GOVERNMENT OF WESTERN AUSTRALIA

Department of **Energy, Mines, Industry Regulation and Safety**

Building and Energy Western Australia

Compliance Inspection Report Three

Timber roof tie-down and wall framing

January 2025

Contents

Glossary of terms, acronyms, and abbreviations

Accessible	Having features that enable use by people with a disability.
Applicable building standards	In general, the applicable building standards for proposed building work is the BCA.
BCA	Building Code of Australia (volumes 1 and 2 of the National Construction Code).
Building Classification	A categorisation system for buildings of similar risk levels based on use, hazard, and occupancy.
Building and Energy	The Building and Energy division of the Department of Energy, Mines, Industry Regulation and Safety.
Building Services Acts	A suite of laws governing building control.
Building Permit	Permission granted by the permit authority for building work to be conducted.
Building Regulations	Building Regulations 2012 (WA).
Building surveyor contractor	Registered individuals, partnerships or companies that undertake to carry out building surveying work and issue approved certificates.
Building Surveyor Practitioner	Registered individuals that conduct building surveying work. They cannot issue a certificate but can be a nominated supervisor for a building surveyor contractor.
CCC	A certificate of construction compliance (CCC) is an approved form issued by a building surveying contractor. It is required to obtain an occupancy permit from the permit authority to occupy a newly completed Class 2 to Class 9 building or a newly completed part of the building.
CDC	A certificate of design compliance (CDC) is an approved form issued by a building surveying contractor. It is required to obtain a building permit from the permit authority to construct a building or incidental structure.
CRA Act	*Building Services (Complaint Resolution and Administration) Act 2011* (the CRA Act).
Compliance Demonstrated	The design documentation includes sufficient information to demonstrate compliance with the applicable building standards. (This information may have been provided in the form of drawings or included or described in specifications or other technical documents including performance solutions).

Compliance not Demonstrated	The design documentation does not include sufficient information to demonstrate compliance with the applicable building standards or the information provided clearly demonstrates non-compliance with the applicable building standards.
Deemed-to-Satisfy (DTS)	Provisions that are deemed-to-satisfy the Performance Requirements of the BCA of Australia.
Design Criteria	These criteria form the basis of the design for the structural and other components and systems for the building and are based on the use, scale, and location of the building.
Design Documentation	Drawings, specifications, and technical documents referenced on a certificate of design compliance that demonstrate compliance with the building standards.
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety.
Emergency Lighting	Lighting provided in a building to aide safe evacuation during an emergency.
NCC	National Construction Code.
Evidence of Suitability	Evidence that supports that the use of the material, product, form of construction or design meets a Performance Requirement or a Deemed-to-Satisfy Provision of the NCC BCA.
Permit Authority	Unless otherwise stated in this report means the local government in whose district the building or incidental structure is, or is proposed to be, located.

1. Executive summary

The Department of Energy, Mines, Industry Regulation and Safety – Building and Energy Division (Building and Energy), undertakes inspections to monitor whether Building Service Acts are being complied with as part of its Audit Strategy 2021-24 (Audit Strategy) [1]. Each year, Building and Energy sets out the areas of focus for the forthcoming year in its Audit Priorities Statement based on construction practices that pose the most significant risks.[2]

As part of Building and Energy's Audit Priorities Statement 2021-22 (Audit Priorities), a compliance inspection of building contractors that construct class 1a residential buildings with a particular focus on roof tie-downs and timber wall framings was commenced. The aim of the inspection was to gather and analyse information about practices associated with these areas of construction so that further advice, information, and education can be provided to the building industry to improve overall compliance. This work was continued the following year with the Audit Priorities Statement 2022-23 identifying the ongoing need to monitor timber roof framing. Wall framing was included in the priority due to its increasing use and links to roof construction, tie down, bracing and building stability.

Compliance Inspection (Technical) Report Three – Timber roof tie down and wall framing (CIR3) details the findings of Building and Energy's inspections into how building standards were applied through the design and installation of timber framing elements in the samples inspected during 2021-22 and 2022-23.

A sample size of 44 buildings was set as a minimum in the Audit Priorities for 2022-23. This was deemed sufficient to allow Building and Energy to gain a snapshot view of industry practices via its technical compliance inspection. In total, 47 buildings were inspected and these related to 31 building contractors. Eleven of the building contractors had previously been the subject of a compliance technical inspection.

As part of the inspection process, any concerns regarding non-compliance with a building standard were discussed with the respective building contractors so that issues could be resolved 'on the spot'. On 42 occasions the contractors were asked to provide proof of rectification where the unsatisfactory work was deemed to be of a high risk. While this achieved a satisfactory outcome with regards to timber framing, one referral was made to the Permit Authority for other unsatisfactory work. This process helped to ensure each building complied with the applicable building standards and was a useful education and training exercise that will help improve future compliance.

Building and Energy also discussed findings made in this report with peak industry bodies, including the Housing Industry Association of Western Australian and the Master Builders Association of Western Australia, to assist with the education and understanding of industry participants.

