



## Chapter

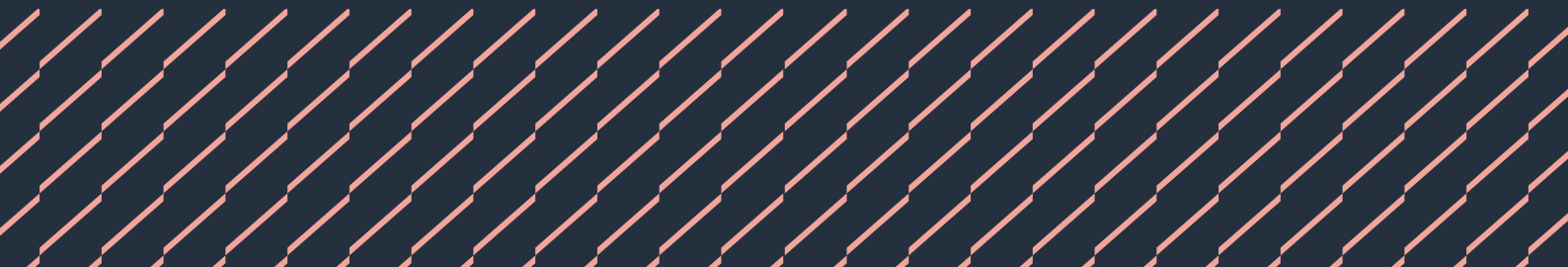
# 4.3



## Strip and trench fill foundations

This chapter gives guidance on meeting the Technical Requirements for strip and trench fill foundations.

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### 4.3.1 Compliance

Also see: Chapter 2.1

**Strip and trench fill foundations shall comply with the Technical Requirements and provide adequate support to all load-bearing elements.**

Strip and trench fill foundations that comply with the guidance in this chapter will generally be acceptable.

Foundations should be designed by an engineer in accordance with Technical Requirement R5 where:

- buildings exceed three storeys in height
- supporting/retaining walls form habitable rooms below ground
- trench fill foundations are deeper than 2.5m
- they will be deeper than those of an adjoining construction.

Elements of the building requiring foundations include:

- external walls
- separating (party) walls
- internal load-bearing walls
- chimney breasts
- piers.

In Scotland, a sleeper wall is defined as a load-bearing element and therefore should be provided with a suitable foundation.

In England, Wales, Northern Ireland and the Isle of Man, sleeper walls should be provided with suitable foundations where the oversite concrete is:

- cast on shrinkable clay soils where heave could take place
- cast on infill deeper than 600mm
- less than 100mm thick.

### 4.3.2 Provision of information

Also see: Chapter 4.1

**Designs and specifications shall be produced in a clearly understandable format, include all relevant information and be distributed to all appropriate personnel.**

Clear and fully detailed drawings should be available on site to enable work to be carried out in accordance with the design. Design and specification information should be issued to site supervisors, relevant specialist subcontractors and/or suppliers. All necessary dimensions and levels should be indicated and relate to at least one benchmark and reference points on the site.

Information on ground conditions, the site investigation and the foundation design may be requested by NHBC, including sites which may not be classified as hazardous.

Both designers and site operatives need to be aware of the ground conditions and any features requiring special attention, such as existing sewers or other services, the water table and the presence of any hazardous substances, including sulfates.

Where toxic materials or those likely to present a health hazard are found, all available information should be supplied to NHBC, together with proposals for remediation.

Full details of junctions, steps, movement joints and any critical sequences of construction should be provided.

### 4.3.3 Ground conditions

Also see: Chapters 3.2, 4.1, 4.2 and 5.2

**Strip and trench fill foundations shall be adequate, of a suitable depth and taken to a suitable bearing stratum. Issues to be taken into account include:**

- 1) the home design and layout
- 2) ground conditions
- 3) frost susceptible soils and cold weather construction
- 4) shrinkable and volume change soils.

#### 4.3.3.1 The home design and layout

Foundation design should take account of site conditions, shape, size and construction of the homes. Foundations for terraced homes may require special precautions to prevent damage from differential settlement, while stepped foundations or suspended floors may be required for sloping sites.

The depth of foundations should provide a clean, firm and adequate bearing for the design loads.

#### 4.3.3.2 Ground conditions

All relevant information about the history of the site, plus the nature and load-bearing capacity of the ground, should be available before the foundations are designed. Information may be available from:

- NHBC
- local authorities
- gas, water and electricity companies
- aerial photographs, Ordnance Survey maps, and geological maps and surveys.

