



# TECHNICAL MANUAL

VERSION 11

**20: TOLERANCES**

# 20. Tolerances

## Contents

- Functional Requirements
- 20.1.1 External Walls
- 20.1.2 External Walls continued
- 20.1.3 Internal Walls
- 20.1.4 Steel Frame and Timber Frame
- 20.1.5 Internal Floors and Ceilings
- 20.1.6 Windows and Door Frames
- 20.1.7 Finishes and Externals

## Limitations of Functional Requirements

1. These Functional Requirements do not and will not apply to create any policy liability for any remedial works carried out by the contractor or otherwise, nor to any materials used in those remedial works (not applicable to: 'Ground Conditions' guidance).
2. A more stringent tolerance may be stated within an existing National or European standard, however, for the purposes of coverage under the relevant Warranty policy, where we have identified a tolerance requirement, this would be deemed suitable to meet our Functional Requirements (not applicable to: Ground Conditions, Foundations and Stairs guidance).
3. We only measure tolerances which are identified within this Technical Manual.

## Workmanship

1. All workmanship must be within the tolerance requirements in this Section by a technically competent person in a workmanlike manner so that the required finishes are achieved.

## Materials

1. All materials should be suitable for the relative exposure of the building.

## Design

1. The design and specification shall provide a clear indication of the design intent and demonstrate a satisfactory level of performance.

# 20.

## Tolerances

### 20.1

#### Tolerances

**Introduction**

- During construction, masonry units should be laid to ensure the wall will be adequately: plumb, straight on plan and straight in section.
- Tolerances and appearances should be considered for the entire wall not individual elements of the construction.
- Assessment should be made in daylight conditions, and from a minimum 10m distance from the element.
- Fair-faced masonry should be completed to a reasonable level, ensuring texture, finish and appearance are consistent.
- A reasonable appearance for single leaf 102.5mm brick walls should be to have one finished side only. A neat and tidy finish should be applied to the other side.
- Mortar blemishes can occur on individual masonry units.
- Efflorescence is naturally occurring in certain types of masonry. Its affects are not harmful and the residue will generally disappear of its own accord over time.
- Certain masonry products specified within the design have features and marks inherent to their fabrication.
- Minor shrinkage may occur within masonry components.
- For fair face natural and cast stonework, finishes should be reasonably uniform in colour and texture.
- Fungal growth, and colour variation may occur due to mitigating factors such as the orientation of the wall, shading, and even pollution.

**Tolerances for external facing masonry**

External facing masonry includes:

- Facing brickwork and blockwork
- Natural stone
- Cast rough faced masonry

Location of measurement	Tolerance
Mortar bed joint	Level of bed joints should be +/- 8mm in any 5m length of wall.  The thickness of a mortar bed should not vary from the average thickness of the next eight successive joints by +/- 1.5mm.
Mortar perpend joint	Centre lines of perpend should be with +/- 15mm of the centre line to the next 5 successive perpend joints.
Straightness in plan	The wall must be relatively straight in plan. A maximum of +/- 8mm deviation in any length of wall up to 5m.
Straightness in section*	The maximum deviation is +/- 8mm in any storey height, up to a maximum of 3m high.
Plumb in section	The maximum deviation from plumb in any storey height up to 3m, is a maximum of 8mm.  Any walls over 3m in height should be a maximum of 8mm from plumb in any storey, and no more than 12mm in total.
Exterior window reveal	The maximum deviation is 4mm per 1m straight edge.
* The method of measurement for fair faced natural masonry and cast rough faced masonry is different to that of fair faced brickwork and blockwork. Please see the additional requirements for the measurement of fair faced natural masonry and cast rough faced masonry.	

**Mortar bed joints**

Masonry bed joints should be satisfactorily straight, with the line of level taken along the top side of the brick or block.

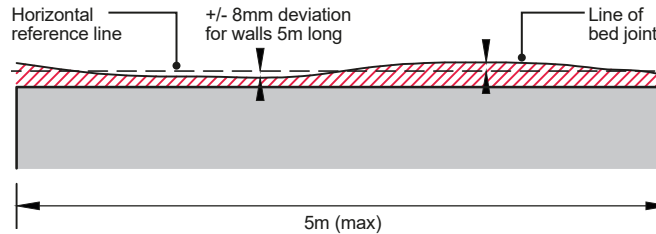
- Level of bed joints should be +/- 8mm in any 5m length of wall; and,
- The thickness of a mortar bed should not vary from the average thickness of the next eight successive joints by +/- 1.5mm

Measure and add 8 successive bed joints and divide by 8 to determine the average size:

$$11+11+12+9+10+10+12+9 = 84$$

$$\text{Divide } 84 \text{ by } 8 = 10.5\text{mm}$$

Therefore, the acceptable range of the bed joint below the 8 measured bed joints is 9-12mm



**Mortar perpend joints**

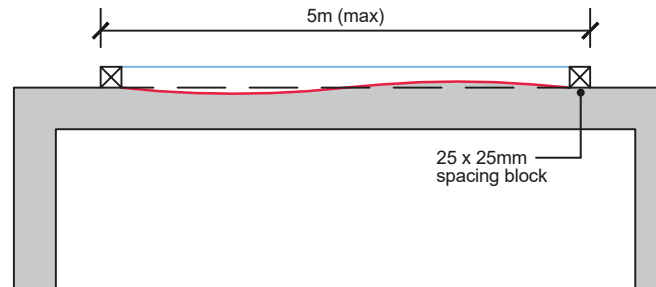
Vertical alignments of perpend joints should not deviate from the perpendicular to an extent which impairs the structural stability of the wall.

