

ISSUE570 BULLETIN



GROUND CLEARANCES

April 2014

■ Insufficient clearance to the finished outside ground levels can result in deterioration of building materials or an increased risk of water entry.

■ Details for level entries must be submitted for consent as an alternative method unless following Figures 17A or 17B of E2/AS1.

■ This bulletin outlines the key requirements from E2/AS1 and NZS 3604:2011 *Timber-framed buildings* to provide adequate ground clearances. It replaces Bulletin 353 *Ground clearances*.

1.0 INTRODUCTION

1.0.1 Insufficient clearance to the finished outside ground levels, such as floor slab to ground or bottom of cladding to ground, is a common building problem as highlighted in the 2010 BRANZ House Condition Survey and can result in deterioration of building materials or an increased risk of water entry into the building.

1.0.2 Where building owners and designers prefer to have indoor floor levels close to the ground or paving at entry points, the proposed details (unless following Figures 17A or 17B of E2/AS1) must be submitted for consent as an alternative method and show how water will be dealt with.

1.0.3 This bulletin outlines the key requirements from E2/AS1 and NZS 3604:2011 *Timber-framed buildings* to provide adequate clearance between building materials, floor levels and the outside ground or paving levels. It replaces Bulletin 353 *Ground clearances*.

1.0.4 The problems that may result from inadequate ground clearances and lack of ventilation may cause internal damage to structural elements, which can remain undetected until it is far advanced.

1.1 WHAT ARE GROUND CLEARANCES?

1.1.1 Excessive moisture levels are the primary cause of poor material performance in buildings, and achieving minimum required distances from the ground or outside levels is necessary to keep buildings as dry as possible. These distances prevent:

- moisture absorption by and deterioration of cladding
- moisture being transmitted from the ground to wall framing and adjacent elements such as insulation and linings
- foulwater overflow from gully traps entering the building.

1.1.2 Specific requirements for ground clearances are:

- providing sufficient distance between the ground and:

- building elements susceptible to moisture damage such as:
 - the underside of the floor framing for suspended timber-framed floors
 - the bottom of the cladding (or between paving and the bottom of the cladding)
 - inside floor levels (or between the floor and a deck or balcony)
- preventing water flow from groundwater or foulwater into a building.

1.2 PROBLEMS CAUSED BY INADEQUATE GROUND CLEARANCES

1.2.1 The most commonly reported problems resulting from inadequate ground clearances are:

- water splash onto absorbent claddings such as timber, fibre-cement and masonry

- water movement by capillary migration to the cladding and/or framing and flooring
- premature failure of paint finishes when claddings are continuously damp
- soil, paving, concrete, gravel or other external surfaces in direct contact with the cladding.

1.2.2 For concrete slab-on-ground floors, specific problems occur when:

- drainage slots for masonry (brick) veneer claddings are below ground level or blocked, causing water to build up in the cavity and creating damp conditions that cause rot in timber wall framing and general dampness resulting in a reduction in insulation, and mould formation within the wall and on interior surfaces
- drainage slots for aluminium joinery are blocked, by paving or soils, causing water to spill inside and damage carpets/floors
- paving is laid on the ground, resulting in a finished level that is above the floor, thus allowing water to migrate through the external envelope into the structure.

1.2.3 For suspended timber floors, the problems caused by having the floor level too close to the ground and/or building up the soil (for gardens) around the building include:

- blocked subfloor ventilation openings, resulting in dampness and premature deterioration of timber framing and flooring materials
- high levels of moisture in subfloor framing, flooring and cladding timbers causing rot in timber, corrosion of fixings, and dampness and mould within the wall and on interior surfaces
- increased levels of humidity inside the building
- damage to insulation within wall framing cavities
- blocked vents and drainage slots in cladding and aluminium joinery
- channelling of water through subfloor ventilation openings
- inadequate space for maintenance access.

