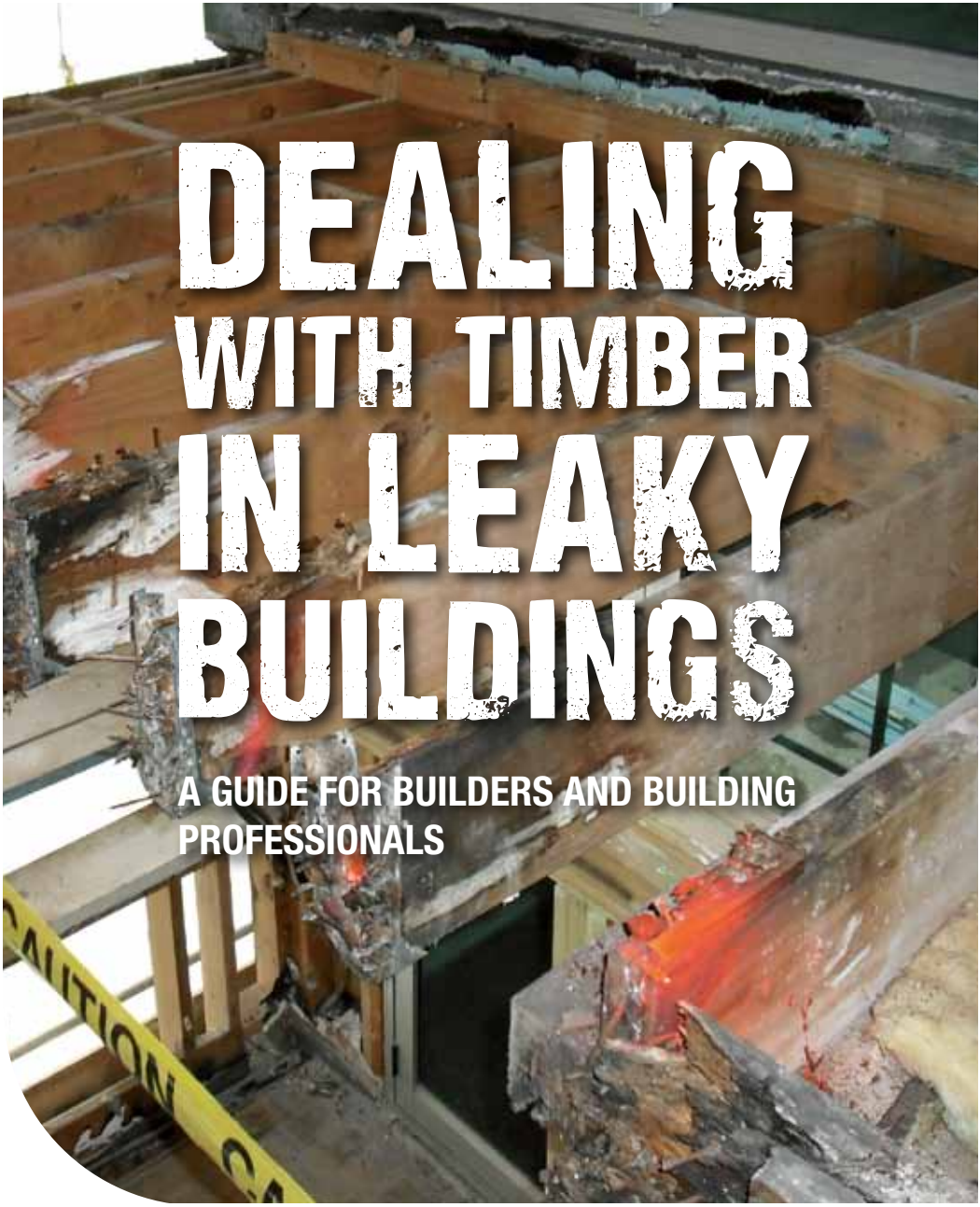
Department of
Building and Housing
Te Tari Kaupapa Whare



DEALING WITH TIMBER IN LEAKY BUILDINGS

A GUIDE FOR BUILDERS AND BUILDING PROFESSIONALS

CONTENTS

What this guide covers

This guide is aimed at builders and building professionals who are involved in repairing leaky buildings. The purpose of the guide is to provide practical advice on dealing with decayed timber that is found once the cladding of a leaky building is removed. The advice covers identifying the extent of timber decay and repairing the framing. Timber remediation is a highly specialised area of work and this guide highlights some circumstances where expert advice should be sought for identifying and testing fungal decay, identifying and removing mould, removing affected timber, and treating timber on-site. The work that is needed to remediate decayed timber in leaky buildings will differ from building to building, so the advice given here needs to be considered in the light of the particular building being repaired.

