

Deck, balcony and window safety

A guideline for the use, inspection and maintenance of decks, balconies and windows

March 2017



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Why this guideline?

This guideline has been developed to help building owners and occupiers, builders and inspectors carry out inspections on balustrades, decks and balconies in order to check the safety of these structures.

The guideline may be useful for industry professionals. However, the information is not a replacement for technical standards used by industry.

Owners and managers of non-residential buildings with a deck or balcony, such as restaurants, hotels and clubs, may also find this guideline relevant.

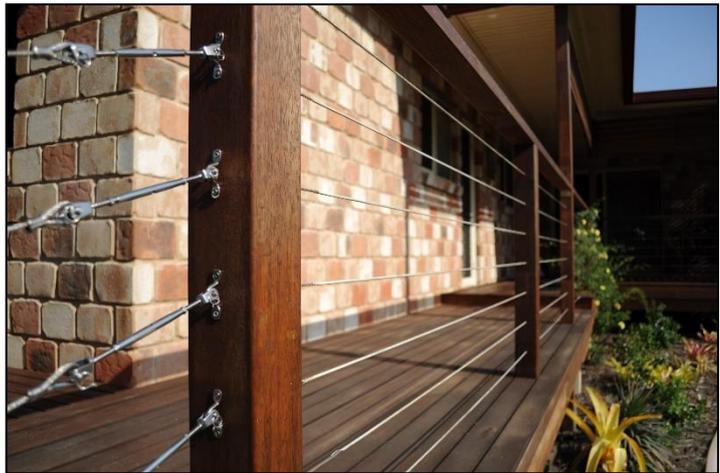
The guideline also provides useful advice about safety issues associated with elevated floors and openable windows.

In recent years a number of deaths and serious injuries have occurred as a result of falls from decks, balconies and windows, or from the collapse of decks and balconies.

Statistics from pre-purchase inspection agencies suggest that approximately six per cent of Australian houses have a timber deck or balcony and about two per cent of these may cause potentially fatal injuries if they collapsed or if the balustrade or railing failed. These numbers are estimated to be even higher in Queensland where, due to our unique climate, timber decks are a major feature of many homes. Some of these decks may have been constructed inadequately or illegally and could now be in danger of collapse.

Building owners especially need to consider risks and consequences arising from an injury or death associated with a failing balustrade or deck, which is shown to be in poor condition or illegally built.

If you own a building with a balcony or deck—whether it is made from timber, metal, concrete or another material—you should ensure it is inspected carefully for decaying timbers, unstable balustrades, corrosion and cracking of concrete.



Adequate maintenance of decks and balconies can save lives

Remember

In Queensland between 2002 and 2012 more than 20 people have died and hundreds have been injured after falling from decks or balconies. A small but significant proportion of cases have been associated with structural failure of the deck or balcony.

Had people been more aware of the dangers associated with elevated areas and the importance of adequate maintenance of decks and balconies, some of these deaths and injuries may have been prevented.

What standards apply?

The National Construction Code (NCC) provides the requirements for new building work throughout Australia. Unless **new** building work is occurring, a building is only required to meet the standards in force at the time of the most recent building approval. The building standards mentioned in this guideline are from the current NCC and apply to new building work. Existing buildings that are the subject of additions, alterations or renovations may also be required to meet the NCC provisions.

Coroner Reports

2010 Coroner's report into deck collapse

In June 2010, the Brisbane Coroner released findings from an investigation into a death caused by a deck collapse. The deck was constructed prior to the 1940s using methods that are not common by today's standards.

The Coroner recommended occupiers of all residential dwellings that include a timber deck or balcony (particularly those built before the 1940s) have them checked for structural integrity.

Figure 1 shows a typical construction method for pre-1940s decks. The beam (or bearer) is cogged out to hold the joist. The joist is held in place with nails. This was the joining method used on the collapsed deck.

In this type of construction method, the ends of the joists are concealed by the bearer in the area where the joist rests. Over time, the nails can rust out, the beam can bow outwards and the joist can separate, potentially resulting in structure failure or collapse as shown in **Figure 2**.

It is important to note that this is just one way in which a deck may fail. Other areas should be inspected on a regular basis to check the structure's reliability and integrity.