- Centre lines of perpend should be with +/- 15mm of the centre line to the next 5 successive perpend joints; and
- Perpend joints within masonry panels between openings may be offset to accommodate setting-out. The perpend joints within the panel should not cumulatively displace more than the above tolerance.

**Method of measurements for fair faced brickwork and blockwork**

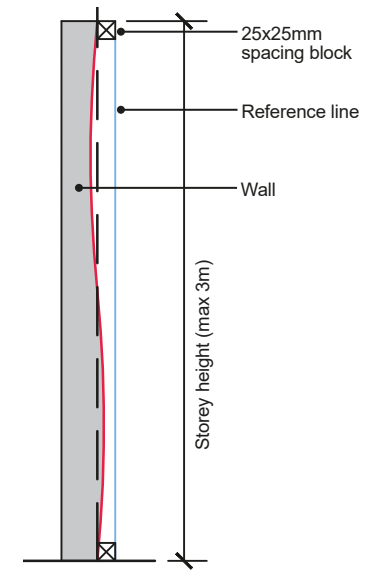
**Method of measurement for straightness in plan**

- The wall must be adequately straight in plan. A maximum of +/- 8mm deviation in any length of wall up to 5m.



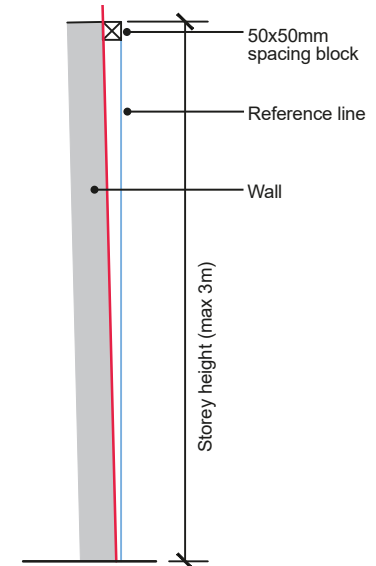
**Method of measurement for straightness in section**

- The maximum deviation is +/- 8mm in any storey height, up to a maximum of 3m high.



**Method of measurement for plumb in section**

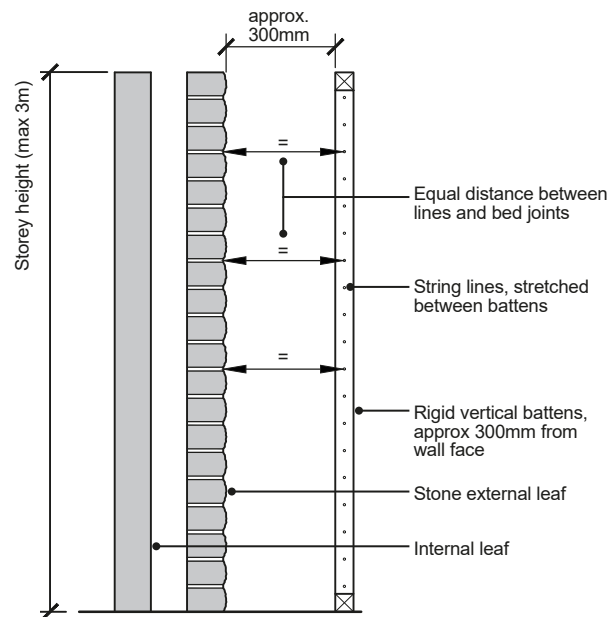
- The maximum deviation from plumb in any storey height up to 3m, is a maximum of 8mm.
- Any walls over 3m height should be a maximum of 8mm from plumb in any storey, and no more than 12mm in total.
- Using 50mm spacing blocks the line of the masonry face in plumb must be between 42mm and 58mm from the reference line.