When initially assessing leaky buildings for repair, building surveyors and assessors only have limited access to framing. They have to make judgements about how much timber is likely to be affected by fungal decay. Further problems with decay are often found once the building is opened up to allow repair work to begin and this can frequently be the main 'unknown' in relation to the cost and extent of the repairs needed.

This document does not cover the diagnosis of leaks or the design of the repairs – these should be completed before repairs are started.

There may be claims or court cases related to the original defective building work taking place while repairs are being carried out. This guide is not intended as advice on claims or liability, and anyone with concerns or questions about a claim should seek independent legal advice.

Repairing a leaky building

Building consent requirements

Repairs and reconstruction of leaky buildings are building work under the Building Act 2004 and must comply with the Building Code. In most cases, this work is not exempted under Schedule 1 of the Building Act and will need a building consent. This must be obtained before any repair work is started.

Where significant unexpected defects in the framing or structure are found during repairs, an amendment to the building consent may be needed. This should be discussed with the designer and the building consent authority (BCA). Guidance on amendments to building consents is available on the Department's website (see 'Additional information' on page 21).

The repair process

The key to success in repairing a leaky building lies in creating a dry environment for framing timber. Any timber remediation work needs to be part of a repair programme that will achieve this. Unless a dry environment is created, fungal decay may become re-established.

A repair programme for a leaky building involves the following steps[1]:

1. Assessment

- A building surveyor or assessor inspects the building, identifies defects causing leaks, assesses the likely damage, and prepares a report with recommendations for repair.

2. Development of repair documentation

- A remediation designer, working with other experts where necessary, draws up a full set of plans, specifications and a quality assurance plan with enough detail to obtain a building consent and go to tender.

3. Getting a building consent

- The BCA reviews the design documentation and issues a building consent.

4. Carrying out repairs

- A builder is contracted by the owner to carry out the repair work.
- As work progresses, additional hidden problems may be uncovered that require input from the remediation designer, advice from other experts, and further timber testing and removal. Amendments to the building consent may also be required.
- The BCA carries out inspections at agreed points.

5. Sign off

- If the work is completed in accordance with the consent, the BCA issues a code compliance certificate after the final inspection.

1. The Department's Financial Assistance Package (FAP) for the owners of leaky buildings follows a defined process, which sits alongside the programme set out here. More information on the FAP is available on the Department's website: http://www.dbh.govt.nz/fap

Additional expertise may be needed at stages 2 and 4 and might include advice from professionals such as a structural engineer, quantity surveyor, specialist laboratory or timber decay expert.

A joint Department of Building and Housing/BRANZ publication: 'Weathertight Homes: Remediation Design Guide' provides more information on remediation design. It can be downloaded from the Department's website (see 'Additional information' on page 21).

Quality assurance for remediating timber

The overall quality assurance plan for the leaky building repair should include a quality assurance plan for identifying and removing decayed timber from a building. This needs to be drawn up before the repair work starts and should establish who is responsible for identifying timber that needs to be replaced and for taking samples for laboratory analysis. Where there is any doubt about whether timber should be removed or left in place, an expert in building assessment should be consulted (for example, a member of the NZ Institute of Building Surveyors). It may be more cost-effective to replace all timber that could be affected by decay, rather than wait for the results of laboratory tests.

The relevant BCA may ask for a quality assurance plan or may have its own procedures for timber identification and removal linked to the building inspection process.

Decayed timber

When decayed timber is found in a leaky building, it is important to identify whether the decayed wood has been preservative treated, the type and extent of decay that is present, and whether mould is present and what kind.

Timber treatments

Up to 1992, most timber used for house framing in New Zealand was radiata pine treated with boron. From the early 1990s, a range of alternative timber framing treatment options for radiata pine became available. From 1998 to April 2004, homes were often built with untreated kiln-dried radiata pine framing.

If the framing used is untreated or has a preservative treatment only effective against insects, it is more likely decay will be both severe and widespread in a leaky building.

