3.

Foundations

Contents

3.1 Foundations: Mass Fill and Strip

Introduction

This section provides guidance on meeting the performance requirements for mass fill and strip foundations for buildings up to 3 storeys[1]. The following situations are not covered by this guidance:

- Mass filled foundations and strip foundations for buildings other than dwellings.
- Foundations on filled ground.
- Mass fill foundations and strip foundations where foundation depths exceed 2.5m.
- Building new structures off existing foundations.

[1] For buildings which are 4 storeys or more, mass fill or strip foundations should be Engineer designed.

3.1.1 Compliance

Mass fill and strip foundations shall meet the performance requirements of this section.

3.1.2 Information to be provided

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

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

1. Site investigation report appropriate for the site specific conditions (please note, a minimum phase one desktop study is required in all circumstances).
2. Where the ground is contaminated a full design package including details of all materials to be used along with a remediation report will be required.
3. Full set of detailed drawings including:
    a. Foundation layouts.
    b. Section drawings showing depth and width of foundations.
    c. Layout drawings showing position of trees in proximity to any foundations.
    d. Location of any services in close proximity to the foundations.
    e. Details of movement joints, junctions or steps in the foundations.
    f. Details of heave precaution requirements.
4. Full set of structural calculations and drawings.

3.1.3 Design

Mass fill and strip foundations shall be appropriately designed to safely transfer loads from the superstructure to the ground without excessive movement and in accordance with the relevant Building Regulations.

Mass fill and strip foundations should follow the guidance provided within this section and BS 8103-1.

Ground conditions

Mass fill and strip foundations should only bear onto original ground, where it does not, the foundation should be designed by a Structural Engineer and appropriately reinforced. It is therefore important that site conditions are appropriately assessed prior to the building design. Please see the ‘Ground Conditions’ section.

Settlement

Mass fill and strip foundations shall be designed to ensure that the building is appropriately supported at all times without excessive settlement.

For ‘low rise structures’, the foundations should be designed to ensure a maximum settlement of 25mm is not exceeded.

In relation to differential settlements, a design limit for maximum tilt of 1/500 is appropriate for the load case, 100% Dead load plus 30% superimposed live load. Where it is clear 100% superimposed live loads will occur for long periods of time, differential settlement checks shall be carried out for 100% Dead and 100% superimposed live load. More stringent values may be required due to the particular circumstances (e.g. medium and high rise structures).

Influence of trees in clay soils

Foundation design should take into account influence from nearby trees. Where construction is to take place in cohesive soils and trees are/were/will be present:

For mass fill foundations:

- If the foundation depth is greater than 1.5m, then heave protection will be required.
- Where foundation depths exceed 2m, short bored piles with ground beams or piled rafts slabs are recommended. All pile designs should be undertaken by an Engineer.
- Foundation depths required to exceed 2.5m are beyond the scope of the online foundation depth calculator and must be a piled engineered solution.

For strip foundations, where construction is to take place in cohesive soils and trees are/were/will be present, and the foundation depth is required (using the online foundation depth calculator) to exceed 1.5m, heave protection will be necessary and strip foundations will not be suitable. Mass fill or short bored piles should be adopted (see the 'Foundations - Mass Fill' and 'Foundations - Piles' guidance).

Further guidance can be found in the 'Foundations - Trees and Clay' section.

Minimum foundation dimensions

Foundation widths

Mass fill and strip foundations should be of a 600mm minimum width for external walls and must take loadings and ground conditions into account. For widths that are less than 600mm for the external wall, an engineer design must be provided.

For single leaf internal walls up to 150mm thick, foundations may be reduced in width to 450mm ensuring that a 150mm projection either side of the internal wall is provided.

In all situations foundations should be situated centrally below the wall.

Thickness of strip foundations

The minimum thickness of strip foundations should be 150mm.

Foundation depths

The depth of all foundations should be determined by specific site conditions. All foundations must bear onto virgin stable subsoil and, except where strip foundations are founded on rock. The foundations should have a minimum depth of 450mm, measured from finished ground level to their underside, to avoid the action of frost. This depth however, will commonly need to be increased in areas subject to long periods of frost or in order that loads are transferred to suitable ground. If the finished ground level will be above the existing ground level then, the foundation depth should be calculated from the existing, not finished, ground level.

Where trees are situated close to a proposed building founded on a clay soil, the foundation depth/design will be affected; further guidance is available in the 'Foundations - Trees and Clay' section. In clay soils with a plasticity index greater than or equal to 10%, foundations should be taken to a depth where anticipated ground movement will not impair the stability of any part of the building, taking into account the influence of vegetation and trees on or adjacent to the site. The depth to the underside of foundations on clay soils should not be less than 750mm, as measured from finished ground level, and depths may need to be increased in order that loads are transferred to suitable ground.