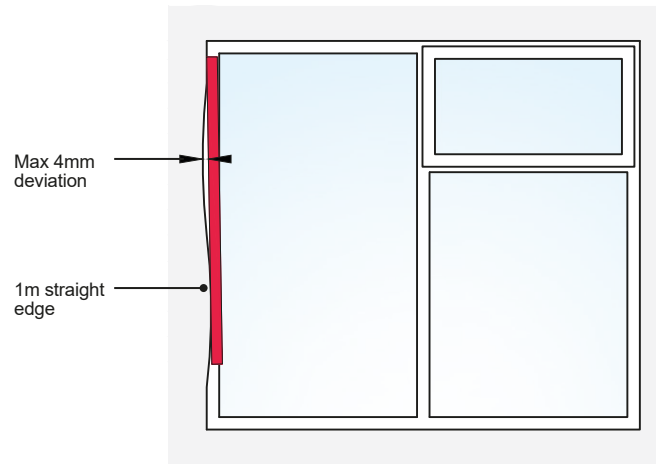
### Additional requirements for the measurement of fair faced natural masonry and cast rough faced masonry

Rather than attempt to use the uneven face of the wall to determine tolerance, the finished face of the bed joint will provide the datum. This is based on the masonry units having a minimum 100mm mortar bed width, achieved at initial laying. For the purpose of tolerance measurement, this cannot be raked or pointed to reinstate tolerance.

- Temporary but rigid battens at the building angles are to be erected approximately 300mm away from the wall face.
- Lines are to be stretched between the battens.
- There should be a constant distance maintained between the line and the bed joint subject to the permissible deviations.



### Exterior window reveal



### Render and cladding

#### Render

- Render should be applied to achieve a consistent texture, finish, and colour in line with the designers proposed specification. Some variations in colour appearance may occur due to variation in suction of the background surface to the render, along with orientation of the wall.
- Completed and set render should be free from crazing (crazing is defined within BS EN 13914-1 as being short, irregular and very fine cracks up to approximately 0.2mm in width). It is worth noting that some localised hairline cracking is likely to occur in traditional, and proprietary render systems. Limited cracking and crazing should not impair the performance of the home.
- Patching and other such repairs may be visible but they should be inconspicuous as possible in application.
- Where the render coat includes features such as bell-casts then tolerances are not applicable at these locations.
- The surface of the render should be within a maximum of +/- 4mm vertical and horizontal deviation when measured with a 5m straightedge.

#### Curtain Walling

Design should allow for the line, level, plumb and plane of the completed curtain wall to be within the acceptable tolerances of:

- Line: +/-2mm in any one storey height or structural bay width, and +/-5mm overall.
- Level: +/-2mm of horizontal in any one structural bay width, and +/-5mm overall.
- Plumb: +/-2mm of vertical in any one structural bay width, and +/-5mm overall.
- Plane: +/-2mm of the principle plane in any one storey height or structural bay width, and +/-5mm overall.

#### Rainscreen cladding systems

Design should allow for the line, level, plumb and plane of the completed rainscreen cladding systems to be within the acceptable tolerances of:

- Line: +/- 3mm in any one storey height or structural bay width
- Level: +/- 3mm of horizontal in any one structural bay width
- Plumb: +/-3 mm of vertical in any one structural bay width,
- Plane: +/- 3mm of the principle plane in any one storey height or structural bay width.

#### Tile Hanging

The uniform appearance is to be maintained for panels of tile hanging, especially at abutments. No significant variations in finish or colour should be present.

#### Timber cladding

Variations in colour to uncoated timbers exposed to weather conditions are to be expected, the rate and extent of which may vary.

#### Brick slip cladding

Tolerances for the finish of brick-slip cladding should meet the same as those listed for fair-faced masonry.

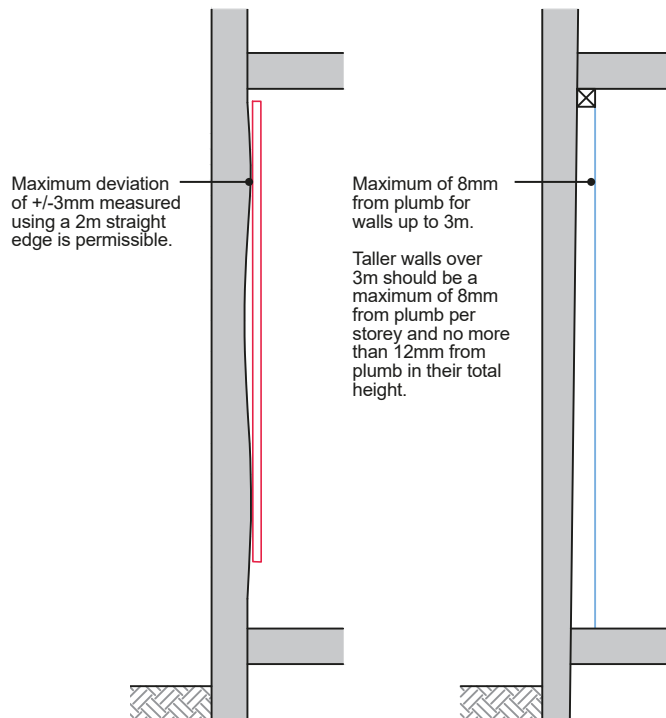
#### Cast and real stone

- Finishes should be reasonably uniform in colour and texture.
- Efflorescence, fungal growth, and colour variation may occur due to mitigating factors such as the orientation of the wall, shading, and even pollution.

