



# BACKGROUND INFORMATION

## General Inspection Report One: A general inspection into metal roof construction in Western Australia

April 2016

**The Building Commission's general inspection into sheet metal-clad, timber-framed roof construction in 2014 identified issues with the way building standards are being applied in Western Australia. To assist readers to understand the general inspection's findings, the Building Commission has provided answers to possible questions about the [report](#) below.**

### What is the National Construction Code?

The National Construction Code (NCC) is a national standard that has been adopted by each state and territory. It comprises of the Building Code of Australia (BCA) and the Plumbing Code of Australia (PCA).

In Western Australia the BCA component is prescribed under the Building Regulations 2012 and the PCA component is prescribed under the Plumbers Licensing and Plumbing Standards Regulations 2000.

The NCC sets out minimum performance standards for the safety and health, amenity and sustainability of buildings. Designers, certifiers or builders must be able to demonstrate that a proposed building will meet the performance standards. This may require a combination of technical analysis, testing and expert judgement. Prescribing performance standards allows for individual design and innovation and for cost-effective construction.

The NCC also contains deemed-to-satisfy (DTS) solutions for most normal types of building. These are based on traditional construction practice and can be adopted without further verification. DTS solutions are often conservative compared to performance solutions, but can be simpler to use.

### What are the standards for roof construction?

The key NCC performance standards for roof construction relate to structural safety, but standards also apply for amenity, such as ceiling heights and sustainability, such as thermal or sound insulation. A roof must hold up its own weight ("dead loads") as well as any temporary loads such as uplift forces caused by wind pressure, snow or people accessing the roof ("live loads"). It must also hold down uplift forces caused by wind pressure.

DTS solutions exist for common types of roof construction, including for the timber-framed, metal-clad roofs that were inspected under GIR1. The DTS solutions prescribe several Australian Standards relating to timber roof construction of which the most important is AS 1684.2–2010 Residential Timber Framed Construction.

### What are the main requirements for timber-framed, metal clad roofs?

Traditional timber-framed roofs are individually constructed on site from sawn timber. They require trained roof carpenters with good trade skills to build them.

The carpenter must ensure that timbers of the correct size are chosen to suit the required span and spacing, and that they are properly connected together to transfer the loads from one piece of timber to the next.

Because of the large number of individual elements in the roof it is usually impractical to calculate the loads and internal stresses of each member to confirm that they meet the performance standard. Designers and roof carpenters usually rely on traditional standards for member size and spacing such as the DTS solutions in the BCA and those in AS 1684.

Traditional roof framing is set out so that under gravity loads (dead loads and live loads from people, snow etc.) the members push against each other and provide mutual support. Nails, screws and other connectors serve mainly to hold the members in place. Conversely, wind blowing over a roof may cause upward forces, rather like an aeroplane wing.

Metal clad roofs may not have enough inherent weight to counter wind uplift, and so the loads in the roof members can reverse, with the joints tending to pull apart. Nails, screws and other connectors must now transfer the load between members, and the roof as a whole must be tied down to prevent it from being blown off.

### **How do you know that a timber-framed, metal-clad roof will perform under wind load?**

Wind loads are very variable over time and over location. Engineers rely on wind records for the location of the building to determine a design wind speed. The shape of the roof is then analysed to determine the pressures on each part of the roof surface caused by the design wind speed. It can be possible to have different design wind speeds from different directions, and hence the roof pressures may also vary with wind direction.

Once the wind pressures are determined they are turned into design wind loads for each member. Usually this means allowing for both upward and downward loads, so that the downward weight of the roof is subtracted from the upward wind forces. Engineers can then assess whether each member is strong enough, and supported sufficiently, to take the calculated load.

Where a roof has been constructed to the DTS provisions in the BCA the roof performance requirements have been met and detailed calculations are not needed.

### **Does GIR1 suggest that recently-constructed roofs in WA will not perform?**

The Building Commission's general inspection into metal roof construction in Western Australia (GIR1) showed that most of the roofs in the sample had examples of poor construction practice (for example, straps not tied off properly, poorly-driven nails) and examples where construction varied from AS 1684 (for example, use of steel battens, fixings too close to the edge of the timber).

Where deficiencies appeared likely to affect the performance of the roof inspected, the builder was notified and asked to fix the problem. Therefore we think that all of the roofs actually inspected will perform satisfactorily.

Further audits of house construction generally have commenced and subsequent inspections of the same inspection points used in GIR 1 have identified improvements to date.

The results of GIR1 should be interpreted carefully. It cannot be said that a particular house will not perform but it is reasonable to expect that a reduction in the number of defects increases the likelihood that a roof will perform to an acceptable level. It is not possible, however, to quantify that increase.

After careful consideration and consultation, the Building Commission does not believe that an unquantifiable increase in the likelihood of non-performance justifies the expense and disruption of requiring all roofs constructed over the last five or six years to be inspected. The overwhelming majority of roofs have in fact performed satisfactorily in the high wind events that have occurred to date. However, the report tells us we should not be complacent and the measures now being put in place will ensure better quality assurance of roof construction in the future.

### **What Western Australian construction practices differ from those in the eastern states?**

Each house is individual, and some houses in WA are constructed in the same way as most houses in the eastern states. In general, though, most WA houses comprise of double brick walls sitting on concrete slabs. Brick veneer walls with timber or steel structural framing are more common in the east. In WA traditional timber framing is usually used for roofs, while timber or steel trusses are common in the east.