1.2.4 For foulwater drainage systems, the potential problems are:

- inability on the part of the drainlayer to achieve the minimum falls as specified in New Zealand Building Code clause G13 *Foul water* AS2 clauses 3.3.1(a) or AS/NZ 3500.2:2003 *Plumbing and drainage – Part 2: Sanitary plumbing and drainage* clauses 4.6.6.6 and 4.6.6.7
- surface water entering the foulwater drain through a gully trap because the trap surround is installed below ground level. The trap surround should have an upstand of 25mm for paved surfaces and 100 mm for unpaved ground (G13/AS2 Figure 2) to prevent surface water entering the drains.

1.3 BUILDING CODE

1.3.1 New building work and most alterations to an existing building must comply with the requirements of the New Zealand Building Code (NZBC). Designers and builders should inform owners (who are usually

unaware of the specific Building Code requirements) of the requirements with respect to ground clearances.

1.3.2 Specific functional requirements of the NZBC relating to ground clearances:

- E1 *Surface water*: Clause E1.2 requires that buildings and sitework shall be constructed in a way that 'protects people and other property from the adverse effects of surface water'.
- E2 *External moisture*: Clause E2.2 states that buildings shall be constructed to provide adequate resistance to penetration by, and the accumulation of, moisture from the outside.

1.3.3 Specific Building Code performance requirements (applicable to housing, communal residential and communal non-residential buildings) relating to ground clearance:

- For clause E1:
 - Surface water from a storm with a 2% probability of occurring annually shall not enter buildings.
- For clause E2:
 - Walls, floors and structural elements in contact with the ground shall not absorb or transmit moisture in quantities that could cause undue dampness or damage to building elements.
 - Building elements susceptible to damage shall be protected from the adverse effects of moisture entering the space below suspended floors.
 - Concealed spaces and cavities in buildings shall be constructed in a way that prevents external moisture from being transferred and causing condensation and the degradation of building elements.

1.3.4 E1/AS1 is limited to sites (of up to 0.25 hectares) that are not in low-lying or flood-prone areas or sites located alongside a watercourse or in a secondary flow path. Building in such areas, which are outside the scope of E1/AS1, require specific design solutions (such as higher pole foundations, higher timber treatment levels) and need to be dealt with as an Alternative Solution. The general principle is that the floor level should be at least 150 mm above the finished level of the surrounding ground immediately adjacent to the building. Figures 1 and 2 in E1/AS1 show that, in addition to this general requirement, specifically:

- where the site is level with or above the road, the floor level of a building must be at least 150 mm above the crown of the road surface (on at least one cross-section through the site)
- where the site is below the road, the floor level must be at least 150 mm above the lowest point on the site boundary.

1.4 REASONS GIVEN FOR INADEQUATE GROUND CLEARANCES

1.4.1 Factors that may have had an influence on buildings being constructed or altered with inadequate ground clearances include:

- lack of knowledge, by builders and designers, of the ground clearance requirements

- failure to show a proper datum point and the necessary clearances on construction drawings
- lack of understanding of the consequences of raising levels around the house by those working on the site after the main construction is completed, in particular landscapers and owners
- not properly understanding why ground clearances are required, or ignoring the ground clearance requirements in order to:
 - satisfy client/designer demands for internal/external surfaces at the same level
 - satisfy aesthetic requirements of the owner/designer
 - reduce the cost of building
- insufficient allowance for the slope of the site during initial site survey
- build-up of ground level against the foundation/cladding after construction to allow for paving or planting
- lack of maintenance around the building perimeter leading to build-up of vegetation and soil level.