### Introduction

- The wall must be relatively flat. Maximum deviation of +/-3mm measured using a 2m straight edge is permissible.
- The wall must be relatively plumb. Maximum of 8mm from plumb for walls up to 3m. Taller walls over 3m should be a maximum of 8mm from plumb per storey and no more than 12mm from plumb in their total height.
- Allowances should be made for minor textural differences around switches and such fittings.
- Board joints should not be readily visible.
- Max +/- 3mm surface deviation when measured using a 450mm straight edge.
- Viewed from a distance of at least 2m in natural daylight (no artificial lighting to be used).
- Jointing tape should not be visible within the finished surface.
- Some cracking (up to 2mm wide) may occur at wall, floor and ceiling junctions, due to shrinkage and differential movement of materials.

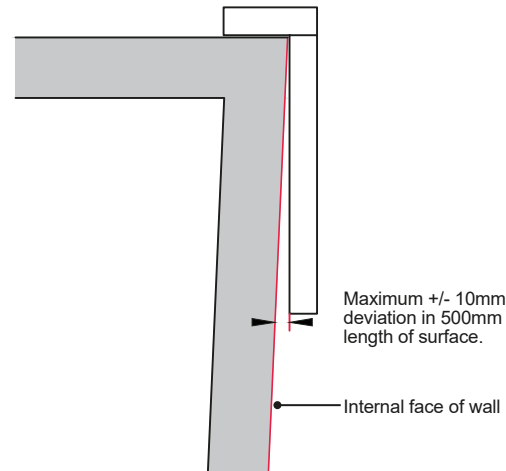
### Flatness and plumb of internal walls



### Outer corners to internal walls

Setting out of corners, duct casings (larger than 250mm), and associated framing should be:

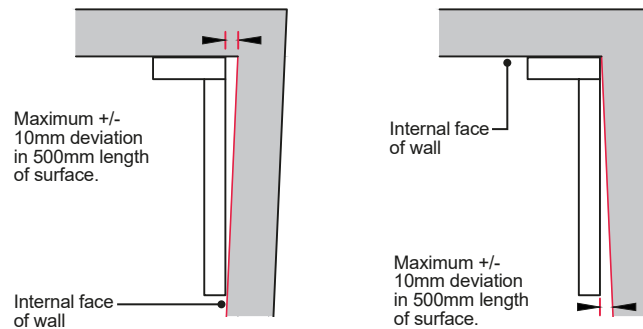
- Square.
- Neat and tidy.
- Provided with appropriate decorative finish to their surface.
- Maximum +/- 10mm deviation in 500mm length of surface.



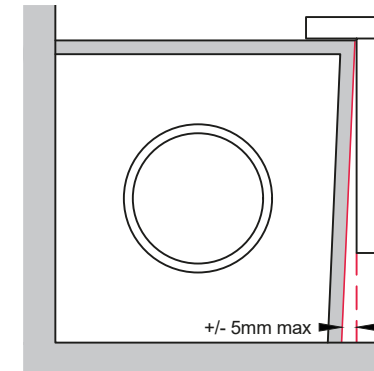
### Internal corners of internal walls

Setting out of corners, duct casings, and associated framing should be:

- Square.
- Neat and tidy.
- Provided with appropriate decorative finish to their surface.
- Maximum +/-10mm deviation in 500mm length of surface.



### Service ducts (up to 250mm)



Setting out of corners, duct casings, and associated framing should be:

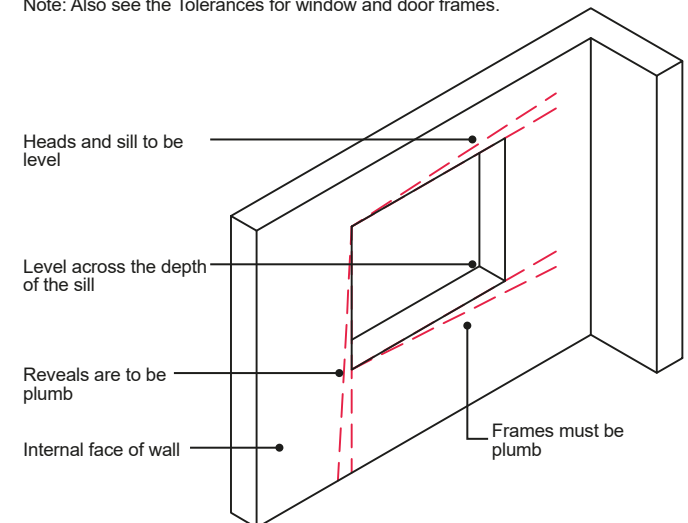
- Square.
- Neat and tidy.
- Provided with appropriate decorative finish to their surface.
- Maximum +/- 5mm deviation in 250mm length of surface relating to the boxing of the service duct (for lengths of wall over 250mm please refer to the requirement for 'Internal corners of internal walls').