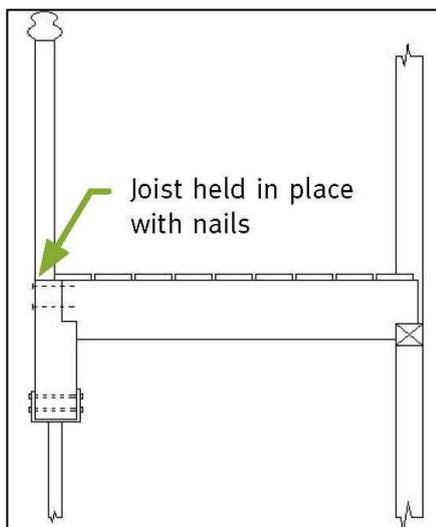


Figure 1: Pre-1940s deck construction with a cogged out beam holding the joist with nails.

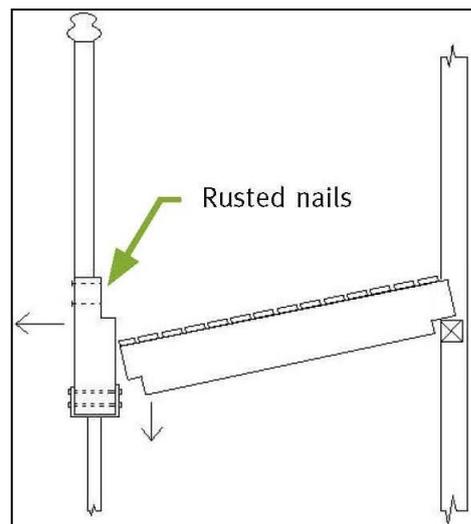


Figure 2: Old nails can rust out causing structure to collapse

2012 Coroner's report into accident on a damaged deck

In September 2012, the Rockhampton Coroner released findings from an investigation into a death caused by a decayed decking board.

The Coroner recommended that State agencies provide guidance about the inspection of decking boards for signs of deterioration that may compromise their structural integrity.

The coroner further recommended that Standards Australia design an Australian Standard to establish how deck inspections should be conducted.



One of the decayed decking boards from the accident.

1. Decks and balconies

Balustrade requirements

In Queensland there are strict requirements for the design and construction of balustrades and railings. Under the NCC, a balustrade or barrier is required where people could fall one metre or more from a floor or accessible roof of a building. Put simply, where a difference in height from the deck or balcony to the ground or another lower level is one metre or more, a balustrade of at least one metre in height is required.

Retaining walls do not require a balustrade unless they are associated with a path of travel to, from or between buildings. However, for other retaining walls, it is a good idea to provide a balustrade or other barrier in situations where there is a risk of a person falling from the retaining wall.

Requirements for balustrades differ depending on the height of the deck or balcony above the ground. For decks or balconies more than one metre above the ground, a balustrade cannot have any openings greater than 125 millimetres, to help prevent people from falling through them. This is also a requirement for decorative balustrades. For decks or balconies more than four metres above the ground, a balustrade must also not have any climbable elements, such as horizontal rails, located between 150 millimetres and 760 millimetres from the floor.

Balustrades must be constructed so that they can resist the forces reasonably expected to be placed upon them. These forces include people leaning against them and strong winds.

Remember

Where a deck or balcony is one metre or higher above the ground, balustrades need to be at least one metre high.

For decks more than one metre above the ground, openings in balustrades, including decorative balustrades, cannot be greater than 125 millimetres.

For decks more than four metres above the ground, balustrades cannot have any climbable elements located between 150 millimetres and 760 millimetres from the floor.

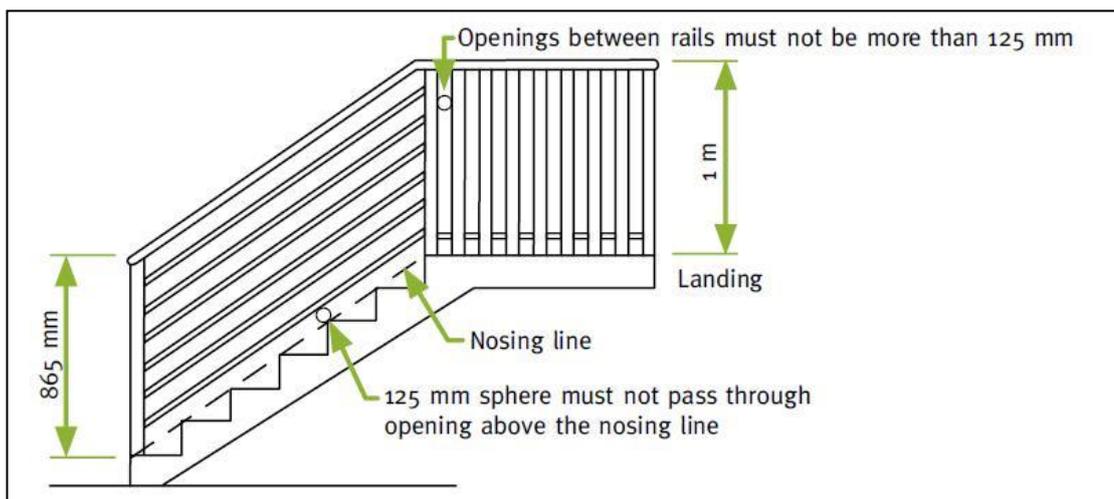


Figure 3: Balustrade or other barrier construction (Courtesy: Australian Building Codes Board).