2.0 PROVIDING ADEQUATE CLEARANCES

2.1 DESIGN AND CONSTRUCTION REQUIREMENTS

2.1.1 At the design stage, the designer should do the following:

- Advise clients of the:
 - legal requirements of the NZBC to protect their health and safety
 - minimum durability requirements of the NZBC for structure (50 years) and cladding (15 years)
 - potential problems that will occur in a building constructed without adequate clearances.
- Take or obtain accurate site levels to determine actual contours and slopes before commencing design. This will allow the minimum ground clearances to be accurately set prior to construction commencing.
- Show minimum clearances of E2/AS1 and NZS 3604:2011, as outlined in Table 1, on the drawings.
- Where at-grade access is essential:
 - detail a drainage system around the perimeter of the building that diverts run-off to the stormwater system
 - always slope paving away from the building (a minimum fall of 1:25 is recommended as shown in Figure 1, although for disabled access ramps, the maximum slope must not exceed 1:12)
 - incorporate proprietary trench drains at entrances (for wheelchair access or where outdoor patio areas are at the same height as the adjoining floor level)
 - consider providing a transition space such as a porch or veranda to provide protection from the weather.
- Make allowance for final soft landscaping and hard landscaping particularly where additional base course fill or topsoil is being brought on to the site to form finished levels. While circumstances differ in every case, a useful guide is to form the surrounding

site at least 300 mm below the finished floor level of the house. This allows for finished landscaping and paving levels to be built up approximately 75 mm.

- At stepped doorways, provide a step of at least 150 mm – sufficient upstand will still remain if paving is then laid on the natural ground.
- For suspended floors, specify:
 - that particleboard or wood-based flooring is installed in accordance with the manufacturer's instructions (for example, particleboard manufacturers require a clear gap of 550 mm between the underside of the flooring and the

ground to meet the durability requirements of the NZBC)

- that, on flat sites, ground levels under the house are preferably higher than the level of the ground outside the house (Figure 1) to reduce the chance of water flowing or ponding under the house.
- Ensure the minimum measurements for the foulwater system are in accordance with G13/AS2 or AS 3500.2 (Figure 2).
- Obtain specific requirements provided by product manufacturers for clearances as they may differ from E2/AS1 and NZS 3604:2011 minimums.