### Internal openings (for reveals) for windows and doors

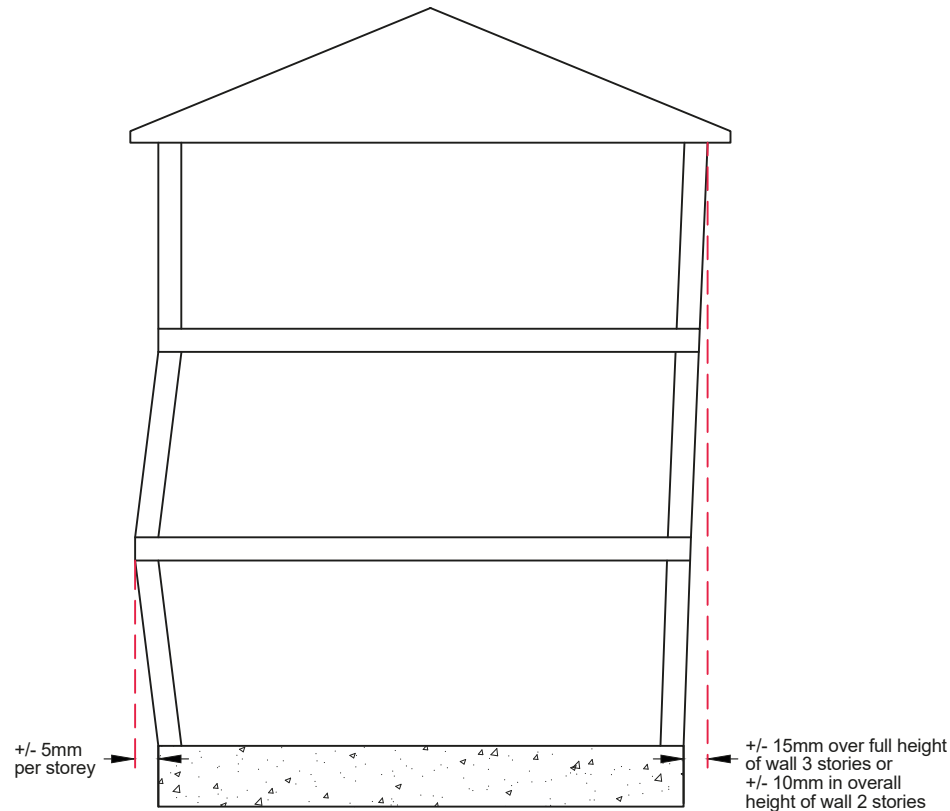
Internal openings must be:

- Flat along the length of sills and boards with maximum deviation of +/-3mm in every 2m.
- Heads and sill to be level, with a maximum deviations of 3mm out of level for openings up to 1.5m; where openings are longer than 1.5m then this deviation may be increased to maximum 5mm out of level.
- Reveals are to be plumb, with a maximum deviation of +/-3mm for openings up to 1.5m high; where reveals exceed 1.5m high then a maximum deviation of +/-5mm is permissible.
- Level within +/- 3mm across the depth of the sill, measured from the face of the frame (tiled sills may be intentionally laid to a fall to allow moisture run-off).
- Reveals are to be square with a maximum deviation of +/- 5mm for reveals up to 250mm deep (deeper reveals should refer to external corners).

Note: Also see the Tolerances for window and door frames.



## Steel frame: wall panel erection tolerances

**Site tolerances**

It is essential that the accuracy of setting out foundations and ground beams are checked well in advance of materials being delivered 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.

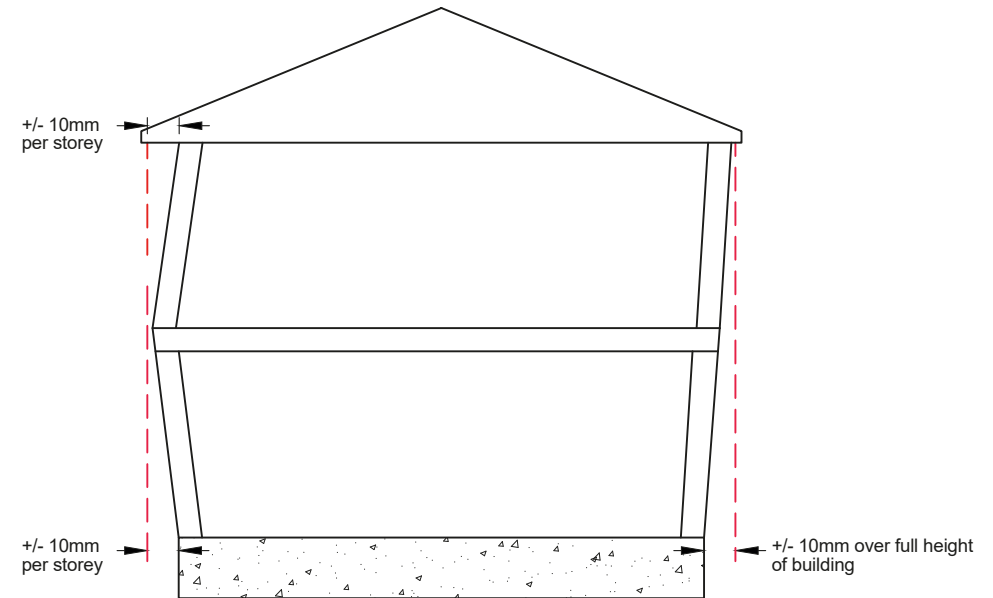
**Metal stud framework**

The wall panel usually consists of a head rail, base rail (sole plate) and possibly horizontal noggins at mid-height, together with vertical wall studs.

