AIVC
#10253

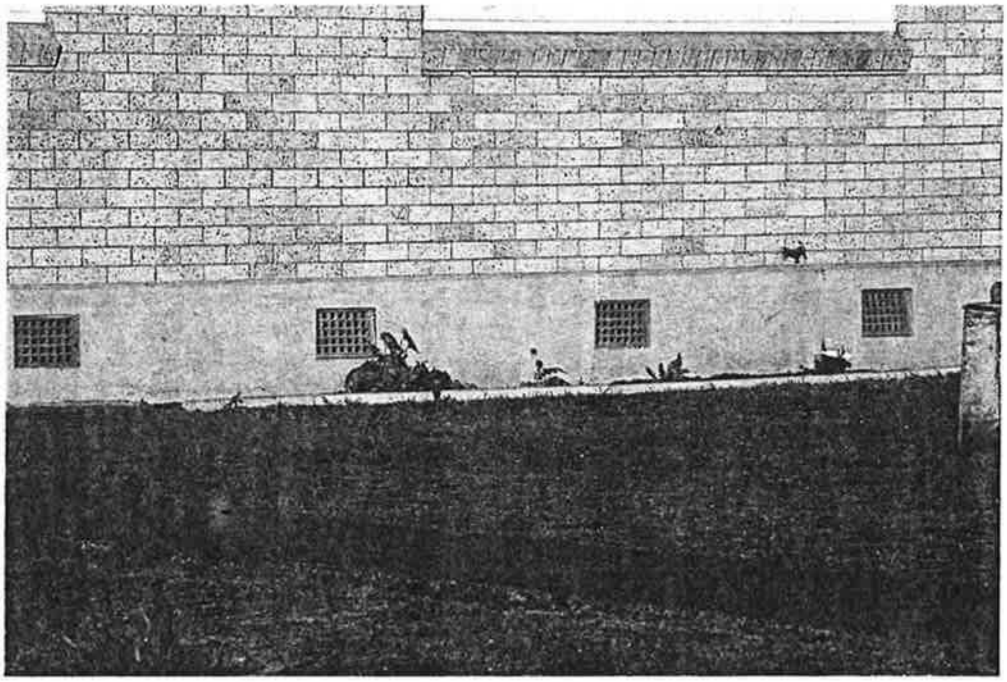
BULLETIN

BRANZ

THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

APRIL 1994 NUMBER 319

SUBFLOOR VENTILATION



- Subfloor ventilation is essential to keep subfloor timber framing and the flooring material dry in suspended timber floors.
- Indications that subfloor ventilation is inadequate include:
  - a musty smell in rooms and wardrobes.
  - cupped floorboards.
  - stains in particleboard floors.
  - blistering of sheet vinyl.
- The New Zealand Building Code sets out minimum subfloor ventilation requirements.
- Large buildings and those with party walls may require a moisture-proof cover on the subfloor soil.
- Paths, driveway levels, plants, soil, framing or cladding must not cover or obstruct the subfloor vents.

INTRODUCTION

New Zealand domestic and light commercial buildings commonly have timber strip or framed particleboard flooring supported on timber joists and bearers. On many flat sites the space between the underside of the bearer and the ground may be only 300 to 400 mm. It is not uncommon for houses built before (about) 1940 to be closer to the ground and in some cases bearers and joists may actually be resting directly on the ground under the house. Such suspended floor systems can suffer from distortion, cupping of strip flooring, and possibly decay and failure as a result of moisture from the ground being absorbed by the timber and/or particleboard.

The major cause of this increase in moisture content is prolonged high moisture levels in the subfloor air and occasional or frequent condensation on cold subfloor supporting timbers or the cold underside of floor decking resulting from restricted, blocked or poor subfloor ventilation.

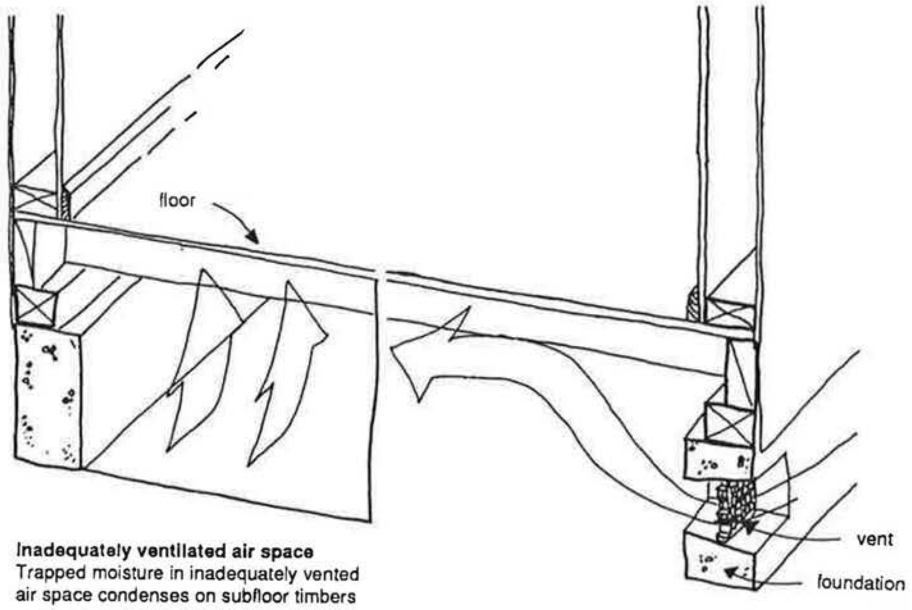
Good ventilation (Figure 1) of the subfloor space under the building is the most effective way to remove moisture present and keep the moisture content of the timber structure at safe levels.

