 50°) to the plane of the rafters (See diagram 2.176). There are other forms of diagonal bracing (See diagram 2.175).

BS 5268:3 requires that narrow fronted houses (where frontage does not exceed 6.6 m) adopt a 'cross' approach to diagonal bracing. Diagonal bracing is taken up from the wall plate at either end of the roof and cross over in the approximate centre of the roof slope. The crossover should be arranged as in diagram 2.178.

Longitudinal bracing
Longitudinal bracing is shown in diagram 2.177, it should be positioned tightly to abut separating and gable walls. In timber frame construction you should ensure that longitudinal braces are fixed to timber frame gables/separating walls to provide additional lateral restraint.

Chevron bracing
Chevron bracing is only required for roof spans exceeding 8 metres. Chevron bracing can be identified as diagonal bracing to the web members of the roof truss.

For spans of between 8 and 11 metres such bracing may only be required to a single web member on either side of the roof (See diagram 2.179). For spans exceeding 11 metres more extensive chevron bracing may be necessary.

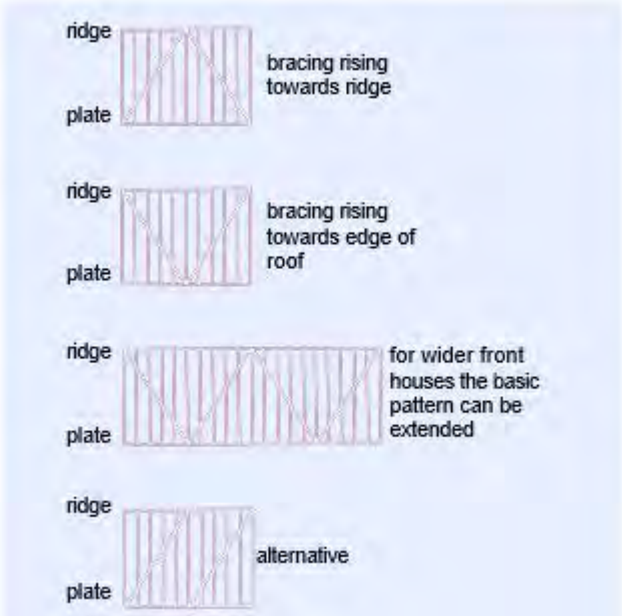


Diagram 2.175: Other forms of diagonal bracing

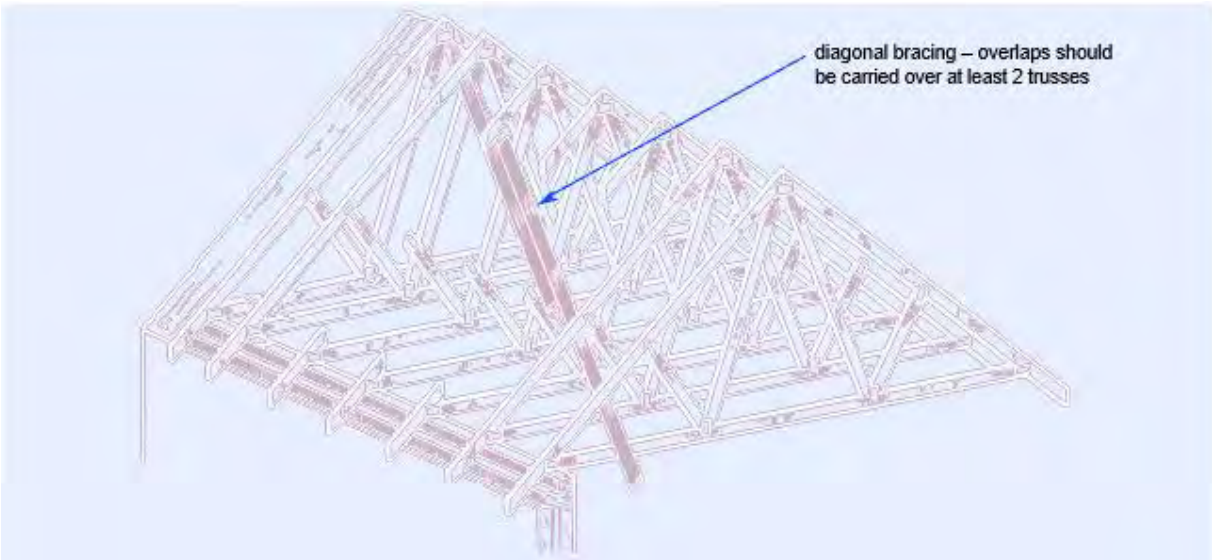


Diagram 2.176: Diagonal bracing

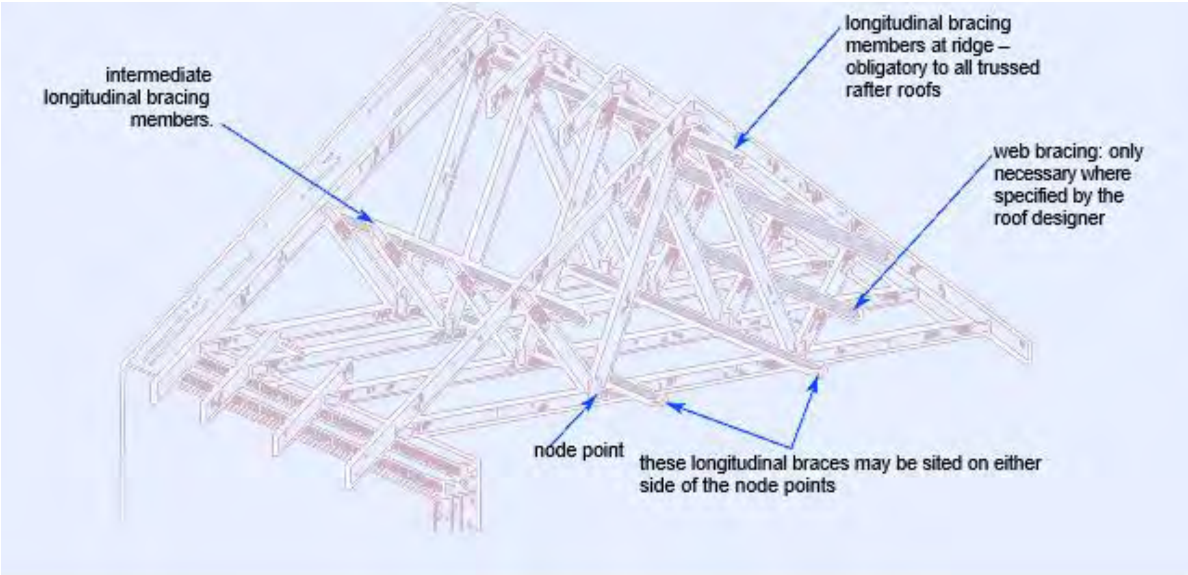


Diagram 2.177: Longitudinal bracing

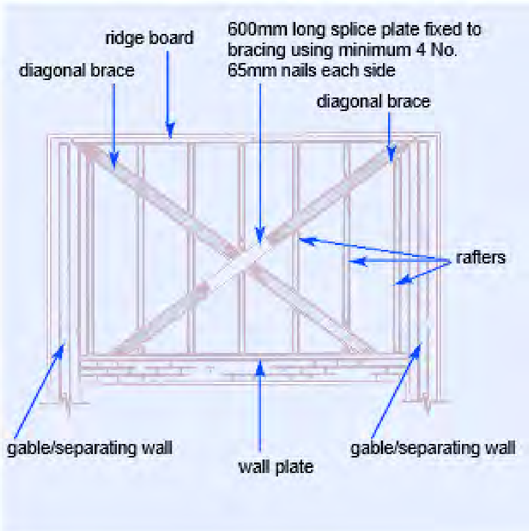


Diagram 2.178: Cross-over bracing – narrow fronted houses
(view from inside of roof)

Mono-pitched roof bracing
In mono-pitched trussed rafter roofs the diagonal bracing pattern for narrow fronted houses (See diagram 2.178) should be adopted. The requirement for longitudinal bracing is the same as for duo-pitched trussed rafter roofs.

Chevron bracing is required to the webs in roofs exceeding 5 metres span and also to upright members where inadequate lateral restraint is provided at the apex of the roof. i.e. not connected to a masonry wall or rigid frame cladding. (See diagram 2.180).

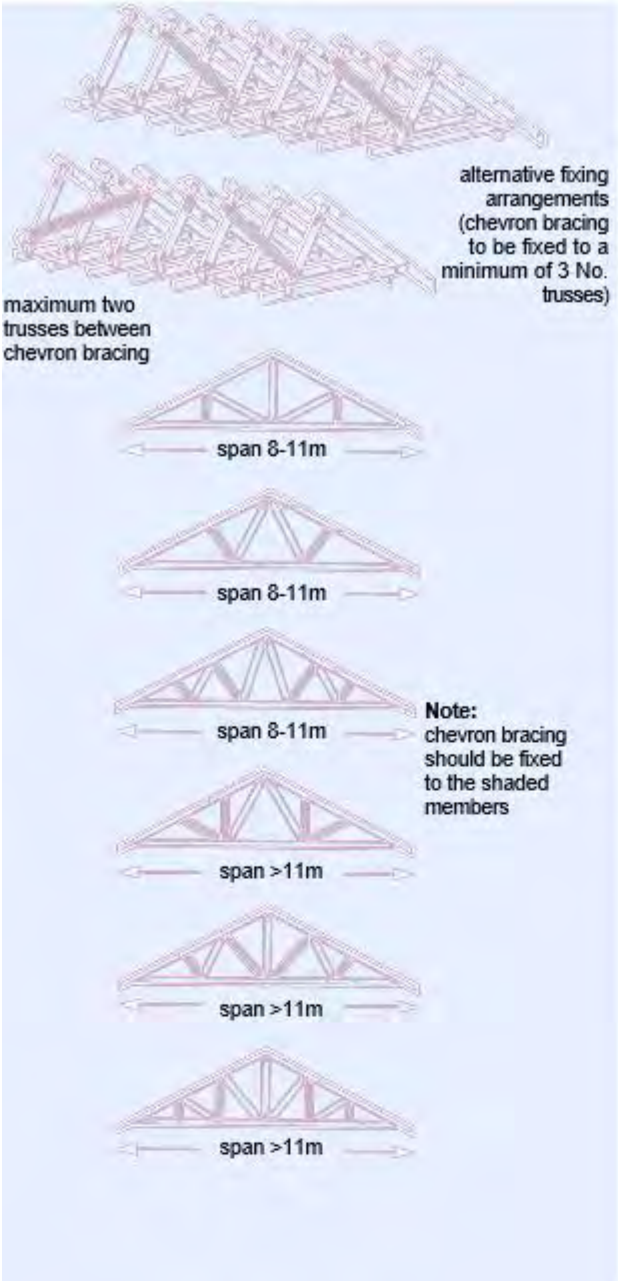


Diagram 2.179: Chevron bracing to common truss platterns (roof span exceeding 8 metres)

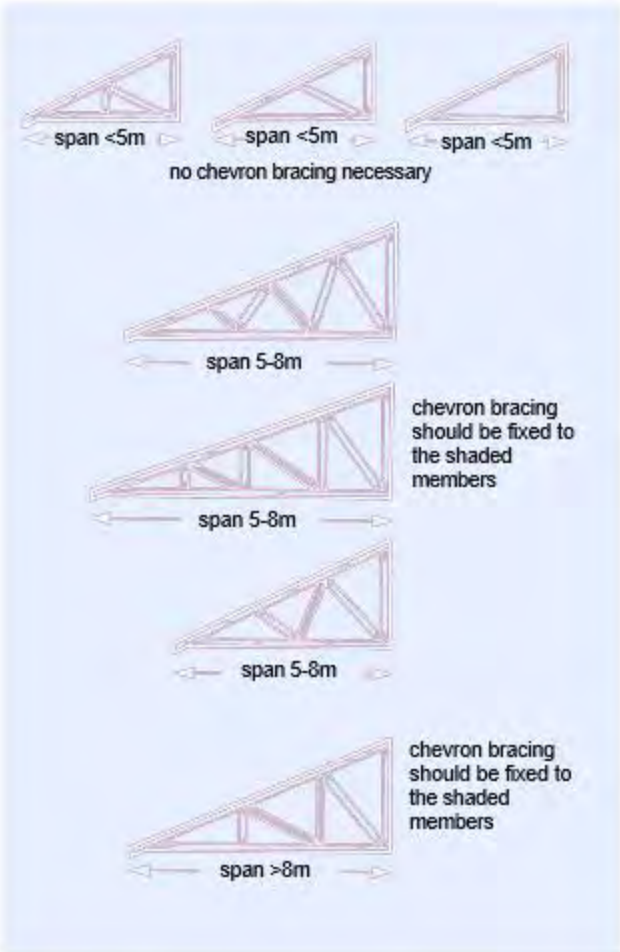


Diagram 2.180: Chevron bracing: mono-pitched roofs

Diminishing Roof Trusses

The truss roof designer should provide details of fixings for the diminishing truss to the main roof truss. (See diagram 2.182).

Where the diminishing truss has a splayed bottom chord which matches the pitch of the main truss (usually where the roof pitch is less than 30^{o}) the truss can be skew-nailed to the main truss with 2 no 3.35mm dia x 75mm galvanised wire nails. (See diagram 2.181).

Where the diminishing truss has a square bottom chord the truss can be skew-nailed to the main truss and supported on a continuous binder also fixed to the main truss. The top of the binder should be splayed to suit the bottom chord to 2 no 3.35mm dia x 75mm galvanised wire nails should be used for the fixing. (See diagram 2.182).

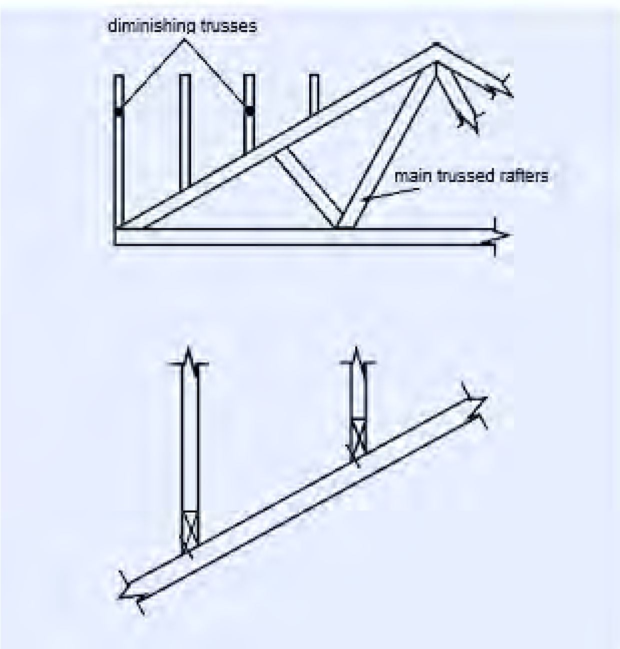


Diagram 2.181: Splayed bottom chord

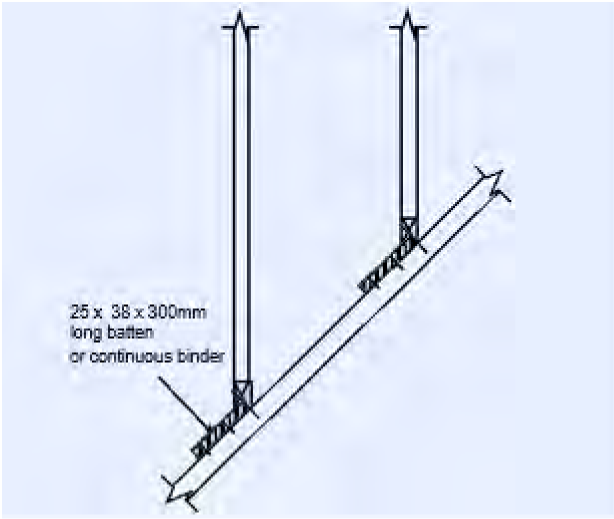


Diagram 2.182: Supported on a continuous binder

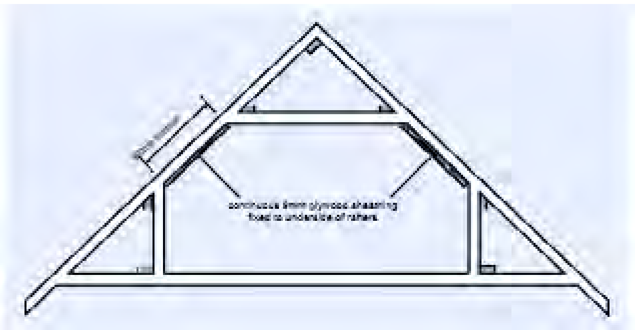


Diagram 2.183: Attic roof truss bracing

Trussed Rafter Roofs

Mono-pitch and girder trusses on trussed rafter hipped-end roofs

Mono-pitch trussed rafters can be used in conjunction with girder trusses on trussed rafter hipped roofs. (See diagram 2.184)

Mono-pitched trusses are fixed to girder trusses by metal shoes. The bearing of mono-pitched trusses onto the mild steel proprietary girder shoe should be confirmed with the roof designer before site installation is attempted. (See diagram 2.185)

Girder trusses are strengthened trusses designed to support loads in another plane (such as mono-pitched trusses).

Multiply-trussed rafters

Multiple trussed rafters may be specified for a particular purpose. The trussed rafters may be delivered to site already fastened together. Alternatively, fixing together on site of multiple rafters may be necessary, in which case full details will be necessary from the roof designer.

Provision for openings i.e loft hatches, chimneys, etc.

Wherever possible a trussed rafter roof should be designed to accommodate necessary openings within the trussed rafter spacing (e.g. a loft hatch). If this is not possible the spacing of trussed rafters may be extended to accommodate an opening as in diagram 2.186. The roof designer should provide all necessary details.

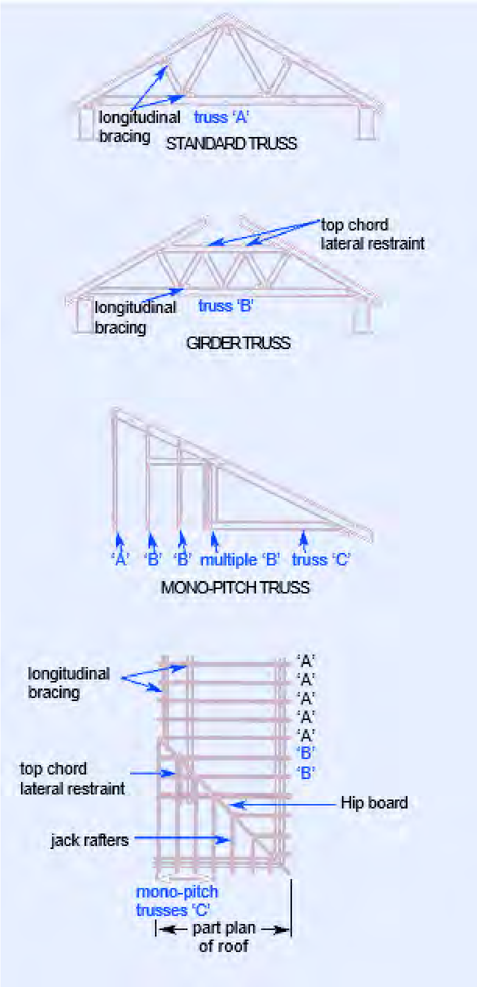


Diagram 2.184: Hip roof arrangement showing standard, girder and mono-pitch trusses

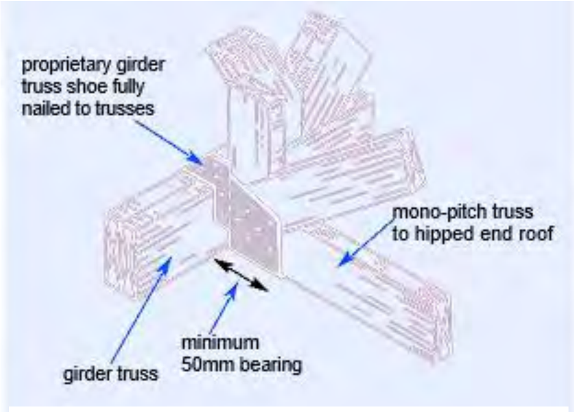


Diagram 2.185: Girder truss shoes

Tank stands

Confirmation should be obtained from the roof designer that a trussed rafter roof design is capable of supporting water storage tanks. Tanks should be supported by bearer beams, as shaded in diagrams 2.187 – 2.189 supported on the ceiling ties portion of the truss. Bearers should be skew-nailed to supports as appropriate. Alternatively, proprietary joist hangers can be used.

Diagram 2.187 illustrates particularly that tank bearers should be situated as close as possible to the node or intersection points of the trussed rafter. The dimensions of the bearers depend upon the size of the supported tank and the span of the trussed rafters (See table 2.40).

If an alternative position is required for a water storage tank from that depicted in diagram 2.189, all bearer members should be designed in accordance with BS 5268:2 by the truss designer**.**

Truss span (metres)	Size of bearer B (dimensions in mm) 230 litre	300 litre
6.50	100x50	125 x 50 or 2 (100 x 38)
9.00	125 x 50 or 2 (100 x 38)	125 x 50 or 2 (100 x 38)
12.00	150 x 50 or 2 (125 x 38)	2 (150 x 38)

Note: All truss spans up to 12m for both 230 and 300 litre tanks, Bearers A and C should be a minimum 75mm x 60mm C16 KD or dry timber

Table 2.40: Bearer sizes (See diagrams 2.187 and 2.188)

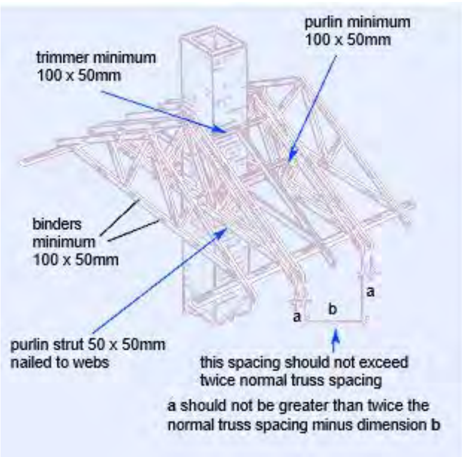


Diagram 2.186: Openings in trussed rafter roofs

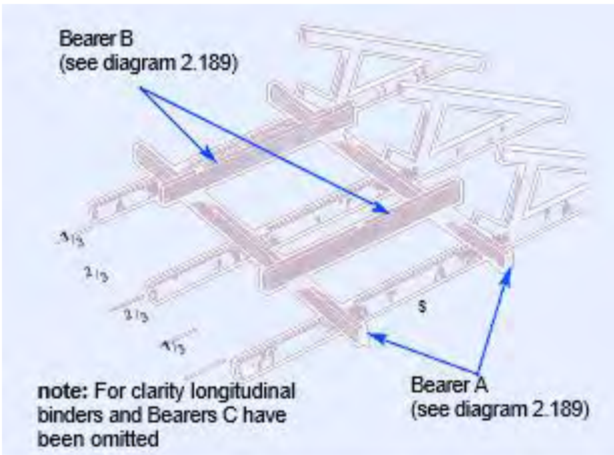


Diagram 2.187: Tank stand across 3 No trusses (max 230 litre tank)

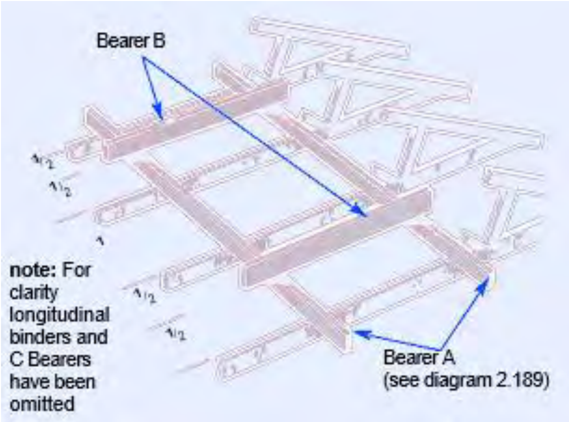


Diagram 2.188: Tank stand across 4 No. trusses (max 300 litre tank)

Modification to trussed rafters

Trussed rafters should never be cut, altered or repaired foruse without the full agreement of the trussed rafter designer. Remedies for defects to erected trusses can be found in BS 5268:3, but the roof designer's advice should be sought prior to repairs being carried out.

Combined trussed rafter and traditionally framed roofs

Extra care is necessary where the two principal timber pitched roof types are being used in conjunction. The trussed rafters should be specifically designed to accept any additional loadings imposed by an adjacent traditional roof. Similarly, account should be taken of any loadings imposed by trusses on traditional roofs where only nominal loadings have been allowed for. If in doubt consult the roof designer.

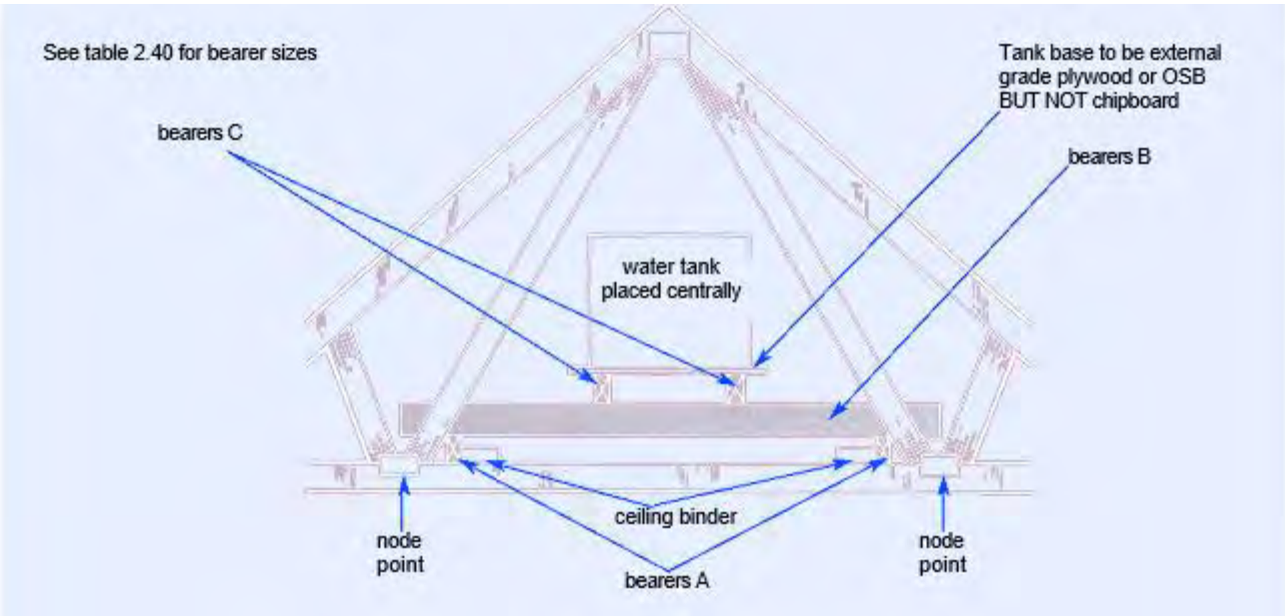


Diagram 2.189: Position of water tank – section through roof

Traditionally Framed Roofs

The moisture content of structural timber should not exceed 20% 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’.

An example of a traditionally framed roof is shown in diagram 2.189. The arrangement illustrated shows the various timber members that make up the roof but the internal configuration of members may vary from roof to roof. Short span roofs can be constructed using rafters and ceiling joists. Ceiling ties or collars are necessary to relieve horizontal thrust from the roof pushing out the walls.

In longer spanning roofs, purlins and binders are used to reduce the effective span of the rafter/joist and avoid the necessity for uneconomic larger dimension timbers.

Purlins and binders should be located at mid-rafter/joist span. Purlins may be located higher in the roof where attic rooms are desired and the roof is to be designed by an Expert.

The purlins/binders should be adequately supported to contribute fully to the roof structure. For example, they could be built into the inner leaf of a gable end wall and supported by struts onto the load-bearing structure at centres specified in the design.

Always ensure that the correct strength class of timber is both ordered and used. Structural timbers are allocated a strength class by BS 5268:2. The most common strength classes used are C16 and C24 (See table 2.42).

The timber supplier will require the following information before supplying timber:

- Type and strength class of timber required.
- Required sizes of timber
- Any treatment required.

The dimensions of rafter, ceiling joist and binder timbers for use in traditionally framed roofs can be found in the tables 2.42 – 2.45 for the majority of loading cases (England & Wales) with live loadings of 0.75 kN/m^2 (snow loading). For other loading situations further guidance can be taken from Approved Document A (E&W), Section 1, Scotland and Part D-N, N. Ireland.

item	size
struts and braces	100 x 50mm
wall plates (generally)	100 x 50mm
hips	splayed rafter depth = rafter depth + 25mm (for pitches exceeding 30°) under 30° a specific design is required
ridges	splayed rafter depth = rafter depth + 25mm
valleys	to be designed

Table 2.41: Roof member sizes

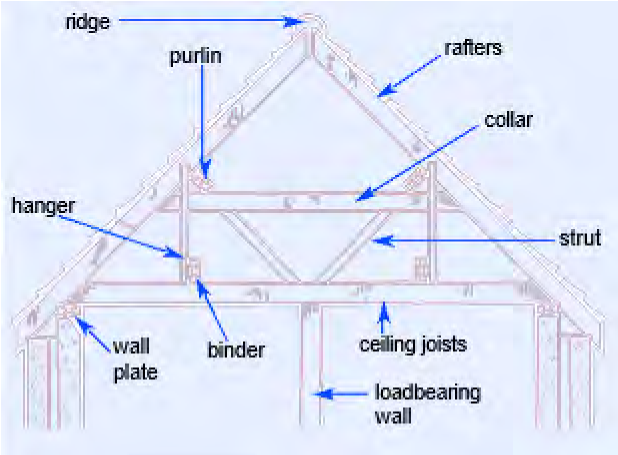


Diagram 2.189: Traditionally framed roof

Pitched roof				**pitch 15° to 22.5°**		
Permissible clear span between supports with imposed loads of 0.75kN/m² (snow loading) **Dead load more than 0.50 but not more than 0.75kN/m²**						
size of joist mm x mm	spacing of rafter (mm) C16[1]			C24[2]		
	400	450	600	400	450	600
	Maximum clear span of rafter (m)			Maximum clear span of rafter (m)		
47 x 100	2.25	2.19	2.03	2.44	2.35	2.13
47 x 125	2.92	2.81	2.56	3.04	2.92	2.66
47 x 150	3.49	3.36	3.06	3.36	3.50	3.18

Purlin												
Permissible clear span between supports. **Dead load more than 0.50 but not more than 0.75kN/m²**												
size of purlin mm x mm	spacing of purlins (mm) – distance between centres of purlin and/or wall plate or ridge and purlin C16[1]						C24[2]					
	1500	1800	2100	2400	2700	3000	1500	1800	2100	2400	2700	3000
	Maximum clear span of purlin (m)						Maximum clear span of purlin (m)					
47 x 175	2.04	1.90					2.13	1.99	1.88			
47 x 200	2.32	2.17	2.04	1.90			2.43	2.27	2.15	2.04	1.95	1.87
47 x 225	2.61	2.44	2.28	2.13	2.00	1.89	2.73	2.56	2.42	2.30	2.19	2.11
47 x 250	2.90	2.71	2.51	2.35	2.01	2.09	3.03	2.84	2.68	2.55	2.44	2.34
47 x 275	3.19	2.97	2.75	2.57	2.41	2.28	3.33	3.12	2.95	2.80	2.68	2.57
63 x 150	1.94	1.82					2.03	1.90				
63 x 175	2.26	2.12	2.00	1.91	1.82		2.36	2.21	2.09	2.00	1.91	1.84
63 x 200	2.58	2.42	2.29	2.18	2.08	1.97	2.70	2.53	2.39	2.28	2.18	1.10
63 x 225	2.90	2.72	2.57	2.45	2.33	2.20	3.03	2.84	2.69	2.56	2.45	2.36
63 x 250	3.22	3.02	2.85	2.72	2.57	2.43	3.37	3.16	2.99	2.84	2.72	2.62
63 x 275	3.54	3.32	3.14	2.98	2.81	2.66	3.70	3.47	3.28	3.13	2.99	2.88
75 x 150	2.06	1.94	1.83				2.16	2.02	1.91	1.82		
75 x 175	2.41	2.26	2.13	2.03	1.95	1.87	2.51	2.36	2.23	2.13	2.04	1.96
75 x 200	2.75	2.57	2.44	2.32	2.22	2.14	2.87	2.69	2.55	2.43	2.33	2.24
75 x 225	3.09	2.89	2.74	2.61	2.50	2.40	3.22	3.02	2.86	2.73	2.61	2.52
75 x 250	3.42	3.21	3.04	2.90	2.77	2.66	3.58	3.36	3.18	3.03	2.90	2.79

KEY: 1. timber is approximately equivalent to SC3 grade timber
2. timber is approximately equivalent to SC4 grade timber

Note: Further guidance is given in: "Span tables for solid timber members in floors, ceilings and roofs (excluding trussed rafter roofs) for dwellings"
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Table 2.42: Span Tables

Pitched roof						pitch 22.5° to 30°
Permissible clear span between supports with imposed loads of 0.75kN/m² (snow loading) Dead load more than 0.50 but not more than 0.75kN/m²						
size of joist mm x mm	spacing of rafter (mm) C16[1]			C24[2]		
	400	450	600	400	450	600
	Maximum clear span of rafter (m)			Maximum clear span of rafter (m)		
47 x 100	2.35	2.28	2.10	2.49	2.40	2.18
47 x 125	2.99	2.88	2.61	3.11	2.99	2.72
47 x 150	3.57	3.44	3.13	3.71	3.58	3.26

Purlin												
Permissible clear span between supports. Dead load more than 0.50 but not more than 0.75kN/m²												
size of purlin mm x mm	spacing of purlins (mm) – distance between centres of purlin and/or wall plate or ridge and purlin C16[1]						C24[2]					
	1500	1800	2100	2400	2700	3000	1500	1800	2100	2400	2700	3000
	Maximum clear span of purlin (m)						Maximum clear span of purlin (m)					
47 x 175	2.08	1.95					2.18	2.04	1.93	1.83		
47 x 200	2.38	2.23	2.10	1.97	1.85		2.49	2.33	2.20	2.09	2.00	1.92
47 x 225	2.67	2.50	2.36	2.20	2.07	1.96	2.80	2.62	2.47	2.35	2.25	2.16
47 x 250	2.97	2.78	2.60	2.43	2.28	2.16	3.11	2.91	2.75	2.61	2.50	2.40
47 x 275	3.26	3.05	2.84	2.65	2.50	2.37	3.41	3.20	3.02	2.87	2.75	2.64
63 x 150	1.99	1.86					2.08	1.95	1.84			
63 x 175	2.32	2.17	2.05	1.95	1.87		2.42	2.27	2.15	2.04	1.96	1.88
63 x 200	2.64	2.48	2.34	2.23	2.13	2.04	2.76	2.59	2.45	2.33	2.23	2.15
63 x 225	2.97	2.78	2.63	2.51	2.40	2.28	3.10	2.91	2.75	2.62	2.51	2.42
63 x 250	3.30	3.09	2.92	2.78	2.66	2.52	3.44	3.23	3.06	2.91	2.79	2.68
63 x 275	3.62	3.40	3.21	3.06	2.90	2.75	3.78	3.55	3.36	3.20	3.07	2.95
75 x 150	2.11	1.98	1.87				2.21	2.07	1.96	1.87		
75 x 175	2.46	2.31	2.18	2.08	1.99	1.92	2.57	2.41	2.28	2.18	2.09	2.01
75 x 200	2.81	2.64	2.50	2.38	2.28	2.19	2.94	2.75	2.61	2.49	2.38	2.29
75 x 225	3.16	2.96	2.80	2.67	2.56	2.46	3.30	3.09	2.93	2.80	2.68	2.58
75 x 250	3.50	3.29	3.11	2.97	2.84	2.73	3.66	3.44	3.25	3.10	2.97	2.86

KEY: 1. timber is approximately equivalent to SC3 grade timber
2. timber is approximately equivalent to SC4 grade timber

Note: Further guidance is given in: "Span tables for solid timber members in floors, ceilings and roofs (excluding trussed rafter roofs) for dwellings"
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Table 2.43: Span tables

Pitched roof							pitch 30° to 45°
Permissible clear span between supports with imposed loads of 0.75kN/m^2 (snow loading) Dead load more than 0.50 but not more than 0.75kN/m^2							
size of joist mm x mm	spacing of rafter (mm) C16[1]			C24[2]			
	400	450	600	400	450	600	
	Maximum clear span of rafter (m)			Maximum clear span of rafter (m)			
47 x 100	2.45	2.38	2.17	2.58	2.48	2.25	
47 x 125	3.09	2.97	2.70	3.21	3.09	2.81	
47 x 150	3.69	3.55	3.23	3.82	3.69	3.36	

Purlin												
Permissible clear span between supports. Dead load more than 0.50 but not more than 0.75kN/m^2												
size of purlin mm x mm	spacing of purlins (mm) – distance between centres of purlin and/or wall plate or ridge and purlin C16[1]						C24[2]					
	1500	1800	2100	2400	2700	3000	1500	1800	2100	2400	2700	3000
	Maximum clear span of purlin (m)						Maximum clear span of purlin (m)					
47 x 175	2.16	2.02	1.91	1.81			2.26	2.11	1.99	1.90	1.82	
47 x 200	2.46	2.30	2.18	2.07	1.95	1.84	2.57	2.41	2.28	2.17	2.08	1.99
47 x 225	2.77	2.59	2.45	2.31	2.17	2.06	2.89	2.71	2.56	2.44	2.33	2.24
47 x 250	3.07	2.88	2.72	2.55	2.40	2.27	3.21	3.01	2.85	2.71	2.59	2.49
47 x 275	3.38	3.16	2.98	2.79	2.62	2.48	3.53	3.31	3.13	2.98	2.85	2.74
63 x 150	2.05	1.92	1.82				2.15	2.01	1.90	1.81		
63 x 175	2.39	2.24	2.12	2.02	1.94	1.86	2.50	2.35	2.22	2.11	2.03	1.95
63 x 200	2.73	2.56	2.42	2.31	2.21	2.13	2.86	2.68	2.54	2.41	2.31	2.23
63 x 225	3.07	2.88	2.73	2.60	2.49	2.39	3.21	3.01	2.85	2.71	2.60	2.50
63 x 250	3.41	3.20	3.03	2.88	2.76	2.64	3.26	3.34	3.16	3.02	2.89	2.78
63 x 275	3.75	3.51	3.33	3.17	3.55	3.03	3.91	3.67	3.48	3.31	3.17	3.06
75 x 150	2.18	2.05	1.94	1.85			2.28	2.14	2.03	1.93	1.85	
75 x 175	2.55	2.39	2.26	2.15	2.06	1.99	2.66	2.49	2.36	2.25	2.16	2.08
75 x 200	2.91	2.73	2.58	2.46	2.36	2.27	3.03	2.85	2.70	2.57	2.46	2.37
75 x 225	3.26	3.06	2.90	2.77	2.65	2.55	3.41	3.20	3.03	2.89	2.77	2.67
75 x 250	3.62	3.40	3.22	3.07	2.94	2.83	3.78	3.55	3.36	3.21	3.08	2.96

KEY:
1. timber is approximately equivalent to SC3 grade timber
2. timber is approximately equivalent to SC4 grade timber

Note: Further guidance is given in: "Span tables for solid timber members in floors, ceilings and roofs (excluding trussed rafter roofs) for dwellings"
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Table 2.44: Span tables

Ceiling joists

Permissible clear span between supports.
Dead load more than 0.25 but not more than 0.50kN/m^2

size of joist mm x mm	C16[1] 400	C16[1] 450	C16[1] 600	C24[2] 400	C24[2] 450	C24[2] 600
	Maximum clear span of ceiling joist (m)			Maximum clear span of ceiling joist (m)		
47 x 72	1.23	1.21	1.17	1.30	1.28	1.24
47 x 97	1.84	1.81	1.73	1.93	1.90	1.83
47 x 122	2.47	2.42	2.31	2.60	2.55	2.43
47 x 147	3.11	3.05	2.90	3.27	3.21	3.04
47 x 170	3.72	3.64	3.44	3.89	3.81	3.61
47 x 195	4.37	4.28	4.04	4.57	4.47	4.22

Spacing of joists (mm).

Binder

Permissible clear span between supports.
Dead load more than 0.25 but not more than 0.50kN/m^2

spacing of binders (mm) – distance between centres of binders and/or wall plate or ridge and binder

size of purlin mm x mm	C16[1] 1200	C16[1] 1500	C16[1] 1800	C16[1] 2100	C16[1] 2400	C16[1] 2700	C24[2] 1200	C24[2] 1500	C24[2] 1800	C24[2] 2100	C24[2] 2400	C24[2] 2700
	Maximum clear span of binder (m)						Maximum clear span of binder (m)					
47 x 150	1.99	1.87					2.09	1.97	1.87			
47 x 175	2.32	2.22	2.11	2.02	1.94	1.87	2.48	2.33	2.22	2.12	2.03	1.96
47 x 200	2.74	2.58	2.44	2.33	2.24	2.16	2.88	2.70	2.56	2.45	2.35	2.26
63 x 125	1.81						1.91	1.80				
63 x 150	2.23	2.11	2.00	1.91	1.84		2.34	2.21	2.10	2.01	1.93	1.86
63 x 175	2.65	2.49	2.37	2.26	2.17	2.10	2.78	2.61	2.48	2.37	2.28	2.20
63 x 200	3.07	2.88	2.74	2.61	2.51	2.42	3.21	3.02	2.86	2.73	2.63	2.53
63 x 225	3.48	3.27	3.10	2.96	2.84	2.74	3.65	3.42	3.24	3.10	2.97	2.86
75 x 125	1.95	1.84					2.04	1.93	1.84			
75 x 150	2.39	2.25	2.14	2.05	1.97	1.90	2.50	2.36	2.24	2.15	2.06	1.99
75 x 175	2.83	2.66	2.53	2.42	2.32	2.24	2.96	2.79	2.65	2.53	2.43	2.35
75 x 200	3.27	3.08	2.92	2.79	2.68	2.58	3.42	3.22	3.05	2.92	2.80	2.70
75 x 225	3.71	3.49	3.31	3.16	3.03	2.92	3.88	3.65	3.46	3.30	3.17	3.06

KEY: 1. timber is approximately equivalent to SC3 grade timber
2. timber is approximately equivalent to SC4 grade timber

Note: Further guidance is given in: "Span tables for solid timber members in floors, ceilings and roofs (excluding trussed rafter roofs) for dwellings"
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Table 2.45: Span table

Weather-tightness

The roof underlay to a pitched roof should be fixed in accordance with the underlay or tile manufacturer's recommendations, with care taken to ensure that water will run off into the gutter, e.g. by use of a tilting fillet where required.

A type 5U quality felt should be used at eaves (above the tilting fillet) and drop into the gutter to prevent solar degradation.

Roofing felt should be fixed with non-corrodible clout nails. Horizontal laps should be not less than 150mm for roof pitches below 35˚, and 100mm for pitches greater than 35˚. Vertical laps should not be less than 100mm and occur only over rafters, to which they should be securely fixed. The underlay should extend into the gutter and the bottom row of tiles should overhang to the centre of the gutter.

Particular care should be taken in ensuring weather-tightness at eaves, verges and valleys.

Movement joints should, where required, extend through the roof covering and be adequately weather-proof, or the roof covering should be of a flexible type and designed to accommodate any movement.

Ensure that roof insulation extends fully to perimeter walls in order to avoid cold bridging and that roof ventilators are not obstructed.

Tiling

Tiling should be in accordance with the recommendations of BS 5534:1. BS 5534 Code of practice for slating & tiling (including shingles)

- should be fixed in accordance with the manufacturer's instructions, due account being taken of the site exposure and the pitch of the roof. Non-ferrous or stainless steel fixing nails should be used
- clipping should be used as recommended by the manufacturer.

Experience shows that tiles are often not fixed on site as they should be. Builders and designers should determine the required tile fixing specifications necessary for their area e.g. by contacting the tile manufacturer who often provides an advisory service.

Fixings may consist of either nailing, clipping or both and proprietary dry verge and ridge fixing systems.

As an alternative to BS 5534 contractors can use the Zonal Method for Roof Tile Fixing Specification which is a joint publication prepared by the Concrete Tile Manufacturers' Association, Clay Roof Tile Council, and the National Federation of Roofing Contractors, for more detail see the following websites:

www.britishprecast.org

www.clayroof.co.uk

www.nfrc.co.uk

The assumptions made in the simplification process may produce a specification with more or stronger fixings than required if the full BS5534 calculation is undertaken. The Zonal Method is not applicable in the following circumstances:

- For buildings where the site altitude is greater than 300m
- For buildings on sites where the maximum gradient of the land within 200m of the building is greater than 10%

- Where the building is within 6 kilometres of an airport and is plus or minus 10 degrees each side of the runway centre line measured from the touchdown point
- Where the ridge height of the building is greater than 15m
- Where the roof pitch is greater than 54° for single lap tiles and 59° for double lap tiles
- For buildings where the roof substructure does not provide a shielding factor of 1 as defined in BS5534 e.g the roof does not have an underlay or sub-roof system such as liner trays or sandwich panels
- For tiles or slates not made of concrete or clay
- Heritage, listed on historic buildings requiring restoration using traditional skills.
- For buildings on sites located in wind zones where the wind speed is greater that 25m/s.i.e zone 3

The fixing specification for the roof covering of any excluded site or building must be determined by calculation in accordance with the methods described in BS5534 and BS6399. For example, in some extreme cases, special nails or clips may be required.

Interlocking tiles

In the case of interlocking tiles, as a minimum all perimeter tiles at eaves, ridges, verges and tiles adjacent to hips and valleys require some form of fixing. Where the pitch exceeds 45° all tiles need to be nailed (and clipped where the pitch exceeds 55°).

Roof pitch (min)	Minimum headlap mm	Nominal length of slate			
		560mm or longer	500mm	460mm	Less than 460mm
		Angle of creep 0°			
45	65	26	26	26	26
40	65	26	26	26	26
35	75	26	26	26	29
30	75	32	32	32	32
27.5	85	34	36	39	48
25	90	36	40	47	–
22.5	100	41	47	56	–
20	115	48	56	65	–

NOTE 1. The headlap may be increased in calculating the width of double lap product.
NOTE 2. These recommendations are minimum values which are more critical at roof pitches below 30° (driving rain exposure <56.5 1/m²) and below 40° . The thickness of slates will reduce the effective slope of the slate surface.
NOTE 3. For steeper roof pitches it is possible to use a greater angle of creep to allow a loss of side lap where it is necessary to cut the slates.
NOTE 4. For artificial double lap slating (fibre cement or artificial slates) these recommendations for headlaps and sidelaps apply, except at roof pitches below 25° (driving rain exposure <56.5 1/m²) and 30° (driving rain exposure ≤56.5 1/m²) in which case manufacturers should produce evidence of satisfactory performance.
NOTE 5. For triple lap shingles or shakes, refer to manufacturers' technical literature.
NOTE 6. The minimum roof pitch for double lap slating in UK climatic conditions is 20°.
NOTE 7. The calculation of the minimum slate width using the relevant angle of creep is normally based upon a nail hole to side edge distance (NF) of 20mm to 25mm. Any greater nail hole side edge distance will require recalculation of slate width in accordance with the expression given in 3.3.6.
NOTE 8. The headlap should not exceed one third of the length of the slate.
NOTE 9. Hook fixing of slates may require greater handicap than those recommended in tables 2.47 and 2.48.

Table 2.46: Recommended minimum headlaps and roof pitches and angles of creep for double lap natural, fibre cement and other artificial slates (driving rain exposure <56.5 1/m² per spell)

NOTE 1: The headlap may be increased in calculating the width of double lap product.
NOTE 2: These recommendations are minimum values which are more critical at roof pitches below 30º (driving rain exposure <56.5 1/m²) and below 40º . The thickness of slates will reduce the effective slope of the slate surface.
NOTE 3: For steeper roof pitches it is possible to use a greater angle of creep to allow a loss of side lap where it is necessary to cut the slates.
NOTE 4: For artificial double lap slating (fibre cement or artificial slates) these recommendations for headlaps and sidelaps apply, except at roof pitches below 25º (driving rain exposure <56.5 1/m²) and 30º (driving rain exposure ≤56.5 1/m²) in which case manufacturers should produce evidence of satisfactory performance.
NOTE 5: For triple lap shingles or shakes, refer to manufacturers' technical literature.
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NOTE 7: The calculation of the minimum slate width using the relevant angle of creep is normally based upon a nail hole to side edge distance (NF) of 20mm to 25mm. Any greater nail hole side edge distance will require recalculation of slate width in accordance with the expression given in 3.3.6.
NOTE 8: The headlap should not exceed one third of the length of the slate.
NOTE 9: Hook fixing of slates may require greater handicap than those recommended in tables 2.47 and 2.48.

Roof pitch (min)	Minimum headlap mm	Nominal length of slate			
		560mm or longer	500mm	460mm	Less than 460mm
		Angle of creep 0°			
45	65	32	32	32	36
40	75	34	35	40	48
35	75	37	40	45	57
30	75	41	44	50	60
27.5	90	43	47	55	–
25	100	45	50	61	–
22.5	115	52	60	–	–
20	130	60	–	–	–

See notes 1 to 9 of Table 2.46

Table 2.47: Recommended minimum headlaps and roof pitches and angles of creep for double lap natural, fibre cement and other artificial slates (driving rain exposure <56.5 1/m^2 per spell)

Plain Tiles
Plain tiles should be twice nailed every fifth course and at perimeters and other areas subject to high wind uplift. Where the pitch exceeds 60°, all plain tiles should be twice nailed.

Slates
Slates over 150mm wide should be twice nailed over the whole roof. The minimum pitch at which slate maybe used is 20°.

Slates should have a reasonably straight cleavage and should ring true when struck. The grain must run longitudinally and not transversely. Whilst the surface may contain stripes it should not be so uneven as to not allow the proper laying of the slates.

All natural slates should be certified to show that they meet the requirements of BS 680 and should be free of iron pyrites and other impurities.

Slate Creep
If the maximum angle of creep for a particular slate is less than the minimum shown in tables 2.46 and 2.47 the sidelap of the slate will be inadequate for the conditions of use. The minimum width of a slate is given by the following equation:

Min. slate width = {9DE - 3DG)tanø} =2NF (See British Standard)

For head and shoulder nailed and hook-fixed slates the value of NF is zero

Recommendations for minimum roof pitch, headlaps and sidelaps (roof)
When considering the minimum recommendations for pitch and laps for slate and tile products, the specifier should take into account any abnormal conditions which may apply to the proposed use of a generic or proprietary product.

Where abnormal weather conditions may be expected, for example on elevated sites, near to the coast, in localities where heavy snow falls are commonly experienced or in conditions of severe exposure, the following recommendations for pitches and laps may not ensure full protection from the weather. In such conditions, the specifier using generic products should seek guidance from an experienced roofing contractor who is conversant with local conditions and any special precautions which should be taken into account in designing the roof covering.

Reclaimed roof coverings
The use of reclaimed roof coverings is acceptable when they have:

Type of slate or tile	450mm span		600mm span	
Slates (double lap)	Width mm	Depth mm	Width mm	Depth mm
Natural: sized or random	50	25	50	25
Fibre cement or concrete	38	25	50	25
Clay and concrete tiles				
Double lap	38	25	38	25
Single lap	38	25	50	25

Table 2.48: Recommended batten sizes (roofing and vertical work)

- Certification to show that they have a minimum life expectancy of 15 years
- A fixing detail provided. Where such materials are no longer manufactured then a fixing schedule for a covering type that is very similar may be acceptable Natural slate must be graded to take account of their variable thickness. They should be selected so that the overall thickness of any one lot of 100 does not exceed, in thickness, by more than 25% any other lot of 100 slates.

Battens
Battens should be spaced so as to ensure adequate laps at each course and provide a neatly aligned and uniform gauge of tiling over the whole area. While the gauge may be reduced, it should not be increased.

Battens should be preservative treated, (BS 8417, or equivalent, hazard class 2), at least 1200mm in length and span across at least three supports. Sizes for battens are given in table 2.48.

Eaves tiles should be supported by a fascia board or by a batten on a tilting fillet.

Dry verge systems should be fixed in accordance with the manufacturer's recommendations.

Plain tiles should have a tile undercourse at the eaves.

Verges should be built so as to provide an upward cant and project beyond the supporting wall or barge-board by a minimum of 38mm.

Undercloak courses of fibre cement board, slate or tile should be neatly bedded in cement based mortar, and neatly jointed in line with the face of the verge.

Plain tile verges should comprise alternate courses of tile and tile and a half widths.

Ridge and verge tiles should be set true to line, bedded on cement based mortar and neatly jointed.

Valleys should be made with purpose made tiles or formed in metal, pvc or other durable sheet materials so as to provide a continuous channel. The junction between tiles and valleys should be neatly jointed with a cement-based mortar. Valley tiles should not be laid below the minimum pitch recommended by the manufacturer.

Hips and ridges should be formed with purpose made tiles of appropriate section, securely bedded and jointed in cement based mortar to true line and level.

Flashings should be fixed in accordance with the recommendations of the Lead Sheet Association and not less than the following:

- soakers in Code 3 lead
- flashings in Code 4 lead
- saddles in Code 4 lead
- valley gutters in Code 4/5 lead
- gutters in Code 5 lead

Generally the length of each piece should not exceed 1.5m.

In timber frame construction, flashings should allow for up to 30mm in vertical differential movement between the roof surface and abutments such as chimneys, parapets and around pipes.

Mortar for roofing work should be 1:3 cement: sand.

Workmanship should comply with BS 8000:6.

Fixing materials
Non-corrosive nails should be used for fixing slating and tiling e.g. stainless steel, aluminium, copper or bronze. Nb. galvanised nails do not have sufficient durability. Aluminium nails should not be used with timber treated with Copper Chrome Arsenic (CCA).

It is common practice to fix roofing battens with ordinary wire nails. However in coastal areas or other regions having an aggressive atmosphere, corrosion resistant nails should be used (e.g. galvanised wire nails).

BS 1118 Code No	Maximum length between drips (mm)	Maximum overall girth (mm)
1	1500	750
5	2000	800
6	2250	850
7	2500	900
8	3000	1000

Table 2.49: Recommended gutter sizes

Where parapet detailing cannot be avoided, the guidance given in the previous section must be followed.

Avoid leaking valley gutters
Valleys are also a common source of roof leaks. Ensure that proprietary gutter linings are fixed in accordance with manufacturer's recommendations. Where valleys are formed by roof pitches that differ by more than 5 degrees the use of preformed valley systems are not generally acceptable. Lead valleys should be used and that lead-lined gutters are (See diagram 2.190 - 2.191):

- Made with code 4 or 5 lead sheets 1.5m long with minimum 150mm lap joints
- Fully supported on boarding
- Dressed a minimum of 200mm under tiles and sarking felt and dressed over an upstand fillet
- Have geotextile matting under lead.