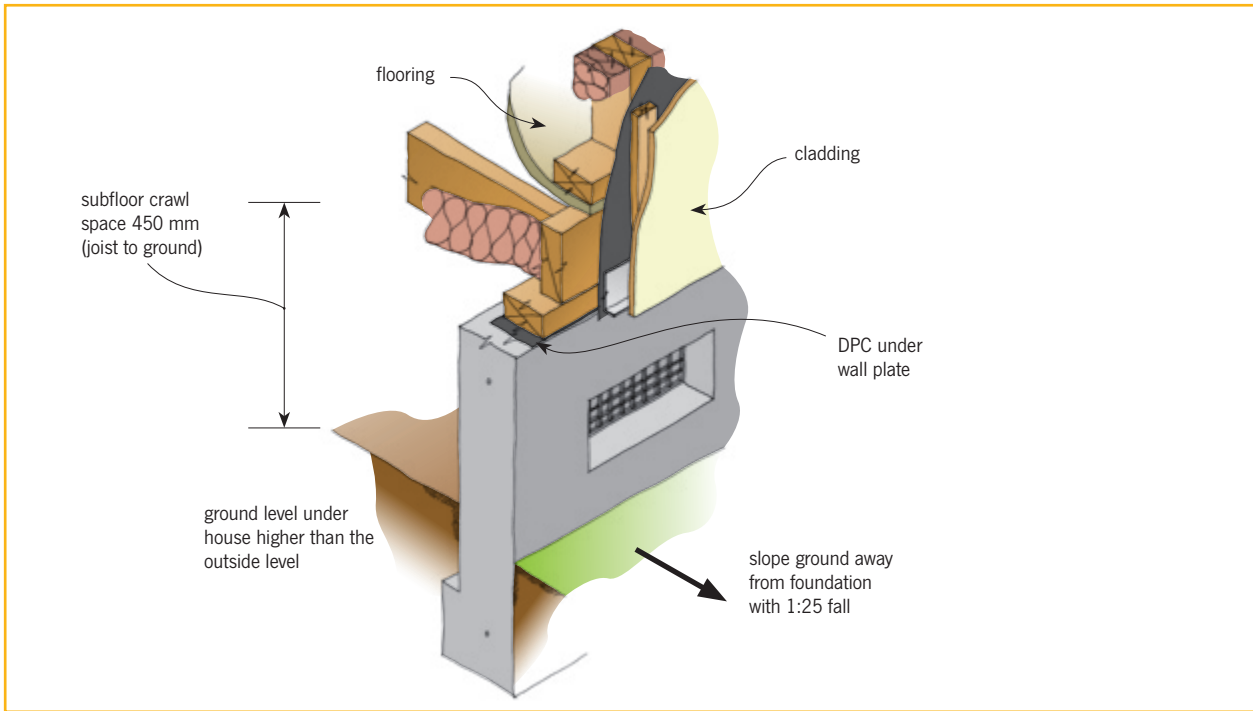


Figure 1 Relative ground levels and recommended subfloor crawl space heights – when sloping ground away from the building, NZS 3604:2011 7.5.2.2 requires the sloped area be at least 1 m wide where practical

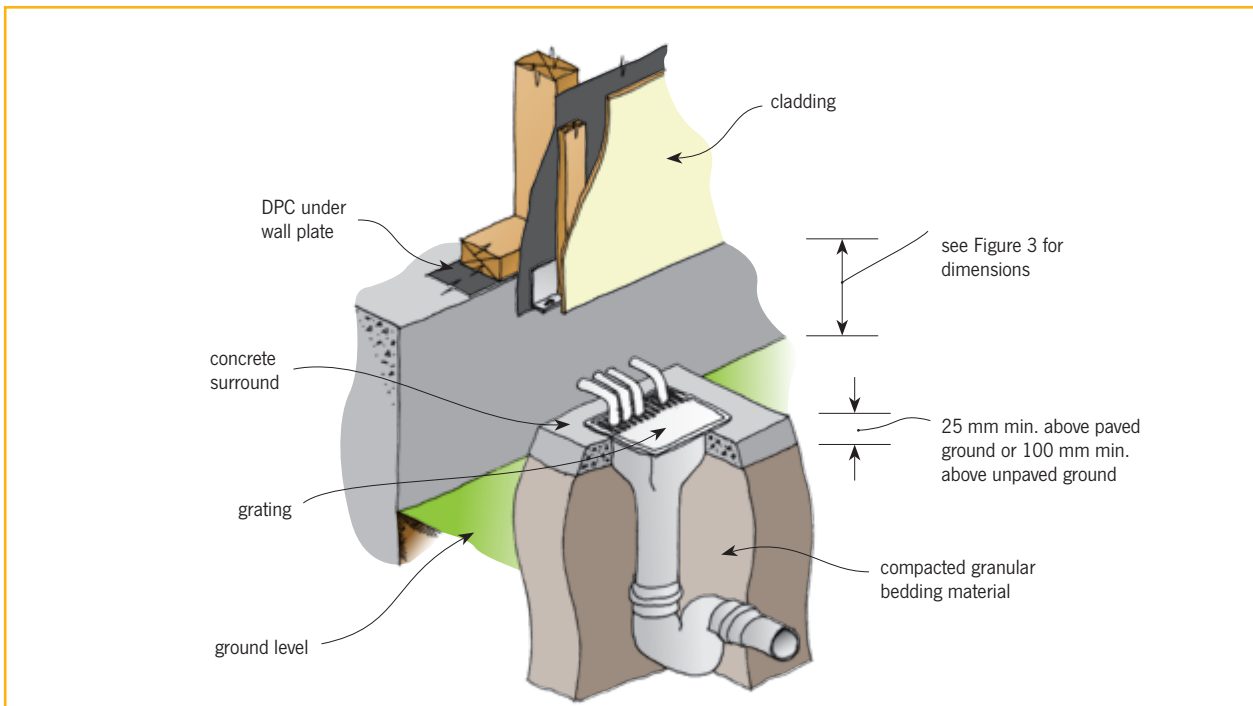


Figure 2 Gully trap construction and dimensions – for concrete slabs on ground, waste pipes must be laid below the concrete slab, which will determine the gully trap installation height – waste pipes through a concrete foundation wall need to be sleeved