Site assessment surveys may require supplementary investigations involving trial pits and boreholes.

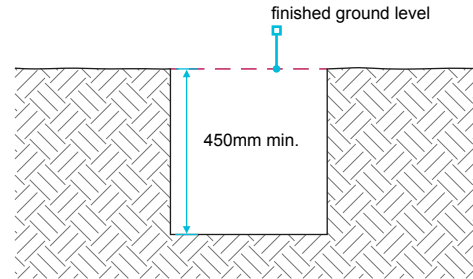
#### 4.3.3.3 Frost susceptible soils and cold weather construction

In frost susceptible soils, eg chalk, the depth to the underside of the foundation should be at least 450mm below finished ground level, to avoid damage from frost action.

Additionally, when construction is undertaken during cold weather, the foundation should either be at least 450mm below finished ground level, or alternatively, precautions should be taken to prevent freezing of the ground.

Where the finished ground level is to be above the existing ground level and cold conditions are expected, the foundation depth should be taken from the existing, not finished, ground level.

Figure 1: Minimum foundation depth below ground to give protection against frost damage



#### 4.3.3.4 Shrinkable and volume change soil

The design should specify the minimum foundation depth.

**Table 1:** Minimum foundation depths in shrinkable soil

Modified Plasticity Index	Volume change potential	Minimum depth (m)
40% and greater	High	1.0
20% to less than 40%	Medium	0.9
10% to less than 20%	Low	0.75

Shrinkable soils are classified as containing more than 35% fine particles (clay and silt) and have a Modified Plasticity Index of 10% or greater.

These minimum depths may only be used where any existing or proposed trees or shrubs are outside the zone of tree influence. Heave is possible in shrinkable soil where trees have been, or are being, removed.

#### 4.3.4 Hazardous ground

Also see: Chapters 2.1 and 4.2

**Strip and trench fill foundations on hazardous ground shall be designed by an engineer, and notice given to NHBC before work commences.**

Where hazardous ground has been identified, NHBC must be notified eight weeks before work starts. Hazardous ground is defined in Chapter 4.1 Land quality — managing ground conditions.

#### 4.3.5 Setting out

**Strip and trench fill foundations shall be set out to take account of the design details.**

The accuracy of setting out should be checked by control measurements of trenches, including their location relative to site boundaries and adjacent buildings. Levels should be checked against accepted benchmarks.

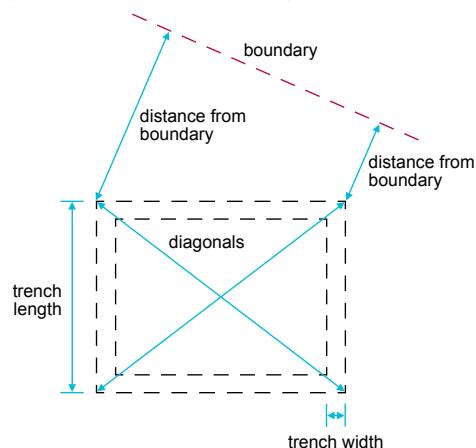
For excavations, check:

- trench lengths
- trench widths
- length of diagonals between external corners.

Walls should be located centrally on the foundation, unless specifically designed otherwise.

Any discrepancy in dimensions should be reported promptly to the designer. Resulting variations should be distributed to all appropriate persons, including NHBC.

Figure 2: Minimum foundation setting out requirements



4.3.6 Services and drainage

Also see: Chapters 5.1 and 5.3

All strip and trench fill foundations shall be installed to:

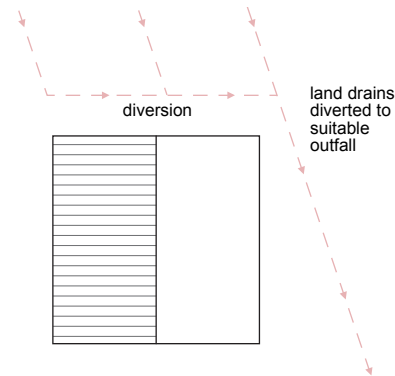
- 1) adequately protect existing services and groundwater drainage
- 2) make allowance for drainage and other services.

4.3.6.1 Adequately protect existing services and groundwater drainage

Any existing services, such as cables, water pipes or gas mains, may need to be supported and protected. Services should not be rigidly encased in the foundations, and drains which are redundant should be cut open and filled or removed. Precautions should be taken to accommodate the effects of settlement where drains run under, or near to, a building.