Box or hidden gutters
Box gutters should constructed in accordance with the recommendations of the Lead Development Association.
Tiles adjacent to valleys should be secured by neatly bedding in mortar or using a proprietary dry fixing system.

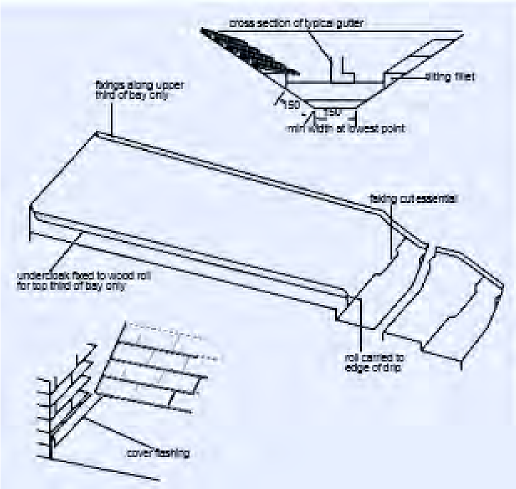


Diagram 2.190: Tapered gutters

Avoid wind blown rain and snow entering into the roof structure
Falls to pitched roofs are dependent on the type of tile and its profile.

The manufacturer's minimum pitch and lap recommendations should be followed in order to prevent ingress of wind driven rain or snow. Larger headlaps are often required for falls of less than 25° and smooth finish tiles are often necessary.

Insulated copper covered (MICC) or located in a metal conduit

- Smoke detectors should be provided in the roof space and within the dwelling, together with an audible warning device located on the upper landing
- Party walls to be fire stopped at junction with thatch roofing
- Galvanised wire netting to be provided to prevent entry of vermin. Galvanised wiring should be 19mm net 20 gauge
- The Developer/Builder to advise the Purchaser that the ridge should be renewed every five years and the roof be subject to an annual inspection and maintenance contract
- Chimneys should be mortar rendered within the roofspace after having ensured that all mortar joints are properly filled and that an appropriate flue lining has been provided

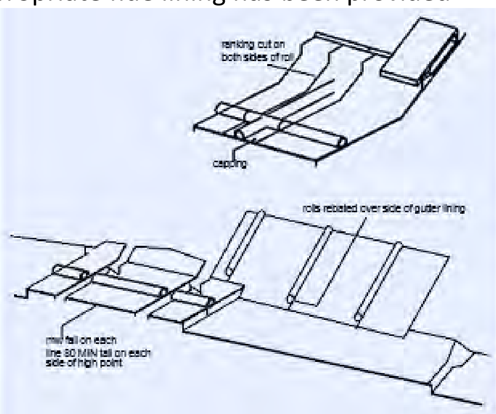


Diagram 2.191: Tapered gutters – high points

Thatched Roofs – new properties and extensions

Thatched roofs should be constructed by a suitably experienced thatcher. Work should be in accordance with the following recommendations:

- The recommended type of thatch is Norfolk water reed. Combed wheat straw may be required by some Planning Authorities but is subject to greater maintenance
- Depth of thatch to be 300 to 375mm
- Fixings should be mild steel thatching nails
- Thatch to be under-drawn with a mineral fibre blanket. A metal foil barrier should also be provided beneath the thatch to provide protection during the construction work and to reduce the risk of accumulation of debris within the roof void and consequential increase of fire risk
- Electrical cables in roof spaces should be mineral insulated copper covered (MICC) or located in a metal conduit
- Smoke detectors should be provided in the roof space and within the dwelling, together with an audible warning device located on the upper landing
- Party walls to be fire stopped at junction with thatch roofing
- Galvanised wire netting to be provided to prevent entry of vermin. Galvanised wiring should be 19mm net 20 gauge
- The Developer/Builder to advise the Purchaser that the ridge should be renewed every five years and the roof be subject to an annual inspection and maintenance contract
- Chimneys should be mortar rendered within the roof space after having ensured that all mortar joints are properly filled and that an appropriate flue lining has been provided
- Thatching materials to be properly stored and protected prior to, and during, erection
- A suitable flashing system should be provided within the thatch layer around chimneys and at abutments (usually code 4 lead)
- A suitable valley gutter should also be incorporated in the thatch at all valley intersections Television aerials, satellite dishes, etc., should be sited on gable walls (not on chimneys etc.) in order that thatch may not be damaged during cleaning or maintenance of these items
- Pitch of roof to be not less than 50˚ (45˚permitted for dormers)
- Detailed fire precautions to be carried out as advised by the Building Control Authority
- Pea shingle drainage trench to be provided around perimeter of building or paving slabs laid to falls to shingle trench
- **Additional guidance can be found in the LABC guidance document - 'The Dorset Model' reproduced below.**

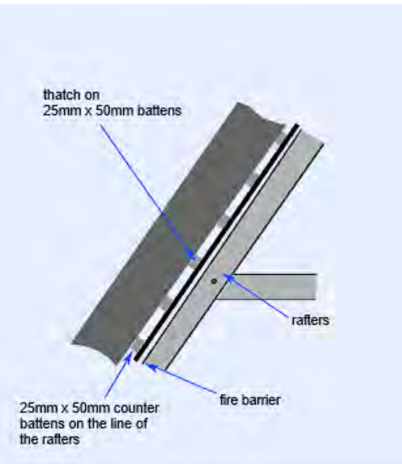


Diagram 2.192: Traditional crook fixing

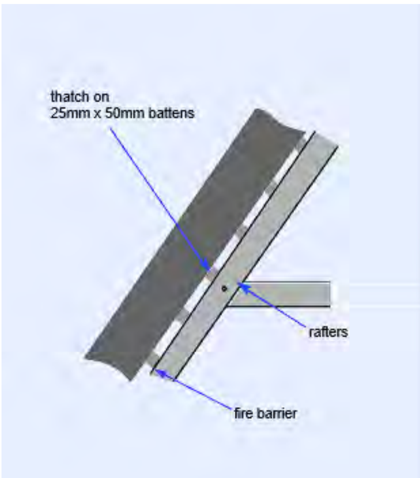


Diagram 2.193: Stainless wire and screw fixing

The following guidelines are to advise you of certain requirements if you are considering extending or constructing a thatched roof building less than 12m from your boundary.

Each proposal will be considered upon its merits, therefore early consultation with a member of the Building Control staff is recommended.

A uniform approach to thatched buildings is now being advocated across Dorset where compensatory requirements are considered acceptable to achieve compliance with the Building Regulations.

Requirements

a) Rafters are to be overdrawn with a minimum 30 minute fire barrier (integrity and insulation) and this barrier should also be water resisting. 50 x 25mm counter battens are recommended on a micro-porous boarding to allow the thatch to breathe. (Dorset Fire and Rescue Service recommend a 60 minute barrier under the thatch for property protection).

b) The chimney, including the pot, should terminate at least 1.8m above the height of the ridge. Due to the risk of condensation forming as hot gases cool, the chimney pot should be limited to a maximum height of 600mm.

c) A domestic mains and battery powered, interlinked smoke alarm system will be required with one smoke alarm fitted in the roof void. The system should generally be in accordance with that specified in Approved Document B to B.S. 5839 Pt. 6.

d) The written comments of the adjoining property owner will be requested by the Local Authority for consideration.

e) A terrace may not consist of more than three thatched dwellings together**Recommendations**

a) The provision of a loft hatch is recommended for firefighting purposes. The minimum recommended size is 600mm x 900mm.

b) Advice should be sought from an approved electrical contractor regarding the most appropriate type of wiring system. Effects from rodent damage and straw debris need to be considered and the National Inspection Council for Electrical Installation Contracting have issued guidance to their members.

c) It is NOT recommended to cut recessed lighting into the ceilings below the thatch. Light fittings within the roof space to be in a bulk head fitting. External floodlights should not be located just under thatch.

d) Spark arrestors on the flues are NOT recommended because they can clog and restrict the flow of flue gases.

e) It is recommended that an external water tap supplied from the rising main, is fitted with a hose capable of reaching all parts of the roof.

f) Any metal plumbing in roof space should use compression joints to avoid the use of blow torches.

Further advice may be sought from the Dorset Master Thatchers Association on how these matters may best be incorporated into their traditional craft. Additional fire safety advice is available free of charge from Dorset Fire and Rescue Service.

The 'Dorset Model' has been jointly produced by the Local Authorities across Dorset in conjunction with Dorset Fire & Rescue Service, The Dorset Master Thatchers Association and after consultation with the National Inspection Council for Electrical Installation Contracting and the Building Research Establishment Ltd. On the basis that evidence has shown that thatch can be made sacrificial in the event of fire.

Visit www.dorset-technical-committee.org.uk

Condensation control in roof spaces

Avoid build up of condensation in roof voids
Excessive condensation in roof spaces can cause decay of damp susceptible materials such as timber, plaster, etc. and reduce the efficiency of thermal insulation.

Cold bridges should be avoided at roof/wall junctions by ensuring continuity of thermal insulation (See diagrams 2.194 and 2.195).

All extraction fans should terminate to the outside of the building and not within the roof void.

Venting Pitched Roofs
Ensure that roof spaces to pitched roofs are vented on two opposite faces by a 10mm continuous ventilation gap (25mm if roof pitch is less than 15 degrees). A proprietary tray should also be provided to ensure that the ventilation is maintained where the roof insulation abuts the eaves (See diagram 2.194).

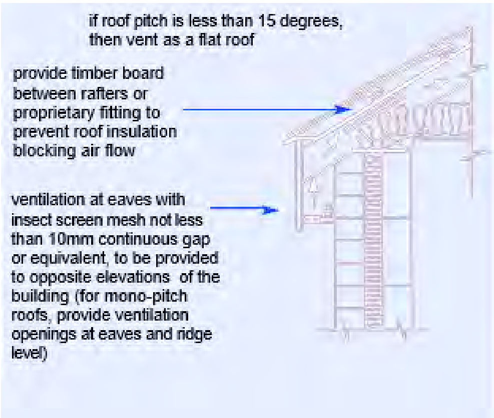


Diagram 2.194: Venting of pitched roof

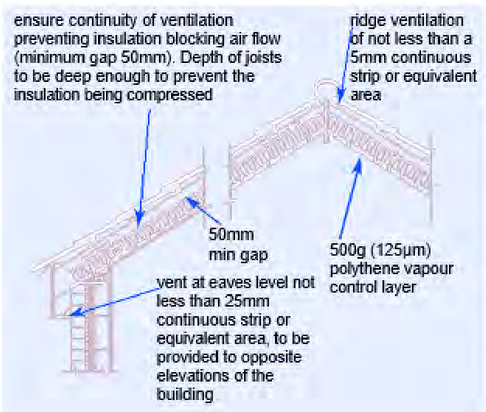


Diagram 2.195: Venting of cold pitched roof

Ceiling following pitch of roof
Provide a 25mm continuous ventilation gap along two opposite eaves and provide additional proprietary ridge or tile vents along ridge line to provide additional ventilation area of 5,000mm^2 per metre run (See diagram 2.195).

Should the air flow be blocked, for example by a roof light, the use of tile vents above and below the blockage should be considered to maintain an air flow.

Pitched roof timbers should be preservative treated where the insulation and ceiling line follow the roof pitch (referred to as a cold pitched roof).

Ensure continuity of the ventilation by preventing the insulation blocking the air flow and maintaining a 50mm air gap between the insulation and the felt. This could be achieved by:

- the use of board fixed to battens between the rafters
- the use of rigid insulation fixed to the sides of the rafters
- or paper backed quilt stapled to the underside of the rafter (See diagram 2.198)

Lean-to roofs

Examples are:

- Monopitched roofs and situations where a party wall is located parallel to the ridge

- Provide 10mm continuous gap at eaves (25mm if roof pitch is less than 15°) and ventilation of 5,000mm^2 per metre run at ridge level using proprietary ridge or tile vents (10,000mm^2 run if the roof pitch is less than 15°) (See diagram 2.196

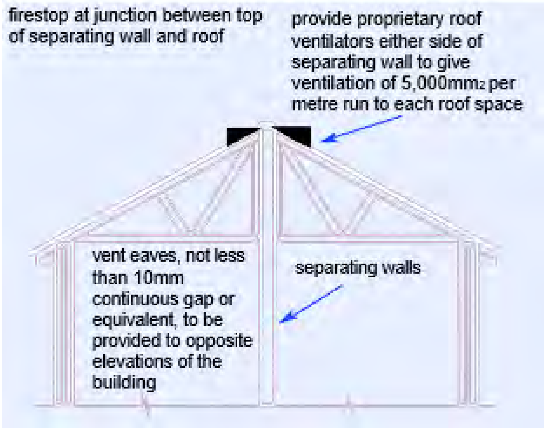


Diagram 2.196: Venting of mono pitched roofs at eaves and ridge

- Small insulated cold pitched roofs (less than 3m^2) do not normally need to be provided with cross ventilation.
- Cross ventilation must be provided to insulated flat roofs or where the ceiling follows the pitch of the roof irrespective of its size. In these cases it may be better to consider an alternative design such as a warm roof or the use of a breathable membrane.

Warm Pitched Roofs

Even with the use of vapour impermeable insulant it is necessary to provide means to allow vapour to exit the system. The use of a third party accredited vapour permeable membrane, when used in accordance with the manufacturers' guidance, negates the need to ventilate above the insulation, which may be difficult in roofs with hips, valleys, roof lights and other roofline interuptions (See diagram 2.197).

Further guidance on the control of condensation in roof spaces can be found in BS 5250 and BRE publication BR 262 "Thermal Insulation: avoiding the risks" 2002 edition.

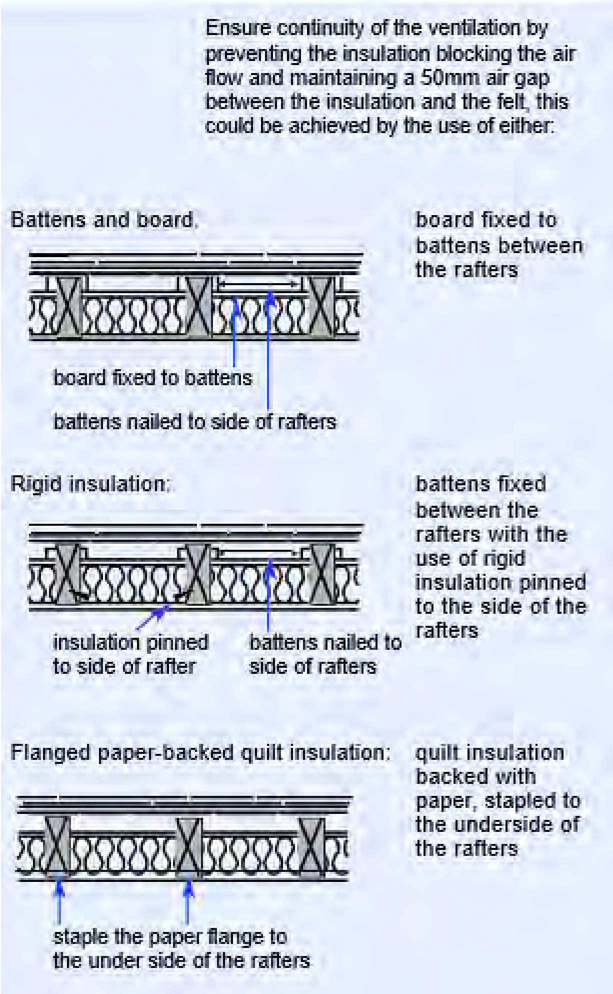


Diagram 2.198: Maintaining a 50mm gap over insulation in a cold pitched roof

Additional guidance for the use of vapour permeable membranes

Alternatively, condensation in warm and cold pitched roofs may be controlled by the use of a Third Party accredited vapour permeable membrane as the underlay in a non-ventilated system. This approach allows for the escape of water vapour through the membrane and exit freely to atmosphere, via laps in the tiles/slates. This method does not require ventilation at eaves, ridges or mid-slope when used in accordance with the manufacturer's guidance.

When using Third Party accredited vapour permeable membranes to control condensation in roof spaces, it is important that the manufacturer's recommendations are followed:

- Ridge or high-level ventilation (at the highest point of each roof slope) equivalent to a continuous opening of 5mm should be provided in accordance with BS 5250 where„unventilated cold roofs have insulation placed over a horizontal ceiling and a vapour-permeable underlay (type LR) is used
- Particular attention should be given to the fitting of eaves carriers to prevent UV light degradation of the membrane. This will also reduce noise by vibration or 'flapping' of the membrane in the gutter.
- The type of roof covering may require the use of ventilation to the batten/counter batten area. Man-made slates and sheet metal profile roof coverings are of particular concern.
- The use of vapour permeable membranes over sarking boards may require the use of ventilation to the batten/counter batten area.
- For guidance refer to diagrams 2.199 and 2.200. A service is usually offered by manufacturers to perform dew point calculations. This will confirm the suitability of the system and compliance with the recommendations in BS 5250.

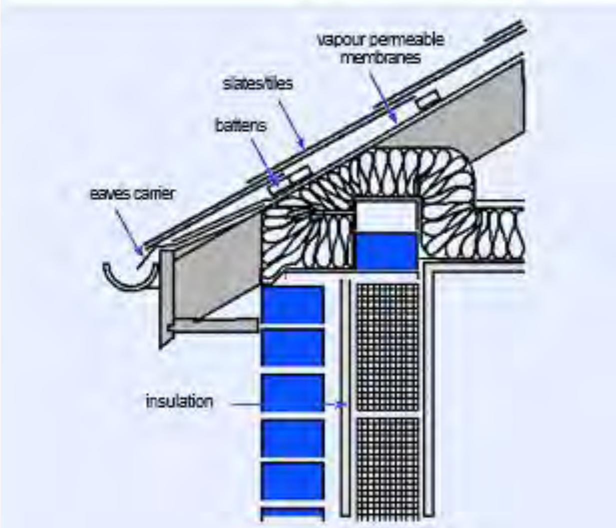


Diagram 2.199: Vapour permeable membrane at eaves

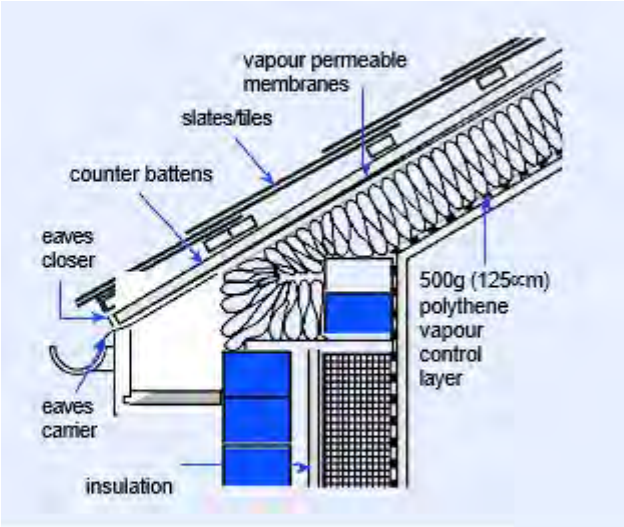


Diagram 2.200: Vapour permeable membrane at eaves with sloped ceiling

Roof void Access

Ensure that roof spaces are accessible and that the access hatch or door is located in a safe place e.g. not over a staircase. The access hatch should be not less than 520mm in either direction, located between structural members, a proprietory hatch is reccomended and fitted with an effective draught seal, insulated and sealed to the surrounding construction in accordance with the manufacturers instructions.

Workmanship should be in accordance with BS 8000:8.

Flat Roofs

General

The moisture content of structural timber should not exceed 20% 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'.

Flat roofs should be designed as either:

- warm deck roofs,
- inverted roofs or
- ventilated cold deck roofs.
- A flat roof should be regarded as having a maximum
- slope of 10˚ from the horizontal
- "Decking" or "deck" is the substrate of a flat roof or
- the upper surface of a balcony

Flat roofs should be laid to a minimum fall of 1 in 40 or to a fall in accordance with manufacturers details provided the product has a third party accreditation acceptable to Q.

Where a cold deck roof is used, ensure that a vapour control layer and minimum ventilation is provided in accordance with BS6229. The vapour control layer should be carefully fitted with lapped joints and no perforations (See diagram 2.203).

Glass fibre Reinforced Plastic (GRP) roof systems are acceptable where designed and installed to the manufacturer's recommendations.

Flat roof construction should comply with the following:

- All roof timbers (with the exception of inverted warm deck roof timbers) to be preservative treated to BS5268:5 with all site cut ends treated
- Weatherproof covering to be hot bonded and consist of 3 layers of high performance felt holding appropriate independent third party certificates acceptable to Q.
- Single layer weatherproofing systems are acceptable with current independent third party certificates acceptable to Q.
- **Chipboard should not be used as a decking material (exterior quality WBP plywood is recommended**)
- The design, workmanship and selection of materials should comply with Model Specification Sheet P.L.1 Built-Up Roofing: Plywood Deck, published by the British Flat Roofing Council.
- Work on site should comply with BS8000:4.

Flat roofing systems should not be laid during wet weather or when the roof deck has not fully dried out.

Metallic roof trims should be of a non-corrodible material and resistant to sunlight. In addition to the manufacturers recommended fixings, roof trims should be fixed within 30mm from any joint.

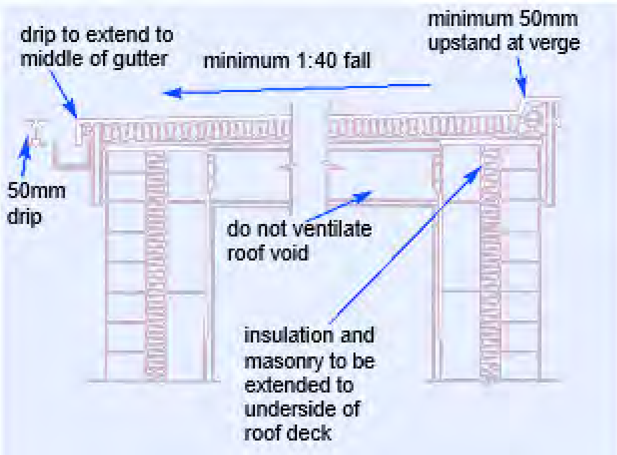


Diagram 2.201: Warm deck flat roofs – details at eaves and verge.
See also diagram 2.202 for more details

Venting Flat Roofs

Warm deck flat roofs should be used in preference to cold deck flat roofs (See diagrams 2.203 and 2.205). Cold deck flat roofs are not permitted in Scotland.

Where cold deck flat roofs are used, the roof void should be vented along two opposite faces by a 25mm continuous gap and a vapour control layer provided to the warm side of the insulation (See diagram 2.204).

Where the span of cold deck flat roofs exceeds 5m, additional provision for ventilation should be made at mid-span using proprietary roof ventilators providing a ventilation area of not less than 50% of the required rate for perimeter ventilation.

Venting junctions at pitched and flat roofs

Provide 25mm ventilation to eaves of cold deck flat roof and 10mm to eaves of pitched roof, ensuring continuity of ventilation at the flat roof/pitched roof junction (See diagram 2.204). In the case of a warm deck flat roof (which is not ventilated) abutting a pitched roof, provide tile vents adjacent to the roof junction to give a ventilation area of 10,000mm^2 per metre run (See diagram 2.205). The type and thickness of flat roof decking should be not less than as set out in table 2.50.

Type of decking	Recommended deck thickness (mm) and joist centres	
	450	600
Preservative treated softwood boarding	16	19
Oriented Strand Board type 3 or 4 BS EN 300	15	18
WBP bonded plywood to BS EN 636-2	12	15-16
Cement bonded particle board to BS EN 634	51mm thick type SB	

Thickness and spans are recommended and not minimum. Recommendations for specific plywood grades issued by the American Plywood Association, Council of Forest Industries or Finnish Plywood International may allow greater spans. In all cases, fixing and other recommendations of these associations should be followed.

Spans shown apply to warm and cold deck roofs accessible for maintenance only. Deck thickness for inverted roofs is directly related to the weight of the top surface and should be in accordance with the manufacturer's recommendations.

Roof timbers to flat roofs should be preservative treated with cut ends dipped or liberally brushed.

Table 2.50: Flat roof construction

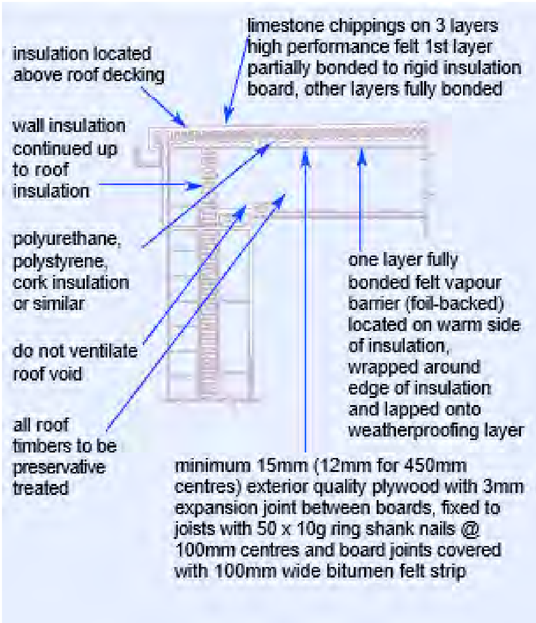


Table 2.202: Typical warm deck flat roof

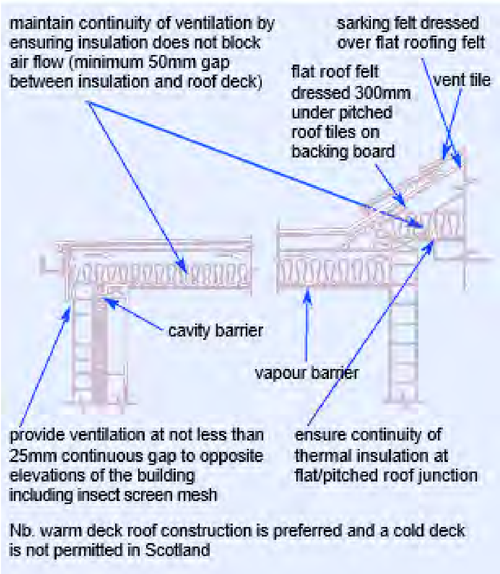


Diagram 2.204: Venting of pitched/cold deck flat roof junction

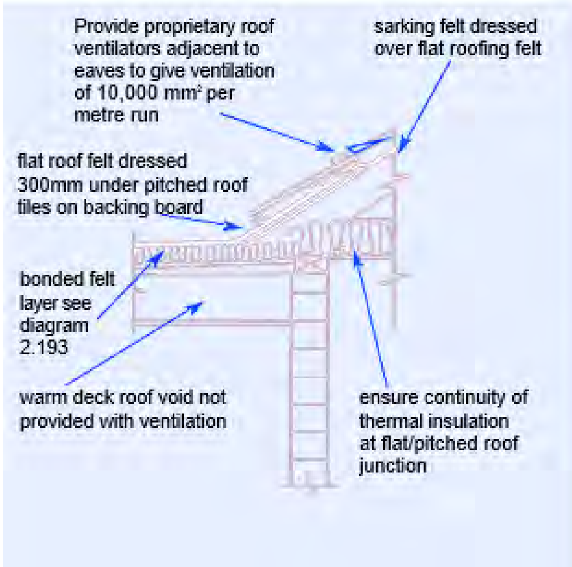


Diagram 2.205: Venting of pitched/warm deck flat roof junction

Rainwater gutters and downpipes

Ensure downpipes discharge directly to a drain
Rainwater downpipes should not discharge directly onto adjacent flat roofs or gutters as this can cause dampness and staining of walls and early failure of flat roof surfaces.

Downpipes should discharge directly to a drain or gully (gullies must be trapped), not on to gardens or highways.

During construction downpipes should be connected as early as possible to a drain in order to avoid rainwater discharge weakening the strength of the foundation subsoil.

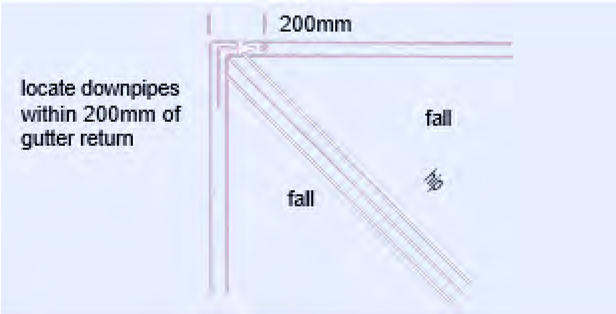


Table 2.206: Location of downpipes

Avoid overflowing rainwater gutters
Where appropriate, rainwater gutters and downpipes can be sized in accordance with the Building Regulations or BS 6367/BS EN 12056.

Advice can also be obtained from product manufacturers.

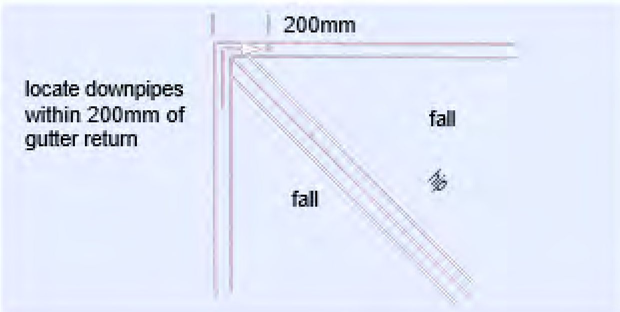


Diagram 2.207: Location of downpipes - corners

Provision of gutters and downpipes
Roofs greater than 6m^2 in area should be provided with rainwater gutters and downpipes. Consideration should also be given to the provision of rainwater drainage to roof areas less than 6m^2, e.g. dormer and porch roofs.

Discharge of gutters into downpipes can be substantially improved by careful location of downpipes e.g.:

- Where more than one downpipe is required, locating downpipes at end quarter positions will double the flow capacity (See diagram 2.206).
- Where changes in the line of the gutter occur, the downpipe should be located within 200mm of the change in direction in order to maintain the flow capacity of the gutter (See diagram 2.207).

type of surface	Effective design area (m^2)
paved areas	plan area
flat roof	plan area of roof
30° roof pitch	plan area x 1.29
45° roof pitch	plan area x 1.50
60° roof pitch	plan area x 1.87
70° roof pitch	elevational area x 0.5

Table 2.51: Calculation of roof area

Max effective roof area (m^2)	Gutter size (mm dia)	RWP. outlet size (mm dia)	Flow capacity (litres/sec)
6.0	-	-	-
18.0	75	50	0.38
37.0	100	63	0.78
53.0	115	63	1.11
65.0	125	75	1.37
103.0	150	89	2.16

Table 2.52: Gutter sizes and outlet sizes

Guidance for design of Gutters
First calculate the area of roof to be drained (See table 2.51).

Next decide which gutter size is appropriate for the designed roof plan area (See table 2.52).

Avoid deformed gutters and downpipes
Gutters should not have a backfall and should preferably slope to downpipes at a 1 in 350 fall.

Gutters and downpipes should be fixed at centres as recommended by the manufacturer. Typically gutters require brackets at 800 – 1000mm centres and downpipes at 1800 – 2000mm centres.

Downpipes should not be located closer than 300mm to balanced flue outlets.

Avoid leaking internal gutters
Internal gutters and associated gutter outlets are common sources of roof leaks. Wherever possible, rainwater should drain to the outer edge of the roof and discharge into an external rainwater gutter.

Avoid ponding on flat roof surfaces
Rainwater should efficiently discharge to a gutter without causing ponding of the roof surface. If ponding occurs, the life of the weatherproof membrane may be reduced.

Provide a minimum 1:40 fall for flat roof decking
Although slopes as low as 1:80 provide flat roofs with an adequate self-draining fall, in practice greater falls are necessary in order to accommodate inaccuracies in levels of supporting walls and the permanent deflection of the roof structure under its own weight.

Ensure that rainwater discharges effectively into roof gutters
Flat roof drips should extend to the middle of the rainwater gutter and a minimum 50mm turndown provided.

Verges to flat roofs should be provided with a minimum 50mm upstand in order to prevent blown water spilling over non draining edges.

Balconies

Balconies should comply with the following:

- Balconies functioning as roofs shall have adequate rainwater disposal to a suitable outfall.
- Balconies and flat roofs to which persons have regular access other than for maintenance shall be guarded adequately.
- Balconies and flat roofs including associated elements such as support and guarding shall be designed to resist the applied loading and should be calculated in accordance with BS 6399 and have adequate durability.
- Structural design shall be undertaken to a recognised standard to ensure that loads are transmitted to the supporting structure without undue movement and should be in accordance with BS 5268 and BS 8103 for timber and BS 8110 for concrete.
- The durability of the structure should be 60 years.

The use of timber in balconies should be limited to secondary elements which are in turn are supported by materials other than timber. Timber can be used in the following circumstances:

- Cantilevered solid timber joist balconies with a waterproof membrane above the joist
- Open balcony constructions with timber decking.
- The decking may be supported on solid timber joists which are supported by materials or components other than timber
- Balustrading.

Timber should not be used for:

- Gallows brackets supporting a balcony
- Posts or columns supporting a balcony
- Guard rails or their support.

Guarding to Balconies

Guarding should be provided to the perimeter of all balconies, unless the drop is less than 600mm. The minimum height of guarding should be 1100mm and should be designed as follows:

- The balustrade should not be easily climbed
- No opening in the balustrade should be large enough for a 100mm diameter sphere to pass through
- Any glazing should be toughened or laminated glass or glass blocks. Wired glass is not safety glass and should not be used
- Balustrading should not be fixed through the weatherproofing unless special precautions are taken

Falls

Balconies should be designed to have a fall of not less than 1:40. To ensure that balconies and flat roofs have an adequate finished fall of 1:80, twice this figure (1:40) should be used for design purposes unless a detailed analysis of the roof is carried out, including overall and local deflections.

Falls should be away from and parallel to the dwelling.

Suitably drained decking may be incorporated above the waterproofing but less than 150mm below the sill.

Where a balcony or flat roof has an upstand on all sides, an overflow outlet should be provided through the parapet walls or perimeter upstands to prevent build-up of water. The size of the overflow should be the same size as the outlets. (See diagram 2.208).

Movement joints should be allowed for in the design of parapet walls.

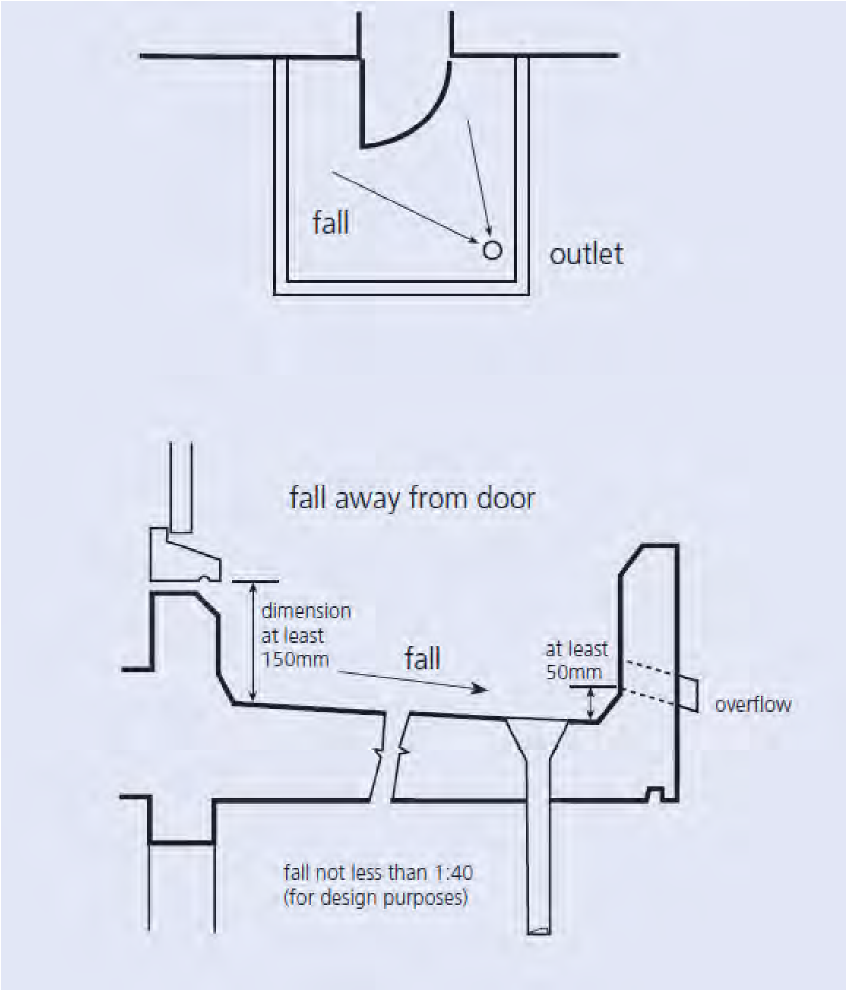


Diagram 2.208: Balcony Falls

INTERNAL / EXTERNAL WORKS, SERVICES & FINISHES

General

Ways of achieving compliance with the requirements

The building should be designed and constructed in accordance with the guidance contained in the following appropriate documents

- **England & Wales**
  - Approved Document A - Structure
  - Approved Document B – Fire safety
  - Approved Document D – Toxic substances
  - Approved Document E – Resistance to passage of sound
  - Approved Document F - Ventilation
  - Approved Document G - Hygiene
  - Approved Document H – Drainage
  - Approved Document J – Combustion appliances and fuel storage systems
  - Approved Document L – Conservation of fuel and power
  - Approved Document N – Glazing
  - Approved Document P – Electrical safety
  - Approved Document 7 – Materials and workmanship

- **Scotland**
  - Section 0: General
  - Section 1: Structure
  - Section 2: Fire
  - Section 3: Environment
  - Section 4: Safety
  - Section 5: Noise
  - Section 6: Energy

- **Northern Ireland**
  - Part A: Interpretation and general
  - Part B: Materials and workmanship
  - Part F: Conservation of fuel and power
  - Part G: Sound insulation of dwellings
  - Part J: Solid waste in buildings
  - Part K: Ventilation
  - Part L: Combustion appliances and fuel storage systems
  - Part N: Drainage
  - Part P: Unvented hot water storage systems
  - Part R: Access to and use of buildings
  - Part V: Glazing

Internal Works - Floors

General

Fire resistance
All floors should have the fire resistance required by the relevant Building Regulations.

I-Joists and metal web joists may require a different specification for the ceiling than that for solid timber joists to achieve the same fire resistance.

Ceilings should not be perforated (e.g. for downlighters) unless it can be shown that the floor construction achieves the required fire resistance.

Fire stopping
Penetrations in floors between dwellings shall be fire stopped. There should be no holes or gaps for smoke to penetrate once the fire stopping has been installed. Where downlighters are incorporated in a ceiling they should be incorporated in accordance with the manufacturer's instructions.

Thermal insulation of ground floors

Provide an effective and durable layer of thermal insulation to ground floors (this includes floors to habitable basements).

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

Thermal insulation materials subject to load (e.g. where located below slab, screed or boarding) should possess current independent third party certificates acceptable to Q, and be laid in strict accordance with its recommendations.

Floors – Insulation

Timber board loose laid system

A loose laid system is where T&G panels of particleboard 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 gauge polythene (125µm) vapour barrier is then laid over the insulation with 150mm lapped and taped joints continued up the walls to 25mm minimum above the insulation (See diagram 3.01).

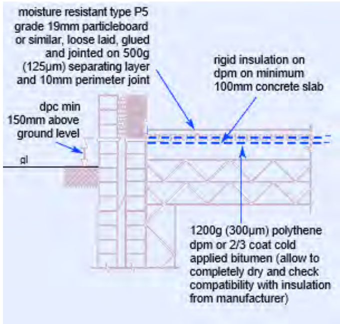


Diagram 3.01: Ground supported concrete slab finished with separate timber boarding and loose laid insulation system

Type P5 or P7 particleboard or similar, with all joints glued with PVA adhesive or similar is then laid over the vapour barrier. Allow for a 10mm gap or 2mm 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 lapped to the dpc (this is to prevent any residual moisture in the slab affecting the particle board). (See diagram 3.02)

The jointing and expansion gaps at walls are as the loose laid system. (See diagram 3.01)

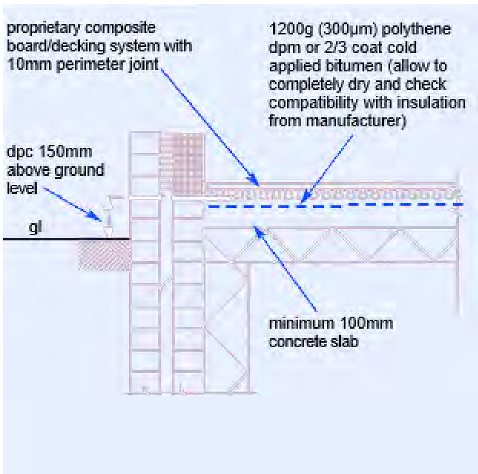


Diagram 3.02: Ground supported concrete slab finished with Composite board/decking system

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.

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 65mm thick and incorporate a layer of either D49, D98 or chicken mesh reinforcement located centrally in the screed (See diagram 3.03), if the floor area of the room exceeds 15m^2.

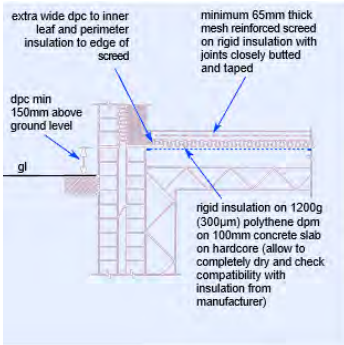


Diagram 3.03: Ground supported concrete slab with insulation located below screed

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 3.04).

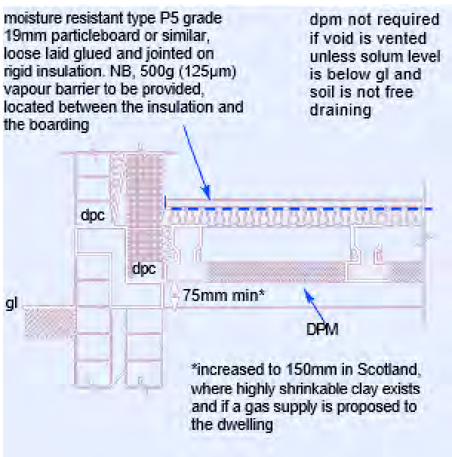


Diagram 3.04: Precast concrete ground floor with timber decking and insulation

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 of the insulation
- Non T&G board joints should be screw fixed to battens eg. at door openings
- 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.

Screeds

General

- The dwelling should be made weather-tight before finishing materials are stored or fixed within the dwelling
- Finishes should be compatible with the supporting surface
- Exposed corners and edges of surfaces which do not have sufficient impact or wear resistance should be provided with a suitable strengthening bead or edging strip
- Movement joints should be provided where required in order to minimize cracking or warping due to expansion, moisture or other causes
- Movement joints should also be provided to finished surfaces to coincide with movement joints which occur in the structure where required.

Screeds to sheet and tile flooring should comply with BS 8203. Care is needed when choosing adhesives. They must be compatible with screed.
Monolithic screeds should be laid within 3 hours of the subfloor being laid and be no less than 12mm and no greater than 25mm thick (See diagram 3.05).

Unbonded screeds should be a minimum 50mm thick (See diagram 3.05).

Bonded screeds should be laid on a thoroughly scabbled or shot-blasted concrete base. The screed thickness should be between 25mm and 40mm (See diagram 3.05). An allowance should be made for deviations in the level of the concrete base. To achieve a minimum thickness of 25mm overall, a design thickness of 40mm may be required.

Floating screeds (screeds laid over an insulating material) should be a minimum 65mm thick. A layer of D49 or D98 mesh reinforcement should be placed centrally in the depth of the screed if the room size is more than $15m^2$. A layer of impervious sheeting should be provided over open cell or other porous insulating material (See diagram 3.05).

Screeds in excess of $30m^2$ should be provided with shrinkage joints.

For screeds, a cement and sand mix of 1: 3 to $4^{1/2}$ by weight should be used. For screeds exceeding 50mm, a concrete mix of 1: $1^{1/2}$: 3 (10mm aggregate) can be used.

Before laying a screed or applying a damp-proof membrane, the surface of the supporting slab should be thoroughly cleaned of plaster, dust, loose debris, oil, etc. Concrete subfloors should not be contaminated with any substances that may have a harmful effect on the screed finish.

Screeds should be fully cured and protected against damage prior to laying of the floor covering.

Proprietary screeds should be laid in accordance with the manufacturer’s instructions. Ensure that PC beam and block floors possess current independent third party certificates acceptable to Q and are:

- Fully supported by loadbearing walls
- Not damaged in any way
- Laid as specified by the designer and the independent third party certificates acceptable to Q.

Ensure that:
Beams and blocks are grouted together with a 1:6 cement/sand mix or in accordance with the manufacturer's instructions.

Screeds in garages are reinforced with minimum A98 steel mesh to distribute car loads alternatively are to the manufacturer's/engineer's requirements.

Mixing
Materials should be thoroughly mixed in correct proportions on a clean surface.

Materials should be frost-free at the time of mixing.

Screed materials should be mixed in force-action mixers.

Free fall drum mixers should not be used.

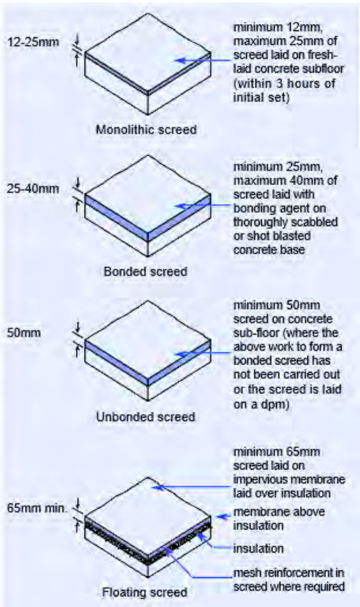


Diagram 3.05: Types of screed

Flexible Floor Coverings

Sheet and tile flooring should comply with BS 8203.

Floor finishes should not be laid until the slab/screed has dried out.

Where it is necessary to use a self-levelling compound to achieve the required quality of finish for the support, the manufacturer's recommendations should be followed.

Where sheet or tiled vinyl is laid on timber floorboards, a sheeting such as 6mm conditioned hardboard, or 4mm plywood should be laid first to give a smooth finish (unless T&G chipboard or a similar level surface is already provided). The sheeting should be securely fixed to the floor.

Floor coverings should always be fitted in accordance with the manufacturer's instructions.

Joints between floor coverings should be even and regular as is appropriate to the material. Cutting and trimming should be carried out neatly.

Floor finishes should be cleaned and adequately protected until the dwelling is handed over.

Floor tiling
Rigid tile flooring should comply with BS 5385.

Adhesives are to comply with BS 5980.

Mortar for fixing floor tiles should be as recommended by the tile manufacturer and must be compatible with the subfloor. (See table 3.01).

Surfaces should be dry, clean and free from any substances that may adversely affect the bonding.

Tile grouting should be selected to suit a particular location. Joints should be thoroughly filled and surplus grout removed. Flexible watertight joints should be provided between sanitary or fixed kitchen units and a tiled surface.

Tiles should be laid reasonably square and to the designed pattern.

Work on site to be in accordance with BS 8000:11.

Floor surfaces that are exposed to rainwater should be laid to self-draining falls connected to a rainwater outlet.

Base	Cement : sand and mortar and cement : lime : sand mortar bonded to base	Cement : sand semi-dry mix Bonded Unbonded*	Adhesive
New concrete (less than 6 weeks old)	UUSU		
New screed (less than 3 weeks old)	UUSU		
Mature concrete	SSSS		
Mature screed	SSSS		
Screed over suspended floor or underfloor heating	UUSC		
Suspended in situ concrete Rigid and new (less than 6 weeks old) Rigid and mature With significant deflection	 UUSU SSSS UUSC		
Timber	UUUC		
Asphalt	UUSC		
Existing hard floor finishes after preparation Terrazzo Unglazed ceramic tile Glazed ceramic tile Granolithic topping Natural stone	 SUSC SSSS SUSC SSSS SSSS		

Key: S Suitable U Unsuitable C Confirm suitability with tile manufacturer or supplier
*Unbonded beds are unsuitable for heavy traffic conditions.

Table 3.01: Suitability of flooring beds for different bases

Internal Works - Walls

Timber Partitions

Loadbearing and bracing internal walls should be designed by an Expert and should not be modified without approval. Partitions should be:

- Adequately supported so as not to be subjected to excessive vertical movement
- Constructed so as not to support any loadbearing elements unless specifically designed otherwise
- Accurately set out and aligned so as to produce a level, plumb and plane surface, ready to receive the wall lining
- Located parallel or perpendicular to the main structural walls unless specifically designed otherwise.

Partitions bearing onto ground supported slabs should be provided with a damp proof course where required by the Building Control Authority.

General

- Partitions should be robust and form a smooth, stable, plane surface to receive decoration
- Supporting members should be accurately spaced, aligned and levelled
- The tolerance of horizontal straightness of a partition should be ±10mm over a 5 m length
- The deviation in vertical alignment of a partition in any storey height should be ±10mm
- Timbers supporting plasterboard should be regularised and have a moisture content not greater than 20% at the time of erection. (Lower moisture contents can reduce the incidents of nail popping and other effects of shrinkage)
- Additional guidance can be found in BS 8000:8 and BS 8212.

Studs should be not less than 38mm wide and not less than 63mm thick (up to a maximum partition height of 2.4m) and 89mm thick (up to a maximum partition height of 3.0m). However, in order to accommodate tolerances for plasterboard fixing, a minimum width of 44mm is recommended.

Head and sole plates should consist of single length members fixed to the building structure at not less than 600mm centres (See diagram 3.06).

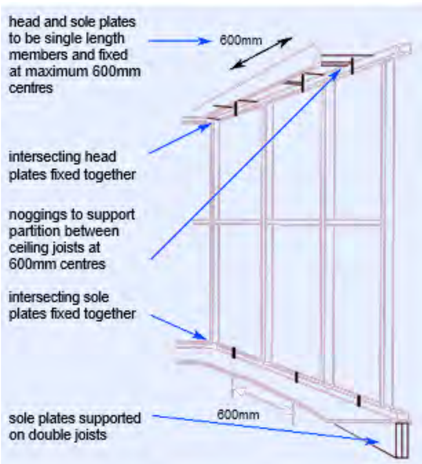


Diagram 3.06: Head and sole plates

Partitions should be located on double joists when parallel to floor joist span and nailed to 50 x 50mm noggins fixed between ceiling joists at 600mm centres when parallel to ceiling joist span. For short lengths of partitions (1.2 m maximum) blocking between joists at 600mm centres may be used. Intersecting head and sole plates should be skew nailed together (See diagram 3.06 and 3.07).

Timber members should be fixed together with minimum 2 No. 75mm long x 2.65mm diameter nails.

Partitions which support wall tiles should be constructed with 12.5mm plasterboard fixed to studs at 450mm maximum centres. Where studs are at greater centres, provide noggings at 600mm centres

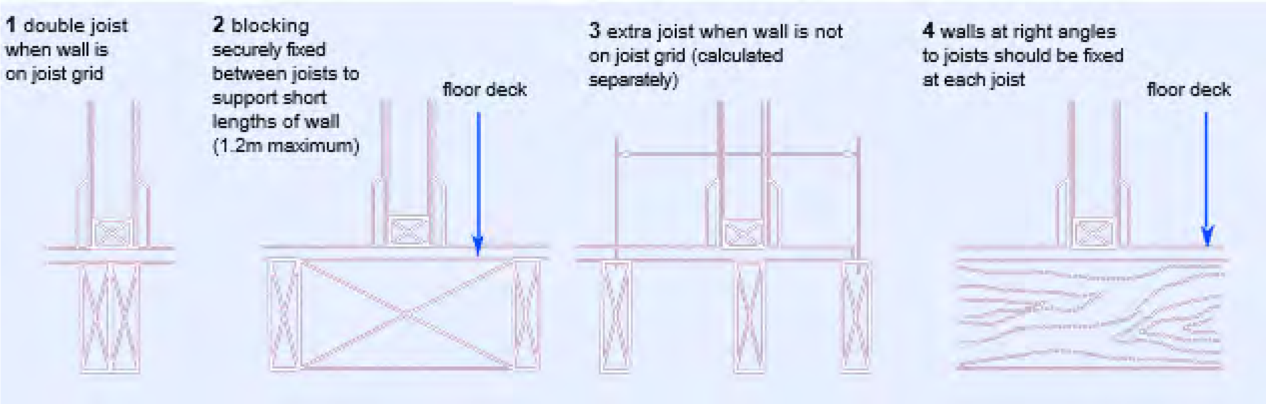


Diagram 3.07: Supporting of non loadbearing internal studwork partitions

Avoid horizontal joints in plasterboard. Where this is unavoidable (e.g. excessive floor to ceiling heights), provide noggings at joint locations and stagger the joints.

Stud members should be nailed or screwed to abutting walls and partitions at maximum 600mm centres (See diagram 3.08).

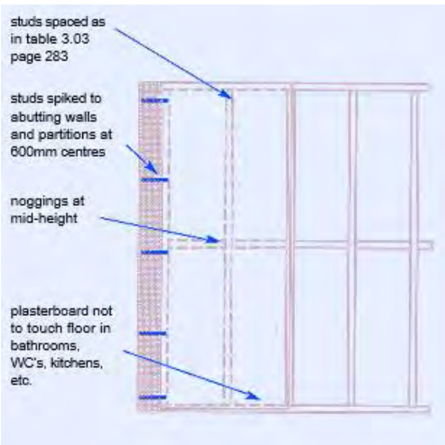


Diagram 3.08: Studs and noggings

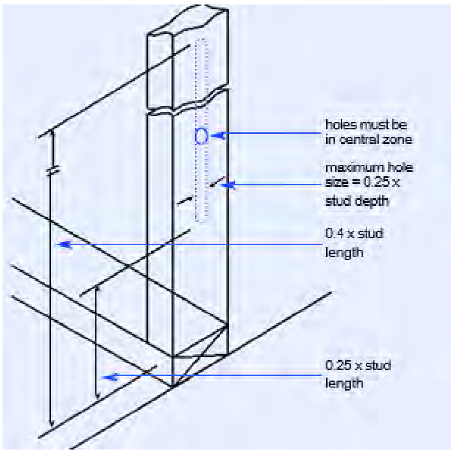


Diagram 3.09: Holes in studs or posts

Unless designed by an Expert, holes for electrical services may only be drilled on the centre line of timber studs between 0.25 and 0.40 of the stud height. Maximum hole size is 0.25 of the stud depth (See diagram 3.09).