[1] Building and Energy – Building Compliance Audit Strategy 2021-24. https://www.commerce.wa.gov.au/publications/building-and-energy-building-compliance-audit-strategy-2021-24

[2] Building and Energy – Audit Priorities Statement 2021-22. https://www.commerce.wa.gov.au/publications/building-and-energy-audit-priorities-statement-2021-22

Our key findings

- **72 percent** (624) of timber roof tie down and wall framing items across 47 buildings inspected were found to be **satisfactory**, with **28 percent** (237) of items found to be **unsatisfactory**;
- The most **common** cause for **unsatisfactory items** (61 percent) was **not adhering** to **design documentation;**
- The most **common item** inspected that **did not adhere** to the design documentation was **tie-down rods and straps.**

When compared to our most recent Compliance Report of June 2021, our findings through this audit indicate a modest improvement for timber roof framing and a significant increase in satisfactory findings for timber wall framing elements.

We found that approximately two out of three unsatisfactory inspection points were a result of the construction not being built in accordance with the approved plans. The unsatisfactory points ranged from a complete change in the building methods used to simpler deviations in individual details from what was specified in the approved plans.

Although we did not perform a full assessment of the design documentation, these documents were referred to during the inspection and were generally considered to contain adequate information and detail for construction purposes.

The remaining unsatisfactory points were found to range from failure to adhere to manufacturer's installation instructions, the National Construction Code (NCC) generally and standards of workmanship.

Our actions

Building and Energy has published industry bulletins providing guidance on the importance of building in accordance with the approved plans and the correct installation of tie-down and timber frame connectors.

Building and Energy will also prepare education and training presentations for its continued work with industry stakeholders.

2. Background

In July 2021, Building and Energy published its 2021-24 Audit Strategy. The Audit Strategy takes a risk-based approach to minimising harm and the associated Audit Priorities detail the compliance activities Building and Energy intends to undertake in each period in response to areas of construction that have been identified as posing the greatest risk to public safety.

Roof tie-down and timber wall framing was identified as an area where a greater understanding of current practices was required because of a number of historic roof failures (refer to section below). Roof failures can pose a life safety risk to people in and around the buildings. These elements of construction were included in the Audit Priorities for 2021/2022 and technical inspections have been undertaken to inform Building and Energy whether a problem exists, its size and scale, and whether a General Inspection Industry Report is required.

Previous research and inspections

Building and Energy published General Inspection Report One: A general inspection into metal roof construction, in 2016 (GIR1).

During the course of GIR1 the following defects were frequently identified –

- related tie-down elements within the structural chain not effectively linked together;
- trades did not appear sufficiently aware of the necessary minimum requirements;
- plans and specifications did not contain sufficient details;
- industry supply chains did not consistently provide WA builders with conforming options; and
- Australian Standards referenced by BCA Volume 2 (as acceptable construction manuals) in some instances did not reflect WA's building conditions and changing construction practice.

Building and Energy published Compliance Report - A summary of technical building inspections in 2021.

This compliance activity included 47 inspections of class 1a under construction buildings with the following findings relating to timber wall and roof framing specifically –

- roof tie-down 54% satisfactory.
- timber roof framing 64% satisfactory
- timber wall framing 31% satisfactory

From 2017 to 2019, Building and Energy investigated several roof failures to residential buildings. The following defect types were noted:

- non-compliance with the NCC;
- non-compliance with the approved documents;

- the approval documentation did not demonstrate how compliance with the NCC was to be achieved; and
- unsatisfactory workmanship.

In 2021, Building and Energy investigated roof and building failures as a result of Severe Tropical Cyclone Seroja (TC Seroja). TC Seroja was classified as a Category 3 severe tropical cyclone and crossed the Mid-West coast of WA near Port Gregory on Sunday 11 April 2021. TC Seroja caused extensive wind damage to buildings in coastal and inland towns with a high number of timber roof and wall framing failures.

3. Objectives and scope

To carry out the Building Commissioner's function to monitor registered service providers and determine if applicable building standards are being complied with, Building and Energy carried out technical compliance inspections of Class 1a buildings focusing on the installation of timber framing elements.

By using past inspection data, Building and Energy was able to target areas known to have a risk of non-compliance. This gave an insight into:

- how the builder is applying the applicable building standards;
- how the required timber framing is being installed; and
- whether the building site characteristics have been identified correctly through the building permit process, including, but are not limited to:
    - wind classification; and
    - corrosion classification.

The aim of CIR3 is to communicate the learnings identified during inspections to relevant professions in the building industry to improve overall compliance and building safety. Building and Energy has used the findings detailed in this report to suggest improvements in demonstrating and meeting the applicable building standards to ensure the safety of people in and around buildings.

4. Methodology

In August 2021, Building and Energy commenced technical compliance inspections of 47 residential buildings.

While the selection of building contractors was random, research was carried out to establish contractors who build predominantly with timber frame, as this compliance inspection focused on timber framing. Cavity brick buildings were also inspected with a focus on the roof construction elements.

