

CYCLONE TESTING STATION

TERRAIN CATEGORIES AND WIND SPEEDS
FOR PRINCIPAL QUEENSLAND TOWNSHIPS

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INTRODUCTION

Prior to 1973, when SAA Interim 350 was used as the basis for design to resist wind forces, there were only two recommended basic design wind speeds and three degrees of exposure. The two basic wind speeds were 110 mph (49 m/s) for the coastal areas north of latitude 25°S and 75 mph (33.5 m/s) for other areas. These velocities were taken as applying for "average conditions of exposure" and were modified by a factor of 0.87 for sheltered conditions or 1.2 for extreme exposure. Thus there were only six wind speeds that were being used in design to resist wind forces.

With the publication of AS 1170 Part 2 - 1973 SAA Loading Code Part 2 - Wind Forces, which was based on a considerably greater amount of recorded meteorological data and background research, came an increase in the degree of sophistication in designing buildings to resist wind forces. The Code contains a map of isopleths for Australia and more precise definitions of exposure called terrain categories. It also extended the number of terrain categories to four. Thus the basic wind speed for any town in Australia can be more accurately determined and a better account be taken of surrounding terrain.

To achieve this increased accuracy it has been necessary to use a greater range of wind speeds and to allow any of the intermediate values to be used. Thus there are some forty values of velocity appropriate throughout Australia, with two or three being applicable to every township.

This document attempts to rationalize the design wind speeds used for domestic construction by listing the appropriate velocities for some four hundred townships throughout Queensland. It also presents guidelines on the effects of abrupt changes in terrain category.

DEFINITION OF TERRAIN CATEGORIES

The current SAA Wind Loading Code, AS 1170, Part 2 - 1975 defines terrain categories in Rule 7.2 as follows:

Category 1 - Exposed open terrain with few or no obstructions and in which the average height of any objects surrounding the structure is less than 1.5 m.

Category 2 - Open terrain with well scattered obstructions having heights generally 1.5 to 10 m.

Category 3 - Terrain with numerous closely spaced obstructions having the size of domestic houses.

Category 4 - Terrain with numerous large high closely spaced obstructions.

Notes are added for the clarification of each definition.

Category 1 includes open sea coasts and flat treeless plains.

Category 2, which is the base category in which wind speed is recorded includes airfields, open parklands and underdeveloped sparsely built-up outskirts of towns and suburbs.

Category 3 includes well wooded areas, and suburbs, towns and industrial areas fully or partially developed.

Category 4 includes large city centres and well developed industrial complexes.

There is also a statement about the permanence of obstructions in areas affected by tropical cyclones. If the obstruction is provided by vegetation, which cannot be relied upon to maintain category 3 conditions, the effective category should be assumed to be midway between category 2 and category 3.

SPECIFICATION OF TERRAIN CATEGORY

For cases other than those obviously fitting within the definitions given in AS 1170, it is difficult in practice to specify accurately the terrain category. The decision is a subjective one, and as such can be made differently by two people of equal competence who may each be acting to the best of their ability. The ramifications of such a situation are rather severe because the decision to specify an area as category 2 instead of category 3 causes the calculated wind forces to approximately double.

One of the main difficulties encountered in specifying a terrain category is to account for the presence of obvious but relatively small areas having a different category to that of the surrounding area. For example a sports field or a large car parking area located within a suburb will affect the wind impact on houses immediately adjacent to it.

The aim of the first part of this document is to present in a quantified form a simple solution to that problem.

Figure 1 defines the space 'S' and the length of built up area on the up-wind side of the space as being 'L'. It also specifies category 'G' as being the terrain category to be determined, and category 'F' as the prevailing terrain category beyond the built up area defined as having length 'L'. By definition therefore category 'F' is either terrain category 1 or terrain category 2.

Table 1 specifies the appropriate terrain category to be used for the two rows of houses defined as being in category 'G'. Wind tunnel studies (Refs. 1 and 2) have clearly shown that for a group of houses subjected to a category 2 wind, only the first two rows receive the full force of the wind. Buildings beyond those rows are in terrain category 3.

In using Table 1 the following should be taken into account:

1. Spaces narrower than 10 metres in the across wind direction can be neglected.
2. If the building of interest is in an area that is in the process of being built up, the exposure conditions expected for the first

five years may be ignored in the assessment of terrain category.

3. If the space S occurs on a slope of more than 1 in 5, then it will be equivalent to a space of 2S on a flat terrain.

SPECIFICATION OF WIND SPEEDS

Appendix A contains design wind speeds for the principal townships in the State of Queensland. For each town the wind speed is given for terrain category 1, terrain category 2 and terrain category 3. The wind speeds were calculated by interpolating between the isopleths for a 50 year return period given in Fig. 1 of the Wind Loading Code, and using a height above ground of 6 m which was considered to be appropriate for single storey, two storey or high set house construction.

