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F10

Brick/Block walling

This guide provides an introduction to writing specifications for masonry walling and should be read in conjunction with the guide Introduction to Writing Architectural Specifications. Together these guides provide an in depth reference for the development of specifications based on a simple framework that can be applied to projects of all sizes.

Contents

This guidance note covers the prescriptive specification of brick and block masonry. Reference should be made to the following sections for the specification of repair works to existing masonry and glass block walling:

- C41 Repairing/Renovating/Conserving masonry.
- F11 Glass Block Walling.

Masonry accessories and sundry items are specified in Work Section F30 Accessories/Sundry items for brick/block/stone walling.

Design Considerations

Masonry comprises a combination of masonry units bonded together with mortar. The overall performance and appearance of masonry is dependent upon the specification of both these elements which must satisfy the specific requirements of the project.

Project requirements include aesthetic and functional criteria as well budget; design life; time and environmental considerations. Once these requirements are established the key characteristics and associated levels of performance required for the masonry and its constituent components can be identified.

The selection of products and materials should be undertaken in consultation with product manufacturers and with reference to relevant British Standards, Statutory Regulations and current best practice.

Masonry Units

Aesthetics Characteristics

The appearance of masonry is determined by the aesthetic properties of the selected masonry unit and mortar colour together with the type of bond and mortar joint used. Characteristics that impact on the appearance of masonry units include:

- Method of manufacture (i.e. hand/machine made)
- Dimensions
- Finish
- Colour
- Surface Texture
- Bond

Compressive Strength

The compressive strength of masonry construction is determined its resistance to vertical load, the thickness of the masonry and any allowances that need to be made for the effects of slenderness and eccentricity of loading.

The compressive strength of the masonry unit must equal or exceed that specified for the wall. Since the declared compressive strength for masonry units is an average value, the probability of units reaching their declared compressive strength should also be checked.

Durability

The principal characteristics that determine the durability of masonry units are:

- **Freeze/Thaw Resistance**: The ability of a unit to withstand saturation and any associated freeze thaw action that may cause damage to the unit itself.
- **Active Soluble Salt Content:** The content of soluble salts within each unit based on percentage of mass.

The level of performance required for each characteristic will depend upon the unit's intended use, final location, environment and the desired design life.

Dry Density/Unit Weight

The dry density, and thereby the mass, of a masonry unit is an key characteristic in establishing acoustic performance and the ease of handling.

Acoustic Performance

The acoustic performance of masonry is primarily determined by the mass of components and the degree of isolation between them. The unit density required will depend upon the specification and design of the whole wall and the level of acoustic performance it must achieve.

Health & Safety

Health & Safety Executive (HSE) Construction sheet 37 'Handling Building Blocks' advises that:

- There is risk of injury in the single-handed repetitive manual handling of blocks heavier than 20kg
- Units of greater than 20kg should be handled mechanically or using a two person team.

The guidance does not prevent an individual handling manually small numbers of units of greater than 20kg, e.g. quoins or reveals. The specification of blocks greater than 20kg is however best avoided.

Thermal/Moisture Expansion

To accommodate the expansion/movement of masonry units, movement joints need to be provided at regular intervals. The frequency and location of joints is governed by the level of expansion the unit undergoes due to changes in its temperature and, or, moisture content. Expansion is measured as a percentage of unit length.

Where specific aesthetic requirements exist for the provision and location of expansion joints the expansion characteristics of the masonry unit will need to be determined.

Thermal Conductivity

The thermal performance of a wall is determined by the thermal properties of its constituent parts and the degree of isolation between them.

The requisite thermal performance of the masonry unit will depend upon the required performance of the whole construction, its design and the performance of other elements.

Water Absorption Rate

The rate at which a masonry unit absorbs water can impact on the selection or mortar and the method of laying units. Where this may be of concern units the appropriate rate of absorption should be specified.

Types of Unit

The main types of masonry units available within the UK are:

- Clay Bricks.
- Calcium Silicate Bricks.
- Concrete Blocks/Bricks (common/facing/paint grade).
- Stone faced Blocks.
- Reconstituted Stone Blocks.
- Unfired Clay Bricks.

British Standards

BS EN 771, a multipart standard, specifies the characteristics and performance requirements for different types of masonry units.

To comply with BS EN 771 manufacturers must declare the performance of their products against a given range of characteristics. Compliance with the standard does not however imply any specific level of performance. By ensuring that masonry units are tested and reported in a consistent manner the Standard enables the like for like comparison of products.

BS EN 771 requires certain performance characteristics to be declared with reference to a defined classification system. This allows the level of performance achieved and, or, the suitability of the product for a given situation to be declared in an easily referenced and understood way.

