

# STA advice notes

## Recommended construction tolerances for timber structures



No. 4 - January 2014

## Part 2 - Sole plate tolerances

### Introduction

Timber framed buildings are prefabricated to a high level of quality within controlled factory conditions and delivered to site for assembly into a structure which can achieve excellent levels of accuracy.

STA membership requires that all manufacturers operate a minimum standard of quality control which ensures the continuation of high standard within the industry. This advice note is for timber structure providers, foundation contractors and site quality control persons.

### Scope of this advice note

This document explains the tolerances required for sole plates that support the timber frame structure above, providing a transition between the foundation and the superstructure.

This advice note is based on good practice and current standards. The project design team may require different tolerances. The structural timber engineers specification for support conditions will override the advice given in this guidance.

This is Part 2 of the recommended tolerances for structural timber construction. Other parts in this series are:

- |        |   |
|--------|---|
| Part 1 | Foundation tolerances                       |
| Part 2 | Sole plate tolerances (this document)       |
| Part 3 | Timber frame wall panel erection tolerances |
| Part 4 | Roof tolerances                             |
| Part 5 | Floor tolerances                            |

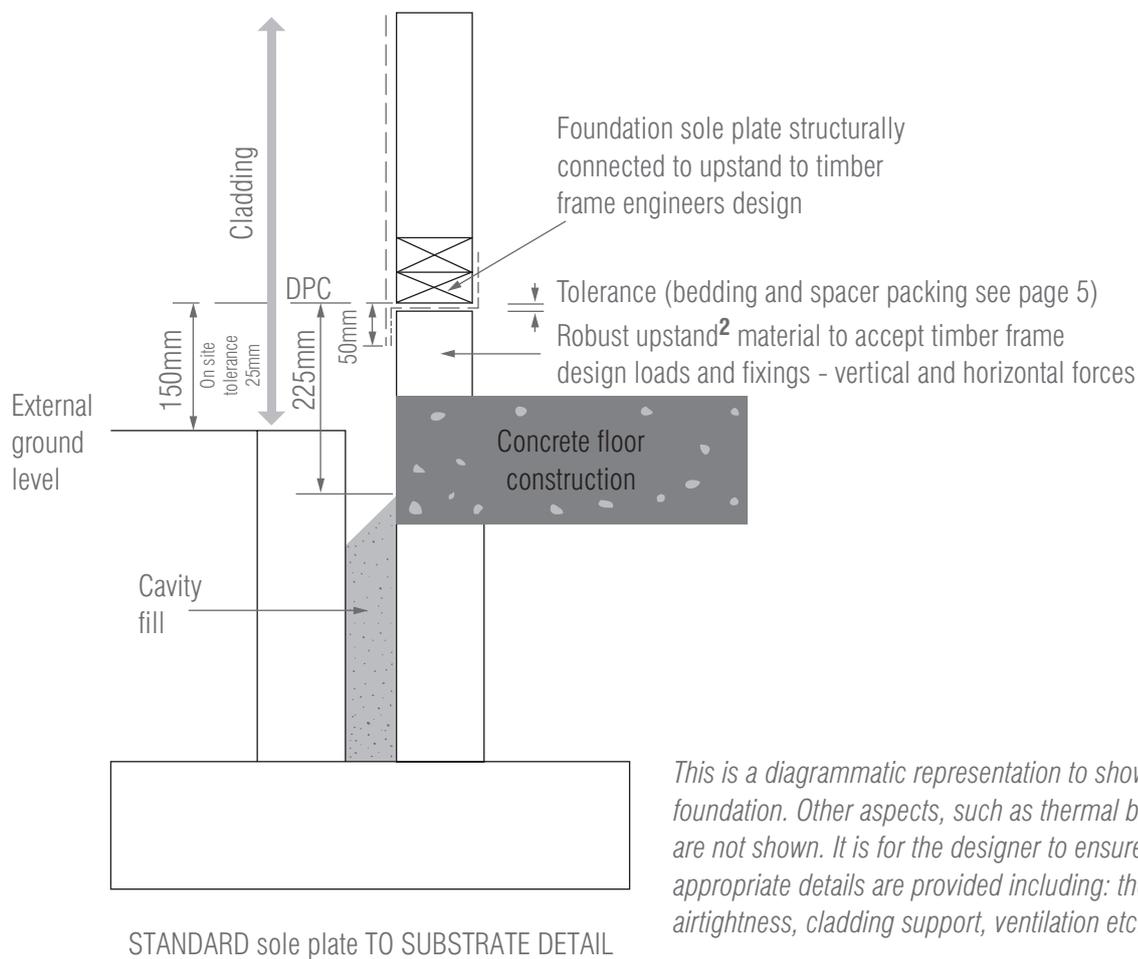


## General principles of sole plate construction

1. The foundation sole plate (or starter plate) is the first timber member above the damp proof course (DPC), and depending on the design there may be single or multiple members fixed one above the other.
2. All foundation sole plates are to have an approved preservative treatment to BS8417 (for example copper containing preservative treatments) : class 2 treatments.
3. A damp proof course shall be located between the foundation sole plate and the foundation.