Stairs

Balustrades or railings on stairs are equally as important as those for decks and balconies. When people ascend or descend stairs, they generally gain support using the railing, which can also act as a barrier. Therefore, stairs require a similar barrier to decks and balconies, and it is important that these balustrades are sturdy and can withstand appropriate pressures, such as the force of a person.

For stairs, a barrier of at least 865 millimetres high above the 'nosing' of the stair treads is required. The 'nosing' of the stair treads can be measured by placing a string line, or straight object, where each stair tread begins, forming a slope. The measurement of 865 millimetres can be taken vertically anywhere along this line to the bottom of the balustrade. As with balustrades for decks and balconies, gaps in balustrades on stairs cannot have openings greater than 125 millimetres. For stairs more than four metres in height, a balustrade must also not have any climbable elements, such as horizontal rails, located between 150 millimetres and 760 millimetres from the floor.



Stairs require a similar barrier to decks and balconies.

Windows

Elevated openable windows, which are common in older Queenslander style houses and units, should be protected to prevent falls. Generally, for bedroom windows with a 2 metre or more drop to the surface beneath and where the window opening is less than 1.7 metres above the floor, window protection is required. This may be in the form of a device to restrict the window opening or a screen with secure fittings. The device or screen must: not permit a 125 millimetre sphere to pass through the opening; resist a 250 Newton outward horizontal action (approximately 25.5 kg force); and have a child resistant release mechanism if the screen or device can be unlocked or removed.

Where a child resistant release mechanism is used, or there is a 4 metre or more drop to the surface below, a barrier is required. Similarly to the balustrade requirements, a 125 millimetre sphere cannot pass through the barrier and no horizontal climbable elements are permitted between 150 and 760 millimetres from the floor.

2. Safety

Children

In the 11 years from 2002 to 2012, data collected by the Queensland Injury Surveillance Unit (QISU) has recorded 936 presentations to participating emergency departments resulting from falls from a balcony.

Note: It has been estimated that the QISU data represents less than a quarter of all paediatric presentations in Queensland resulting from a fall¹. QISU data is not collected in the Gold Coast and Sunshine Coast areas where high rise developments predominate.

Of the QISU data, the peak age for balcony falls was 0-4 years, with presentations in this age group accounting for 41% of cases.

Severe injuries requiring immediate resuscitation were recorded in 3% of cases, however 70% of those severe injuries were in children aged 0-4 years.

Nearly one third of patients required admission or transfer to another facility after falling from a balcony.

Helping prevent falls from decks and balconies

The most common reasons children fall from a deck or balcony are:

- climbing horizontal parts of balustrades
- passing through the horizontal parts of a balustrade
- climbing on furniture on a deck or balcony
- lack of supervision of children on a deck or balcony.



Children represent a large proportion of hospitalisations from falls from high levels

Kidsafe Queensland and QISU advise that parents can take a number of precautions to help ensure the safety of children around decks and balconies and recommend that buildings occupied by children should be adapted to make them safe.

Where a deck or balcony is more than one metre above the ground, there should be absolutely no climbable objects placed near to the balustrade. Any furniture placed on the deck should be:

- positioned well away from the balustrade

¹ It is estimated that data is captured in approximately 80% of injury cases presenting to QISU participating hospitals, and that presentations to participating hospitals represent approximately 25% of all paediatric presentations in the state and 20% of all adult presentations. Therefore, numbers presented above should be adjusted accordingly in order to estimate the total number of presentations state-wide.

- heavy enough to discourage children from moving it close to the balustrade.

One of the best ways to help prevent a child from falling from a deck or balcony is by constantly supervising them. Also, if a deck or balcony is inaccessible to an unsupervised child, the likelihood of a fall is dramatically decreased. Child access to decks and balconies can be restricted by installing high locks and latches and self-closing devices on the access points.

Helping prevent falls from windows

The most common reasons children fall from windows are:

- furniture placed below openable windows
- failure of flyscreens to protect openings
- non-safety grade glass (often in older buildings where this requirement did not apply at the time of construction)

Building design can play an important part in helping prevent injuries from falls from windows. QISU recommends that where rooms may be used by children, larger openable windows should be avoided and higher positioned louvre-type windows should be used instead.

