Government of Western Australia
Department of Mines, Industry Regulation and Safety
Building and Energy

General Inspection (Snapshot) Report Four

Wind classification compliance for Western Australian houses

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Department of Mines, Industry Regulation and Safety
Building and Energy

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General Inspection (Snapshot) Report Four (GIR4)

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Contents

Glossary

The following is a summary of key terms frequently used in this document. The definitions listed apply unless otherwise indicated.

AS/NZS	Australian Standard/New Zealand Standard
BCA	Building Code of Australia (Volumes 1 & 2 of the National Construction Code)
Building permit	In general a building permit, granted by a permit authority, is required before building work can be carried out.
CDC	Certificate of design compliance
Compliance	Compliance is referred to herein as meeting the requirements of all applicable building standards, approved design documentation and manufacturer's installation instructions as appropriate. Compliance should result in something that is fit for purpose and does not pose a concern to the safety or amenity of building occupants or the wider public.
CRIS	Consultation Regulatory Impact Statement
Deemed-to- satisfy provision	A provision contained in Section 3 (of the BCA) which are deemed to comply with the Performance Requirements.
Department/DMIRS	Department of Mines, Industry Regulation and Safety of which Building and Energy is a division
GIR4	General Inspection Report Four: Wind classification compliance for Western Australian houses
IB	Industry Bulletin
Local government	One of Australia's three spheres of government – i.e. Federal, State, and Local. Local government may be referred to as local councils and may have the prefix of City, Shire, or Town.
Performance requirement	Means a requirement which states the level of performance which a Performance Solution or Deemed-to-Satisfy Solution of the BCA must meet.
Permit authority	The permit authority for the building or incidental structures as defined in Section 6 of the Building Act 2011. Unless otherwise prescribed it is normally the local government in whose district the building or incidental structure is/is proposed to be, located
Registered building service provider	Either a building practitioner or a building contractor, registered under the Building Services (Registration) Act 2011.
WA	Western Australia

Executive Summary

As part of its risk-based audit program, the Department of Mines, Industry Regulation and Safety - Building and Energy Division (Building and Energy) conducts general inspections to assess how well building standards are being applied. A 'Snapshot' inspection informs Building and Energy on whether a problem exists; its size and scale; and whether a more comprehensive general inspection is required.

In April 2016, Building and Energy carried out a general inspection into metal clad timber framed roof construction (GIR1) which identified issues with the tie-down of residential roofs to resist wind actions.

General Inspection (Snapshot) Report Four – *Wind classification compliance for residential houses* (GIR4), is a snapshot general inspection. GIR4 extends the work of GIR1 by assessing the accuracy of wind classifications for Western Australian (WA) residential housing against the applicable building standards from which they were derived.

The two key areas of interest in GIR4 were:

- Was an appropriate wind classification provided?
- If not, was the wind classification used less than what is considered appropriate?

GIR4 entailed a desktop review of the building documentation associated with a sample of 284 building permits to provide a snapshot of the accuracy of wind classifications. Buildings for inclusion in GIR4 were selected based on the availability of records obtained in connection with other inspection activities. Wind classifications were reviewed up until mid-2019 and follow-up actions on sites found to have inappropriate classifications, concluded in January of 2020.

GIR4 found 51 of the 284 sets of approval documents (18%) had incorrect/missing wind classifications for the subject buildings. The main cause for inappropriate wind classifications was the use of Australian Standard AS 4055 – Wind loads for housing (AS 4055: 2012), when not applicable. Unsuitable selection of factors related to the site surroundings also resulted in incorrect wind classifications.

Building and Energy has implemented a number of initiatives to assist industry with wind compliance classifications and associated construction details for residential housing. This includes issuing Industry Bulletin 124 - *Warning on inappropriate wind classifications,* to increase compliance in the application of AS 4055: 2012.

Due to the small sample size of dwellings included in GIR4 Building and Energy did not draw conclusions as to broader levels of compliance in the industry. Building and Energy will continue to monitor whether wind classifications are being applied correctly and whether the initiatives implemented to date have been effective in achieving improvements in the industry.

1. Background

Since issuing GIR1, Building and Energy's Audit Branch has developed its expertise about the assessment of wind classifications as prescribed in AS 4055: 2012. While carrying out compliance and general inspections in 2017-2018, Building and Energy came across building permit documents that appeared to have relied on inadequate wind classification assessments.

The wind classifications assessed as part of GIR4 were all nominated to AS 4055: 2012. AS 4055: 2012 follows a prescriptive deemed-to-satisfy (DTS) pathway of the Building Code of Australia (BCA) "i.e. like a recipe book, they tell you how, what and in which location things must be done" (Australian Building Codes Board, 2019).

