

Good Craftsmanship Guide

Foundations, Substructures
and Ground Floors



Introduction

This Good Craftsmanship Guide highlights key problems with foundations, substructures and ground floors and gives guidance on how to avoid them. The problems are those most commonly identified during NHBC's inspection of homes under construction. All photographs are of defects and were taken on real building sites.

The Guide, based on the NHBC Standards, is intended for use by NHBC registered builders and inspection staff.

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Contents

Foundations (strip and trench fill)	
Foundation depth	2
Building near trees	4
Setting out (foundation)	6
Excavation	8
Heave precautions	11
Concreting	13
Substructure	
Setting out (substructure)	16
Position of DPC	17
Access and thresholds	18
Drains/service entries	20
Ground bearing floors	
Ground below fill	22
Fill supporting ground bearing slabs	24
Damp-proofing	25
Insulation	27
Suspended ground floors - block and beam and precast planks	
DPC position	28
Heave precautions	29
Ventilation of underfloor voids	30
Bearings	31
Radon and other ground gases	32

Foundation depth

Problem to avoid:

- Foundation movement



What to do:

- excavate foundation to design depth (refer to Appendix 4.2-H of NHBC Standards when building on clay soil near trees)

- in frost susceptible soils ensure minimum foundation depth is 450mm to avoid frost action
- in soils that are subject to volume change on drying e.g. clay the following table should be observed

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

obtain Engineer's advice if foundation is more than 2.5m deep

Building near trees

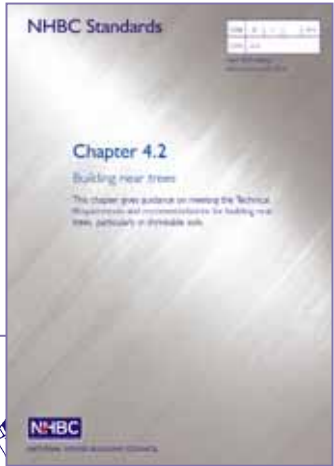
Problem to avoid:

- Foundation movement due to shrinkage or heave of clay soil



What to do:

- identify species of existing, removed and proposed trees and their water demand
- measure height of trees and distance from foundations (including trees outside the plot boundary)
- determine volume change potential of soil (if not known, assume 'high')
- determine the minimum acceptable foundation depth in accordance with NHBC Standards Chapter 4.2 'Building near trees'



- incorporate heave precautions - see page 11

Setting out (foundation)

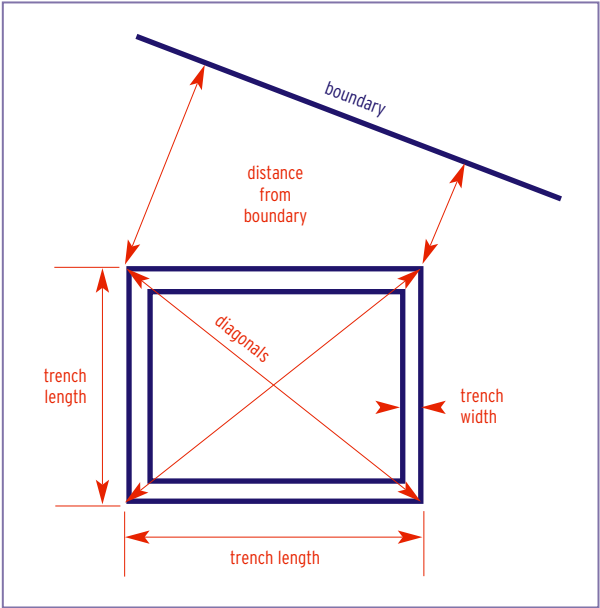
Problem to avoid:

- Foundation in wrong place
- Foundation wrong size
- Foundation not square
- Foundation out of level



What to do:

- check all measurements carefully
- on sloping sites check measurements horizontally
- check diagonals are equal
- check levels carefully



Excavation

Problem to avoid:

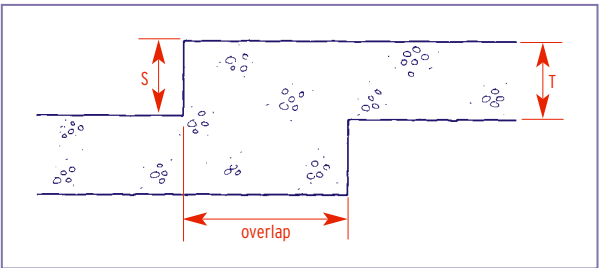
- Foundation movement



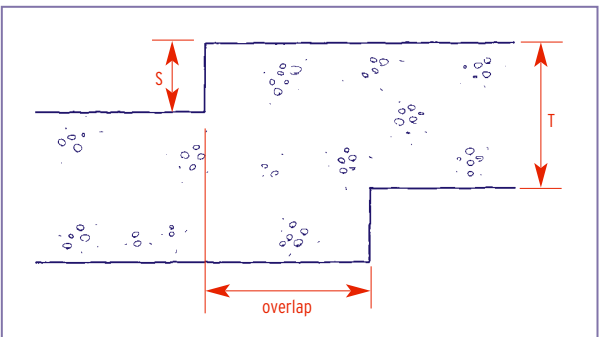
What to do:

- foundations should bear onto consistent and competent ground
- investigation should prove that the ground is competent below the foundation for a distance of at least 1.5 times the width of a strip or trench fill foundation
- ensure trenches are in the right place and straight
- excavate trench to correct depth and width
- ensure trench sides are vertical and bottoms horizontal
- make sure any steps in trench are in the right place
- make sure any steps are of the right height and provide for the correct overlap

- the overlap should be *not less* than:
 - $2 \times S$, or
 - T (maximum 500mm), or
 - 300mm,whichever is the largest



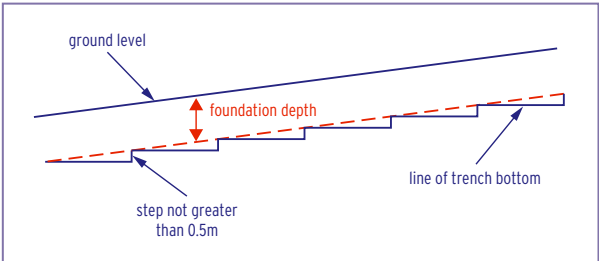
- the overlap should be *not less* than:
 - $2 \times S$, or
 - one metre,whichever is the larger



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Excavation

- in clay soils near trees steps should not exceed 0.5m



- obtain Engineer's advice if unexpected ground conditions or significant quantities of roots are encountered
- re-bottom trenches if affected by ground water or drying

Heave precautions

Problem to avoid:

- Foundation movement due to heave of clay soils

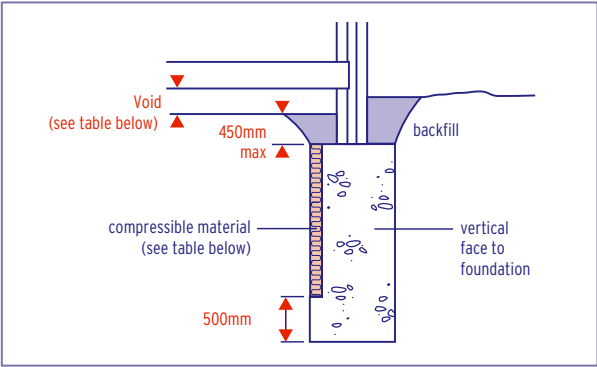


What to do:

- provide heave precautions to the inside faces of external wall foundations that are more than 1.5m deep

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Heave precautions



Note: It is essential that:

- compressible material is provided to the entire area shown, and
- the foundation excavation has a vertical face. Where the excavation is battered or if there is overbreak or concrete overspill it may be necessary to consult an Engineer.

	Against side of foundation and ground beam
Volume change potential	Void dimension [mm] ¹
High	35
Medium	25
Low	0

Note: ¹For compressible material the void dimension is the amount the material should be able to compress to accommodate heave. The actual thickness of compressible material required should be established from the manufacturer's recommendations and is generally in the order of twice the void dimension shown.