Timber studs should not be notched.

All plasterboard edges to partitions (including bound edges) should be supported by noggings.

Openings should be trimmed with minimum 38mm wide noggings.

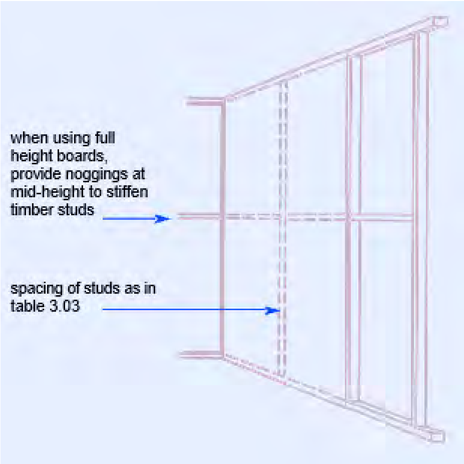


Diagram 3.10: Ceiling height boards

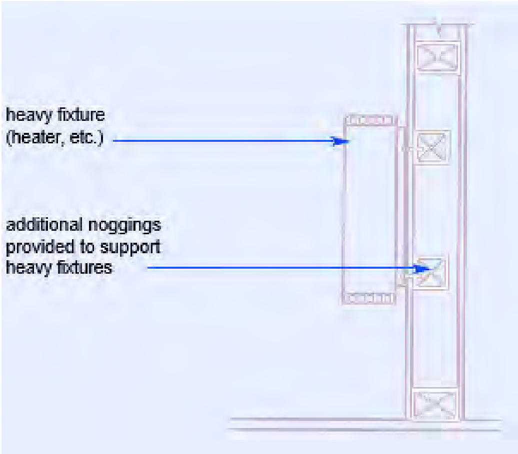


Diagram 3.11: Support of heavy fixtures

In the case of full height boards, noggings should be provided at mid-height in order to prevent studs from twisting and provide additional rigidity (See diagram 3.10).

Fixings

Additional reinforcement framing should be provided to support medium to heavy fixtures, e.g. radiators, wall cupboards, etc. (See diagram 3.11). Lightweight fixtures should be supported using proprietary fixings.

Many proprietary fixings for dry wall linings i.e. stud walls are readily available for fixing wall shelves and pictures. Any system used should be suitable for the wall type and the end use loadings applied. All installations should be in accordance with the manufacturers instructions.

Fixing of plasterboard

- All cut and bound edges of partitions should be provided with noggings
- Perimeters of all boards should be provided with noggings. However, when 15mm plasterboard is fixed at right angles to timber framing at centres not exceeding 600mm then noggins are not required
- Manufacturers' recommendations should be followed. Table 3.02 is provided for fixing guidance
- Fixings should be positioned not closer than 13mm to unbound edges (10mm from bound edges) or 6mm to edges of timber supports. (See diagram 3.12)
- Partition boards should be fixed with at least 8 nails per metre along each supporting member or spaced at approximately 150mm centres (See diagram 3.13). Screw fixings are recommended at 230mm centres for ceilings and 300mm for walls.

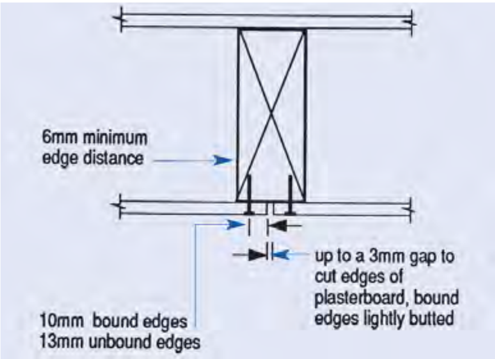


Diagram 3.12: Fixing of plasterboard to studs

Nail popping

Unsightly nail protrusion can be reduced by:

- Lowering moisture content of timber to that recommended by BS 5286: Part2.
- Nailing or preferably screwing plasterboard tightly to the timber framework.
- Avoiding overdriven or skewed nails puncturing the paper of the board.
- Not forcing boards to fit. They will bow and prevent secure contact with the frame.
- Avoiding fixing to twisted or misaligned framework.
- Driving home nails that are not securely driven into framing and re-fix in new ones.

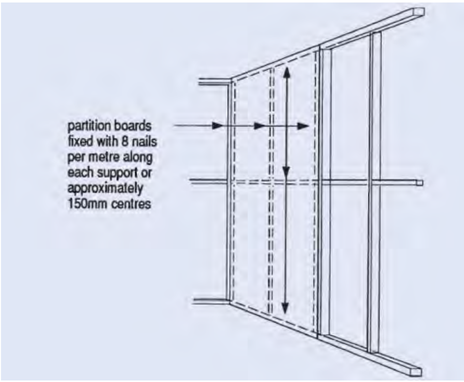


Diagram 3.13: Fixing of plasterboard to partitions

Non-Timber Partitions

board thickness (mm)		Drywall screw length (mm)	Nail length (mm)
	9.5	32	30
	12.5	38	40
	15	38	40
	19	41	50
2nd layer	12.5 over 12.5	51	50
2nd layer	15 over 15	60	65
2nd layer	12.5 over 19	60	65
2nd layer	15 over 12.5	60	65

Notes:
- Nail diameter of 2.5 mm and head of 7 mm
- For engineered 'I' beams and metal frames screw fixing is recommended
- Fixing centres should be :
  1. Screws 300mm for walls and 230mm for ceilings
  2. Nails for 150mm

Table 3.02: Nail fixings for plasterboard

Thickness of plasterboard

The thickness of plasterboard required depends upon the stud spacing and the board width (See table 3.03)

board thickness	board width	maximum spacing of studs
9.5mm	900mm	450mm
9.5mm	1200mm	400mm
12.5mm	900mm	450mm
12.5mm	1200mm	600mm

Table 3.03: Dry finish and skimmed plasterboard partitions

Where the partition separates a bedroom from a bathroom area it may be necessary to increase the thickness/weight of the plasterboard to achieve the required sound insulation.

Please refer to the following section for more information.

Metal studs system

There are a number of proprietary systems on the market. Generally they consist of "U" shaped channels which act as ceiling (head), base plates (tracks) and the vertical studs. These systems are lightweight, versatile and quick to erect.

Installation should always be carried out in accordance with the manufacturer's instructions. Plasterboard coverings are screw fixed to the metal studs, with, generally, the perimeter studs/tracks being mechanically fixed to the surrounding walls, ceilings and floors.

It may be necessary to provide earth-bonding to the metal stud system. Please refer to your NEIC registered contractor

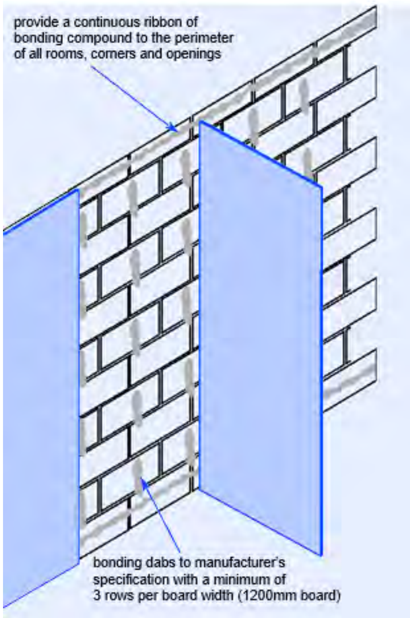


Diagram 3.14: Dry Lining

Other systems
Other proprietary internal non-loading bearing walling systems are available. Systems such as plasterboard walls with solid or hollow cores are commonplace and are generally accepted by Q, provided it can be shown that they are rigid enough to accommodate the predicted working and impact loads, and are designed to be suitable in performance for the environment in which they will be used.

Masonry partitions
Masonry partitions should not be supported on timber floors or beams unless designed by an Expert and the timber can be proven to be sufficiently dry and/or the masonry is reinforced. Generally, they should be supported by suitably designed steel beams or be built off ground floor masonry partitions provided with a foundation.

Dry lining
Fixing plasterboard direct to masonry can be achieved either by a proprietary mechanical system (in accordance with the manufacturer's instructions) or by plaster dabs (See diagram 3.14), the latter being the most commonly used form of dry lining for masonry construction. When using plaster dabs it is important to use a proprietary bonding (adhesive) plaster compatible with both the board and the background masonry.

It is also necessary to provide sufficient dabs (adhesive) together with a continuous ribbon to all room perimeters (floor, ceilings, corners and all openings). This prevents air movement (heat loss) behind the lining, it also assists in sound attenuation.

Finishes

General

- The dwelling should be made weather-tight before finishing materials are stored or fixed within the dwelling
- Wall linings should have a resistance to impact loads not inferior to that obtained from 9.5mm plasterboard continuously supported at 400mm centres
- Finishes should be compatible with the supporting surface
- Exposed corners and edges of surfaces which do not have sufficient impact or wear resistance should be provided with a suitable strengthening bead or edging strip
- Precautions should be taken at the junction between different surfaces to minimize cracking or warping occurring in linings due to expansion, moisture or other movement
- Movement joints should be provided to finished surfaces to coincide with movement joints which occur in the structure, where required
- Linings should not extend below any dpc or dpm.
- Wall linings should meet an appropriate British Standard or be assessed as suitable by an independent testing authority and be installed in accordance with the manufacturers instructions
- Plasterboard linings should be fixed plumb
- Moisture resistant boards should used in bathrooms and shower rooms

Direct decoration finish

Jointing should be carried out in accordance with the manufacturer's instructions.

Gaps greater than 3mm should be filled with jointing compound and allowed to set.

For joints and internal corners, apply a continuous thin layer of compound with tape pressed firmly into the joint ensuring no air bubbles remain. Immediately, apply a layer of joint compound flush with the surface. Once set, a final layer of feather-edged joint finish should be applied.

Galvanised metal beading or better should be provided to external corners firmly bedded in jointing compound and allowed to set.

Plastered finish

Gaps between boards and all nail holes should be filled with plaster. A nominal 50mm paper tape or glass fibre mesh tape (or other suitable joint reinforcement material) should be bedded over all joints and internal corners.

Galvanised metal beading trim should be provided to all external corners. The trim should be fixed to the plasterboard with corrosion-resistant nails or dabs of finish plaster at 600mm centres.

Final plastering should take place as soon as possible after fixing of boards.

Direct plastering to masonry Mixing

Materials should be thoroughly mixed in correct proportions on a clean surface.

Materials should be frost-free at the time of mixing.

Additionally the background should be frost-free, at least until the plaster is substantially dry.

Supporting surface	Number of coats	Average total thickness (mm)
Concrete	1	2
Brickwork	2	13
Blockwork	2	13
Metal lath	3	13
Gypsum on plasterboard	1	2

Table 3.04: Internal plastering

Internal Plastering
Internal plastering should comply with BS 5492. Table 3.04 provides details of the minimum number of coats and total thickness of plaster suitable for various types of supporting surfaces.

Wall paper and fabric finishes
Surfaces to be papered should be dry, thoroughly cleaned and prepared to provide a flat even surface. Where necessary, surfaces should be sealed or sized to reduce their porosity. Adhesives should be as recommended by the paper or fabric manufacturer. Surplus adhesive should be removed from the finish and any surrounding surfaces.
Work on site should be in accordance with BS8000:12.

Fire Resistance

Typically in dwellings only a half hour or one hour fire resistance is required to satisfy the Building Regulations, with regard to fire separation between dwellings and/or compartments within dwellings.

Table 3.05 provides typical examples of how these ratings can be readily achieved.

Material	1/2 hour FR	1 hour FR
Brick	90mm thickness	90mm thickness
Block	90mm thickness	90mm thickness
Plasterboard on timber	12.5mm board on both sides of framing	Two layers of 12.5mm board on both sides of framing **OR** Proprietary fire boards (typically 12.5 – 15mm) on both sides of framing
Plasterboard laminated wall	12.5 mm laminated on both sides of 19mm board	N/A

Notes:
1. All masonry joints should be properly filled with mortar.
2. All junctions with floors, walls, ceilings and roof coverings should be adequately fire stopped with a suitable non-combustible material.
3. All plasterboard layouts should aim to achieve staggered joints, with all joints being taped and filled.
4. All plasterboard layers should be fully fixed in accordance with manufacturer's recommendations to achieve the appropriate fire rating (see table 3.02 for fixing guidance)
5. Ceiling/wall junction layers should be alternated to form a 'Z' joint.

Table 3.05: Typical examples of achieving adequate fire ratings on walls

Sound Insulation
For information and guidance on sound insulation for floors and walls please refer to previous section.

Internal Works – Ceiling

Linings to Ceilings

General
The building should be made weather-tight before damp susceptible materials are stored or fixed within the building.

Exposed corners and edges of linings which do not have sufficient impact or wear resistance should be provided with a suitable strengthening bead or edging strip.

Precautions should be taken at the junction between different surfaces to minimize cracking or warping occurring in linings due to expansion, moisture or other movement.

Voids behind linings and duct-casings should not connect with the exterior of the dwelling or with a ventilated roof space, floor space or other ventilated void. (See diagram 3.15).

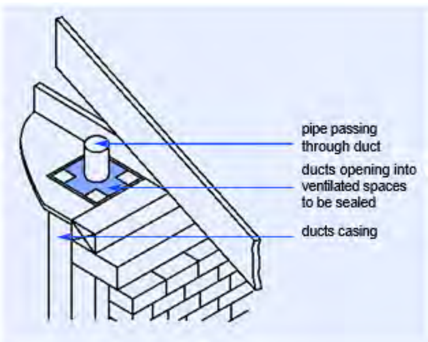


Diagram 3.15: Draught sealing of service ducts at ceiling level

Ensure that roof spaces are accessible and that the access hatch or door is located in a safe place e.g. not over a staircase. The access hatch should be not less than 520mm in either direction, located between structural members, a proprietory hatch is reccomended and fitted with an effective draught seal, insulated and sealed to the surrounding construction in accordance with the manufacturers instructions.

Workmanship should be in accordance with BS 8000:8.

Plasterboard linings
Gypsum plasterboards should comply with BS 1230:1.

Plastered ceilings with plasterboard backing should follow the manufacturer’s recommendations

Plasterboard nails should comply with BS 1202:1.

Plasterboard thickness, board size, size and type of fixings for each location should be in accordance with the manufacturer’s instructions or not less than as set out in tables 3.02, 3.03 and 3.06.

board thickness	board widths	ceilings* (preferred)	ceilings* (maximum)
9.5	900	400	450
9.5	1200	400	450
12.5	900	450	600
12.5	1200	450	600

* all dry and skim finish ceiling board edges to be supported.

Table 3.06: Dry finish and skimmed plasterboard ceilings

Cracks in ceilings can be largely avoided by following the guidance set out below:

- Ceilings should be robust and form a smooth stable plane surface to receive decoration
- Supporting members should be accurately spaced, aligned and levelled
- The tolerance of horizontal surface planeness should be ±10mm over a 5m length
- Timbers supporting plasterboard should be regularised and have a moisture content not greater than 20% at the time of erection
- Additional detailed guidance can be found in BS 8000:8 & BS 8212.

Plasterboard Ceilings

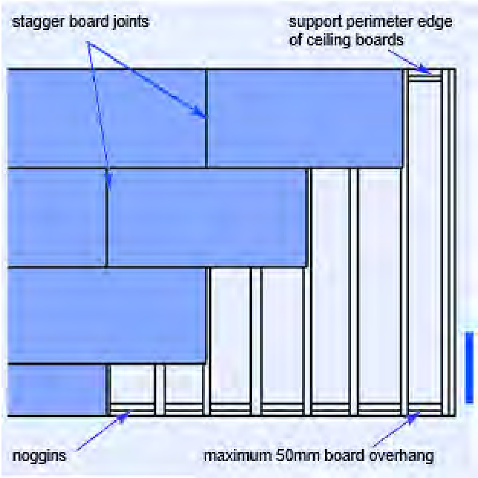


Diagram 3.16: Plasterboard ceilings with 2 coat plaster finish

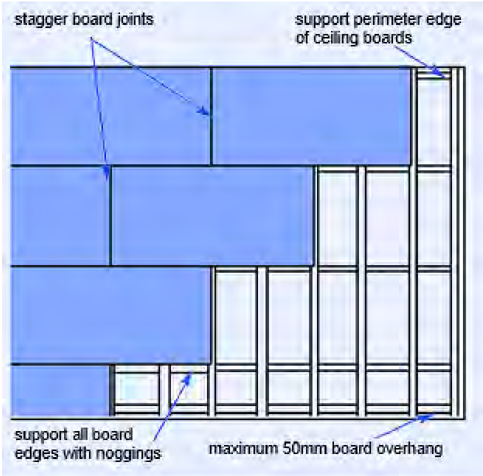


Diagram 3.17: Plasterboard ceiling for direct finish

Timber ceiling joists and noggings
Ceiling joists should be not less than 38mm wide (35mm for trussed rafters). In order to accommodate tolerances, a minimum width of 44mm is generally recommended.

Noggings or joists should be provided at wall/ceiling junctions to support the perimeter edges and located not more than 50mm from the wall (See diagram 3.16).

All cut edges should be supported by noggins or joists.

In direct decoration ceilings all joints should be provided with noggins (See diagram 3.17) unless the joist spacing is reduced in accordance with manufacturer's requirements. Openings should be trimmed with minimum 38mm wide noggins.

Fire resistance to domestic floors/ceilings
Within low rise dwellings (up to 3 storey) fire separation between floors and/or separate units will range from a modified half hour fire resistance (ground to first floor of a two storey house) to one hour between flats.

Table 3.07- 3.08 provides guidance on how typical floor/ceiling construction details can achieve the required fire resistance.

fire resistance	floor decking	min joist width	max joist spacing	ceiling finish
30 mins (modified)	square edge board (structurally adequate)	38mm	600mm	12.5mm plasterboard
	15mm T&G flooring grade board	38mm	600mm	12.5mm plasterboard
30mins	square edge board (structurally adequate)	38mm	600mm	2 layers plasterboard (joints staggered)
	21mm s.w T&G boarding or 15mm T&G plywood or chipboard	38mm	600mm	12.5mm plasterboard
60mins	15mm T&G plywood or chipboard	47mm	600mm	at least 30mm plasterboard with joints staggered

Notes:
1. All joints to plasterboard to be taped and filled. Where two layers of board are used joints should be staggered.
2. All plasterboard layers should be fully fixed in accordance with manufacturers recommendations (see table 3.02).
3. Ceiling/wall junction layers should be alternated to form a 'Z' joint.
4. The thickness of floor decking and ceiling finish may need to be increased to provide sufficient sound insulation.

Table 3.07: Fire resistance to ceilings/floors in dwellings

Holes in ceilings
Downlighters and other flush fitting attachments should not be installed through a ceiling if the ceiling is providing part of the required sound insulation or fire resistant properties to the dwelling. An additional suspended ceiling, light box or proprietary fittings must be installed to maintain the integrity of the ceiling construction.

Fixing of plasterboard
Ceiling boards should be staggered to minimise cracking and fixed across the supporting members.

Joints between plasterboards and adjacent walls, ceilings, openings and fittings should be neatly made (See diagrams 3.18 and 3.19).

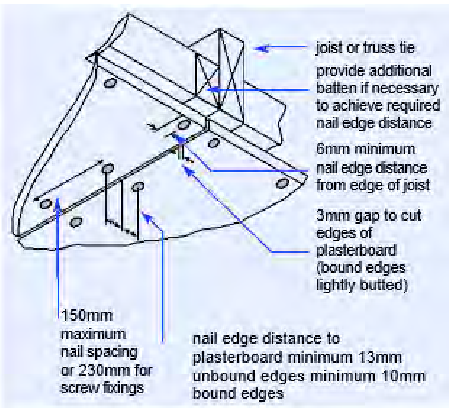


Diagram 3.18: Plasterboard edge fixing

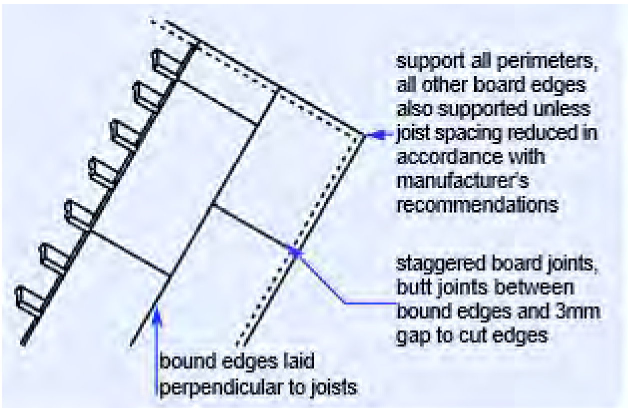


Diagram 3.19: Plasterboard – layout of boards

Nail popping
Unsightly nail protrusion can be reduced by:

- Lowering moisture content of timber to that recommended by BS 5286: Part2: 1991.
- Nail or preferably screw plasterboard tightly to the timber framework.
- Avoid overdriven or skewed nails puncturing the paper of the board.
- Do not force boards to fit. They will bow and prevent secure contact with the frame.
- Avoid fixing to twisted or misaligned framework.
- Drive home nails that are not securely driven into framing and re-fix with new ones.

Finishes – General
The dwelling should be made weather-tight before finishing materials are stored or fixed within the dwelling.

Finishes should be compatible with the supporting surface.

Exposed corners and edges of surfaces which do not have sufficient impact or wear resistance should be provided with a suitable strengthening bead or edging strip.

Movement joints should also be provided to finished surfaces to coincide with movement joints which occur in the structure where required

Plastered finish
Gaps between boards and all nail holes should be filled with plaster. A nominal 50mm paper tape or glass fibre mesh tape (or other suitable joint reinforcement materials) should be bedded over all joints and internal corners.

Final plastering should take place as soon as possible after fixing of boards.

Direct decoration finish
Jointing should be carried out in accordance with manufacturer's instructions and as previously detailed for partitions.

The information on plasterboard provided in the following table (next page) is correct as at 21 July 2003 but it is the users responsibility to ensure it remains current prior to use. Approved Document E generally requires 10kg/m2 per layer.

		Weight Kg/m2						
Manufacturer	Plasterboard Type	6.0mm	9.5mm	12.5mm	15mm	19mm	25mm	Remarks
British Gypsum	Gyproc WallBoard		6.5 Kg/m2	8 Kg/m2	9.8 Kg/m2			
	Gyproc WallBoard Duplex		6.5 Kg/m2	8 Kg/m2	9.8 Kg/m2			*With vapour barrier*
	Gyproc Plank					14.5 Kg/m2		
	Gyproc HandiBoard		6.5 Kg/m2	8 Kg/m2				*Ivory face*
	Gyproc HandiBoard Duplex		6.5 Kg/m2	8 Kg/m2				*With vapour barrier*
	Gyproc FireLine			9.5 Kg/m2	11.5 Kg/m2			*Pink coloured*
	Gyproc FireLine Duplex			9.5 Kg/m2				*Pink coloured /vapour barrier*
	Gyproc FireLine MR			9.5 Kg/m2	11.5 Kg/m2			*Pink coloured / black bar marks*
	Glasroc MultiBoard	6 Kg/m2	8.5Kg/m2(10mm)	10.63 Kg/m2				*Glass reinforced*
	Gyproc Moisture Resistant			8.5 Kg/m2	10 kg/m2			*Green face*
	Gyproc SoundBloc			10.5 Kg/m2	12.5 Kg/m2			*Pale blue*
	Gyproc SoundBloc MR			10.5 Kg/m2	12.5 Kg/m2			*Pale blue but water repellant*
	Gyproc SoundBloc RAPID			10.5 Kg/m2	12.5 Kg/m2			
	Gyproc SoundBloc RAPID MR				12.5 Kg/m2			
	Gyproc DuraLine			11.5Kg/m2(13mm)				
Knauf	Wallboard		6.2 Kg/m2	8.3 kg/m2	10.2 kg/m2			*Ivory face*
	Baseboard		6.2 Kg/m2					*Grey face*
	Plank					13.2 Kg/m2		*Ivory face*
	Vapourshield		6.2 Kg/m2	8.3 kg/m2	10.2 kg/m2			*Ivory face / foil back*
	Vapourshield baseboard		6.2 Kg/m2					*Grey face / foil back*
	Fireshield			9 Kg/m2	10.7 kg/m2			*Pink face*
	Moistureshield			10 Kg/m2				*Green face*
	Sound Moistureshield			12 kg/m2	13.8 kg/m2			*Blue face*
	Fire Moistureshield			10 Kg/m2	12 kg/m2			*Green face*
	Denseshield			11.6 kg/m2	13.9 kg/m2			*Mustard face*
	Soundshield			12 kg/m2	13.8 kg/m2			*Blue face*
	Coreboard					16 kg/m2		*Green face*
Lafarge	Standard wallboard		6.3 Kg/m2	8.0 Kg/m2	10 Kg/m2	14 Kg/m2		*Ivory face*
	E-Check			10 kg/m2				*Sky blue*
	Baseboard and lath		6.0 Kg/m2	7.8 Kg/m2				*Grey faces*
	Moisturecheck			8.0 Kg/m2	10 kg/m2			*Green*
	Firecheck			10.2 Kg/m2	12.3 Kg/m2			*Pink*
	Megodeco			11 kg/m2	13 kg/m2			*White*
	Toughcheck			13 Kg/m2				*Mustard*
	MR Firecheck			10.2 Kg/m2	12.3 Kg/m2			*Pink / Green*
	dBcheck			11 kg/m2	13 kg/m2			*Blue*
	MR dBcheck			11 kg/m2	13 kg/m2			*Blue*
	Coreboard						21 Kg/m2	*Green*
	Contour	5.4 Kg/m2						*Ivory*

Table 3.08: Plasterboard type/weights

Suspended ceilings

- Should comply with BS 8290.
- Should be fixed securely to the main structure in accordance with the manufacturer’s instructions.
- Ceiling systems should be set out to provide a visually acceptable finish, i.e. level framework, straight joint lines and located parallel to adjacent walls unless specifically designed otherwise.
- Allowance should be made for thermal expansion as recommended by the manufacturer.
- Fire stopping should be installed as necessary to comply with Approved Document B. (Technical
- Standards for Scotland: Section 2 and Part E for N.Ireland). Refer back to sound/dwellings in previous section.

Where a suspended ceiling is continuous over adjoining rooms, provision should be made to maintain an adequate degree of sound insulation between WCs and other parts of a dwelling.

Internal Works - Fireplaces

General

Fireplaces should be:

- Built in level and plumb
- Securely supported and tied into the supporting structure.

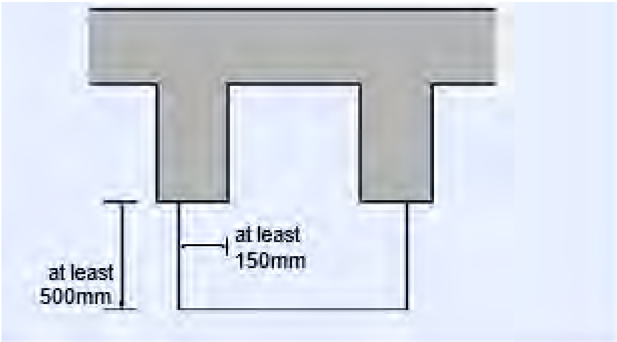


Diagram 3.20: Plan view of hearth in fireplace opening

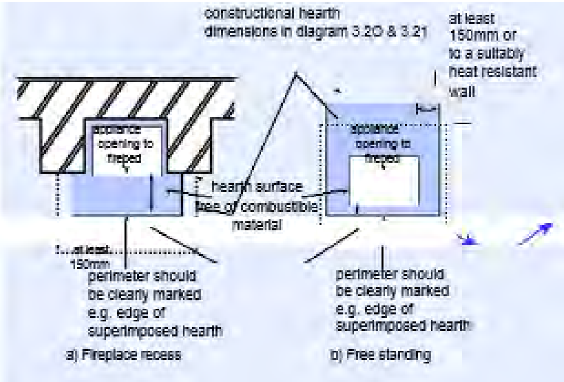


Diagram 3.21: Non-combustible hearth surface surrounding a solid fuel appliance

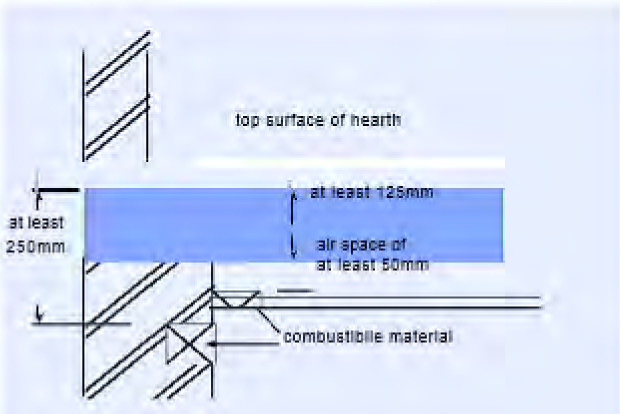


Diagram 3.22: Constructional hearths suitable for solid fuel appliances (including open fires)

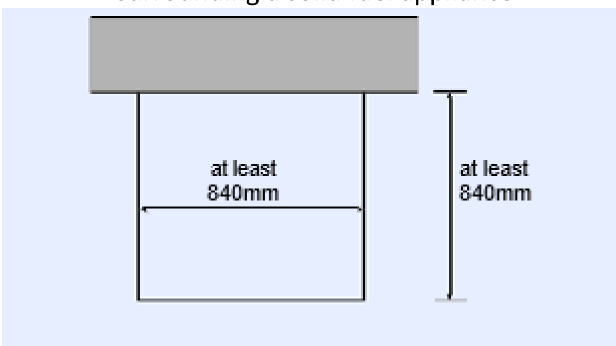


Diagram 3.23: Plan view of free standing hearth

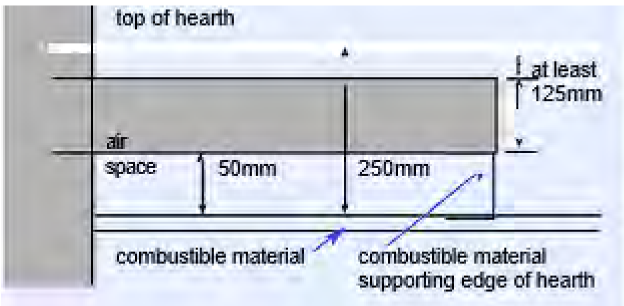


Diagram 3.24: Section through hearth

Relationship of fireplaces with combustible materials
To inhibit the likelihood of ignition of any part of the building by direct radiation, conduction or falling embers, an appliance must be set and positioned on a non- combustible hearth in accordance with diagrams 3.20 -3.24.

Combustible material should not be included under a constructional hearth except:

- To support the edges of the hearth or
- Where there is an air space of at least 50mm between the material and the underside of the hearth or
- Where there is a distance of at least 250mm between the material and the top of the hearth (refer to diagram 3.22).

Air vents and grills supplying air ventilation for combustion appliances should not be installed within the fireplace or hearth.

A fireplace recess must be suitably constructed of solid non-combustible material, and the walls and jambs forming the fireplace opening lined with fireclay at least 38mm thick, except in the following circumstances:

- The appliance itself is lined with fireclay at least 38mm thick; or
- The appliance is installed in a suitably constructed purpose made appliance chamber.

Guidance on how to achieve this is given in table 3.09 below:

Construction of fireplace recesses		
Position of recess	Minimum aggregate thickness of materials (mm)	
	Brick or block of fire resistant composition	Other
Forming part of a separating wall*	200	300
Other*	300	150

OR a prefabricated chamber of solid concrete

- Which is connected to a chimney or flue pipe
- Which is supplied by the same manufacturer, with pre-made jointing arrangements, assembled on site using a cement specified for the purpose by the manufacturer
- Which is of insulating concrete having a density of between 1200 and 1700 kg/m^3
- Which has components of the minimum thickness shown below

Thickness of appliance chamber component	
Part	Minimum thickness (mm)
Base	50
Sides	75
Back panel and top slab	100
Hood and bar lintels	100

- Which is installed on a constructional hearth, and
- If serving an open fire, has the space between the appliance and the internal wall of the unit filled with vermiculite cement concrete

* Where the recess is constructed of solid non-combustible material, extending the full height of the fireplace opening.

Table 3.09: Construction of fireplace recesses and thickness of appliance chamber components

Dimensions of fire openings in fireplaces

The dimensions of openings in fireplace surrounds should be as given in table 3.10. (Where fire size is related to the free opening at the front of the fireplace recess when the firebricks are in place).

nominal size of fire	dimension width*	height**
350mm	360mm	560mm
400mm	410mm	560mm
450mm	460mm	560mm
500mm	510mm	560mm
Tolerances on dimensions:	*±10mm	**±5mm

Table 3.10: Dimensions of fireplace openings

Gathers and canopies

To minimise resistance to the proper working of flues, tapered gathers should be provided in fireplaces for open fires.

Ways of achieving these gathers include:

- Using prefabricated gather components built into a fireplace recess, as shown in diagram 3.25; or
- Corbelling of masonry as shown in diagram 3.26; or
- Using a suitable canopy, as shown in diagram 3.27; or
- Using a prefabricated appliance chamber incorporating a gather.

When drylining around fireplace openings any gaps should be filled to prevent flue gases entering the void behind the lining.

Notice plates for hearths and fireplaces

Information essential to the correct use of hearths, fireplaces, flues or chimneys should include the room location, category of flue with type, size and the manufacturer's name including the installation date. A robust notice plate containing this information should be securely fixed in the dwelling at a prominent site i.e. next to the consumer unit, water stopcock or fireplace.

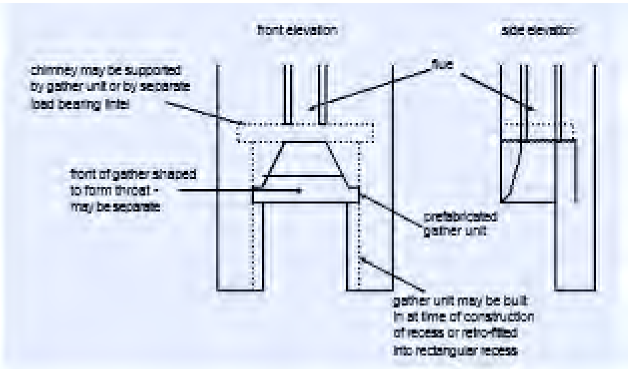


Diagram 3.25: Construction of fireplace gathers

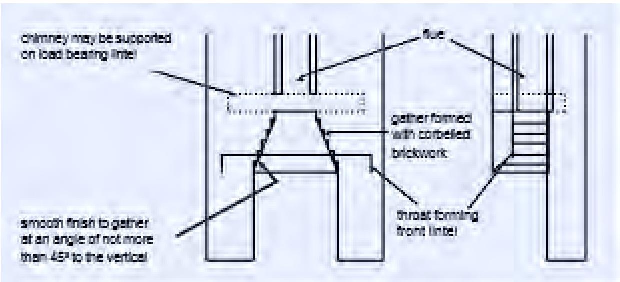


Diagram 3.26: Construction of fireplace gathers

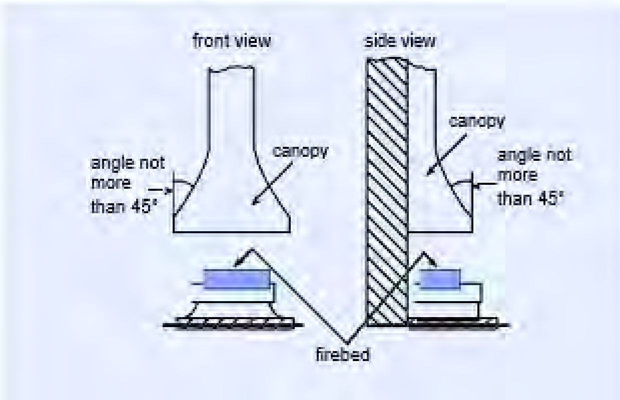


Diagram 3.27: Canopy for an open solid fuel fire

Internal Works - Carpentry

General

Internal joinery and fittings
Joinery items should, where appropriate, comply with the requirements of the following British Standards:

BS 585:1 Wood stairs
BS 4787:1 Internal and external wood door sets, door leaves and frames
BS EN 942 Timber for and workmanship in joinery

Internal joinery should not be installed until the building is weather-tight. The moisture content of the timber should generally not exceed 15% at the time of installation.

Materials and workmanship should follow the recommendations of BS 1186 and BS EN 942.

- Where metal stud partitions have been specified it is particularly important that adequate consideration is given, at the design stage, as to where joinery items are required to ensure that the requisite fittings to support such items have been provided.

All joinery items should be fixed reasonably plumb, level and square.

If fixing battens for curtain rails are required within hollow lintels by manufacturers, the location of the batten should be clearly indicated on the finished surface.

Kitchen units, wardrobes, cupboards and other fittings should be securely fixed, in accordance with manufacturer's recommendations.

Access panels should be of a durable material and screw fixed.

Frames, linings and screens should be located so that they:

- Fit openings
- Do not carry load unless designed to do so
- Are securely fixed at 600mm maximum centres and within 150mm of the corner of a frame.

Doors should fit frames or linings with even margins not exceeding 6mm. Latches or locks should engage easily.

Airing cupboard doors should be hung on 3 No. hinges. Other internal doors should be hung on minimum 2 No. hinges.

Latches, locks and other ironmongery should be securely and neatly fixed using matching screws. Locks to bathrooms and WCs should be releasable from outside in emergencies.

Joints between the wall and frames or linings of fire resisting doors should be sealed to maintain the required fire resistance (See diagram 3.28).

Fire Doors
Fire doors shall be in accordance with BS 8214 and tested to BS 476. Fire resisting doors should be fitted with a positive self-closing device.

Fire doors can be ordered in sets i.e. a complete fire resisting door and purpose made frame. However, for half hour fire doors between a garage and the dwelling, either a 30minute fire door set should be installed or, alternatively, a fire door tested to an FD20 standard installed with intumescent strips fitted, normally, to rebates within the doorframe.

There should be a minimum 100mm threshold between a garage and a dwelling

Where fire doors are required they should fit tightly with a margin of 3mm (top and sides) and be fitted with an appropriate self closing device. Rising butts are acceptable within a dwelling house but not in flats or maisonettes.

Fire doors should be hung on a minimum of 3 hinges.

Further guidance on the type of hardware suitable for fire doors is available in Code of Practice, "Hardware essential to the optimum performance of fire-resisting timber doorsets" published by the Association of Builders Hardware Manufacturers.

BM TRADA operates 'Q-Mark' certification schemes for fire door manufacture, fabrication and installation.

Q-Marked fire doors are marked as being accredited by BM TRADA using colour-coded plastic plugs.

Further details can be found on the BM TRADA website –

www.bmtrada.com

fire rating of door	description
FD30	white tree in YELLOW circle
FD60	white tree in BLUE circle
FD90	white tree in BROWN circle
FD120	white tree in BLACK circle

Table 3.11: Indentification of fire rating on doors

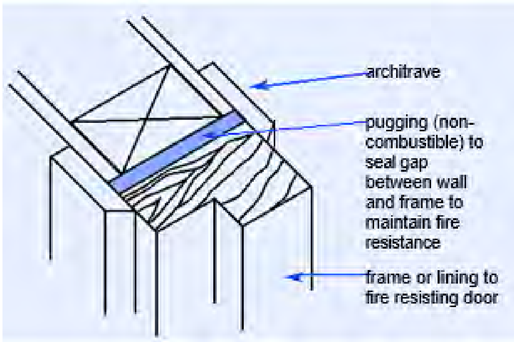


Diagram 3.28: Maintaining fire resistance of frames to fire doors

Skirtings, architraves and other trim finishes
Timber trim should be selected in accordance with BS EN 942 & BS 1186 and should be correctly sized to cover joints and allow for any shrinkage.

Trims and panelling should be securely fixed.

Internal panelling of timber or wood based boards should be fixed on suitable timber battens, to give a smooth, flat surface.

Proprietary panels and trims should be fixed in accordance with the manufacturer's recommendations.

Timber trim should have a primer or stain base coat applied prior to the finishing coat.

Timber window boards should be fitted to timber frames with a tongue rebated into the frame.

Stairways
Ensure that staircases, newels, balustrades and handrails are adequately fixed to avoid excessive deflection. Staircases should be supported by strings securely fixed to a supporting wall and not by the top tread.

There is no longer guidance given for a minimum width of a staircase **unless** it is a means of ingress/egress from a communal type building. In these circumstances the width and pitch etc. will be determined by the use of the building.

For staircases serving individual properties the need is that a safe means of access between different levels is provided.

In both circumstances consideration should always be given to the practicality of a staircase design for those that may have a disability and to the moving of furniture etc.

All staircases within domestic units should have a maximum rise of 220mm with a minimum going of 220mm, however the stair pitch which is a line connecting all nosings should not exceed 42˚.

The minimum width of the tread (winder) should be no less than 50mm at its narrowest point.

The minimum headroom over the flight and landing should be 2.0m.

Handrails and guarding over the flight and landing should be set at a height of between 900mm and 1000mm. It should be non-climbable and any gap within a riser or guarding should not exceed 100mm.

Where the staircase is greater than or equal to 1000mm a handrail should be provided to both sides of the staircase.

Safety
When designing buildings, full consideration should be given to all factors that affect safety in the home, including:
- Spatial layout, e.g. circulation spaces, kitchen layout and location of steps
- Minimizing obstructions, e.g. arrangement of opening doors and windows, and the ease of access of opening lights, switches, meters, etc.
- Locks to WCs and bathroom doors to be openable from the outside in an emergency
- Provision of non-slip surfaces particularly in kitchens, bathrooms, etc.

Provide adequate storage space to dwellings
Adequate general storage space should be provided at each floor level within a dwelling.

Typical guidance on the level of storage suggested is given in table 3.12.

size of dwelling	storage space
1 bedroom	$1.6m^3$
2 – 4 bedrooms	$2.8m^3$
More than 4 bedrooms	$3.6m^3$

Table 3.12: Total storage space for dwellings

At least 25% of the storage accommodation with one robust shelf should be located in a heated airing cupboard if provided.

A minimum $1.75m^3$ of the storage accommodation ($0.75m^3$ for one bedroom dwellings) should be located in the kitchen and be available for food storage. Part of this accommodation should consist of a space reserved for a refrigerator and have a 13 amp fused electricity supply.

The remainder of the storage accommodation should be arranged such that a degree of storage accommodation is provided at each floor level.

Painting

Paint systems should be used as recommended by the manufacturer and comply with BS 6150.

Surfaces should as appropriate be knotted, stopped up, rubbed down, sealed and primed prior to painting.

Keep surfaces to be decorated clean while work is proceeding.

A minimum of two coats of paint should be provided in all cases, with each coat of paint being left to dry fully before application of a subsequent coat.

The use of materials from more than one manufacturer in any one system may result in failure due to incompatibility. It is therefore recommended that all paints are obtained from the same manufacturer to avoid such occurrences.

Remove from site any materials that, on opening are found to be incorrectly labelled or defective. If materials are found to be defective when in use, set them aside.

Work on site should be in accordance with BS 8000:12.

Do not apply painting materials if:

- The moisture content of the background exceeds 18%
- Surfaces are affected by damp or frost
- The air or substrate temperature is below or likely to fall below 5˚C
- Condensation is likely to occur before the paint is touch dry
- Rain or snow is likely to occur before the paint is touch dry
- Heat is likely to cause faults to develop
- Airborne dust is likely to spoil wet paint
- The light is insufficient
- Substrates have not adequately dried out e.g. plaster
- It interferes with the proper functioning of components such as radiator valves, stop valves or other service components.

Ensure good ventilation is provided as this is necessary:

- To remove unpleasant, toxic and flammable vapours arising from painting materials
- To ensure that paints dry and harden.

Services

System Design

Service supplies and installations should be designed by an Expert. Service installations should be designed according to the methods and data published by the Chartered Institution of Building Services Engineers.

Building elements supporting service installations
Walls, floors, ceilings and the like should be specifically designed to carry any supported service appliance or equipment.

Full account should also be taken of the added mass of water contained in the appliances and equipment during their normal use. (This is particularly applicable to cold water storage cisterns, hot water storage cylinders and boilers).

Gas and water services should not generally be run in timber frame external wall panels unless the design specifically allows for this.

Precautions against frost, entry of gas and vermin
All water services, including those for space heating, should comply with BS 6700. Any part of a water pipe or appliance liable to freezing should be located within the heated thermal envelope of the building.

Where pipes, ducts or cables pass through the building envelope, holes and floor perimeters should be sealed and made watertight with a flexible, vermin-proof and gas- tight compound (See diagram 3.29).

Appliances – Safety and location
Exposed surfaces of accessible appliances should have no sharp edges which could cause injury to persons. All appliances and components which are heated in normal operation should be located so that movement and shrinkage of structural and other timber is minimized.

Flue outlets to gas and oil appliances should be protected with a suitable guard where people can come into contact with them, or where they could be subject to damage i.e. vehicular access. Balanced flue outlets should be located 300mm and 600mm minimum respectively away from any opening into the dwelling, including roof voids.

In certain circumstances a minimum of 1200mm is required. For further details refer to Approved Document J (Technical Standards for Scotland: Part F).

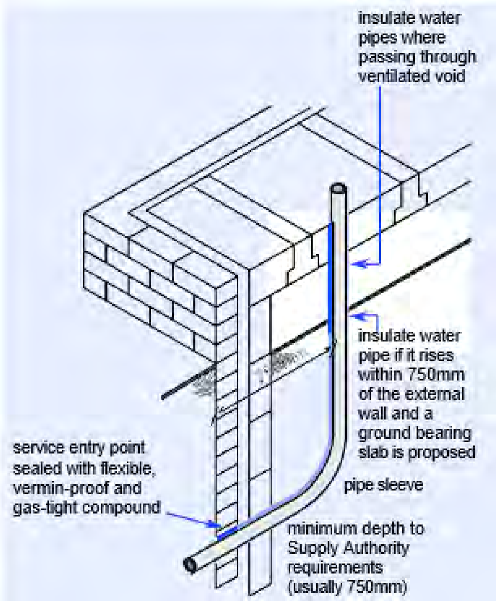


Diagram 3.29: Sealing of service entry points

Selection of appliances and equipment

Materials and equipment should, wherever possible, either bear the British Standard 'Kitemark' symbol and be manufactured by firms registered under the BSI 'Kitemark' scheme, or should comply with the relevant British Standard and be manufactured by a firm operating a BS EN ISO 9001-9004 Quality Assurance System which is regularly assessed by a recognised independent third party.

Materials should be selected so that corrosive deterioration is minimised. If different metals are used in combination, particularly in humid locations, they should be chosen to be as near as possible in the electro-chemical series of metals so that galvanic action is unlikely to occur (i.e. not more than two metals apart in the list). Some typical metals in the order they appear in the series are:

- Stainless steel
- Copper/Cupro-nickel
- Brass/Gunmetal
- Steel
- Aluminium
- Galvanised iron
- Zinc

If metals remote from each other in the series have to be used, adequate precautions should be taken to prevent their corrosive interaction.

All materials and equipment should be installed and commissioned as specified by the manufacturer.

Appliances and equipment should be selected so that they are suitable for the designed thermal loads, fluid flow rates and fluid pressures.

Installation of pipes, ducts and cables

- Pipes, ducts and cables should be securely fixed to walls within floor zones etc. at suitable intervals to prevent sagging, using purpose made proprietary support brackets or clips
- All joints in pipework should be carefully made to eliminate leaks
- Pipes should be laid to falls away from high points in the installation to aid being drained and provision made for air venting at the high points where required
- Pipework should be arranged to prevent contact with electric cables
- Provision should be made for expansion of water service installations where required
- Pipework and cables should have a neat appearance where visible, with all bends being neatly made using the correct tools
- Appliances shall be installed level unless specifically designed otherwise, using durable fixings
- Workmanship should comply with BS 8000:13/15.
- Installation of electrical cables and gas pipework shall be undertaken by qualified tradesman registered by NICEIC – National Inspection Council for Electrical Installation & Contracting / Registered Gas Safe Installers.
- Gas pipework in the proximity of electrical cables should follow the Gas Safe requirement guidance – see this section.

Services embedded in floors and walls and positioned beneath floor slabs

Service pipes and cables should not be laid within a structural element unless approved by the designer of the building. Where permitted, they should not be solidly embedded.

Service pipes and cables should be sleeved, isolated and sealed when passing through a structural element. Where passing through joists, it is recommended that hessian or similar is provided to prevent expansion noise.

Pipes should not be cast into walls and floors, the use of a proprietary accessible ducting system being strongly recommended. (See diagram 3.30). Pipes behind dry lining should be placed either horizontally below the valves, vertically within the radiator width from ceiling to floor level or within 150mm of a wall junction or a door frame. If located outside these zones, then mechanical protection should be provided.

Appliances should be so located and positioned as to allow reasonable access for operation, inspection, maintenance and removal.

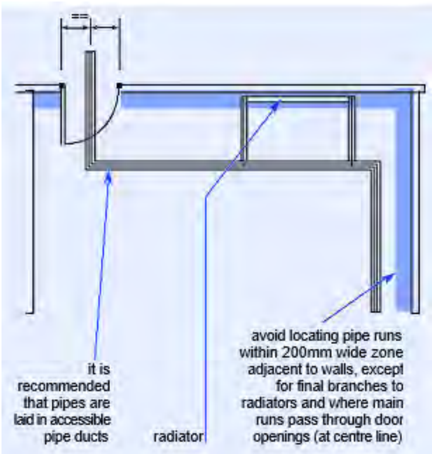


Diagram 3.30: Recommended positioning of pipes in screeds

In order to avoid subsequent damage during the laying of floor coverings, it is recommended that principal pipework runs in screeds are not located within 200mm of walls and should pass through door openings at the centre line (See diagram 3.30).

Only pipework forming part of a closed circuit system of under floor space heating or above ground central heating may be laid in floor screeds and should be laid as follows:

- A clear minimum thickness of screed of 25mm is required over and above the thickness of any pipework buried in the screed or insulation
- Where the screed is to be laid upon insulation, the required nominal reinforcement to the screed should be continuous over the pipework. D49 or D98 mesh reinforcement should also be provided over multiple pipes laid together in normal screeds
- Allowances for thermal and other types of movement must be made
- Pipes bedded in screeds should be tested to twice the designed operating pressure of the system and joined with the minimum number of capillary joints
- It is advisable to check that pipes bedded in screeds will meet the requirements of the local supply company.

Conduits and ducts should be located in such a manner as to allow reasonable access for inspection and maintenance without major disruption to the structure.

Flexible connections should be provided to services, conduits and ducts at their entry point into the structure. Raft foundation design details should show such service arrangements in relation to the reinforcement details.

Warm air ducts below ground floors should be constructed and positioned to avoid ingress of moisture into the duct or surrounding insulation.

Warm air ducts located beneath the ground floor of a dwelling which sits on clay soil should be positioned and insulated so as to prevent heat drying the clay, which may cause subsidence of the structure.

Services in walls

When installing services i.e. cables in walls or behind dry lining care should be taken to avoid back to back chasing which could affect the stability of the wall (See diagram 3.31).

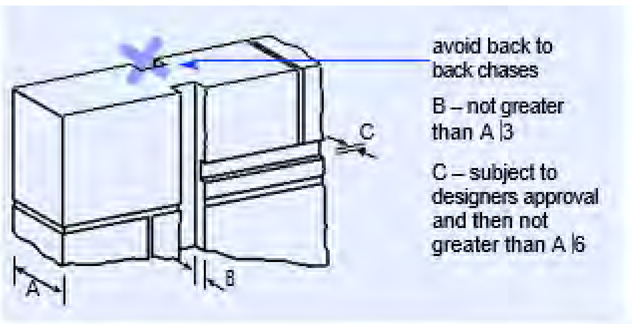


Diagram 3.31: Service chases in masonry

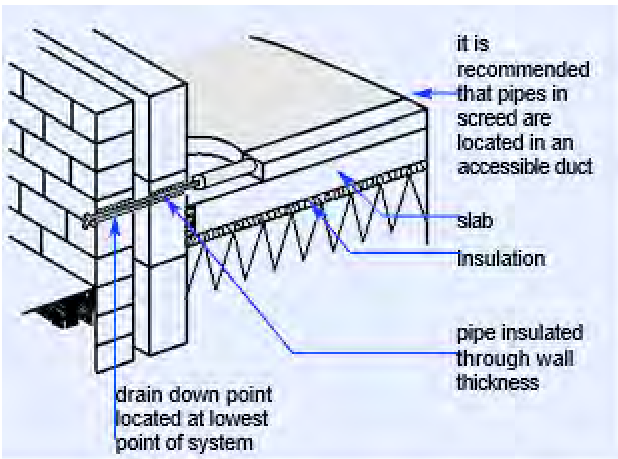


Diagram 3.32: Location of water service drain down points

Isolation, draining down and maintenance of service installations
Installations designed to hold water should be capable of being drained. Drain cocks, or similar, should be located at the lowest point of the system. In some circumstances there may be short lengths of pipe at low level, such as when passing under a door, that may not be practical to drain. However if a substantial amount of pipework is run in a screed then arrangements should be made for complete drainage (See diagram 3.32).

Wet systems serving more than one dwelling should be capable of being drained down separately.

Isolation valves and switches should be provided to services serving separate dwellings within the same building and should be accessible and clearly identified.

Telephone
A conduit should be provided from the telephone position to the communications company's duct or overhead terminal. A draw wire should be left in the conduit.

The conduit entry from outside to inside the building should be sealed to prevent moisture ingress.

Television
A single, unbroken length of cable suitable for frequencies currently in use for television should be provided between an aerial point in the loft and a co-axial socket outlet in the main living room. A 'tail' of approximately 4m should be left in the loft. The cable from the loft to the living room should be installed to comply with BS 6330.

Fire-stopping
Fire-stopping should be provided around any services which penetrate fire- resisting floors, walls or partitions.

Where a proprietary system, such as an intumescent seal, is used it should be installed in accordance with the manufacturer's instructions.

Electrical Installations

System design
Electrical installations will be subject to the requirements of Approved Document P Electrical Safety and the electric installation should comply with the Wiring Regulations of the Institute of Electrical Engineers (IEE) and BS 7671.

Part P applies to electrical installations in buildings or parts of buildings comprising:
- Dwelling houses and flats;
- Dwellings and business premises where there is a common supply;
- Common access areas in blocks of flats such as corridors and staircases;
- Shared amenities of blocks of flats such as laundries and gymnasiums.

Part P also applies to parts of the above electrical installations:
- In or on land associated with the buildings – for example fixed lighting and pond pumps in gardens;
- In outbuildings such as sheds, detached garages and greenhouses.
- Where there is a relevant material change of use.

Certification
The installation should be designed and installed to provide appropriate protection against mechanical damage, and so that they do not present electric shock and fire hazards to people.