The most reliable way of finding out what timber treatment (if any) has been used, is to take timber samples and have them tested in a laboratory. An assessment report completed on the building should provide some information on the type of timber treatment used in the building. However, the assessor is only able to access a limited part of the timber framing and it is quite common to find a mix of timber treatments in the framing of any individual building that have not been identified in the assessment report. If there are no markings on framing timber identifying the treatment type and level, it is safer to assume it is untreated.

Types of fungal decay

Framing timber with severe decay is usually easy to see. However, the early stages of fungal decay often cannot be seen by the naked eye. It is important to identify the type of fungal decay that is in the framing and how far it has spread, so that recommendations can be developed for removing it.

Identifying types of fungal decay requires specialised skills and needs to be carried out by an appropriately qualified expert with access to a laboratory.

TYPES OF FUNGAL DECAY

BROWN ROT

Brown rots eventually cause wood to turn dark brown, and crack along and across the grain, creating a pattern of cubes (Photos 1 – 3). Brown rots are usually hard to spot in the early stages and can rapidly cause serious decay and strength loss, even when the timber is not particularly wet. Brown rots are less common in timber that has been treated with boron, but common in untreated radiata pine.

1. Brown rot in apparently sound timber

2. Start of brown rot from leak off the end of a head flashing

3. Advanced brown rot

WHITE ROT

White rots at well-advanced stages cause the timber to become lighter in colour and fibrous in texture without cross-checking along and across the grain (Photo 4). White rots are less common in radiata pine than brown rots.

4. White rot in timber joinery

SOFT ROT

Soft rot is more common in boron-treated timber that has been wet for a prolonged period. It is difficult to spot as there is often little outward sign of decay. Sometimes the timber may become a dirty grey-brown colour, but not always (Photo 5). When a sample at least the size of a matchstick is broken off, the surface at the break can sometimes look like a broken carrot.

5. Fracture surface of timber with soft rot

DRY ROT

Dry rot is the common term for a particular brown rot, *Serpula lacrymans*. This is relatively rare in New Zealand but, if found, it is a serious problem and will require specialist advice.

MOULDS

Moulds are a type of fungus but do not usually cause strength loss. The presence of mould is a sign of high humidity which can be caused by poor or inadequate heating and ventilation or moisture from leaks. Some moulds can grow on almost any surface, not just timber.

Some moulds and decay fungi that can grow in a leaky building are linked with health risks, particularly for older people, infants, and people who are unwell or suffer from asthma. In particular, certain types of moulds such as *Stachybotrys* may produce harmful toxins. *Stachybotrys* is most commonly found on paper lining on gypsum wallboard, fibre-cement board, building paper, and other materials that contain cellulose.

Because all moulds tend to look the same to non-specialists (Photo 6), moulds found on site can only be identified under a microscope by qualified laboratory specialists with experience in identifying fungi.

Black moulds on black building paper are almost impossible to see. Any paper-based materials that have lost strength and crumble easily should be handled as if they have been affected by mould.

6. Mould on plasterboard lining around a leak

Taking samples for testing

Finding out whether decay fungi are present in timber and identifying fungi and moulds are highly specialised tasks and should be carried out by a suitably qualified person in a laboratory.

Choosing where to take timber samples from for laboratory analysis also needs specialised knowledge. This should be done by a building surveyor experienced in this work or other appropriately qualified and experienced professional. It is useful to provide the laboratory with good background information on the building and where the samples have come from. Photographs showing the location of the sample on a piece of framing and the location of that framing in the building are very helpful.

The surveyor or other professional should also advise what size the samples need to be and how they should be taken and labelled.

Health and safety when dealing with mould

It is often better for occupants to move out during repair work to a leaky building, given the dirt, noise and disruption caused by the work. Furthermore, tarpaulins block out natural light and can flap in wind causing sleep deprivation. If the occupants have moved out, it also makes it easier for the builder to comply with health and safety requirements for a construction site and to carry out the repair work more efficiently.

If extensive mould growth is found during repairs, the occupants should be strongly encouraged to move out of the house while the repairs are completed and the mould removed.

Where moulds and fungi have to be removed as part of the repair, building professionals should ensure they comply with relevant Health and Safety requirements and should ensure workers removing moulds and fungi in the building wear suitable protective equipment including disposable overalls, appropriate breathing masks and gloves. OSH Workplace Health Bulletin No. 17 provides helpful information and the OSH website should be checked for further information (see ‘Additional information’ on page 21).