Despite the technical provisions of the NCC, QISU suggests it would be good practice that where it is likely a child can gain access to a window, the opening should be limited to a maximum of 100 millimetres.² To do this, windows can be fitted with devices (to allow a window to only open 100 millimetres for example) or barriers (metal mesh or bars with no opening greater than 100 millimetres). Natural ventilation of rooms will also need to be considered where windows are fitted with these devices or barriers.

Remember

Positioning air-conditioners or other climbable objects on a balcony or deck close to a balustrade should be avoided or made non-climbable as these can be used as a foothold for children to climb on.

Similar to the pool safety requirements, it is recommended that a non-climbable arc of 900mm be maintained outwards from the top of a balustrade.

Also, do not place beds, furniture or other climbable objects beneath or near openable windows.

While these measures are not a requirement of the NCC, they are best practice and strongly encouraged to promote the safety of children.

Fly screens may be effective barriers for insects, but they do not prevent children from falling out of windows. A metal mesh or grill is a suitable alternative that will allow a breeze through the building.

Avoid placing climbable objects close to balustrades or openable windows as shown in the picture to the right.



² Note - The NCC specifies a 125mm maximum opening. Home owners can choose to apply the more stringent QISU recommendation however.

Adults

The most common reasons for adults falling from balconies or decks are:

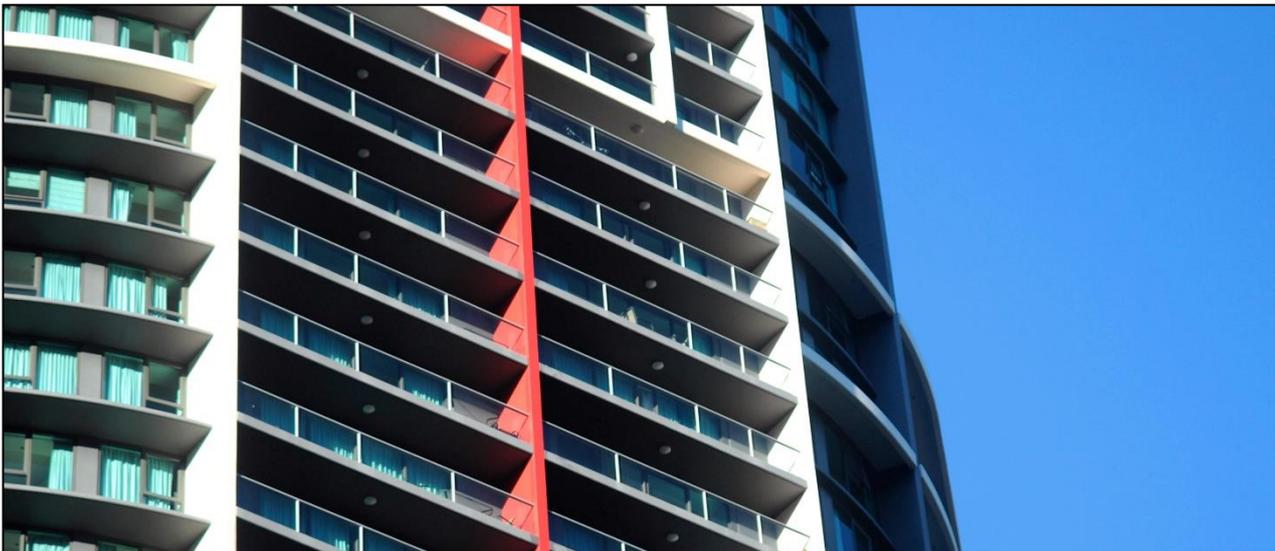
- the effects of alcohol or drugs
- sitting on top of the balustrade
- balustrade failure.

Numerous deaths associated with falls from decks and balconies have been due to alcohol or drug consumption. Most of these falls occur in high-rise buildings. Other known cases of falls have involved a person climbing from one balcony to another, or over a balustrade.

Remember

When using a deck or balcony, you need to be aware of the dangers and effects that alcohol or drugs can have on your judgement and balance.

Never climb from one balcony to another, or over a balustrade, especially in multistorey or high-rise buildings.



Numerous deaths have been associated with falls from high-rise balconies.

3. Maintenance issues to consider

Over time decks and balconies will deteriorate. It is important to undertake routine maintenance to ensure their ongoing safety. This chapter addresses key maintenance considerations such as termite attack, decay and moisture, coastal effects and loads on the structure.