The installation must be suitably inspected and tested to verify that they meet the relevant equipment and installation standards. A way of demonstrating this compliance would be to follow the procedures in Chapter 74 of BS 7671 and to supply:
- To the person ordering the work copies of the forms called for, signed by a person competent to do so; and
- In the case of a competent person registered with an electrical self-certification scheme, to the building control body a declaration that compliance with the Building Regulations has been achieved.
- Certificate showing compliance must be shown to Q at Final Inspection.

To be able to complete the relevant forms it is necessary to ensure that work has been inspected both during erection and on completion. The work must comply with the appropriate British Standards or harmonised European Standards, selected and installed in accordance with BS 7671 have not been visibly damaged or defective so as to be unsafe.

Testing must include confirmation that there is a satisfactory performance in relation to continuity of conductors, insulation resistance, separation of circuits, polarity, earthing and bonding arrangements, earth fault loop impedance and functionality of all protective devices including residual current devices.

The inspection and testing of DIY work should meet the same requirements
Electrical installations should be fitted by an installer registered with the National Inspection Council for Electrical Installation and Contracting (NICEIC) or the Electrical Contractors Association (ECA).

Power systems should comprise ring main circuits in preference to radial circuits.

Table 3.13 indicates guidance on the minimum number of socket outlets that should be provided in a dwelling. However this is subject to the size and type of property.

location and socket outlets
Living room 6 – 10 Double bedroom 4 – 6
Dining room 3 Single bedroom 4 – 6 Hall 1
Kitchen 6 – 10 Study / home office 6 Loft 1
Utility 2 Stairs / landing 1 Garage 2
The table is for guidance and is subject to the size and type of property.

Table 3.13: Guidance for provision of socket outlets

Socket outlets should be conveniently situated and evenly distributed around each room.

It is suggested that in kitchens and utility rooms, socket outlets should also be provided adjacent to any spaces specifically reserved for appliances such as refrigerators, dishwashers and washing machines.

Accessible consumer units should be fitted with a child- proof cover or installed in a lockable cupboard.

A cooker control unit should be provided in kitchens adjacent to the cooker position

Socket outlets should be conveniently positioned, close to television aerial and telephone outlets to allow for associated ancillary equipment such as answering machines, TVs and videos.

Points of guidance to note:

- At least one fixed electric light fitting should be provided to kitchens, utility rooms, halls, landings and entrances respectively.

All other rooms should be provided with either:

- One fixed light to rooms less than 25 m^2 and two fixed lights for areas greater than 25 m^2 or;
- Additional socket outlets, corresponding to the number of fixed lights required.

Lights on stairways should be controlled with two-way switches.

Immersion heater switches should be located in a prominent position and provided with an indicator light.

Cables located adjacent to thermal insulation should be de-rated accordingly.

It is important to assist people whose reach is limited and to enable them to use wall mounted switches and socket outlets more easily. Switches and socket outlets for lighting and other equipment should be positioned at appropriate heights between 450 mm and 1200mm from finished floor level.

Examples of electrical installations diagrams

The following simplified diagrams do not give all the information required to achieve compliance with BS 7671, nor do they cover all the electrical services found in dwellings, some of which (e.g. swimming pools and saunas) are subject to special requirements

The diagrams must not be used for installation purposes

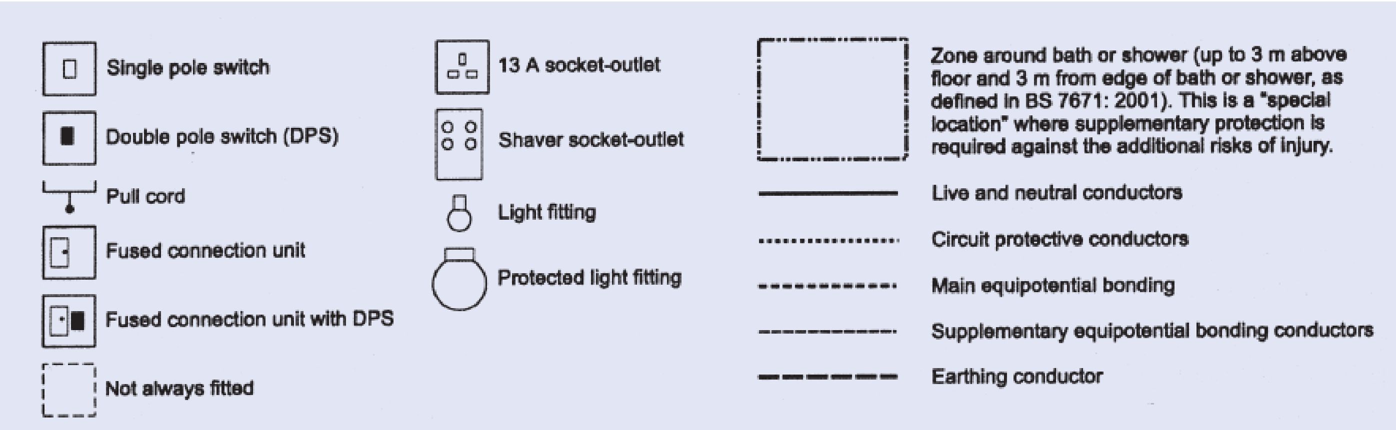
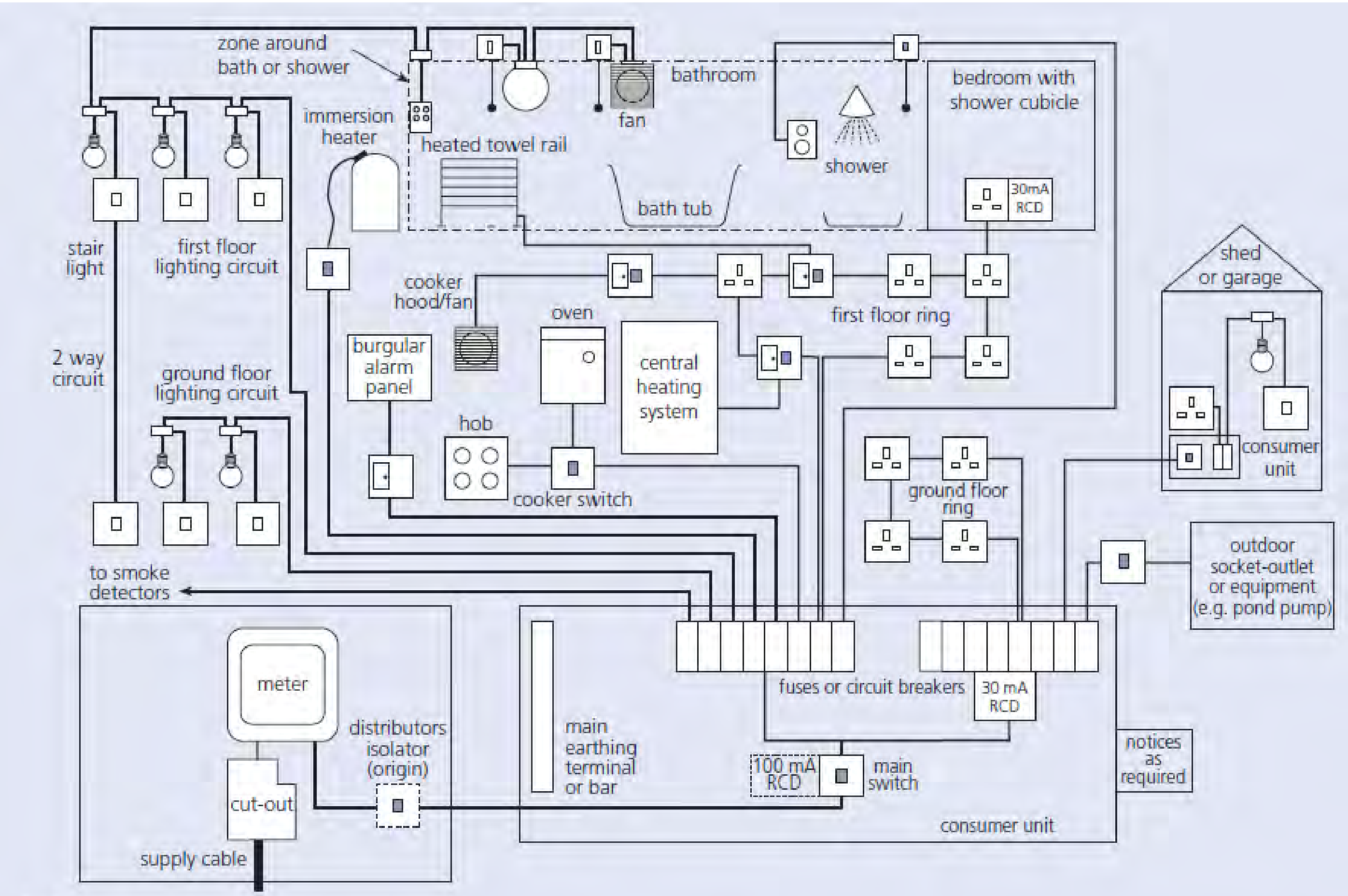


Diagram 3.33: Key to diagrams



Note:

1. See the general rules in BS 7671 : 2001.
2. The RCD component in the main switch is required for TT systems. Individual circuit 30mA RCDs may be required to avoid unnecessary tripping.
3. The notices include advice on periodic testing and regular test operation of the RCDs.
4. The zone shown around the bath or shower corresponds to zone 3 Section 601 of BS7671 : 2001. The socket-outlet shown in the bedroom with the shower cubicle must be outside zone 3.

Diagram 3.34: Illustration of the fixed electrical installation commonly encountered in a new home

Earthing

For most dwellings where PME is provided the main equipotential bonding conductor must be at least $10mm^2$. Refer to diagram 3.35.

Where no PME is available the minimum size for the equipotential bonding conductor is at least $4mm^2$.

It is not permitted to use gas, water or other metal service pipe as a means of earthing for an electrical installation. This does not preclude equipotential bonding connections to these pipes.

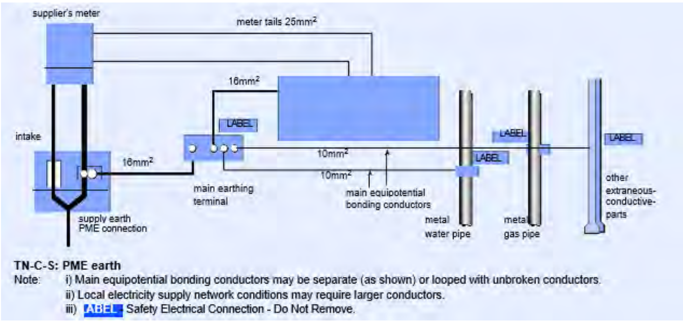


Diagram 3.35: Illustration of the earth and bonding conductors that might be part of the electrical installation shown in Diagram 3.34 (indicates earthing and bonding arrangements that may be necessary)

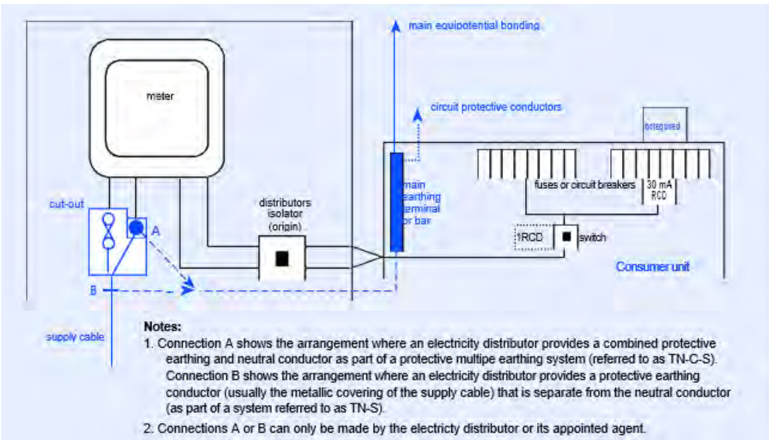
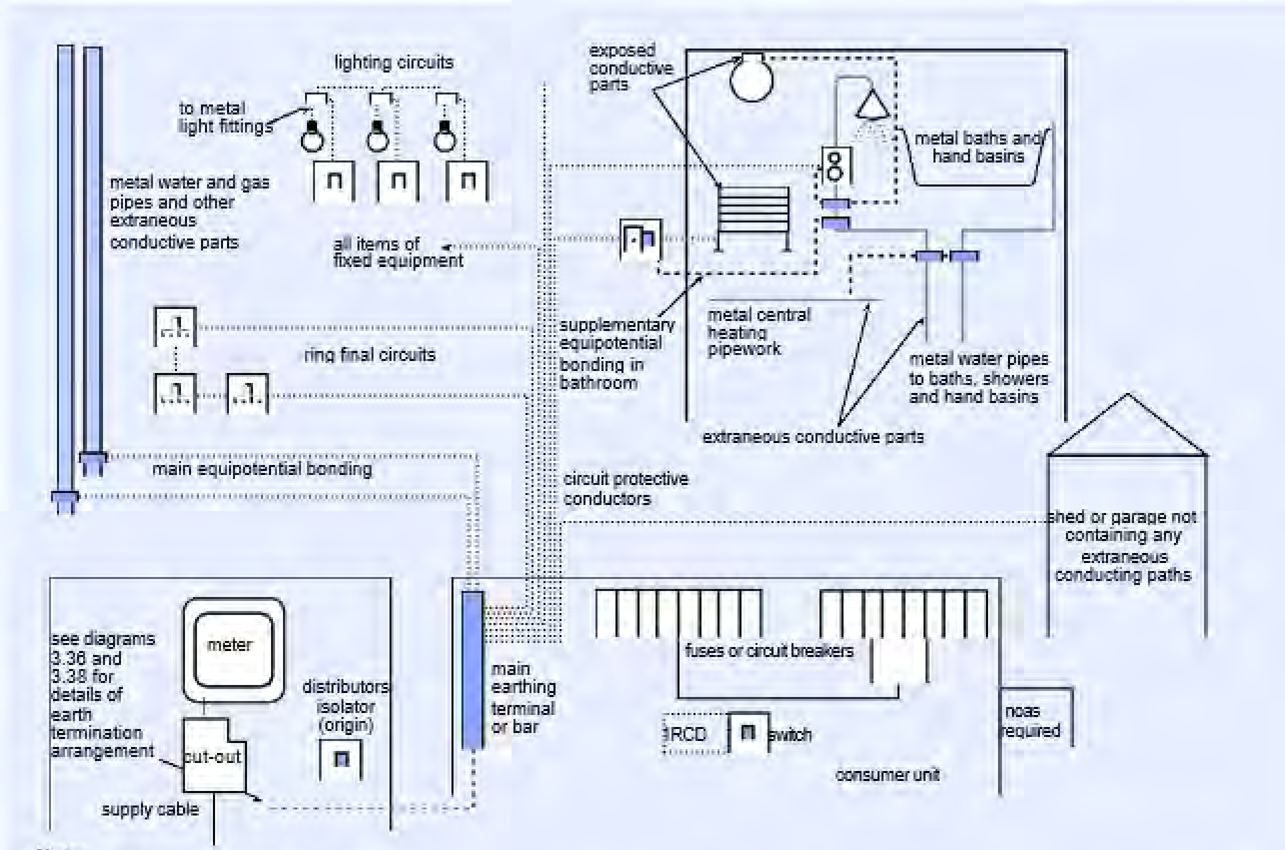


Diagram 3.36: Example earthing arrangement where the electricity distributor provides the earth connection (referred to as TN-C-S where the connection is made to A, or TN-S where the connection is made to B- the most common systems in urban areas). Indicates earthing arrangement as might be provided by electricity distributors.



Note:

1. See the general rules in BS 7671 : 2001.
2. Circuit protective conductors are taken to all items of fixed electrical equipment and local isolation and switching devices which appear in Diagram 3.35
3. In the case of a protective multiple earthing (PME) supply (see Diagram 3.36), consult the electricity distributor.
4. Supplementary bonding is required in bathrooms to an extent dependent upon the presence of metallic fixtures, fittings and pipework: see section 601 of BS 7671 : 2001

Diagram 3.37: Illustration of the earthing and bonding conductors that might be part of the electrical installation shown in diagram 3.34

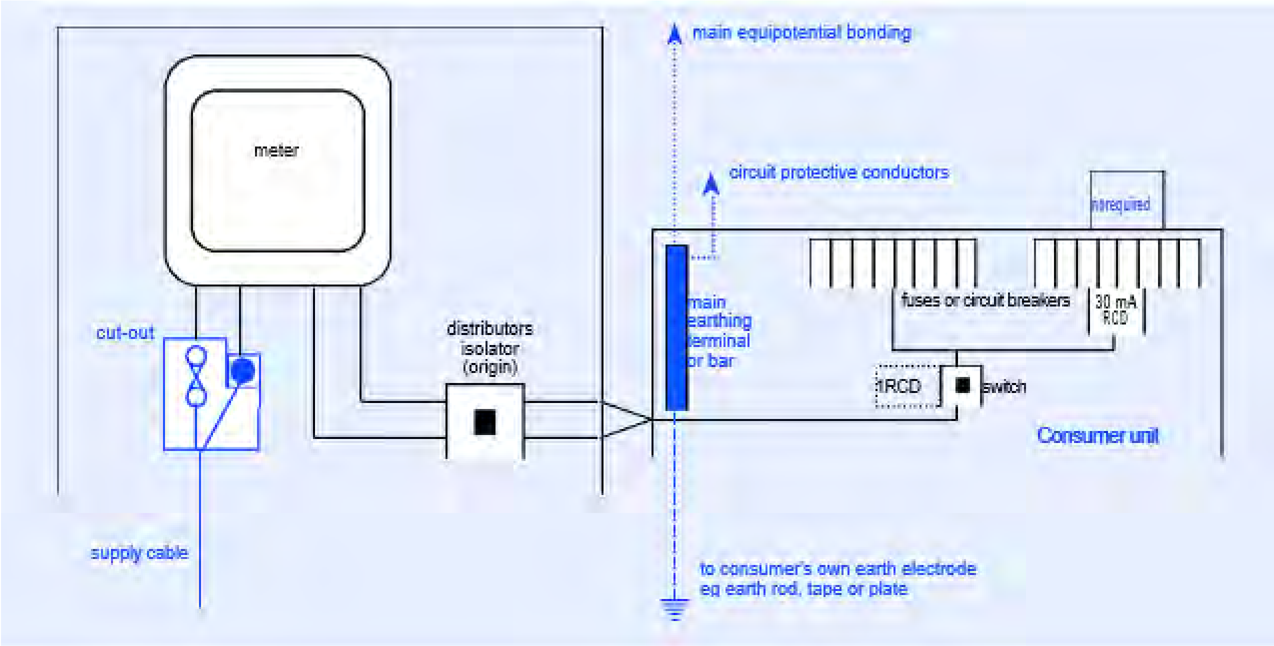


Diagram 3.38: Example earthing arrangement where the electricity consumers provide their own earthing connection (referred to as TT system) indicates earthing arrangements as might need to be provided by the consumer.

The minimum size of the main equipotential bonding connector is $10mm^2$

The minimum size of the supplementary equipotential bonding connector is $4mm^2$

Holes in ceilings

Downlighters and other flush fitting attachments should not be installed through a ceiling if the ceiling is providing part of the required sound insulation or fire resistant properties to the dwelling. An additional suspended ceiling, light box or proprietary fittings must be installed to maintain the integrity of the ceiling construction.

Where downlighters are provided to ceilings below roof voids (excluding thatched roofs) precautions should be taken to ensure that no fire risk is created by the proximity of other materials. This can be achieved by the following

- Use light fittings that produce a maximum temperature of 50^{o}C at the rear of the fitting
- Provide sections of 225mm plastic pipe over the rear of the fitting.
- Provide a downlighter flue, which will ensure adequate air circulation and clearance, is maintained.

Downlighters should not be used to the ceiling on the underside of a thatched roof.

Energy efficient lighting

Reasonable provision is to provide dedicated low energy fittings as follows:

1 for every $25m^2$ floor area created or 1 in every 4 fixed light outlets provided (whichever is greater). These should be provided in the most used rooms i.e. hall/landing, lounge, kitchen, dining room. Use in garages, cloakrooms and cupboards cannot be counted towards the required provision.

Reasonable provision should be made for the use of energy efficient external lighting. External lighting includes porches but not lighting in garages and carports. When providing external lighting either install a system which:

- Be of max. 150W and automatically extinguishes when there is enough daylight, and when not required at night; or
- Have fittings that will only take lamps of a luminous efficiency of 40 lumens per circuit watt.

Selection of materials and equipment

All components, equipment and appliances should be constructed in accordance with BS 3456 and BS EN 60335.

Additional guidance for locations containing bathrooms and showers

BS 7671, has a series of classification zones relating to locations containing baths and or showers. They are as follows:

- Zone 0 – the interior of the bath or shower.
- Zone 1 – is above zone 0 to a height of 2.25m above the floor.
- Zone 2 – 'wraps' around zones 0 and 1 for a horizontal distance of 0.6m.
- Zone 3 – 'wraps' around zone 2 for a further horizontal distance of 2.4m.

The above zones affect the safe installation, method and location of:

- Supplementary bonding.
- Protective measures against electric shock.
- Wiring methods i.e. surface and embedded wiring.
- Switchgear and control gear.
- Fixed current using equipment, amongst others include pumps, heaters, lights and extractor fans.

Further detailed guidance can be found in BS 7671.

It is further recommended that sockets and switches outside those rooms containing a bath or shower but never the less still prone to splashing, should be positioned a minimum of 300mm from the water source i.e. kitchen sinks and cloakroom basins.

It is not permitted to use a gas, water or other metal service pipe as a means of the main earthing for an electrical installation. This does not preclude equipotential bonding connections to these pipes.

Main equipotential bonding conductors are required to connect to the main earthing terminal for the installation in the following:

- Metal water service pipe
- Metal gas installation pipes
- Other metal service pipes and ducting
- Metal central heating and air conditioning systems
- Exposed metal structural parts of the building
- Lightning protection systems

NB if the incoming service pipe is plastic it is not necessary for this to be main earth bonded. However if the pipes within the plumbing installation are metal then main earth bonding is required. The bonding should be applied to the consumer side of any meter, main stopcock or insulating insert and to the metal pipes of the installation. If the incoming services are a mix of plastic and metal then the metal pipes must be main bonded.

The connections of the bonded pipes must be made with a propriety clamp to BS951 and be complete with a label:

SAFETY ELECTRICAL CONNECTION-DO NOT REMOVE.

Typical earthing arrangements and protective conductor csa-TN-C-S is shown in Diagram 3.36 (indicates earthing and bonding arrangements that maybe necessary).

Supplementary Earth Bonding
For domestic situations supplementary bonding is required in areas of increased risk. These are rooms containing a bath or shower. Supplementary bonding in kitchens, utility rooms or wash rooms is desirable but not mandatory. Diagrams 3.39 - 40.

Where plastic pipes are used within a bathroom or shower room then supplementary bonding is not required to the pipes or the metal fitments attached to them.

Where short lengths of metal pipes connected to bathroom fittings are attached to plastic pipes (a common practice to provide a more aesthetic finish) these also do not require supplementary bonding.

Supplementary bonding is still required to electrical equipment for example an electric shower or electric heater. Such bonding is also required to be connected to the protective conductor of all circuits supplying electrical equipment in the bathroom e.g. at a flex outlet or switch.

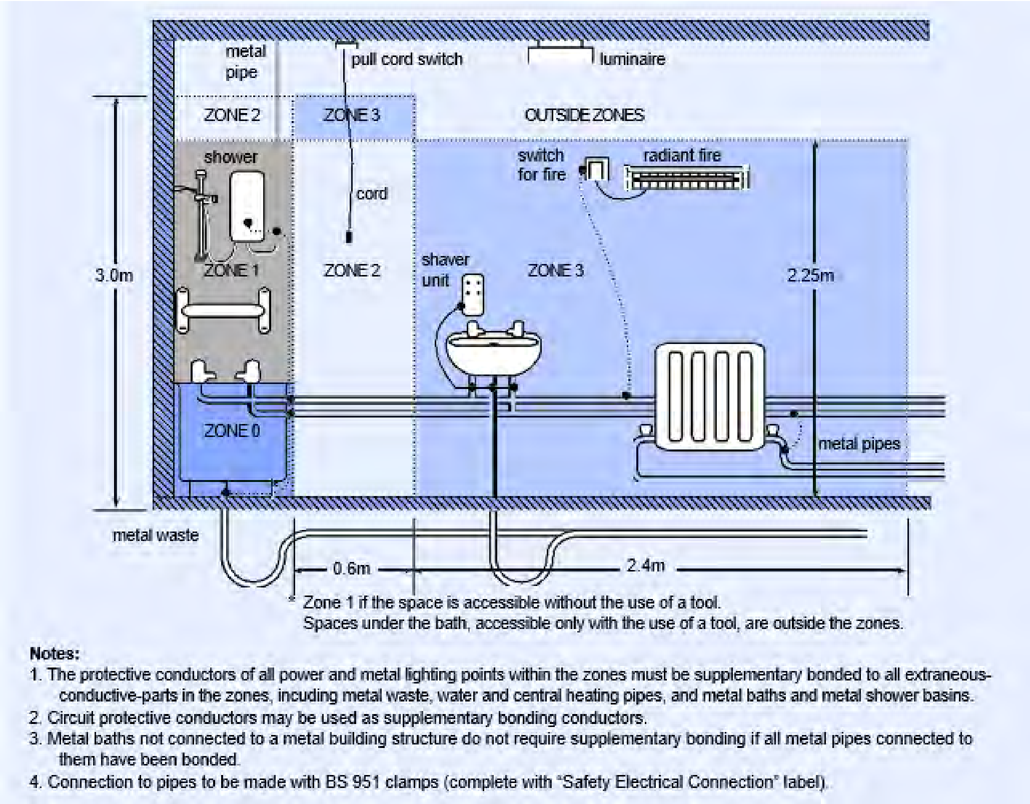


Diagram 3.39: Supplementary bonding in a bathroom – metal pipe installation

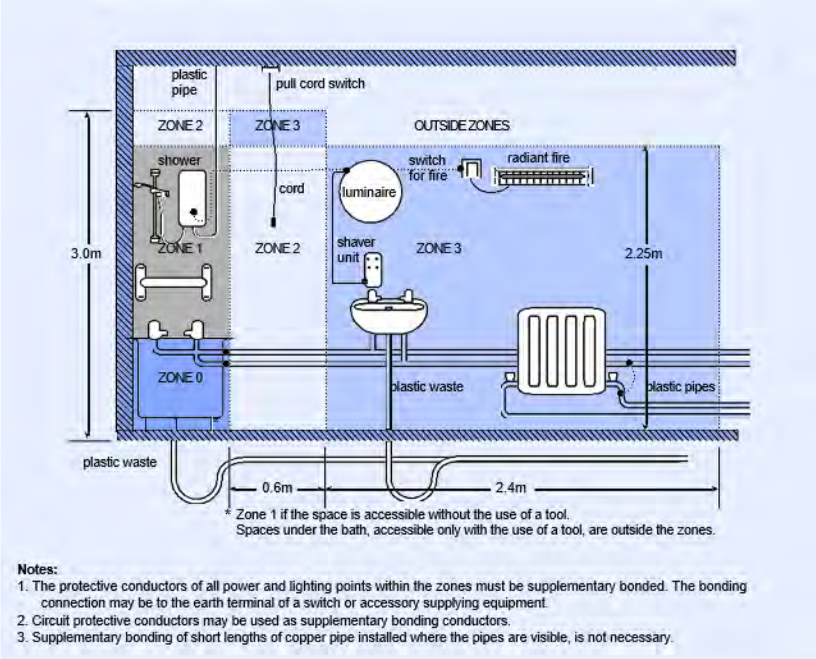


Diagram 3.40: Supplementary bonding in a bathroom – plastic pipe installation

Approved document M - Access and facilities for the disabled

Most electricians are more generally aware of these requirements and the diagrammatic guidance given in the IEE On-site.

Guide is reproduced here. See diagram 3.41

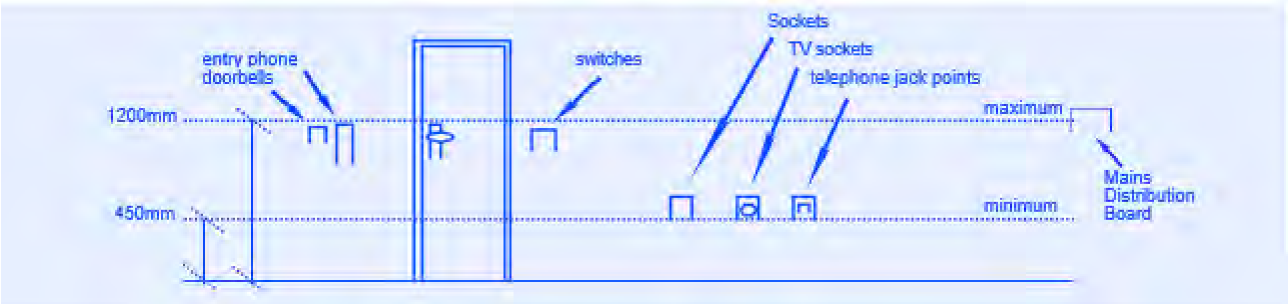


Diagram 3.41: Heights of wiring accessories

Electricity supply

The position chosen for the electricity supply intake should be accessible.

If the local supplier service cut-out and meter are located inside the dwelling, then the main cable entry should normally be via a sleeve having a slow bend (See diagram 3.29).

External meter boxes should be of a type approved by the supply authority and located as close as practicable to the main access point to the dwelling.

The installer should provide tails (3m maximum) of sufficient length on the incoming side of the CCU for connection to the Electricity Board's meter. The supply from an external meter to the CCU (Customer's Consumer Unit) may be via a duct through the wall. In such cases the CCU should be located inside the building adjacent to the external meter cupboard.

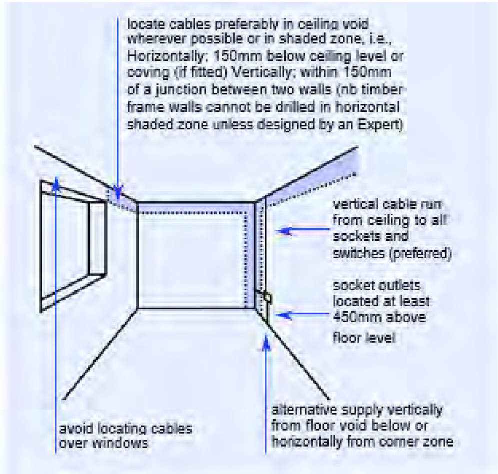


Diagram 3.42: Location of electric cables in walls

The earth connection of the CCU should be connected to the sheath of the supply cable or to a separate earth electrode if the Electricity Authority does not provide an earth.

Generally, cables should be located as follows:

- Within the shaded zones shown in diagram 3.42
- The final cable run to switches and socket outlets should be vertical or horizontal
- Cables located outside these areas must be enclosed in an earthed metallic conduit or sheath. Wherever possible, horizontal cable runs should be located in floor voids
- Cables located within 50mm of the top or bottom of floor/ceiling joists or battens supporting plasterboard must be contained in an earthed metal conduit.

Earth bonding

The earth conductor should be not less than $6mm^2$ connected from the consumer unit (earth bar) via suitable bonding clips to the service entry of the incoming water main, gas main and oil supply if provided. In all cases the earth strapping should be located as close to the inlet into the dwelling as possible.

Consumer unit

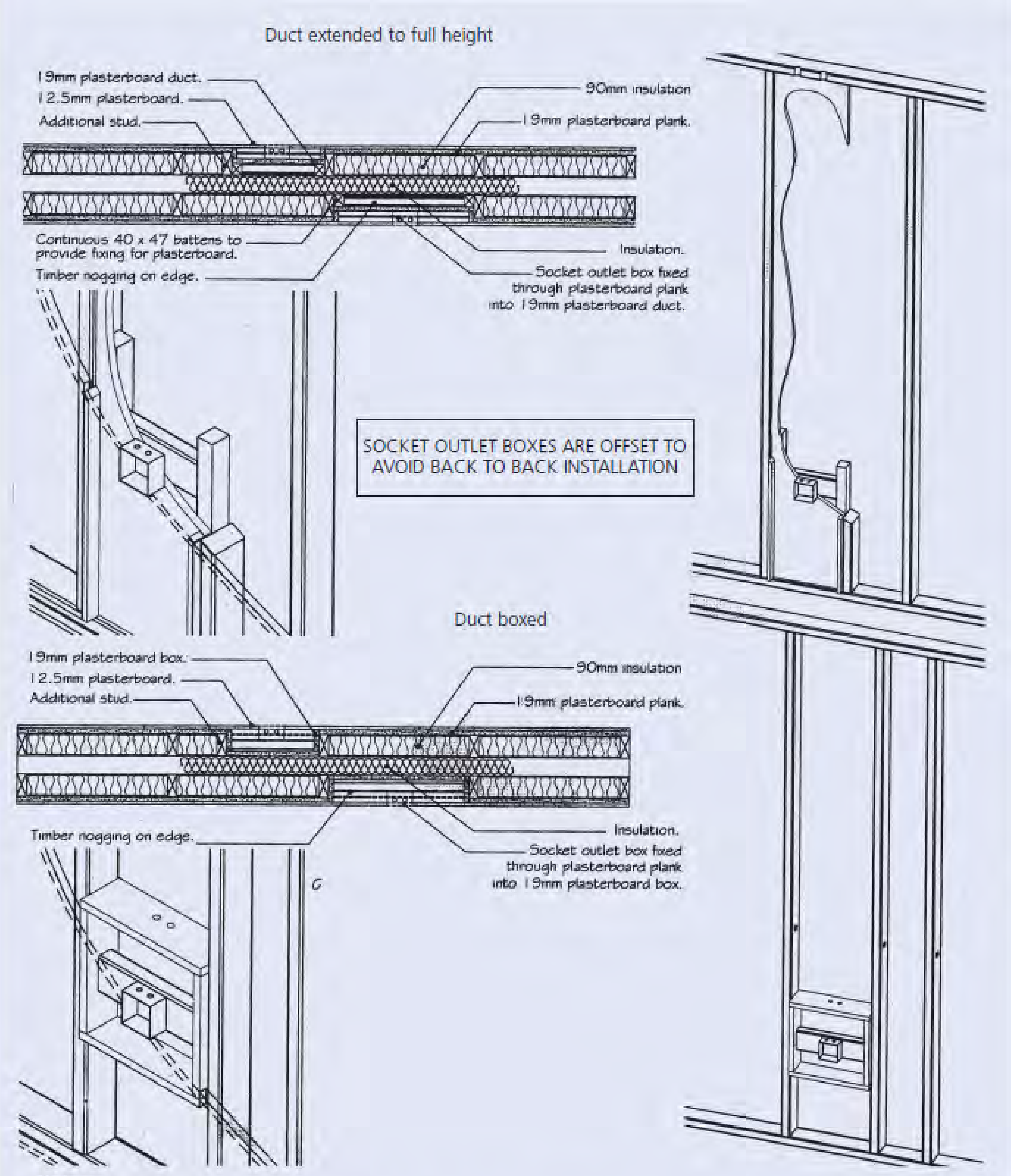
The main consumer unit for the electrical installation should be protected by a residual current device (RCD) in order to satisfy the IEE requirements regarding external appliances. All circuits on the consumer board should be clearly marked.

Wiring to fittings: No unprotected wires should be left within a void. All connections must be made within a protected environment i.e. a junction box or as found on ceiling and wall mounted smoke detectors a pattress which is mounted directly beneath the detector (ceiling side), to allow all wiring connections to be made on the room side of the ceiling i.e. preventing unprotected wiring connections being pushed up into the floor/ceiling void.

All metal lighting fittings should be earthed, and ideally the neutral wire from the switch to the light fitting or junction box should be marked with red tape to indicate that this is actually a live wire in this instance.

Party Walls

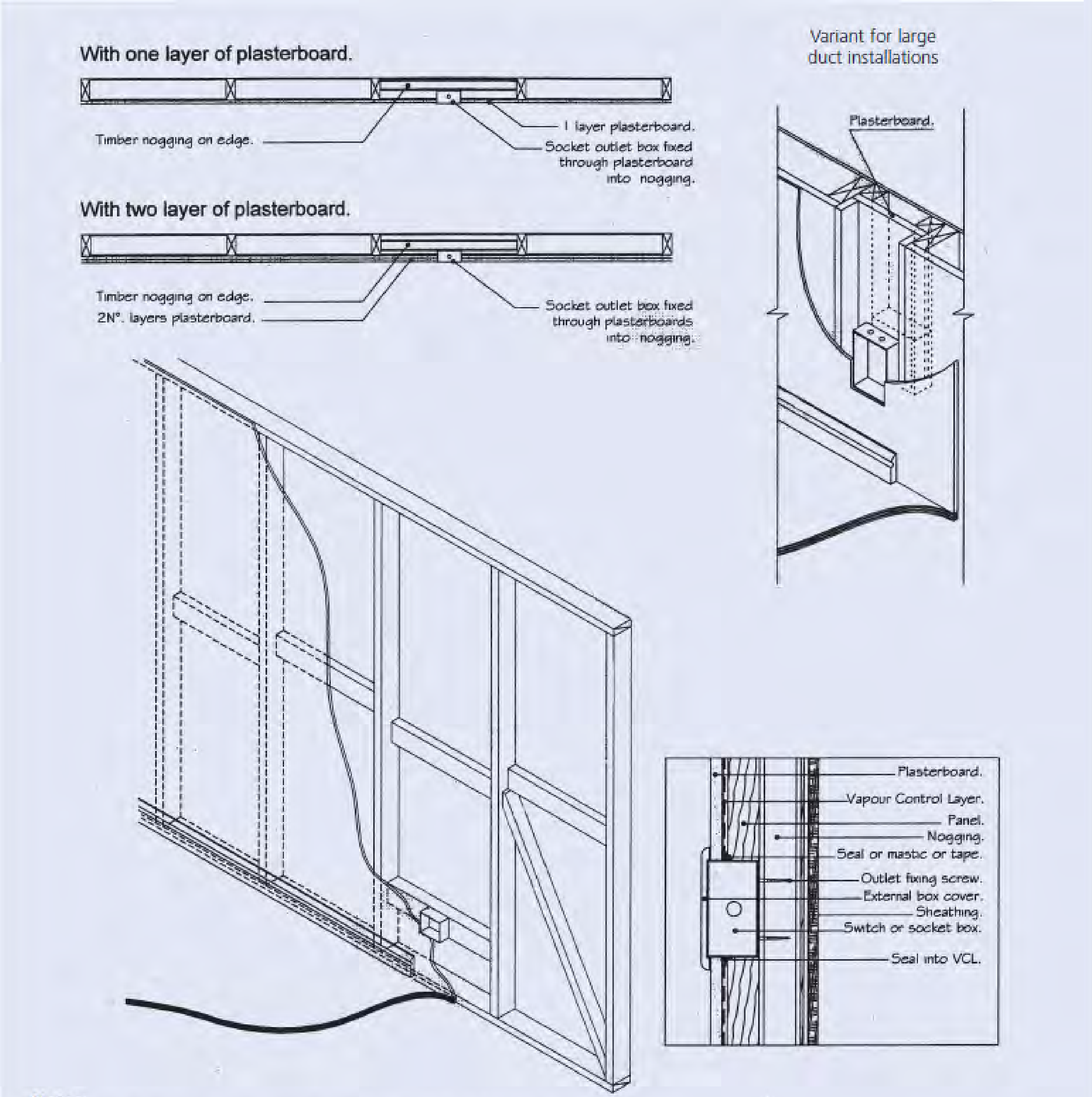
Wherever possible avoid placing electrical fittings in separating Party Walls. Services in Party walls must be adequately fire stopped and sealed for acoustic performance. For electrical services in Timber frame walls see the following diagrams: 3.43 & 3.44.



Notes:

1. Wiring can be located in the floor, roof or wall voids in timber construction. Wherever possible avoid placing the electrical fittings in Separating Party Walls.
2. In Separating Party Walls penetration by pipes, cables and sockets must be adequately Fire stopped and sealed for Acoustic performance. A minimum of 150mm stagger between outlets on opposite walls is required.

Diagram 3.43 – Party Wall Details



Notes:

1.Wiring can be located in the floor, roof or wall voids in timber frame construction.

2. When wiring is installed in external walls which incorporate a vapour control layer, is essential that the hole VCL is sealed against air leakage.

Diagram 3.44 – Party Wall Details

Smoke detectors

Mains operated self-contained smoke detectors shall be provided in all dwellings.

- There shall be at least one detector on each floor of a dwelling. Where more than one is provided they shall be interconnecting to operate the alarm signal simultaneously in all of them.
- There shall be a smoke detector in the circulation space within 7.5m of the door to every habitable room.
- Where the kitchen area is not separated from the stairway or circulation space by a door, a heat detector must be fitted in the kitchen in addition to the smoke detector fitted in the circulation space.

Self-contained detectors should be permanently wired to a separately fused circuit at the dwelling's electricity consumer unit. However, where a battery backup device is fitted it is acceptable to connect the separate wiring to the fuseway of any lighting circuit.

A test should always be carried out on completion to ensure that all units are interconnecting and are operational, where the system is reliant on a battery back up the power should be disconnected during the test.

Flexible wiring systems

Flexible wiring systems can be used for the provision of electrical services in traditional and for all types of off-site manufactured homes which can be panelised, volumetric or hybrid construction with the benefit of both labour and time reduction on site.

The systems are complete with miniature power connectors facilitating easy upgrade. A typical system will comprise of:

- Consumer unit
- Power circuit, tee connectors and socket outlets and connection units with flying leads
- Lighting circuit, lighting hub, locking connectors with light switches/fittings with flying leads. See diagrams 3.45 & 3.46

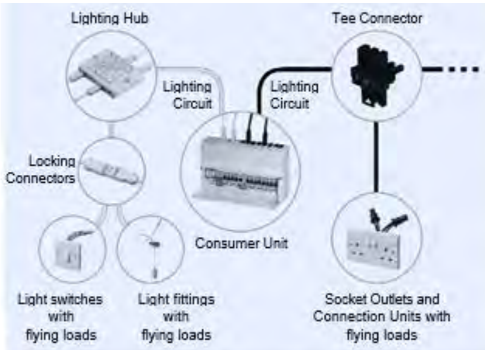
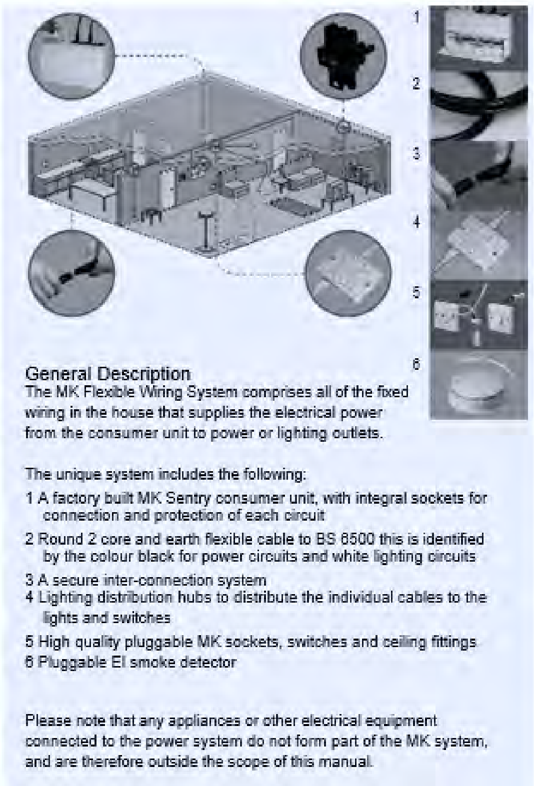


Diagram 3.45: Flexible wiring components



General Description
The MK Flexible Wiring System comprises all of the fixed wiring in the house that supplies the electrical power from the consumer unit to power or lighting outlets.

The unique system includes the following:
1 A factory built MK Sentry consumer unit, with integral sockets for connection and protection of each circuit
2 Round 2 core and earth flexible cable to BS 6500 this is identified by the colour black for power circuits and white lighting circuits
3 A secure inter-connection system
4 Lighting distribution hubs to distribute the individual cables to the lights and switches
5 High quality pluggable MK sockets, switches and ceiling fittings
6 Pluggable EI smoke detector

Please note that any appliances or other electrical equipment connected to the power system do not form part of the MK system, and are therefore outside the scope of this manual.

Diagram 3.46: Typical flexible wiring system

The system installation is in four phases:

1. Design. The system designer converts the architect drawings into a detailed proposal for a wiring system to complement the manufacturing techniques of the factory. The system will be designed to the latest edition of the BS7671 16th Edition Wiring Regulations and in accordance with appropriate Building Regulations.
2. Supply. The flexible system designer is responsible for supplying comprehensive training, installation instructions and manuals to the building manufacturer. This includes training operatives and training trainers, thus allowing the factory to be self-sufficient to install the flexible wiring systems.
3. Installation. Final on-site connections by the customer. An NICEIC trained electrical contractor will then carry out final testing for the installation and supply the NICEIC test certificate.
4. Handover. The flexible system supplier will supply every home with a homeowner's manual; this will include an explanation of the system and a set of drawings of the particular installation.

A typical supplier of this type of system is MK Electrical and more detailed information can be attained at the address below.

MK Wiring Systems
The Arnold Centre, Paycocke Road, Basildon, Essex, SS14 3EA

Tel:	01268 563020
E-mail:	mkwiringsystems@mkelectrics.co.uk
Website:	www.mkwiringsystems.com

Other Fuels

Gas supply
A meter control valve should be fitted on the supply side of the meter.

External meter boxes should be of a type approved by the supply authority and located as close as practical to the main access point to the dwelling.

The pipe from an external meter box to the inside of a building should be through a sleeve. After installing the pipe the sleeve should be made water-tight with a mastic sealing material.

When located inside a building, the meter should be installed as near as practicable to the point of entry of the gas service supply pipe into the building.

Gas Safety Regulations require ventilation for ducts at each floor containing gas pipes. Gas pipes may be contained in a separate ventilated duct or they can remain unducted.

For typical balanced flue and gas meter box installation in timber framed building see diagrams 3.47 and 3.48.

Installation of service supplies
Gas supply systems should be fitted by British Gas or an installer registered with the Confederation of Registered Gas Installers (Gas Safe).

Commissioning and testing
Gas installations should be inspected and tested before and after the installation of the meter in accordance with the following British Standards and Codes of Practice as appropriate:

BS 6400 Specification for installation of domestic sized gas meters
BS 6891 Specification for installation of low pressure gas pipework.

After testing, the gas installation should be purged as detailed in the above-mentioned British Standards and

Codes of Practice. After purging is complete the builder should verify that:

- The governor outlet pressure is correct (where appliances are already installed)
- The governor is resealed after any adjustment has been made.

Gas Safe Requirements
Where installation pipes are not separated by electrical insulating material, they shall be spaced as follows:

a) at least 150mm away from electricity meters and associated excess current controls, electrical switches or sockets, distribution boards or consumer units;
b) at least 25mm away from electricity supply and distribution cables.

Additional requirements:

- Behind dry-lined wall: provide either a solid perimeter dab to both sides of the pipe or, chase in, wrap the pipe to protect and mortar over.

- Within timber frame, this includes timber frame external walls and internal stud walls (timber or metal stud): Studs should be provided either side of the pipe and a blocking/infill "stud" behind. The small void created needs to be filled with insulation or equivalent as any duct/space exceeding $0.01m^2$ needs to be ventilated.
- BS 6891 2005 allows for gas pipes in intermediate floors as these are considered as voids and voids don't need ventilating. However, the Gss Safe Regs have amended this. Due to changes in construction methods, e.g. glued and screwed floors, sound insulation etc the previous fortuitous ventilation achieved by gaps in construction are no longer considered to exist. It is, therefore not acceptable to run gas pipes within intermediate floor zones. This applies to Party floors in similar circumstances.
- As any duct greater than $0.01m^2$ needs venting, therefore this would apply to block and beam, or similar, intermediate floor where the gas pipe is run within the suspended ceiling.

Oil and solid fuel
Oil-fired boiler installations should comply with BS 5410:1.
Solid fuel fired installations should comply with BS 8303:1.

Hot water heating systems should be installed by firms which are registered members of the:
- Heating & Ventilating Contractors Association (HVCA), or the
- Gas Safe Registered Gas Installers.

Solar
Solar powered systems should hold independent third party accreditation acceptable to Q and comply with BS 5918.

For further information on design, installation service for solar water heating, solar photovoltaic, rainwater harvesting, heat pumps, bio fuel boilers, energy saving lighting contact Ecofirst:

The Tithe Office,
Abbey Manor Business Centre,
Preston Road, Yeovil, Somerset, BA20 2FJ

Tel No: 01935 848571
Website: www.ecofirst.net
Email: info@ecofirst.net

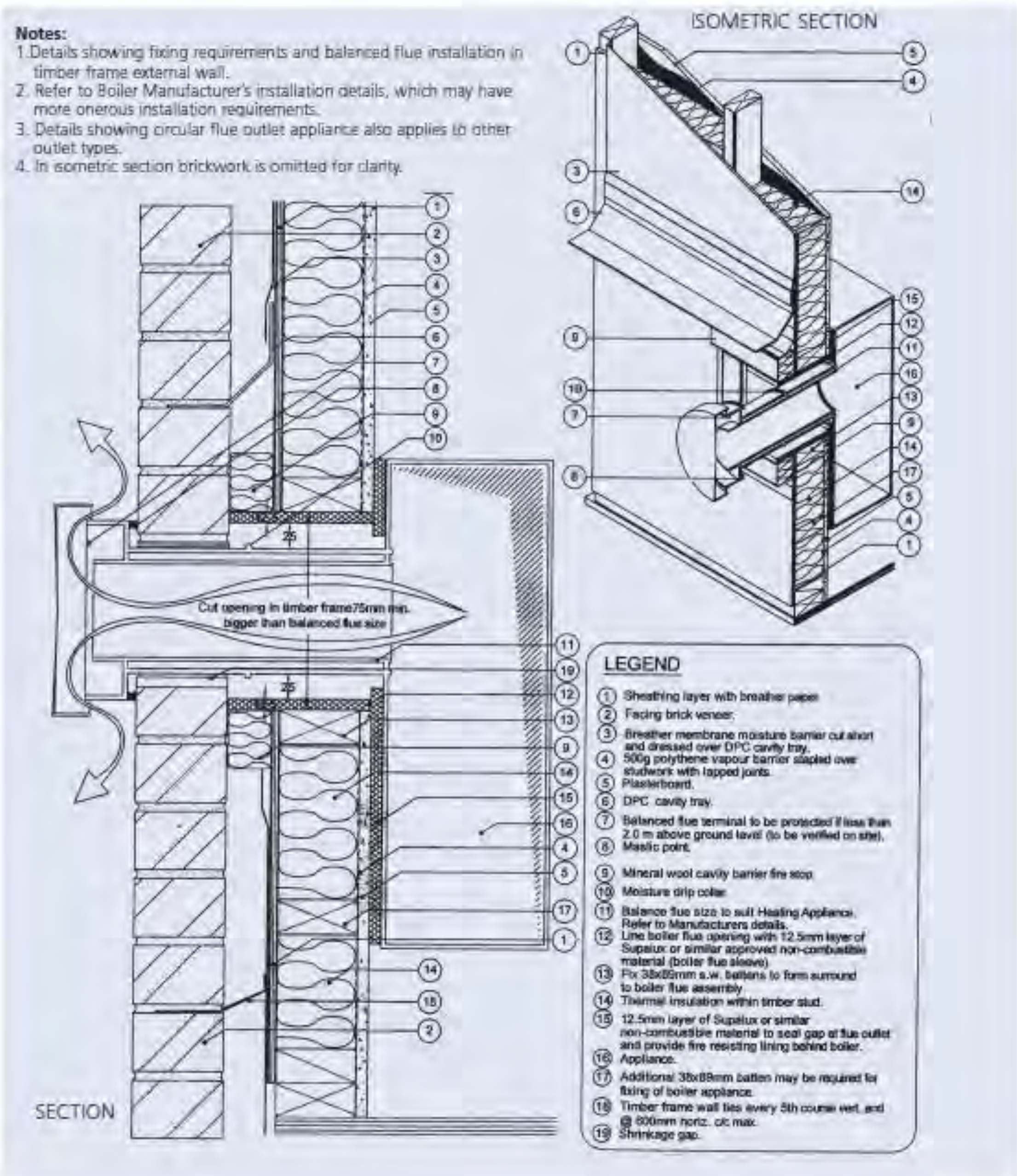


Diagram 3.47: Typical Balanced flue detail

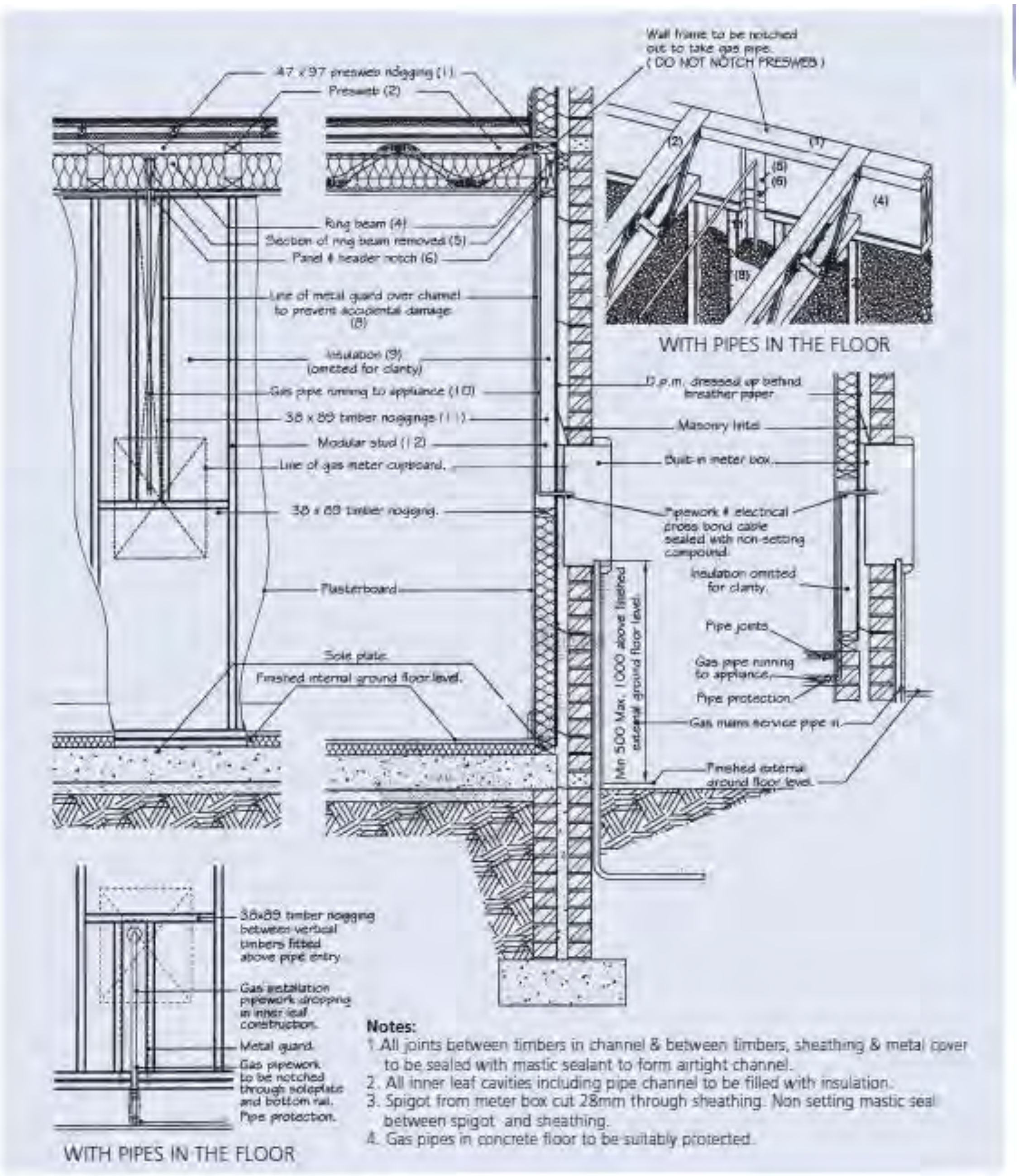


Diagram 3.48: Typical Gas meter box detail

Plumbing / Heating

Cold Water Services

System design
Cold water supply systems should be designed to comply with BS 6700.