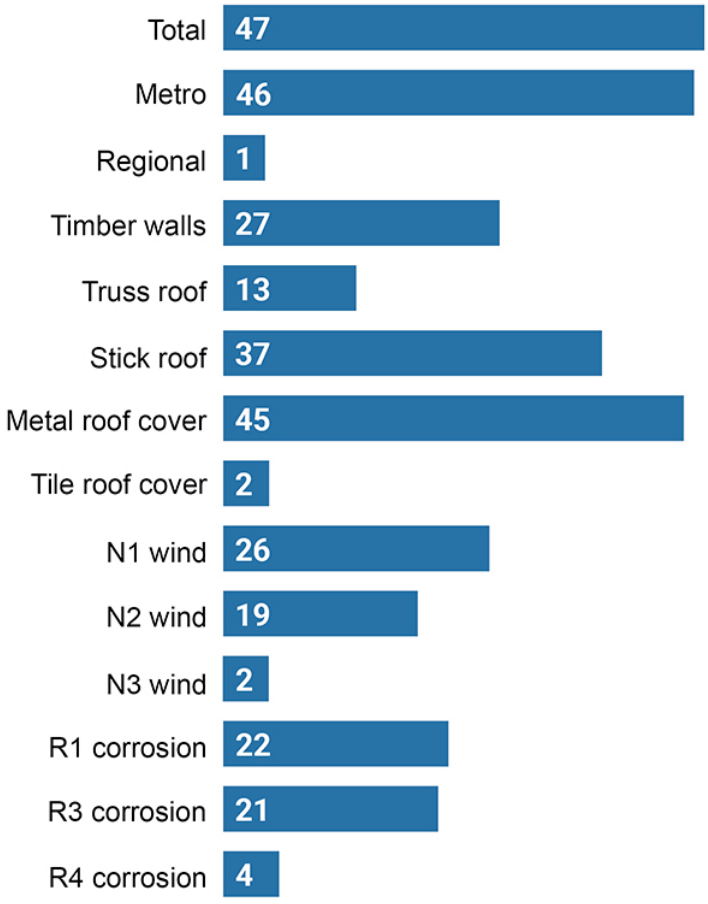
Building and Energy issued an electronic notification to the building contractor of its intention to perform compliance inspections on buildings under construction including a request for a list of current projects.

From the lists provided, one to four buildings were selected for a compliance inspection from each building contractor. The number of buildings selected to inspect from each building contractor was dependant on the number of buildings the building contractor had under construction at the appropriate stage for inspection. There were 47 buildings chosen for inspection with a possible 40 inspection points per building making a possible 1880 inspection points overall. As not all inspection points were available to be inspected on all buildings, a total of 913 inspection points were identified for inspection.

The buildings inspected were constructed by 31 different building contractors, ranging from those with a relatively high volume of projects, to those considered to be niche or bespoke builders.

Of the 47 buildings inspected, 46 were within the Perth metropolitan region, 27 included sections of timber wall framing, 13 included trussed roof parts, 37 included stick roof construction and 45 had metal roof cover. Additionally, the inspected buildings covered a range of wind classifications from N1 to N3 and corrosion classifications from R1 to R4.

Table 1. Building Characteristics



Once a site at the correct stage of construction (timber roof framing complete) was identified for an inspection, Building and Energy gathered and reviewed all the necessary building approvals information about the site prior to conducting the inspection.

Each building was inspected and compared against the approved documents specified in the building permit.

A thorough inspection of all building elements able to be observed at the time of inspection was then carried out on each chosen building. On completion of the inspections, data was extracted in the areas of roof tie-down, timber roof framing and timber wall framing, covering 40 inspection points.