Provision should be made to divert or protect any existing groundwater drains affected by excavation work, see Figure 3.

Figure 3: Diversion of land drains when interrupted by proposed development



4.3.6.2 Make allowance for drainage and other services

Where services are to pass through or above foundations, provision should be made for suitable ducts or lintels to enable later installation.

Strip foundations

Services should not pass through strip foundations but through the masonry above. Adequate lintels should be provided in the masonry.

Trench fill

The load-bearing capability of foundations should not be affected where services pass through. Services should be either sleeved (Figure 4) or pass through a suitably strengthened opening in the foundation (Figures 5 and 6). This is to ensure that differential movement will not damage services.

For drainage, it is important to leave sufficient space for movement to ensure that the drain is capable of maintaining line and gradient.

Figure 4: Over-sized pipe cast as sleeve within foundations

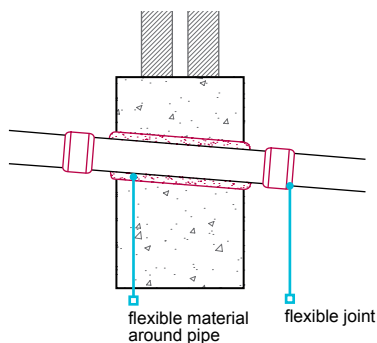


Figure 5: Opening left in masonry above or near the top of foundation with lintel over

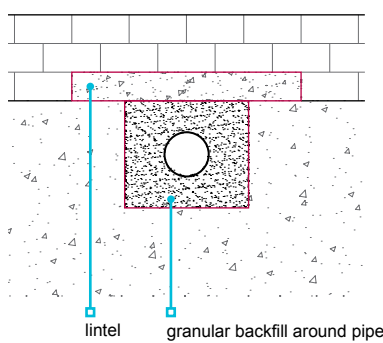
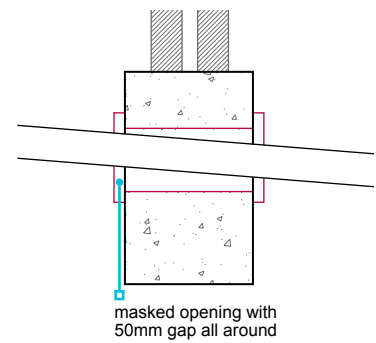


Figure 6: Opening left within deep trench fill foundation for service penetration



**4.3.7 Safe transmission of loads**

Also see: BS 8103-1

**Strip and trench fill foundations shall transmit loads to the ground safely and without excessive settlement, and take into account:**

- 1) dead and imposed loads
- 2) foundation width and thickness
- 3) stability of any adjoining building.

**4.3.7.1 Dead and imposed loads**

Dead and imposed loads should be calculated in accordance with:

<b>BS EN 1991-1-1</b>	UK National Annex to Eurocode 1: Actions on structures. General actions — Densities, self-weight, imposed loads for buildings
<b>BS EN 1991-1-3</b>	UK National Annex to Eurocode 1: Actions on structures. General actions — Snow loads
<b>BS EN 1991-1-4</b>	UK National Annex to Eurocode 1: Actions on structures. General actions — Wind actions
<b>BS 648</b>	Schedule of weights of building materials

All foundations should be:

- continuous throughout the building, including integral garages, porches, conservatories, bay windows, etc
- symmetrical beneath load-bearing elements (ie, walls should be located centrally on foundations).

**4.3.7.2 Foundation width and thickness**

The following guidance covers the design and construction of foundations only in normal or undisturbed natural ground — ie, for which the use of strip footings or trench fill foundations using unreinforced concrete, as shown in Figure 7, are sufficient. For sites where hazardous conditions exist, as described in Clause 4.3.4, and which might require reinforced strip footings, rafts or piled foundations, the design should be undertaken by a suitably qualified person.

The width of the foundation should:

- be of sufficient width throughout to avoid overstressing the ground, especially where the foundation is required to support piers or columns
- depend on the load-bearing capacity of the subsoil and the loads from the building
- not be less than the wall thickness, plus at least 50mm each side.