AS 1684 is a general timber framing standard based on framed timber internal walls and timber roof construction. It provides for tying the roof down around the perimeter and in the middle of the house through connections to the timber frame. In WA it is more difficult to tie timber roof framing to brick, and so it is usual to tie the whole roof down around the perimeter using metal straps passing down the brick cavity and built in to the lower part of the brick wall.

GIR1 also noticed an increasing use of light-gauge metal battens to support the roof sheeting. These are also used in the eastern states, but are not covered by AS 1684 which is purely a timber framing code.

### **What WA construction practices need to be verified for compliance with the NCC?**

The GIR1 used AS 1684 as a reference standard. This does not apply to some practices, such as the use of metal battens. It is common to use nail guns to construct roofs and the special nails used are also not covered by AS 1684. The NCC also specifies minimum galvanising thicknesses for components such as tie-down straps. In WA suppliers have provided straps with a variety of thicknesses, and new products with specialist coatings are being introduced to the market.

Some designers and builders have verified the use of some of these practices before using them, but this was not always done, and “common practice” has spread through usage without clear documentation. By verifying that these common practices will meet the performance standards in the NCC the housing industry and the Building Commission can reassure the community that roofs that have been constructed using these practices will perform to a satisfactory level. Technical verification will open the way to apply to the Australian Building Codes to include Western

Australian practice into the NCC, and to apply to Standards Australia to include Western Australian practices into relevant Australian Standards. This will simplify design, documentation and certification of house roofs, which in turn will assist with housing affordability.

### **Why do documentation standards need to be prescribed?**

A proposed new house or major renovation must be checked by a registered building surveyor to confirm that, if built in accordance with the plans and specifications, it will comply with the relevant performance standards in the NCC. The building surveyor needs information on the drawings to show how the roof is to be constructed.

With some Western Australian practices often differing significantly from the DTS provisions in the NCC it is important that these differences and any unique construction requirements are clearly set out.

The builder and the roof carpenter rely on the drawings and specifications to know precisely what is to be built, and what requirements may differ from normal practice or the DTS solutions in the NCC. By prescribing minimum documentation standards the builder and carpenter will have ready access to all of the information needed to build a roof properly. They will have somewhere to look for specified construction details or variations from common practice. Consistency in documentation will also make it easier for suppliers, supervisors and inspectors to know what is required.

### **Why do we need mandatory inspection of finished roof framing?**

GIR1 showed very variable knowledge of roof construction requirements and quality of workmanship. While a roof carpenter constructs most of the roof, there are other trades involved who may affect how the roof will ultimately perform. The builder is responsible for overall coordination of trades and the compliance of the finished work and should check that the finished roof framing is consistent with the approved drawings and specification. Most builders already do this, but GIR1 also showed very variable knowledge of roof construction requirements among supervisors.

By prescribing a minimum inspection regime the housing industry and the Building Commission can reassure owners and the community that each roof has been properly built and will perform as expected.

By ensuring that inspections are carried out by registered people we can control the minimum skill and knowledge required, and take disciplinary action if needed if inspections are not carried out.

### Why do we need consistent compliance monitoring and enforcement by permit authorities?

The Building Act makes the builder responsible for ensuring the finished building complies with each applicable building standard.

The Building Act also gives local governments, which issue most building permits, wide powers to inspect work under construction and to issue building orders if the work is deficient. Local governments have had similar inspection powers for many years, but the level of inspection and types of inspections carried out by individual local governments has become very variable over time.

The Building Commission will work with individual local governments and with the Western Australian Local Government Association to identify an appropriate level of monitoring and to ensure that local governments have the skills and resources needed to do this important work.

While it is the builder's role to manage the quality control of each project, a minimum and consistent level of monitoring by local governments is important to ensure that the process is working correctly. This role of local governments complements the role of the Building Commission in monitoring the behaviour of registered people, including building surveyors and builders, and helps ensure that the design, certification and construction of buildings is properly carried out.

### What can consumers do to ensure their builder is building to the right standards?

Firstly, always engage a registered builder to carry out building work valued at over \$20,000 where a building permit is required. Consumers can consult the Building Commission's website for information on [building or renovating](#) including a complete checklist on what to do before, during and after construction.

Consumers who are not confident to manage their own contracts can engage their own independent expert to advise on the construction of their homes.

**It is advised that a trained qualified professional carries out any work or inspection in a roof space. The roof space has hidden dangers that include electrical wiring, overhead obstacles and unstable under foot conditions. Extreme caution is advised when entering a roof or any confined space.**

### What should consumers do if they are concerned about their roof?

The Australian building standards require homes to be constructed to a very high standard, so a failure to comply with a building standard does not necessarily mean the roof will fail to perform.

Consumers who believe they have faulty building work should contact their builder in the first instance. It is the person named as the builder on the building permit who is responsible for ensuring any building work carried out complies with the applicable codes and standards.

If a consumer does not get a satisfactory response from the builder, the consumer should consider engaging the services of a qualified building inspector (this could be a builder, building surveyor, architect or some other suitably qualified individual) in order to identify the nature or extent of any problems.

If an inspection identifies issues of concern, consumers should put this in writing to the builder outlining what the problem is and giving a reasonable amount of time for the builder to respond or to fix the issue.

If after writing to the builder the consumer still cannot resolve the issue, the consumer can make a formal complaint to the Building Commission. However, the consumer would need to provide the supporting evidence of any faults, such as the inspection report.

For the Building Commission to accept a complaint, the home must have been completed within the past six years. Further information on the [complaints process](#) is available on our website or phone 1300 489 099.

For homes built more than six years ago, information about civil claims can be found on the relevant court websites. Prior to pursuing any action, it is advisable that consumers seek their own independent legal advice.