For minimum depths of foundations in cohesive soils where trees are/were/will be present, please use the online foundation depth calculator. Further guidance can be found in the 'Foundations - Trees and Clay' section.

Where the depth of mass fill or strip foundations is in excess of 2.5m, they must be designed by a Chartered Structural Engineer in accordance with current British Standards and Codes of Practice. For trench fill, it is imperative to check that the finished foundation level is correct and horizontal. It will be difficult to adjust for discrepancies in the small number of brick courses between foundation and DPC level.

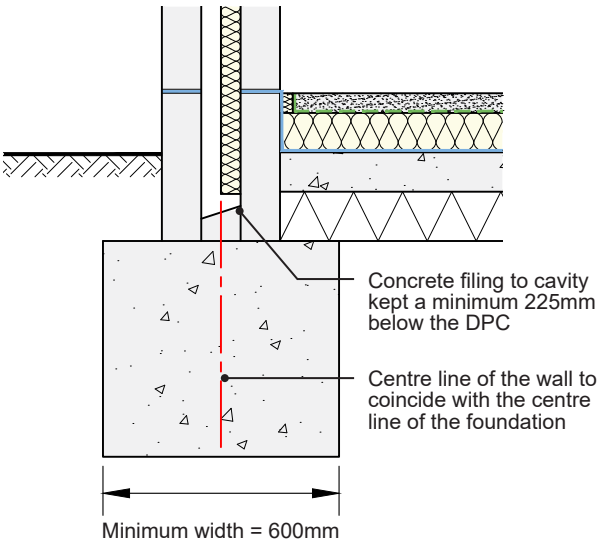
Prior to concreting, excavations should be 'bottomed out' to remove any debris that may have fallen into the trench; the excavations should be free from water, and if it has been left open for a long period of time, further excavation may be required to a non-weathered strata.

Minimum foundation depths		
Modified plasticity index	**Volume change potential**	**Min foundation depth**
40% and greater	High	1.00m
20% to less than 40%	Medium	0.9m[1]
10% to less than 20%	Low	0.75m[1]
[1] If the modified plasticity index is not confirmed, the minimum foundation depths should be 1m.		

The Plasticity Index may be used without modification; for soils comprising of pure clays, with 100% of particles less than 425µm, the Plasticity and Modified Plasticity Indexes will be the same. The adoption of the Modified Plasticity Index in mixed soils, such as glacial till, however, may result in a more economical design.

Typical mass filled foundation

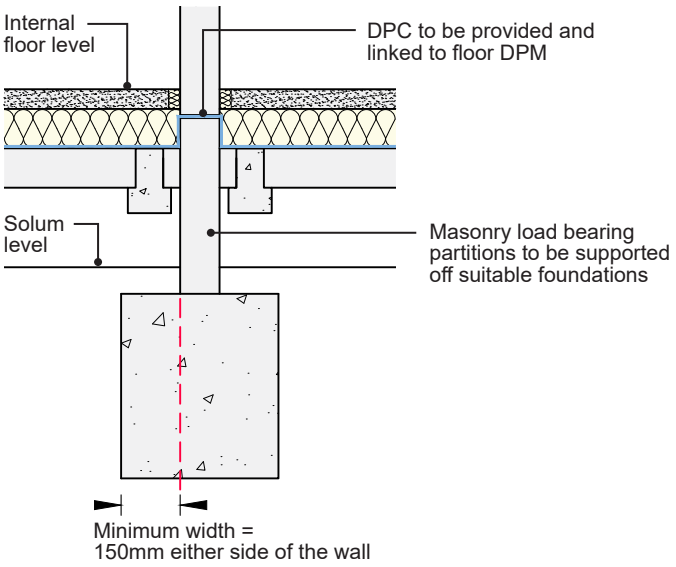
External wall



Depth of foundation (below ground level) to be taken to:

- Suitable virgin sub-soil.
- A depth that gives sufficient bearing and protection from frost.
- When building on cohesive soils, is at a depth that is not under potential influence of nearby trees.
- Below the invert level of any adjacent drain/sewer.