The range of performance classifications used varies for each type of masonry unit. The principal and most referenced performance classifications for masonry units include:

Freeze/Thaw Resistance

Brick units are classified in accordance with their ability to withstand varying degrees of exposure:

- F0: Passive Exposure (i.e. only used for protected or internal walling).
- F1: Moderate Exposure (i.e. where units will not remain saturated).
- F2: Severe Exposure (i.e. frost resistant in all normal building situations).

No standard approach to the reporting of freeze/thaw resistance is available for block units and as a result the method of reporting may vary between manufacturers.

Active Soluble Salt Content (brick units only)

Units are classified in accordance with their ability to withstand varying degrees of saturation:

- S0: subject to prolonged saturation.
- S1: normal exposure.
- S2: completely protected (i.e. internal, rendered or clad).

Compressive Strength

The minimum compressive strength of a masonry unit should be provided by the Manufacturer measured in N/mm^2.

Units are further categorised by their probability of reaching the declared compressive strength.

- Class I: probability strength < 5%.
- Class II: probability strength > 5%.

Dimensional Tolerance

The method of measuring and reporting dimensional tolerance varies depending on the type of unit being considered. The methods for measuring and categorising each type of unit are set out within BS EN 771 parts 1 to 6.

Where the dimensional accuracy of units is important (e.g. in thin joint masonry construction) reference can be made to the appropriate standard. Alternatively dimensional tolerances (i.e. actual results and not the general classification) may be requested from the manufacturer.

Engineering Bricks

With a high compressive strength and low water absorption, engineering bricks are supplied in two classifications:

- Class A: 70 N/mm^2 compressive strength.
  4.5% max water absorption.
- Class B: 50 N/mm^2 compressive strength.
  7% max water absorption.

They are suitable for applications such as retaining walls or for ground works. They are also frequently used for copings and other features that are subject to saturation. It should be noted that predominantly engineering bricks are not manufactured to give a uniform appearance.

Special Units

Special units can be specified using the specials shape referencing system defined within BS 4729. This referencing system is commonly used by brick manufacturers for 'standard' specials and referencing details can by found within websites of major manufacturers. Bespoke brick shapes not covered by BS 4729 will need to be specified in conjunction with supporting drawings.

The properties of special shape units are often different from those of standard units. Special shape units are also frequently used in exposed locations, i.e. increased exposure to saturation and freezing when used to form copings, plinths, cills, etc. The suitability of special shape units must therefore be checked with the manufacturer.

Before specifying specials their availability should also be confirmed. This is because some manufacturers will not be able to offer all the special shapes defined within BS 4729. This may be because the properties of the unit mean certain shapes are not practical or due to limitations of the manufacturing process. Where specials are available, it is recommended that potential delivery periods are checked since specials are frequently only made to order and delivery times can be long.

Whether standard or bespoke specials are specified sufficient information needs to be provided within the Contract Documentation for the Contractor to calculate required quantities. This is especially important where specials are made to order or have long lead-in times.

Types of Mortar

Cement Mortars

Cement Mortars are made with sand using cement as the binder. Lime and air entraining plasticizers can also be added to improve the working qualities, water retention and adhesion of the mortar. Types of cement mortar are:

- Cement:sand: uses cement and sand to provide a strong and durable mortar.
- Cement:lime:sand: this type of mortar uses non-hydraulic lime to improve working qualities, water retention and adhesion. Mortar strength is weaker with this mix.
- Air-entrained cement:sand: plasticisers are used to entrain air into the mix, as an alternative to lime, to improve working qualities. Plasticisers do however reduce the strength of mortar.
- Air-entrained cement:lime:sand: plasticisers are used to entrain air into the mix, in addition to lime, to improve working qualities. The strength of these mortars is again weaker .

Lime Mortars

Lime Mortars are made with sand using lime as the binder. Two different types of lime can be used:

- Non-Hydraulic Lime Mortars: sets by reaction with atmospheric carbon dioxide. These mortars take a long time to set and do not adhere as strongly to masonry units. This is advantageous in construction using soft masonry units or where minor movement may occur (typically in historic buildings).
- Hydraulic Lime Mortars: sets by reaction with water. These mortars set quicker than Non-Hydraulic Lime mortars and are stronger, although not as strong as cement:sand mortars.

The most appropriate mortar type and mix proportions will depend on the location, type of masonry unit used, permissible construction period and structural requirements.

The decision on how mortar is to be supplied is normally left to the Contactor. Where coloured mortar is required it may be advantageous to stipulate the manufacturer, method of supply and product used. This is due to the greater accuracy and colour consistency that can be achieved by factory made mortar when compared to site mixed mortars.