Termite attack

Termites can be a major problem in timber structures. Timber in the ground should be termite resistant or treated in accordance with the relevant standards in the NCC.

All timber construction should have a termite management system, either physical or chemical, to help protect it and to help ensure termites cannot bypass protection systems to adjacent structures. Termite management systems must be designed so they can be readily and regularly (6 to 12 months) inspected and maintained.

To reduce termite attacks it is also important to ensure all timber is removed from around buildings, including timber stacks, old tree stumps, sleepers and logs.

Termites also prefer humid conditions so keep air under the building or structure dry by improving sub-floor ventilation, drainage and access.

Decay and moisture

What to look for:

- any decaying timber that forms part of the deck or balcony
- discoloured or blistered paint
- depression of timber
- termite mud nests
- any build-up of soil around the base of the timber—if timber is untreated it should not be in contact with soil
- fine 'sawdust'-type material around or below timber—this can signal that termites are active.

Decay occurs when timber decomposes due to high levels of moisture. It often occurs when two pieces of timber are in contact, trapping water and moisture. Timbers exposed to the elements need to be adequately painted to help protect the timber from contact with water and moisture.

To reduce the likelihood of decay, any areas of the deck or balcony that are frequently damp should be addressed immediately. Dampness can occur when pot plants without bottom plates or feet are placed on the deck or balcony. Soil and other debris should also be cleared away from the deck or balcony, bearers or joists (if it is a low deck or balcony), and posts or supports.



Keep trays or feet under pot plants to reduce moisture on decking

If decay occurs in structural timbers (such as posts, bearers or joists), seek expert advice to establish the implications for the structural integrity of the deck or balcony.

Any structural problems need to be addressed immediately as well as the causes of the decay and moisture. There is little or no benefit in repairing the damage if it is only going to reappear soon.

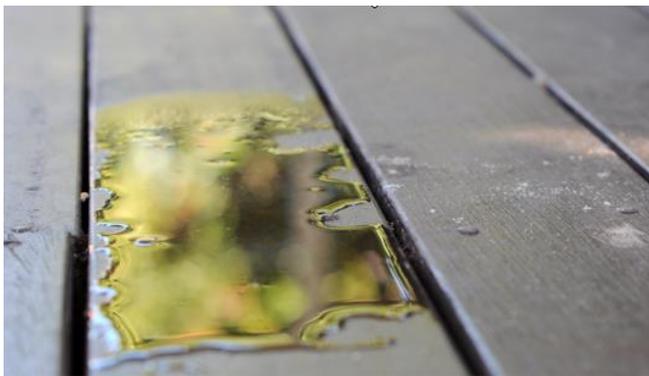
If decay is found in deck or balcony posts, joists, bearers or handrails or balusters, these members will require replacement with new durable timber as it may not be economically feasible or practical to repair them to a structural standard.

For a temporary repair in small non-structural areas, decayed timber can sometimes be cut away and a new piece of timber adequately joined to the remaining timber. If the damage is confined to a very small area, an epoxy-based repair kit can sometimes be used to fill the damaged area once it has been cut back to sound timber and the new surface of the timber can be treated with a suitable coating. Such measures are only temporary solutions and will only delay the failure of the structure.

Water damage to your deck or balcony may also occur at the junction of the floor material and to elements such as timber posts or handrails.

In these areas there is the potential for water to lie on horizontal surfaces such as bearers or joists, particularly where such structures are enclosed.

Care should be taken to inspect these sections for decay and to do this adequately may require temporarily removing decking boards.



Water left on timber can cause fixings to deteriorate and rust



Removing this decking board has revealed a decayed joist

Coastal effects

Decks and balconies on properties near the coast can have a higher risk of potential failure. This is due to the harsh environment and corrosive effects of salt, sand and wind, which can affect unprotected timber and steel structures, reinforcing steel and fixings such as bolts and fixing plates. Such corrosion can lead to mechanical or abrasive wear. It can also cause timber to break down adjacent to rusted metal connections and for steel to corrode.

One of the best ways to help protect timber in this type of coastal environment is to apply and maintain an oil-based paint on exposed timber surfaces such as bearers, joists, posts and balustrade systems.

Steel used in coastal areas should, as a minimum, be hot dipped galvanised and additionally, may require specialized paint coatings. This protection should be carried out at the time of construction to help prevent initial deterioration. Steel that is left unprotected and starts to rust or corrode should be dealt with promptly to prevent further deterioration. In severe coastal conditions such as proximity to breaking surf, all connections and fasteners should be stainless steel.

Loads

Building elements need to be designed and engineered to withstand certain loads.