- ensure correct thickness and type of compressible material is used - check manufacturer's recommendations and volume change potential of soil
- ensure compressible material is held in place firmly

Problems to avoid:

- Contamination of concrete
- Reduced strength

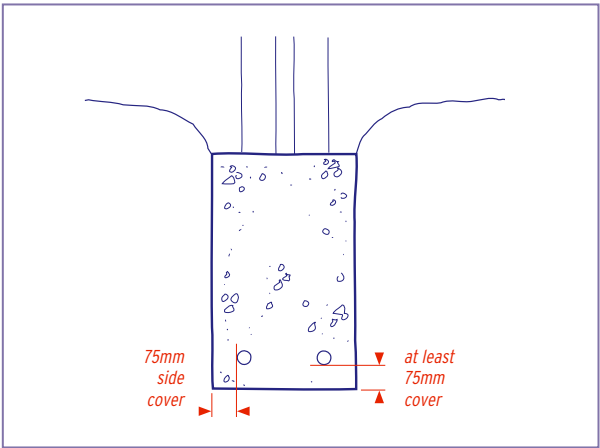


What to do:

- remove all water and loose material from base of trench
- re-bottom trenches if affected by ground water or drying
- make sure any reinforcement is correctly placed in accordance with the design with at least 75mm cover (or as specified in the design)

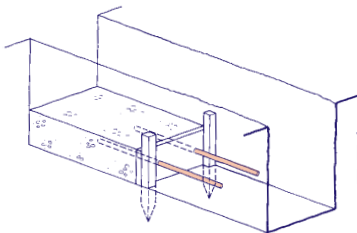
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Concreting



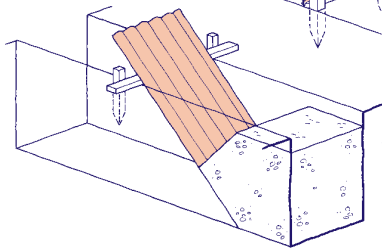
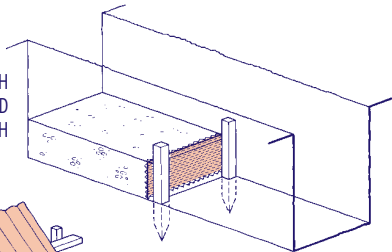
What to do:

- ensure reinforcement is adequately lapped and tied
- make sure the correct mix of concrete is used in accordance with the design - check delivery notes for ready-mixed concrete
- ensure the depth of concrete is in accordance with the design and not less than 150mm
- if construction joints are unavoidable they should be formed away from returns in the foundation by one of the methods opposite



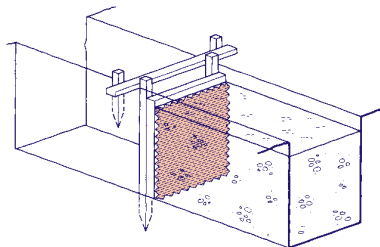
JOINT USING
REINFORCING
BARS

JOINT WITH
EXPANDED
METAL LATH



JOINT USING
CORRUGATED
METAL FORMER

JOINT WITH
EXPANDED
METAL LATH



Setting out (substructure)

Problems to avoid:

- Inadequate support
- Substructure in wrong place
- Substructure wrong size
- Substructure not square
- Substructure out of level



What to do:

- make sure substructure wall is located centrally on foundation to avoid eccentric loading
- check all measurements carefully
- check diagonals are equal
- check levels carefully

Position of DPC

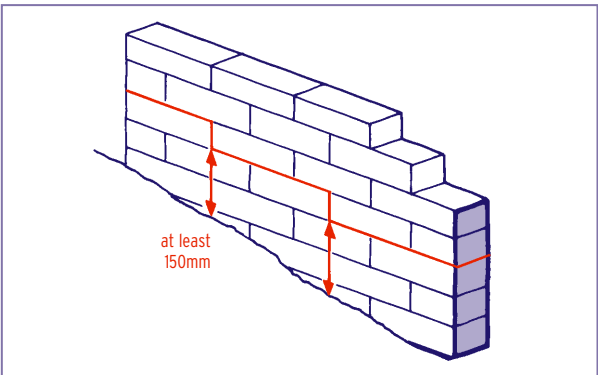
Problem to avoid:

- Rising damp



What to do:

- locate dpc at least 150mm above external ground or paving level



Access and thresholds

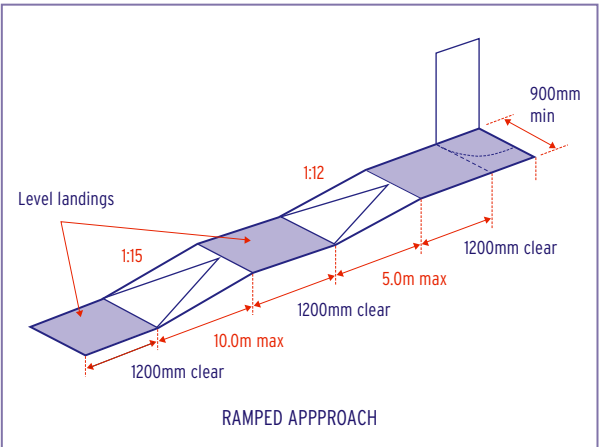
Problem to avoid:

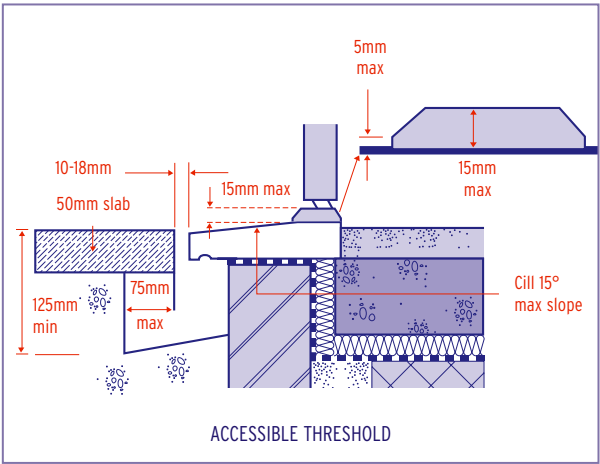
- Unacceptable ramps



What to do:

- ensure ramps to principal entrance do not exceed 1:12 and ideally 1:20





Note: The design of the threshold is critical in terms of accessibility and being weathertight.

Drains/service entries

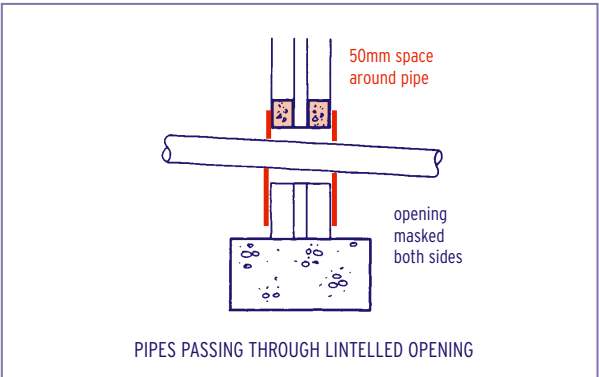
Problem to avoid:

- Entry of vermin and gases

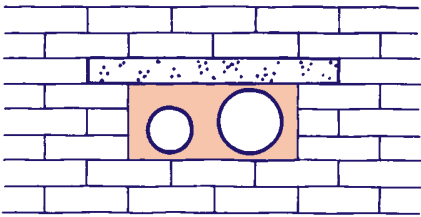


What to do:

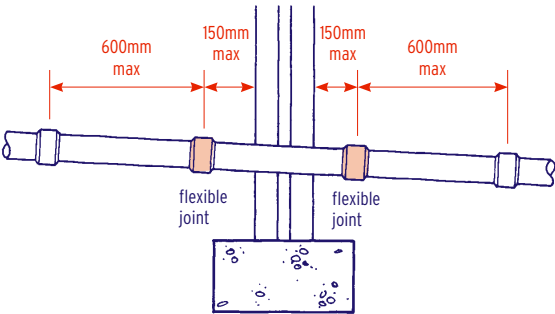
- mask service entries to prevent vermin entry. Rigid plastics board is a suitable material



lintel over multiple services



- where required, seal around drains and service entries to prevent entry of gases
- alternatively services can be built in provided that movement is allowed for