AS 4055: 2012 provides a simplified wind classification assessment method for one or two storey housing only, used as a DTS solution under the BCA Volume 2 for:

- timber member sizes and connections selected from the *AS 1684 – Residential timber-framed construction* series, according to the applicable wind classification
- windows and doors selected in accordance with the *AS 2047 – Windows and external glazed doors in buildings* design and manufacture requirements
- Cladding materials with published performance data to AS 4055 classifications (see Appendix C for more information)

The failure of either of the building elements listed above could cause internal pressurisation of the building which in non-cyclonic regions can increase roof tie-down loads by a factor of two or more. This can lead to significant damage to roof systems and significantly higher risk of injury to occupants. All of the incorrect or missing wind classifications identified through GIR4 applied to non-cyclonic regions of WA. The design pressures in AS 4055: 2012 account for internal pressurisation of buildings in cyclonic regions, but not in non-cyclonic regions.

Notwithstanding internal pressurisation, where a building has been designed to a lower wind classification than required by the relevant Australian Standards, the strength and serviceability of elements such as cladding, connections and windows may be substandard. The net design uplift at the top of walls can almost double between subsequent wind classifications for houses with metal clad roofs, with an even greater increase possible for houses with tiled roofs (refer to Figure 4). As a result, the tie-down requirements to prevent roofs from being lifted off, also increase substantially between consecutive wind classifications (i.e. N1, N2, N3 etc. or C1, C2, C3 etc.). A lesser wind classification than required increases the chance of failure in a design wind event and may also lead to failure in events that are less than the design event.

2. Methodology

The objective of GIR4 was to inspect a limited sample of approved plans relating to Certificates of Design Compliance (CDCs) of residential dwellings (Class 1a/10a structures) to assess how well compliance with the wind loading requirements of the BCA was being documented.

The two key areas of interest were:

- Was an appropriate wind classification provided?
- If not, was the wind classification used less than what is considered appropriate?

Building and Energy's general inspection assessed compliance levels of documentation against the wind loading requirements of the BCA deemed-to-satisfy provisions (namely the primary referenced documents/ acceptable construction manuals under the BCA Volume 2).

The initial assessment verified whether AS 4055: 2012 was applicable and if not, whether an equivalent wind loading was calculated in accordance with AS/NZS 1170.2. Assessment of the AS 4055: 2012 design assumptions, or of other applicable buildings standards (i.e. AS/NZS 1170.2 and AS 1684.2) followed.

The sample for GIR4 consisted of 284 building sites of Class 1a/10a construction (see Table 1 for description of building classes).

BCA Classification	Description of building
1a	a single dwelling, being either a detached house, or one of a group of two or more attached dwellings, each separated by a fire resisting wall, such as a row house, terrace house, town house or villa.
10a	a non-habitable building or structure, such as a private garage, carport, shed.

Table 1: BCA classifications for residential buildings[1]

These buildings mainly comprised houses inspected during Building and Energy's regular compliance and general inspections. Building and Energy's in-house building permit database mapping tool was also used to incorporate lesser represented areas such as regional WA (further sample of 36).

A limited number of approved plans relating to the cyclonic wind regions of WA were reviewed due to limited building activity in those areas at the time of the general inspection. No inappropriate wind classifications were identified in these cyclonic regions.

[1] Building Code of Australia Vol 1, Part A3.

3. Findings

Of the sample set, **51 sites (18 per cent)** were identified as either having the incorrect wind classifications or none referenced within the approved plans.

One of these 51 sites was a Class 10a building associated with a Class 1a house, the remainder being Class 1a's. *Appendix A – Case Studies* highlights some key areas identified for improvement.

A summary of main issues and measures to improve compliance are outlined below:

- AS 4055 was incorrectly used as the allowable house height, width and/or number of storeys were exceeded.

  Where the AS 4055 limitations are exceeded, AS/NZS 1170.2 must be used to derive the applicable wind loads under the BCA deemed-to-satisfy pathway. A number of buildings inspected during GIR4 were assessed as non-compliant, having not met the deemed-to-satisfy pathway or with a performance solution alternative demonstrated.

- A rougher terrain category was selected than permitted by the presence of a large open area within 500 m of the site.

  Rougher terrains, that is ground with lots of obstructions like trees or buildings, can slow the wind as it passes over them and conversely smoother terrains allow the wind to build up speed. The smoothest terrain (category with lowest number) within a 500 m radius of the site applies to AS 4055. In this regard sites within 500 m of a golf course, large reserve or open farmland will typically be TC2, or less (for example, if also within 500 m of a body of water that is wider than 200 m). It is recommended that satellite imagery is used to create a circle of 500 metres radius, centred about the site when assessing the terrain.

- The site location near the top of a hill was not reflected in the incorrect topographic class applied.