Selection of Masonry Units & Mortar

The higher the cement content in a mortar the higher its strength. High cement content however tends to result in higher shrinkage and a more rigid mortar. As a result where the strength of mortar is greater than that of the masonry unit there is a risk of:

- delamination occurring between the mortar and unit on the bond line.
- the mortar forcing cracks through the masonry units as it shrinks, resulting in a vertical crack forming through the masonry construction.

Because vertical cracks are difficult to repair it is better to use mortar that is of a lower strength than the masonry unit. Any shrinkage and resultant cracking will then occur within the mortar bed, which can be easily repair by re-pointing the affected joints. Therefore the compressive strength of mortar must not exceed that of the masonry unit being used.

The impact of mortar strength on the overall strength of masonry is not proportional. Research indicates that the strength of masonry only increases by about 10% when mortar compressive strength increases by 130%.

The strength of mortar does impact on its durability, its resistant to damage by freezing and soluble salts when saturated. A reduction in the proportion of cement within the mortar mix while increasing workability, reduces strength, brittleness and the durability of the mortar.

Because of their greater resistance to soluble salts there is a tendency to use stronger, more durable mortars with bricks that have a higher soluble salt content. Likewise where masonry is exposed and more prone to saturation a stronger mortar will provide greater resistance to freezing.

A guide to the selection of suitable masonry units and mortar mixes for different locations and uses is provided within the Concrete Centre's guide 1. *Introduction to Eurocode 6, Table 6: Selection of masonry units and mortar for various exposure conditions* (refer to list of references at rear of this guide).

Jointing

The type of joint specified for masonry should take into consideration:

- Aesthetic: the appearance of jointing and the overall appearance of the masonry.
- Exposure: the requirement to enhance the weathering characteristics of the mortar, e.g. struck or bucket handle joint to aid the shedding of water.
- Application of render/plaster or pointing: the requirement for joints to be raked out in order to provide a key for render/plaster or to allow the joint to be pointed, e.g. where a coloured mortar finish is required but is not used for the jointing.

Movement Joints

Un-mortared movement control joints are needed to accommodate the expansion and shrinkage of masonry due to changes in moisture content and temperature. Movement control joints may be required:

- Within long runs of masonry.
- Where changes in wall height and thickness occur.
- At abutments with other forms of construction e.g. steelwork and reinforced concrete.
- Where intersections with other walls and partitions occur.
- At return angles in L, T and U shaped masonry.
- Adjacent chases/recesses for piping, pilasters, fixtures, etc.
- One or both sides of some large wall openings, e.g. windows, louvres or doors (the provision of localised bed-joint reinforcement above and below openings may be used in some instances to eliminate the need for control joints).
- Structural movement joints which must be continued through the wall construction.

Movement joints will not normally be required for masonry located below DPC level. This is because in this location masonry will typically enjoy relatively constant moisture content and temperature.

Within long runs of masonry the spacing at which expansion joints need to be provided to accommodate thermal expansion is dependent upon the type of masonry unit used. It is therefore recommended that spacing requirements are confirmed with the unit manufacturer. Where this information is not available BS EN 1996 sets out the following guidelines on the maximum spacing of movement control joints for different forms of masonry construction:

- Clay masonry – unreinforced 15m
- Calcium silicate masonry 9m
- Aggregate concrete 9m
- Manufactured stone masonry 9m
- Autoclaved aerated concrete masonry 9m

BS EN 1996 also sets out the following requirement that must be observed:

- Distances should be reduced for long horizontal panels of masonry where the ratio, length to height of panel, is 3 to 1 or less. This does not apply to clay masonry.
- Movement joints should be 50% of the normal joint spacing away from an internal or external angle.
- Movement joints within free standing walls should also be at 50% of the normal joint spacing.

Specification Guidance

Form of Specification

The specification of masonry will normally be prescriptive in nature, even where the Contractor is responsible for the design of the works under the Contract terms. This is because the Designer will generally wish to control the appearance and performance of masonry to a level where the benefits of a performance specification are negated.

Where the Contractor is simply required to match existing masonry construction or where only common brickwork or blockwork is required then a performance based specification may be appropriate, subject to the provisions of the Contract.

This guide covers the prescriptive specification of brick and block masonry only.

Scope

The Scope provides a brief description of the works specified within the particular section and details any contractual matters that are relevant to them. Care should be taken to avoid repeating particulars already included within the Contract Preliminaries.

Scope of Specification

To help the reader quickly understand which elements of the works are covered in this Works Section it is useful to provide a brief description of items specified, e.g. *facing brickwork to external walls.*

Form of Specification

State whether the specification is performance based or prescriptive together with any contractual requirements or information that relate to the Works Section. Do not include any requirements or information already set out within the Contract Preliminaries.