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).

## Timber frame: wall panel erection tolerances

**Manufacturing tolerances**

The following are our manufacturing tolerances that timber frame manufacturers' must adhere to:

- Length: +/-3mm.
- Height: +/-2mm.
- Diagonals should be equal, acceptable deviation is +/-5mm.
- Opening dimensions: +5mm.

**Sub structure**

It is important that the tight tolerances for timber frame are understood, getting the location and level of the sub-structure correct is one of the most important parts of the build process. The sub-structure or upstands that support the timber frame should be set out to the dimensions noted on the timber frame drawings:

- Within +/-10mm in length, width and line.
- Diagonals should be within +/-5mm up to 10m, and +/-10mm more than 10m.
- Levelled to +/-5mm from datum.

**Location**

Sole plates should:

- Be levelled to +/-5mm from datum.
- Not overhang or be set back from the substructure by more than 12mm on a 89mm sole plate and 20mm for a 140mm sole plate.
- Be set out within +/-10mm in length and in line within +/-5mm, as defined by the timber frame drawings.
- Diagonals should be within +/-5mm up to 10m, and +/-10mm for more than 10m.

**Wall panel erection tolerances**

Wall panels should be erected to the following tolerances:

- +/-10mm from plumb per storey height.
- +/-10mm from plumb over the full height of the building.
- +/-3mm from line of sole plate, with maximum +/-5mm deviation from drawing.
- +/-5mm from line at mid height of wall panel.
- Inside faces of adjacent wall panels should be flush.
- Adjacent wall panels should be tightly butted.
- The sole plate and base rail faces should be flush.

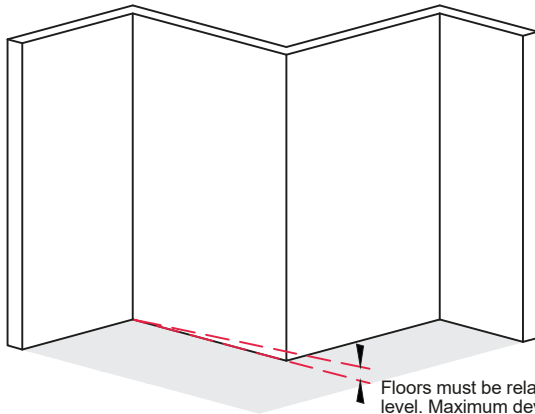


### Floors

#### Floors levels

The effects of normal drying out / shrinkage of floors (timber and concrete) may result in minor differences in level and can result in squeaking of materials as they move against each other which might not be able to be eliminated entirely.

- The floor must be relatively flat. Maximum deviation of +/- 5mm is permissible using a 2m straight edge with equal offsets.
- Floors must be relatively level. Maximum deviation of 3mm per 1m is permissible for floors up 6m in length.
- Floors over 6m horizontal length are permitted to have a maximum deviation of 20mm across their length.



#### Floor deflection limits

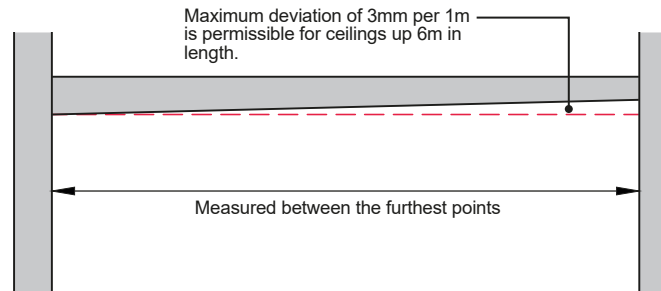
The deflection limit must be  $0.003 \times$  the span with a maximum deflection of 14mm where strutting is provided and 12mm where strutting is not provided. This is based on the total and imposed loads for combined bending and shear.

The Engineer must ensure that the design of the floor construction does not deflect greater than the above tolerances, unless the relevant BS or EN design code requires the deflection to be smaller.