Cold water systems may have provision for storage or be directly connected to the main supply. Drinking water should be supplied direct from the supply main.

Cold water pipes and storage cisterns located in roof spaces and other unheated areas should be insulated to BS 6700 and BS 5422.

Distribution pipes should be sized to provide the flow rates at draw-off points as set out in table 3.15.

location	flow rate (l/s)
bath tap (22mm)	0.3
shower	0.1
wash hand basin tap (15mm)	0.15
kitchen sink tap (15mm)	0.2
WC	0.1

(1) The height of the cistern should be such as to allow these flow rates without excessive size of distribution pipes and fittings.
(2) These flow rates should be available to each outlet when only that outlet is open.

Table 3.15: Design flow rates for appliances

Draw off points in gravity fed systems should be provided with a minimum 1m head of water measured from the base of the cistern.

Shower installations, where provided, should be designed and installed so that there is no serious rise or drop in the temperature of the water when another water outlet in the dwelling is used. Pipe size design, thermostatically controlled shower units, or a separate cold water supply provided from a header tank can achieve this.

Cold water installations storage systems
The storage capacity of water cisterns should be as set out in table 3.16.

storage type	capacity (litres)
for cold water storage only	100-150
for cold water storage plus feed to hot water storage cylinder	200-300

Table 3.16: Storage capacity of cisterns

If it is considered that the water supply may not be regular, a larger capacity cistern should be installed based on a storage of 90 litres per person normally expected to be resident in the dwelling.

Feed and expansion cisterns for hot water space heating systems should comply with BS 5449.

Storage cisterns should be provided with a full-way gate valve at every outlet other than the header pipe.

All outlet pipes serving cold water draw-off points should be connected to the cistern so that the lowest point of the outlet is at least 30mm above the bottom of the cistern.

Outlet pipes supplying a hot water system should be at least 25mm above cold water draw-off outlets.

An overflow pipe should be provided to all cisterns and be laid to a uniform fall and discharge in a conspicuous place outside the building. It is recommended that overflows are insulated or within the thermal envelope of the building.

Installation
Cold water services should be installed to comply with BS 6700 .

Pipes supplying drinking water should not be in close proximity to hot pipes.

After installation, the cistern should be cleaned of all debris and, if galvanized, coated internally with a non- staining, non-toxic, bituminous paint approved by the Water Research Centre

Hot Water Services

System design
Hot water supply systems should generally comply with BS 6700 and be energy efficient.
Gas-fired hot water systems should comply with BS 5546.
Electric water heating installations should comply with
BS 6700.

Hot water systems may have provision for storage or may be of the instantaneous type (e.g. combination boilers). Solar powered systems should comply with BS 5918.

Distribution pipes should generally be sized to provide the flow rates at draw-off points as set out in table 3.17.

Certain instantaneous systems may not achieve these flow rates (consult manufacturer) but they can deliver hot water continuously without time to reheat. Where, considering demand and a reduced design flow rate is deemed acceptable, a shower should be provided in addition to any bath to compensate for the reduced flow rate.

location	flow rate (l/s)	(° C)
bath tap	0.3	50
sink	0.2	60
shower	0.05-0.1	40
wash hand basin	0.15	50

The height of any storage cylinder should be such as to achieve these flow rates without excessive size of distribution pipes and fittings.
These flow rates should be available to each outlet when only that outlet is open.

Table 3.17: Design flow rates for hot water draw-off points

Hot water distributing pipes should be as short as practicable and should not exceed the lengths as set out in table 3.18.

internal pipe diameter	maximum length*
less than 19mm	12.0m
19 – 25mm	7.5m
over 25mm	3.0m

*Distance from draw-off point to storage vessel (or secondary circulation pipe).

Table 3.18: Design flow rates for hot water draw-off points

For details of controls for heating systems, see "Space Heating" in the following pages.

Open vented hot water heating systems should be provided with a feed and expansion cistern and separate cold feed and vent pipes to comply with BS 5449.

Expansion vessels used in unvented hot water heating systems should comply with BS 4814. Insulation should be provided to control the heat losses through the safety fittings and pipe work but without impeding safe operation and visibilty of warning discharges.

Pumps for circulating hot water should comply with BS EN 1151

Domestic hot water storage systems

A storage system should have a storage capacity of not less than 115 litres (200 litres for off-peak heating or in accordance with the electricity authority's recommendations), and should meet the insulation requirements of BS 1566, BS3198 or BS 7206 (as appropriate).

Hot water should normally be stored at a mean temperature not exceeding 65˚C. For normal use 60˚C is recommended.

The hot water heating system should be capable of heating the total stored water quantity from cold (10˚C) to 60˚C in the times as set out in table 3.19.

system type	heat-up period
gas-fired	2.5 hours
oil-fired	2.5 hours
solid fuel-fired	4.0 hours
electric	2.5 hours

Table 3.19: Domestic hot water heat up period

Boilers and circulators supplying the hot water system should have sufficient heat generating capacity to allow the above recovery times to be achieved when supplying the maximum design space heating load.

Pipes distributing domestic hot water from the hot water storage cylinder should be used solely for that purpose.

A stop-valve should be fitted in the secondary cold feed pipe to the hot water storage cylinder.

A drainage tap should be fitted at the lowest point of the secondary cold water feed pipe to allow draining of the stored water. This tap should be suitable for a hose connection.

Hot water storage cylinders should be of the indirect type except where the heating is by electric immersion heater, in which case a direct type cylinder may be used.

Cylinders should be insulated, a factory applied coat of 35mm thick PU-foam having a minimum density 30kg/m^3, is normally sufficient.

Where primary circulation is by gravity, the return pipe should be connected to a separate connection on the boiler or into an injector type fitting in the return pipe of the space heating circuit. The hot water storage cylinder should be located at a sufficient height above the boiler to ensure good circulation.

Flow and return pipes between a boiler and a hot water storage cylinder should be used for domestic hot water heating.

Provision should be made to limit the heat loss to pipe work / ducts located outside the fabric insulation as recommended in BS 5422. Hot pipes connected to hot water storage vessels, including the vent pipe, and the primary flow and return to the heat exchanger, where fitted should be insulated to BS 5422.

Hot water storage cylinders should always be controlled by a thermostat.

Space Heating

Space design
Space heating systems should comply (as appropriate) with the following British Standards and Codes of Practice:

- BS 5410:1/2 Code of practice for oil firing
- BS 5449 Specification for forced circulation hot water central heating systems for domestic premises
- BS 5482:1 Domestic butane and propane gas burning installations
- BS 5864 Specification for installation in domestic premises of gas fired ducted air heaters
- BS 5871:1 Specification for installation of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances
- BS 6700 Specification for design, installation, testing and maintenace of services supplying water for domestic use
- BS 8303 Installation of domestic heating and cooking appliances burning solid mineral fuels

Any whole house heating system should be designed to provide internal temperatures to the levels set out in table 3.20 when the outside temperature is -1˚C and using the corresponding air changes per hour. For traditional systems these temperatures may be taken as air temperatures. For non-conventional systems and for all warm-air heating systems they should be considered as dry resultant temperatures.

location	temperature	air changes
living room	21°C	1 per hour
dining room	21°C	1 per hour
kitchen	18°C	2 per hour**
bedrooms*	18°C	1 per hour
bed-sitting room*	21°C	1 per hour
bathrooms	22°C	2 per hour**
hall & landing	16°C	2 per hour
separate WC	18°C	2 per hour**

* As the use of a bedroom may be changed to that of a play-room or study, or occupied by an elderly person as a bed sitting room, it is recommended that all bedrooms be capable of being heated to 21°C
** These values are based on natural ventilation. Where mechanical ventilation is used an extra allowance of 50% should be made.

Table 3.20: space heating requirements

Open vented hot water heating systems should be provided with a feed and expansion cistern and separate cold feed and vent pipes to comply with BS 5449:1.

Expansion vessels used in unvented hot water heating systems should comply with BS 4814.

Pumps for circulating hot water should comply with BS EN 1151, BS 1394, and BS EN 60335-2-51.

Ducts for warm air heating systems should be sized according to the methods and data published by:

The Chartered Institution of Building Services Engineers
222 Balham High Road, London SW12 9BS.

Tel: 020 8675 5211.
W: www.cibse.org

Controls
Wet heating systems should be provided with the following controls (See diagram 3.49):

- Zone controls i.e. room stats. or thermostatic radiator valves.
- Timing controls.
- Boiler control interlocks.

Where thermostatic radiator valves are fitted to radiators, the system should be arranged so that manufacturer's minimum flow rate will continue to flow through the boiler when all valves are closed at the same time.

- Ducted warm air systems should be provided with the following controls:
- Room thermostat controlling the heater unit.
- Time switch allowing at least two heating periods a day. In the case of electrically heated storage systems (Electricaire) there will normally be a further time switch to control the electrical 'charging' periods to conform with the chosen tariff.
- a programmer to select:
  - o hot water
  - o space heating
  - o hot water and space heating.

Independent heaters e.g. night storage heaters, should be provided with a thermostat sensitive to the room air temperature (this is often an integral part of the appliance).

Selection of appliances and equipment
Boilers should be selected for their efficiency, demonstrated by using a boiler with a SEDBUK not less than the appropriate entry in Table 3.21.

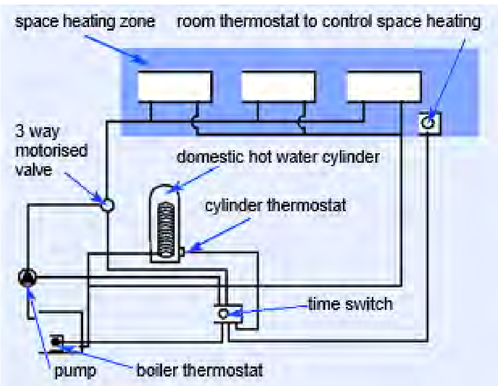


Diagram 3.49: Controls for combined space heating and domestic hot water installation

SEDBUK table for target U-value Method

Table 2 Minimum boiler efficiencies as listed by SEDBUK

Central heating system fuel	SEDBUK %
Mains natural gas	86
LPG	86
Oil	85[1]

Note:
1. For oil-fired combination boilers a SEDBUK of 82%, as calculated by the SAP-2000 method, would be acceptable.
2. Standard oil boilers installed after 1st April 2007 required to have efficiency of 86%

Table 3.21: SEDBUK table

Gas-fired, oil-fired, solid fuel and electric boilers should be type tested by the appropriate authorities.

Electricaire ducted air heaters should have been approved by the Electricity Council's Appliance Testing Laboratory.

Metal ductwork for warm air heating systems should be constructed to comply with the specification for sheet metal ductwork (DW/142) published by the Heating & Ventilating Contractors' Association.

Radiators, convector-radiators and convectors used in the installation should comply with BS 3528.

Forced circulation hot water systems should comply with BS 5449:1

Installation

The installation of gas-fired ducted air heaters should comply with BS 5864.

All ductwork should be reasonably sealed against air leakage at the normal operating pressure.

Electric storage systems should be installed by a member of the National Inspection Council for Electrical Installation and Contracting, (NICEIC) or the Electrical Contractors Association.

The installation of 'Electricaire' units should conform to the requirements of the manufacturer's installation instructions and those set out in the Electricaire Design Manual (published by the Electricity Council), and be installed by a registered member of the National Inspection Council for Electrical Installation and Contracting (NICEIC) or the Electrical Contractors Association.

The installation of gas-fired independent heaters should comply with BS 5871:1.

The installation of solid fuel-fired independent heaters should comply with BS 8303 (this standard is applicable to open fires without convection, room heaters, independent boilers and warm air heating appliances with natural convection).

The installation of electric storage independent heaters should be strictly in accordance with the manufacturer's instructions.

In order to maintain stability because of their large mass, care should be taken to ensure that electric storage heaters rest on an even and level surface.

If boilers and electric thermal storage room heaters are to be mounted on a wall, extra care must be taken to follow strictly the manufacturer's instructions regarding fixing and the minimum mounting height.

Radiators should not be painted with a metallic paint unless due allowance has been made for reduced heat emission.

Above Ground Drainage

Waste disposal

All above ground plumbing systems should be designed to allow the unobstructed flow of waste water from an appliance to the underground drainage system. To achieve this the following points should be noted at the design and installation stages:

- Provide rodding access facilities at all changes of direction
- Avoid bends and changes of direction in the wet part of the above ground drainage system
- 75mm deep seal traps should always be used except
- on a WC
- where an appliance on the ground floor discharges directly into a trapped gully
- Pipe sizes should not exceed the dimensions for diameter against pipe length given in table 3.22
- Pipe should be laid at a gradient of 1/80 or better
- Any admittance valve fitted to the system should be located above the highest flood level of any appliance connected to that stack pipe
- Enclosures to air admittance valves should be adequately ventilated
- The highest point of a drainage system (head of run) should always be vented to the external air.

appliance	permitted maximum length of pipework for diameter given			
	32mm	40mm	50mm	100mm
sink	-	3m	4m	-
wash hand basin	1.7m	3m	4m	-
bath	-	3m	4m	-
shower	-	3m	4m	-
bidet	1.7m	3m	4m	-
WC	-	-	-	6m

Note:
Soil and vent pipes (stacks) should be at least 100mm diameter (this can be reduced to 75mm diameter above the last discharge point [wet part] when it is then used purely for ventilation of the system)
Length can be extended if anti-syphonic traps are used. Further guidance can be provided by the Building Regulations Approved H1 and BS EN 1205

Table 3.22: Permitted length of pipework

Ventilation

Air Admittance Valves

These valves provide a means of ventilation to the drainage system to prevent the loss of water seals in traps

The valve should have third party accreditation and the drainage system should be designed in accordance with BS 5572:1994.

Air admittance valves are suitable for use in domestic buildings e.g. bungalows, houses, multi-storey flats, halls of residence.

Air admittance valves are not suitable when the discharge stack provides the only ventilation to septic tanks or cesspools or when the connecting drain is subject to periodic surcharging or is fitted with intercepting traps.

• The 32mm valve is for connection to waste pipes where the trap seal may be lost due to self and induced siphonage.
• The 56mm valve is for use on branch discharge pipes
• The 82mm and 110mm valves are for use on discharge stacks serving up to 10 storeys (see diagram 3.50 and 3.51)
• The 110mm valve maybe used as a substitute for the 82mm valve where the 110mm spigot diameter makes it easier to install
• The 125mm valve is for use on discharge stacks serving up to 12 storeys.

Satisfactory drainage systems incorporating an air admittance valve are shown in diagram 3.50 - 3.52

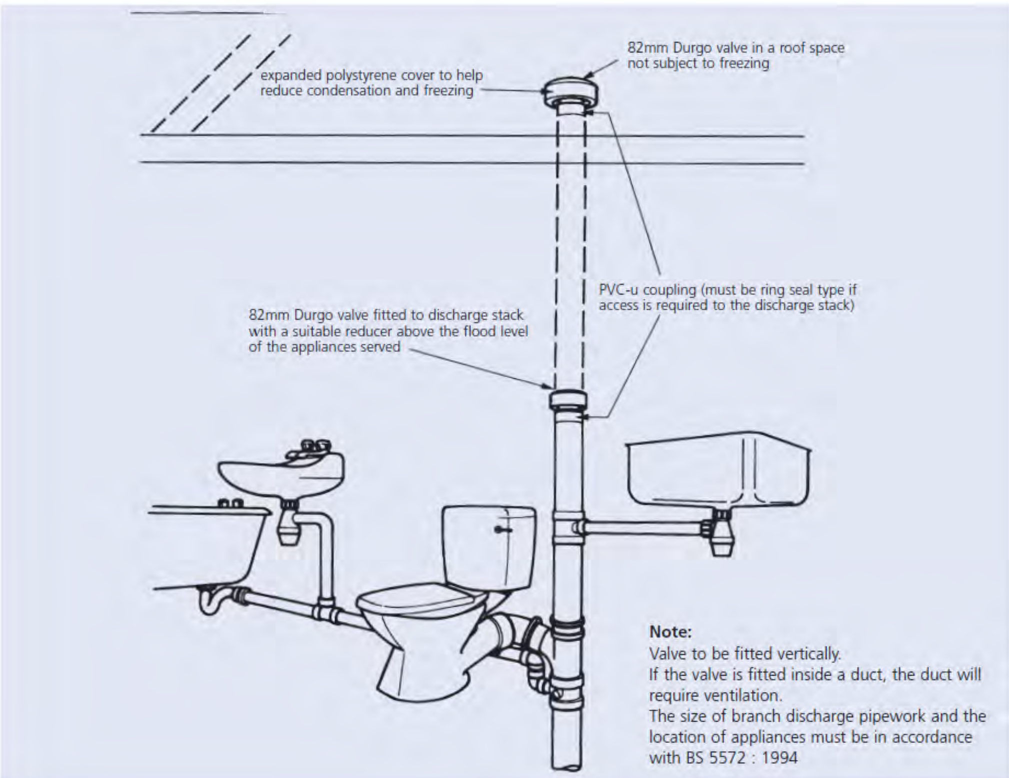
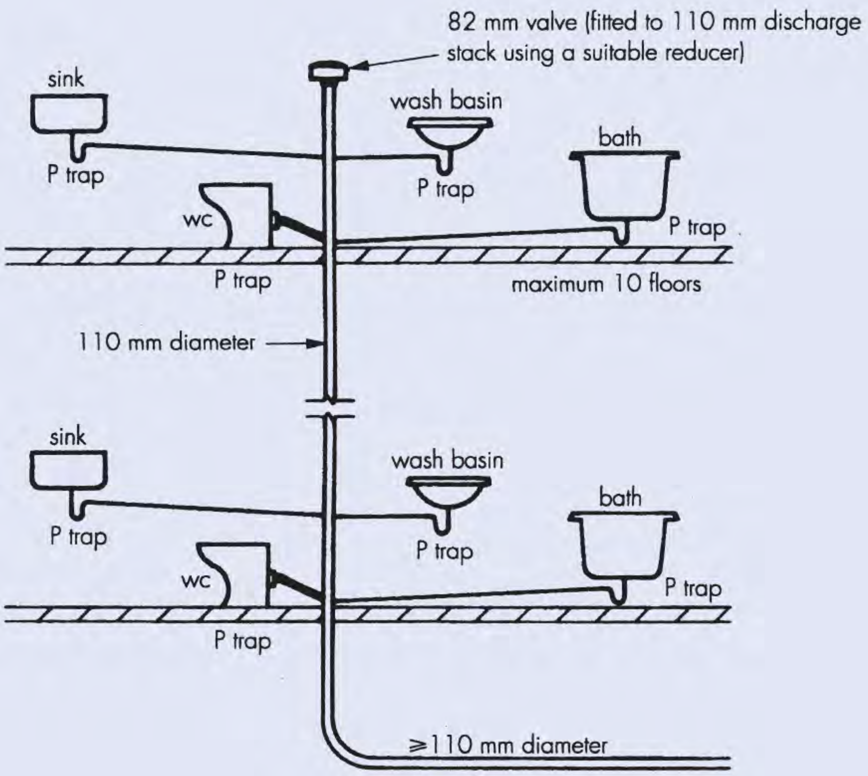


Diagram 3.50: Typical domestic installation (e.g. bungalow or house)



Note:
Maximum of two groups of appliances per floor. A group of appliances consists of one wc, one washbasin, one sink and one bath (and/or shower).
The maximum distance of appliance traps from the discharge stack must be in accordance with BS 5572 : 1994 paragraph 7.2.2 and Figures 16,18,19 and 20. The separate ventilation shown on the BS figures may be provided by a 56mm valve which must be within 300mm of the appliance trap.
The valve must be fitted into a ring seal coupling where access is required to the discharge stack.
The size of branch pipework and the location of appliances must be designed in accordance with BS 5572 : 1994.

Diagram 3.51: Domestic discharge system (e.g. multi-storey flats and halls of residence)

To contribute to the ventilation of the underground drain the branch or main drain serving a stack or stacks fitted with an air admittance valve may require venting. (See diagram 3.52).

For other multi-storey dwellings conventional drain venting should be provided if more than one such building, each equipped with the valves, is connected to a common drain which itself is not vented by means of a ventilating stack or discharge stack not fitted with a valve.

Position
The air admittance valve should be installed within the building:

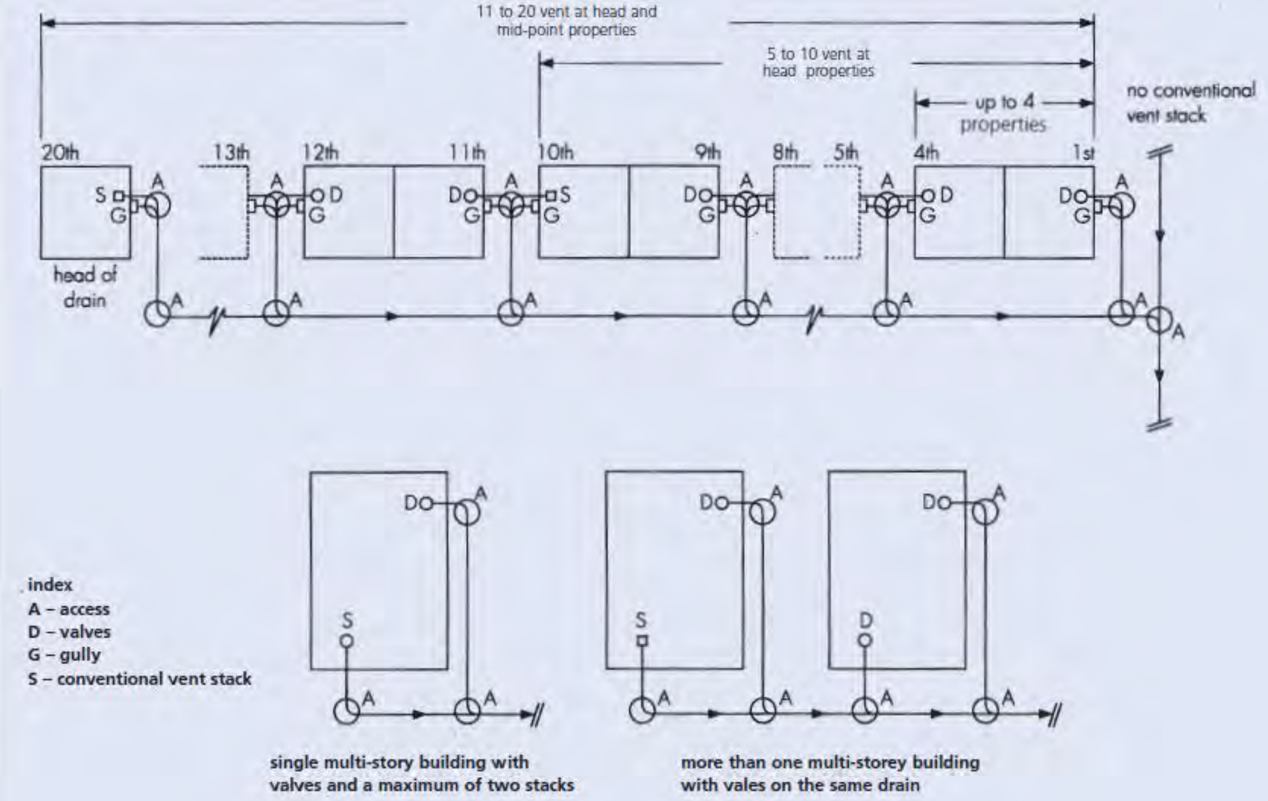
- Preferably in a non-habitable space. In a roof or other space where there is a risk of freezing the insulating cover should be provided.
- Where noise of operation will not cause a nuisance provide sound insulation when this is not possible.
- If self-siphonage may occur, a connection to the 32mm valve is required within 300mm of the trap.

Where the air admittance valve is enclosed within a boxing the boxing should be ventilated.

A free area of 2500mm^2 is acceptable.

The use of ventilation grilles, discreet gaps around the boxing or ventilation of the boxing into a roof void are acceptable methods of providing ventilation

Testing of above ground drainage system
As the air admittance valve is an integral part of the above ground drainage system it should be in place when the system is tested.



Notes:
Access arrangements are indicative only and may be varied to suit particular system layouts.
The underground drain must be designed in accordance with BS 8301 : 1985
If the branch drain is fitted with an intercepting trap before the connection to the main drain/sewer then a conventional open topped ventilation discharge stack must be provided at the nearest point upstream of the intercepting trap.

Diagram 3.52: Drain ventilation provisions

System design
The system should comply with the following:

- BS 5250: Code of Practice for control of condensation in buildings
- BS 5720 Code of Practice for mechanical ventilation and air conditioning in buildings
- BRE Digest 398.

In England & Wales the Approved Document shows three main ways of complying with the requirements: (see below)

a. providing the ventilation rates set out in paragraphs 1.4 to 1.7; or
b. following the system set out:
   i. for dwellings without basements (paragraph 1.8); or
   ii. for dwellings with basements (paragraphs 1.9 to 1.11);

or

c. using other ventilation systems provided it can be demonstrated to the building control body that they satisfy the Requirement, e.g. by showing that they meet the moisture and air quality criteria set out in Appendix A.

room	purge ventilation (openable window/door)	background ventilation (mm²)	extract rates: fans or passive stacks (PVS)
habitable room	1/20th floor area	8,000	–
kitchen	any opening window	4,000	30l/s adjacent to hob 60l/s elsewhere or PSV
utility (access via dwelling)	any opening window	4,000	30l/s or PSV
bath/shower room	any opening window	4,000	15l/s or PSV
sanitary accomodation (separate from bathroom)	1/20th floor area or 6l/s extractor fan	4,000	–

Note:
Sanitary accommodation can be ventilated by either purge ventilation of 1/20th floor area or by mechanical extraction of 3 air changes per hour.

Table 3.23: Ventilation requirements in dwellings

Where ductwork from extractor fans pass through unheated spaces such as roof voids the following action should be taken to reduce the possibility of condensation forming within the ducting and any consequential damage caused to finishes and the fan unit:

- Ensure ducting discharges to the outside air
- Provide insulation to the outside of the ductwork and lay to a fall away from the fan.

The system should provide the rates of change with the external air as set out in:

- Approved Document F (E&W)
- Technical Standards: K (Scotland).
- Part K: Ventilation (Northern Ireland)

It is a requirement that all habitable and service rooms within dwellings have some form of ventilation, whether it be permanent background ventilation, mechanical ventilation or indeed an openable window. Table 3.23 provides guidance as the provisions of ventilation to rooms.

For internal rooms (non-habitable), provide either 15 minutes overrun to the mechanical extraction unit, provide PSV or an open flued heating appliance may be acceptable. In all cases some form of air inlet is required.

Whole Building Ventilation

Whole building ventilation rate for the supply of air to the habitable rooms in a dwelling should be no less than specified in Table 3.24

Ventilation	Number of bedrooms in dwelling				
	1	2	3	4	5
Whole building ventilation rates (l/s)	13	17	21	25	29

Notes:
a. In addition, the minimum ventilation rate should be not less than 0.31l/s per m internal floor area (this includes each floor, e.g. for a two-storey building, add the ground and first floor areas.
b. This is based on two occupants in the main bedroom and a single occupant in all other bedrooms. This should be used as the default value. If a greater level of occupancy is expected, then add 4l/s per occupant.

Table 3.24: Whole building ventilation rates

Passive Stack Ventilation

The system should comply with the recommendations contained within BRE information paper 13/94 or hold an appropriate third party certification such as a BBA Certificate.

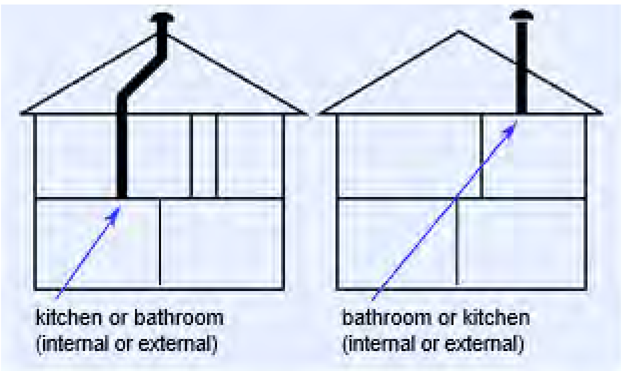


Diagram 3.53: Kitchen and bathroom ducts for PSV extraction

System Layout

The PSV layout should be designed to:

- Avoid crossflow between the kitchen and bathroom/WCs
- Prevent, as far as possible, air flow in the ducts being adversely affected by the prevailing wind speed and direction, or by sudden changes in these
- Minimise resistance to air flow by having ducts that are as near vertical as possible

The layouts shown in diagram 3.53 are considered to be suitable for the majority of dwellings of up to three storeys. Separate ducts are taken from the ceiling of the kitchen, bathroom, utility room or WC to separate terminals on the roof. A common outlet terminal or branched ducts between these rooms should be avoided as they could (usually in the high wind speed conditions) result in air from one room being routed to another.

There are broadly two suitable positions for the duct outlet terminals (See diagram 3.53).

Duct size and materials
To achieve an adequate, but not excessive, air-flow rate the diameter of the ducting should be chosen in accordance with diagram 3.51 and table 3.24. Off the shelf PVC-u pipes and fittings, of the type used for soil pipes, are suitable and have the advantages of being inexpensive, widely available and, to some extent, self -supporting.
Flexible ducting has the advantage of being easier to install where a completely vertical duct is not viable. It is also available in a pre-insulated form. There is, however, the disadvantage of the need to support any bends in a smooth curve. Tests have shown that flexible ducting and rigid ducting have similar resistance to air flow at the flow rates found in typical PSV systems.

location	diameter of duct (mm)	internal cross sectional area (mm²)
WC	80	5000
bathrooms	100	8000
utility	100	8000
kitchen	125	12,000

Table 3.25: PSV duct sizing

All ventilators and pipes should be fitted with mesh grilles or be a type designed to avoid entry of birds and insects.

Air transfer between rooms
To ensure good transfer of air throughout the dwelling, there should be an undercut of minimum area 7600mm^2 in all internal doors above the floor finish (equivalent to an undercut of 10mm for a standard 760mm width door).

External Works

Introduction

General

Fixings
Fixings should:

- Be corrosion resistant where located externally
- Resist or accommodate movement of the fixed element during the course of its normal life
- Be chemically compatible with the element they support and adjacent elements.

Control of building movement
In determining whether adequate precautions have been taken to minimize or accommodate whole and differential movement of elements, consideration must be given to the following causes of movement which occur within a building:

- Settlement and heave
- Deflection (lateral and vertical)
- Drying shrinkage
- Cyclical changes in moisture content and humidity
- Thermal movement
- Differential movement of adjacent dissimilar materials
- Chemical action.

Treatment of materials susceptible to premature decay or decomposition
In determining whether materials should be treated against premature decay or decomposition, consideration must be given to the resistance of the material to attack from the following:

- Frost
- Moisture
- Fungal growth
- Insects
- Sunlight
- Oxidation
- Atmospheric pollution
- Acid and alkaline attack
- Other chemical attack

Timber based materials should not be incorporated into the structure unless precautions have been taken to prevent the occurrence of dry rot, due account being taken of the location of the element. In particular, attention should be given to materials located within the external fabric of the building envelope, permanent shuttering, perimeter insulation and filling of movement joints.

Storage and protection of materials
Materials susceptible to damp, dust and frost should be stored in a clean and dry place. Those which have a limited storage life should be used in date rotation and before the use-by date.

Manufactured units should be clearly identified and kept in their protective wrappings until incorporation into the construction.

Materials should be stored in such a manner that damage does not occur during the period of storage and individual elements may be withdrawn from storage without being damaged or causing damage to other elements.

Materials which are withdrawn from storage for incorporation into the construction should be transferred directly to the work and temporarily stored in such a manner as to avoid damage occurring. Damp susceptible materials should not be incorporated into the construction until the building is weather-tight.

Where appropriate, uncompleted construction work should be provided with temporary protection and support.

After incorporation into the construction, all work should be protected from damage until handover of the dwelling.

Fences
Boundary wooden and concrete fences are not covered under the policy.

Please contact a specialist fencing contractor for advice.

External Works – Retaining / Boundary Walls

Retaining Walls

Where retaining walls are provided they should be designed and constructed of materials suitable for the ground conditions. Retaining walls should be designed to resist vertical movement, overturning, sliding, rotation, and thermal and moisture movement. (See diagram 3.54).

The findings and recommendations of the site investigation report should be taken into account.

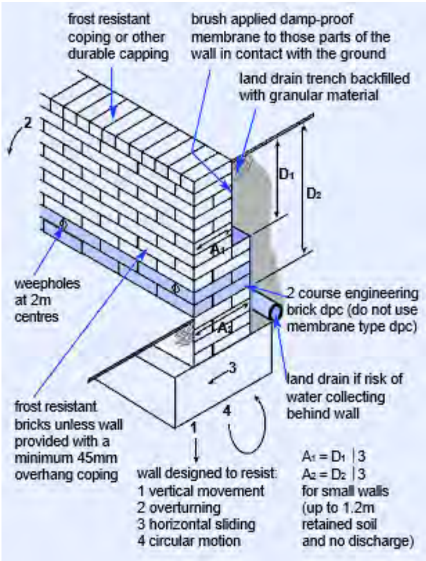


Diagram 3.54: Retaining walls – design principles

Small masonry retaining walls retaining less than 1200mm of dry earth may be designed using the empirical formula (See diagram 3.54):

A = D ÷ 3, where
A = Thickness of wall at considered point
D = Height of retained earth at the point considered

Retaining walls should be provided with a damp-proof course at low level and tanking system so as to prevent ingress of moisture from the retained ground. The damp- proof course should not be of a membrane type (2 courses of engineering brick is recommended).

Subsoil drainage should be provided behind a retaining wall where underground waterways are interrupted or where it is likely that the ground water table may rise above the foundation level.

Retaining walls constructed of proprietary precast concrete units or timber cradles are to be used in accordance with the manufacturer's recommendations.

Retaining walls should be designed by an Expert and constructed in accordance with BS 8110 or BS 5628 as appropriate.

Boundary Walls

Walls should be constructed on a concrete foundation capable of safely transmitting all loads into the ground without causing excessive movement.

The recommendations of the site investigation report should be taken into account for the design and construction of walls.

Generally, free standing walls should be designed and constructed in accordance with BS 5628:1 and of materials as specified in BS 5628:3, Table 13(J).

- Clay bricks should be type FN or FL (or type MN or ML if a minimum 45mm overhang to the coping is provided). Bed in a 1:3 to 1:4 sulphate resisting cement-sand mortar with plasticizer or a 1: $^1/_2$: 4 sulphate resisting cement : lime : sand
- All materials above high level dpc should be frost resistant
- Concrete bricks (compressive strength 20 N/mm^2) and calcium silicate bricks (classes 3 – 7) should be bedded in a 1:5 to 1:6 cement : sand with plasticizer or a 1:1:5 to 6 cement : lime: sand mortar
- See diagram 3.55 for general construction details

Where a brick wall is located amongst windbreaks such as a town or a well wooded area, then table 3.25 may be used to give a maximum height to thickness ratio up to 2.5m maximum, otherwise design by an Expert is necessary.
Walls should be provided with a two course engineering brick damp-proof course situated not less than 150mm above the adjacent finished ground level. A precast concrete coping or other durable capping should also be provided in order to prevent ingress of rainwater into the top of the wall.

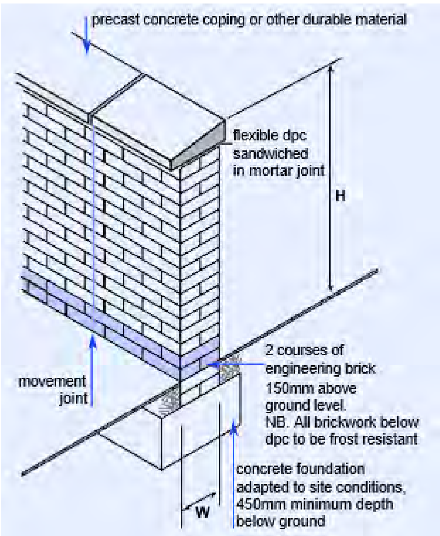


Diagram 3.55: Freestanding walls

wind zone	H/W
1	8.5
2	7.5
3	6.5
4	6

W = width of wall H = height of wall from ground level
See diagram 3.56 on page 331 for wind zones

Table 3.26: Maximum height to thickness ratio (H/W)

Diagram 3.56: Wind zones – British Isles

Concrete Mixes

General

Table 3.27 provides guidance on concrete mix design together with the required strengths and workability factors for various situations. Other specific mix designs are acceptable, this table provides guidance to suit the majority of situations found in house construction.

Application	Standard Mix	Designated Mix	Compressive strength @ 28 days N/mm² (MPa)	Suggested workability slump (mm)	Suggested method of compaction
Foundations					
Blinding and mass concrete fill	ST2	GEN 1	10.0	75	Poker or
Strip footings[1]	ST2	GEN 1	10.0	75	beam vibration
Mass concrete foundations[1]	ST2	GEN1	10.0	75	and/or tamping
Trench fill foundations[1]	ST2	GEN1	10.0	125	Self compacting
Reinforced foundations[1]	N/A	RC 35	35.0	75	Poker
Foundations in Class 2 sulphate conditions[2]	N/A	FND 2	35.0	75	Poker
Foundations in Class 3 sulphate conditions[2]	N/A	FND 3	35.0	75	Poker
Foundations in Class 4A sulphate conditions[2]	N/A	FND 4A	35.0	75	Poker
Foundations in Class 4B sulphate conditions[2]	N/A	FND 4B	35.0	75	Poker
General applications					
Kerb bedding and backing	ST1	GEN 0	7.5	V. Low (10)	Tamping
Drainage works to give immediate support[1]	ST2	GEN 1	10.0	V. Low (10)	Tamping
Other drainage works[1]	ST2	GEN 1	10.0	50	Tamping
Oversite below suspended slab[1]	ST2	GEN 1	10.0	75	Tamping
Floors					
House floors with no embedded metal					
permanent finish to be added e.g. screed	ST2	GEN 1	10.0	75	Poker or beam
no permanent finish to be added e.g. carpeted	ST3	GEN 2	15.0	75	vibration and/or
Garage floors with no embedded metal	ST4	GEN 3	20.0	75	tamping
Paving					
House drives, domestic parking and external parking					
Heavy duty external parking	N/A	PAV 1	35.0	75	Poker or beam
	N/A	PAV 2	40.0	50	vibration
Other reinforced and prestressed concrete applications					
Reinforced or prestressed concrete: mild exposure	N/A	RC 30	30.0	75	Poker
Reinforced or prestressed concrete: moderate exposure	N/A	RC 35	35.0	75	Poker

1 In non – aggressive soils i.e. Class 1 sulphate conditions as given in table 7a BS 5328: 1
2 see table 7a BS 5328: 1 for all sulphate conditions

Definitions

Standard Mix (ST)	Designated Mix (GEN, FND, RC, PAV)
A standard mix is a concrete designed using the materials and mix proportions given in BS 5328: 1 Section 4 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.	Designated mixes are designed and specified in accordance with BS 5328: 1 Section 5. It is a quality controlled mix, produced under BS EN ISO 9001 conditions. The purchaser orders the mix by specifying its required strength and it's intended use i.e. RC to be used for reinforced concrete and GEN for general usage.

Table 3.27: Selection guide to the use and specification of Standard and Designated concrete mixes

External Works - Garage and Small Outbuildings

General
Garages and small outbuildings including carports and other single storey outbuildings etc., should be designed and constructed to adequately resist lateral and vertical loads such as wind (including uplift), self-weight, snow and other live loads. **Refer to Substructure and Superstructure pages within this manual.**

In particular, foundations for garages, conservatories or any other permanent outbuilding should be designed and constructed to suit the ground conditions and loadings relevant to the particular site.

In all cases, foundations should be constructed under the same criteria as that of the house. Reference should be made to the Foundations Section of this manual.

- All walls should be laterally tied to roofs
- Roofs should be securely tied down to walls where required by the design to resist wind uplift.

Walls, columns and piers should be constructed on a concrete foundation capable of safely transmitting all loads into the ground without causing excessive movement.

Walls should be designed and constructed so as to accommodate movement.

Masonry walls taller than 2400mm above the ground level should be designed and constructed in accordance with BS 5628.

Floor construction should be a minimum 100mm float finished grade ST4 or GEN3 concrete laid on a minimum 100mm consolidated and blinded hardcore. If a perimeter toe-beam is provided it shall extend to 350mm below ground level and be a minimum of 350mm wide.

It is recommended that a dpm be incorporated under garage slabs to resist the ingress of ground moisture.

Walls should have the minimum weather resistance equivalent to that provided by 100mm masonry pointed both sides of the wall.

Prefabricated buildings should be erected in accordance with the manufacturer's instructions.

Doors to outbuildings should be externally lockable.

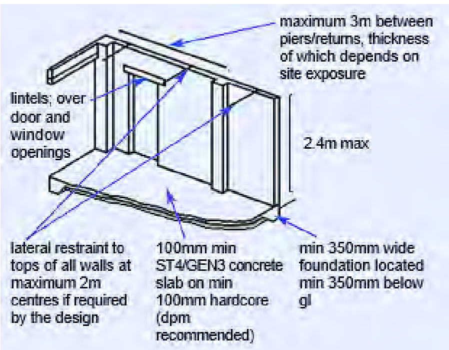


Diagram 3.57: Small detached outbuildings

Roofs should be weather-tight and provided with a minimum fall of 1:40, or if a specialist roofing system is used then falls in accordance with the third party accreditation certificate. Rainwater to discharge into a rainwater drainage system or a soakaway located at least 5m from any building or watercourse. The soakaway should have a minimum capacity of $1m^3$.

All separating walls between multiple garages should be taken up to the underside of the roof to provide adequate security and fire resistance between garages.

Small Outbuildings of Masonry Wall Construction

Small outbuildings of masonry wall construction which are:

- Not higher than 2400mm above ground level
- Located on ground having a minimum safe bearing capacity of $100kN/m^2$ and not requiring special precautions and
- Which only support wind and distributed roof loads may be constructed in accordance with the following guidance (See diagram 3.57).

Minimum wall thickness should be 100mm for stability and weather resistance (pointed both sides of the wall).

A 100mm thick wall will not necessarily resist wind driven rain. If a greater degree of weather resistance is required an extra wall thickness or an external coating/cladding should be considered.

Roof Timbers

Piers or wall returns should be provided at each end of the wall and at centres not exceeding 3m maximum. Piers and returns should be of sufficient depth to provide lateral stability to the supported wall, due account being taken of the wind exposure of the site (consult Building Control Authority).

The top of all walls should be laterally supported by the roof structure or other means at maximum 2m centres.

Walls should be provided with a damp-proof course situated not less than 150mm above the adjacent finished ground level.

Wall thickness should be in accordance with Approved Document A.

Suitable concrete or steel lintels should be provided over window and door openings.

Timber span tables 2.42 to 2.45 provide guidance on the selection of ceiling joists and rafter sizes for the majority of spans and loading cases for small outbuilding

External Works - Paths, Drives, Patios & Gardens

Ground Preparation

Excavation to formation levels should be made ensuring that all organic materials are removed. On wet sites the ground under paths and drives may need to be drained by land drains.

Trenches should be backfilled with granular material to formation level, compacted in layers not greater than 300mm so as to achieve a level of compaction not inferior to the adjacent ground.

Where the general ground level has to be raised to achieve the formation level, a properly compacted sub-base material should be used in layers not exceeding 150mm. (See diagram 3.58). Formation level tolerances should not exceed ±30mm.

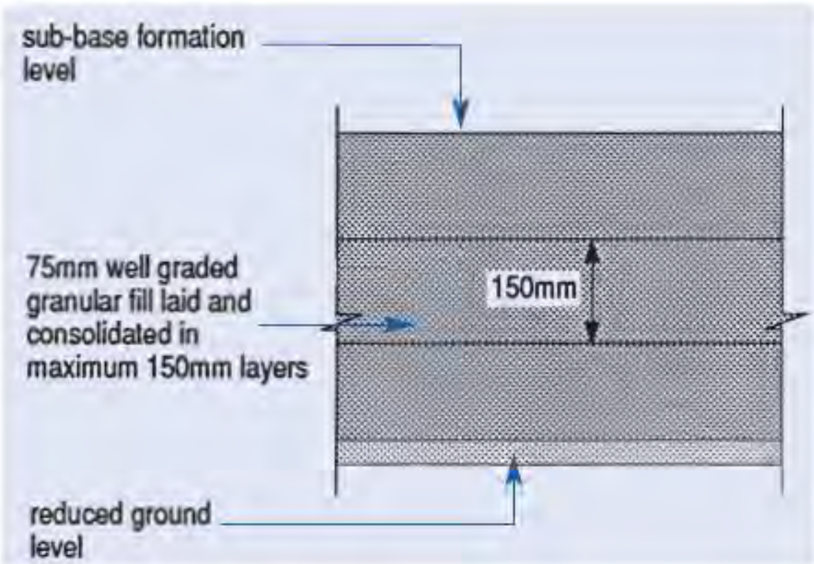


Diagram 3.58: Filling to sub-base level

Sub-base

The sub-base should be formed with either:

- Well graded crushed rock or concrete (maximum size of aggregate 75mm)
- Lean mix concrete (ST1)

Type of compactor	Size of compactor	Minimum number of passes 100mm base	150mm base
Vibrating plate	> 1400 < 1800 kg/m²	8	unsuitable
	> 1800 < 2000 kg/m²	5	8
	> 2000 kg/m²	3	6
Vibrating roller	> 700 < 1300 kg/m width	16	unsuitable
	> 1300 < 1800 kg/m width	6	16
	> 1800 < 2300 kg/m width	4	6
Engine driven vibro-tamper	< 65 kg	5	8
	> 65 < 75 kg	3	6
	> 75 kg	2	4

< less than > more than
Source: National Paving and Kerb Association

Table 3.28: Compaction of sub-bases

In the case of weak sub-grade soils (i.e. soils having a California bearing ratio of less than 10%), a thicker sub- base is required and should be determined by an Expert. Tolerance of finished sub-base level should not exceed ±20mm. Granular sub-bases should be compacted in accordance with table 3.28.

Thickness of the sub-base should not be less than:

- Paths, patios, etc. – 75mm minimum
- Drives (light duty) – 100mm for drives subject to light domestic traffic
- Drives (medium duty) – 150mm for drives subject to medium domestic traffic (e.g. where lorry access is required to cess-pits, fuel storage, etc.).

Edgings

- Avoid damage and displacement of edgings of paths and drives
- Edgings should be provided to all unsupported edges, with the exception of in situ concrete and, in the case of paths precast concrete paving slabs laid on a mortar bed
- Concrete edgings to drives should be bedded on minimum 200 x 100mm deep ST1 mix concrete base and haunched with concrete to within 50mm of the top of the edging (See diagram 3.59)
- Edgings should be laid to a smooth alignment and to a tolerance of ±13mm measured over a 2m straight edge
- Timber edgings should be preservative treated and should only be used for paths (i.e. not to be used for drives)
- Paths should be at least 600mm wide.
- Drives should be at least 2.4m wide, and turns should be laid out so as to be easily negotiated by a 5m car
- Gradients should not be greater than 1:8.

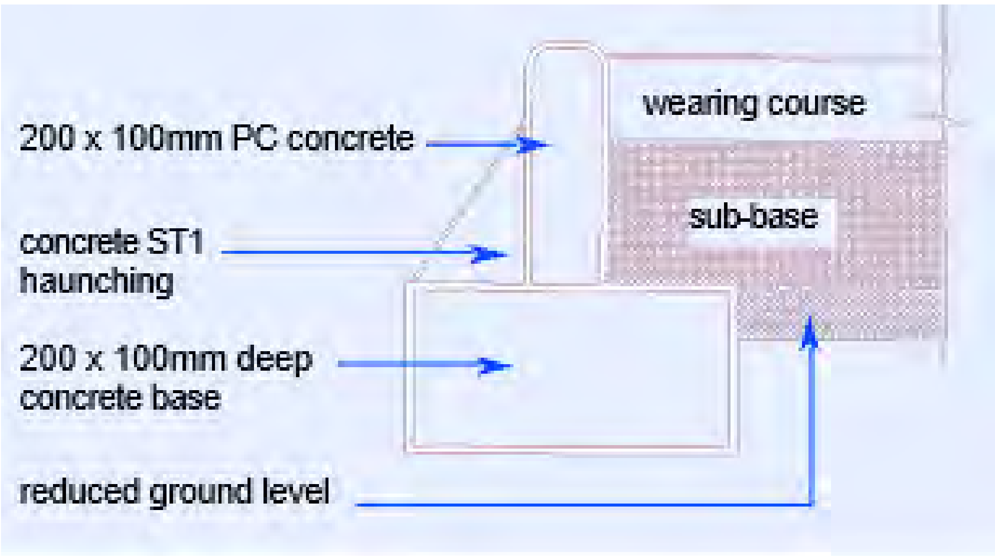


Diagram 3.59: Concrete edgings

Surfacing

Surfacing of paths and drives
Surface coatings to paths and drives should comply with one of the specifications set out in table 3.29 and be laid to a tolerance of ±10mm measured over a 2m straight edge.

Paving slabs should be:
- Laid on either 25mm of sharp sand (BS 882) or a full bed semi-dry mortar mix of 3:1 sand cement
- Laid with a 2 – 4mm joint and filled with a jointing sand as recommended by the manufacturer
- Cut with a saw or disc cutter
- Where more than 25% of the slab is cut away the slab should also be mitre cut

Brick paviors should be:
- Bedded on 50mm of Grade C sharp sand (BS 882)
- Laid with a 2 – 5mm joint and after compaction with a plate vibrator, filled with a jointing sand as recommended by the manufacturer
- Cut with a mechanical or hydraulic block splitter
- Cut paviors should not be less than 25% of the original block size

In situ concrete should be:
- Laid in bays not exceeding $20m^2$ or maximum bay lengths not to exceed 6m
- Isolated where abutting walls, etc (See diagram 3.63).

Sub-bases to macadam or asphalt paths and drives should be fully dried and primed before laying the surface covering. All surfaces should be consolidated by a vibratory roller to achieve the required texture of finish.

Level access details should be considered (See diagrams- 3.62).

type of surface	specification	thickness (mm) path	drive	British Standard
macadam single course	40 mm coated macadam	75	75	BS4987
rolled asphalt	coarse asphalt, 10 mm nominal size	60	60	BS 594
macadam two course	base course open graded 20 mm coated macadam wearing course 6 mm textured bitumen macadam or fine cold asphalt	60 20	60 20	BS 4987 BS 4987
concrete	designated mix: (see table 3.25, page 281)	75	100*	BS 8110 BS 5328
brick pavior	clay or calcium silicate laid to BS 6677:2 1986	50	50****	BS 6677
block pavior	precast concrete block paving	60	60**	BS 6717
paving	dense concrete	50	63***	BS 7263:1
gravel	maximum 12 mm well graded, washed crushed stone or gravel	25	25	

* Increase to 150mm for poor/weak soil or on clay
** 80mm if access is required for heavy vehicles. (i.e. commercial vehicles such as a refuse lorry, removal lorry or tanker, etc.)
*** Maximum slab size not to exceed 450mm x 450mm for drives. 600 x 600mm can be used for paths
**** If access is required for heavy vehicles, then consult the paver manufacturer who may recommend a thicker unit. It is also important that the sub-base under drives is adequate for heavy vehicles (i.e. commercial vehicles such as a refuse lorry, removal lorry or tanker, etc.)

Table 3.29: Surface finish to paths and drives for family cars

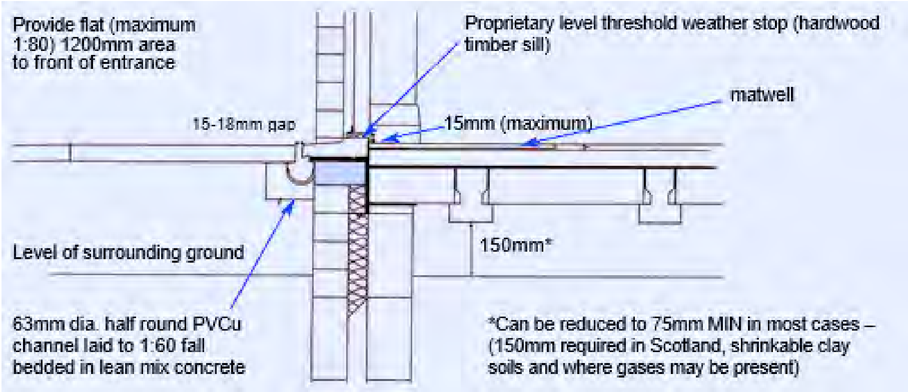


Diagram 3.60: Level threshold with approach rising towards property

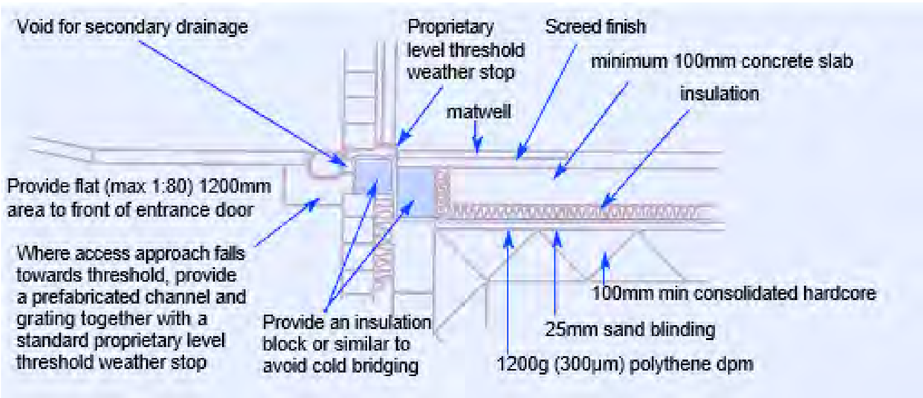


Diagram 3.61: Level threshold with approach falling towards property

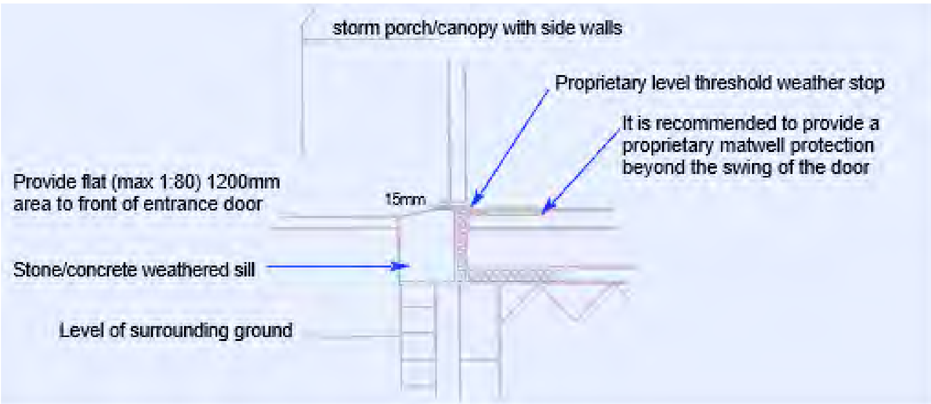


Diagram 3.62: Level threshold with porch/canopy protection

Notes to diagrams 3.60, 3.61 and 3.62:

In severe/very severe exposure zones set frame well back to provide further protection (it is recommended to provide a storm porch or canopy whenever using level thresholds) It is recommended to provide a proprietary Matwell projecting beyond the swing of the door.