Where the specification is prescriptive in nature requirements placed on the Contractor may include:

- The selection, supply and incorporation into the works of all listed accessories and sundry items in conjunction with the manufacturer's recommendations.
- The selection, supply and use of all minor items as recommended by the manufacturer for the installation of specified materials and products.
- The preparation of fabrication/setting out drawings prior ordering of materials to ensure the correct interpretation of the prescribed design, e.g. pre-fabricated masonry units.

It is usual for the terms of a contract or the Contract Preliminaries to state that the Contractor may offer equivalent and, or, substitute products. Where this is not applicable to all Works Sections an appropriate statement must be provided.

Execution of the Works

Any general requirements or information relating to the execution of masonry works which are not contained within the Contract Preliminaries should be listed. These might comprise:

Reference Documents

A list of all instructions, guidance and standards concerning handling, storage, installation and maintenance of materials that the Contractor is to comply with while executing the works must be given. This may include:

- Installation instructions and recommendations provided by the manufacturer(s) of specified masonry units and mortar.
- British Standards, *e.g. BS 8000-3:2001 Workmanship on building sites. Code of practice for masonry and, or, NHBC Standards.*
- Workmanship clauses provided within the Specification.

In some circumstances conflicts might exist between the requirements set out within the documents listed. A statement should be included that sets out which documents take precedence or confirms whether compliance with the most or least onerous condition is required.

Dimensions

Construction tolerances and the imperfect nature of existing works mean that dimensions provided within the Contract Documents may not reflect final built dimensions. It is therefore advisable to require that the Contractor confirms the actual site dimensions before setting out and laying masonry.

Product

Within prescriptive specifications the Contractor needs sufficient information to:

- Gain a clear and full understanding of the required works.
- Price the works.
- Order all materials, products and systems required in the execution of the works.

The level and type of product information provided will vary depending on the scope of the project, the type of contract and the nature of the works.

The different forms of masonry construction that might be specified within this Works Section can be grouped by type of masonry unit, *e.g. Clay Facing Brickwork.*

Masonry construction comprises two principal components, masonry units and mortar, plus associated accessories or sundry items. Both the masonry unit and mortar should be specified within each clause. The information required to specify each type of masonry construction is broadly similar.

Masonry Units

- Manufacturer: Name of manufacturer, website and telephone number.
- Reference: Product/system reference name and, or, code.
- Size: Provide dimensions of masonry units in millimetres.
- Specials: Where specials are to be utilised it is recommended that each one is identified on a separate line referencing any associated setting out drawings or specification clauses.
- Bond: Name of bond to be used, *e.g. Stretcher, Flemish.*

Where masonry comprises more than one type of masonry unit (e.g. where features are emphasised by use of a secondary unit) these units can be specified in two ways:

- Provide a separate clause for each type of masonry unit with a description indicating where units are to be used, *e.g. all soldier courses.*
- Add additional reference for feature units stating location to be used within the same clause as the principal masonry unit, *e.g. Motley Red generally, Motley grey to soldier courses.*

The second method is only appropriate where the feature unit is used in limited locations and is supplied by the same manufacturer as the principal unit.

Mortar

Mortar is an integral part of the construction and should be specified together with the masonry unit. Mortar can be specified by manufacturer if this is desired. Generally just the mortar classification is specified together with the location of where it is to be used:

- Manufacturer: Name of manufacturer, website and telephone number.
- Reference: Reference.
- Mortar Class: *e.g. M4 generally, M6 to parapets.*
- Mortar Colour: *e.g. white/grey/black.*
- Mortar Joint: *e.g. flush, bucket handle, raked to receive render.*

Accessories/Related Components

Accessories and sundry items for masonry should be specified within Works Section F30. Related components that are neither accessories or standard units may however be required. Examples include pre-fabricated units which are manufacturer using the specified brick, e.g. prefabricated chimney units or arches.

These can be specified in two ways:

- Prefabricated Units: reference F10.4100 Pre-Fabricated End Gable Chimney.
- Prefabricated Units: Pre-Fabricated End Gable Chimney Reference XXXX.

The last option is suitable where only a reference is required and, or, the final selection of the product can be undertaken by the unit manufacturer. The first option is suitable where additional information needs to be provided, e.g. dimensions, .

Additional Information

Additional descriptive or performance related information can be provided where it is felt that this will aid the Contractor in understanding the scope of works, how they are to be achieved and the required level of workmanship. Examples include:

- Location: Depending upon the scope and size of the project, the Specifier may wish to indicate the location of specified masonry, *e.g. below DPC level.*
- Density/Weight: Where masonry units weigh 20kg or more it is important that this is highlighted so that the Contractor can establish, and price for, a safe system of work before block-laying commences.
- Thermal Performance: Where Building Consent is to be obtained by the Contractor or the Contractor may wish to propose alternative materials/construction, it can be helpful to include information relating to the thermal performance of specified masonry units.