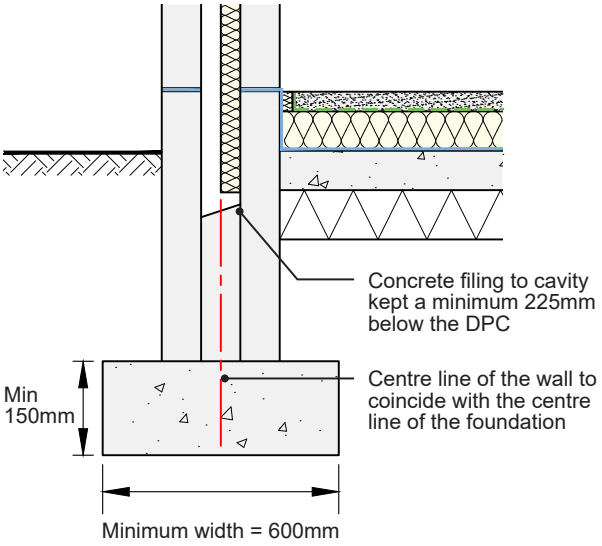
Internal wall



- Foundation to be centrally located under the wall.
- The foundation width should be in accordance with the relevant Building Regulations.

Typical strip foundation

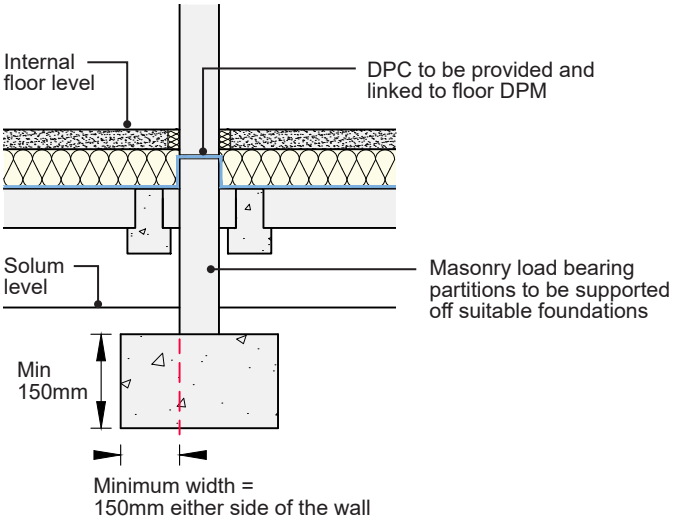
External wall



Depth of foundation (below ground level) to be taken to:

- Suitable virgin sub-soil.
- A depth that gives sufficient bearing and protection from frost.
- When building on cohesive soils, is at a depth that is not under potential influence of nearby trees.
- Below the invert level of any adjacent drain/sewer.

Internal wall



- Foundation to be centrally located under the wall.
- Width of the strip foundation to ensure a 150mm minimum projection either side of the wall is provided.
- The foundation width should be in accordance with the relevant Building Regulations.

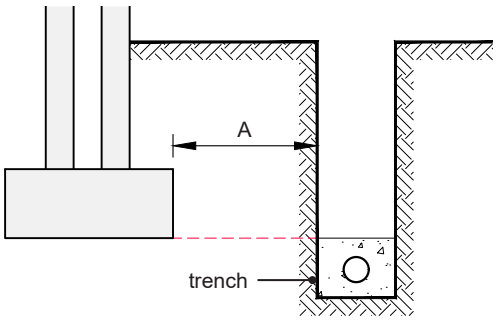
Reinforcing

Reinforcement, if needed, should be clean and free from loose rust and should also be placed correctly. Bars, of an appropriate size, should be supported to guarantee that they are 75mm above the base of the foundation, or as indicated in the design. They should be secured at laps and crossings. If in doubt about any soft spots, the Engineer's advice should be taken prior to placing the concrete.

Protecting pipes and services adjacent to foundations

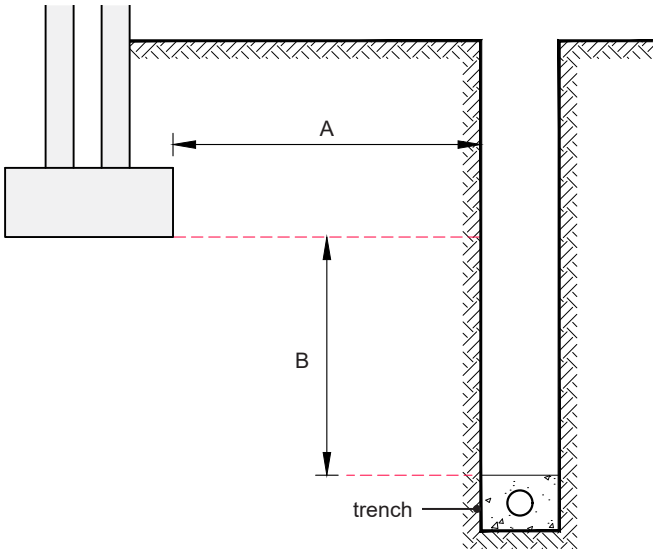
Where it is not physically practical to locate drains so they are not impacted by foundation loads, the pipes should be protected. Examples of how the pipes may be protected are given below:

Scenario 1 - where A is less than 1m



Where the trench is 1m or further from the foundation, the trench is to be filled with concrete up to measurement B as shown above.