Moulds and fungi should be disturbed as little as possible. Fungi can produce spores that, when dried out, can easily become airborne, meaning that they can be breathed in easily. When wet, the spores tend to stick together and are less likely to be breathed in when building materials are disturbed.

Where materials have heavy mould growth on them, it is better to replace them rather than attempting to clean off mould. The materials need to be wrapped in polythene or put in polythene bags and sealed to prevent them drying out. Mould can be cleaned from smaller isolated areas where it would be difficult or impractical to remove materials. This should be done by thorough washing and rinsing, and collecting the cleaning solution and rinse water for disposal. A wet dry vacuum cleaner is useful for this. If areas of mould need to be cleaned, this should be done before they dry out.

Once suitable temporary covers are in place, cladding should be removed with the linings still in place. This avoids any potentially dangerous moulds being released into the building. The lining also acts as a wind barrier reducing the wind load on the covers.

Where internal remediation work is needed, care needs to be taken to avoid contaminating other areas of the house with mould. Advice should be sought from a specialist on how to keep the work area separate from the rest of the dwelling (for example with polythene sheets and taped joints and using a negative pressure environment). The work environment should be kept well-ventilated. If mould has been found and removed, it will be necessary to sample the air when the work is completed using a non-viable spore trap. Laboratories and some building surveyors may provide this service.

Removing decayed timber

The building surveyor, or other appropriately qualified and experienced professional, is responsible for finalising the recommendations for timber removal. When making a decision about how much timber to remove and from where, there are several important issues to consider:

- Are decay fungi present and what type?
- How far have the fungi spread in the framing?
- What recommendations have the testing laboratory or other expert made, if any?
- Has a timber preservative treatment been identified in the framing and at what level?
- What is the most cost-effective way to repair the framing?

It is always better to err on the side of caution when replacing untreated timber framing. If the timber has been adequately preservative treated, then it may be possible to remove less timber.

Decayed timber needs to be removed and replaced with H1.2 (or higher) treated framing. Where the timber shows obvious signs of failure (as in photos 3 and 4, for example) there is typically no need to test the decayed portions before removal. Testing should focus on identifying where the timber is sound. The general recommendation is to cut out any timber at least one metre beyond the last visual signs of fungal decay on any individual piece of timber (see Figures 1 and 2).