Where additional information is provided it should be grouped together with the relevant item or clause.

Accessories

Where related components are specified in detail all information required by the Contractor to order the correct materials or products must be given.

Check with the manufacturer of the principal materials, products and system to ensure that the selected components are compatible with other systems. Information to be provided includes:

- Manufacturer: Name of manufacturer, website and telephone number.
- Reference: Product/system reference name and, or, code.
- Brick: For prefabricated units fully specify brick or reference the appropriate clause, *e.g. as Clause F10.3100.*
- Mortar: For prefabricated units fully specify mortar or reference the appropriate clause, *e.g. as Clause F10.3100.*
- Fixing: Where a specific method of fixing is required that differs from the manufacturer's recommendations this should be stated.

Workmanship

Additional requirements relating to the installation of specified materials and products can be provided within Workmanship Clauses. Requirements may relate to:

- Scope of works, e.g. frequency of movement joints.
- Additional design information, e.g. setting out information, joint widths, etc.
- Quality control, e.g. permissible tolerances, discarding non-compliant materials.
- Method of working, e.g. sequencing of works.

In the majority of instances the instructions and guidance provided by the manufacturer and BS 8000 Part 3 will be sufficient to enable the Contractor to undertake the work to a high standard. Additional requirements may be included that expand upon, alter, confirm or emphasise requirements already outlined within the reference documents (e.g. where work needs to be undertaken to an historic building in a particular manner).

Where workmanship clauses stipulate the method of working to be employed by the Contractor, check with the relevant manufacturer that any instructions given will not reduce the performance of the material, product or system in question.

Condition of Masonry Units

To ensure the aesthetic quality of masonry and its performance, masonry units that are cracked, damaged or contaminated brick/blocks should not used. State that the Contractor must check all units and discard any that do not met the required standard.

Where handmade or second hand masonry units are used it is recommended that a sample unit or sample panel is requested. Once approved this can act as a record of what is deemed acceptable in terms of masonry unit quality and the nature of imperfections. Where a sample is not requested a definition of quality and the term 'imperfection' must be included to allow the objective assessment of masonry units, *e.g. no chips greater than 5mm diameter.*

Colour Consistency of Masonry Units

For facing masonry it is important to check that units are of a consistent nature and are appropriately mixed prior to laying in order to avoid patches, horizontal stripping and racking back marks.

To help achieve a uniform appearance require the Contractor to:

- Check batches of masonry units for consistency and compare them with approved samples or sample panels.
- When laying units, take units from a minimum of three packs and in a vertical manner, from top to bottom of the pack.

Storage of Masonry Units

Units must be stored correctly upon delivery to site and prior to use to avoid:

- Physical damage to the bricks.
- Contamination (e.g. with oils, paints, etc) that may effect the performance or appearance of the brick.
- Rain and excessive moisture that might cause the leaching of soluble salts.
- Splashes that may result in cause staining to the face of masonry units.

Because of the difficulty of addressing any issues that arise once the masonry has been constructed it is recommended that the specification instructs the Contractor to:

- Store masonry units appropriately, i.e. within original packaging and off the ground.
- Once packaging is removed, cover units with waterproof sheeting, that allows air movement underneath.

Additional precautions should be taken for masonry units susceptible to damage, i.e. stacking of pallets or individual units not to be permitted.

Protection of Masonry

Completed masonry needs to be protected against accidental damaged during the completion of remaining works, with particular reference to arrises of opening and corners.

Protection may also be needed to new areas of masonry until the mortar has matured. In wet conditions new masonry will need to be protected to prevent:

- Soluble salts present in bricks and mortars being washed out on to the surface of the wall by excess water.
- Soluble lime (produced during the hydration of Portland cement) from being washed on to the surface of the wall by the movement of rainwater through freshly set and hardened mortar.

This is particularly important in low temperatures where mortar takes a longer period to set sufficiently to withstand wet conditions and potential frosts.

In hot conditions or drying winds masonry also needs to be covered to prevent mortar drying out to quickly, thereby removing the water needed for the mortar to set properly.

Note that soluble salts left behind on walls (efflorescence) remain soluble and will generally wash off naturally over time. Soluble limes however react with the air to form an insoluble white crystalline solid that requires removal with dilute acid to restore the good appearance of brickwork. It is therefore important that measures are taken to protect new masonry and minimise the risk of staining to facework.

Instruct the Contractor to cover newly completed works and undertaken other protective measures to prevent masonry becoming saturated or contaminated, *e.g. require that scaffold boards adjacent to masonry are turned up so that rain does not splash on to the walls.*

Setting Out

The Contract Drawings should detail the setting out of masonry. In conjunction with the general guidance provided within BS 8000 Part 3 additional guidance can be given to ensure that a high standard of workmanship is achieved.