Loads are an important aspect to consider when you are establishing the stability and integrity of a deck or balcony. It is often easy to overlook the load that the combined weight of a number of people exerts on the structure. Every time 13 people gather on a deck or balcony, they exert the same force as a small car. This force is greatly increased when the people jump, dance or move about. Large pots, water features and furniture can also contribute to the loads applied to your deck or balcony.

What to look for:

- avoid installing heavy objects such as spas on a deck or balcony, unless the deck or balcony has been specifically designed to withstand this extra load
- avoid excessive jumping, dancing or other movement on a deck or balcony, unless the deck or balcony has been specifically designed to withstand this extra load
- remember that as a deck or balcony ages, elements generally deteriorate, reducing its ability to withstand the loads for which it was originally designed
- avoid having large numbers of people gather on a deck or balcony at once, unless the deck or balcony has been specifically designed to withstand this load.

4. Inspecting decks and balconies

Decks and balconies require regular and effective maintenance to help ensure their long-term safety. The frequency of this maintenance depends on the materials, type of finish, climate and the degree of exposure to the weather.

It is important to allow access for visual inspections of a deck or balcony. Of particular interest are the areas where timbers join, where metals are in contact and areas providing ground support. Enclosing the underside of a deck or balcony by cladding between the posts or installing a ceiling, is not recommended because it can prevent the ability to visually inspect these areas.

Helpful hint

Take photos of your deck or balcony after completing building work. The section below outlines the key components that should be photographed to assist with future inspections. Use these photos as reference points when carrying out inspections to identify any changes or movement of components.

Components of decks and balustrades to regularly inspect

Fixings

Fixings, including post brackets, should be free from rust, bending or fractures. Although rust can occur more rapidly in coastal regions, products can be applied to metal fixings or components to slow or prevent this process.

For a weather-exposed deck or balcony, all fixings such as nuts, bolts, screws and nails should be metal with non-corroding properties. In most cases, hot dipped galvanised fasteners should be used. However, in some highly corrosive coastal atmospheres, stainless steel fixings will be needed.

What to look for

- Bending or stress of post brackets—in most cases these brackets will be above ground level, which will make visual inspection easier.
- Deterioration of nuts, bolts, screws or nails—these fasteners can be integral to the deck or balcony and need to be free from deterioration. Rusting metal may be easier to find as it may leave a mark on the connecting timber or paint. Identify, repair and replace these areas as soon as possible.



Inspect post brackets for bending or stressing



What to look for:

- rusting of steel posts
- warped, cracked or damaged posts
- signs of decay in timber.

During inspections it is good practice to remove bolts to see their internal condition

Posts

Where the deck or balcony is raised and relies on posts for support, adequate engineering is required to ensure the strength and stability of these components.

Deterioration and subsequent failure of posts can result in death or serious injury to people and damage to property. Timber should be treated appropriately if in the ground or be of a species that will not degrade in soil.

Check timber posts for decay where bearers and other timbers are in contact with posts. Signs of decay include a fungus type growth on the timber, timber becoming spongy and fibrous and failure of the timber. Steel posts in the ground should be checked for signs of rust and deterioration as water can pool around these areas.

Bracing

Bracing is often used to support a deck or balcony, helping prevent it from moving under load. Decks and balconies can come under considerable stress from swaying or twisting. If bracing fails, there is a significant risk of harm being caused to people and property. It is therefore important to inspect any bracing of a deck or balcony to ensure there has not been any excessive structural movement.



What to look for:

- warped, cracked or damaged bracing elements
- fixings that are coming loose or deteriorating.
- cracked or rusted welds

Inspect bracing on decks and balconies for undue structural movement

Bearers and joists

Bearers and joists are vital to the integrity of a deck or balcony. Bearers support the joists, which in turn support the decking. It is important that bearers and joists are in good condition and free from defects such as warping and cracking.

What to look for:

- warped, cracked or damaged bearers or joists.
- decay and looseness at butt joints and termite damage



Check bearers and joists for warping or cracking

Ledgers or pole plates

Decks and balconies are often attached to the main external walls of the house or other structure such as a pool, by supporting joists or bearers off ledgers or pole plates. These members have to have adequate structural connections to their supporting structure which may mean connecting them through the external wall cladding to the structural frame of the house. It is common for brick veneer houses that have a deck added to just use a masonry fastener (expanding anchor) to connect the ledger or pole plate and this is not usually an acceptable, structurally adequate connection. Ledgers or pole plates connected to brick veneer should be thoroughly checked for their adequacy.