  Houses near the top of hills typically experience higher wind speeds than houses on flat land during the same wind event. It is recommended that contour maps (often available for free on local council websites, Google maps terrain view and the like) are used to find the top and bottom of hills, ridges and escarpments and to calculate their height and slope.

- The selected shielding class was inappropriate.

  The amount that the wind is blocked for the subject site can be over-estimated if more shielding than available is relied on. Shielding objects must be house-sized objects, likely to be present five years on. Shielding objects must be

closely spaced – typical of housing densities of 10 houses or more per hectare with stricter provision applying in cyclonic areas.

By designing for a smaller building than appropriate or one with an inappropriate wind classification, the design wind speeds may be under-estimated. Specified building elements may therefore fail to achieve applicable performance requirements.

In addition to assessing the accuracy in which AS 4055 was applied, analysis of the various parties involved in providing technical advice, certification, permits and construction of the buildings examined in this general inspection occurred. Trends in geographic areas were also considered.

With respect to the 51 incorrect or absent wind classifications identified in GIR4:

- One third of the approval documents were certified by two building surveying contractors (24 different building surveying contractors for 51 CDC's)
- 35 different registered building contractors and four owner-builders were involved. One particular building contractor was involved in seven of the houses.
- Two engineering companies were responsible for almost half (47%) of the building works with wind classification errors, with approved plans relating to four building permits having no wind classification or engineering input noted.
- Regional areas were more highly represented in the incorrect or absent wind classifications (37 per cent) compared to the percentage within the GIR4 sample set (25 per cent regional)
- The building work was spread amongst 14 local government areas. Approximately 63 per cent of the incorrect or absent samples reside within four local government areas, all of which had a proportion of building sites situated within 500 m of the ocean.

Further guidance for building surveyors, builders, engineers, local governments and any other party involved in the design, construction, supply or analysis of residential housing reliant on a wind classification is provided in *Appendix A* and *Appendix B*.

4. Conclusion

The findings of GIR4 indicate there were errors and omissions being made in relation to wind classifications across various parties involved in the design and construction of buildings. Industry Bulletin 124 (***Appendix B***), offers guidance to these professionals on how to improve compliance with wind classifications and associated construction details for residential housing.

Building and Energy continues to monitor the appropriateness of wind classifications in inspection activities and to provide tailored education to the building industry.

GIR4 has highlighted the challenges that builders and building surveyors face when relying on design documentation provided by civil/structural engineers.

Building and Energy is currently undertaking a number of reviews in response to the recommendations of the Building Confidence Report by Shergold and Weir (2018)[2] including the introduction of occupational registration for engineers. The findings of GIR4 have been considered in parts of the review relating to the registration of engineers. The findings have also been considered in relation to the focus on improving design documentation raised in the Building Confidence Report. Building and Energy has released two Consultation Regulatory Impact Statements (CRISs) and two consultation papers related to implementing the Building Confidence report recommendations.

[2] Shergold P and Weir B (2018). Building Confidence – Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia. https://www.industry.gov.au

5. Actions taken in response to findings

Registered professionals responsible for building or certifying Class 1a and 10a structures must ensure wind classifications are correctly determined using AS 4055: 2012. They must also ensure appropriate measures are taken when a building wind classification appears inappropriate or is absent. In the first instance, this may involve asking the design engineer to review the wind classification or provide an appropriate wind classification.

The Building Act requires a registered building surveyor to sign a Certificate of Design Compliance (CDC) to the effect that the building design meets the performance requirements of the BCA. The Building Act requires the builder to construct the building or incidental structure in accordance with the plans and specifications listed in the CDC. Additionally, the builder is to ensure, that the building or incidental structure complies with each applicable building standard on completion.

GIR4 found that in 51 instances, the technical specifications relied upon by the building surveyor were either incorrect or the building surveyor had approved the CDC without a wind classification documented. Building and Energy liaised with the respective builder and in some instances the engineers engaged, to ensure that appropriate actions were taken in respect to 36 of the 51 subject buildings. The remaining 15 buildings have been referred to the relevant permit authorities for further action.

Other actions taken by Building and Energy follow:

5.1 Development of educational resources

Building and Energy has published Industry Bulletin (IB) 124 as per *Appendix B*. IB 124 clarifies the use of Australian Standard AS 4055-2012: Wind loads for housing (AS 4055) and AS/NZS 1170.2-2011: Structural design actions; Part 2: Wind actions (AS/NZS 1170.2).

Building and Energy has also prepared a seminar series targeting industry members and local government areas identified through GIR4 as having a higher risk profile in relation to misapplication of AS 4055. A metropolitan and regional seminar has been provided in this regard, however due to coronavirus (COVID-19) the seminar series was paused.