MOISTURE SOURCES

The ground below the subfloor space is often warmer in winter than the air above it. Under these conditions water will evaporate from the ground. The ground may appear dry but water vapour will readily pass through most soils and water vapour can come from damper soil beneath the surface.

If the subfloor timber and underside of the floor decking are cold enough, this water vapour in the air can condense on their cold surfaces and be absorbed. This condensation can often be observed in winter on bearers and floor joists, particularly those with poor subfloor ventilation, on the cold south end of a building.

Measurements made of the rate of moisture release from various soil types at different locations around the country show that on average 0.4 litres of water can evaporate from a square metre of ground in 24 hours. In terms of a house with a 100 m^2 floor area this amounts to 40 litres in 24 hours. About 3% of this moisture can be absorbed by subfloor timber without it becoming excessively wet (more than 20% moisture content). The rest has to be removed by the subfloor ventilation if progressive damage



Inadequately ventilated air space
Trapped moisture in inadequately vented air space condenses on subfloor timbers

Properly ventilated air space
Continuous circulation of air leads to removal of moisture in properly ventilated air spaces

Figure 1 Ventilate to Prevent Moisture Damage

This Bulletin replaces Bulletin No 245 of the same name.

is to be avoided. Preservative-treated timbers are not an alternative to good ventilation as the type and level of treatment is such that frequent and prolonged wetting can still result in decay.

Other possible sources of subfloor moisture are:

- leaking water pipes, sewer pipes, downpipes, gully traps and defective waste pipes.
- exhaust hoses from clothes dryers (which can expell large quantities of water vapour if vented into the subfloor space, .sometimes with spectacular and disastrous results).
- surface water being able to drain (and pond) under the building.

Overflowing of appliances such as tubs and washing machines inside the house and can also substantially add to subfloor dampness problems.

SIGNS OF DAMPNESS

The most common indication that all may not be well below a floor is a musty smell inside the building. Other signs of subfloor problems are: cupping of strip (timber board) flooring; patchy brown coloured stains on clear finished particleboard floors, dampness in carpet and under rubber underlay, blistering of sheet vinyl, persistent mould growth (particularly in a well ventilated house) and excessive condensation on all windows.

If one or more of these signs is present the subfloor space should be checked. Excessive dampness can often be detected without a moisture meter by the presence of mould (or condensation) on subfloor timber or particleboard or condensation on foil insulation. In some cases white fungi may grow on subfloor soil or on the timber.

BUILDING CODES

The performance requirements of the New Zealand Building Code (Section E2 External Moisture) enacted in 1991 requires that 'Building elements susceptible to damage shall be protected from the adverse effects of moisture entering the space below suspended floors'. To ensure adequate ventilation of the subfloor space the Acceptable Solution of the code (E2/AS1) requires the provision of a minimum of 100 x 35 mm clear ventilation opening for every 1 m² of floor area by either one or a combination of the following ventilation methods:

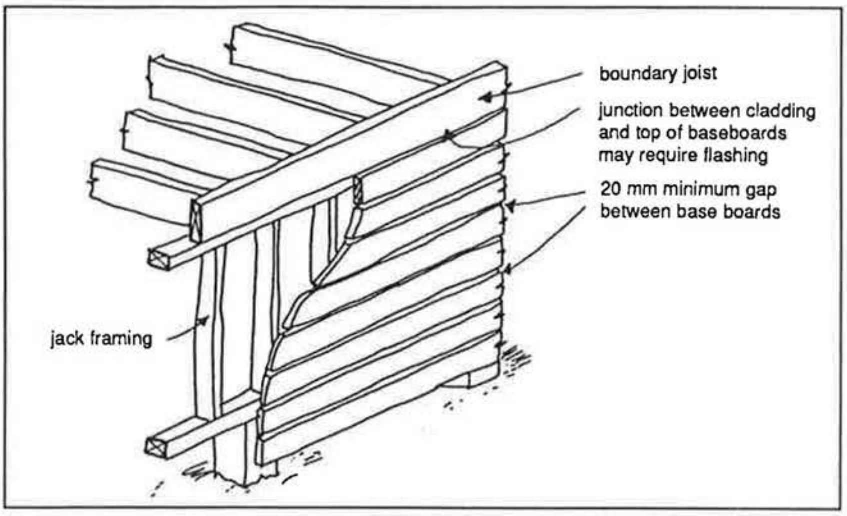
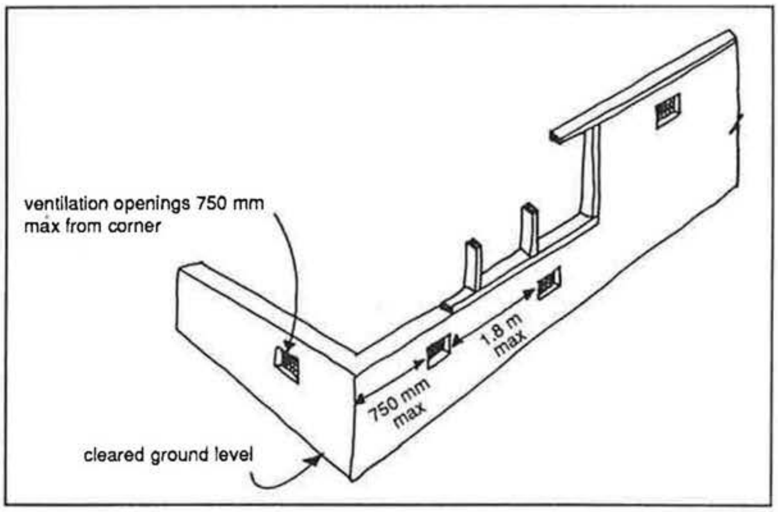


Figure 2 Base Boards

Figure 3 Foundation Wall Ventilators



- continuous gaps at least 20 mm wide between the base boards fixed around the perimeter of the buildings subfloor area. This method usually meets the Code requirements with ease. (Figure 2)
- wall ventilators, spaced at 1.8 m maximum centres around the perimeter of the building to provide the required amount of clear ventilation area. A ventilation opening must be provided within 750 mm of each building corner. The net open area of a ventilator must be no less than 50% of the gross ventilator area. (Figure 3)

In addition the code defines adequate ventilation as that which has:

- the subfloor air flow unobstructed by party or dividing walls, internal foundations, attached terraces or any other obstruction (such as rubbish or stored materials).
- no point on the ground being more than 7.5 m from a ventilation opening.

- a subfloor ventilation rate which is greater than 10 air changes per hour for wet sites or greater than 5 air changes per hour for dry sites. (If the soil itself sticks to the hand when rubbed conditions are too damp).

Where a subfloor cannot be adequately ventilated (such as dwellings with a large floor area, rows of home units with party walls or halls and recreation spaces) the Code requires that the ground under the building be covered with a vapour barrier such as polyethylene (polythene) sheet which has a vapour flow resistance of 50 MN s/g and a thickness of no less than 0.25 mm.

SIZING AND POSITIONING VENTS

The most important factor is the clear ventilation area (airway) provided and not the overall size of the vent. Vents are made in a variety of sizes but this alone is not an indication of their effectiveness. Some poor designs have only 21% perforations to 79% solid material, while others have close to a 50:50 ratio. Fixtures with less than 50% perforation may fail to meet the minimum Code requirements of 3500 mm² of clear opening per 1 m² of floor area if used at the usual 1.8 m spacing.

It may thus be necessary to use larger vents to obtain the appropriate clear ventilation area (such as those designed for use in concrete masonry foundation walls [390 x 190 mm]) or to increase the number of smaller or less effective vents.

The commonly used ventilation grille in concrete perimeter foundation walls is approximately 250 x 150 mm and set in formed openings. The vents should be as close as practicable to the underside of the bearers and wall plates - the top of the vent opening must be 100 mm below the wall plate to maintain adequate concrete cover for the reinforcing steel.

Open base boarding (Figure 2) is another common and very effective way of providing airflow below suspended floors. It is often used in buildings which have corner foundation walls together with perimeter piles or those buildings totally supported on piles.

With veneer construction, as for other types of cladding, the vents should be placed in the foundation walls. Unless the veneer starts at a level well below the underside of the bearers this will normally mean it is not interrupted by vents. Do not set the vents in the lower courses of the brick or block veneer at the same level as the wall plates and joists because a proper airflow is effectively blocked by the timber. Furthermore, such openings are usually made to suit brick or block sizes and are thus considerably smaller than the usual 250 x 150 mm vents.