Table 2. Inspection points

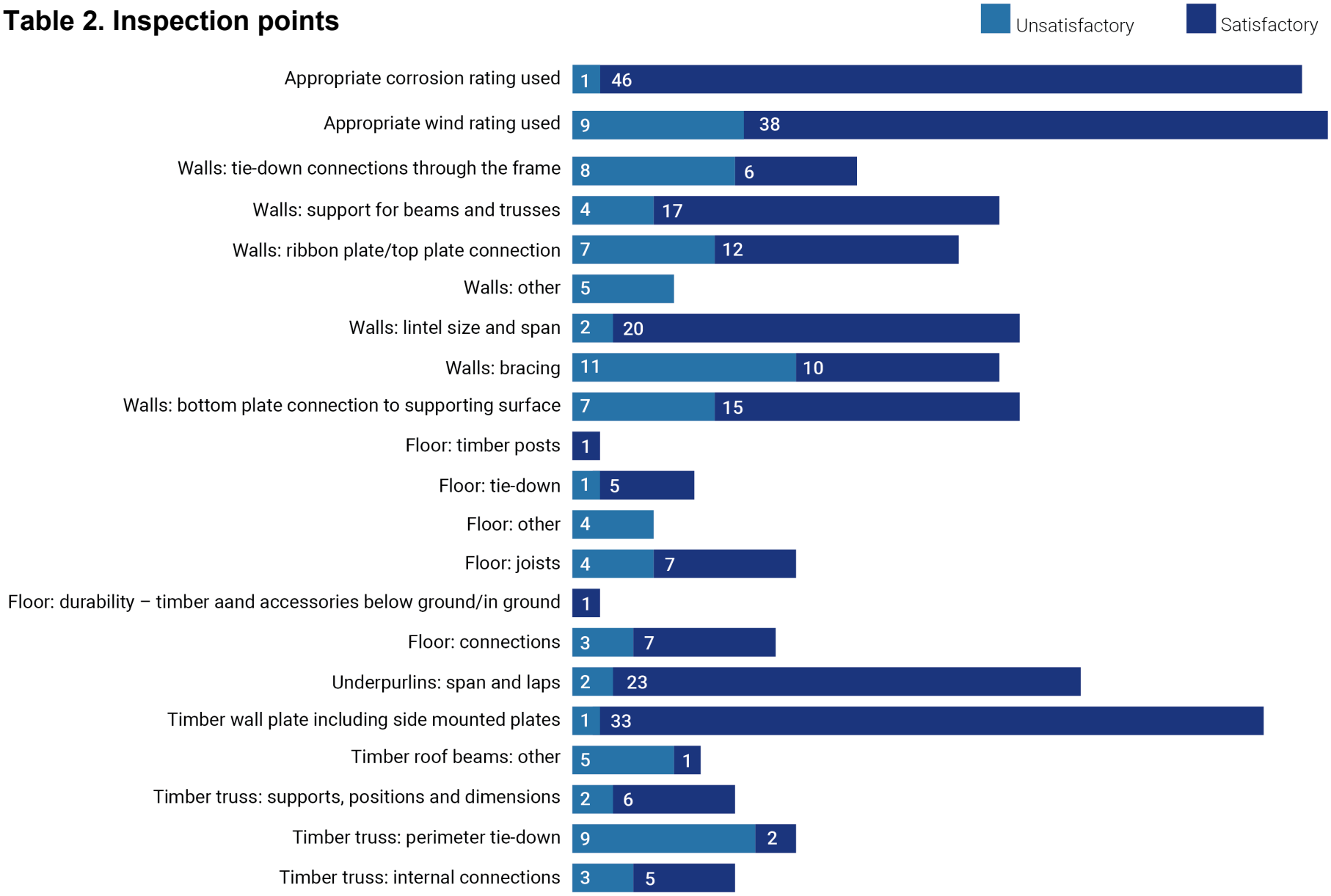
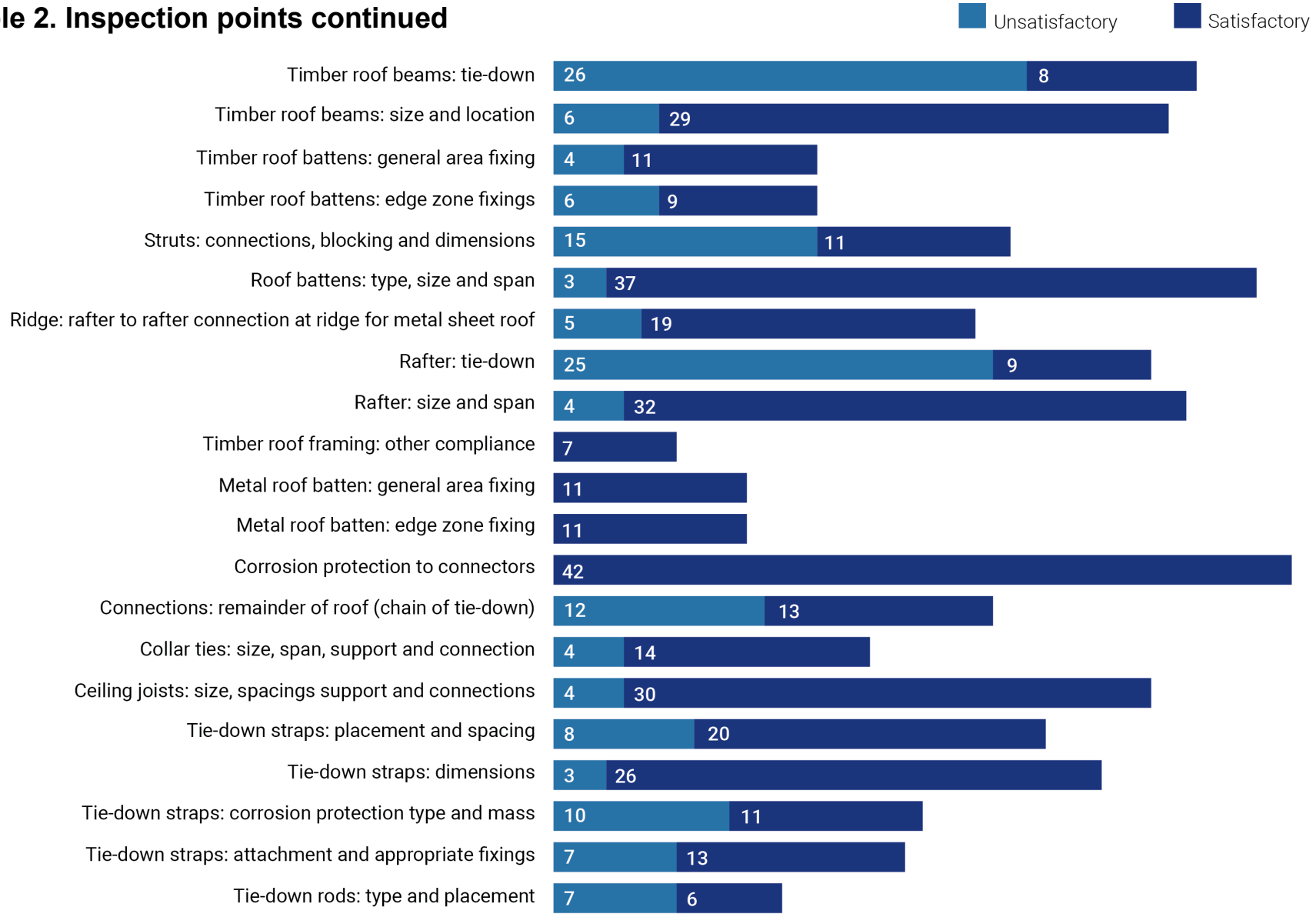