5.2 Provide input into Australian Standard committees for wind loading

GIR4 has identified a number of areas where common mistakes in the use of AS 4055: 2012 occur, some of which also pertain to the more comprehensive standard AS/NZS 1170.2. Building and Energy has worked closely with members of AS 4055

and AS/NZS 1170.2 review committees and provided input to the revision of AS/NZS 1170.2 released for public comment in early 2020. Building and Energy will also provide input to the revision of AS 4055 released for public comment in late 2020. It is anticipated that clarifications suggested by Building and Energy will improve the accuracy in how these Australian Standards are being applied.

Appendix A – Case Studies

Two case studies from GIR4 are provided to highlight key areas for improvement.

Case study 1: N4 building work site given an N2 rating

A class 1a building with a tiled roof, directly opposite the ocean shoreline in wind region B was given an N2 wind rating.

The subject building work sits within 100 metres of the shoreline. Where the ocean is within 500 metres of the subject building work, AS 4055-2012 nominates a terrain category of **TC 1.5.** No combination of topography and shielding can give a wind classification lower than N3 for wind region B with TC 1.5 (AS 4055, Table 2.2).

The subject building work is not on a significantly elevated site and as such the minimum topographic classification applies **(T0)**.

As there are no house-sized obstructions to block the wind from the direction of the ocean to the subject building work, AS 4055 provides that no shielding **(NS)** applies and that the applicable wind classification for this site is **N4** (AS 4055, Table 2.2 *as below*).

Conclusion

The net design uplift wind pressure at tops of walls (design load to anchor down the tiled roof) is 0.14kPa (14.3kg/m^2) for an N2 wind classification and 1.4kPa (142.7kg/m^2) for an N4 wind classification (AS 4055, Table 4.1). The design tie-down loads for between the roof and walls therefore need to be **ten times greater** for an N4 classification compared to an N2.

The approved plans associated with the CDC for the subject building, notes the roof framing is to comply with AS 1684 (which provides deemed-to-satisfy details applicable to the given AS 4055 wind classification). The approved plans do not demonstrate that if “the building or incidental structure that is the subject of the application is completed in accordance with the plans and specifications that are specified in the certificate, the building (including each incidental structure associated with the building) or incidental structure will comply with each applicable standard” as required under the Building Act.

Compliance tip

Where unobstructed views over an open space apply to a subject building, it will often be the case that the minimum AS 4055 wind classification for the given wind region does not apply. In the subject case study, panoramic views of the ocean were present. Building and Energy expect that the registered professionals responsible for building or certifying the house would have raised concerns about the N2 wind classification provided by the project engineer.

It is recommended that aerial imagery and a visit to the site or at the least street view imagery is used in conjunction with land contours when determining a wind classification or assessing the validity of a classification provided to AS 4055.