Ventilation grilles made of pressed metal or plastic are usually installed where the base of the building is clad in flat sheets or the weatherboards or other types of cladding are taken down to ground level. Ensure the effective opening size, number and location of these vents is adequate to meet ventilation requirements. Do not allow the framing or cladding material to obstruct or cover the vent particularly where stucco or sprayed-on finishes are used.

REMEDYING SUBFLOOR DAMPNESS

Initial Steps

If there is a dampness problem the first steps to take are:

- check if the soil is dry or wet.
- check for obvious sources of water - leaking pipes, ground water (springs) runoff.
- check that existing vents are installed and are not obstructed by soil, shrubs, plants and paving, framing, cladding.
- count the number of vents and measure the clear ventilation area of the vents.

There are a number of options which can usually be readily carried out to improve the subfloor ventilation such as:

- unblocking vents which have been covered, by removing soil and vegetation.
- clearing the subfloor space of stored materials or rubbish so that airflow is not blocked.
- changing the subfloor access door from a solid door to one with an open, slatted construction.
- removing existing vents and replacing them with ones that increase the air flow.
- installing additional vents. If the dampness persists then the ground should be covered with a vapour barrier.

OBSTRUCTIONS

When concrete porches and terraces are attached to the foundation walls, normal subfloor ventilation methods are usually not possible. In such cases it is important

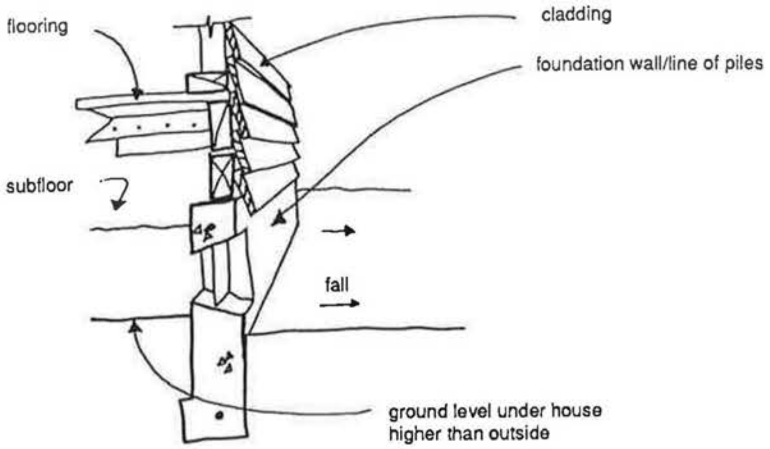


Figure 4 Draining Surface Water Away From the Subfloor Space

to install air ducts under terraces or larger porches to vent the subfloor spaces. Earthenware or plastic pipes, 100 mm in diameter, can be used for this purpose.

Rows of flats separated by party walls often suffer dampness problems because only the outside walls are available for ventilation openings. It is often not possible to meet the minimum Code requirements, especially if concrete entrance steps also take up some of the outside wall.

BUILDINGS WITH LARGE FLOOR AREAS

It is also difficult to ensure an adequate flow of air under buildings enclosing large spaces such as halls. The same solution can be applied to rows of flats where party walls prevent adequate ventilation. Polythene is the most commonly used material. It should be laid out neatly against the walls, cut and fitted around piles with the joints between sheets lapped 75 mm minimum. Bricks or rocks can be used to secure it in. place.

LANDSCAPING

The area around the building should be graded to prevent water from accumulating under it. The land immediately around the building must be lower than subfloor levels and should slope away from the walls for at least 1.0 m to drain water away from the foundations. (Figure 4)

Paths, driveways and paving should never be laid so that ventilation openings are obstructed or so that water can flow through vents into the subfloor space.

If the building is close to a bank (say within 1 m) subfloor ventilation may not be very effective. If ventilation is obviously poor or dampness signs show, cover the ground under the building with polythene or similar material as described above.

DRAINAGE

If the general slope of the land presents risks after grading or if the ground can become waterlogged, field drains should be installed to intercept and divert ground water.

Good subfloor ventilation is not a complete solution under these conditions. There must, in addition, be proper site drainage.

Drains should be carefully graded to falls and be of adequate capacity to cope with the worst conditions known to occur at the site.

FURTHER READING

New Zealand Building Code. 1992. Building Industry Authority. Wellington

BRANZ Housebuilding Guide. 1993. Building Research Association of New Zealand. Judgeford.

BRANZ Bulletin 278. 1991. Preventing Dampness in Houses. Building Research Association of New Zealand. Judgeford.

THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

MISSION

To promote better building through
the application of acquired knowledge,
technology and expertise.

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CI/SfB
| (13.1) | (L2) |
April 1994
ISSN 1170-8395