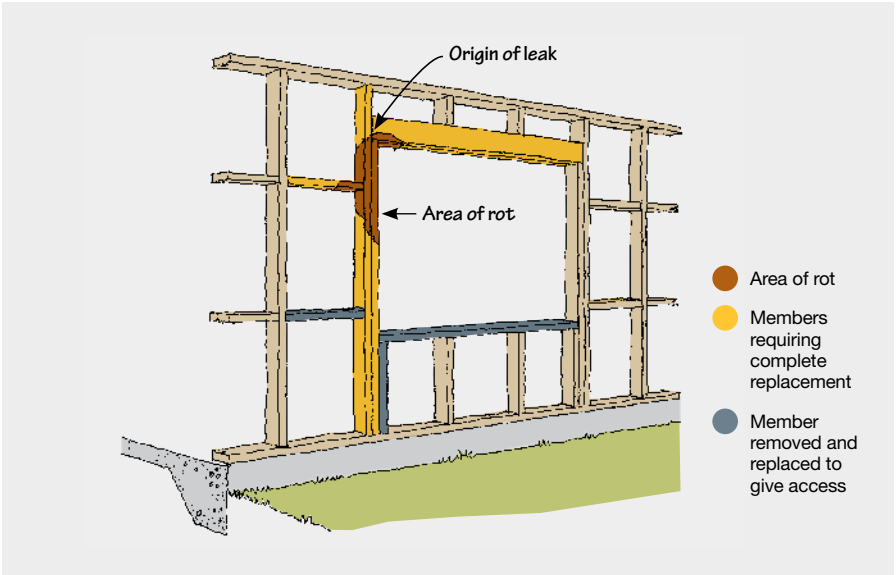


Figure 1. Damage caused by leak at end of head flashing

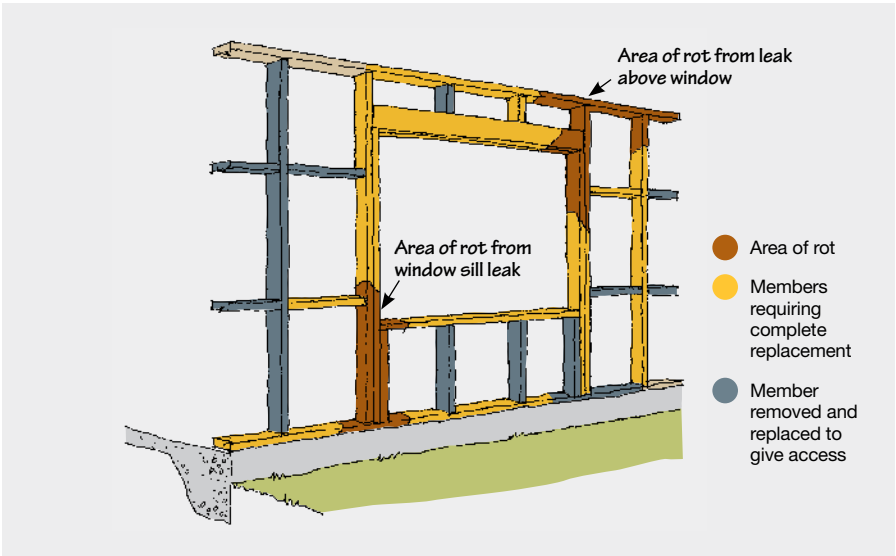


Figure 2. Damage caused by leaks from above and from window sill requiring 100% replacement of window sill

With timber members that are difficult to replace such as floor joists running back into a building, it may be possible to reduce the recommended one metre distance by taking samples of timber at 150 mm, 300 mm and 600 mm distances from the visible signs of decay and getting them analysed in a laboratory. The timber will only need to be removed as far back as the first sample that has no decay present.

For wall framing, it is often easier and more cost-effective to remove and replace the timber than to cut out the decay and flitch in new framing. Note that NZS 3604 does not allow the jointing of studs, so any studs with visible decay will need to be fully replaced. Where more than 30% to 40% of the timber in a particular part of the framing is affected by decay, it is usually more economic to replace all framing.

Particular care is needed where several pieces of timber are fixed together.
The timber faces exposed after the cladding is removed may appear sound but there could be fungal decay on the hidden faces of the timber which can be difficult to detect. Examples of these are multiple studs, doubling or jack studs, boundary joists and lintels.

Alternate or front timber members can be removed to expose the hidden timber surfaces and to check for decay (Figures 3-5). This can also allow brush-on preservative treatments (see below) to be applied to at least three faces of each piece of timber.