Scenario 2 - where A is 1m or greater

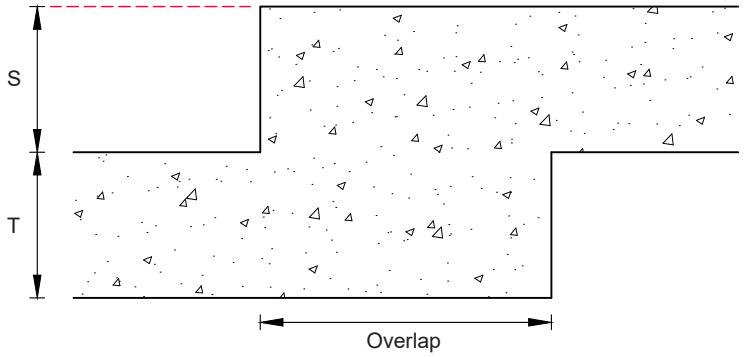


Mass fill and strip foundations must be:

- Constructed to a depth which will not be affected by nearby drainage or other services.
- Any drain or service pipe must not pass through the base of the foundation. Where such services are at the same level, the base of the foundation must be stepped below and the drain/services sleeved through the substructure wall above.
- Existing ground water drains should be diverted to a suitable outfall.

Steps in foundations

Steps in foundations must not be of a greater dimension than the thickness of the foundation. Where foundations are stepped (on elevation), they should overlap by twice the height of the step, or 1m whichever is the largest.



Mass foundations

The overlap should not be less than:

- 2 x S, **or**
- 1m

whichever is the largest.

Strip foundations

The overlap should not be less than:

- 2 x S, **or**
- T (max 500mm), **or**
- 300mm

whichever is the largest.

3.1.4 Setting out foundations

Mass fill and strip foundations shall be accurately set out to take account of the design.

The accuracy of setting out foundations should be checked by set controlled trench measurements, including their location relative to site borders and neighbouring buildings. Levels should be checked against benchmarks, where appropriate. In particular, for excavations check:

- Trench widths.
- Trench lengths.
- Length of diagonals between external corners.

Walls should be located centrally upon the foundation, unless specifically designed otherwise. Any discrepancy in dimensions should be reported promptly to the designer. Resulting variations should be distributed to all concerned with site works, including the Warranty surveyor.

Standards referred to:

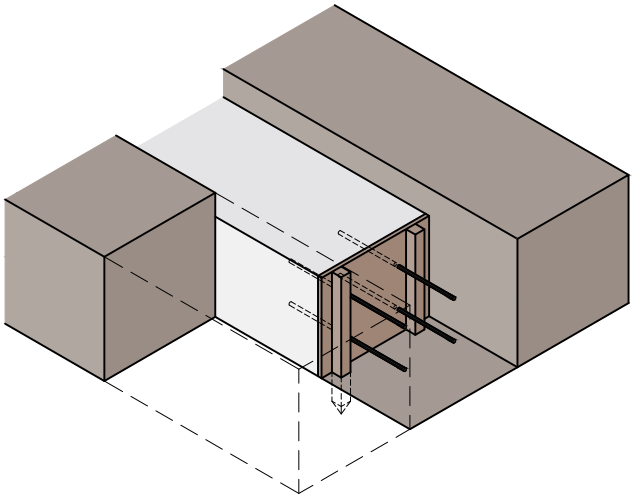
- BS 8004 Code of Practice for foundations and Eurocode
- BS 5950-1 Structural use of steelwork in buildings and Eurocode
- BS 6399 Loadings for buildings and Eurocode
- BS 8103 Structural design of low rise buildings and Eurocode
- BS 8110 Structural use of concrete and Eurocode

3.1.5 Construction joints

Where construction joints are required, they shall be suitably formed in accordance with the design.

If construction joints are necessary, they should not be positioned within 2m of a corner or junction in the foundation. All shuttering should be removed before work progresses beyond the construction joint.

Using reinforcement bars across a joint



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