Decking boards

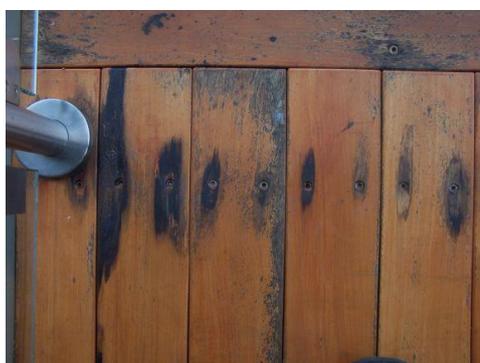
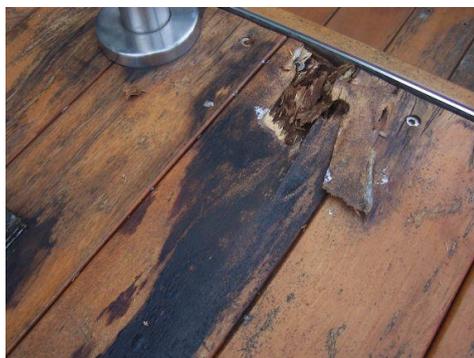
Decking boards are the direct link between inhabitants and the structure. Timber boards should be inspected for decay regularly. Signs of decay include a fungus type growth on the timber, timber becoming spongy and fibrous and failure of the timber. Using a screwdriver or chisel to poke suspect timber can assist in identifying decay.

Investigation method

Where warranted, a small diameter (3 to 4mm) drill could be used to detect internal decay in timber which may not always be detectable on the outside of the timber. Decayed timber will have less resistance to the penetration of the drill and would indicate more intrusive investigation is necessary. This procedure should be used carefully as it may compromise the structure. An epoxy repair kit can be used to repair the drill hole.

What to look for:

- warped, cracked or damaged decking boards.
- signs of decay in timber.



Examples of decking board decay

Balustrades

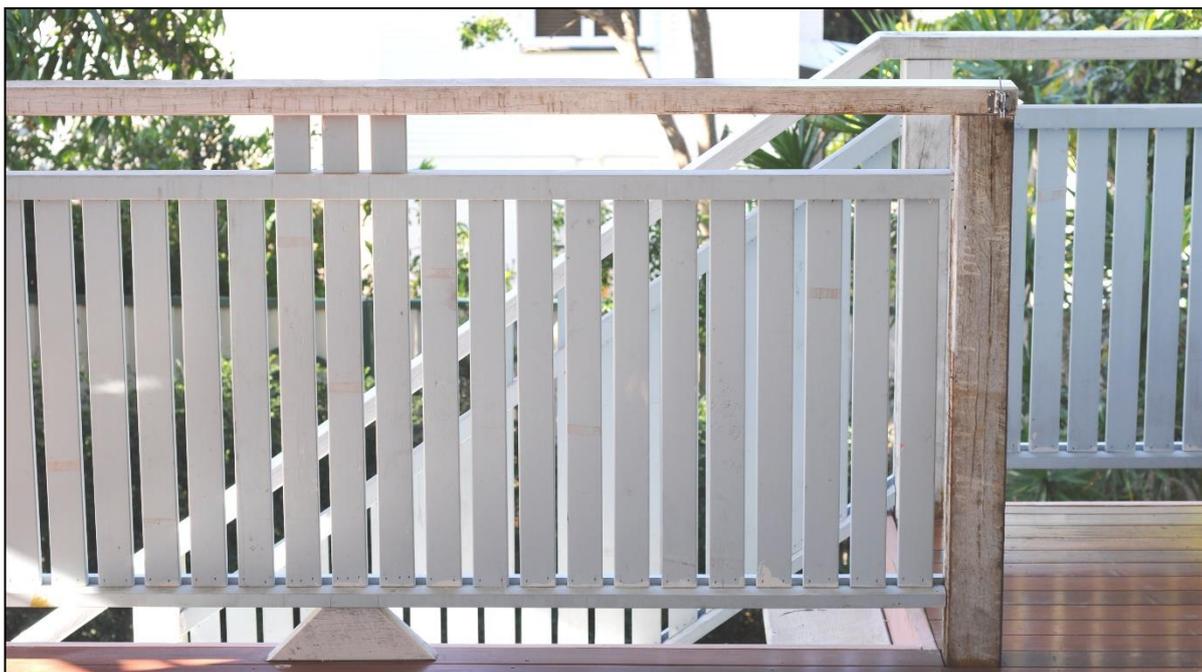
Anchor points of the balustrade should be inspected regularly to ensure these are free from deterioration. Any weakening of these anchors could cause them to fail if a load was applied to the balustrade, such as a person leaning against the balustrade.