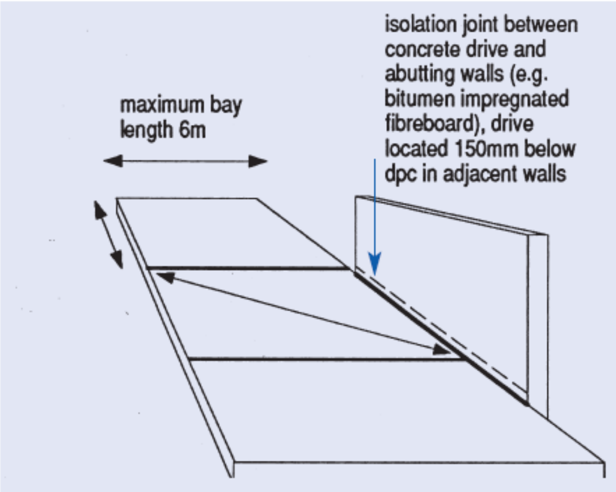


Diagram 3.63 – Insitu Concrete Drives

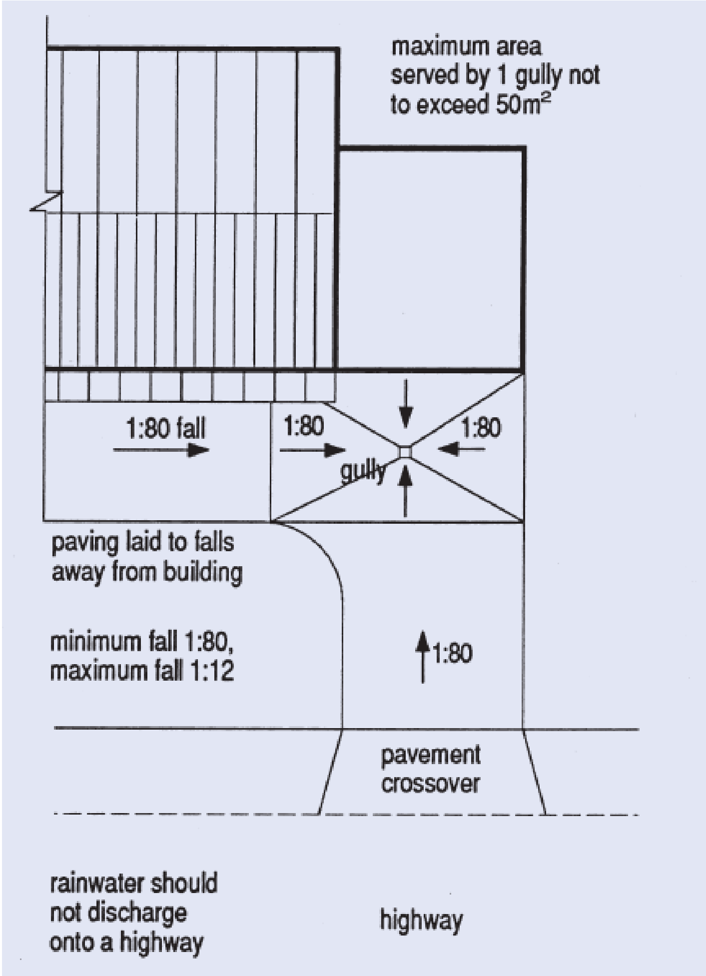


Diagram 3.64 – Drainage of Paths & Drives

Avoid ponding of paths & drives

Paths and drives should be properly drained in order to ensure that rainwater is evacuated and that ponding does not occur adjacent to the dwelling.

Areas of particular concern include paved areas that provide:

- access for the disabled
- access for solid waste disposal
- passage giving access to the building where this is intended to be used in common by the occupiers of one or more other buildings.

Impervious surfaces should be laid to falls away from buildings to a trapped gully or a permeable part of the garden provided that it is free draining. Rainwater should not discharge onto a highway or adjacent property.

No part of the surface should be less than 150mm below a dpc. with exception of provision for level access detailing at entrance doors.

Surfaces should be laid to cross falls of not less than 1.25% (1:80) and not greater than 8.3% (1:12) (See diagram 3.64). Drainage channels should be laid to longitudinal falls of not less than 1% (1:100).

Gullies should be trapped when a drain discharges to a soakaway (in order to prevent long term silting of the soakaway).

Trapped gullies are also required when Local Authority approval has been granted to permit rainwater to discharge into a foul sewer.

A gully should be provided for every 50m^2 of impervious drained area and should be centrally located particularly in the case of enclosed courtyards.

Standing water

One hour after rain has stopped isolated areas of temporary standing water up to 1m^2 and no deeper than 7mm are considered to be reasonable.

Variations in surface finish

The surface should not exceed ± 10mm deviation from a 2m straight edge with equal offsets.

Reinstatement of Garden Areas

Redundant foundations, masonry structures and the like occurring within 300mm of the finished ground level should be cleared from the site. Garden levels and top soil should be reinstated to uniform levels appropriate to the level of the building, adjacent roads and other properties.

Where the ground levels need to be raised by site fill, any excessive thickness of existing topsoil should first be removed and subsequently reinstated.

Where slopes exceed the natural angle of repose for the soil material, retaining walls should be provided or other soil stabilization methods used.

Trees and large bushes should not be planted adjacent to any building unless considered fully in the foundation, drain or underground service design. As a general rule, a distance equal to the mature height of the tree or bush should be taken as the closest permissible distance.

Avoid flooding of garden areas

Subsoil drainage may be necessary in garden areas in cases where:

- Site works have affected the natural flow of ground water within 4m of the dwelling (e.g. exposing of underground springs)
- Ground water table rises to within 250mm of the finished ground within 4m of the dwelling
- Subsoil is poor draining and the ground contours make the site prone to waterlogging within 4m of the dwelling (See diagrams 3.65, 3.66 and 3.67).

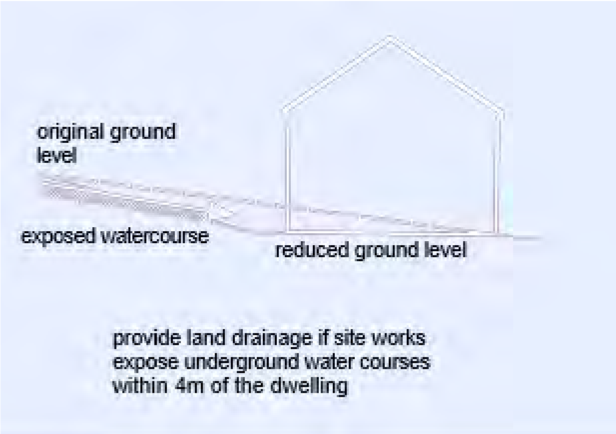


Diagram 3.65: Ground water exposed by site works

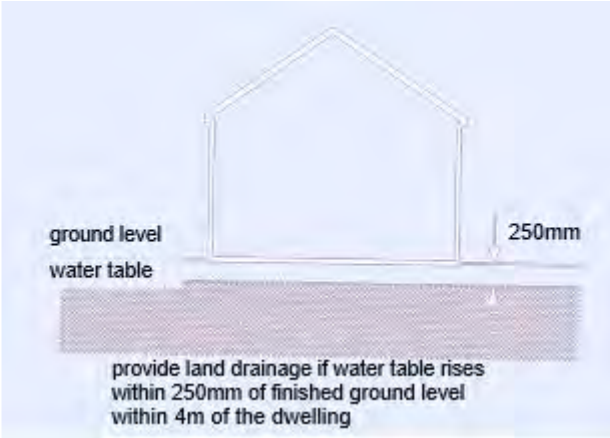


Diagram 3.66: Ground water – high water table

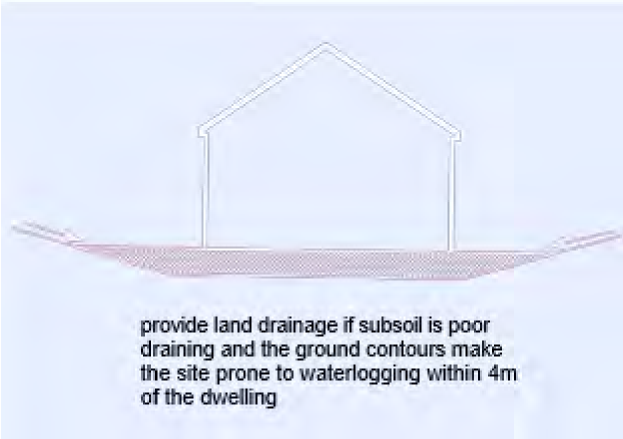


Diagram 3.67: Ground water – waterlogged site

External Works - Security

Design – General

From the 1st of October 2015 the building regulations Approved Document Q has been in force and this requires that new dwellings should make reasonable provision to resist the unauthorised entry into the property. Compolience is largely shown to have been achieved if the Industry spoecificatiuon PAS 24:2012 has been complied with.

Comprehensive security can be provided to the dwelling and site by following the guidance set out below. The guidance given also reflects the principles of the Secured by Design scheme operated by the UK Police Authorities.

The objectives of Secured by Design is to encourage the building industry to adopt recommended crime prevention guidelines, in both house and estate design, and thus gain approval to use an official Police approved logo in marketing of new houses.

To achieve approval under the Secured by Design initiative, it is important for the designer to consult with the Architectural Liaison Officer of the relevant Police Authority at an early stage of the design.

The provisions illustrated in this section are designed to limit the incidence of attempted burglary and burglary.

In most cases of reported burglary, entry was gained by means of an unlocked or unsecured door or window; many of the following provisions therefore relate to effectively securing doors and windows. The high incidence of forced entry necessitates sufficiently robust fixings and fittings to all doors and windows.

Burglars are interested in buildings where access is easy and where the contents are valuable. Accessible windows and external doors that are at the rear of the dwellings and that are out of sight of neighbours and passers-by in the street are especially vulnerable. Ground floor windows and windows accessible from balconies, walkways and adjacent roofs are more vulnerable than upper level windows that are beyond normal reach.

The security provisions in this section apply to houses, flats and maisonettes and cover the following matters:
- Passive security measures such as estate layout, landscaping and the design of doors and windows
- Active security measures such as intruder alarms and security lighting

Estate layout and landscaping
Designers should achieve the following objective for layout and landscaping of new estates and wherever possible for new dwellings constructed in existing residential areas:
- Estate boundaries should be clearly defined and dwellings sited in small clusters which provide an unobstructed view of neighbouring homes, (with a minimal effect on the residents individual privacy).
- There should be a mixture of housing, e.g. bungalows, two and three bedroomed dwellings, etc., whereby opportunities for natural surveillance are increased, as there is then potential for occupation throughout the day.
- Create a semi-private appearance to common areas which is likely to discourage intruders from passing beyond an estate boundary (whether real or imagined) and entering into the estate - see diagram 3.68 note 2.
- Position individual dwellings so that there is a clear view of adjacent dwellings but without impinging excessively on individual privacy.
- Limit the number of access roads and paths to the estate in order to facilitate surveillance by residents or people entering the estate

- Deter access by intruders to private areas of individual dwellings, e.g. by providing secure gates and fences near to the building line, linking the side elevations of buildings (See diagrams 3.68 note 3 and diagram 3.69)
- Meter boxes and refuse collection points should be located in areas which do not require officials to enterthe secure part of a garden (See diagrams 3.68 note 5 and diagram 3.69)
- Avoid wherever possible the location of privategardens adjacent to open land, recreation areas, public roads and paths, railways and the like by which an intruder can gain access to the estate, e.g. by providing back to back rear gardens (See diagram 3.68 notes 4 and 6)
- Car parking areas should be off-street and, together with garage entrances, should be located so they can be easily viewed by estate residents (See diagram 3.68 note 7).

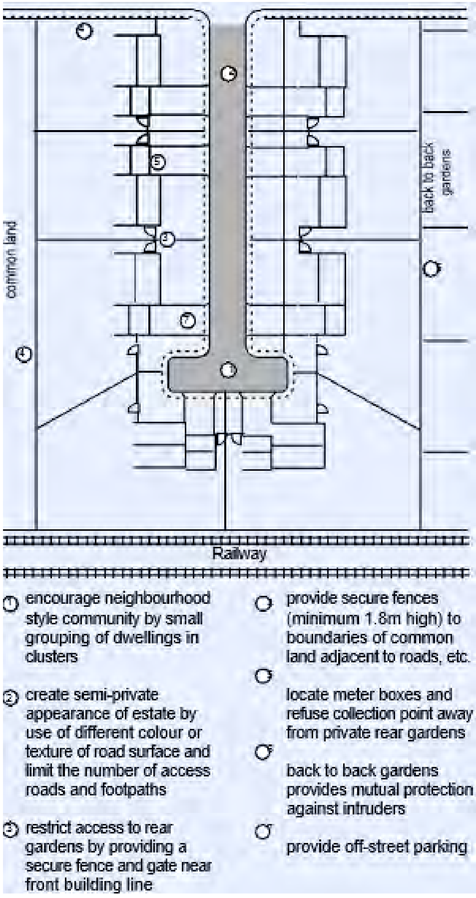


Diagram 3.68: An option of a typical estate layout

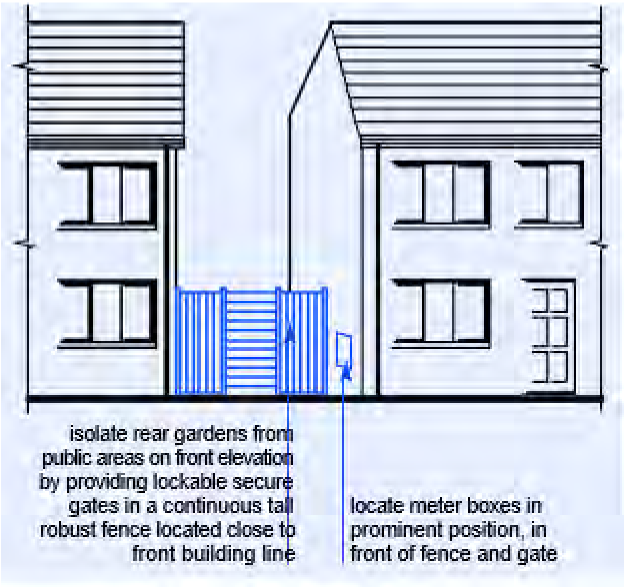


Diagram 3.69: Security of rear gardens

General
External doors should be constructed to the following standards or an acceptable equivalent.

Where a porch is provided:

- Either the external door should be considered as the principal door (See diagram 3.70) and comply with the recommendations set out below
- Or, the porch perimeter and outer door should be glazed to provide an adequate view of the inner principal door which should comply with the recommendations set out below (See diagram 3.70)
- Door frames should be securely fixed to reveals of openings (600mm centres maximum and at least one fixing 150mm from the corners of the frame)
- Doors should be of robust construction to resist forced entry by kicking, charging, levering, etc Non-panelled areas should be at least 44mm thick solid core. Timber door stiles should be at least 119mm wide (See diagram 3.71)
- Doors should be hung on minimum 3 No. 100mm metal hinges. If the hinge pin is externally located, complementary hinge bolts should be provided (See diagram 3.71).
- Non-glazed door panels should be small enough to prevent entry by a person (See diagram 3.71) or made sufficiently robust to resist unauthorized entry.

Main Entrance doors

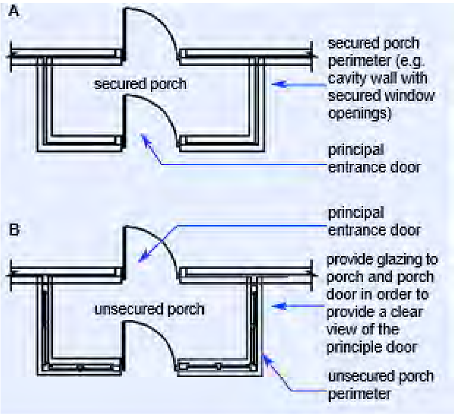


Diagram 3.70: Security principal entrance door

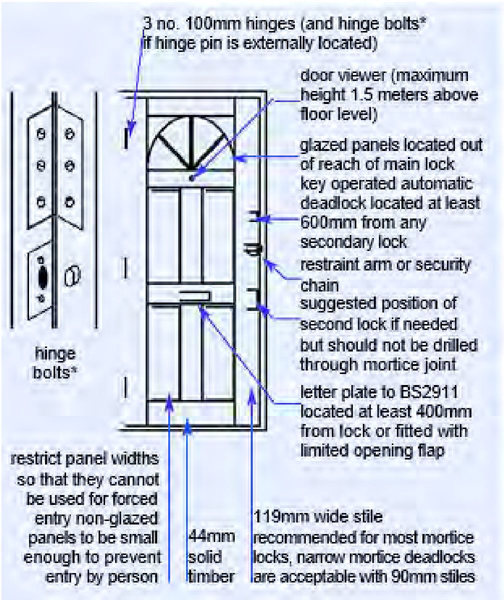


Diagram 3.71: Main entrance door

Single dwelling-houses

- The principal door to a single dwelling-house should be provided with a security lock and keep, complying with
- BS 8621, or that has:
- An automatic deadlocking facility
- At least 1000 differs
- A fixing which if forced open would not pull out without breaking the frame or door
- A hardened steel bolt or inserts to prevent sawing
- The capability of operation from the inside by simple manual use not requiring a key
- A restraint arm or security chain and a wide angle viewfinder should be provided
- The “throw” of the lock should be 20mm

Glazed panels should be located out of reach of the door lock, i.e. more than 1m is generally considered reasonable, or laminated glazing should be used (See diagram 3.71).

Flats and maisonettes

The main communal entrance door to buildings containing flats or maisonettes should be provided with an automatic locking latch and the door fitted with a self closing device (See diagram 3.72). Where there are more than four flats or maisonettes in the building, the main entrance door should be provided with an intercom and electronic lock release facility which can be operated from within each flat or maisonette.

In order to ensure adequate means of escape and firefighting access in case of fire, entrance doors of flats should be a 5 lever mortice lock of a type which does not operate automatically when the door is slammed shut. The deadlock mechanism should be non-key operated internally (See diagram 3.73).

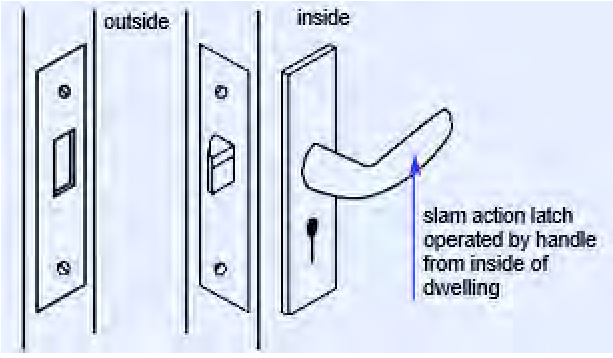


Diagram 3.72: Automatic mortice locking latch for communal exit doors to blocks of flats

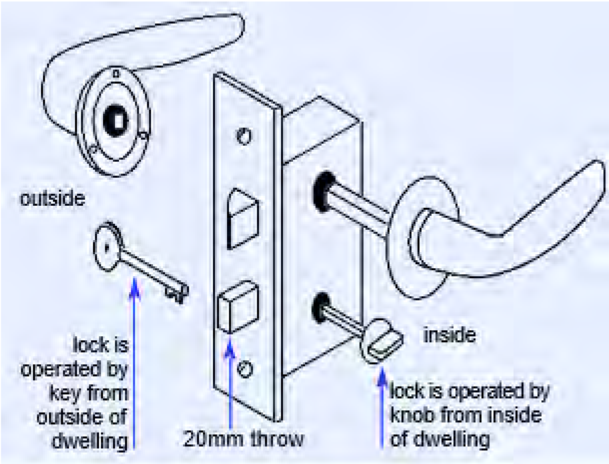


Diagram 3.73: Mortice lock for entrance door to flat

Letter-plates

Letter plates should comply with BS 2911 and either be located not closer than 400mm to the main door lock or be fitted with a limited opening flap. (See diagram 3.71). Where fitted to a fire resistant door (e.g. in flats), the letterplate should have the same degree of fire resistance as the door or an inner steel plate should be fitted, preferably with an adequate overlap. The letter plate should not be set any higher than halfway up the door as the lateral pressure of fire against the door increases with height.

Glazing to doors

Glazed side panels should be located on the hinge side of the door wherever possible (See diagram 3.74). Laminated glass should be used in small glazed panels to doors and adjacent side glazing if within 1m of the door lock. (See diagrams 3.74 and 3.75). Generally glazing should comply with the safety requirements of BS 6206.

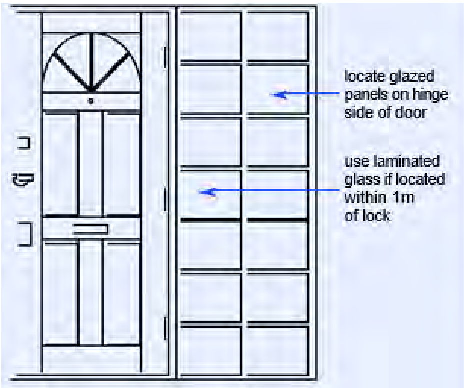
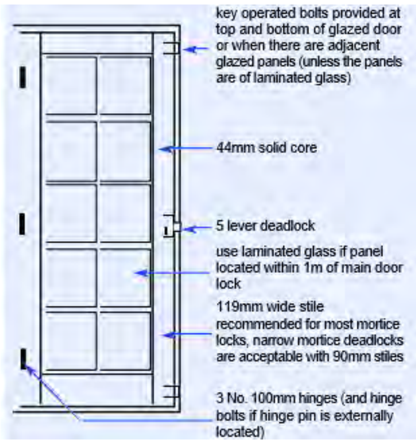


Diagram 3.74: Glazed side door panels



Digram 3.75: Other entrance doors

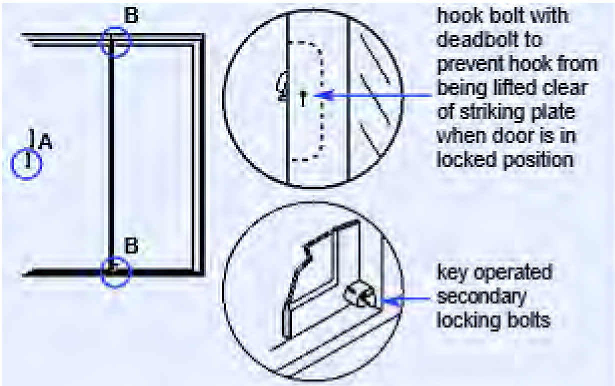


Diagram 3.76: Security of patio doors

Other external doors
Other external doors such as side and rear doors (including communicating door to integral garages) should be provided with a 5 lever deadlock to BS 3621 and robust bolts at the top and bottom of the closing edge of the door (e.g. 100mm barrel bolts fixed with robust screws (e.g. at least 30mm long No.8 screws). Where the door is panelled or glazed or if there are adjacent glazed panels, then the bolts should be key operated unless the glazing is laminated (See diagram 3.75).

Sliding doors should be designed so that they cannot be forced out of the frame from the outside and if not fitted with a multi-point locking system, are provided with push to lock key operated locking bolts located at the top and bottom of the meeting stile of the inner door leaf. The sliding door should be glazed with laminated glass and be preferably located on the inside of the frame (See diagram 3.76).
The meeting stiles of external double doors such as French doors should be rebated and meet the security provisions of other doors, i.e. key operated bolts to the leading edge of the first closing leaf with the second closing leaf secured by a mortice deadlock to BS 3621.

Doors to outbuildings should be provided with a five lever morticed deadlock or a stout padlock.

Windows

Windows should be constructed to the following standards or an acceptable equivalent:

- Window frames should be fixed to reveals (maximum 600mm centres and within 150mm of the frame corners)
- Opening lights should be provided with a securing device that cannot be sprung open by levering the casement or sash from the outside
- Externally located hinge pins should be non-demountable (e.g. welded or disturbed ends)
- Trickle ventilators should be used in preference to small opening fanlights that can be left open
- Louvred windows should not be used
- Key operated locks should be provided to all opening window lights on the ground floor and on upper floors where access can be gained by a balcony, flat roof, drain pipe, etc. Window locks which are push-to-lock, key-to-unlock type are recommended
- External timber glazing beads should be continuously glued or pinned to frames at maximum 150mm centres. It is important to ensure the weather- tightness of the window is maintained by using a flexible putty, sealant or mastic (compatible with frame and glazing unit) that can accommodate movement
- External glazing beads to aluminium and PVC-u windows should be effectively secured in position (e.g. mechanically or by bonding). Alternatively, the glass may be secured in position prior to positioning the beads. As another alternative, the recommendations of the Glass and Glazing Federation can be followed
- Rooflights should not be used on single storey or other accessible roofs unless they are specifically designed to provide adequate deterrent against forced entry (e.g. use of wired glass and lockable with a removable key).

N.B. The requirements of Approved Document B must also be considered with regards to means of escape.

Lighting / Alarms

Lighting should be provided to the following standards or an acceptable equivalent:

- Electric lighting should be provided to public footpaths, roadways and communal garage areas, communal entrance halls and access areas. Well-lit general circulation areas contribute to easy observation of intruders and would often be aesthetically desirable to residents
- Security lighting should be provided adjacent to principal entrances and other external entrances of residential buildings. The lighting should be operated when someone is nearby by a photo-electric cell or an infra-red detector on a time switch for economy

Intruder alarms
Facilities for the easy installation of intruder alarms should be provided and an unswitched 13 amp fused spur with neon indicator to be located in a suitable place for the installation of an alarm control panel (e.g. in a stair or cloaks cupboard). Further information about Secured by Design can be found at: **www.securedbydesign.com**

Further information regarding community safety, security and risk solutions can be found at:

Perpetuity Research and Consultancy International (PRCI)

148 Upper New Walk
Leicester
LE1 7QA
United Kingdom

Tel: 0116 222 555
Fax: 0116 222 5557
Email: prci@perpetuitygroup.com
www.perpetuitygroup.com

ADDITIONAL GUIDANCE FOR CONVERSIONS

General

Ways of achieving compliance with the requirements.
The building should be designed and constructed in accordance with the guidance contained in the following appropriate documents

England & Wales

Approved Document A - Structure
Approved Document B – Fire safety
Approved Document D – Toxic substances
Approved Document E – Resistance to passage of sound
Approved Document F - Ventilation
Approved Document G - Hygiene
Approved Document H – Drainage
Approved Document J – Combustion appliances and fuel storage systems
Approved Document K – Protection from falling, collision & impact
Approved Document L – Conservation of fuel and power
Approved Document M – Access facilities for disabled people
Approved Document N – Glazing
Approved Document P – Electrical safety
Approved Document 7 – Materials and workmanship

Scotland

Section 0: General
Section 1: Structure
Section 2: Fire
Section 3: Environment
Section 4: Safety
Section 5: Noise
Section 6: Energy

Northern Ireland

Part A: Interpretation and general
Part B: Materials and workmanship
Part D: Structure
Part E: Fire safety
Part F: Conservation of fuel and power
Part G: Sound insulation of dwellings
Part H: Stairs, ramps, guarding and protection from impact
Part J: Solid waste in buildings
Part K: Ventilation
Part L: Combustion appliances and fuel storage systems
Part N: Drainage
Part P: Unvented hot water storage systems
Part R: Access to and use of buildings
Part V: Glazing

Depending on the condition of the original building, an Experts survey is usually required for the elements below. If the Report concludes that any of these elements are unable to meet the life expectancy of 30 years for structure and 15 years for non-structural elements, they should be systematically replaced or repaired. The main report may be made up of several individual reports, such as an Engineer's report on foundations and a specialist company report on rising damp and/or timber treatment.

Additional guidance on Q's Requirements

- The project must achieve compliance with Q technical requirements and the Building Regulations.
- All conversions must be registered with Q Building Guarantee at least 15 working days prior to any works commencing on site.
- Your Q surveyor is unable to inspect the development until we have received all of the reports, plans, specifications etc. and carried out a desktop appraisal.
- Testing of reclaimed materials such as bricks, timbers, tiles, slates etc. may be subject to a third party test to show suitability
- All new structural timber must be stamped KD or DRY timber
- Additional information and guidance regarding the registration of a conversion is available, please contact our office.

Retained elements:

1. Foundations and load-bearing structures, including floors, walls and roof
2. Damp-proof courses and membranes*
3. Timber treatment against insect and fungal attack*
4. Roof coverings*
5. Weather resistance of walls including claddings, render, re-pointing etc.
6. External doors and windows. Existing single glazed windows must be replaced with suitable double glazed units or an endorsement will be added to the policy to exclude them from cover.
7. External and internal services
8. Drainage

Retained timber

- They are free from any rot / decay/ insect infestation. If appropriate they should be treated and an insured certificate of guarantee provided
- They must be stress graded by an Expert prior to them being used
- A structural engineer must provide calculations to justify their adequacy.

Green Timber/ Ungraded timbers

- The use of green timber/ ungraded timbers are not permitted as structural members e.g. lintels, beams, joists, rafters, purlins etc, nor where they are aesthetic elements but are "fixed" to the structure, as the extent of their shrinkage is unknown and can lead to structural damage of the property.
- They can be used as lintels providing the detail within diagram 4.29 is followed and allowance is made for any possible shrinkage and / or swelling of the timber.

In addition to the installer guarantee, the Builder is required to provide a **10 year insured certificate/guarantee:**

- for chemical damp-proof course and basement tanking
- timber treatment against insect and fungal attack,
- specialist roofing systems
- proprietary externally applied weather-proofing and/or insulation systems.

Where some of the timber elements are new and replaced as part of the conversion/refurbishment no report is necessary.

The treatment should be:

- Carried out by a specialist contractor and supervised by a CSRT or ASRT qualified surveyor. All BWPDA contractors meet this specification.
- Be the subject of a suitable insured guarantee. An insured guarantee will meet the following minimum requirements:
    - A certificate of insurance (not a warranty or guarantee or (insurance backed 'guarantee') will be issued specifying the insured property.
    - This insurance certificate shall be issued by a UK registered and regulated insurance company.
    - Insurance carried IPT (Insurance Premium Tax) NOT VAT.

The guarantee itself should:

- Cover failure of the work and consequent opening up and making good.
- Remain valid for a period of 20 years and be automatically transferred to subsequent purchasers/ successors in title.
- Provide cover against the specialist contractor's insolvency.
- An insured guarantee must meet the following minimum requirements.
- The report should identify those parts of the building that have not been fully inspected at the time of the survey.
- Suitable Experts, with relevant experience, normally include:
    - Registered Architects
    - Chartered Civil
    - Structural Engineers
    - Chartered Building Surveyors
    - Members of the Chartered Institute of Building
    - Members of the Association of Building Engineers.

More detailed guidance on conversions is contained in the following section of this manual.

If you require any further assistance please contact our advice centre on 0333 577 2808. For conversion properties, we will always need to carry out a technical assessment of your conversion project before we can agree to offer a warranty/policy cover under our warranty policy scheme. The assessment process is not just a desktop overview of your proposals and specification of the project, but will also include a site visit. We understand that you need to make quick progress on site, in order to help you do this we set out below how we can help each other to streamline the assessment process.

The flow chart on the pages to follow shows you the stages, from notification of the project to our decision to accept, or, unfortunately, on some occasions to decline.

Ensuring Our Quick Assessment

General

What are we looking for?
In order to understand your project, we need to know as much as possible about it as soon as possible. In particular we need to see your

- Project specification – remedial proposals, plans and specifications
- Structural engineer's report – to comment on structural adequacy of retained elements and confirm life expectancy of at least 30 years
- Experts reports – these will be in addition to the structural engineer's report and should include specialist reports on rising damp, timber infestation and fungal attack (see guidance on reports later in this document).

By providing us with the information when you notify us of the site we will be able to complete our desktop overview and arrange a site visit without delay.

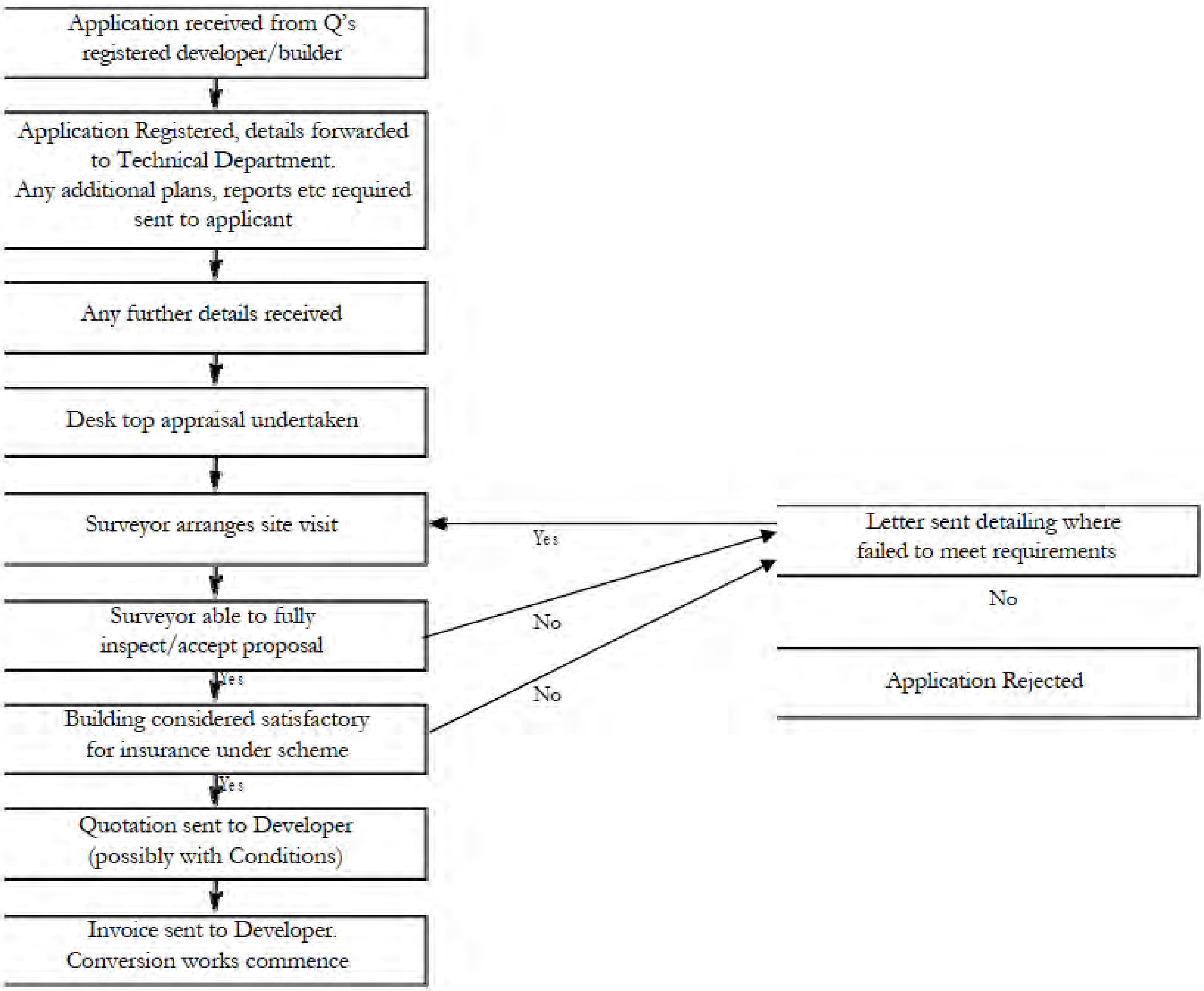
Ideally the inspections for all of the expert/specialist reports should be carried out when all the relevant parts of the building are opened up. Existing plaster and other redundant elements should have been removed e.g. at the "SOFT STRIP" stage. This will enable us to confirm our initial acceptance of the scheme. However, on larger projects it may be more practical for reports to be received by us on later stages of the building as work proceeds. If this is the case please mention it when you first register the project. This will save unnecessary questions and delay later.

What remedial works we expect

- Any roof covering that is not in sound condition should be replaced. If you propose to retain any roof coverings we will need safe access so we can inspect both above and below the covering. This safe access will also be needed by your expert for their report.
- All external walls must prevent moisture penetration to the inside and be insulated to building regulation requirements. This can be achieved where walls are "drylined" with a suitable independent system, which will both insulate the fabric and prevent moisture ingress, or by the provision of an externally applied render/insulation system.
- Any habitable areas either below or partially below ground level must be provided with a minimum grade 3 tanking system or equivalent.
- All repairs and treatments identified in the expert's and engineer's reports.
- In addition to the contractors guarantee, min 10 year insured guarantees are required for chemical dpcs, timber treatments for insect and fungal attack, specialist roofing systems and proprietary externally applied weather proofing/insulation systems. Rising damp and timber treatments must be carried out by a BWPDA member.
- Windows, doors and internal services should be replaced to modern standards.
- All cavity walls must have a boroscope inspection and the report passed to Q Surveyor to determine the condition of the cavity wall ties and any possible defects that exist.

Such insured guarantees are available from the Guarantee Protection Administration Limited. In addition to the guarantees, certified copies of invoices, reports & plans indicating the areas treated must be supplied.

Conversion Guide Flow Chart



Guidance on experts reports for retained elements
A full structural report of the existing building as described in BRE Digest 366 including:

- Foundations
- Any basements
- Suspended timber floors, including joist ends, wall plates and ventilation
- Ground bearing slabs
- External and internal walls, including lintels and any built-in timber
- Intermediate floor, including, for timber, the condition of any built-in joist ends, wall plates and floor coverings
- Any structural concrete (incl. carbonation) / steel frame
- Roof structures, including wall plates, joist ends, valley/parapet gutters
- Chimneys and parapets
- Report on investigations regarding rising damp, insect infestation and fungal decay. The report should be compiled by a suitably qualified expert (e.g. Certified Surveyor for Remedial Treatment).
- Weather resistance of walls including claddings, render, re-pointing, parapets and chimneys etc.
- Report on any retained roof coverings, including adequacy of fixings from above and below
- External doors and windows
- External and Internal services

If the elements are to be replaced no report is necessary.

More detailed guidance on conversions is contained in the following chapter.

If you need further assistance please contact Q on 0333 577 2800.

Substructure

Foundations

An appraisal of the existing building and its foundations should be carried out by a Structural Engineer or similarly approved expert by Q.

This appraisal should address such items as settlement, heave, foundation depth and type, soil type, radon and contamination, basement walls and floors and trees adjacent to buildings. When carrying out the appraisal the person should take into account the proposed increased loading on the structure and foundations, alterations to existing load paths and any alterations to the existing stability of the building.

Where it is proposed to use existing foundations, Q should be consulted at the design stage. Providing the building shows no sign of movement and the proposals do not increase the loading on the foundations Q may accept the existing footings. Trial holes should be dug to ascertain the extent of the foundation and make up of the sub-soil.

Where either the existing foundations are inadequate and the building has moved/cracked and/or the proposals are to increase the load on the footings, a qualified engineer should design a suitable solution, which should be discussed with Q prior to implementation.

When it is necessary to underpin a building, this is covered under the Building Regulations and an application should be made to the Building Control Authority and work inspected by them.

Proposals for underpinning should be prepared by an Expert and be in accordance with BS 8004 or a proprietary underpinning system.

Underpinning involves extending the foundations downwards in order that the building bears on to more stable ground. There are a number of ways of achieving this and these include:

- Traditional mass concrete
- Angle pile
- Pile and beam
- Pier and beam
- Proprietary underpinning methods.

The decision as to which system should be used depends on a number of factors, including the type of existing foundation, depth of suitable strata, position of water table.

Traditional underpinning

Sequence of underpinning to be carried out in accordance with the approved plans (generally, alternate bay sequence). See diagram 4.01.

Where a bay is located at a wall intersection or return, at least 600mm of the intersecting wall or return should be underpinned at the same time.

Maximum bay length not to exceed 1.0 metre. Reduce to 0.7m if the brickwork is poor quality

Excavations to be properly bottomed and dewatered.

Size of new foundation to be appropriate for the safe bearing capacity of the supporting sub-soil (See diagram 4.02).

New Concrete foundations should be cast to within 25- 50mm of the underside of the existing foundations and 'Dry Packed' with a Dry mix of sand/cement mortar with an expansion addative tested to EN 12390

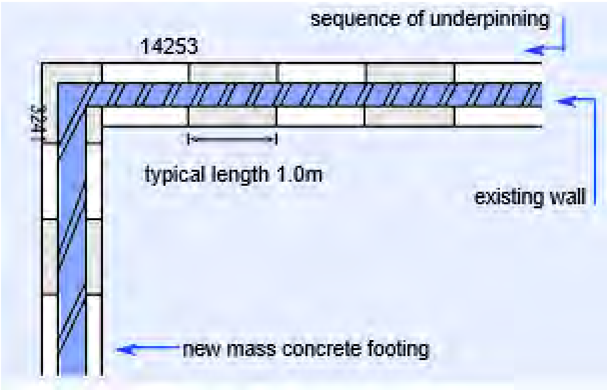


Diagram 4.01: Plan of foundation

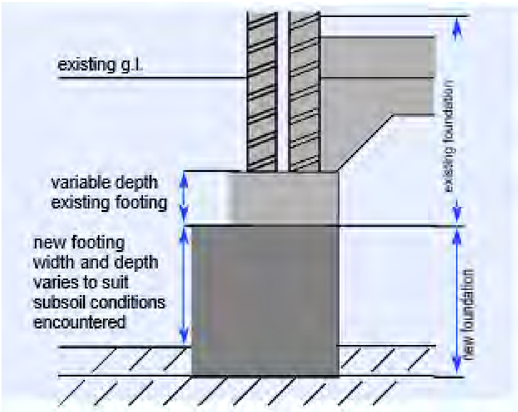


Diagram 4.02: Section through foundation

Angle pile
The stabilization of an existing wall foundation by the use of pairs of piles installed at an angle, through drilled holes in the existing foundation (See diagram 4.03 and 4.04).

Pile and beam
The stabilization of an existing wall foundation by the installation of Mini Piles in pairs, one as a tension pile, one as a compression pile, connected by a reinforced concrete or concrete encased steel needle beam supporting the wall (See diagram 4.05 and 4.06).

Pier and beam
The stabilization of an existing wall foundation by the installation of a series of Piers connected to the existing wall by a reinforced concrete tee beam, and connected together with a longitudinal ground beam to provide lateral restraint.

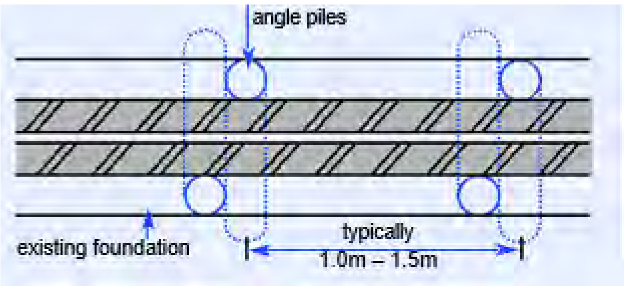


Diagram 4.03: Plan of foundation – angle pile

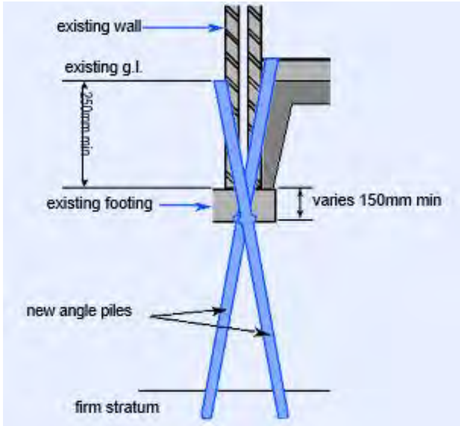
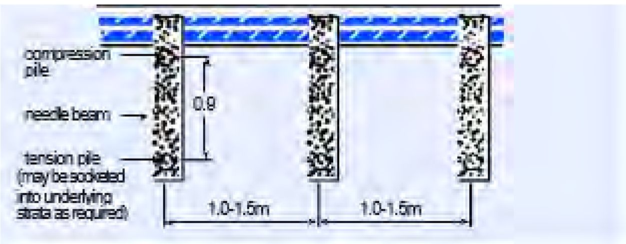


Diagram 4.04: Section through foundation – angle pile



Diaram 4.05: Plan of foundation – pile and beam

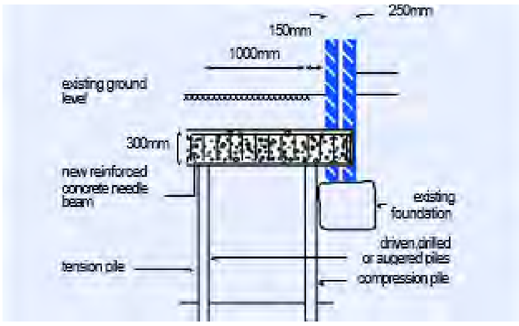


Diagram 4.06: Section through foundation – pile and beam

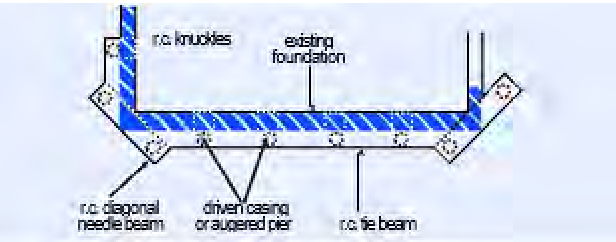


Diagram 4.07: Plan view of pier and beam

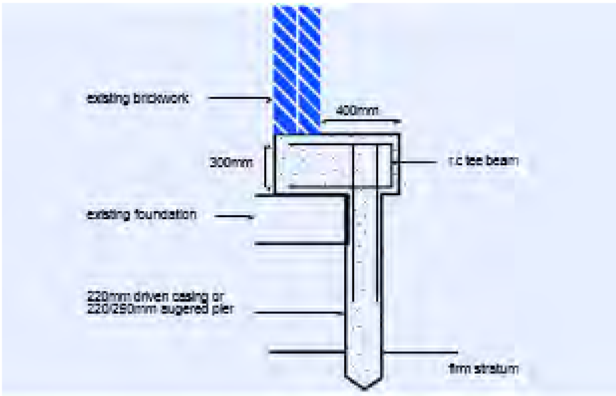


Diagram 4.08: Section through pier and beam

Tanking – Basement Space

If the building has an existing basement or it is proposed to build a new basement it is important that Q

Insurance are consulted at the design stage to discuss and agree the proposals. The designer should identify the intended use of the basement as this has a bearing on its design and construction.

Where it is intended that any accommodation below ground level is to be habitable, then the design should be such that no moisture/damp should enter this area. There are a number of possible solutions to tanking existing basements and a guidance is given in BRE Good Building Guide 3 – Damp Proofing Existing Basements.

Additional information is provided in Approved Document – Basements Design, which although covers design of new basements, identifies a number of key points which are applicable to the design of all basements.
This includes:

- Determine the position of water table
- Assess the drainage characteristics of soil
- Select an acceptable construction type, this will probably be one of the following:
  - Mastic asphalt
  - Cementitious render
  - Self adhesive membranes
  - Liquid applied membrane
- Products which are used should have independent third party certificates acceptable to Qs and, where required, should be installed by an approved installer.

The following are examples of different types of tanking systems. However the installations must be applied strictly in accordance with the manufacturer's recommendations:

Mastic asphalt
Method: Build up a 2 coat asphalt angle fillet, at wall/floor and wall/wall junctions. Apply 3 coats of asphaltto total of 30mm on floor slab and 20mm to walls, Joints between successive coats should be staggered by at least 150mm (floors) and 75mm (walls). Add 50mm protective sand/cement screed, and reinforced concrete loading, coat,

Build a vertical masonry lining wall (loading coat), backfilling progressively against the asphalt with a 40mm cement/sand mix, (See diagram 4.09).

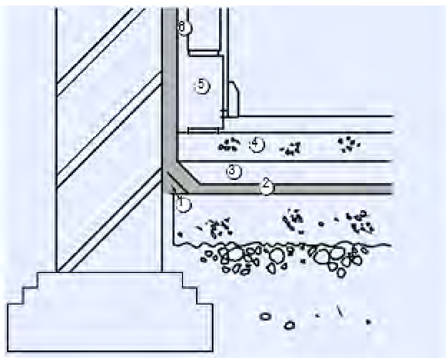


Diagram 4.09: Mastic asphalt

Cementitious render or cementitious compound
Method: Apply a cement corner fillet at wall/floor and wall/wall junctions. Render: apply three coats of the proprietary mix. Lap coats in accordance with the render manufacturer's instructions and cure. Skim-plaster walls if necessary. Compound: damp substrate, apply two coats to manufacturer's recommendations, followed by a loading coat and floor screed (shown dotted see diagram 4.10 below):

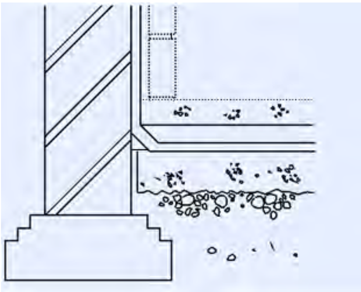


Diagram 4.10: Cementitious render or cementitious compound

Self-adhesive membrane
Method: Add wall/floor and wall/wall fillets. Secure the membrane to the dry wall and floor surfaces following the manufacturer's guidance allowing at least 150mm overlap at joints. Protect the floor membrane and build up blockwork lining wall, progressively backfilling with 18mm layer of cement/sand mortar. Add a new floor screed of at least 50mm thickness and replaster (See diagram 4.11).

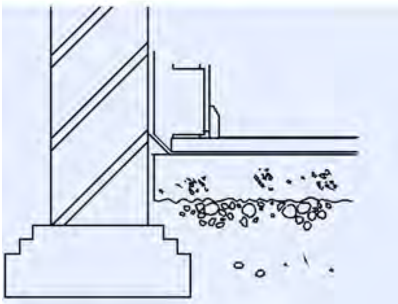


Diagram 4.11: Self-adhesive membrane

Liquid-applied membrane
Method: This system will normally be one of the following: Bitumen emulsions and solutions, rubber latex polyurethane compounds, epoxy resins. Usually one or more liquid coats are applied which require a period of cure before laying of a new floor screed and construction of a new inner leaf (normally backfilled with cement/sand mortar). Protect the floor membrane from damage during building operations (See diagram 4.12).

Existing basement floors may be suitable if it can be shown that the slab is of an adequate thickness, usually in the region of l00mm, and is bearing on to a suitable inert hardcore. The proposals to tank the basement should address both the walls and the floor, in order to ensure the integrity of the basement area.

It may also be necessary to provide land drainage to the external perimeter of the basement in order to reduce hydrostatic pressure to acceptable levels (consult the Building Control Authority who may have local knowledge of water table conditions).

Internal walls will also require tanking if they either do not have an effective dpc located at the same level as the floor tanking membrane, or if they link with an external wall which is in contact with the adjacent ground
(See diagram 4.13).

Wall tanking should extend at least 150mm above adjacent ground levels. Where the adjacent ground is retained to the full height of the wall, the wall tanking should lap over the wall dpc located above ground level (see diagram 4.13).

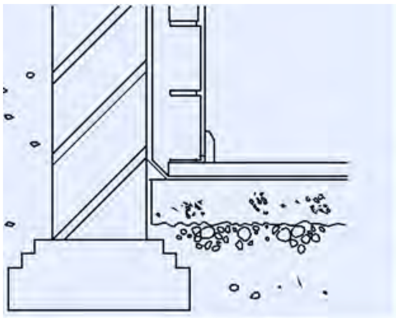


Diagram 4.12: Liquid-applied membrane

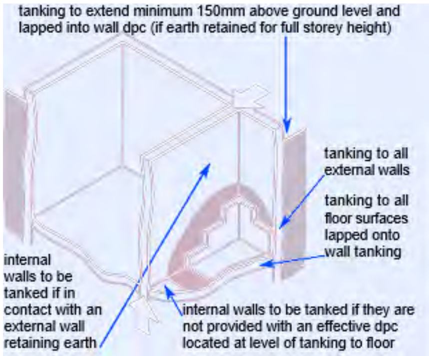


Diagram 4.13: Internal tanking of basement walls

Built-in structural timbers such as timber lintels shall be replaced (e.g. with concrete lintels) if they are sealed by tanking.

Ensure continuity of tanking is maintained around chimney breasts. To simplify the problem, consideration should be given to the removal of the chimney breast in the basement and providing adequate support at ground level to the retained chimney.

Maintain continuity of the tanking system by continuing into the reveals of openings.

Ensure continuity of the tanking system is maintained where service pipes pass through the tanking.

Where the basement area is to be non-habitable, such as storage, it should be designed to ensure that the area is (Grade 2) reasonably dry and well ventilated. This is of particular importance where timber is present in order to prevent the outbreak of wet/dry rot in the building. The measures to ensure that the storage areas are reasonably dry are not as onerous as when designing a habitable basement, guidance on ventilation of non-habitable areas is shown in table 4.01.