The width of strip foundations should account for ground conditions and be in accordance with the following table:

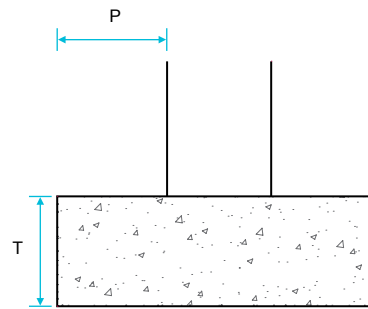
**Table 2:** Acceptable foundation widths

Type of ground	Condition of ground	Field test applicable	Total load of load-bearing walling not more than (kN/linear metre)					
			20	30	40	50	60	70
			Minimum width of strip foundation (mm)					
Rock	Not inferior to sandstone, limestone or firm chalk	Requires at least a pneumatic or other mechanically operated pick for excavation	Equal to the width of the wall plus 50mm each side					
Gravel Sand	Medium dense	Requires pick for excavation Wooden peg 50mm square in cross-section is hard to drive beyond 150mm	250	300	400	500	600	650
Clay Sandy clay	Stiff	Can be indented slightly by thumb	250	300	400	500	600	650
Clay Sandy clay	Firm	Thumb makes impression easily	300	350	450	600	750	850
Sand Silty sand Clayey sand	Loose	Can be excavated with a spade Wooden peg 50mm square in cross-section can be easily driven	400	600	Does not fall within the provisions of this guidance where the total load exceeds 30kN/linear metre			
Silt Clay Sandy clay Clay or silt	Soft	Finger can be pushed in up to 10mm	450	650				
Silt Clay Sandy clay Clay or silt	Very soft	Finger can be easily pushed in up to 25mm	Refer to specialist advice					

The thickness (T) of the foundation should be:

- equal to projection (P) or 150mm (whichever is greater)
- 150mm to 500mm for strip foundation
- 500mm minimum for trench fill foundations.

Figure 7: Typical foundation detail



### 4.3.7.3 Stability of any adjoining building

Where foundations are taken deeper than an adjoining building, excavation and construction will usually need to be carefully supervised by the design engineer, to check the standard of workmanship. Where necessary, allowance should be made in the design for differential movement.

### 4.3.8 Sloping ground and stepped foundations

**Strip and trench fill foundations shall be taken to a suitable bearing level when building on sloping ground, and steps shall be suitably formed.**

Sloping ground may require stepped foundations.

Where foundations are stepped, the height of the step (S) should not exceed the thickness of the foundation (T), unless it forms part of a foundation designed by an engineer in accordance with Technical Requirement R5.

Figure 8: Typical stepped foundation detail

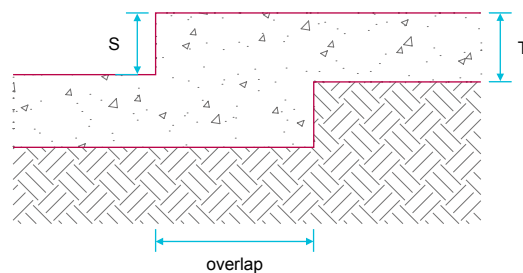


Table 3: Foundation overlap

	Strip foundations	Trench fill foundations
The overlap should be not less than:	<ul style="list-style-type: none"> <li>• 2 x S, or</li> <li>• T (maximum 500mm), or</li> <li>• 300mm, whichever is largest</li> </ul>	<ul style="list-style-type: none"> <li>• 2 x S, or</li> <li>• one metre, whichever is largest</li> </ul>

### 4.3.9 Excavations

Also see: Chapter 4.2

**Excavations for strip and trench fill foundations shall:**

- 1) take account of the design dimensions
- 2) take account of localised effects
- 3) be compact, reasonably dry, even and correctly shaped.

#### 4.3.9.1 Design dimensions

Inaccuracy may prevent walls and piers from being located centrally and therefore result in eccentric loading of foundations and possible foundation failure.

Excess excavation should be avoided. Accurate trench digging is particularly important where the width of the foundation is only slightly wider than the wall to be supported.

Acceptance from the foundation designer is required where the foundation design is modified.

#### 4.3.9.2 Localised effects

At soft spots, excavations should be deepened to a sound bottom or the concrete should be reinforced. Hard spots should be removed.

Where roots are visible at the bottom or sides of trenches, especially in clay soils, excavations may need to be taken deeper, or special precautions determined by an engineer in accordance with Technical Requirement R5.

**4.3.9.3 Compact, reasonably dry, even and correctly shaped**

Unless otherwise designed by an engineer in accordance with Technical Requirement R5:

- trench bottoms should be horizontal, with all loose material removed
- trench sides and steps should be, as near as possible, vertical.

Trench bottoms affected by rainwater, groundwater or drying should be rebottomed to form a sound surface.