What to look for:

- rust and wear at anchor points (where the balustrade is fixed to the deck or balcony, walls or posts)
- handrail is securely fastened to the balustrade
- glass balustrades are free from chips or cracks
- openings in balustrade must comply with the relevant building standards.

Helpful hint

If you can displace or dislodge a handrail or balustrade with a good 'thump' using a heavy rubber mallet then the connection will not be adequate.



Weakened anchors for balustrades could cause them to fail if people lean against them

Planning on extending, renovating or repairing

If you are planning to extend your house or carry out renovation or repair work, ensure you use a licensed contractor. You can search the Queensland Building and Construction Commission's website and conduct a licence search of licensed contractors at www.qbcc.qld.gov.au

You should also check with your Local Government or a private building certifier to determine if a planning and/or building approval is required.

Make sure that all the materials that are used have the required Code compliant durability.

For structural timber, the NCC requires that the timber be in accordance with 'Construction timbers in Queensland – Properties and specifications for satisfactory performance of construction timbers in Queensland'

For metal, steel etc a range of Australian Standards must also be met.

Contacts for advice and/or inspection services

Queensland Building and Construction Commission www.qbcc.qld.gov.au

Timber Queensland www.timberqueenslandcom.au

Board of Architects of Queensland www.boaq.qld.gov.au

Board of Professional Engineers of Queensland www.bpeq.qld.gov.au

If you have purchased a property with an existing deck or balcony, you should also contact your Local Government to check that all required building approvals have been obtained.

Acknowledgements

The Queensland Injury Surveillance Unit, Mater Health Service provided information for use in this guideline. www.qisu.org.au

Kidsafe Queensland provided information for use in this guideline. www.kidsafeqld.com.au

Timber Queensland provided information and images for use in this guideline. www.timberqueensland.com.au

Queensland Building and Construction Commission www.qbcc.qld.gov.au

Glossary

Balustrade – means a protective barrier to prevent accidental falls and usually comprises handrails, infill and posts that support it. A balustrade may be made from many materials including timber, metal, glass etc.

Bearer – means a beam supported by a wall, piers or posts that in turn supports joists or other framing.

Joist – means a horizontal framing member that is supported on or by bearers, ledgers or other structural members that in turn supports floor or ceiling linings such as decking boards.

Ledger – means a member that is attached to a house frame. It is designed to support a deck and transfers the weight of the deck to the house foundation.

Pole plate – means a horizontal plate, bolted or fixed to a wall, which the roof framing is fixed to.

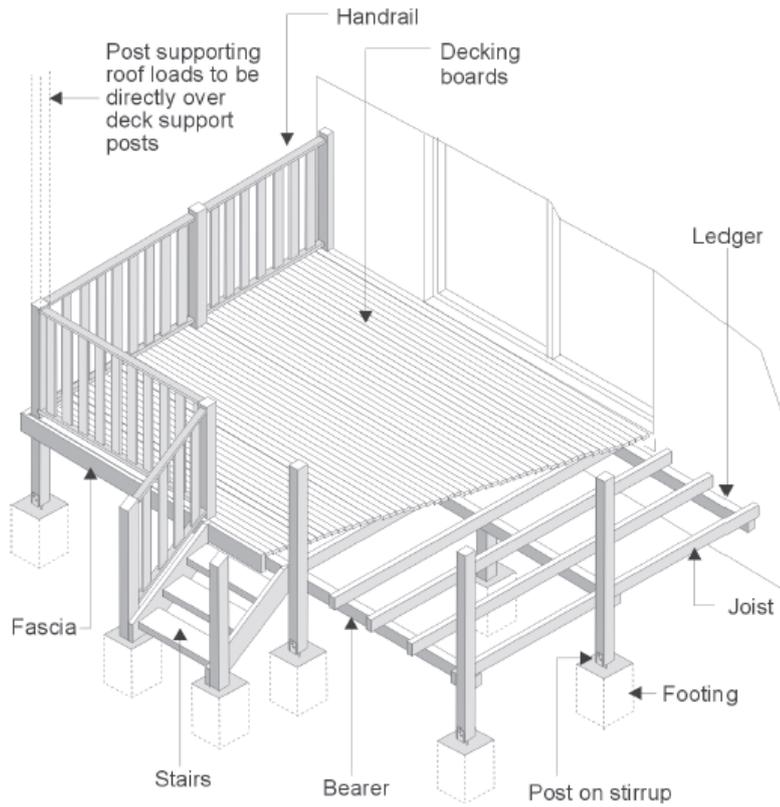


Figure 4 – Example diagram showing common deck components