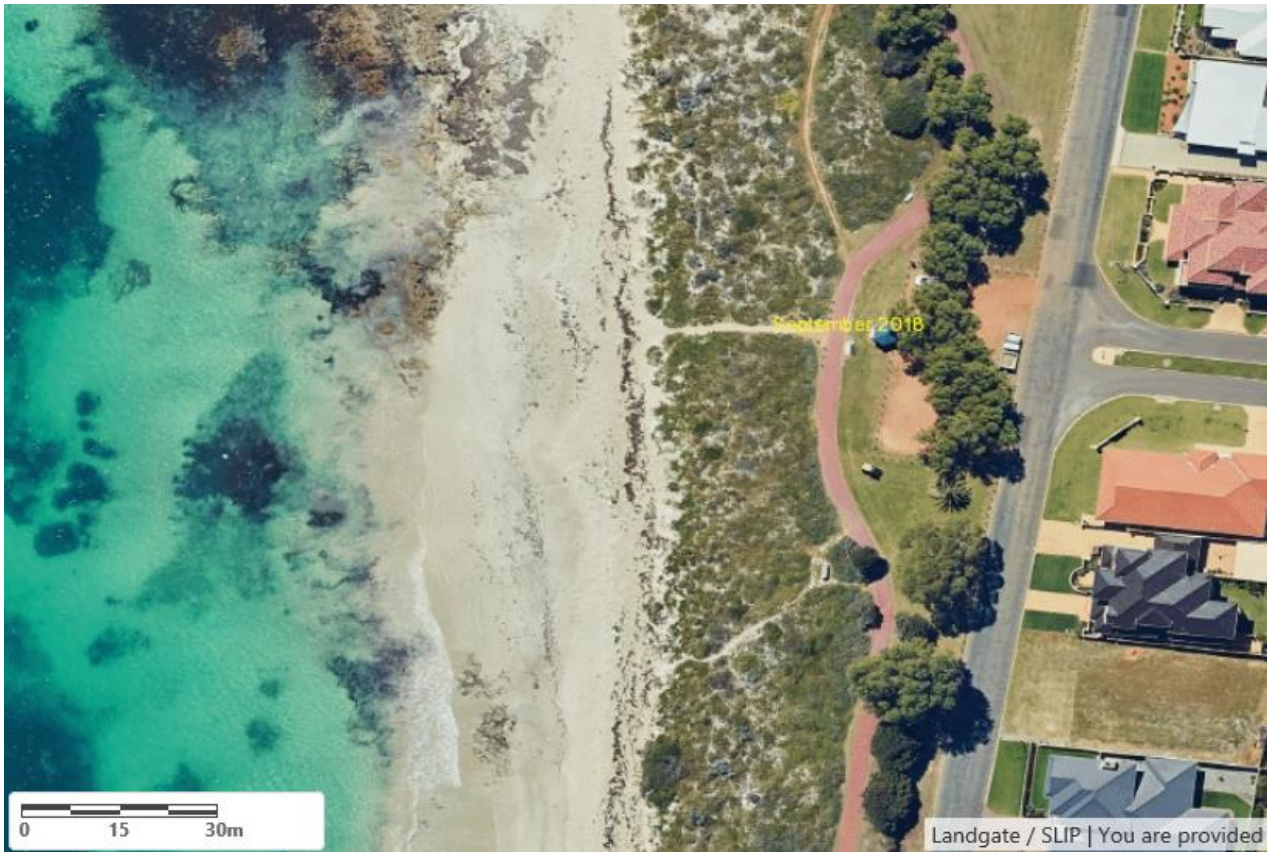

Figure 1: Plan view of the subject surroundings (Photo courtesy Landgate)

Figure 2: Streetview of the subject surroundings (Photo courtesy Google streetview)

TABLE 2.2

WIND CLASSIFICATION FROM WIND REGION AND SITE CONDITIONS

Wind region	TC	Topographic class												
		T0			T1			T2			T3		T4	T5
		FS	PS	NS	FS	PS	NS	FS	PS	NS	PS	NS	NS	NS
A	3	N1	N1	N1	N1	N2	N2	N2	N2	N2	N3	N3	N3	N4
	2.5	N1	N1	N2	N1	N2	N2	N2	N3	N3	N3	N3	N4	N4
	2	N1	N2	N2	N2	N2	N3	N2	N3	N3	N3	N3	N4	N4
	1.5	N2	N2	N2	N2	N3	N3	N3	N3	N3	N3	N4	N4	N5
	1	N2	N3	N3	N2	N3	N3	N3	N3	N4	N4	N4	N4	N5
B	3	N2	N2	N3	N2	N3	N3	N3	N3	N4	N4	N4	N4	N5
	2.5	N2	N3	N3	N3	N3	N3	N3	N4	N4	N4	N4	N5	N5
	2	N2	N3	N3	N3	N3	N4	N3	N4	N4	N4	N5	N5	N6
	1.5	N3	N3	N4	N3	N4	N4	N4	N4	N4	N5	N5	N5	N6
	1	N3	N4	N4	N4	N4	N4	N4	N5	N5	N5	N5	N6	N6

Figure 3: Excerpts from AS 4055 – 2012 outlining applicable wind classification for the subject building works

TABLE 4.1

NET DESIGN UPLIFT PRESSURES FOR DETERMINATION OF ANCHORING REQUIREMENTS AT TOP OF WALLS

kilopascals

Wind class	Serviceability limit state		Ultimate strength limit state	
	Tile roof	Sheet roof (see Note 4)	Tile roof	Sheet roof (see Note 4)
N1	0	0.04	0	0.33
N2	0	0.04	0.14	0.59
N3	0	0.25	0.68	1.13
N4	0	0.54	1.40	1.85
N5	0.42	0.95	2.44	2.89
N6	0.90	1.44	3.58	4.03

Figure 4: Change in uplift load between wind classifications as per AS 4055 – 2012 Table 4.1.

Case study 2: AS 4055 used inappropriately where not applicable

A two storey class 1a building with a tiled roof in the Perth metropolitan area was given an N1 wind rating to AS 4055 – 2012 which is the minimum wind classification possible (AS 4055, Table 2.2).

The dimensions of the subject house compared to the maximum geometric limits for which AS 4055 – 2012 applies (in brackets) is as follows:

- maximum height from eaves to averaged/natural ground level= 7.3m (6.0m limit)

- maximum height from top of roof to natural ground level= 10.3m (8.5m limit)

- house width measured across the ridge line= 16.1m (16.0m limit)

Note: Natural ground level is represented by the dotted straight line between the bottom of the retaining wall on one side and the ground beside the external wall on the opposite side of the house in AS 4055-2012, Figure 1.1.

Conclusion

The house does not comply with the geometric limitations of AS 4055. AS/NZS 1170.2 must be used to evaluate the wind forces on a building significantly higher than the height limitations in AS 4055.