Table 2. Inspection points continued



Included in the inspection was an assessment of building site characteristics specified in the certificate of design compliance (CDC) documentation. This was to identify wind and corrosion classifications. This data was used to assess whether these classifications were appropriate for the building location and design.

Limitations

This compliance inspection was a technical inspection of timber framing elements of buildings and the connection of the timber framing to other elements for the purpose of uplift resistance. Therefore, the compliance inspection did not include metal framing or steel members.

While the findings include the assessment of the physical building against the certified design documentation, the report does not include a general assessment of the design documentation itself, only wind and corrosion classifications were assessed in this regard. Although a full assessment of the design documentation was not carried out, these documents were generally considered adequate when used to carry out the inspections.

5. Findings

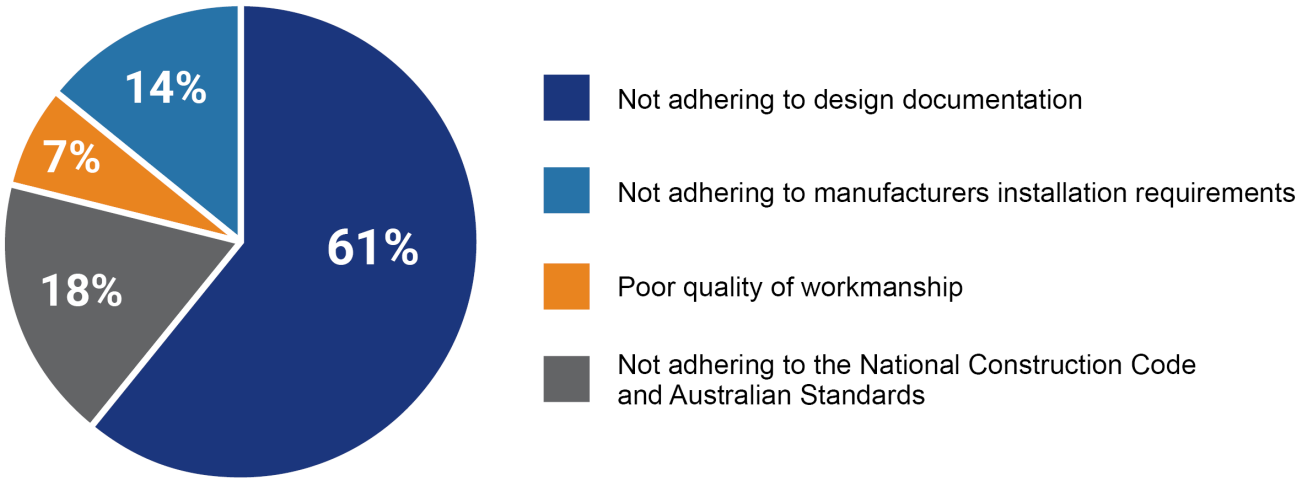
From the 40 inspection points, 237 items of unsatisfactory building work were identified across the 47 inspections.

As a result, several themes became evident. The themes can be categorised as:

- departure from the approved design documentation;
- departure from the manufacturer's installation requirement of timber connectors;
- poor quality of workmanship; and
- not adhering to the NCC and the referenced Australian Standards (when these building solutions are chosen and approved).

Table 3 shows percentages of the 237 items found to be unsatisfactory attributed to categories.

Table 3. Unsatisfactory building work by category



Design documentation

The design documentation is required to be approved via the building permit process that includes the signing of a CDC by a registered building surveyor which assists the building contractor to ensure it is constructed to meet the applicable building standards. The inspection identified approximately 25 percent of building work from the 40 inspection points to be unsatisfactory. From the 237 items of unsatisfactory building work identified, 61 percent (145) of those items were attributed to not adhering to the approved design documentation.