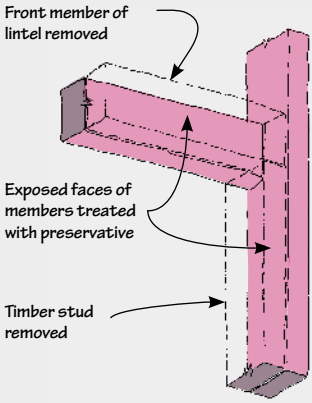


Figure 3. Lintel and trimmer removed to apply preservative treatment

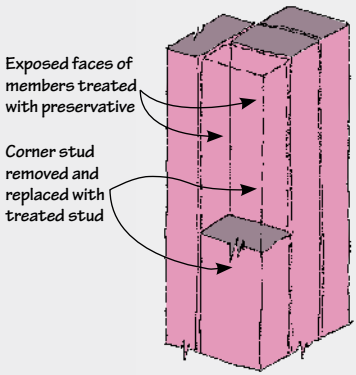


Figure 4. Corner stud removed to apply treatment

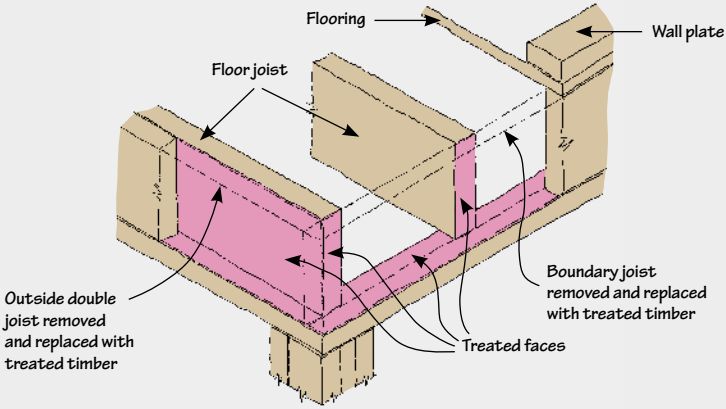


Figure 5. Boundary joist and outer joist removed to apply treatment

Where decay has affected floor joists, it may be possible to insert a new beam within the floor space to support the remaining length of joist and the replacement joists, usually by using joist hangers (Figures 6a and 6b). The beam will need to be supported and the design must ensure loads are transferred to the foundations. Other timbers frequently affected by decay are plywood deck substrates. Replacement of these timbers often requires demolition of decks and balustrades and usually affects the floor joists of cantilevered decks.

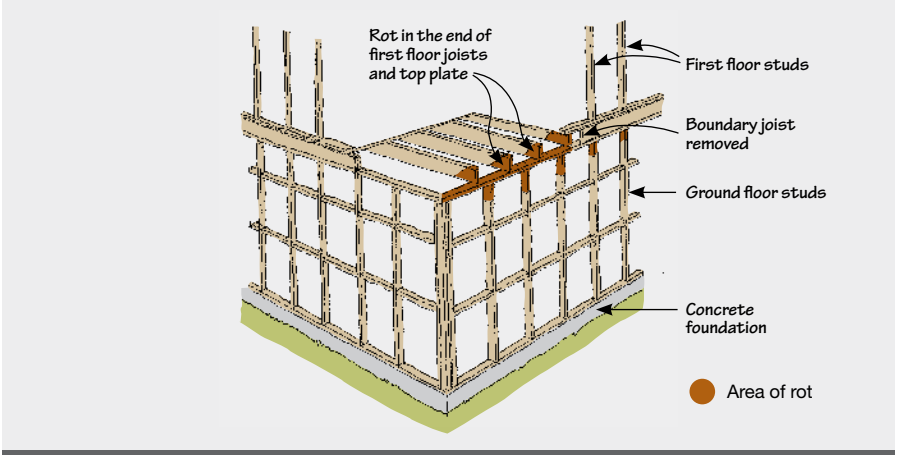


Figure 6a. Rotted ends of first floor joists prior to remediation

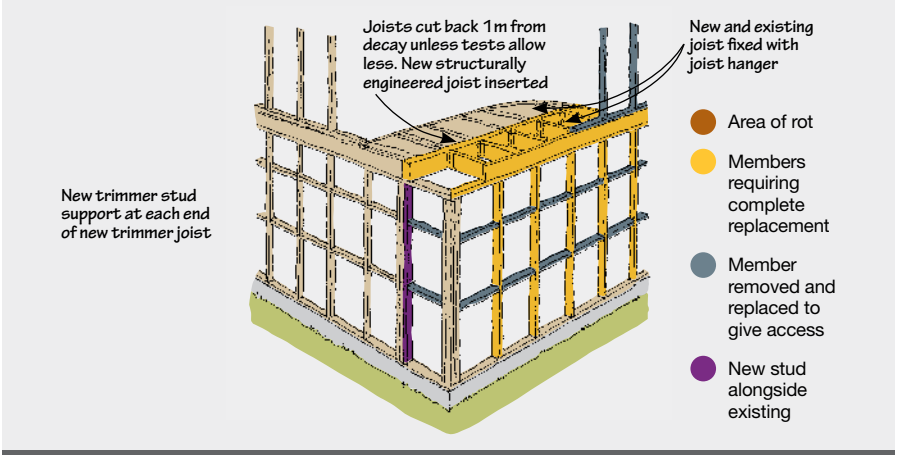


Figure 6b. New trimmer joists and joist ends inserted

When replacing timber:

- work should be done in dry conditions under cover
- existing timber framing must be supported and protected as necessary until the new framing is installed (the builder should have ‘vibration and removal of support’ included under their public liability insurance)
- replacement timber must be preservative-treated in accordance with Acceptable Solution B2/AS1 to at least H1.2 (see ‘timber treatment’ below)
- dry storage should be provided on site for replacement timber before it is installed.

Where there is extensive damage to wall framing, the repair may also require the replacement of internal linings, floors, internal trims, insulation, wall underlay, wiring and plumbing pipes. It may also require removal of kitchen fittings, bathroom fittings, windows, floor coverings and wet area internal linings to allow existing timber to be removed and new timber installed.