General Requirements

Where masonry is to be constructed abutting or between two existing (or newly constructed) points site dimensions may vary from those indicated within the Contract Drawings. So bond patterns are maintained the Contractor may need to adjust the setting out of units within stated tolerances and joint widths. Where this is not practical the Contractor should be required to notify the Employer's Agent.

To ensure that lintels have adequate bearings state that the Contractor must set out units ensuring that full-length units occur below lintel ends. Also require that other components and other built-in elements are successfully incorporated.

Coursing

Where the construction comprises brick/block of varying sizes between adjacent leaves it is important that courses are level where wall ties, lintels, all plates, bonding courses and other components that span between the leaves of cavity walls occur. It may be advantageous to highlight this requirement when non standard units or units with poor dimensional consistency are utilised, e.g. second hand bricks.

Where new masonry is erected adjacent existing masonry, the coursing of the new masonry must align with that of the existing. As well as for aesthetic reasons this allows starter ties to be fixed into existing mortar beds.

Incorporation of Components

Components should be incorporated into the works so that they the are level, plumb and located accurately within the correct position. State any requirements relating to the incorporation of special items or components, *e.g. Where components are to be placed on a full bed of mortar of no greater depth than that of the surrounding work use of brick slips/slate to make up coursing where necessary.*

Bonding Units

Where new and existing facework lying in the same or different planes are to be bonded together state the method of bonding:

- Straight and vertical.
- Bonded together at every course.
- Formed by bonding new masonry pockets cut into the existing masonry.

Where new masonry is to be bonded into the existing masonry confirm the method and setting out of bonding including:

- Depth of pockets to be cut into existing masonry, e.g. full thickness of the wall.
- Vertical height of pockets, e.g. 3 courses vertically.
- Centres of pockets, e.g. every other block course.

Cutting Units

Cut units that are incorrectly sized or left with uneven faces are likely to result in mortar joints that are of an inconsistent width, outside permissible tolerances. It is therefore recommended that the Contractor is instructed to only cut masonry units using a masonry saw.

Some types of masonry unit, e.g. glazed units, should not be cut on site due to the damaged caused to the face of the unit. Advise the Contractor accordingly and specify the appropriate special shapes.

Where special shapes are specified state that these are to be supplied by the manufacturer and the cutting of standard units by the Contractor to form required shapes will not be permitted.

Laying Units

To ensure the quality of facework it may be necessary/ advisable to stipulate the method by which units are to be laid. Examples include:

- Where facework will be visible overhand laying should not be permitted. Where unavoidable, it is recommended that a sample area is provided by the Contractor for approval upon commencement of the works.
- Where handmade bricks are specified, instruct the Contractor to lay units in a consistent manner with the lowest point of creases to brick faces laid at bottom of the brick to aid the shedding of water.
- When working with glazed or stone face bricks it is important that care is taken to ensure faces do not become chipped or scratched. Advise the Contractor not to level units using the edge of the trowel for levelling and that additional care must be taken when moving, stacking and laying units.
- Where frog bricks are used the structural strength of the masonry needs to be maintained. To achieve this all frogs must be fully filled with mortar. Instruct the Contractor to lay units with frog uppermost and fully fill with mortar. Where double frog bricks are used the deeper frog must be uppermost.
- Over-stressing of new mortar beds before they have had time to develop sufficient strength must be avoided. To prevent this masonry work should not rise by more that 1.5m in a day. Where a lightweight unit is used a rise of more than 1.5m may be permissible and conversely where dense units are used lifts may need to be restricted to lower than 1.5m per day.

  Advise the Contractor of specific requirements following, where appropriate, consultation with the unit manufacturer.
- Masonry units that have a high rate of water absorption, if not treated properly, can pull the water out of the mortar preventing complete hydration. This can impact on the ability of the mortar to set correctly resulting in a mortar with low adhesion, of lower strength and decreased workability.

  Where masonry units with a high absorption rate (i.e. greater than 12%) special measures may need to be taken either in the method of laying (i.e. the wetting of bricks in clean potable water before laying) or the use of a modified mortar mix.

Joints

The quality of joints formed within masonry can have a significant impact on its overall aesthetic quality as well as its ability to resist weathering.

Require the Contractor to finish joints to the specified profile as the works proceeds ensuring a regular and consistent profile is achieved. Once the initial set of the mortar has occurred the Contractor must also remove any remaining feathers of mortar and laitance. Where appropriate additional requirements may be stated, *e.g. the requirement to stipple/tamp joints with the brush to achieve a course texture to the mortar.*

Where masonry is to receive a render or plaster finish, joints need to be raked out in order to provide a suitable key for the render/plaster. The Contractor should be instructed to rake out joints as work progresses, and before the mortar hardens, to a depth of approximately 10mm. Care must be taken so that bricks are not damaged.