Wind speeds increase with height above natural ground level. Because this house was assessed using AS 4055, which assumes maximum height to the eaves is 6.0 m, but the actual height is 7.3m, the wind loads and pressures from the assigned wind classification may be inappropriate for some elements.

Compliance tip

It is recommended that the geometric limits of AS 4055 be checked against the dimensions for proposed two storey houses, particularly when built up on a block above the natural ground level. **AS 4055 height limits are measured to the natural (averaged) ground level rather than the finished ground level** as it is this level that the wind responds to.

In numerous instances, Building and Energy found that the wind classification was performed during the site soil classification and not updated following finalisation of the proposed house design, where the house exceeded the AS 4055 geometric limits.

It is recommended that all parties involved in the building process (particularly builders, building surveyors and engineers) **validate assumptions made in earlier stages prior to finalising the design/construction**. Where proposed building work exceeds the AS 4055 geometric limits, it is expected that AS/NZS 1170.2 is used to demonstrate the AS 4055 wind classification relied upon as equivalent.

Building and Energy identified an increase over the past year in approved engineering plans for larger houses where the equivalent wind classification was derived using AS/NZS 1170.2. This increases confidence that appropriate design details were documented. Building and Energy notes that other standard design details that may be affected such as the batten fixings and glazing should also be updated to reflect for instance, the increase in edge zone size over which a higher wind loading applies.

Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**
Building and Energy

Industry Bulletin 124

Warning on inappropriate wind classifications

Building and Energy has become aware through audit activities that AS 4055 has been inconsistently used in the wind loading classification of houses. This bulletin provides technical guidance on determining wind classifications for houses. It clarifies the use of Australian Standard AS 4055-2012: Wind loads for housing (AS 4055) and AS/NZS 1170.2-2011: Structural design actions; Part 2: Wind actions (AS/NZS 1170.2). Using the correct wind classifications is important to ensure that a house will be designed and constructed to comply with the applicable building standards.

Background:

Building and Energy are continuously identifying incorrect wind classifications during inspections of plans for residential houses. The main concern in such wind classifications is the use of AS 4055 when the house falls outside of the geometric limits applicable to it. Other wind classifications issues include incorrect terrain category (i.e. not accounting for presence of a large open space within 500m, such as a golf course or waterway); incorrect topographic class (not accounting for site being elevated on a hill) and inappropriate shielding applied to houses where it is not possible to have a row/rows of housing surrounding each side of the subject site within five years.

The net design uplift at the top of walls can almost double between subsequent wind classifications for houses with metal clad roofs, with an even greater increase possible for houses with tiled roofs (refer Table 4.1 of AS 4055). As a result, the tie-down requirements to resist the roofs from being lifted off, also increase substantially between consecutive wind classifications (i.e. N1, N2, N3 etc. or C1, C2, C3 etc.). A building may experience damage in a design wind event if it is constructed to the requirements of a lower wind classification.

This industry bulletin aims to address common areas of concern and improve the determination of wind classifications for houses in Western Australia. It provides simple steps to assist builders, building surveyors, design engineers and building designers to be confident in the accuracy of wind classifications when determined using AS 4055. Where the house falls outside of the scope of AS 4055, AS/NZS 1170.2 may be used by suitably qualified engineers to determine wind speeds equivalent to an AS 4055 wind classification. Information is provided on differences between these standards that builders, building surveyors and designers should be aware of.

When does AS 4055 apply?

AS 4055 provides a simplified method of assessing the wind classification for one or two storey housing only. AS 4055 -2012 considers topography, shielding and hills in all directions, but makes a single evaluation of wind classification based on the worst case for each. Class 1 and 10 structures (as per the National Construction Code which is also referred to as the Building Code of Australia) can be designed using AS 4055 if they meet the dimensional parameters set out in Clause 1.2:

- maximum external wall height under the eaves ≤ 6m;
- maximum roof height above the natural ground line ≤ 8.5m;
- maximum house width between external walls across the ridge line ≤ 16m; and
- maximum roof pitch ≤ 35°.

Where the geometric limitations in Clause 1.2 are not met, AS/NZS 1170.2 must be used to derive the applicable wind loads. AS/NZS 1170.2 is used by engineers to determine the wind pressures on any size building, and can be used for houses. Eight different wind directions must be assessed for terrain category, shielding and topography. AS/NZS 1170.2 gives design wind speeds and wind pressures for each direction applicable to the building.

Further note:

The Residential timber-framed construction standards (AS 1684) are simplified timber standards for housing, and have similar geometric limitations to AS 4055. Where these limits are not met, the AS 1720 series (Timber structures) must be used to design timber elements in the house.