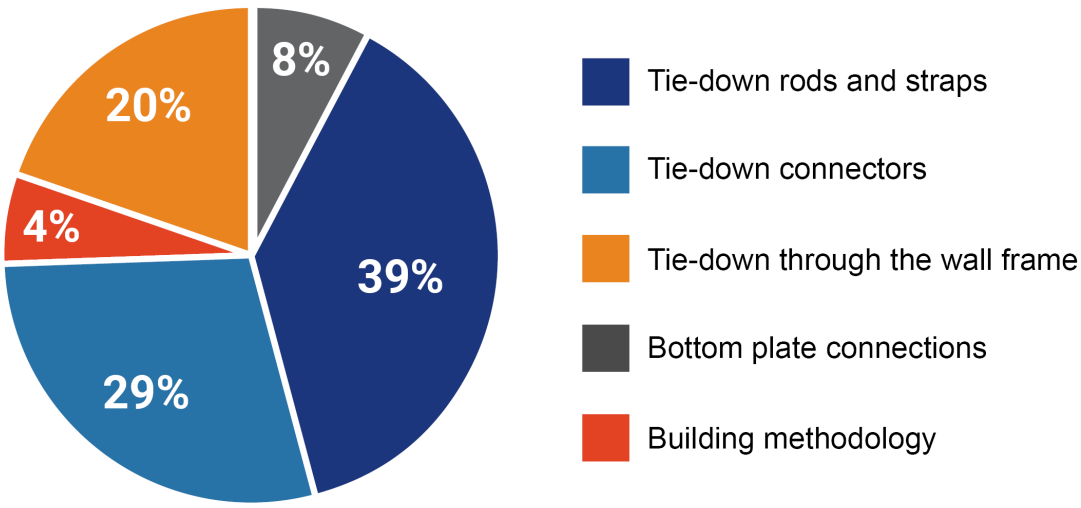
Building and Energy acknowledges a failure to construct a building to the approval does not necessarily mean the building will fail to perform. However, failure to comply with either the building permit or the applicable building standards may be assessed as non-compliant and/or considered unauthorised building work.

Examples of building work not carried out in accordance with the approved design documentation:

- change in building methodology from conventional roof construction to truss;
- tie-down rods and straps not included and/or connected as specified;
- tie-down connectors not included as specified;
- bottom plate connections to the supporting surface not installed as specified; and
- tie-down connections through the wall frame not installed as specified.

Table 4 shows percentages of the 145 items of unsatisfactory work categorised by how they were observed to not adhere to the approved documentation.

Table 4. Non-adherence to design documentation by category



Manufacturer's installation requirements

The inspection identified 14 percent (34) unsatisfactory items to be a result of not following the manufacturer's installation requirements.

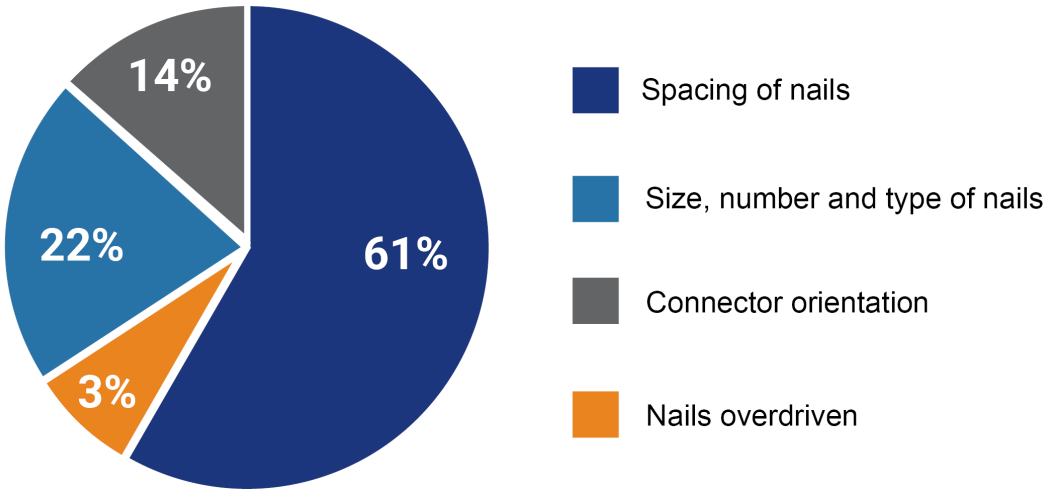
Most new homes now include the use of proprietary timber connectors in the approved design documentation. Each manufacturer of timber connectors has specific installation requirements for their own connectors. An installation manual will generally provide tested joint design capacities for connectors installed in accordance with the manufacturer's installation instructions. It is important for installers to refer to the manufacturer's instructions for the specific connectors they are installing. Failure to install the connectors in accordance with the manufacturer's installation instructions will result in a reduced capacity of the joint.