Movement Joints

Movement joints must pass through the full thickness of the wall and be filled with a soft, compressible material and then sealed against water penetration.

The quality of masonry construction either side of movement control joints needs to be high if adequate movement is to be accommodated and a suitable seal across joints achieved. State that the Contractor is to:

- Keep movement joints free from mortar.
- Make sure the brick face against movement joint has properly filled joints.
- Keep the joint vertical and or a constant width.
- Align mortar beds either side of joints.
- Ensure joints are of adequate size, i.e. joint width in millimetres equals the joint spacing in metres plus 30%.

Pointing

In some instances new masonry will need pointing, e.g. where a colour mortar finish is specified but not used to form jointing or remedial works are required.

Prior to pointing new masonry the jointing must be completed in accordance with the specification before they are raked out to a given depth, typically 10mm. Care must be taken so that existing masonry units are not damaged. Joints then need to be cleaned in order to remove any loose material and dust before lightly wetting the existing mortar and then pointing with new mortar.

Set out requirements and highlight the need for the Contractor to ensure that joints are to the specified profile and are regular and consistent in nature.

Supporting Masonry

Where new masonry will provide structural support to existing masonry or soffits it is important that the top joint is suitably filled. If the top joint is poorly filled then masonry above or soffits may drop.

Instruct the Contractor to fill the top joint with mortar that is consolidated by ramming, and temporary shuttering is provided to ensure mortar is not displaced during consolidation.

Forming Openings

To avoid damage to units and achieve adequate tolerances windows, doors, etc should not be built in. Instead rigid templates must be used to form openings that are dimensionally accurate and allow for required tolerances around frames once fitted. Failure to provide adequate tolerances may result in a tight fit between materials leaving insufficient room for movement and expansion, risking distortion to window and door frames.

State that frames are not to be built in and require the use of suitable templates.

Adverse Weather

If water in the mortar freezes it expands. This disrupts the bond between the masonry unit and mortar leading to a weaker bond and causes cracks to appear in joints as ice crystals melt. Frost also leads to a weaker more porous mortar that is susceptible to flaking. Similarly if surfaces that the mortar will be placed on are at or below freezing the mortar bed will immediately freeze upon application and no bond with form.

To ensure the mortar suitably bonds to masonry units and its performance is not impaired state that masonry works are to be only undertaken when:

- The surface temperature of masonry or concrete onto which new work is to be placed surface is above freezing.
- The air temperature is above 3^{o} C and there is no risk of frost, i.e. the air temperature is rising.

For proprietary mortars and hydraulic lime mortars the minimum recommended temperature for laying masonry may be higher. Acceptable conditions must therefore be confirmed with the mortar manufacturer.

Air-entraining admixtures can be used to improve the performance of mortar in low temperature conditions. Admixtures however reduce the strength of mortar and affect the bond achieved. Because of this it is recommended that the Contractor is advised admixtures are not to be used unless otherwise approved.

In the event that any frost damage does occur to the mortar once laid remedial works maybe required, the scope of which will be dependent upon the extent of any damage. State that the Contractor will be responsible for undertaking any necessary remedial works including:

- Where damage is significant, rebuilding of affected areas.
- Where damage is limited, raking out of joints to a depth of 12-15mm before re-pointing joints from the top of the wall downwards.

Tolerances

Construction tolerances for masonry and stonework are provided within BS 8000 Part 3. These requirements are intended to ensure the structural integrity and not the visual appearance of the works. The NHBC (National House Building Council) Standards, *Chapter 1.2 A consistent approach to finishes*, provide an alternative set of construction tolerances. Both standards vary slightly in scope with the NHBC Standards generally requiring a slightly higher standard of workmanship.

The need for the completed works to be undertaken in accordance with either or both standards must be stated within the Scope of the Specification for the Works Section. Where alternative or additional construction tolerances are to be met then these should be set out.

Samples, Tests, Certificates, etc

The following guidance should be read in conjunction with the guidance provided for Samples, Tests, Certificates, etc within Specright's Introduction to writing Architectural Specifications.

Samples

Where the specification is prescriptive in nature it is recommended that units and mortar are reviewed prior to writing the specification. Where aesthetics are particularly important samples of any coloured grout, expansion joints, trims and other accessories should also be reviewed.