4. DPCs should be installed below the sole plates of all ground floor walls, including internal partitions, to protect timber from rising damp construction moisture.
5. The foundation sole plates are to be constructed so that they adequately carry the loads from the timber frame structure (including any concentrated point loads from groups of studs or posts within the wall framing) to the supporting foundation structure. Both vertical and horizontal loads need to be considered.
6. The standard foundation sole plate detail is for the sole plate to be a minimum of 150mm above external ground level, except at thresholds where local detailing to avoid moisture build-up is required. A tolerance in the ground level of up to 25mm is acceptable, leading to a reduced dimension of 125mm for the sole plate above ground level as the absolute minimum. This must not be a design value and is provided to give some site tolerance for ground levels. This reduced dimension should not occur over more than 50% of the building perimeter.
7. Where the underside of the foundation sole plate is required by the design to be less than 150mm above the external ground level, the principles of the drained sole plate detail should be adopted. See figure 3.

Where sole plates are supported by a concrete slab<sup>1</sup>, the following principles should be adopted:

1. It is considered good practice to have the foundation sole plate and DPC at transfer slab level even if the transfer slab is at a first floor level.
2. The design of the transfer slab, including the positioning of reinforcement, should take account of the sole plate fixings.
3. The timber frame to sole plate detail is to take account of adequate ventilation and avoidance of moisture / wet build up to the cavity face.
4. The location of external finishes on transfer slabs may require an upstand plinth, step in the slab or a drained cavity to be provided to maintain the sole plate at 150mm above finished ground level. In all cases the risk of moisture saturation of the sole plate should be considered and alternative details undertaken if there is a risk identified.