Timber framing should not be closed in until the moisture content is less than 20%. A building assessor or inspector will be able to confirm the moisture content with a calibrated electrical resistance moisture meter. It should be noted that some brush-on timber treatments can cause resistance moisture meters to read higher than the actual timber moisture content.

Treating sound timber

Any sound timber in external walls or decks uncovered during repairs that is untreated or has a preservative treatment that does not meet the current Acceptable Solution B2/AS1, should be treated, where practical, with a brush-on preservative treatment.

To maximise the surface area of framing that can be treated, it is important to apply brush-on timber treatments after decay-affected timber has been removed, but before new treated timber is installed. Where localised repairs are carried out on roofs, any timber in the area of the repair should be treated.

A suitable brush-on treatment can add to the durability of the timber and can also limit the progression of decay in its very early stages before timber strength is affected. However, it will not restore strength to damaged timber. Nor is it necessarily a substitute for framing treated to Acceptable Solution B2/AS1, as it is difficult to get the penetration levels required to meet full H1.2 and higher treatment specifications.

The suitability of using brush-on treatments and where to apply them must be assessed for each project.

Research[2] has shown that boron in glycol treatment[3] is effective in limiting the spread of the early stages of brown rots provided at least two coats are applied by brush to at least three faces of the timber and the recommended concentration, application method and coverage rate is followed. The effectiveness decreases if fewer faces of the timber are treated.

2. For further information on this research, see Additional information.
3. The boron treatment was 23% w./w boric acid equivalent in monoethylene glycol 750g/litre with the balance being water, biocide (benzalkonium chloride) and red dye.

Features that will help with the effectiveness of preservative treatments include the concentration of active ingredients. For boron glycol type preservative, a minimum concentration of 20% boric acid equivalent (BAE) is recommended. Two generous undiluted coats of preservative treatment should be applied as recommended by the manufacturer on all exposed surfaces. Using a treatment solution with coloured dye helps to apply it evenly.

For studs where three faces cannot be accessed, a combination of two coats applied by brush and injection of boron glycol into holes drilled into the interface between studs is recommended. The holes should be 6 mm in diameter and 80 mm deep, sloping downwards (at approximately 30 degrees to the horizontal) at 300 mm intervals (Figure 7). Ten ml of treatment solution should be injected into the holes followed by a second 10 ml injection 30 minutes later.

A similar technique can be used on double lintels. Two coats of boron glycol should be applied by brush followed by injection of boron glycol into 6 mm by 45 mm deep holes drilled into the outer lintel 10 mm below the top edge. A drill hole spacing of 100 mm is recommended starting 75 mm from the end of the lintel (Figure 8). 15 ml of treatment solution should be injected into the holes followed by a second 15 ml injection 30 minutes later.

APPLY BRUSH-ON TREATMENTS BEFORE INSTALLING REPLACEMENT TIMBER

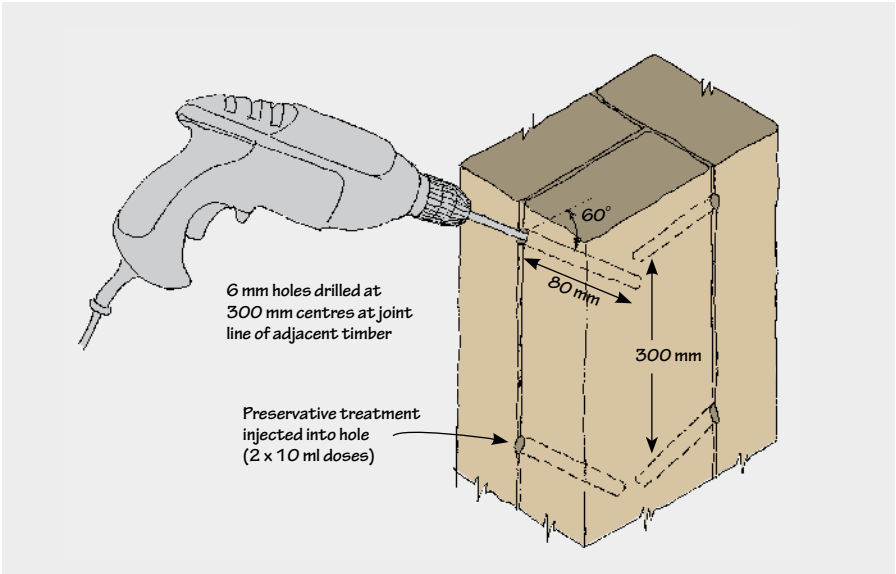


Figure 7. Drill holes for application of treatment between timber surfaces

Adhesive tape should be applied to the bottom of the joint before injecting the treatment to minimise treatment running out the bottom of the lintel. One of the main influences on boron coverage is the size of the gap between the two pieces of timber. If the gap is too large, the treatment rapidly runs out with little coverage and penetration. Temporary clamping of the lintel can help minimise this.