Deviations from the manufacturer's installation instructions included:

- incorrectly orientated connectors;
- incorrect size, number and type of nails used for connectors;
- connector nails overdriven into the connector; and
- connector nails installed with insufficient spacing between –
    - the edge of the connector;
    - existing holes in the connector; and
    - other nails installed in the connector.

Table 5 shows percentages of the 34 items found to be attributed to not adhering to the manufacturer's installation requirements against each one found to be unsatisfactory.

Table 5. Unsatisfactory installation of timber connectors by category



Workmanship

Approximately 7 percent (16) of the unsatisfactory items identified were found to be unsatisfactory workmanship.

Items of unsatisfactory workmanship generally related to the installation of fixings. Items included:

- failure to comply with edge distance requirements for the installation of fixings;
- bracing and strapping not sufficiently tensioned; and
- tie-down straps and rods not installed vertically.

Failure to uphold satisfactory workmanship standards will generally result in the reduced timber framing joint capacities.

Building codes and Australian Standards

The building inspections identified 18 percent (42) of unsatisfactory items did not meet the appropriate requirements of the NCC referenced in the approval.

Design requirements, such as corrosion protection and steel grade, are often specified in the structural design documents to be in accordance with the appropriate Australian Standard. Building contractors need to be familiar with the BCA and referenced standards for the elements referenced in the design documentation.

The building inspections identified nine of the 47 site classifications appeared to have an inappropriate wind classification and one appeared to have an inappropriate corrosion classification. Wind classifications appeared to not be correctly assessed in accordance with the appropriate standard, often not meeting the limitations of the standard.

The remaining unsatisfactory items were generally identified to cover a range of BCA and standard requirements including timber span and connection requirements.

Previous inspection findings

Previous audit programs have included inspections of roof framing and tie-down system where it was found that tie-down systems were often omitted. It was found through this compliance inspection that there is generally more effort attributed to the installation of the tie down system through the roof construction. The unsatisfactory items in this inspection were mainly limited to placement of tie-down elements, including type and number of fixings rather than the omission of these items.

This compliance inspection also included timber wall framing which has not previously been identified as an area of priority by Building and Energy.

6. Our Guidance for improving construction

1. **Building contractors should have appropriate processes in place so that any required changes have the necessary certification and building permit requirements satisfied**.
   If the building methodology is required to be changed, the building contractor is responsible for ensuring all required building certifications and approvals are updated in accordance with the *Building Act 2011* (the Building Act).

2. **Construction supervision staff and installers should have a clear understanding of the chain of tie-down**. By being able to follow the load paths and understanding the chain of tie-down requirements, installers should then be able to, in conjunction with the design documents, install suitable connections and possibly identify where connections are inadequate.

3. **Follow the manufacturer's installation instructions**. Building staff and installers should be familiar with the manufacturer's installation instructions of the connectors being installed. Building contractors should be aware that while different manufacturers may specify similar installation requirement for similar styles of connectors, there are often subtle differences, for example the appropriate use of machine-driven nails. The installation of timber connectors is required to be in accordance with the appropriate manufacturer's requirements.

4. **Using correct wind classifications is essential to ensure that a building will be designed and constructed to comply with the applicable building standard**. Further information on determining the appropriate wind classification can be found in the Building and Energy, Industry Bulletin 124.

7. Our Actions

Action 1: Building and Energy, in line with internal processes and future audit priorities, will consider targeting timber framing and contractors who were found to have carried out unsatisfactory work considered to be of high risk.

Action 2: Building and Energy has produced Industry Bulletin 154 to provide guidance on the importance of building in accordance with the approved documents. The industry bulletin will assist in providing greater assurance that completed building work will be correctly certified as meeting the BCA requirements and correctly authorised.

Action 3: Building and Energy has produced an Industry Bulletin 151 to provide guidance on the importance of tie-downs and connections in timber framed walls. The industry bulletin alerts industry of the inadequacies identified, providing an opportunity for improvement.

Action 4: Building and Energy will continue to work with key stakeholders in the building and construction industry, including the Australian Institute of Building Surveyors, the Housing Industry Association, Master Builders Association, and the Institution of Engineers Australia, along with permit authorities, to provide further information, education and training based on the findings of this inspection.

Action 5: Building and Energy will consider undertaking a full general inspection into timber framing to determine if the action items above have been effective in improving compliance.

8. Appendices

Role and powers of Building and Energy

WA has a suite of laws governing building control, including the Building Act, the *Building Services (Complaint Resolution and Administration) Act 2011* (the BSCRA Act), and the *Building Services (Registration) Act 2011* (the Registration Act).

The BSCRA Act empowers the Building Commissioner to monitor any building or building service in WA to verify how building services have been or are being carried out, and how building standards have been or are being applied.

The Building Commissioner can designate Building and Energy officers to review approval documentation and to inspect buildings during construction and after the completion of building works.