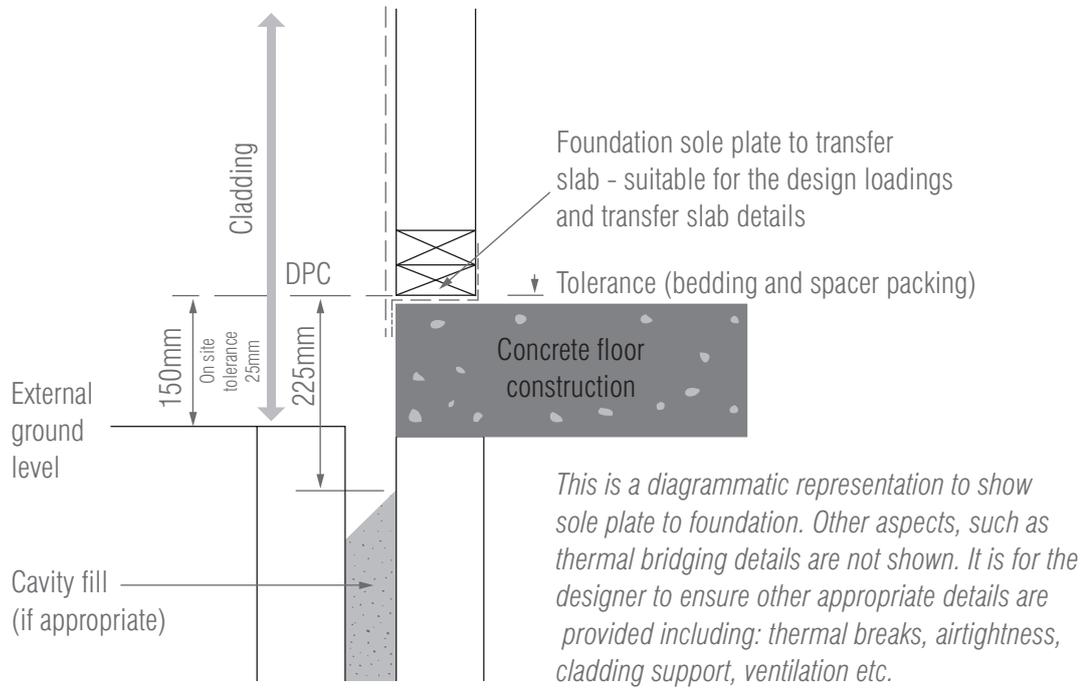


**Fig 1: Sole plates supported by an upstand plinth**

**Note 1: Concrete beams and steel beam support conditions are to be treated similarly.**

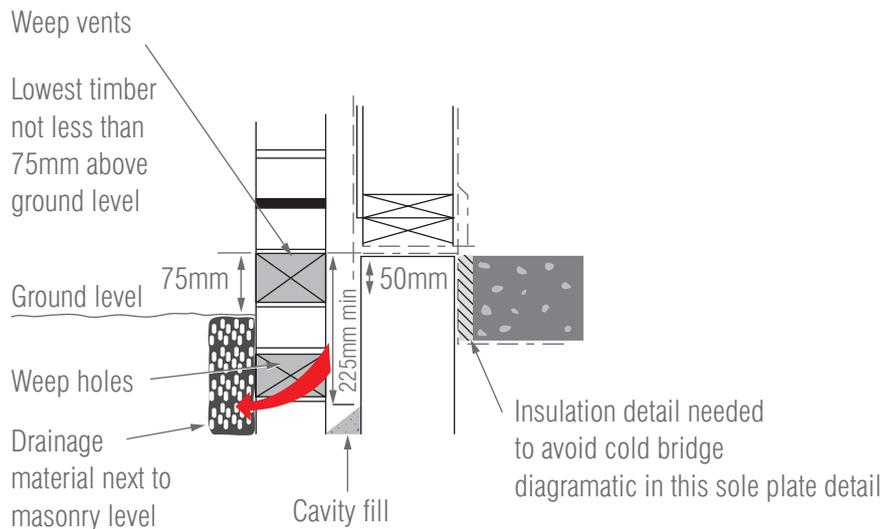
**Note 2: The design of the upstand is by the foundation engineer and care is needed to select materials that will not shatter when fixing the foundation level sole plate.**

ALTERNATIVE SOLE PLATE TO SUBSTRATE DETAIL



**Fig 2: Sole plates supported directly by a slab**

## Drained sole plate design principles



**NOTE:**

This detail is only acceptable in situations where the site is not subject to a high water table or where the cavity will not have standing water. The project engineer will design drainage detail.