TABLE 1 MINIMUM PERMITTED CLEARANCES (FROM E1/AS1, E2/AS1 AND NZS 3604:2011)		
Description	Minimum height (mm)	Source (1)
Building floor level: • for sites below road level • for sites level with or above the road	Suspended floors and slabs on ground shall be at least 150 mm above the finished level of the surrounding ground immediately adjacent to the building and: • 150 mm above the lowest point on the boundary • 150 mm above the road crown	NZBC E1/AS1 Figures 1 and 2 and clause 2.0.1
Concrete slab on ground – finished floor level to ground (Figure 3) for brick veneer cladding	• Floor level 100 mm minimum above paving, or 150 mm minimum above soil • Floor level 50 mm minimum rebate depth with 25 mm minimum from rebate level to paved ground and 100 mm to unpaved ground	NZBC E2/AS1 E2/AS1 (Fig 73D); NZS 3604 (Fig 7.11)
Concrete slab on ground – finished floor level to ground (Figure 4) for other cladding types	• Floor level 150 mm minimum above paving, or 225 mm minimum above soil	E2/AS1 Table 18
• Bearer framing (i.e. top of timber pile) above finished ground level (Figure 5) • Driven timber piles • Bearer framing (i.e. top of concrete pile) above finished ground level	• 300 mm, or 150 mm with damp-proof course (DPC) • 300 mm, or 150 mm with DPC • 150 mm with DPC	NZS 3604 6.4.1.1(c) NZS 3604 Fig 6.4 NZS 3604 Fig 6.3
Top of foundation wall above finished ground level	225 mm	NZS 3604 6.11.2
Bottom of the cladding to the ground for suspended timber floor construction	175 mm	NZS 3604 Fig 6.21
Recommended crawl space (measured from ground to the underside of joists) (2,3)	450 mm – can be formed by trenching to provide access under bearers	NZS 3604 6.14.4
Concrete floor of attached garage to paving (with 20 mm set-down rebate for garage door)	50 mm – at the door opening, the height between the bottom edge of garage cladding and the driveway must be at least 25 mm	E2/AS1 9.1.3, Fig 65 and Table 18
Horizontal clearance between cladding and adjacent ground	450 mm horizontal (at bottom of cladding)	NZS 3604 6.14.5, Figs 6.21 and 7.12

Notes:

- (1) NZS 3604:2011 is deemed to be an Acceptable Solution to the NZBC clause B1 *Structure*.
- (2) Clearance must be provided at one point along each line of bearers to allow a person access under the bearer.
- (3) Check the literature of the flooring manufacturer to determine product-specific minimum ground/flooring dimensions.