Determining wind classifications using AS 4055-2012:

1) **Determine wind region** – Use the map in Figure 2.1 of AS 4055.

   (Building and Energy recommend using the higher wind region for houses for sites within the border of two wind regions.)

   For the next steps, focus on the site. A visit to the site is recommended. You need to picture what it will look like in five years. For example, it might be on the edge of a development now, but in five years, it may be surrounded by new houses.

2) **Determine the terrain category** – Use satellite imagery to create a circle with the site at the centre and a radius of 500m. Clause 2.3 defines five terrain categories (1 is the smoothest and 3 is the roughest). Rougher terrains, that is ground with lots of obstructions like trees or buildings, can slow the wind as it passes over them. If there are different terrain categories within a 500m radius, the one with the lowest number is selected. Determine the lowest terrain category within 500m of the site. (e.g. a site within 500m of a river, lake or canal wider than 200m will typically be TC1, and within 500m of a golf course or farm land will be TC2) – refer to Section 2.3.

3) **Evaluate topographic class** – Houses near the top of hills generally experience higher wind speeds. Use contour maps (often available on local council websites and the like) to find the top and bottom of hills, ridges and escarpments and calculate their height. The topographic class is different depending on where the site is located relative to the top of the hill and the slope of the hill.

4) **Determine shielding class** – Determine shielding applicable to the house estimating likely development five years forward from the assessment date. 'Full shielding' applies to houses with two rows of houses on all four sides; 'Partial shielding' applies to houses with at least one row of housing on all four sides; 'No shielding' applies to houses where there is no house on either of the sides. Refer to Clause 2.5.

5) **Determine wind classification** – Use Table 2.2 to determine the wind classification based on the factors from above.

6) When house dimensions have been finalised, re-check whether AS 4055-2012 still applies (Section 1).

Frequently asked questions

1) AS 4055 does not apply to my building as it is outside the geometric limitations of the standard. Can I still work to an equivalent N# or C# wind classification?

Yes, AS/NZS 1170.2 can be used to calculate the maximum wind speed ($V_{sit.\beta}$), for each of the eight directions. The largest of these can be compared with the ultimate wind speed ($V_{h.u}$) in AS 4055 Tables 2.1A/B. If the house is in wind region A or B it will have an 'N' classification, otherwise it will have a 'C' classification.

The 'N' or 'C' classification is selected so that $V_{h.u}$ in AS 4055 Table 2.1 has a velocity greater than or equal to the maximum wind speed ($V_{sit.\beta}$) calculated from AS/NZS 1170.2.

Important note:

Where the house is outside the scope of AS 4055, it will also be outside the scope of AS 1684. So, even if wind speeds calculated using AS/NZS 1170.2 have been converted to a 'C' or 'N' classification, some parts of AS 1684 (Residential timber-framed construction standards) may still not apply. Other methods must therefore be used to select tie-down details. However, it still may be possible to order windows and doors by the 'N' or 'C' classification.

2) Do the geometric limits of AS 4055 apply to an existing house undergoing alterations and additions where a wind classification is required for the new construction?

Yes, the geometric limitations apply to the completed house. For instance, AS 4055 may not apply when adding an extra storey to an existing single storey house, if the combined height exceeds the geometric limits. In these cases, AS/NZS 1170.2 should be used to determine the design site wind speed. This could be used to derive a 'C' or 'N' wind classification for design of windows etc.

Likewise, AS 1684.2 limits would not apply and AS 1720.1 should be the reference standard for the design of timber framing.

3) Would the first house in a new subdivision have a higher wind classification than the houses built after it?

Wind classifications using AS 4055 are based on the likely terrain and shielding five years from the design stage. Therefore, a house can be classified according to a reasonable assumption of the surrounding build-up within five years. Local councils can provide information on approved planning schemes for areas around the site.

Note that where houses exceed the geometric limits in AS 4055, they must use AS/NZS 1170.2 to evaluate design wind speeds. AS/NZS 1170.2 refers to known future changes when assessing the terrain category and shielding around the proposed house. Therefore, for use of AS/NZS 1170.2 it is only those houses that are known to be at least as big as the subject house (i.e. already built or in construction) that can be considered in selecting shielding class.

4) If a house is built above a retaining wall, how does this affect the geometric limits in AS 4055?

Building and Energy note that:

- The maximum 8.5m height dimension in Figure 1.1 of AS 4055 -2012 indicates that this distance relates to the averaged ground level. Where retaining occurs to build up a site, the averaged ground level is often below the finished ground level for part of the house. The wind loads on the house may be higher as the house sits higher on the pad above the retaining wall. The slope of roads around the site can help identify the averaged ground level.