Prevent conditions of damp that may cause decay or failure of materials such as timber, insulation and reinforced concrete.

Remove excessive condensation trapped within fabric of the building.

Prevent the build-up of gases escaping from the ground or leaking gas pipes.

type of floor	minimum ventilation per metre run
timber	3000mm^2
concrete	600mm^{2}*

Note: *Building Control Authorities may require higher standards

Table 4.01: Ventilation of cellars and voids

type	size (mm)	net area (mm^2)
squared holed clay air brick	225 x 75	1400
	225 x 150	4300
	225 x 225	6400
louvred clay air brick	225 x 150	2000
	225 x 225	6400
PVC (typical values)	225 x 75	4645

Table 4.02: Net areas of air bricks and ventilators

The rate of ventilation should be as shown in table 4.1.

Table 4.02 gives the approximate ventilation areas for various types of ventilators and grilles. For exact net opening areas, consult manufacturers technical literature. Detailed guidance on waterproofing basements is contained in the following:

- BRE Good Building Guide 3 – Damp proofing existing basements
- Approved Document – Basements for dwellings
- BS8102 Code of Practice for Protection of Structures against water from the ground
- British Cement Association Basement Waterproofing Design Guide
- British Cement Association Basement Waterproofing Site Guide

Damp Proofing

Damp Proofing
An minimum 10 year insured guarantee to the satisfaction of Q shall be provided for all injected chemical damp proof courses.

A suitable damp proof course should be provided to existing walls, and be placed at least 150mm above external ground level to ensure that ground moisture does not enter the inside of the building.

An existing damp proof course may be acceptable to Q, if a specialist's survey report confirms it's adequacy.

Where a damp proof course needs to be installed in an existing wall there are two options available:

- Injected chemical damp proof courses
- Physically cutting in a new damp-proof course.

Injected chemical damp proof courses shall be installed by a registered member of the British Wood Preserving & Damp-proofing Association (who will provide a 10 year underwritten guarantee) and be in accordance with BS 6576 Code of Practice for Installation of Chemical Damp-proof Courses.

www.bwpda.co.uk

Most types of wall are suitable for treatment by a remedial damp-proof course system. There are exceptions to this and these include:
Walls of exceptional thickness, i.e. greater than 600mm

- Rubble filled walls
- Random flint/granite walls or other similar impermeable materials
- Mud walls (cob), wattle and daub
- Rat trap bond

Advice should be sought from the specialist installer as to the suitability of their products/system. Products used in chemically injected systems shall always hold current independent third party certificates acceptable to Q.

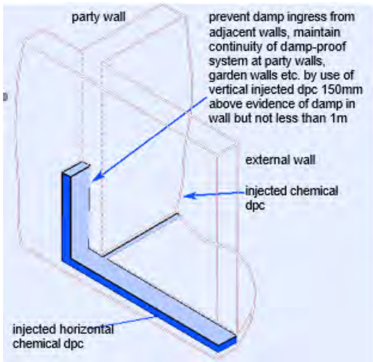


Diagram 4.14: Vertical injected dpc at abutments

Provision can be made for physically cutting in a new damp-proof course. The drawback is that they have to be mechanically inserted into brickwork or coursed stonework. Random flint walls, rubble infilled or unusually thick walls may therefore require some rebuilding. When cutting into the walls to install the dpc it is essential to ensure that all pipes and wiring have been moved out of the way. The new dpc should be linked to any membrane beneath a solid concrete floor, or turned down the wall to protect timber and joist ends.

Location of damp proof courses and membranes
It is essential that any new damp-proof courses are continuous with other damp-proof courses and membranes so as to provide an effective barrier against rising damp

Damp-proof courses should be located in a manner that damp susceptible materials such as suspended timber floors, joist ends and wall plates are located within a dry zone of the wall construction.

Continuity of injected damp proof courses should be maintained at changes in floor levels, around chimneys and fireplaces, within recesses, alcoves, party walls, garden walls, etc. (See diagram 4.14).

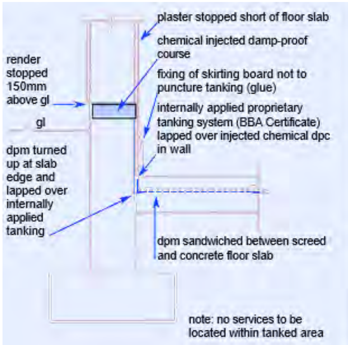


Diagram 4.15: Continuity of damp-proofing system when not subject to hydrostatic pressure

Often in refurbishment work it is not possible to lower ground levels adjacent to walls as this will reduce the depth or cover to foundations and footings. In cases where the ground level is higher than the adjacent floor level special attention is required to maintain continuity of the damp proofing system (See diagram 4.15).

Further guidance on damp-proofing is available:
- BRE Digest 245 Rising Damp in Walls
- BRE Good Repair Guide 5: Diagnosing the causes of damp
- British Wood Preserving and Damp proofing Association
- Independent third party certificates acceptable to Q.

Treatment of timbers – Rot/Insects

An minimum 10 year insured guarantee to the satisfaction of Q shall be provided for all remedial timber treatment.

Any remedial treatment shall be carried out by registered members of the British Wood Preserving and Damp- proofing Association in accordance with their Code of Practice for Remedial Treatment and associated technical leaflets.

In order to obtain insurance it is necessary to undertake a detailed investigation of all timber members to identify the presence of any insect or fungal decay and treat the affected areas as appropriate. It is essential that the type of fungal attack is correctly identified as treatment methods vary for dry rot and wet rot.

Alternatively it may be acceptable to Q to use a specialist building pathologiost who will provide reports and designs which will design out the cause of damp, rot or infestation in older buildings and will proviode a guarantee backed by their proffesional indemnity insurance. This approach may be more suitable for historic and listed buildings examples of such companies include
Hutton + Rostron Environmental investigations Ltd
Netley House, Gomshall, Guildford, Surrey, GU5 9QA
Tel No 01483 203221 Fax No. 01483 202911
www.handr.co.uk

Fungal attack covers wet rot and dry rot. Wood rotting fungi can be divided into two categories according to their effects on the wood:

- Brown Rot – causes the wood to become darker in colour and crack along and across the grain when dry. Badly decayed wood will crumble to dust, and the majority of wet rots and dry rot fall within this group.
- White Rot – the wood becomes lighter in colour, the wood cracks along the grain. All white rots are wet rot
- Insects attack includes Common Furniture, Death Watch, House Longhorn and Powder Post Beetle

The root cause of fungal attack is dampness. For example, dampness may be caused by the following:

- Rain penetration
- Condensation
- Hygroscopic salts
- Defective rainwater goods and roofs
- Bridging of existing dpc's, or no dpc
- Defective renders
- Direct penetration of rainwater through solid walls, particularly those facing prevailing winds
- Leaking drains and internal plumbing

Fungal attack is controlled by two sets of measures: **primary and secondary.**

Areas which have not been inspected should be clearly identified to enable a subsequent inspection to be carried out when the structure has been fully exposed, this could include rafter feet and wall plates which are particularly prone to rot.

Primary measures consist of locating and eliminating sources of dampness and promoting the rapid drying out of the structure. Where the timber becomes wet and remains wet e.g. the moisture content exceeds 20%, then it is likely to decay, and by eliminating the source of dampness and drying of timbers below 20%, the fungus will normally stop growing and will eventually die.

Secondary measures consist of determining the full extent of the outbreak then either:

- Removing all decayed timbers
- Treating of walls so to contain fungi within the wall (only applicable to dry rot)
- Treating of sound timbers with preservative on a localised basis where required
- Using preservative-treated replacement timbers (pre- treated)
- Introducing support measures such as isolating timbers from walls and provision of ventilation between timbers and the walls or:
- Appoint a specialist company who are able to provide an automatic building monitoring system. Timber identified as being at risk of decay such as lintels, joist ends, flat roof timbers, rafter feet, etc., can be monitored and any changes in moisture content recorded by a central computer and the appropriate action taken before serious damage occurs

Dry rot commonly occurs when timber is in contact with damp brickwork and where ventilation and heating are inadequate. Therefore, particular attention should be paid to cellars, basements and sub-floors and also behind panelling. (see table 4.01 for ventilation of cellars and voids)

Floors

Existing Concrete Floors

Where there is an existing concrete ground floor and this is to remain, the following areas should be identified:

- The thickness and condition of the existing slab, a minimum 100mm concrete is normally expected. Slabs less than 100mm are more likely to be vulnerable to rising damp, especially if the concrete is of poor quality
- If there are proposals to increase the load on the existing slab, such as building a masonry wall, then the new wall should be built on an adequate foundation or the existing slab proved for adequacy by calculation
- Are there any gaps between the skirting and floor suggesting settlement of the slab, is the fill beneath the slab over 600mm
- Are there any cracks in the floor slab due to settlement
- If the slab has settled it may be practical to re-level the floor with a new screed or self-levelling compound. Before undertaking any works to a slab which has settled, it must be ascertained that the settlement has stopped
- Has the slab heaved due to either sulphate attack or clay swelling. Concrete ground floor slabs are vulnerable to attack by water soluble sulphates present in the hardcore, e.g. colliery shale. Where the slab has lifted and is no longer in contact with the hardcore, sulphate attack is the most probable cause. When the slab lifts it causes the walls containing the slab to be pushed out.

Clay heave can be attributed to the swelling of the clay subsoil when there is a recovery of the desiccated zone following the removal of a tree. The amount of heave can be as much as 150mm, this swelling of the clay, forces the ground floor slab upwards and can also push out the walls.

Where a slab has heaved, further investigation is necessary to determine the reason for this and appropriate measures taken to rectify the cause and damage.

Guidance on this subject matter is available in BRE Good Building Guide 28 domestic floors.

Where it can be shown that the existing ground floor is structurally adequate but does not incorporate a damp proof membrane, remedial measures will be required. In such cases a damp proof membrane may be laid over the existing slab e.g. 2/3 coat bitumen paint or 1200 gauge (300µm) polythene over which a minimum 50mm 1:3 screed should be laid (65mm minimum thickness in the case of floating screeds and incorporating D49, chicken wire mesh reinforcement). The damp proof membrane should lap with the damp proof course.

Existing Suspended Timber Floors

Where it is proposed to keep the existing ground floor, the following guidance should be followed:

- The existing floorboards/finish should be lifted to ascertain the condition of the timber joists, wallplates and a report carried out by a specialist relating to insect infestation and fungal attack.

When deciding if an existing ground floor is adequate, there are a number of areas which should be addressed, these include:

- An adequate DPC to walls/sleeper walls
- Are all timbers free from rot, insect infestation, and particular attention should be given to the ends of the joists and wallplates
- Adequate ventilation to the sub-floor. (1500mm^2 of free opening in air bricks per metre run of wall, in older properties where there is no oversite (sub floor) this figure should be doubled.)
- Adequate foundations supporting sleeper walls
- Joists are of sufficient size and span
- Are any load-bearing internal walls built off floor joists
- Have joists been weakened by excessive notching or drilling
- Adequate trimming to hearth
- Strutting of joist with spans in excess of 2.5m

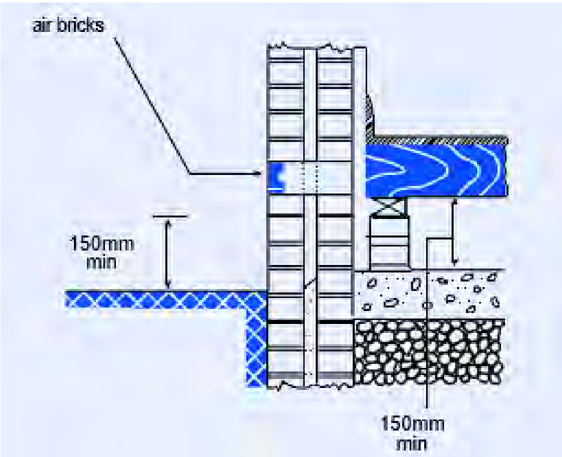


Diagram 4.16: Typical existing layout

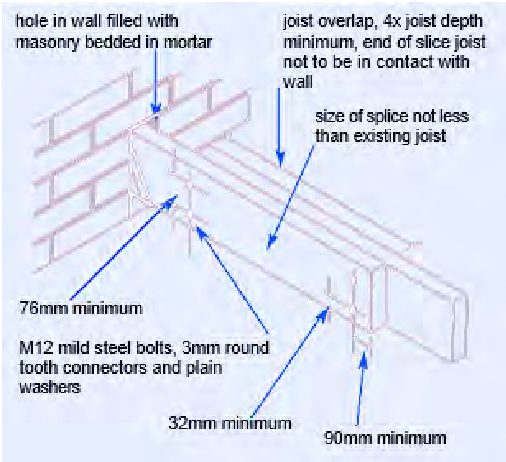


Diagram 4.17: Repairing joists ends

The surface of the oversite covering should be above the highest level of adjoining ground or laid to a fall with a drainage outlet above the lowest level of the adjoining ground and the outlet screened against rodent entry.

All sub-floor voids should be cleared of all timber/builders rubble as this can provide a ready source of food for dry rots and insects.

Timber joists which are previously built into walls and the joist ends have decayed can be isolated from the damp walls by cutting back the joist and supporting on joist hangers. If the decay extends beyond the proposed cuts for the joist hangers, then the timber can be replaced in accordance with the diagram 4.17. This repair method should only be used where not more than three joists are affected per floor zone and the joist depth being not less than 140mm, unless designed by an Expert.

There are also proprietary methods of splicing new timbers to existing joists with galvanised plates, these systems are an acceptable method of repairing rotten or damaged joists.

Radon and Contamination

The aim is to improve the resistance to contaminants and moisture as much as possible but it has been recognised that this is not always practical. In arriving at an appropriate balance between historic building conservation and improving resistance to contaminants and moisture the advice of the Local Planning authority's conservation officer should be sought at an early stage in the design process. (See diagram 4.18)

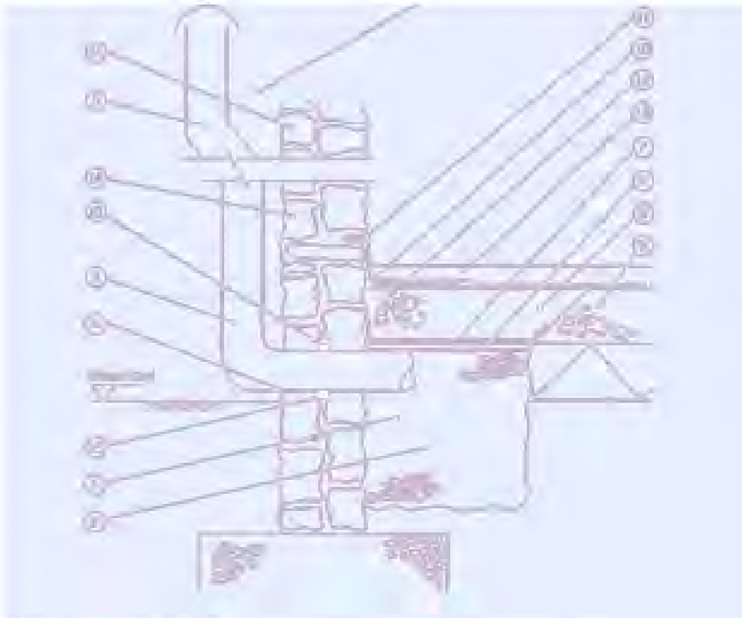
Further information can be found within the following documents:

- BS 7913 Guide to the principles of the conservation of historic buildings
- SPAB Information Sheet 4 1986 The need for old buildings to breathe.
- BRE Report BR 267 Major alterations and conversions
- BRE GBG 25 Buildings and radon.

New Concrete Floors

Replacement ground floor slabs should:

- Be minimum 100 mm thick and preferably located 150mm above the adjacent ground levels
- Incorporate a damp-proof membrane located immediately below the screed and lapped so as toform an integral barrier with the adjacent wall dpc (See diagram 4.19)
- Be laid on minimum 100mm consolidated and well graded non-organic hardcore. Hardcore which is used must be free from water soluble sulphates and other deleterious materials. Outbreaks of dry rot have been recorded and attributed to hardcore containing pieces of wood infected with dry rot



Construction details

1. Existing concrete oversite broken out; excavate a sump approximately 400 x 400 x 400 mm.
2. Fill the excavation with crushed rock or crushed concrete.
3. 110 mm UPVC pipe with minimum bends inserted through hole broken through existing wall.
4. Existing wall reinstated around pipe and sealed with a suitable gun-applied sealant.
5. Vent cowl on a vertical riser cranked around the eaves.
6. Fibreboard permanent formwork.
7. Grout check membrane.
8. Paint the exposed concrete with neat polymer or polymer-modified cement grout, then reinstate the concrete slab.
9. Small cracks in the existing slab to be sealed with polyurethane roofing paint. Larger cracks should be cleaned and repaired with a suitable flexible filler. If the concrete is badly cracked over a large area and in poor condition, it may need to be replaced.
10. Before replacing skirting, force sealant into the gap and form a fillet with the sealant between the floor slab and the wall.
11. Gas-resistant membrane dressed into a continuous chase cut in the existing wall and sealed and protected immediately after installation.
12. Gas-resistant membrane.
13. Screed and insulation.
14. Proprietary cavity vents installed just above the damp-proof course and just below eaves at centres recommended by the manufacturer.
15. Cavity sealed with polyurethane foam sealant.

Diagram 4.18: Radon protection construction detail

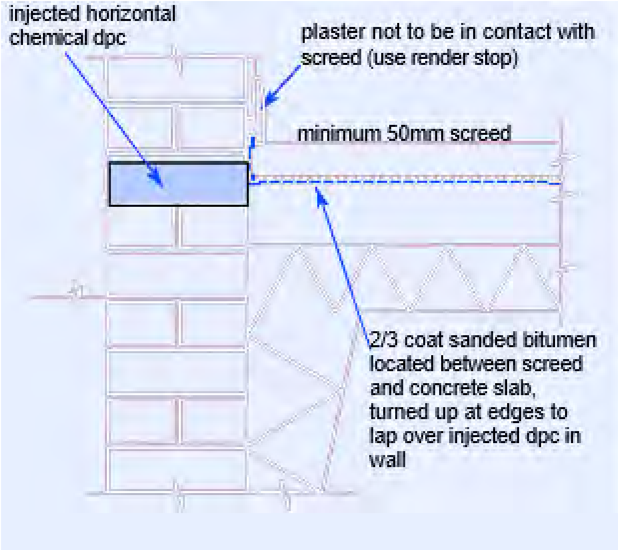


Diagram 4.19: Damp proof membranes

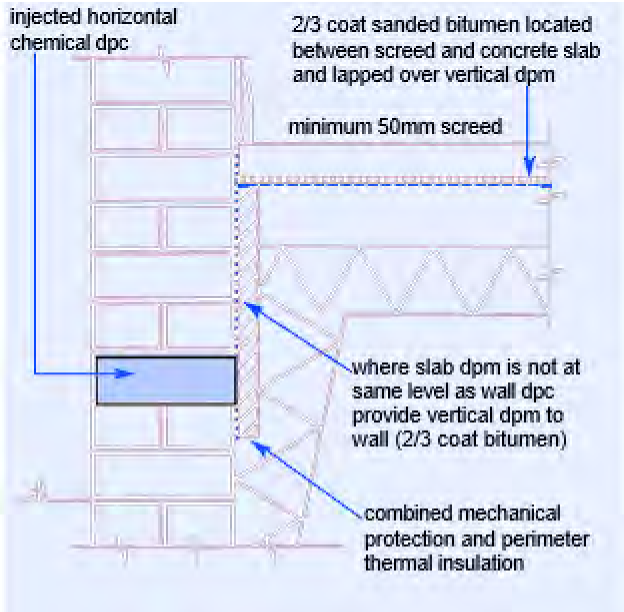


Diagram 4.20: Damp proofing between dpc and screed

Drainage

In cases where the finished slab level is substantially higher than the damp-proof course level in the wall, special attention is needed to ensure that damp does not bridge the dpc (See diagram 4.20).

Drainage
Where it is intended to use the existing below ground foul drainage system a CCTV survey should be carried out to ascertain the condition of the drains and manholes. The survey should cover size, type of drain, falls and its adequacy to take the proposed discharge. An air or water test could also be carried out.

The use of existing surface water drainage may be acceptable providing that it can be shown to be carrying the water away from the building i.e. to a soakaway located 5m away, public sewer etc.

Drainage and ground services
Excavations for new drains and below ground services should not extend below the spread load line of foundations unless special precautions are taken such as protecting the drains/service installations from damage by backfilling trenches with concrete whilst maintaining flexibility of the drainage system to accommodate movement (See diagram 4.21).

Often with refurbishment work it is necessary to extend the drainage system to connect to additional sanitary accommodation. Slab levels and drain inverts are fixed and consequently insufficient cover may be provided to the extended drain. The manufacturer’s recommendations for protection should be followed (See diagram 4.22).

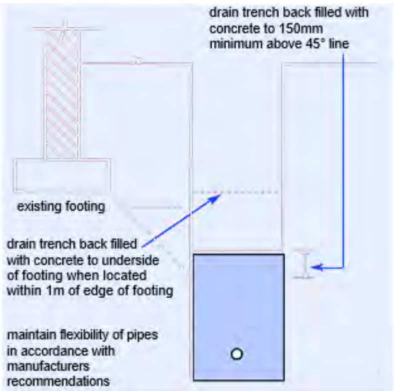


Diagram 4.21: Drain and service trenches adjacent to foundations

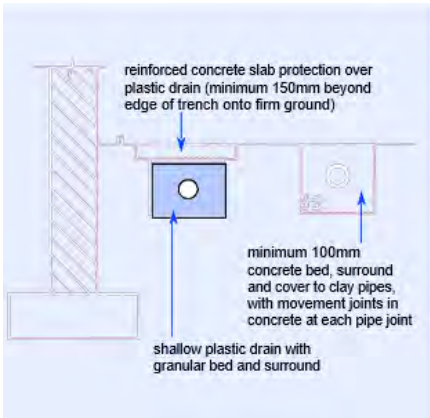


Diagram 4.22: Protection to shallow drains

Structural Repairs

General

Prior to undertaking structural repairs, it is essential that the root cause of the structural defect has been remedied e.g. by underpinning, addition of adequate lateral restraint, buttressing etc. Strengthening works to the structure may also be necessary to accommodate increased or modified loads.

Masonry Walls

When damage has occurred to walls, the cause needs to be investigated. Likely reasons for the damage include:

- Ground Movement – foundation failure, settlement, subsidence, chemical attack
- Thermal Movement – thermal expansion of wall due to temperature changes
- Roof Spread – pitched roofs not properly tied, spreading at eaves
- External and internal walls not bonded together
- Wall tie corrosion
- Lintels inadequate over openings
- Sulphate attack – water soluble sulphates attack cement based mortar, normally in a wet environment, i.e. below ground level and parapet walls
- Frost attack
- Bonding timbers present and subject to rot and shrinkage
- Ineffective or no lateral support at floor and roof level
- Moisture ingress

Cracking in Masonry Walls

Minor cracking can be defined as cracking which occurs in the mortar joints and which does not extend through the masonry components. Providing that the crack is no wider than 4mm and there has been no lateral displacement of the wall, the wall can be repointed. Minor cracking does not usually affect the structural integrity of the wall and may be remedied by raking out mortar joints to a minimum depth of 15mm and repoint with a mix 1:2:9 cement: lime: sand. If the existing mortar is very weak use a 1:3:12 mix.

Major cracking affects the structural integrity of the wall and investigation should be undertaken to find the cause of the problem. If it is necessary, cut out the brickwork either side of the crack (minimum 225mm) and replace, ensuring that adequate bonding is maintained between new and existing brickwork. It is recommended that brickwork reinforcement is used within the new mortar joints.

Avoid strong mortar mixes and use a well graded sand to minimise shrinkage. The use of gun-applied mortar pointing systems should be considered, as they are able to match strength and colour of the existing wall.

Where repointing a wall or building a new wall, jointing should be ‘bucket handle’ or ‘weathered’ in preference to flush jointing. Recessed pointing is not acceptable (See diagram 4.23).

Additional guidance on mortar mixes can be found in table 2.04.

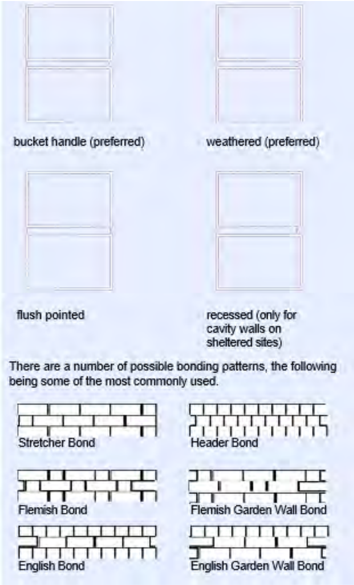


Diagram 4.23: Repointing of masonry

Walls out of plumb/bulging

Where walls are more than 25mm out of plumb or bulge more than 10mm within a storey height a Structural Engineer should comment on the stability. The wall may need to be rebuilt or strengthening works undertaken. (See diagram 4.24)

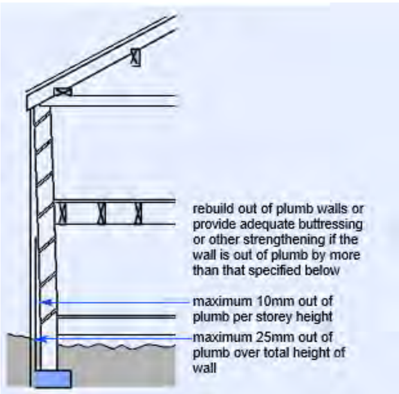


Diagram 4.24: Determination of out of plumb walls

Where it is intended to provide buttressing walls to support out of plumb and/or bulging walls, they should be designed by an engineer.

In raised tie roofs (where no ceiling ties are provided at eaves level) lateral spread of the brickwork just below eaves level may have occurred because the roof has deflected. In such cases it is necessary to prop the roof and to rebuild the affected part of the wall (See diagram 4.25).

Lateral Support at Floor and Roof Level

Buildings may show signs of insufficient lateral support through bulging of walls. Many older houses are built with the floors spanning between the front and back walls with a load bearing spine wall and there is no lateral support to the flank walls at floor or roof level.

To overcome this, metal rods running through the building at floor and roof level, pulling together with end restraint nuts, can be fitted. This method is still acceptable, but due to the disruption involved as the tie will have to pass through every joist, it is more practical to apply the following system (See diagram 4.26).

Other methods of achieving the required lateral supports are available and these include self-tapping tie bars. This system is suitable for tying the walls to floor joists only (See diagram 4.27).

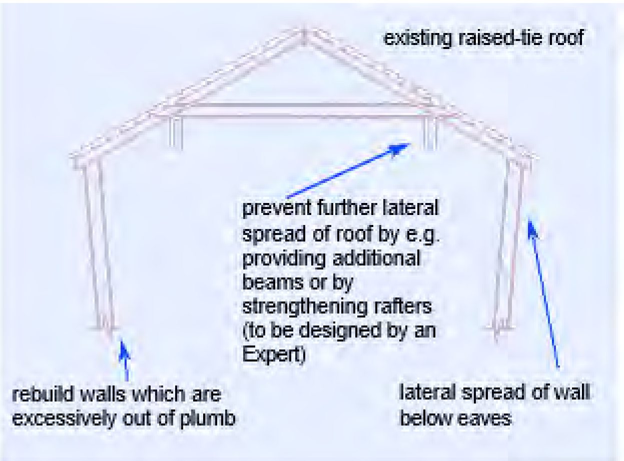


Diagram 4.25: Lateral spread of walls supporting raised-tie roofs

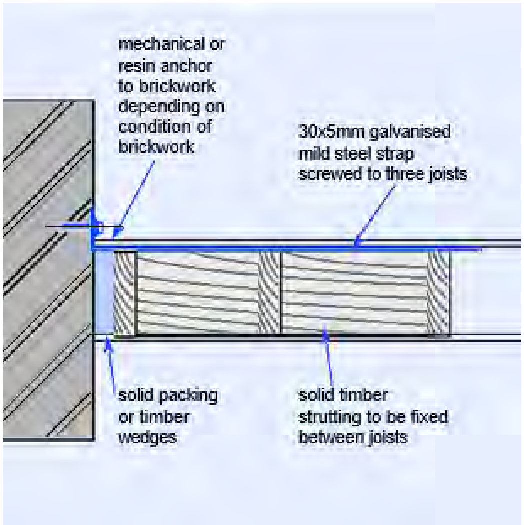


Diagram 4.26: Restraint straps fixed to existing wall/floor

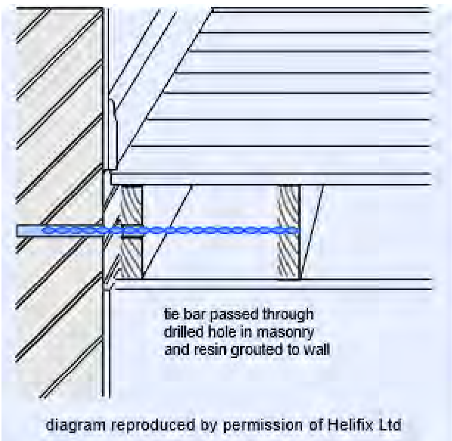


Diagram 4.27: Tie bar passed through drilled hole in masonry and resin grouted to wall

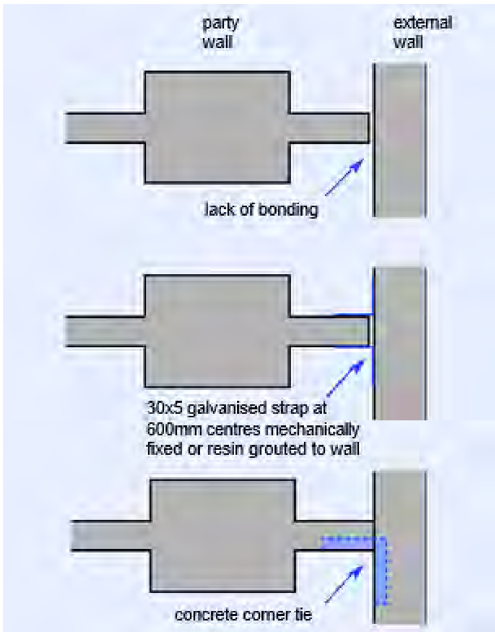


Diagram 4.28: Bonding internal to external walls

Lateral Restraint at Roof Level

The solution is to use a retro-strap system, fitting solid noggins between the first three rafters and mechanically or resin bonding the strap to the wall and screwing it to the noggins. Further guidance is available within the BRE Good Building Guide 29: Connecting walls to floors

Bonding Timbers

These are common in Georgian buildings and were laid in the internal skin of the wall to reinforce it and to provide fixings for paneling etc. With the low compressive strength of lime mortar and general timber decay, the bond timber compresses under load. As the timber is on the inner skin, the compression causes bulging outwards. This may be apparent on the external face. Normally bond timbers should be exposed during the conversion and removed in short lengths and replaced with bonded masonry.

External and Internal Walls not bonded together

A common defect in properties up to the 1920s is the lack of bonding/tie of party walls to the external wall. Different bricks and bricklayers were often used, with the poorer quality materials and labour being used on the party walls. This junction should be exposed when undertaking a conversion and if the bond is inadequate a suitable stitching detail incorporated. (See diagram 4.28)

Arches and Lintels

Where existing timber lintels support structural walls and it can be shown that the lintel is adequate for its purpose, i.e. there is no sign of any structural movement, loads will not be increased and the timbers are free from rot and insect infestation, this lintel can be retained. In order to ensure that a lintel is free from rot, a percentage of all lintels should be exposed at both ends and on the outer face for openings in external walls. Q should be consulted to determine a suitable percentage of lintels to be exposed.

Where movement has occurred and the timber lintel is inadequate, the lintel should be replaced with either a concrete or steel lintel and have the appropriate bearing. Consideration may be given to replacing timber with timber and calculations should be provided to justify this. One solution to this, is where new timber lintels are provided over openings, additional structural support can be provided by a concealed steel angle so that the timber lintel acts as a non-structural element (See diagram 4.29)

Where cracking has occurred in masonry arches (openings not supported by a lintel), then it will be necessary to prop the wall and rebuild the arched construction. In cases where failure has occurred due to the low pitch of the arch, it may be necessary to incorporate a lintel.

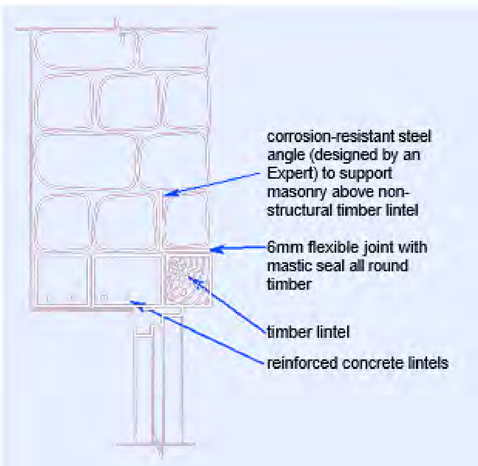


Diagram 4.29: Timber lintels

Wall Tie Corrosion

Cavity walls have been constructed since 1850, but it was not until 1920 that this form of construction was widely adopted. It is important when undertaking a conversion to confirm the construction of the external wall. Care should be taken, where headers are incorporated into the bond of the external brickwork, you should investigate the wall construction, as many properties in the Victorian period were built with either a 215mm outer leaf and cavity behind, or a 215mm inner leaf, cavity and a half brick outer leaf with snapped headers.

Where the wall is of cavity form, a survey of the wall ties on a percentage of the development should be carried out. An initial survey can involve cutting out bricks to inspect the condition and predict (remaining) life span of the ties. During opening up works the ties can be inspected for their suitability and acceptance by Q.

The report should cover:

- Age of property
- Condition of wall ties – evidence of rust or corrosion
- Are there enough wall ties – at least 2.5 ties/m^2 ?
- Ties should have at least 50mm embedment into each leaf
- Do ties slope towards the internal leaf ?
- Is the cavity bridged by mortar ?

Initial evidence of cavity wall failure can include cracking of bed joints in mortar (typically every sixth course). This is due to the expansion of the wall tie as it corrodes.

Bulging of the external leaf could indicate that the ties have failed.

Where there is wall tie corrosion or inadequate ties, a specialist company should be employed to provide a report which includes measures to overcome these defects.

Where wall ties have corroded to an extent that it is serious enough to threaten the stability of the wall or building, a structural engineer should be appointed to determine the necessary remedial works.

Further guidance is contained in:

- BRE Digest 329: Installing Wall Ties in Existing Constructions.
- BRE Digest 401: Replacing Wall Ties
- BRE Good Repair Guide 4: Replacing Masonry Wall Ties
- Wall Tie Installers Federation Tel: 0151 494 2503

Internal Walls

New Masonry
Masonry walls should be built off a suitable foundation, incorporate a dpc and be in accordance with table 2.05 and Approved Document A (E&W) and Regulation 11(Scotland) (up to three storeys). When a wall is outside the scope of these documents, a qualified Structural Engineer should design the element.

Existing Masonry
Where a wall is adequately founded or supported on a beam which shows no signs of distress, it can remain providing there is no increase in load onto the wall. Any increase in load should be justified by calculation.

However, masonry supported on timber beams should be avoided.

In older properties it is possible that Flitch beams and Bressumers may be supporting masonry walls and these should be examined by an appropriate Expert to ascertain its capability to carry the load. (An appraisal by a qualified engineer may not be necessary in all cases, it is suggested that your Q surveyor be involved at the early stages to establish whether clarification by an engineer is actually necessary)

Existing External Walls

Weather Resistance
Existing solid brick or stone walls may be acceptable as a weather resisting wall subject to the exposure category of the building (see exposure to wind driven rain map above) and the porosity of the masonry. It is anticipated that all buildings located in severe or very severe locations will require at least one of the additional treatments noted below. However, all solid masonry wall situations will require a specialist’s report to identify the extent of any necessary remedial treatment.

The specialist report including the proposed design and / or the manufacturer’s details must be forwarded to Q for approval along with other requested reports that form part of the conditions placed on the warranty.

If the above situations cannot be satisfied, then a new external cladding or render system will need to be installed alternatiovely an independent metal or timber lining sytem should be used.

Independent metal or timber framed systems.
These should not be fixed to the existing masonry walls, but fixed at the “head and base” to avoid direct contact. Ventilation should be provided to avoid build-up of condensation between the masonry and the inner lining system. For timber/metal lining systems with insulation between the studs these should also incorperate a vapour barrior on the warm side of the insulation.

Impervious sheet and drained sheet systems.
Systems to prevent water penetration should be installed in accordance with the manufacture’s recommendations and shall possess third party accreditation acceptable to Q.

Timber Walls

New Studwork
Studwork should be in accordance with the previous section regarding Timber Walls.

Existing Studwork
Many properties before 1880, have trussed internal partitions, usually located approximately halfway back in the depth of the property. Often these walls are load bearing and continue up through the building and carry floor and roof loads on to the foundations.

If a timber partition is load bearing, provided it is adequate and the loads are not being increased and the timber is free from rot and insect infestation, the partition can remain. Where there are defects i.e. the floor sags on the line of the partition and there is distortion of door heads then additional strengthening works should be undertaken.

New door openings cut into an existing trussed partition should be overseen by a qualified structural engineer, as it can adversely affect the triangulation of the truss.

Timber Floors

Timber Floors above Ground Level
Existing timber floor joists can be retained within the building providing that they are adequate for their purpose. The following points should be considered (please refer to the previous section for further details):

- joists are of sufficient size for the span (see table 2.22)
- load on the floor is not being increased
- have joists been weakened by excessive notching and/or drilling (refer to previous section)
- are ends of joists are free from rot
- all timbers to be treated for insect infestation and wood rot
- no masonry walls are built off timber joists
- adequate trimming to hearth
- solid strutting or herringbone as per prevous section

Where the existing joists do not comply with the span tables shown on table 2.21 in the previous section, but it can be shown that the joists are adequate, in that there has been no floor deflection, Q will consider these to be acceptable.

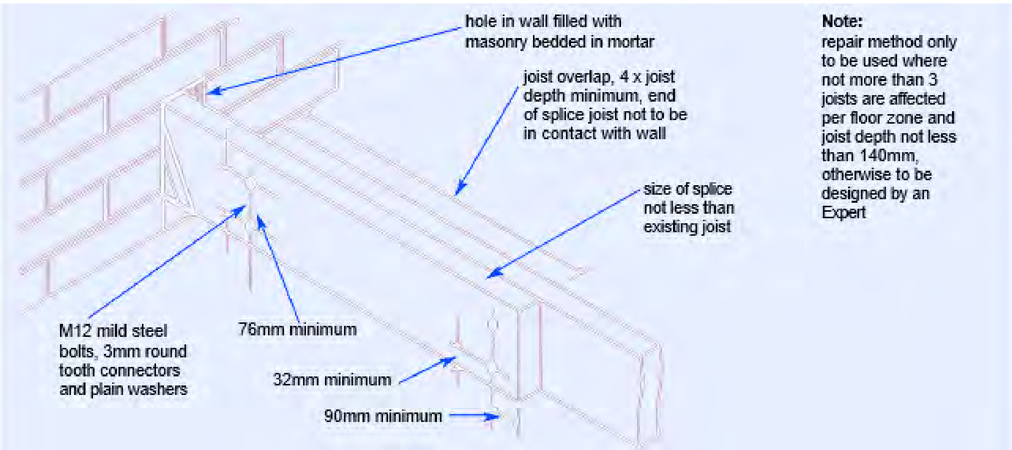


Diagram 4.30: Repairing joist ends

A common defect in floor joists is that the ends which are built into solid external walls have often rotted. A percentage of all existing joists should be examined to ascertain if there is any rot in these timbers. (Q should be consulted to determine a suitable percentage of floor joists to be exposed.) Where timber rot is identified in these joists, then further investigation should be undertaken on a further percentage of the joists.

A system of dealing with the rotten joists should then be implemented (See diagram 4.30):

- Before carrying out this type of work, you should consult a qualified structural engineer to ensure the structural integrity of the building is not compromised
- Proprietary methods of splicing new timbers to existing joists with galvanised plates is also an acceptable method of repair
- Where joists have been previously excessively notched to accommodate services then they should be replaced or the joists strengthened, e.g. by the addition of steel plates securely connected to joists (See diagram 4.31).

Differential Movement

Movement joints between new and existing construction
In order to avoid the damage resulting from differential movement between new and existing work, it is necessary to isolate the new extension from the existing construction whilst at the same time maintaining lateral support to the new construction and ensuring a weather-tight joint. The isolation joint should extend through to the foundations (See diagram 4.32 for typical solution).

Walls of special construction
If it is intended to retain walls of special construction such as wattle and daub, Tudor, mud walls (cob) etc., they should be altered so as to form a non-structural element e.g. by the incorporation of an additional load bearing wall or framing which provides lateral support to the wall and supports all structural loads previously supported by the wall. It is also necessary to ensure that the wall provides an adequate barrier to the passage of rainwater into the fabric or the inside of the building. This may be achieved by e.g. the formation of cavity construction whereby the special wall forms the external leaf and the cavity construction provides the required resistance to rainwater penetration. It is recommended that Expert advice is obtained for these types of construction

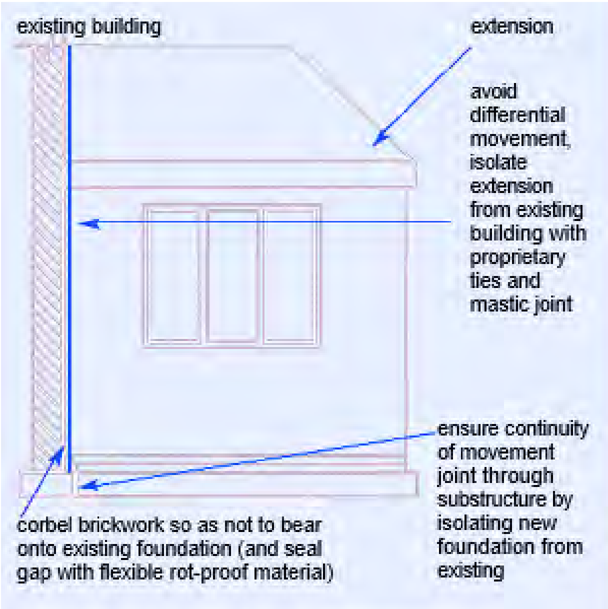


Diagram 4.32: Abutment of new build to existing structure

Alterations to existing openings
Where existing openings are to be filled with masonry, the new work should be adequately bonded to the existing, the weather resistance of the wall maintained and, if a party wall, comply with the requirements for sound insulation.

Often it is necessary to make minor modifications to existing openings in order to accommodate new frames. In such cases the length of bearing of the supporting lintels should be verified and where less than 150mm the lintel may have to be replaced.

Imperial Brickwork – Metric Blockwork
Where it is intended to use this construction particular attention should be made to ensure that the wall ties do not slope inwards towards the inner leaf. Conventional coursing of 450mm centres vertically will not match as imperial bricks are bigger than metric. The use of proprietary walls ties should be considered.

Chimney Removal

Chimneys
When removing chimney stacks, they should be taken down to below roof level and capped. Chimneys located on external walls should be ventilated to the external air at roof and base level.

Where it is intended to re-use existing flues they should be tested for airtightness.

Adequate support should be provided to chimneys after removal of chimney breasts (See diagram 4.33). Cantilever slabs built into existing walls or corbelling should not be used.

The design of any support should be justified by calculation.

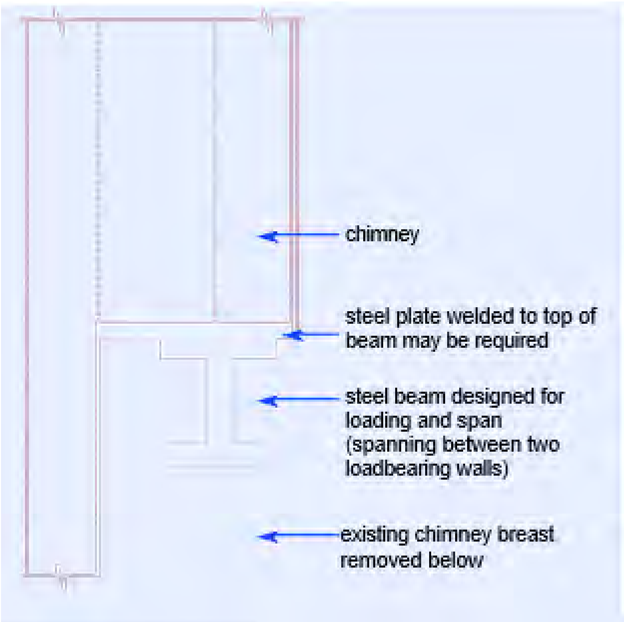


Diagram 4.33: Support of chimneys

Sound Insulation

Pre completion sound testing - Conversions
Sound testing is needed in accordance with Q's requirements and Building Regulations Approved Document E. Resistance to the passage of Sound.

Q must be consulted in order to agree the test regime in addition to the Building Control body.

Where pre completion testing is carried out the construction needs to achieve the values shown in Tables 2.30 and 2.31. You must contact your Q Surveyor and the Building Control Officer to agree the number of tests required. In certain cases Q may require more or additional tests than Building Control. Further guidance on the extent and number of tests is provided on pages 12-14 of Approved Document E.

We will require copies of the sound tests confirming the separating walls, floors and stairs have achieved the performance levels as set out in Table 1a & 1b of the Approved Document E prior to Q carrying out the completion inspection.

Note in the event of a failed set of test results appropriate remedial treatment should be applied to the rooms that failed the test. A failed set of tests raises questions over the sound insulation between other rooms sharing the same separating elements. The developer should demonstrate that these rooms meet the performance standards. Normally this would be done by additional testing, and/or applying the appropriate remedial treatment to other rooms, and/or demonstrating that the cause of failure does not occur in other rooms.

If the building is deemed "historical" and it is not practical to improve the sound insulation to the standards set out in Tables 1a & 1b of Approved Document E, see further guidance in the next paragraph.

Historic buildings
The aim is to improve the sound insulation as much as possible but it has been recognised that this is not always practical. Where the performance standards cannot be met due to maintaining the character of the building it is acceptable to "test and declare" and provide a fixed notice in the building to show the sound insulation values achieved. For further information on testing, please refer to this section.

Historic buildings include:

- Listed buildings
- Buildings situated within conservation areas
- Buildings which are of architectural and historic interest and which are referred to as a material consideration in a Local Authority's development plan
- Buildings of architectural and historic interest within national parks, areas of outstanding natural beauty and world heritage sites
- Vernacular buildings of traditional form and construction

Further guidance on the principles that should be applied when proposing work on Historic Buildings can be found in: BS 7913 -The principles of the conservation of Historic Buildings.

The sound tests must be carried out by a practice registered either with the United Kingdom Accreditation Service (UKAS) or Association of Noise Consultants (ANC).

www.associationofnoiseconsultants.co.uk
Tel: 01763 852958
Fax: 01763 853252
E-mail: mail@anc

www.ukas.org/testing
Tel: 020 8917 8400
E-mail: info@ukas.com

Party walls and floors

Where the conversion, refurbishment of the building does not constitute a "material change of use" there is no requirement under the Building Regulations to upgrade existing party floors and walls i.e. if the building is already sub-divided into flats and these are remaining, there is no need to upgrade sound resistance.

In this instance Q will normally require any existing party floors and walls to be upgraded to achieve the decibel reduction given in Tables 2.30 & 2.31. However, in special circumstances, such as a listed building, this requirement may be waived.

Air Pressure Testing

Historic Buildings
To do nothing to existing windows is not an option unless keeping is specific condition of listed building consent.

Historic buildings are not by right exempt from improving energy efficiency.
Only exempt where change would unacceptably alter character or increase risk of long term deterioration of fabric.

Other buildings other than Historic are to be tested as described within the previous sections of this manual, relating to Insulation and Pressure Testing.

Concrete/Steel frames

Where the scheme involves converting a concrete or steel framed building into dwellings the following guidance is given.
An appraisal of the existing building should be carried out by a qualified Structural Engineer taking into account the proposals for the change of use, this will include:

- condition of the structural frame including joints
- proposals to increase loadings on the structure and foundations
- alterations to existing load paths
- alterations to stability systems
- changes in environmental exposure
- recommendations to cover additional reports, testing by specialists.

The floor loads on the building may decrease as they will now be for domestic use only, where previously they were for example, offices. Q will accept a statement from a qualified Structural Engineer confirming, where appropriate, that the existing foundation design is acceptable for the new loads subject to the building showing no signs of distress i.e. movement, cracking etc.
Where the intention is to increase the load on the existing structure e.g. by the introduction of an additional floor, then structural calculations should be provided to prove the adequacy of the building and foundations.

Concrete Framed Buildings
Where the building is of concrete construction additional reports are needed for:

- Carbonation
- Chlorination

The two major causes of corrosion in concrete are carbonation in association with inadequate depth of cover to reinforcement and chlorine penetration due to de-icing salts and admixtures used to accelerate the setting and hardening of concrete in temperatures at or below freezing point.

Carbonation involves a reaction of carbon dioxide in the air with the free lime present in the concrete. Over a period of time this reduces the pH level of the concrete. With a reduction in the alkalinity, and the presence of both water and oxygen, corrosion of the embedded steel will occur.

Visual surveys on concrete structures are a starting point to gather information. However, care should be taken as the concrete structure may not show any obvious signs of corrosion and yet corrosion of the reinforcement may be occurring.

It is important that a second stage survey incorporates the following:

- Chemical tests on the concrete structure to ascertain if corrosion of the steelwork is or is likely to occur
- Depth of carbonation can be assessed either on site or in the laboratory and the depth of the reinforcement measured. This allows those areas of risk to be identified
- Chloride ion content can be taken by analysis of a drilled dust sample from the concrete.

Where concrete repairs are necessary they should be carried out by a specialist contractor.

High Alumina Cement Concrete (HACC)
Where High Alumina Cement Concrete has been used in a building and the intentions are to keep the existing structure, Q may consider the property for warranty subject to:

- The structure being free from obvious signs of deterioration
- The building being weather-tight
- Structural calculations being provided to show that the floors and roof can solely carry the loads imposed on them.

Typically HACC precast concrete beams were cast as “X” or “I” shaped beams.

Steel Framed Buildings
In addition to any structural reports a visual inspection of the steel frame should be carried out to assess the extent of any corrosion of the framework.

Where corrosion is present accurate measurements can be made using an ultrasonic gauge. Data collected can then compare the thickness of steel sections against the original steelwork drawings, British Standards and Historical Structural Steelwork Handbook to ascertain if the structural frame is adequate for the proposed loads.

When corrosion is apparent, what appears is a thick layer of rust e.g. 10mm only actually indicates a loss of between 1.0mm and 1.6mm of steel and it is therefore important to take readings.

Exterior Steelwork should be inspected. Where corrosion is visible, the steel can be grit blasted cleaned and recoated.

Perimeter Steelwork in direct contact with the outerleaf of the building can be prone to corrosion particularly in older properties. A sign indicating that this has happened is the displacement of the external masonry due to the expansion of the steelwork caused by corrosion.

Corroded steelwork occupies between 6 and 10 times the original volume of the steel.

Perimeter steelwork can normally be inspected during the conversion process and the appropriate repairs/ replacement carried out.

Interior Steelwork - normally corrosion of unprotected steelwork within the interior of a building is low with only superficial rusting.

Providing a visual inspection confirms this and the environment intends to remain dry no further treatment of the steel will be required.

Where the proposals involve the steelwork in a “wet” environment such as kitchens and bathrooms it should be be adequately protected.

Bimetallic Corrosion
This should be considered in the existing and proposed structure. Bimetallic corrosion occurs where two different metals are in electrical contact and are also bridged by water or water containing other chemicals to form an electrolyte, a current passes through the solution from the base metal to the noble metal. As a consequence the noble metal remains protected and the base metal suffers increased corrosion.

Where there is a possibility of this occurring or if it has already occurred advice should be taken from a specialist on how to deal with it.

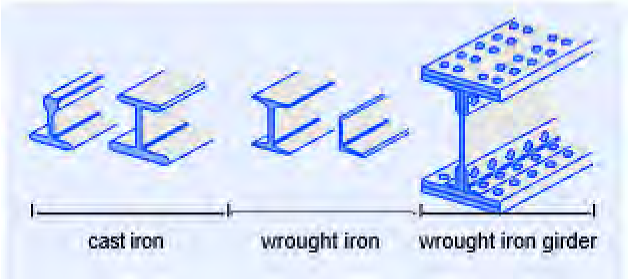


Diagram 4.34: Typical beam structures

Cast Iron, Wrought Iron and Mild Steel Structures

Many older buildings which are converted into dwellings e.g. warehouses, cotton mills etc. were built using cast iron, wrought iron or mild steel. Typical beams are shown in diagram 4.34.

Cast and wrought iron were first introduced in 1800s followed by the use of steel around 1890. With the onset of steel the use of cast and wrought iron declined.

When the intention is to keep the existing structural elements, an appraisal of the existing building is necessary and guidance is given (See previous section, Introduction to Conversions).

In addition to this the engineer should comment on the following:

- determine age of the building and materials used
- assess how its construction has faired
- justify the loadings by calculation
- identify areas where additional testing and/or opening up is necessary.

If the proposed loads remain unchanged or are reduced, as will probably be the case, and it can be shown that the existing structure has not suffered any deterioration due to corrosion, deflection of structural members etc., the building may only require localised structural alterations.

When the intention is to increase loads, carry out major structural alterations, or the existing building is under designed, a structural engineer should comment on this and provide calculations to justify the proposals.

Filler Joist Floors

Many buildings of late Victorian and Edwardian period were built with floors constructed of clinker concrete supported by embedded iron or steel joists. The concrete produced with clinker aggregate was porous and therefore provided poor corrosion protection to the metal (See diagram 4.35).

The clinker also contains particles of unburnt or partially burnt coke or coal which contain substantial proportions of sulphur. As the concrete is porous the sulphur oxidises to form Sulphur Dioxide (SO2) and if moisture is present this then forms Sulphuric Acid (H2SO4). Where floors have been subject to the weather for any length of time severe corrosion of the embedded iron or steelwork is likely to have occurred.

When considering a conversion in a building which has filler joist floors it is important to firstly investigate to ascertain if the floors have been subject to damp conditions and whether any significant corrosion has taken place.