The Registration Act provides a framework for registering building surveyors and builders and includes disciplinary provisions to manage sub-standard work and conduct by a registered building service provider.

For a new building of any classification that requires a building permit, the Building Act requires a registered building surveyor to sign a certificate of design compliance (CDC) for the building design. The CDC contains a statement to the affect that if the building is completed in accordance with the plans and specifications that are referenced in the certificate the building will comply with each applicable building standard.

Additionally for new Class 2-9 buildings that require a building permit, the Building Act requires a registered building surveyor to sign a certificate of construction compliance (CCC) for the completed building. The CCC contains a statement to the affect that the building has been completed in accordance with the plans and specifications that were referenced in the CDC, and as such the building complies with each applicable building standard.

Further information about the role of Building and Energy is available on its website.

Building approvals

The building approval process for WA is legislated under the Building Act and associated Building Regulations. This legislation controls the application of building standards for the design and construction of buildings and incidental structures and sets out when a building permit is needed for building work.

The Building Act generally requires a building permit for the construction of a new building and an occupancy permit to allow a building to be occupied (applies to Class 2-9 only). As part of the process for getting a building permit, a building surveyor needs to sign a CDC stating that if the building is completed in accordance with the plans and specifications, the building will comply with each applicable building standard that applies to it.

For an occupancy permit a building surveyor needs to sign a CCC stating the building has been completed in accordance with the plans and specification specified in the CDC.

The permit authority (usually the local government in whose district the dwelling will be built) can grant building permits and occupancy permits if satisfied that the application for a permit addresses the requirements of the Building Act and Building Regulations. The permit authority can request further information to assist it in considering an application (if there is an error) and impose conditions on the grant of a building permit if necessary.

The builder named on the building permit is responsible for ensuring that the building is constructed in accordance with the building permit (including any conditions) and the applicable building standards.

Building surveyors must be satisfied that the building has been constructed in accordance with the approval documentation prior to signing a CCC.

The Building Act gives the permit authority powers to monitor and inspect building work to ensure compliance with these requirements. The Building Act also provides permit authorities with the power to issue building orders to remedy or stop building work, and to prosecute builders and owners for non-compliance.

Further information about the building permit process is available on the DEMIRS website.

Building standards

The Building Regulations, made under the Building Act, set out a general position as to applicable building standards, as well as a series of qualifications for particular circumstances and types of building. The general position is that the applicable building standards are those set out as the Performance Requirements in the BCA in effect at the time the building application is made or were in effect 12 months before the building permit application was made.

The BCA is a comprehensive set of building standards that is the product of a series of efforts by the Commonwealth, state and territory governments during the 1960s, 1970s and 1980s to develop a uniform national position on building standards.

The BCA was first published in 1988 and has been revised several times. In 2008 the Council of Australian Governments agreed to develop a national code covering building plumbing, electrical, and telecommunications standards. The National Construction Code (the NCC) was published in 2011. To date the NCC only encompasses building and plumbing standards.

The NCC consists of three volumes. Volume One of the NCC deals with building standards for Class 2 to Class 9 buildings (multi-residential, commercial, industrial and public buildings); Volume Two deals with building standards for Class 1 and Class 10 buildings (residential and non-habitable buildings and structures); and Volume Three deals with plumbing standards. The term BCA refers to volumes one and two of the NCC.

The BCA sets out minimum Performance Requirements that buildings must achieve. A Performance Requirement can be satisfied using a deemed-to-satisfy (DTS) solution, a performance solution (previously known as an alternative solution) or a combination of DTS and performance solutions.

A DTS solution is one that follows the prescriptive DTS requirements contained in the BCA. These requirements may cover materials, components and/or construction methods that are to be used and design factors that are to be considered.

A performance solution is any solution other than a DTS solution that satisfies the stated Performance Requirement. Deemed-to-satisfy solutions are typically the 'time proven' methods of construction that are known to produce an acceptable outcome. Such methods may however prove to be inefficient or come with other intrinsic limitations. Performance solutions by contrast are flexible and allow for the development of innovative construction methods and products.

For a DTS solution these assessment methods are:

- compliance with the DTS provisions of the BCA.

For a performance solution these assessment methods are:

- provision of certain types of documentary evidence;
- verification through the conduct of tests, inspections, calculations;
- expert judgement; and
- comparison with the DTS requirements.

Part A2 of the BCA Volume One contains the acceptance of design and construction provisions. This part outlines the options that can be used as evidence to support that the use of materials, products or forms of construction meet the NCC requirements.

Additional resources

Industry Bulletin 144 – Technical documents is available on the Building and Energy website.

Feedback

Feedback on the content of this report can be submitted via be.info@demirs.wa.gov.au.

Department of Energy, Mines, Industry Regulation and Safety
Building and Energy

Office: Level 1, 303 Sevenoaks Street, Cannington WA 6107
Post: Locked Bag 100 East Perth WA 6892

Phone: 1300 489 099 Fax: (08) 6251 1901

Email: be.info@demirs.wa.gov.au
Web: www.demirs.wa.gov.au/building-and-energy