There was considerable variation in the boron glycol coverage achieved on the inner faces of both studs and lintels during testing; however most samples tested achieved average cross section boron retention levels of 0.4% or better although the treatment was concentrated in the outer 30% of the timber.

Because of the variability associated with the boron injection process, it is recommended as a remediation method only where there is a high degree of confidence that there is no decay present between studs or lintel members.

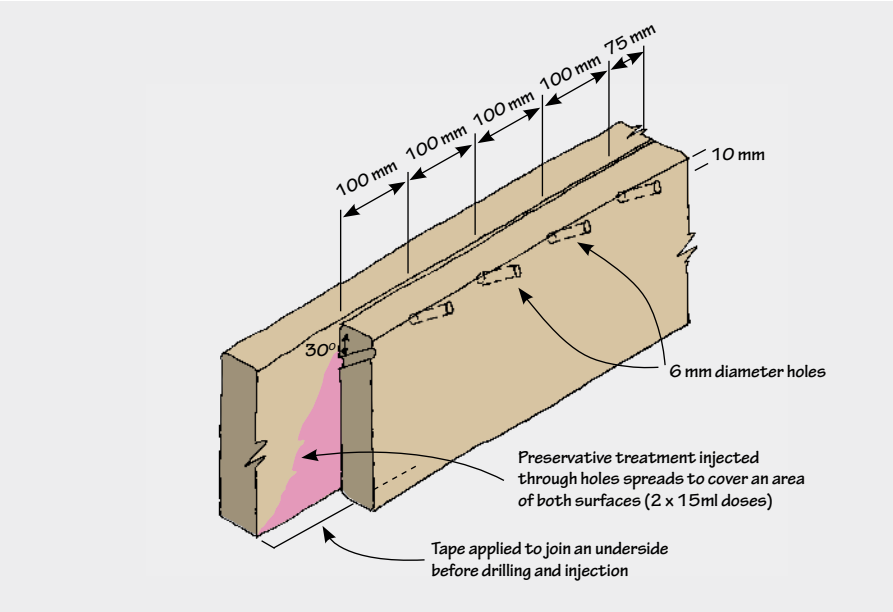


Figure 8. Application of treatment to attached lintels

While boundary joists have some similarities to lintels, this method of treatment cannot be relied on to achieve adequate levels of site preservative treatment because of more limited access to the timber surfaces. In addition, as boundary joists have less drying potential than lintels, hidden and difficult to find decay can occur. Accordingly, the removal of the boundary joist as shown in Figure 5 is recommended, which allows for preservative application and for any timber with decay to be identified and removed.

Other products and methods of applying site preservative than those covered in this guide may be developed and introduced to the market. These should be supported by technical data, application instructions and preferably independent technical investigation. The Department has produced general guidance for product manufacturers seeking to introduce products to the market (see Additional information).

Useful information

Where to get further help

The NZ Institute of Building Surveyors website http://www.buildingsurveyors.co.nz has contact details for:

- certified weathertightness surveyors
- remediation specialists.

Additional information

Available from www.dbh.govt.nz

- Building Code Acceptable Solutions E2/AS1 and B2/AS1
- External moisture – a guide to using the risk matrix
- Minor variations to building consents
- Site-Applied Timber Treatment: Summary of research carried out by Scion for the Department of Building and Housing
- Weathertightness: Guide to Remediation Design (also at www.branz.co.nz)
- Weathertightness: Guide to the Diagnosis of Leaky Buildings
- Using the Product Assurance Framework to Support Building Code Compliance – A Guide for Manufacturers and Suppliers of Building Products 2010

Available from www.osh.dol.govt.nz

- Risks to Health from Moulds and Other Fungi. OSH, Workplace Health Bulletin No. 17, November 2002

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