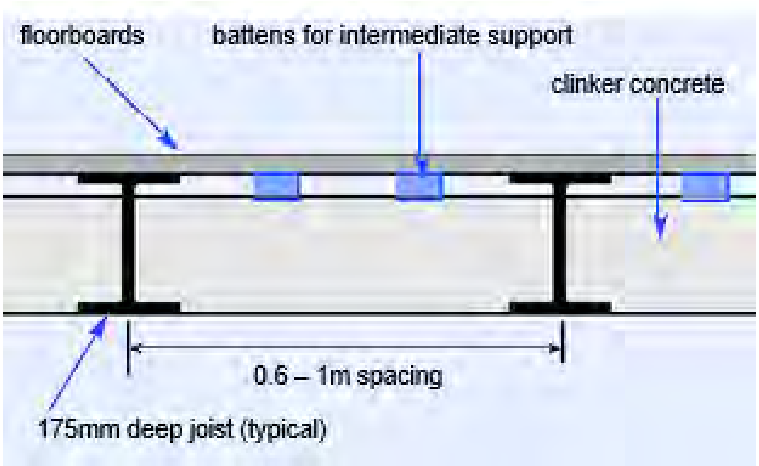


Diagram 4.35: Typical floor using filler joists

PRC Repairs

PRC - Prefabricated Reinforced Concrete
PRC houses covered under NTHAS (Non Traditional Housing Appraisal Scheme) are suitable for warranty providing the category of repair is either 3, 4 or 5 (See table 4.03).

Particular attention should also be made during the conversion to ensure that the floor remains dry and this could include providing a temporary covering if removal of the existing roof is necessary.

Works under Category 1 and 2 are not suitable.

location	damage	time for carbonation to reach steel	chloride limit	category	treatment
external and internal	no	40 years	0.4%	1	none
external and internal	no	25 years	0.6%	2	approved surface coating and ventilation
external and internal	no	no limit	0.6%	3	insulation, masonry overcladding and ventilation
external internal	yes no	no limit no limit	unlimited 0.6%	4	replacement of external PRC components and ventilation
external and internal	yes	no limit	unlimited	5	replacement of all PRC components & ventilation

Table 4.03: Category ratings for PRC repairs

The NTHAS appraisal includes a visual inspection followed by testing of the structure. The testing covers:

- Depth of concrete cover to the reinforcing steel
- Degree of carbonation of the concrete
- Calcium chloride content

After the test results have been analysed the property is placed in the appropriate category.

The scheme is managed by a panel of engineers:

- Curtin Consulting Engineers
- Dinardo Partnership
- L G Mouchel & Partners Ltd
- Michael Dyson Associates.

Q will need to inspect the property prior to work commencing to comment on those elements which are being retained:

- Ground floor slab – any signs of movement or damp
- First floor joists – deflection, rot
- Roof void – deflection of structural timbers, rot, adequate ventilation, insulation
- Drainage – external below ground drainage
- External – paths, drives, garden walls
- Services – gas, electricity, water etc.

Where any obvious defects are apparent in the retained structure they should be replaced or repaired.

PRC Demolition and Rebuild

Where the PRC property is demolished to slab level Q will consider the rebuild for warranty purposes subject to:

- A structural engineer should comment on the adequacy of the existing foundations to take the proposed loads. Where it is necessary, the footing should be underpinned or a new foundation 'stitched' to the existing
- The existing slab should be examined for any signs of settlement, heave or sulphate attack and where appropriate trial holes cut into the slab to ascertain the thickness of concrete and type of hardcore
- Any new load-bearing walls are to be built on foundations unless it can be justified by calculation that the existing slab can carry the load
- Where the existing below ground foul drainage system is retained a CCTV survey should be carried out.

Timber Roofs

Surveying Roof Timbers
All roof timbers should be surveyed by a specialist and any necessary treatment carried out. Particular attention should be given to rafter feet, wall plates and valley timbers as these often show signs of rot.

Roof structure
It is essential that the roof structure has adequate strength, stiffness and dimensional accuracy appropriate for the new roof covering. In many existing buildings the roof structure is inadequate to support roof loads and has suffered from excessive deflection (See diagram 4.36). Often, the necessary remedial works are relatively simple and inexpensive. Common problems encountered include:

- Excessive spans of rafters, purlins, binder and ceiling joists
- Inadequate ties between rafters and ceiling ties
- Insufficient number of collar ties at purlin level
- Decay of rafter feet and valley beams
- Settlement of purlin supports
- Lateral spread of raised-tie roofs.

There are a number of solutions for strengthening timber roofs (See diagram 4.37) which include:

- Provision of diagonal struts supported on loadbearing walls to reduce effective spans of purlins
- Provision of additional purlins
- Inclusion of new binders and collars
- Strengthening of rafters at ceiling level in raised tie ceilings
- Additional ties to connect rafter feet to ceiling joists
- Splicing new timber to rafter feet

All strengthening work should be designed by an engineer.

Additional supports are often required for new water tanks in roof spaces. These should be located such that ceiling joists are not excessively loaded and the loads imposed are transmitted directly to supports (See diagram 4.38).

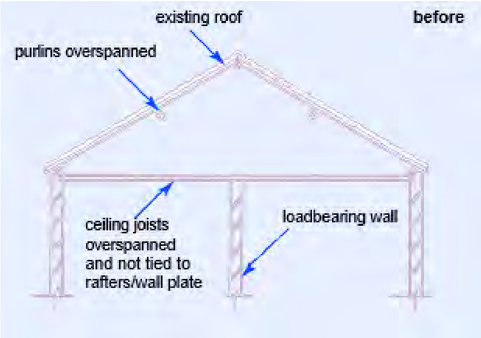


Diagram 4.36: Existing pitched roof

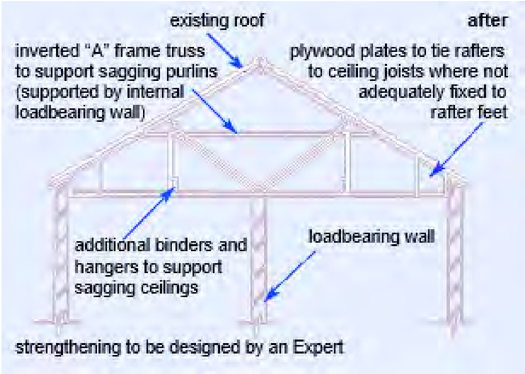


Diagram 4.37: Strengthening of pitched roofs

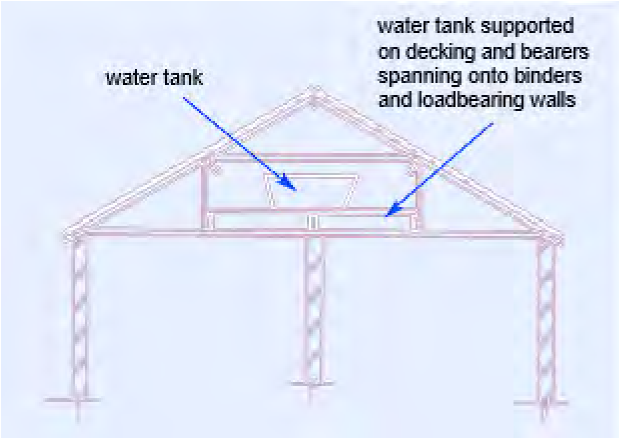


Diagram 4.38: Supporting of water tank

Roof Coverings

Systematic replacement of all roof coverings, including associated support systems such as battens, felt, flat roof decking, fascias, soffits and flashings should be carried out, unless it can be shown that the existing roof covering is adequate. The existing roof covering will only be considered as adequate if it has been replaced in the last 15 years and must be subject to an Expert's report. All roof coverings older than this should be replaced. Consideration of reusing slates /tiles will be given subject to the condition of them and we may request that these be tested by a specialist organisation.

Fixing of slates, tiles, the condition of existing fixings e.g. nails and clips should be examined if the intention is to keep the roof covering.

Where the existing construction is close boarded and there are no provisions to strip the roof to felt and batten Q will consider close boarding to be acceptable if:

- Subject to survey by an expert which must also consider the exposure level
- There are no signs of damp ingress into the roof void due to wind driven rain, snow or capillary action of moisture.

A specialist report will be required to confirm the adequacy of the existing roof covering and if timber treatment is required. If the proposals are to replace the existing roof coverings, then a temporary roof must be erected to protect the building and prevent water ingress into it. Failure to do so can lead to the building becoming saturated and the risk of wet/dry rot occurring. **Please note that if you do not provide a temporary covering, Q Building Guarantee may refuse to provide policy cover for the project.** Adequate ventilation of valley gutters and parapets are often overlooked and may need additional ventilation to prevent stagnant air. Adequate ventilation of the roof should be provided in accordance with the guidance in the previous section regarding roofs.

Where it is intended to re-use existing roofing tiles or slates they should have a life span of at least 15 years.

Where replacement coverings are heavier than the existing coverings, then the works are usually controlled under the Building Regulations and approval is required in respect of the strengthening works to the roof structure.

In the case of replacement roof coverings where no extra load is incurred it may still be necessary to strengthen the roof structure if the roof has deflected.

Claddings

Weather Resistance of Walls and Cladding

Existing solid brick or stone walls **may** be acceptable as a weather resisting wall subject to the exposure category of the building (see exposure to wind driven rain map – diagram 2.69) and the porosity of the masonry. It is anticipated that all buildings located in severe or very severe locations will require at least one of the additional treatments noted below. However, all solid masonry wall situations will require a specialist's report to identify the extent of any necessary remedial treatment.

The specialist report including the proposed design and / or the manufacturer's details must be forwarded to Q for approval along with other requested reports that form part of the conditions placed on the warranty.

External Treatments

Existing claddings can be retained if it can be shown that:

- the system is maintaining the integrity of the building
- it is adequately fixed and the expected life span of the fixings where appropriate is in excess of 15 years
- the cladding material is free from any defects
- adequate provision for movement has been allowed.

If the above situations cannot be satisfied, then a new external cladding or render system will need to be installed.

Internal Treatments

An alternative to preventing moisture penetration by using externally applied claddings and renders is internally applied methods.

Systems are available that are installed on the inside of existing walls to prevent moisture penetration reaching the internal accommodation. These include:

- **Independent metal or timber framed systems.**
  These should not be fixed to the existing masonry walls, but fixed at the "head and base" to avoid direct contact. Ventilation should be provided to avoid build-up of condensation between the masonry and the inner lining system.

- **Impervious sheet and drained sheet systems.**
  Systems to prevent water penetration should be installed in accordance with the manufacturer's recommendations and shall possess third party accreditation acceptable to Q.

Interstitial condensation

Vapour control layers may need to be incorporated on the warm side of the thermal insulation. Voids and cavities may also need to be ventilated.

Surface condensation

Measures should be taken to prevent surface condensation, this can be based on guidance contained in BS 5250.

Summer Condensation

Under certain conditions the warmth from sunlight falling onto a damp solid masonry wall can drive moisture inwards and form condensation on the outside of a vapour barrier. Diagrams 4.39 and 4.40 indicate two methods of upgrading the thermal properties of existing solid walls whilst attempting to limit the risk of summer condensation.

Control of damp penetration

Measures should be taken to ensure that thermal insulation in cavities does not encourage the passage of damp from the ground or from the exterior of the building to the inside of the building.

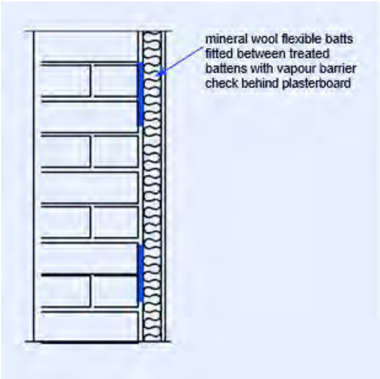


Diagram 4.39: Upgrading U-value of existing one brick walls

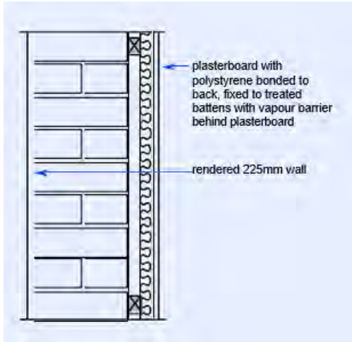


Diagram 4.40: Upgrading U-value of existing one brick walls

Thermal insulation of walls and claddings

Various methods exist to upgrade the thermal insulation of existing walls and floors. Regardless of the methods adopted, it is essential that risks associated with increased thermal insulation are minimised, including:

- Surface condensation caused by improvements to draught proofing of the building.
- Interstitial condensation caused by moisture-laden air passing from the dwelling to within the fabric of the structure and condensing on cooler surfaces.
- Increased risk of damp penetration caused by filling of cavities with insulation.
- Maintaining the robustness of the external and internal wall surfaces by the provision of adequate mechanical protection over insulation materials, e.g. externally applied insulation systems with render coat mechanical protection.
- Avoidance of cold bridges around openings and where structural elements extend through thickness of the building envelope.
- Where planning restrictions prevent the thermal upgrade of the building then Q may deem it appropriate to add an endorsement to the policy regarding the risk of condensation.

Diagrams 4.39 and 4.40 provide guidance on increasing thermal values of existing walls.

It should be noted that these diagrams are for upgrading thermal values but are not ways to prevent moisture penetration. Diagram 4.41 to be used when calculating the elemental method for conversions.

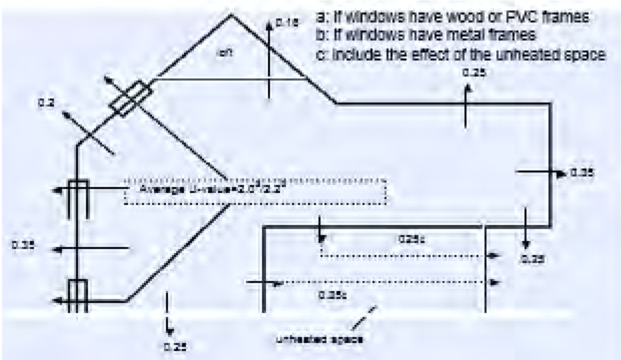


Diagram 4.41: Summary of elemental method

Render Application

Rendering for conversion/refurbishment
Where the condition and bond of the existing render can be shown to be adequate it can remain subject to the following exceptions:

- If the render bridges the dpc
- Above door and window openings where it is necessary to examine the type and condition of the lintels
- Where there are signs of structural movement in the building and further investigation is required

See tables 2.16 and 2.17 for a suitable mix and design.

Guidance on this subject is available:
BRE Good Building Guide 23 & 24

- Assessing external rendering for replacement or repair
- Repairing external rendering

Protection of render
Renders are vulnerable to damage through exposure to extremes of temperature during the first few days.
Therefore the following appropriate precautions should be arranged in advance:

- In hot weather, the wall should be shaded from the direct heat of the sun or the work programmed to be carried out in the shade
- In cold weather, rendering should not be attempted when there is a risk of frost occurring during the day or the following night
- Air temperature should be at least 5˚C at the time of application
- When rendering has been applied, it should be prevented from drying out for two or three days until the morta has hardened
- In drying winds it may need to be kept damp by gentle spraying

Plaster Finishes

Plaster for conversions/refurbishment

Where the condition and bond of the existing plaster can be shown to be adequate, it can remain with the exception of the following:

The existing plaster should be removed where:

- Where rising damp is present
- Where a chemical damp-proof course is installed
- At the junction of external walls and party walls to see if they are properly bonded
- Above openings to examine the make-up and condition of lintels
- Where there is a possibility of bond timbers which may have decayed.

Where a chemically injected damp-proof course is installed it is necessary to remove the plaster one metre above the dpc level or 600mm above any apparent salt line/dampness whichever is the higher.

Replastering work should be delayed as long as possible in order to encourage rapid evaporation of residual moisture and the building should be well ventilated during the drying period.

Plastering work must comply with independent third party certificates acceptable to Q Building Guarantee and the chemical damp-proof course manufacturer's recommendations. Recommended plasters usually incorporate adhesives to increase resistance to the passage of hygroscopic salts from the wall into the plaster. They should not, however, act as a vapour barrier.

Gypsum plaster should not be used in conjunction with chemically injected damp proof courses. The plaster should not bridge the damp-proof course or be in contact with the ground floor slab.

Final redecoration should not be carried out until residual moisture has disappeared. Matt emulsion paint is recommended for use during this period. Internally drilled holes which are concealed by skirting boards etc., should not be plugged. Other visible holes and external holes should be plugged.

Additional advice on plaster is available in BRE Good Building Guide 7 – Replacing Failed Plasterwork.

APPENDICES

Approved Documents

Building Regulations (England & Wales) – Approved Documents
BR E&W AD A:
Approved Document A - Structure

BR E&W AD B:
Approved Document B – Fire safety

BR E&W AD C:
Approved Document C - Site preparation and resistance to moisture

BR E&W AD D: A1
Approved Document D - Toxic substances.

BR E&W AD E:
Approved Document E - Resistance to the passage of sound

BR E&W AD F:
Approved Document F1 - Means of Ventilation

BR E&W AD G:
Approved Document G - Hygiene

BR E&W AD H: A1
Approved Document H - Drainage and waste disposal

BR E&W AD J: A1
Approved Document J - Combustion appliances and fuel storage systems
AD J Edition – Guidance and Supplementary Information on the UK Implementation of European Standards for Chimneys and Flues

BR E&W AD K:
Approved Document K - Protection from falling, collision and impact.
BR E&W AD L1A, L1B, L2A and L2B

Approved Document L - Conservation of fuel and power
BR E&W AD M:
Approved Document M - Access facilities for disabled people.

BR E&W AD N:
Approved Document N - Glazing - safety in relation to impact, opening and cleaning.

BR E &W AD P:
Approved Document P-Electrical safety.

BR E&W AD 7:
Materials and workmanship - Approved Document to support Regulation 7.
BR E&W Amendments: Amendments to the Approved Documents

Scottish Regulations-

Part A - S of the Scottish building regulations have been replaced by six numbered sections based on the European Construction Product Directive

Scotland

Section 0: General
Section 1: Structure
Section 2: Fire
Section 3: Environment
Section 4: Safety
Section 5: Noise
Section 6: Energy

Building Regulations (Northern Ireland)

Approved Documents

Part A: Interpretation and general
Part B: Materials and workmanship
Part C: Preparation of site and resistance to moisture
Part D: Structure
Part E: Fire safety
Part F: Conservation of fuel and power
Part G: Sound insulation of dwellings
Part H: Stairs, ramps, guarding and protection from impact
Part J: Solid waste in buildings
Part K: Ventilation
Part L: Combustion appliances and fuel storage systems
Part N: Drainage
Part P: Unvented hot water storage systems
Part R: Access to and use of buildings
Part V: Glazing

International Standards
BS EN ISO 140: 1
Acoustics – Measurement of sound insulation in buildings and of building elements: Requirements for laboratory test facilities with suppressed flanking transmission

BS EN ISO 140: 3
Acoustics – Measurement of sound insulation in buildings and of building elements: Laboratory measurement of airborne sound insulation of building elements

BS EN ISO 140: 8
Acoustics – Measurement of sound insulation in buildings and of building elements: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor

BS EN ISO 9000: 1
Quality management and quality assurance standards: Guidelines for selection and use

BS EN ISO 9001:
Quality systems
Model for quality assurance in final inspection and test

BS EN 1S0 9001
Quality systems
Model for quality assurance in production, installation and servicing

BS EN ISO 9002

BS EN ISO 9004: 1
Quality management and quality system elements:
Guidelines

European Standards
BS EN 295: 1
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Requirements

BS EN 295: 2
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Quality control and sampling

BS EN 295: 3
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Test methods

BS EN 295: 4
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Requirements for special fittings, adaptors and compatible accessories

BS EN 295: 5
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Requirements for perforated vitrified clay pipes and fittings

BS EN 295: 6
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Requirements for vitrified clay manholes

BS EN 295: 7
Vitrified clay pipes and fittings and pipe joints for drains and sewers: Requirements for vitrified clay pipes and joints for pipe jacking

BS EN 120
Wood based panels – Determination of formaldehyde content. Extraction method called the perforator method

BS EN 300
Oriented strand boards (OSB) – Definitions, classification and specifications

BS EN 310
Wood–based panels – Determination of modulus of elasticity in bending and bending strength

BS EN 312: 1
Particleboard – General requirements

BS EN 312: 2
Particleboard – Requirements for general purpose boards for use in dry conditions

BS EN 312: 3
Particleboard – Requirements for boards for interior fitments (including furniture) for use in dry conditions

BS EN 312: 4
Particleboard – Requirements for load-bearing boards for use in dry conditions

BS EN 312: 5
Particleboard – Requirements for heavy duty load-bearing boards for use in humid conditions

BS EN 312: 6
Particleboard – Requirements for heavy duty load-bearing boards for use in dry conditions

BS EN 312: 7
Particleboard – Requirements for heavy duty load-bearing boards for use in humid conditions

BS EN 314: 1
Plywood. Classification and terminology – Test methods

BS EN 314: 2
Plywood. Classification and terminology – Requirements

BS EN 316
Wood fibreboards – Definition, classification and symbols

BS EN 317
Particleboards and fibreboards – Determination of swelling in thickness after immersion in water

BS EN 318
Fibreboards – Determination of dimensional changes associated with changes in relative humidity

BS EN 319
Particleboards and fibreboards – Determination of tensile strength perpendicular to the plane of the board

BS EN 320
Fibreboards – Determination of resistance to axial withdrawal of screws

BS EN 321
Fibreboards – Cyclic tests in humid conditions

BS EN 322
Wood–based panels – Determination of moisture content

BS EN 323
Wood–based panels – Determination of density

BS EN 324: 1
Wood–based panels – Determination of dimensions of boards – Determination of thickness, width and length

BS EN 324: 2
Wood–based panels – Determination of dimensions of boards – Determination of squareness and edge straightness

BS EN 325
Wood–based panels – Determination of dimensions of test pieces

BS EN 338
Structural timber – Strength classes

BS EN 382: 1
Fibreboards – Determination of surface absorption: Test methods for dry process fibreboards

BS EN 622: 1
Fibreboards. Specifications – General requirements

BS EN 622: 2
Fibreboards. Specifications – Requirements for hardboards

BS EN 622: 3
Fibreboards. Specifications – Requirements for medium boards

BS EN 622: 4
Fibreboards. Specifications – Requirements for softboards

BS EN 622: 5
Fibreboards. Specifications – Requirements for dry process boards (MDF)

BS EN 634: 1
Cement – bonded particleboards – Specification: General requirements

BS EN 636: 2
Plywood – Requirements for plywood for use in humid conditions

BS EN 942
Timber in joinery – General classification of timber quality

BS EN 20140
Acoustics – measurement of sound insulation in buildings and building elements: Laboratory measure of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it

BS EN 338
Structural timber: Strength classes

BS EN 442: 1
Specification for radiators and convectors: Technical specifications and requirements

BS EN 442: 2
Radiators and convectors: Test methods and rating

BS EN 442: 3
Radiators and convectors: Evaluation of conformity

BS EN 60335: 1
Specification for safety of household and similar electrical appliances: General requirements

BS EN 60335: 2.30
Specification for safety of household and similar electrical apparatus: Particular requirements: Room heaters

BS EN 12209
Building hardware - Locks & Latches
Mechanically operated locks, latches and locking plates

Current International Standards

BS 5328: 3
Concrete: Specification for the procedures to be used in producing and transporting concrete

BS 5328: 4
Concrete: Specification for the procedures to be used in sampling, testing and assessing compliance of concrete

BS 5390
Code of practice for stone masonry

BS EN 12056-2
Code of practice for sanitary pipework

BS 5628: 1
Code of practice for use of masonry: Structural use of unreinforced masonry.
Partially superceded BS EN 1052 -1

BS 5628: 2
Code of practice for use of masonry: Structural use of reinforced and pre-stressed masonry

BS 5628: 3
Code of practice for use of masonry

BS 5628: 3
Materials and components, design and workmanship

BS 5837
Guide for trees in relation to construction

BS 5911: 114
Precast concrete pipes and ancillary concrete products: Specification for porous pipes

BS 5930
Code of practice for site investigations

BS 5950: 3.1
Structural use of steelwork in building (limit state): Design in composite construction: Code of practice for design of simple and continuous composite beams

BS EN 772 - 3
Precast concrete masonry units: Specification for precast concrete masonry units

BS 6073: 2
Precast concrete masonry units: Method for specifying precast concrete masonry units

BS 6206
Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings

BS 6297
Code of practice for design and installation of small sewage treatment works and cesspools

BS 6367
Code of practice for drainage of roofs and paved areas
BS 6399: 1
Loading for buildings: Code of practice for dead and imposed loads

BS 6399: 2
Loading for buildings _ Part 2: Code of practice for wind loads

BS 6399: 3
Loading for buildings: Code of practice for imposed roof loads

BS 6576
Code of practice for installation of chemical damp –proof courses

BS 6649
Specification for clay and calcium silicate modular bricks

BS 6744
Specification for austenitic stainless steel bars for the reinforcement of concrete

BS 6744
Stainless steel bars for the reinforcement of and use in concrete. Requirements and test method

BS 7348
Specification for electrical apparatus for the detection of combustible gases in domestic premises

BS 8000: 1
Workmanship on building sites: Code of practice for excavation and filling

BS 8000: 2.1
Workmanship on building sites: Code of practice for concrete work: Mixing and transporting concrete

BS 8000: 2.2
Workmanship on building sites: Code of practice for concrete work: site work with in situ and precast concrete

BS 8000: 4
Workmanship on building sites: Code of practice for waterproofing

BS 8000: 5
Workmanship on building sites: Code of practice for carpentry, joinery and general fixings

BS 8000: 14
Workmanship on building sites: Code of practice for below ground drainage

BS 8002
Code of practice for earth retaining structures

BS 8004
Code of practice for foundations

BS EN 752
Drain and sewer systems outside buildings

BS EN 752 Part 1
Generalities and definitions
BS EN 752 Part 3
Planning

BS EN 752 Part 4
Sewerage: Hydraulic design and environmental considerations

BS EN 752 Part 5
Sewerage: Rehabilitation

BS 8007
Code of practice for design of concrete structures for retaining aqueous liquids

BS 8102
Code of practice for protection of structures against water from the ground

BS 8103: 1
Structural design of low – rise buildings: Code of practice for stability, site investigation, foundations and ground floor slabs for housing

BS 8110: 1
Structural use of concrete: Code of practice for design and construction

BS 8110: 2
Structural use of concrete: Code of practice for special circumstances

BS 8110: 3
Structural use of concrete: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns
BS 8215
Code of practice for design and installation of damp – proof courses in masonry construction

BS 6399: 2
Code of basic data for the design of buildings: Loading: Wind loads – replaced by BS 6399: 2: 1997

BS DD 140: 2
Wall ties: Recommendations for design of wall ties – pre-standard

BS 10175
Code of practice for identification of potentially contaminated land and its investigation – pre-standard

BS EN 10244: Part 2
Specification for testing zinc coatings on steel wire and for quality requirements

BS 644: 1
Wood windows: Specification for factory assembled windows of various types

BS 729
Specification for hot dip galvanized coatings on iron and steel articles

BS 747
Specification for roofing felts

BS 1088 replaced by No's below Specification for fibre building boards – Being replaced
BS EN 120, 310, 316, 317, 318, 319, 320, 321, 322, 323, 324-1, 324-2, 325, 382-1, 622

BS 1186: 2
Timber for and workmanship in joinery: Specification for workmanship

BS 1243
Specification for metal ties for cavity wall construction

BS 1297
Specification for tongued and grooved softwood flooring

BS 1881: 5
Testing concrete: Methods of testing hardened concrete for other than strength –
Partially BS 1881: 121, 122, & 209

BS 1881: 101
Testing concrete: Method of sampling fresh concrete on site. Partial superseded BS EN 12350 - 1: 2000

BS 1881: 102
Testing concrete: Method for determination of slump.
Partial superseded BS EN 12350 - 2: 2000

BS 1881: 103
Testing concrete: Method for determination of compacting factor.
Partial superseded BS EN 12350 - 4: 2000

BS 1881: 104
Testing concrete: Method for determination of Vebe time
Partial superseded BS EN 12350 - 1: 2000

BS 1881: 105
Testing concrete: Method for determination of flow
Partial superseded BS EN 12350 - 5: 2000

BS 1881: 106
Testing concrete: Methods for determination of air content of fresh concrete
Superseded BS EN 12350 - 7: 2000

BS 1881: 107
Testing concrete: Method for determination of density of compacted fresh concrete
Partial superseded BS EN 12350 - 6: 2000

BS 1881: 108
Testing concrete: Method for making test cubes from fresh concrete
To be superseded in 2003 BS EN 12390 - 1: 2000

BS 1881: 109
Testing concrete: Method for making test beams from fresh concrete

BS 1881: 110
Testing concrete: Method for making test cylinders from fresh concrete
To be superseded in 2003 BS EN 12390 - 1
BS 1881: 111
Testing concrete: Method of normal curing of test specimens (20˚C method)

BS 1881: 112
Testing concrete: Methods of accelerated curing of test cubes

BS 1881: 113
Testing concrete: Method for making and curing no – fines test cubes

BS 1881: 114
Testing concrete: Methods for determination of density of hardened concrete
To be superseded in 2003 BS EN 12390 - 7: 2000

BS EN 12390 - 4
Testing concrete: Specification for compression testing machines for concrete

BS 1881: 116
Testing concrete: Method for determination of compressive strength of concrete cubes

BS 1881: 117
Testing concrete: Method for determination of tensile splitting strength

BS EN 12390 - 6

BS 1881: 118
Testing concrete: Method for determination of flexural strength BS EN 12390 - 5: 2000

BS 1881: 119
Testing concrete: Method for determination of compressive strength using portions of beams broken in flexure (equivalent cube method)

BS 1881: 121
Testing concrete: Method for determination of static modulus of elasticity in compression

BS 1881: 122
Testing concrete: Method for determination of water absorption

BS 1881: 124
Testing concrete: Methods for analysis of hardened concrete

BS 1881: 125
Testing concrete: Methods for mixing and sampling fresh concrete in the laboratory

BS 1881: 127
Testing concrete: Method of verifying the performance of a concrete cube compression machine using the comparative cube test

BS 1881: 128
Testing concrete: Methods for analysis of fresh concrete

BS 1881: 129
Testing concrete: Method for determination of density of partially compacted semi – dry fresh concrete

BS 1881: 130
Testing concrete: Method for temperature-matched curing of concrete specimens

BS 1881: 201
Testing concrete: Guide to the use of non-destructive methods of test for hardened concrete

BS EN 12504 Part 2

BS 1881: 203
Testing concrete: Recommendations for measurement of velocity of ultrasonic pulses in concrete

BS 1881: 204
Testing concrete: Recommendations on the use of electromagnetic cover meters

BS 1881: 205
Testing concrete: Recommendations for radiography of concrete

BS 1881: 206
Testing concrete: Recommendations for determination of strain in concrete

BS 1881: 207
Testing concrete: Recommendations for the assessment of concrete strength by near-to-surface tests

BS 1881: 208
Testing concrete: Recommendations for the determination of the initial surface absorption of concrete

BS 1881: 209
Testing concrete: Recommendations for the measurement of dynamic modulus of elasticity

BS EN 355
Fungal resistance of panel products made of or containing materials of organic origin: Method of determination of resistance to wood – rotting Basidiomycetes See BS EN 335

BS 2750: 1: not current but cited in B.R. Measurement of sound insulation in buildings and of building elements: Recommendations for laboratories – Replaced BS EN ISO 140: 1

BS EN 20140: 2
Measurement of sound insulation in buildings and of building elements: Statement of precision requirements (Replaces BS 275012: 1980)

BS EN ISO 140-3
Measurement of sound insulation in buildings and of building elements: Laboratory measurement of airborne sound insulation of building elements (BS 2750: 3: 1995 is no longer current but cited in the Building Regulations)

BS EN ISO 140-4
Measurement of sound insulation in buildings and of building elements: Field measurements of airborne sound insulation between rooms (BS 2750: 4: 1980 is no longer current but cited in the Building Regulations)

Cited BS 2750: 6 C 93 Measurement of sound insulation in buildings and of building elements: Laboratory measurements of impact sound insulation of floors

BS EN ISO 140 - 6

BS 2750: 7 C 93 cited, not current
Measurement of sound insulation in buildings and of building elements: Field measurements of impact sound insulation of floors

BS EN ISO 140 - 7

BS EN ISO 140: 8
Measurement of sound insulation in buildings and of building elements: Laboratory measurements of the reduction of transmitted impact noise by floor coverings on a standard floor

BS 2750: 9
Measurements of sound insulation in buildings and of building elements: Method for laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it –
Renumbered BS EN 20140: 9

BS 2911
Specification for letter plates

BS 8621
Specification for thief resistant locks

BS 3921
Specification for clay bricks

BS 4016
Specification for building papers (breather type)

BS 4787: 1
Internal and external wood doorsets, door leaves and frames: Specification for dimensional requirements
BS 4873
Specification for aluminium alloy windows

BS 6229
Flat roofs with continuously supported coverings – Code of practice
Code of practice for control of condensation in buildings

BS 5268: 2
Structural use of timber: Code of practice for permissible stress design, materials and workmanship

BS 5268: 3
Structural use of timber: Code of practice for trussed rafter roofs

BS 5268: 4.1
Structural use of timber: Fire resistance of timber structures: Recommendations for calculating fire resistance of timber members

BS 5268: 4.2
Structural use of timber: Fire resistance of timber structures: Recommendations for calculating fire resistance of timber stud walls and joisted floor constructions

BS 5268: 6.1
Structural use of timber: Code of practice for timber frame walls: Dwellings not exceeding four storeys

BS 5268: 7.1
Structural use of timber: Recommendations for the calculation basis for span tables: Domestic floor joists

BS 5268: 7.2
Structural use of timber: Recommendations for the calculation basis for span tables: Joists for flat roofs

BS 5268: 7.3
Structural use of timber: Recommendations for the calculation basis for span tables: Ceiling joists

BS 5268: 7.4
Structural use of timber: Recommendations for the calculation basis for span tables: Ceiling binders

BS 5268: 7.5
Structural use of timber: Recommendations for the calculation basis for span tables: Domestic rafters

BS 5268: 7.6
Structural use of timber: Recommendations for the calculation basis for span tables: Purlins supporting rafters

BS 5268: 7.7
Structural use of timber: Recommendations for the calculation basis for span tables: Purlins supporting sheeting or decking

BS 5328: 1
Concrete: Guide to specifying concrete

BS 5328: 2
Concrete: Methods for specifying concrete mixes

BS 5328: 3
Concrete: Specification for the procedures to be used in producing and transporting concrete

BS 5328: 4
Concrete: Specification for the procedures to be used in sampling, testing and assessing compliance of concrete

BS 5534 Code of practice for slating & tiling (including shingles)

BS 5628: 1
Code of practice for use of masonry: Structural use of unreinforced masonry

BS 5628: 2 cited, not current now

BS 5628: 2
Code of practice for use of masonry: Structural use of reinforced and pre-stressed masonry

BS 5628: 3
Code of practice for use of masonry: Materials and components, design and workmanship

BS EN 312
Particleboard: Specification for wood chipboard

BS EN 312
Particleboard: Specification for oriented strand board (OSB)
BS EN 312
Particleboard: Specification for cement bonded particleboard

BS 5707
Specification for preparations of wood preservatives in organic solvents

BS 5950: 1
Structural use of steelwork in building (limit state): Code of practice for design in simple and continuous construction: hot rolled sections

BS 5950: 2
Structural use of steelwork in building (limit state): Specification for materials, fabrication and erection: hot rolled sections

BS 5950: 3.1
Structural use of steelwork in building (limit state):
Design in composite construction: Code of practice for design of simple and continuous composite beams

BS 5950: 4
Structural use of steelwork in building (limit state): Code of practice for design of composite slabs with profiled steel sheeting

BS 5950: 5
Structural use of steelwork in building (limit state): For design of cold formed thin gauge sections

BS 5950: 6
Structural use of steelwork in building: Code of practice for design of light gauge profiled steel sheeting

BS 5950: 7
Structural use of steelwork in building (limit state): For materials and workmanship: cold formed sections

BS 5950: 8
Structural use of steelwork in building (limit state): For fire resistant design

BS 5950: 9
Structural use of steelwork in building (limit state): Code of practice for stressed skin design

BS 6206
Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings

BS 6262
Code of practice for glazing for buildings

BS 6262: 4

BS 6367
Code of practice for drainage of roofs and paved areas

BS 6375: 1

BS EN 12056 - 3
Performance of windows: Classification for weather tightness (including guidance on selection and specification)

BS 6510
Specification for steel windows, sills, window boards and doors
Replace with No's below -
Plywood: Specification for bond performance of veneer plywood – BS EN 314: 1, BS EN 314: 2and BS EN 636 will replace

BS 7412
Specification for plastics windows made from PVC-U extruded hollow profiles

BS EN 514
Specification for white PVC-U extruded hollow profiles with heat welded corner joints for plastics windows: materials type A

BS 8000: 1
Workmanship on building sites: Code of practice for excavation and filling

BS 8000: 2.1
Workmanship on building sites: Code of practice for concrete work: Mixing and transporting concrete

BS 8000: 2.2
Workmanship on building sites: Code of practice for concrete work: Site work with in situ and precast concrete

BS 8000: 3
Workmanship on building sites: Code of practice for masonry

BS 8000: 4
Workmanship on building sites: Code of practice for waterproofing

BS 8000: 5
Workmanship on building sites: Code of practice for carpentry, joinery and general fixings
BS 8000: 6
Workmanship on building sites: Code of practice for slating and tiling of roofs and claddings

BS 8000: 7
Workmanship on building sites: Code of practice for glazing

BS 8000: 8
Workmanship on building sites: Code of practice for plasterboard partitions and dry linings

BS 8000: 9
Workmanship on building sites: Code of practice for cement / sand floor screeds and concrete floor toppings

BS 8000: 10
Workmanship on building sites: Code of practice for plastering and rendering

BS 8000: 11.1
Workmanship on building sites: Code of practice for wall and floor tiling

BS 8000: 11.2
Workmanship on building sites: Code of practice for wall and floor tiling: Natural stone tiles

BS 8000: 12
Workmanship on building sites: Code of practice for decorative wall coverings and painting

BS 8000: 13
Workmanship on building sites: Code of practice for above ground drainage and sanitary appliances

BS 8000: 14
Workmanship on building sites: Code of practice for below ground drainage

BS 8000: 15
Workmanship on building sites: Code of practice for hot and cold water services (domestic scale)

BS 8000: 16
Workmanship on building sites: Code of practice for sealing joints in buildings using sealants

BS 8103: 1
Structural design of low-rise buildings: Code of practice for stability, site investigation, foundations and ground floor slabs for housing

BS 8103: 2
Structural design of low-rise buildings: Code of practice for masonry walls for housing

BS 8104
Code of practice for assessing exposure of walls to wind- driven rain

BS 8110: 1
Structural use of concrete: Code of practice for design and construction

BS 8110: 2
Structural use of concrete: Code of practice for special circumstances

BS 8110: 3
Structural use of concrete: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns

BS 8212
Code of practice for dry lining and partitioning using gypsum plasterboard

BS 8213: 1
Windows, doors and rooflights: Code of practice for safety in use and during cleaning of windows and doors (including guidance on cleaning materials and methods)

BS 8217Reinforced bitumen membranes for roofs:
Code of Practice for built-up felt roofing

BS 8417, Recommendations for the preservation of timber.

BS EN ISO 9001
Quality management and quality assurance standards: Guidelines for selection and use

BS EN ISO 9001
Quality systems – Model for quality assurance in design, development, production, installation and servicing

BS EN 338
Structural timber – Strength classes

BS EN 442: 1
Specification for radiators and convectors: Technical specifications and requirements

BS EN 442: 2
Radiators and convectors: Test methods and rating

BS EN 442: 3
Radiators and convectors: Evaluation of conformity

BS EN 599-1, Durability of wood and wood-based products — Performance of preventive wood preservatives as determined by biological tests — Part 1: Specification according to hazard class.

BS EN 942
Timber in joinery – General classification of timber quality

BS EN 60335: 1
Specification for safety of household and similar electrical appliances: General requirements

BS EN 60335: 2.30
Specification for safety of household and similar electrical apparatus: Particular requirements: Stationary circulation pumps for heating and service water installations

Current Publications Referenced in Manual

BS 12
Specification for Portland cement
BS 65 A1 95 C 97
Specification for vitrified clay pipes, fittings, joints and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings

BS 187A1 87
Specification for calcium silicate (sandlime and flintlime) bricks

BS 476: 22
Fire tests on building materials and structures: Methods for determination of the fire resistance of non –loadbearing elements of construction

BS EN ISO 1461
Specification for hot dip galvanized coatings on iron and steel articles

BS 882
Specification for aggregates from natural sources for concrete
BS 970: 1
Specification for wrought steels for mechanical and allied engineering purposes: General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels
BS 5911: 114
Specification for concrete porous pipes for underground drainage

BS 1196
Specification for clayware field drain pipes and junctions

BS 1243
Specification for metal ties for cavity wall construction

BS 1377: 1
Methods of tests for soils for civil engineering purposes:
General requirements and sample preparation

BS 1377: 2
Methods of tests for soils for civil engineering purposes: Classification tests

BS 1377: 3
Methods of tests for soils for civil engineering purposes: Chemical and electro – chemical tests

BS 1377: 4
Methods of tests for soils for civil engineering purposes: Compaction – related tests

BS 1377: 5
Methods of tests for soils for civil engineering purposes:
Compressibility, permeability and durability tests

BS 1377: 6
Methods of tests for soils for civil engineering purposes:

Consolidation and permeability tests in hydraulic cells and with pore pressure measurement
BS 1377: 7
Methods of tests for soils for civil engineering purposes:
Shear strength tests (total stress)

BS 1377: 8
Methods of tests for soils for civil engineering purposes:
Shear strength tests (effective stress)

BS 1377: 9
Methods of tests for soils for civil engineering purposes: In – situ tests

BS 3921
Specification for clay bricks

BS 4449
Carbon steel bars for the reinforcement of concrete

BS 4483
Specification for steel fabric for the reinforcement of concrete

BS 4962
Specification for plastics pipes and fittings for use as subsoil field drains

BS 5328: 1
Concrete: Guide to specifying concrete

BS 5328: 2
Concrete: Methods for specifying concrete mixes

BS 585: 1
Wood stairs: Specification for stairs with closed risers for domestic use, including straight and winder flights and quarter or half landings

BS 594: 1
Hot rolled asphalt for roads and other paved areas:
Specification for constituent materials and asphalt mixtures

BS 644: 1
Wood windows: Specification for factory assembled windows of various types

BS 882
Specification for aggregates from natural sources for concrete

BS 1186: 1
Timber for and workmanship in joinery: Specification for timber – Superseded BS EN 942

BS 1186: 2
Timber for and workmanship in joinery: Specification for workmanship

BS 1186: 3
Timber for and workmanship in joinery: Specification for wood trim and its fixing

BS 1202: 1
Specification for nails: Steel nails

BS 1230: 1
Gypsum plasterboard: Specification for plasterboard excluding materials submitted to secondary operations

BS EN 1151
Stationary circulation pumps for heating and hot water service systems: Specification for physical and performance requirements – Replaced BS EN 60335 - 1& BS EN 60335 - 2.51

BS 2750: 1 C 93 not current, cited
Measurement of sound insulation in buildings and of building elements: Recommendations for laboratories – Replaced BS EN ISO 140: 1
BS EN ISO 140 - 3
Measurement of sound insulation in buildings and of building elements: Statement of precision requirements – Replaced BS EN 20140: 2

BS 2750: 3not current, cited
Measurement of sound insulation in buildings and of building elements: Laboratory measurement of airborne sound insulation of building elements

BS 2750: 4 C 93 not current, cited

BS EN ISO 140 - 5
Measurement of sound insulation in buildings and of building elements: Field measurements of airborne sound insulation between rooms
BS EN ISO 140 - 5
Measurement of sound insulation in buildings and of building elements: Field measurements of airborne sound insulation of facade elements and facades

BS 2750: 6 C 93 not current, cited

BS EN ISO 140 - 6
Measurement of sound insulation in buildings and of building elements: Laboratory measurements of impact sound insulation of floors

BS 2750: 7 C 93 not current, cited

BS EN ISO 140 - 7
Measurement of sound insulation in buildings and of building elements: Field measurements of impact sound insulation of floors

BS 2750: 8: 1980 C 93 not current, cited
Measurement of sound insulation in buildings and of building elements: Laboratory measu rements of the reduction of transmitted impact noise by floor coverings on a standard floor – Replaced BS EN ISO 140: 8: 1998

BS EN 20140: 9
Measurements of sound insulation in buildings and of building elements: Method for laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it

BS 2911 C 80
Specification for letter plates

BS EN 60335: Part 1
Specification for safety of household and similar electrical appliances: General requirements – See also BS EN 60335

Replace No's below
Specification for convection type space heaters operating with steam or hot water – Replaced BS EN 442 - 1,
BS EN 442 - 2& BS EN 442 - 3

BS 3621
Specification for thief resistant locks

BS 4787: 1 C A3 95
Internal and external wood doors etc, door leaves and frames: Specification for dimensional requirements

BS 4814 A1 95
Specification for expansion vessels using an internal diaphragm, for sealed hot water heating systems

BS 4873
Specification for aluminium alloy windows

BS 4987: 1 A2 94 not current, cited

BS 4987: 1
Coated macadam for roads and other paved areas: Specification for constituent materials and for mixtures

BS 4987: 2 A2 94 not current, cited

BS 4987: 2
Coated macadam for roads and other paved areas: Specification for transport, laying and compaction

BS 5250 C 95
Code of practice for control of condensation in buildings

BS 5262
Code of practice for external renderings

BS 5268: 2 A1 97
Structural use of timber: Code of practice for permissible stress design, materials and workmanship

BS 5268: 3
Structural use of timber: Code of practice for trussed rafter roofs

BS 5268: 4.1 A2 90
Structural use of timber: Fire resistance of timber structures: Recommendations for calculating fire resistance of timber members

BS 5268: 4.2
Structural use of timber: Fire resistance of timber structures: Recommendations for calculating fire resistance of timber stud walls and joisted floor constructions

BS 5268: 5 C 97
Structural use of timber: Code of practice for the preservative treatment of structural timber

BS 5268: 6.1 A1 96
Structural use of timber: Code of practice for timber frame walls: Dwellings not exceeding four storeys

BS 5268: 7.1
Structural use of timber: Recommendations for the calculation basis for span tables: Domestic floor joists

BS 5268: 7.2
Structural use of timber: Recommendations for the calculation basis for span tables: Joists for flat roofs

BS 5268: 7.3
Structural use of timber: Recommendations for the calculation basis for span tables: Ceiling joists

BS 5268: 7.4
Structural use of timber: Recommendations for the calculation basis for span tables: Ceiling binders

BS 5328: 1
Concrete: Guide to specifying concrete

BS 5385: 1
Wall and floor tiling: Code of practice for the design and installation of internal ceramic and natural stone wall tiling and mosaics in normal conditions

BS 5385: 2
Wall and floor tiling: Code of practice for the design and installation of external ceramic wall tiling and mosaics (including terracotta and faience tiles)

BS 5385: 3 A1 92
Wall and floor tiling: Code of practice for the design and installation of ceramic floor tiles and mosaics

BS 5385: 4
Wall and floor tiling: Code of practice for tiling and mosaics in specific conditions

BS 5385: 5
Wall and floor tiling: Code of practice for the design and installation of terrazzo tile and slab, natural stone and composition block floorings

BS 5410: 1 not current, cited
Code of practice for oil firing: Installations up to 44 kW output capacity for space heating and hot water supply purposes

BS 5410: 2 A1 81
Code of practice for oil firing: Installations of 44 kW and above output capacity for space heating, hot water and steam supply purposes

BS 5422
Methods for specifying thermal insulating materials on pipes, ductwork and equipment (in the temperature range - 40˚C to + 700˚C)

BS 5449
Specification for forced circulation hot water central heating systems for domestic premises

BS 5482: 1 A1 97
Domestic butane - and propane - gas – burning installations: Specification for installations at permanent dwellings

BS 5492
Code of practice for internal plastering

BS 5546
Specification for installation of gas hot water supplies for domestic purposes (1st, 2nd and 3rd family gases)

BS 5950: 3.1
Structural use of steelwork in building (limit state): Design in composite construction: Code of practice for design of simple and continuous composite beams

BS 5950: 4
Structural use of steelwork in building (limit state): Code of practice for design of composite slabs with profiled steel sheeting

BS 5950: 5
Structural use of steelwork in building (limit state): For design of cold formed sections

BS 5950: 6
Structural use of steelwork in building: Code of practice for design of light gauge profiled steel sheeting

BS 5950: 7
Structural use of steelwork in building (limit state): For materials and workmanship: cold sections

BS 5950: 8 A1 95
Structural use of steelwork in building (limit state): For fire resistant design

BS 5950: 9 A2 97
Structural use of steelwork in building (limit state): Code of practice for stressed skin design

BS 5980 C A1 97
Specification for adhesives for use with ceramic tiles and mosaics

BS 6150
Code of practice for painting of buildings

BS 6262 A3 94
Code of practice for glazing for buildings

BS 6262: 4
Glazing for buildings: Code of practice for safety. Human impact

BS 6330
Code of practice for reception of sound and television broadcasting

BS 6375: 1
Performance of windows: Classification for weather tightness (including guidance on selection and specification)

BS 6375: 2 A3 96
Performance of windows: Specification for operation and strength characteristics

BS 6400 A1 97
Specification for installation of domestic sized gas meters (2nd and 3rd family gases)

BS 6510 A1 85
Specification for steel windows, sills, window boards and doors

BS 6677: 1 C 97
Clay and calcium silicate pavers for flexible pavements: Specification for pavers

BS 6700
Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages

BS 6717: 1 not current, cited
Precast concrete paving blocks: Specification for paving blocks

BS 6891
Specification for installation of low pressure gas pipework of up to 28 mm (R1) in domestic premises (2nd family gases)

BS 7263: 1
Precast concrete flags, kerbs, channels edgings and quadrants: Specification

BS 7412 A1 94
Specification for plastics windows made from PVC-u extruded hollow profiles

BS EN 514
Specification for white PVC-u extruded hollow profiles with heat welded corner joints for plastics windows: materials type A

BS 7671 A2 97 not current, cited

BS 7671
Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition revised but remains current

BS 8000: 1
Workmanship on building sites: Code of practice for excavation and filling

BS 8000: 2.1 A1 97
Workmanship on building sites: Code of practice for concrete work: Mixing and transporting concrete

BS 8000: 2.2
Workmanship on building sites: Code of practice for concrete work: site work with in situ and precast concrete

BS 8000: 3
Workmanship on building sites: Code of practice for masonry

BS 8000: 4
Workmanship on building sites: Code of practice for waterproofing

BS 8000: 5
Workmanship on building sites: Code of practice for carpentry, joinery and general fixings

BS 8000: 6
Workmanship on building sites: Code of practice for slating and tiling of roofs and claddings

BS 8000: 7
Workmanship on building sites: Code of practice for glazing

BS 8000: 8
Workmanship on building sites: Code of practice for plasterboard partitions and dry linings

BS 8000: 9
Workmanship on building sites: Code of practice for cement / sand floor screeds and concrete floor toppings

BS 8000: 10 A1 96
Workmanship on building sites: Code of practice for plastering and rendering

BS 8000: 11.1 A1 95
Workmanship on building sites: Code of practice for wall and floor tiling

BS 8000: 11.2
Workmanship on building sites: Code of practice for wall and floor tiling: Natural stone tiles

BS 8000: 12
Workmanship on building sites: Code of practice for decorative wall coverings and painting

BS 8000: 13
Workmanship on building sites: Code of practice for above ground drainage and sanitary appliances

BS 8000: 14
Workmanship on building sites: Code of practice for below ground drainage

BS 8000: 15
Workmanship on building sites: Code of practice for hot and cold water services (domestic scale)

BS 8000: 16
Workmanship on building sites: Code of practice for sealing joints in buildings using sealants

BS 8103: 1 A1 95
Structural design of low rise buildings: Code of practice for stability, site investigation, foundations and ground floor slabs for housing
BS 8110: 1
Structural use of concrete: Code of practice for design and construction

BS 8110: 2 A1 89
Structural use of concrete: Code of practice for special circumstances

BS 8110: 3A1 89
Structural use of concrete: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns

BS 8203
Code of practice for installation of resilient floor coverings

BS 8220: 1
Guide for security of buildings against crime: Dwellings

BS 8290 A1 93
Suspended ceilings: Code of practice for design

BS 8290: 2 A1 93
Suspended ceilings: Specification for performance of components and assemblies

BS 8290: 3
Suspended ceilings: Installation and maintenance

BS 8303: 1
Installation of domestic heating and cooking appliances burning solid mineral fuels: Specification for the design of installations

BS EN 772
Methods of testing masonry units

BS EN: 10326
Continuously hot dip zinc coated structural steel strips and sheets of structural steel - Technical delivery conditions.

BS 8214
Fire door assemblies with non-metallic leaves.

BS 3456
Electrical services

BS 8417
Recommendation for the preservation of timber

BS EN599-1
Durability of wood and wood-based products: performance of preventative wood preservatives as determined by biological tests: Part 1: specification according to hazard class.

BS EN 10088-1
Stainless steels. List of stainless steels

BS EN 10088-3
Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wires, sections and bright products of corrosion resisting steels for general purposes.

Material Testing Facilities

Laboratory detail

Celtest Ltd
Cyttir Lane, Bangor, Gwynedd, Wales,
United Kingdom, LL574DA
+44 (0)1248 355269

BSI Product Services
Maylands Avenue, Hemel Hempstead, Hertfordshire,
United Kingdom, HP24SQ
+44 (0) 1442 230442/278535

BRE and LPC Testing
Bucknalls Lane, Garston, Watford,
United Kingdom, WD259XX
44+ (0)1923 664334

Jacobs Babtie Laboratories
Doubleday House, St Michael's Close, Aylesford,
Kent, United Kingdom, ME207BU
+44 (0) 1622 605 881

CERAM
(CERAM Research Limited), Queens Road, Penkhull,
Stoke-on-Trent, Staffordshire, United Kingdom, ST47LQ
+44 (0)1782 764444

Lafarge Roofing Technical Centers Ltd
Sussex Manor Business Park, Gatwick Road, Crawley,
West Sussex, United Kingdom, RH109NZ
+44 (0) 1293-618418

Sandberg LLP
5 Carpenters Place, Clapham High Street, London,
United Kingdom, SW47TD
+44 (0)20 7565 7000

STATS Ltd
Porterswood House, Porters Wood, St Albans,
Hertfordshire, United Kingdom, AL36PQ
+44 (0) 1727 833 261

British Board of Agrement
PO Box 195, Bucknalls Lane, Garston, Watford,
Hertforshire, United Kingdom, WD259BA
+44 (0)1923 665300

Stanger Testing Services Ltd
Cambuslang Laboratory, Bogeshole Road, Cambuslang,
Glasgow, United Kingdom, G727DD
+44 (0) 141 641 3623

Stanger Testing Services
A member of the Stanger Testing Services Ltd Group
Ardownie Quarry, Monifieth, Dundee, DD5 4HW
+44 (0)1382 532272

Stanger Testing Services
A member of the Stanger Testing Services Ltd Group
c/o Geddes Quarry, Waulkmill Quarry,
Inverkeilor, Arbroath
+44 (0)1241 830346