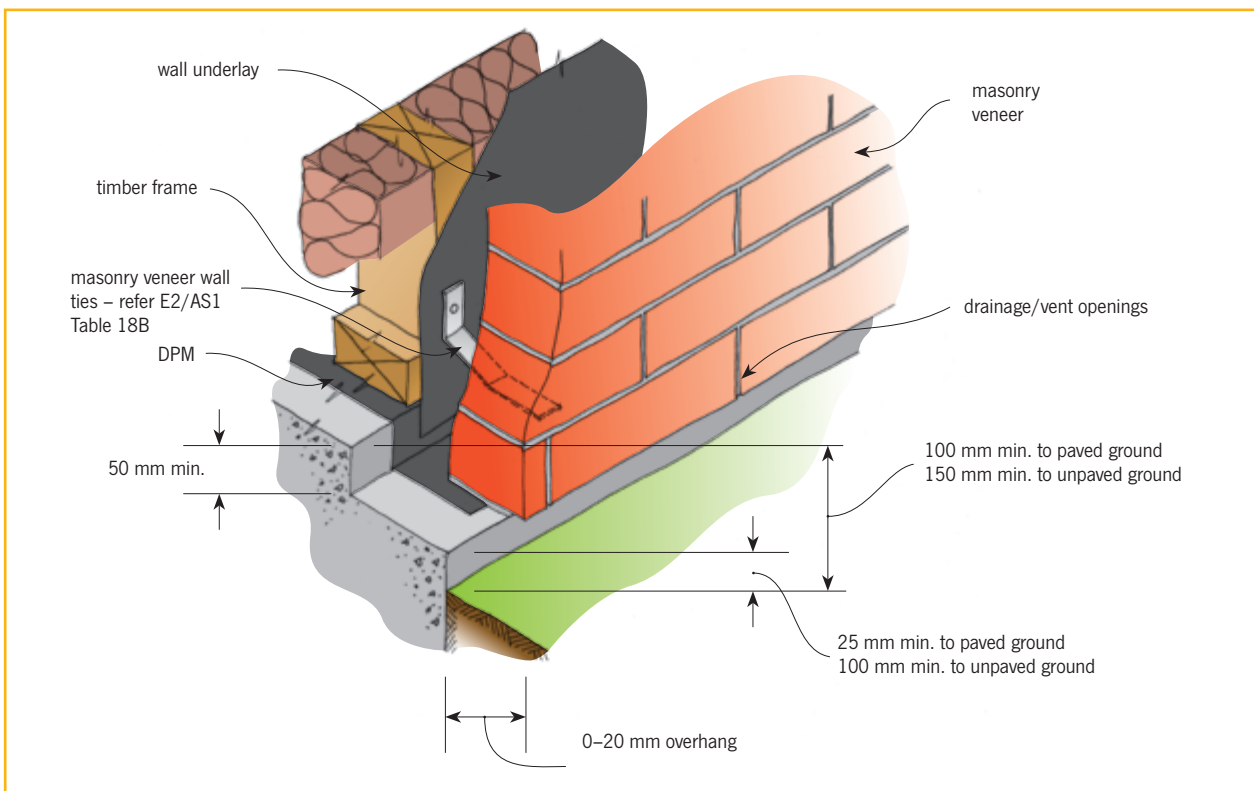


Figure 3 E2/AS1 floor rebate detail for masonry veneer

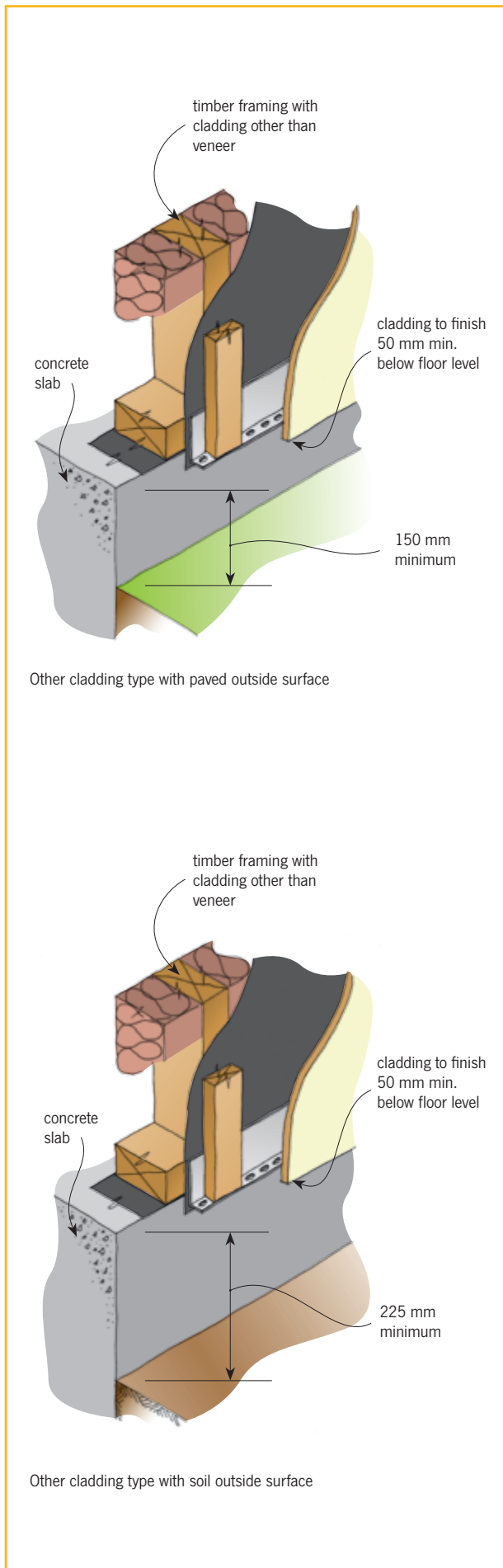


Figure 4 Minimum clearances for claddings other than masonry veneer

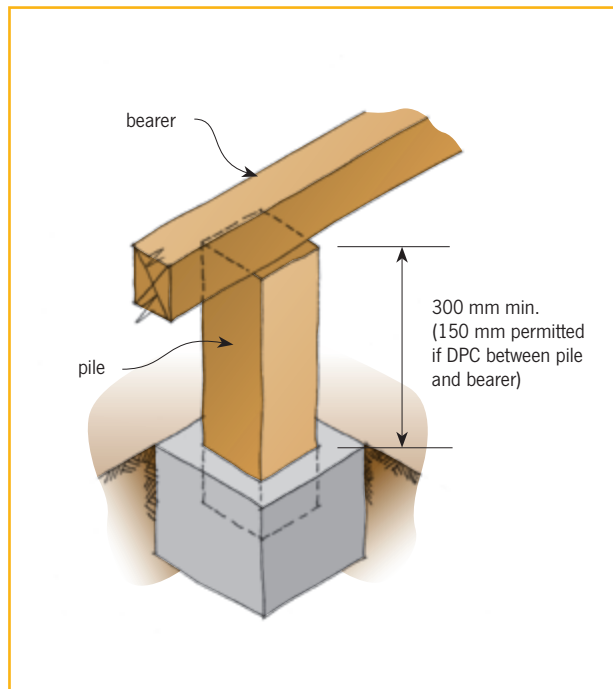


Figure 5 Minimum heights for an ordinary timber pile

2.1.2 During construction, the builder should:

- ensure that construction drawings provided by the designer include accurate site levels and datum, with floor levels and clearances
- remove surplus soil from the area immediately around the building
- ensure drainage slots to veneer claddings are clear
- not obstruct subfloor vents with subfloor framing, plaster or paint
- ensure that new paved areas are constructed to direct water away from the building and are finished to the correct level.

2.1.3 For completed buildings, the owner should be advised by those designing and constructing the building to:

- not build up soil or garden mulch around the base of the building unless the top surface will be below subfloor vents, drainage slots in veneer walls and aluminium joinery
- not introduce any planting in front of subfloor vents
- not block vents to stop airflow under suspended floors.

2.2 REMEDYING EXISTING BUILDINGS

2.2.1 In older homes, some bearers or even floor joists may often be too close to the ground or, in the worst cases, in direct contact with the ground. Where existing buildings have a moisture problem related to insufficient ground clearance, the situation can be improved by laying a damp-proof membrane (polythene) over the ground and ensuring ventilation of the subfloor is at least in accordance with NZS 3604:2011. If the moisture problem persists or access needs to be provided, options are:

- excavating to lower ground levels and laying paving around the outside of the building – paving should be laid with a cross-fall to direct surface water away from the building

- lowering the ground levels around the house by removing excess soil (bearing in mind that lowering the ground level below that of an adjacent property may give rise to the need for a retaining wall and may also introduce water from the adjacent site)
- clearing obstructions to vents and veneer drainage slots
- ensuring there is a DPC between any timber and concrete
- increasing the area of permeable paving around the building to maximise surface water dispersal and absorption into the ground (rather than concentrated collection)
- installing subsoil drains around the perimeter of the building (Figure 6), which must then discharge by gravity (or pump) via a sump into a stormwater drain
- installing trench drains for paved areas – E2/AS1 includes examples (Figures 17B (a) and (b) for level-access thresholds at entrances for both concrete and timber floors
- excavating between rows of piles if there is inadequate crawl space for houses constructed on piles – raising the entire structure may also be considered (particularly if repiling is required in any case). The local District Plan should be checked for planning rules such as overall building height and height in relation to boundary restrictions before deciding to raise the structure.