*This is a diagrammatic representation to show sole plate to foundation. Other aspects, such as thermal bridging details are not shown. It is for the designer to ensure other appropriate details are provided including: thermal breaks, airtightness, cladding support, ventilation etc.*

**Fig 3: Drained sole plate detail**

1. The level of the drained foundation sole plate is not to be lower than 75mm above external ground level, including tolerances. Refer to figure 3.
2. In some instances the architectural features are such that the external ground level is between 0 and 50mm below the underside of the foundation level sole plate; unless the design takes account of the need to ensure that the sole plate remains dry and away from water such as protection from a suitable and durable tanked retaining wall with a drained and vented cavity. If there is a requirement for levels to be below the 50mm minimum then the timber frame designer shall consider each design and agreement to proceed based on a durability risk assessment submitted by the building designer. In this case it is considered appropriate to have a detailed drainage system externally and is only suitable for sheltered sites and walls. In no case can the external ground level be above the sole plate level.
3. When adopting this drained cavity solution a durability risk assessment shall be carried out to take account of ground water, external finishes and the risk of the cavity below ground level being filled with debris and mortar droppings during construction. This assessment shall be undertaken by the Building Designer and is not the responsibility of the Timber Frame Designer.
4. The detail in Fig 3 is not to be adopted for high water tables / or potential for high ground water levels.

## Packing of sole plates

The support structure/foundation shall be within the recommended tolerances (see Part 1 of this advice note). The as-built position and level of the sole plates will impact on the line and level of the timber frame structure above.

The sole plates are typically installed by an erecting company to the line and levels indicated on the timber frame sole plate layout drawings and are fixed to the substructure using approved structural fixing details.

Where it is necessary to level the sole plates, the method of levelling the sole plate shall be agreed before any works commence. There are three common methods to level sole plates as described below. The principal behind all methods is to ensure that the loading from the studs can be transferred without undue deformation down to the foundations.

### 1) **Level the sole plates using packers**

Typically 0.6m to 1.8m centres. Structurally fix the sole plate (ensuring that the length of any fixings are sufficient to take account of the gap between the sole plate and foundation) and erect the first level of timber frame walls and floor. The gap between the sole plate (DPC under the plate) and foundation is then fully filled with a non-shrinkable grout to the foundation engineer's specification. This ensures a continuous structural support to the sole plate, before any further frame erection is allowed to proceed. Typically, gaps of less than 10mm are not easily filled with grout and in these conditions the use of structural packs under each point load (studs and columns) is required. The structural packs should extend over the full contact area of the stud or column member.

### 2) **Using twin sole plates**

The first sole plate is fixed to the contours of the foundation support (with suitable continuous packing as described in method 1) and then a second sole plate is installed and levelled on top of the first plate. The gap between the two sole plates is packed with structural packs under each point load as described in method 1.

### 3) **Using packers**

Temporarily level the sole plates using packers, sometimes called spacers, at no more than 1.8m centres. The sole plate is then removed for a mortar bed to be laid using the shims as a guide to the mortar bed thickness. The sole plate is then bedded onto the mortar. Once the mortar is cured the sole plates are fixed and subsequent wall panels are erected.

## Packing of sole plates cont.../

The specification and supply of the structural fixings which are to be used to secure the sole plate to the foundations are the responsibility of the timber frame supplier and should be designed to allow for a maximum packing thickness of up to 20mm.

Where packing of thicknesses greater than 20mm is required, agreement is to be obtained from both the substructure engineer and the timber frame engineer. Attention shall be given to the length of fixings - which may need to be increased to suit packing thicknesses exceeding 20mm.

Packers are provided by the timber frame supplier and are to be robust and durable for the end application.

Grout and mortar mixes are the responsibility of the main contractor unless specifically agreed to be done by others in the contract agreement.

If the recommended tolerances of the foundations supporting the timber frame sole plates are exceeded, remedial action may be required to the foundation structure to provide additional support to the timber frame structure. Any such remedial works shall be undertaken with full agreement of the structural timber engineer and substructure engineer.

Where adjustments to the level of the sole plates are required, to take account of substructures which are outside of the recommended tolerances, then it may be necessary to adopt a revised sole plate datum level. This revised datum level shall be used by the main contractor to adjust the building levels e.g. finished floor and external cladding levels, accordingly.