**4.3.10 Reinforcement**

Also see: Chapter 3.1

**Reinforcement for strip and trench fill foundations shall ensure the safe transfer of loads and be suitable for localised ground conditions.**

Reinforcement should be:

- appropriately sized
- placed correctly
- clean and free from loose rust
- secured at laps and crossings
- supported to ensure that they are 75mm above the base of the foundation or as indicated in the design.

If in doubt about any soft spots, the designer's advice should be taken before placing the concrete.

**4.3.11 Concrete**

Also see: Chapters 3.1 and 3.2

**Concrete for foundations shall be:**

- 1) of a mix which is suitable for the intended use
- 2) durable against chemical or frost action

Concreting should be carried out, as far as possible, in one operation, taking account of weather conditions and available daylight. Concrete should be placed as soon as possible after the excavation has been checked.

For trench fill foundations, it is particularly important to check that the finished level is correct and horizontal, as it is difficult to adjust for discrepancies in the small number of brick courses between the foundation and the DPC.

Concrete procurement and execution shall be in accordance with Chapter 3.1 Concrete and its reinforcement and BS EN 13670.

**4.3.12 Movement joints**

**Strip and trench fill foundations shall have movement joints suitable for their intended purpose.**

Where movement joints are specified, they should be continuous with those in the superstructure.

Figure 9: Foundations with horizontal bottom and vertical sides and steps

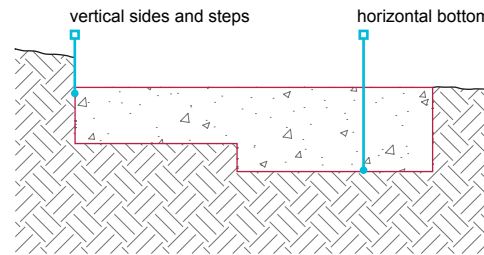
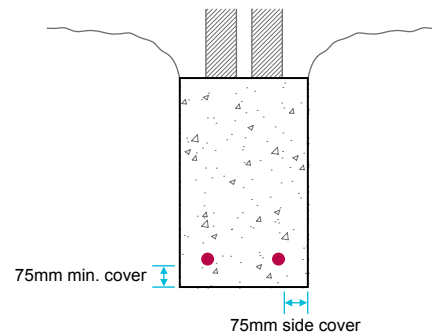
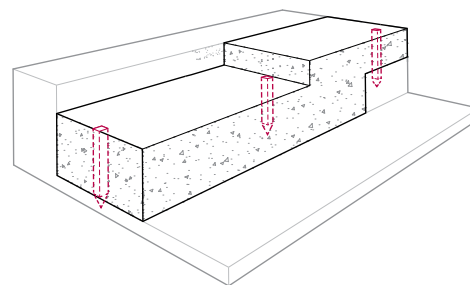


Figure 10: Reinforced foundation showing reinforcement cover



- 3) correctly mixed, placed and cured.

Figure 11: Use of pegs to ensure correct foundation levels





### 4.3.13 Construction joints

Construction joints in strip and trench fill foundations shall be suitably formed.

Where construction joints are unavoidable:

- they should not be positioned near a return in the foundation
- all shuttering should be removed before work continues beyond the construction joint
- all shuttering should be removed before work continues.

Construction joints for strip and trench fill foundations may be formed by one of the methods shown below:

Figure 12: Construction joint connected with reinforcing bars

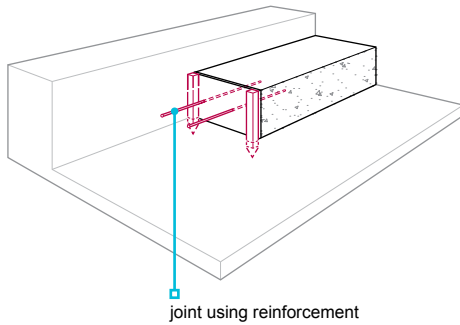
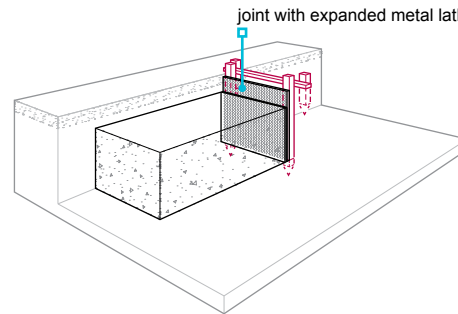


Figure 13: Construction joint formed using expanded metal lath



### 4.3.14 Further information

- *BS8103-1 Structural design of low-rise buildings. Code of practice for stability, site investigation, foundations, precast concrete floors and ground floor slabs for housing*

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