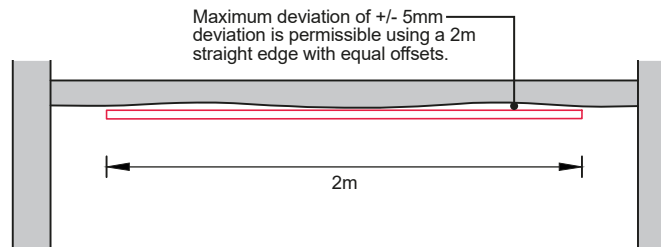
### Internal ceilings

- The ceiling must be relatively flat. Maximum deviation of +/- 5mm is permissible using a 2m straight edge with equal offsets.
- Ceilings must be relatively level. Maximum deviation of 3mm per 1m is permissible for ceilings up 6m in length.
- Ceilings over 6m horizontal length are permitted to have a deviation of 20mm across their length.
- Some cracking (up to 2mm wide) may occur at wall, floor and ceiling junctions, due to shrinkage and differential movement of materials.

#### Level of ceiling



#### Flatness of ceiling



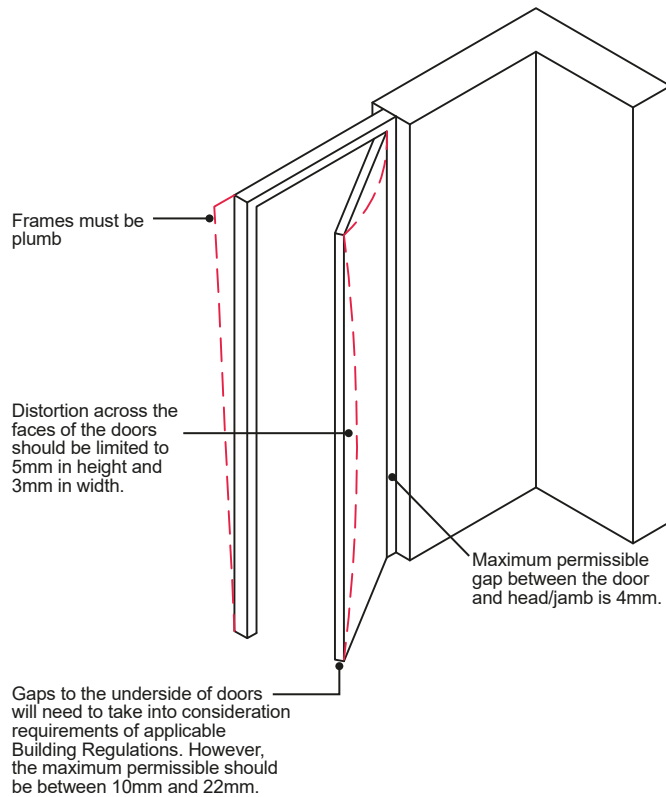
### Doors

All doors should be installed in accordance with the manufacturers' guidance and recommendations. Door installations should adhere to Building Regulatory requirements for Fire & Ventilation.

- Frames must be plumb within a maximum deviation of  $\pm 5$ mm over the total height to the frame.
- Maximum permissible gap between the door and head/jamb is 4mm.
- Where double doors meet the gap at the stiles should be within 4mm.
- Distortion across the faces of the doors should be limited to 5mm in height and 3mm in width.
- Gaps to the underside of doors will need to take into consideration requirements of applicable Building Regulations. However, the maximum permissible should be between 10mm and 22mm.

Note: These dimensions are without prejudice to satisfactory performance in terms of weather tightness, exclusion of draughts and fire resistance where appropriate.

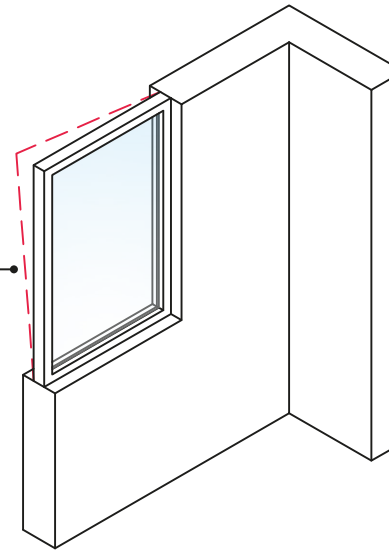
### Door frames



### Window frames

Frames must be plumb within a maximum deviation of  $\pm 3$ mm for window frames up to 1.5 in height. Maximum deviation can be increased to  $\pm 5$ mm for frames over 1.5m high.

Frames must be plumb



### Glazing

Glass must meet the visual assessment criteria of CWCT Technical Note 35 (TN 35). The total number of faults permitted in a glass unit shall be the sum total of those permitted by the relevant BS EN Standard for each pane of glass incorporated into the unit concerned.

Acceptable faults include:

- Bubbles or blisters.
- Hairlines or blobs.
- Fine scratches not more than 25mm long.
- Minute particles.

When assessing the appearance of glass:

- The viewing distance used shall be the furthest stated in any of the BS EN Standards for the glass types incorporated in the glazed unit. In the event of doubt, the viewing distance shall be 2m (3m for toughened, laminated, or coated glass).
- The viewing shall commence at the viewing distance, and shall not be preceded by viewing at a closer distance.
- The viewing shall be undertaken in normal daylight conditions, without use of magnification.
- 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 the manufacturer's instructions, which may include polishing out, re-spraying or painting.
- In rooms where there is no daylight, scratches should be viewed in artificial light from fixed wall or ceiling outlets, and not from portable equipment.