PIPES BEDDED IN WALLS

Ground below fill

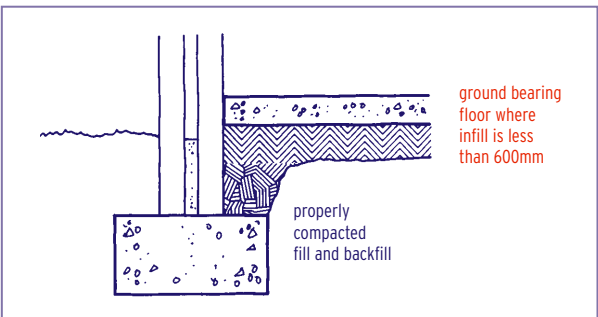
Problem to avoid:

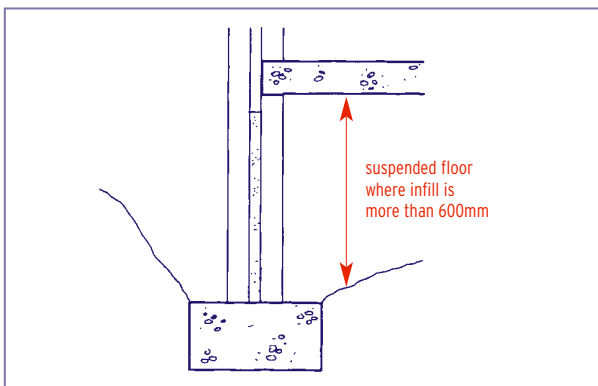
- Movement of floor due to inappropriate fill



What to do:

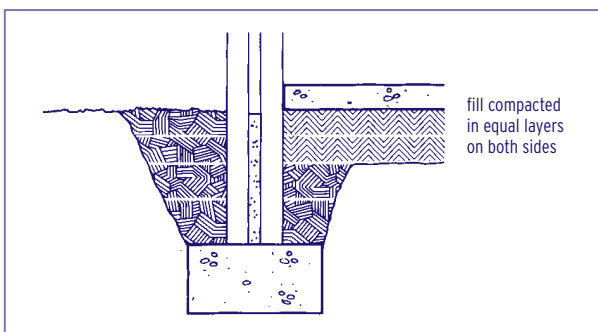
- strip all vegetable soil and organic matter
- ensure depth of fill will not exceed 600mm, otherwise use a suspended floor
- compact fill in layers





What to do:

- ensure ground is suitable to support floor loads and any other loads
- compact trench backfill carefully and equally on both sides of substructure



- avoid constructing ground bearing slabs on clay in summer and autumn unless NHBC is satisfied the soil is not desiccated

Fill supporting ground bearing slabs

Problem to avoid:

- Movement of floor



What to do:

- ensure depth of fill will not exceed 600mm, otherwise use a suspended floor
- use well graded inert fill without hazardous materials which passes a 150mm x 150mm screen
- mechanically compact fill in layers not exceeding 225mm

Damp-proofing

Problem to avoid:

- Rising damp

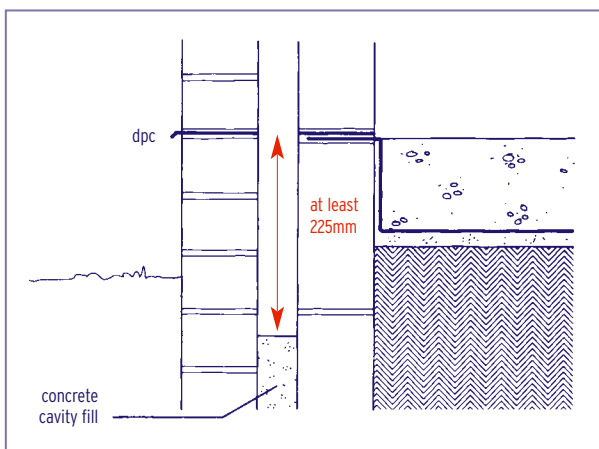


What to do:

- provide smooth blinding, e.g. sand
- use suitable dpm material e.g. 1200 gauge (0.3mm) polythene sheet
- ensure dpms are lapped at least 300mm and sealed where necessary
- link floor dpm with wall dpcs

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Damp-proofing



Insulation

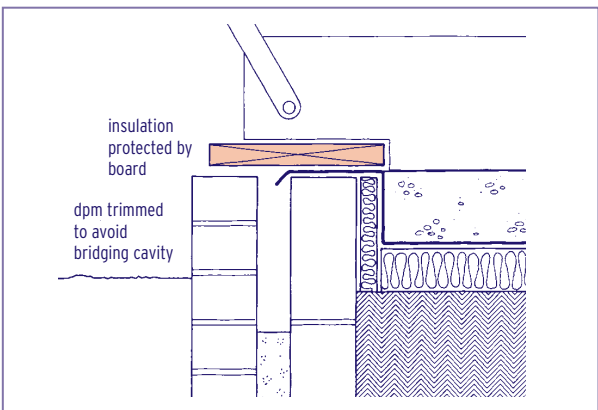
Problem to avoid:

- Cold bridging and condensation



What to do:

- provide insulation to floors in accordance with design
- protect insulation during construction to avoid damage



DPC Position

Problem to avoid:

- Rising damp through floors



What to do:

- provide dpc below end bearings of floor beams or planks. Alternatively position dpc on top and provide a dpm to top surface of floor

Heave precautions

Problem to avoid:

- Movement of floor due to heave of clay soil



What to do:

- provide void under floors to accommodate heave where required, to comply with NHBC Standards Chapter 4.2

	Precast concrete
Soil heave potential	Void dimension [mm] ¹
High	225
Medium	175
Low	125

Note: ¹ Measurement from underside of floor/beam to ground level (includes 75mm ventilation allowance).

Ventilation of underfloor voids

Problems to avoid:

- Condensation and dampness
- Build-up of gases



What to do:

- provide a void of at least 75mm (see page 27 for minimum void where heave precautions are necessary)
- ventilate underfloor void:
 - provide clay air bricks (225mm x 75mm) at 2m centres
 - provide clay air bricks (225mm x 150mm) at 1.5m centres in Scotland
- Ensure air bricks / ventilators are unobstructed

Bearings

Problems to avoid:

- Inadequate bearing
- Bridging the cavity



What to do:

- ensure minimum bearing of 90mm at each end of beam/plank
- ensure beams do not obstruct the cavity

Radon and other ground gases

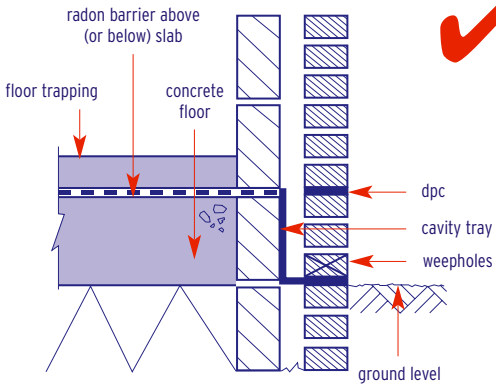
Problems to avoid:

- Radon/Gas leaks
- Damp penetration

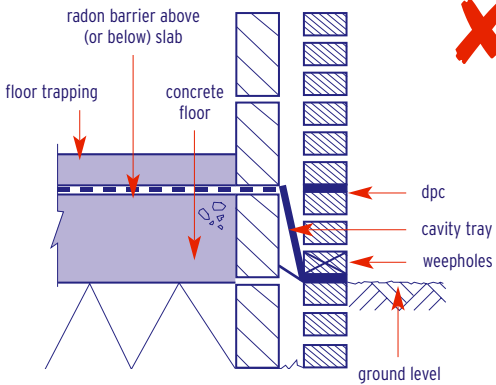


What to do:

- use correct materials
- carefully lap and seal membrane
- carefully seal around service entries (preformed components are available)
- ensure membrane is not damaged
- position correctly across the cavity - stepped not diagonal
- ensure good workmanship particularly at corners and door openings (preformed components are available)
- provide cavity trays and weepholes



CORRECT INSTALLATION



INCORRECT INSTALLATION

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