Responsibility for levelling and packing the sole plates should be made clear in the contract agreement. In the absence of an agreement it is common practice for the anchorage, line and level of the sole plates and use of structural spacers/ packers (where needed) to be undertaken by the company erecting the frame and the structural grout or bedding mortar bed to be carried out by the main contractor.



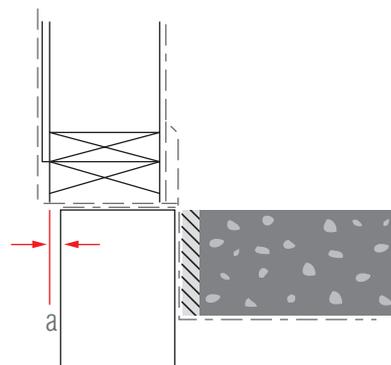
**Fig 4: Packing of sole plates**

## Recommended sole plate tolerances for timber frame structures

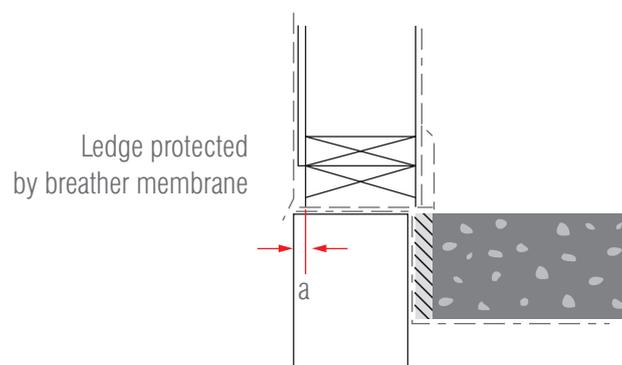
The sole plate (or starter plate) generally consists of a treated timber plate fixed above the DPC, to a slab, concrete block foundation wall or upstand plinth which forms a template for the building both in terms of its level and horizontal dimensions. The robustness of the upstand is by the client's structural engineer.

The sole plate setting out detail needs to be carefully understood by the erectors as the methods for positioning wall panels onto sole plates vary within the industry. Most timber frame manufacturers align the sole plate with the bottom rail of the panel. Timber frame walls should be set out so that they are in line with correctly set out foundation support conditions.

The load from the timber frame walls needs to be supported as intended by the design. If the foundation edge is set back or extends beyond the sole plate by more than 15% of the width of the stud to a maximum of 20mm whichever is the lesser (dimension 'a' in figure 5). The timber frame designer needs to be consulted as the sole plate may be unstable or the clear cavity width may be compromised.



Ledges can form moisture traps. Where these occur protection should be provided



**Fig 5: Extract from NHBC Standards 6.2. S2 showing permissible sole plate overhang and setback. Other construction details omitted for clarity**

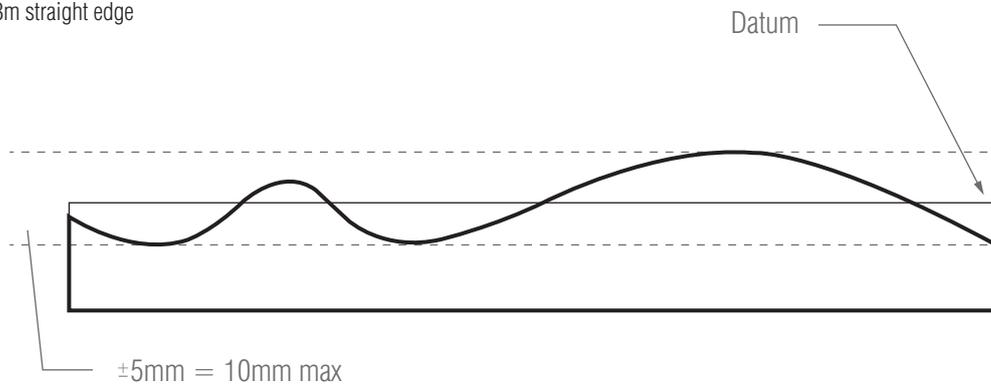
## Sole plate level

As for the foundation slabs and walls to which they are fixed, variability in surface level can be expressed in two ways according to BS5606: either variation from a target plane or 'flatness' of the surface.