### Joint sealants

Sealants must be tool finished in order to:

- Remove any blisters and irregularities within the product.
- Achieve a compressed and smooth, neat finish within its surface.

### Skirtings

- The gap between the floor (without coverings) and the bottom face of the skirting should not exceed 5mm at the time of completion. It should be noted that the gap may increase due to normal drying out, shrinkage, or deflection (particularly to timber floors).
- It is possible that there will be joints in skirtings on long walls. When viewed from a distance of 2m in daylight, joints will need to show a consistent appearance.
- It is anticipated that there will be some initial shrinkage of the skirting after occupation of the building.

### Fitted furniture

- Fitted furniture with doors and drawers should be aligned vertically, horizontally and in plan.
- Factory finished components should not have conspicuous abrasions or scratches when viewed in daylight from a distance of 0.5m.
- Function as designed by the manufacturer.
- Adjacent doors and/or drawers with any gaps between them should be consistent.
- At the intersection of adjacent worktops, there should not be a visible change in level.

### Painted and varnished surfaces

- All surfaces should be reasonably smooth as practicably possible when viewed in daylight from a 2 metre distance and not by shining any artificial light onto the surface.
- Significant nail holes, cracks and splits should not be seen and should be filled to reduce their visible appearance.
- Colour, texture and finish should be reasonably consistent and any joints are to be filled where necessary. Although it should be noted that some variations can occur.
- External finishes may dull over time depending on a number of factors.
- Some seeping of resin from knots is a natural occurrence that may cause paintwork discolouration both internally and externally.

### Sanitary ware

Sanitary fittings should be free from conspicuous abrasions, scratches and chips when viewed from a distance of 0.5m in general daylight. Where sanitary ware is provided in windowless accommodation the items should be viewed in artificial lighting from the fixed wall or ceiling provisions (not from portable equipment).

### Drives and paths

- Surface variation should not exceed +/-10mm from a 2m straight edge with equal offsets. However, it should be accepted that localised falls into gullies and channels are acceptable.
- Design and construction should be completed to minimise the potential for standing water. Sixty minutes after rainfall has ceased, areas of temporary standing water should be no deeper than 5mm, nor exceed 1m<sup>2</sup> in area. Temporary standing water should not be present adjacent to entrance doors.
- Some fracturing or weathering may also appear if using natural stone due to the make-up of the material. This tolerance applies to principle pathways and driveways to the building that are required to meet the standards of Part M (Access to and use of buildings).

### Drainage system covers

- Drainage system covers in hard standing areas should line up neatly with the adjacent ground.

### Wall tiling

Courses should be straight and even to form a plane and regular surface, especially around fittings and fixtures.

- There should be no cut or unfinished tiles at exposed edges or external corners.
- Joints should be even and cut neatly.
- Spacing should be sufficient to allow for expansion.
- Up to sanitary fittings and fixings, the sealing method should be in accordance with the design and account for movement.
- Proprietary water-resistant grouting should be used in accordance with the manufacturer's recommendations.
- Appropriately designed movement joints should be:
  - Built into tiling at centres at a maximum of 4.5m, vertically and horizontally.
  - Provided at vertical corners in large tiled areas.
  - Located at junctions where there are variations in surfaces or backgrounds.
  - 1-2mm where tiles are without spacer lugs.
- Grouting should be:
  - As specified in the design, including mix and colour.
  - Cement-based epoxy resin or a proprietary product.
  - Waterproof in and around shower enclosures and where tiling can be saturated.

### Radiators and similar appliances

Appliances displayed in and about the home should be:

- Free from cracks, holes, and splits.
- Have any joints filled consistent to the main material.
- Reasonably uniform in colour, texture and finish.

### External plastic and UPVC materials (other than windows and doors)

Materials such as fascias, soffits, meter boxes, etc. should be provided to meet the following:

- Be reasonably smooth in their finish. Free from nail holes, any cracks or splits.
- All joints to be sympathetically filled to replicate the main material.
- Be reasonably uniform in colour, texture, and finish.

### Pitched roof coverings

Coverings should have an aesthetically suitable appearance.

Tiles and slates should:

- Be reasonably uniform, with a consistent texture and finish.
- Be selected from mixed packets to avoid excessive colour banding.

It should also be accepted that:

- Some minor blemishes can occur within the surfaces of the tile or slate.
- Variations in colour, texture, and finish can occur within tiles and slates, especially when natural quarried items.
- Efflorescence is to be expected.

### Garages

Garages shall be constructed to achieve an acceptable appearance. The floors, walls, and roofs should be built to appropriate tolerances.

- Garages are not considered habitable spaces.
- Gaps up to 2mm wide may be experienced in unplastered blockwork. Caused by thermal movement and/or shrinkage.
- Garage floors may be installed with falls provided in order to either assist with drainage, or to satisfy the requirements of the Building Regulations.

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