Responsibilities of parties with respect to evaluation of wind loads and classifications

Building and Energy expects that the registered professionals responsible for building or certifying Class 1a structures understand how wind classifications are determined using AS 4055 and **take appropriate measures when a building wind classification appears inappropriate or is absent**. In the first instance, this may involve asking your design engineer to review the classification or provide an appropriate classification.

Where the building is outside of the limits for which AS 4055 applies, suitable guidance should be provided to demonstrate that any 'N' or 'C' classification used is appropriate, and detail should be provided for any further limitations (i.e. the edge zones over which increased uplift applies may require widening).

Building surveyors must be satisfied that the technical documents (i.e. a wind classification) included in a CDC will allow completed building work to comply with all applicable building standards.

Section 19 of the *Building Act 2011* requires the **certificate of design compliance** to *"contain a statement of the building surveyor signing the certificate to the effect that if the building or incidental structure that is the subject of the application is completed in accordance with the plans and specifications that are specified in the certificate, the building (including each incidental structure associated with the building) or incidental structure will comply with each applicable standard"*.

It is the responsibility of builders to ensure the appropriate wind classification is relayed to the relative parties through the supply chain (i.e. prefabricated framing and truss suppliers, window and door suppliers) and is applied to the construction of the building.

Section 29 of the *Building Act 2011* (the Act) requires **builders** to construct the building or incidental structure in accordance with the plans and specifications listed in the applicable certificate of design compliance. Section 37 of the Act requires the builder to ensure, on completion of the building or incidental structure, that the building or incidental structure complies with each applicable building standard. Builders have a responsibility to comply with both requirements under the Act.

Building and Energy appreciates the difficulty that registered building service providers may face when they have relied on a design professional to determine an appropriate wind classification/structural design for the subject building in which they are involved, however require them to ensure that houses are built to the applicable building standards (to resist the correct wind loads).

James Cook University has published educational videos to assist the building industry including building surveyors and builders on wind classification for houses. A link to one such video is provided in the below "Additional resources".

Building and Energy has liaised with **structural engineers** regarding concerns over incorrect site wind classifications. The responsible engineers have in most cases taken action to ensure that the houses have been built/upgraded to meet applicable building standards. In instances this has been burdensome to the builder.

When incorrect determination of wind loads, wind classifications and design requirements lead to house construction failing to comply with applicable building standards, public safety is put at risk. Building and Energy may investigate building surveyors and builders for negligence in connection with carrying out a building service.

Additional resources:
https://www.jcu.edu.au/cyclone-testing-station/videos/industry

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Appendix C - Applicable Standards

AS 4055 – Wind loads for housing, provides a simplified method of assessing the wind classification for one or two storey class 1 and 10 buildings only.

Class 1a and 10a structures can be designed using AS 4055 if they meet the dimensional parameters set out in Clause 1.2 (Standards Australia, 2012):

• maximum external wall height under the eaves ≤ 6m;

• maximum roof height above the natural ground line ≤ 8.5m;

• maximum house width between external walls across the ridge line ≤ 16m; and

• maximum roof pitch ≤ 35°.

Where the geometric limitations in Clause 1.2 are not met, AS/NZS 1170.2 must be used to derive the applicable wind loads under the BCA deemed-to-satisfy pathway. AS/NZS 1170.2 is used by engineers to determine the wind pressures on any size building and can also be used for houses. AS/NZS 1170.2 gives design wind speeds and wind pressures for each direction applicable to the building. This differs from AS 4055 - 2012 which makes a single evaluation of wind classification based on the worst topography, shielding and hill properties in all directions.

Within GIR4, numerous houses with wind classifications nominated to AS 4055 relied on a note similar to ‘timber framing to AS 1684’ although they exceeded the AS 4055 geometric limits. Where the house is outside the scope of AS 4055, it will also be outside the scope of AS 1684.

Parts of the Australian Standard 1684 series – ‘Residential timber-framed construction standards’ (AS 1684) are simplified timber standards for housing and have similar geometric limitations to AS 4055. So, even if wind speeds calculated using AS/NZS 1170.2 have been converted to a ‘C’ or ‘N’ classification, some parts of AS 1684 may still not apply. Where these limits are not met, the BCA deemed-to-satisfy pathway nominates the AS 1720 series (Timber structures) for design of timber elements and connections in the house.

For houses more than 6.0 m wide for which AS/NZS 1170.2 is the only applicable wind loading standard, the roof edge zone size would be underestimated if the simplified standards AS 4055 and AS 1684.2 were applied. The roof battens may therefore be inadequate unless other methods were used to select these and other structural elements relating to roof tie-down. It still may be possible to order windows and doors using the equivalent AS 4055 ‘N’ or ‘C’ classification to the AS/NZS 1170.2 maximum wind speed. The definition of corner windows may however change as the application of AS/NZS 1170.2 changes the size of the wall edge zones over which disrupted wind flow causes higher wind pressures.

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