2.2.2 In the case of concrete floors, if moisture is an issue (which can be attributed to the lack of a suitable damp-proof membrane), a solution may be to lay a new topping slab over a new damp-proof membrane.

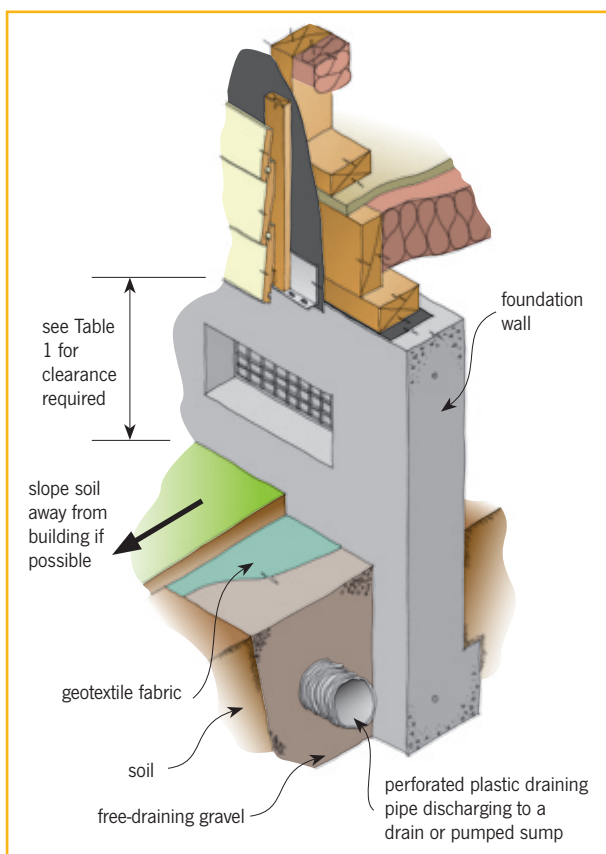


Figure 6 Subsoil drain around a building

2.3 CLADDINGS BELOW GROUND

2.3.1 With the exception of masonry veneer (provided it is correctly detailed), BRANZ does not support the practice of installing claddings below ground.

2.3.2 Where an existing building has cladding that is too close to or below the ground, the options are to:

- lower the outside ground levels
- lift the existing house (piled foundations)
- for concrete slabs on ground, obtain the advice of a remediation design specialist – one option is removal of cladding and the construction of a nib to the existing slab to lift the bottom plates and therefore the bottom of the new cladding. The MBIE publication *Weathertightness: Guide to remediation design* and the BRANZ website www.weathertight.org.nz provide useful diagrams showing possibilities for remediation where clearances are inadequate (for concrete floors, door thresholds and concrete decks).

2.4 PROVIDING LEVEL ACCESS

2.4.1 E2/AS1 Figure 17B details one Acceptable Solution for providing level access to a doorway that incorporates a drainage channel adjacent to the building structure, but this detail is limited to drainage channels with a maximum length of 3,700 mm with a minimum fall of 1:200. Details outside these dimensions will need to be submitted for consent as an alternative method that shows the:

- capacity it is designed for
- extent of the drainage channel – length, width
- slope of the channel and the adjacent paving
- connection of the channel to the stormwater drain
- how the channel is to be accessed for cleaning.

3.0 FURTHER READING

BRANZ Bulletins

- 379 *Preventing moisture problems in existing buildings*
- 449 *Keeping water out – timber-framed walls*
- 457 *Ventilation of enclosed subfloor spaces*
- 469 *Damp-proof membranes to concrete slabs*
- 516 *Moisture management in masonry veneer*
- 550 *Damage from weathertightness failure*

4.0 CODES AND STANDARDS

New Zealand Building Code Acceptable Solutions

- E1/AS1 *Surface water*
- E2/AS1 *External moisture*
- G13/AS2 *Foul water*

Standards New Zealand

- NZS 3602:2003 *Timber and wood-based products for use in building*
- NZS 3604:2011 *Timber-framed buildings*
- NZS/AS 3500.2:2003 *Plumbing and drainage – Part 2: Sanitary plumbing and drainage*

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