Samples that may be requested include:

- Product Samples: Generally required where the specification is prescriptive in nature and there is a need to agree or check the aesthetic quality of proposed masonry units, e.g. to agree level of permissible imperfections in second hand bricks.
- Sample Panel: Sample panels provide the opportunity to establish the quality of workmanship prior to the commencement of works; quality of masonry units, including permissible level of colour variation and confirm the incorporation/setting out of common features, special shapes and components.
- Sample Area: A sample area may be suitable where a sample panel is not requested but a benchmark for the quality of workmanship throughout the project is required.

In accordance with PAS 70: Guide to Appearance and Site Measured Dimensions and Tolerance sample panels and sample areas should be viewed from a distance of 3m when assessing quality or workmanship and compliance with sample panels/areas within the final works.

Sample areas and panels may also incorporate items specified within Work Section *F30 Accessories/Sundry items for brick/ block/stone walling.* State any requirement together with appropriate clause references.

Mortar Strength Test

The requirement for testing and the most appropriate testing regime will depend upon the nature of the works, their duration and method by which mortar is supplied/produced.

The limitations of testing mortar include:

- Where mortar is mixed on site by hand or machine the quality of mortar will be dependent upon the quality of mixing. Even where this is high minor variations between batches are likely to exist.
- For small projects or where the quantity of masonry is limited it is probable that masonry works will be completed before initial test results are available.

Where on site mixing is undertaken by the Contractor and the scope of works is limited it is recommended that the mixing process employed be observed to ensure that proportions are measured and mixed correctly.

For structural masonry and other instances where the final compressive strength of the mortar is important instruct the Contractor to under take the sampling and testing of mortar (Where a Structural Engineer forms part of the Design Team it is recommended that advise is sought on the requirements for the testing of mortar and appropriate testing regime). The purpose of testing is to confirm that:

- That mortar mix used on site is correct and complies with the requirements of the specification.
- Where plastisers are used within the mortar mix compressive strengths are maintained in accordance with the requirements of the specification.

How mortar samples are taken and subsequently handled can impact upon the outcome of any testing. Samples must therefore be handled correctly and in a consistent manner. BS 4551 sets out detailed procedures for the taking and handing of mortar samples together with the methodology for determining its compressive strength.

Where mortar testing is required, state that the Contractor is to undertake this in strict accordance with BS 4551 together with the following requirements:

- Frequency of sampling, e.g. for each mortar/wall type and, or, every storey.
- Number of cubes per sample, e.g. 6 cubes per sample.
- Testing regime, e.g. 3 No. cubes at 7 and 28 days respectively.
- Results to be achieved, e.g. state compressive strength of specified mortar (N/mm^2).

Confirm any requirement for the reporting of test results together with action to be undertaken where specified compressive strengths are not achieved.

Note that BS 4551 is not applicable for mortars containing high alumina cement or mortars whose principle binder is hydraulic lime. Where hydraulic lime mortars are specified mortar testing should be undertaken in accordance with BS EN 1015-11.

Standards & References

Design & Workmanship

BS EN 1996-1-1	Eurocode 6. Design of masonry structures. General rules for reinforced and unreinforced masonry structures
BS EN 1996-1-2	Eurocode 6. Design of masonry structures. General rules. Structural fire design
BS EN 1996-2	Eurocode 6. Design of masonry structures. Design considerations, selection of materials and execution of masonry
BS EN 1996-3	Eurocode 6. Design of masonry structures. Simplified calculation methods for unreinforced masonry structures
PD 6697	Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996-2
BS 8103-2	Structural design of low rise buildings. Code of practice for masonry walls for housing
BS 8000-3	Workmanship on building sites. Code of practice for masonry

Masonry Units

BS EN 771-1	Specification for masonry units. Clay masonry units
BS EN 771-2	Specification for masonry units. Calcium silicate masonry units
BS EN 771-3	Specification for masonry units. Aggregate concrete masonry units (dense and lightweight aggregates)
BS EN 771-5	Specification for masonry units. Manufactured stone masonry units
BS EN 771-6	Specification for masonry units. Natural stone masonry units
BS EN 772 Parts 1 - 21	Methods of test for masonry units
BS 4729	Clay and calcium silicate bricks of special shapes and sizes.

Mortar

BS EN 998-2	Specification for mortar for masonry. Masonry mortar
PD 6678	Guide to the selection and specification of masonry mortar
BS 4551+A1	Mortar. Methods of test for mortar. Chemical analysis and physical testing
BS EN 1015-11	Methods of test for mortar for masonry. Determination of flexural and compressive strength of hardened mortar

Useful References

Introduction to Eurocode 6 publish by The Concrete Centre

(http://www.brick.org.uk/2011/03/introduction-to-eurocode-6/)

NHBC Standards Chapter 1.2 A consistent approach to finishes

(http://www.nhbc.co.uk/NHBCpublications/LiteratureLibrary/Technical/filedownload,15912,en.pdf)

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