Variation from a target plane or level will be a direct result of the level of the foundations to which the sole plates are fixed and is therefore outside of the control of the timber frame erector.

Flatness or level of the sole plate should be such that the variation is not greater than:

±5mm in level over a 3m straight edge



## Line and length

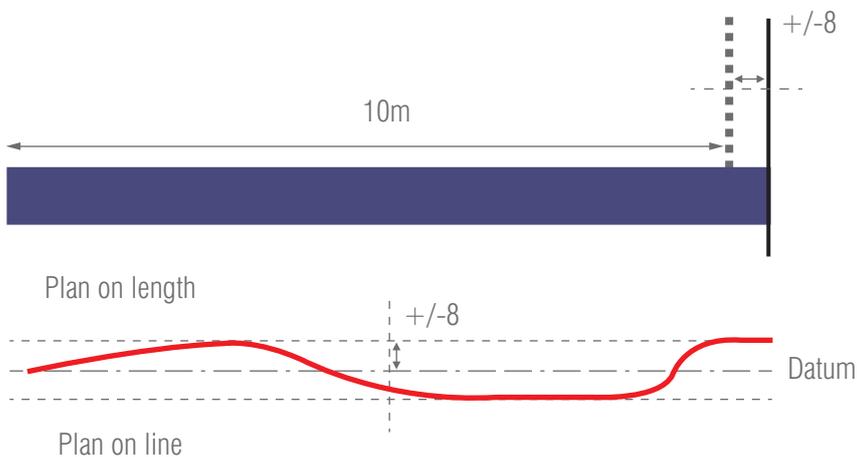
Permissible horizontal setting-out dimensions are calculated using the following equation:

$$\pm T = \sqrt{(4 \times d) + 1} \text{ or } 5 \text{ mm (whichever is the greater)}$$

Where **T** is tolerance in mm subject to a minimum of 5mm and **d** is the distance under consideration in m

The following table uses the above equation and may be used to interpolate acceptable tolerances.

### Example



Sole plate	
Distance (m)	+/- Tolerance (mm)
3	5
5	6
10	8
15	9
20	10
25	11
30	12
40	14
50	16

## Squareness

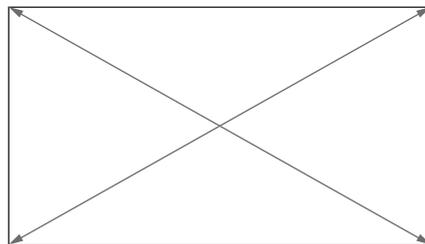
±15mm in any diagonal for buildings with a foot print in excess of 1500m<sup>2</sup>

± 10mm in any diagonal within a right angle building up to 1500m<sup>2</sup> foot print

Buildings of plan area less than 300m<sup>2</sup> 600m<sup>2</sup> foot print (e.g. domestic scale buildings):

up to 10m: ± 5mm

more than 10m: ± 10mm



## Other useful references

### **STA Advice Note 5 - Recommendations for the design of transfer podia required to support timber frame structures**

The STA recommend that the structural design of podium slabs should be in accordance with this document which is available free as a download from the STA website.

### **STA 'A Site Pocket Guide to Timber Frame Construction' 2014 edition**

A useful reference document for site supervisors and those responsible for checking the workmanship of timber frame structures.

### **NHBC Standards - Chapter 6.2 External timber frame walls**

Provides guidance for achieving compliance with the NHBC standards, including the positioning of sole plates, to satisfy the Technical Requirements of the NHBC standards.

### **BS5606:1990 - Accuracy in Building**

Provides ranges of deviations normally achievable for construction in accordance with BRE research for both items of construction and manufactured components.

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