This document does not mean to imply that all three categories are appropriate for every town listed. The specification of terrain category can only be made on site, or with an intimate knowledge of the area concerned.

In specifying the wind speed, no account has been taken of local topographical features which could cause eddy currents or shielding or even the degeneration of a tropical cyclone. Some allowance for the effect of such topography may be made, based on local knowledge.

ACKNOWLEDGEMENTS

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REFERENCES

1. Vickery, B.J. (1976), Wind Loads on Low Rise Buildings, DRC Seminar, Darwin, March 30, 1976.
2. Vickery, B.J. (1975), Structural and Environmental Effects of Wind on Buildings and Structures, Lecture notes for Postgraduate Course at Department of Mechanical Engineering, Monash University, May 1975.

TABLE 1
SPECIFICATION OF CATEGORY G

Space S	Category G		
	L Greater than 1500 m	L 1500m to 100 m	L less than 100m
Greater than 1500m	2	2	F
50m to 150m	3	2	F
Less than 50m	3	3	F

APPENDIX A - DESIGN WIND SPEEDS

Every effort has been made to include in this list all the principal townships of Queensland without making the list too long. The design wind speeds for towns not included in the list can be estimated by assuming them to be the same as a nearby principal township. If the nearest principal town is not very close, a slightly more accurate estimate of wind speeds would be made by using the figures for a town to the north or south, rather than to the east or west.

Most islands off the Queensland coast should be considered susceptible to tropical cyclones, and therefore the design wind speeds should be taken as the same as for mainland towns within the cyclone zone, e.g. Cairns, Townsville, Mackay. The only islands not in the cyclone zone are those surrounding Moreton Bay or south thereof. The design wind speeds for these islands should be assumed to be the same as for Brisbane.

	Terrain Category 1	Terrain Category 2	Terrain Category 3		Terrain Category 1	Terrain Category 2	Terrain Category 3
Abercorn	46	42	30	Bollon	42	39	27
Adavale	41	38	26	Bonshaw	46	42	30
Allora	47	43	30	Boomi	44	40	28
Almaden	45	41	29	Boonah	50	46	32
Alpha	42	39	27	Booyal	56	51	36
Ambrose	65	59	42	Bororen	65	59	42
Amby	43	39	28	Boulia	43	39	28
Amiens	47	43	30	Bowen	65	59	42
Aramac	41	38	27	Brandon	65	59	42
Aramara	65	59	42	Brigalow	45	41	29
Arrilalah	41	38	27	Brisbane	52	47	33
Atherton	65	59	42	Brooweena	54	49	34
Augathella	41	38	27	Buderim	65	59	42
Ayr	65	59	42	Bundaberg	65	59	42
Babinda	65	59	42	Bungunya	44	40	28
Bajool	65	59	42	Burketown	65	59	42
Ballendean	48	44	31	Burleigh	52	47	33
Banana	46	42	30	Byrnestown	46	42	30
Baralba	45	41	29	Caboolture	52	47	33
Barcaldine	41	38	27	Cairns	65	59	42
Bargara	65	59	42	Calen	65	59	42
Bauple	65	59	42	Callide	46	42	30
Beaunesert	52	47	33	Calliope	65	59	42
Bedourie	44	40	28	Caloundra	65	59	42
Beenleigh	52	47	33	Camboon	45	41	29
Bell	46	42	30	Camooweal	43	39	28
Betoota	44	40	28	Canterbury	43	39	28
Biboohra	65	59	42	Canungra	52	47	33
Biggenden	46	42	30	Capella	44	40	28
Biloela	46	42	30	Cardwell	65	59	42
Birdsville	45	41	29	Carmila	65	59	42
Blackall	41	38	27	Catwarral	65	59	42
Blackwater	45	41	29	Cecil Plains	46	42	30
Blair Athol	44	40	28	Charleville	41	38	27
Bloomsbury	65	59	42	Charters Towers	45	41	29
Bluff	45	41	29				
Bogantungan	43	39	28	Cheepie	41	38	27
Boggabilla	45	41	29	Childers	65	59	42

	Terrain Category 1	Terrain Category 2	Terrain Category 3		Terrain Category 1	Terrain Category 2	Terrain Category 3
Chillagoe	45	41	29	Edmonton	65	59	42
Chinchilla	45	41	29	Eidsvold	45	41	29
Clermont	44	40	28	Einasleigh	44	40	28
Clifton	47	43	30	El Arish	65	59	42
Cloncurry	39	36	27	Emerald	44	40	28
Cloyna	46	42	30	Emmet	41	38	27
Coen	65	59	42	Emu Park	65	59	42
Collinsville	47	43	30	Eromanga	41	38	27
Comet	44	40	28	Esk	49	46	32
Condamine	44	40	28	Eton	65	59	42
Cooktown	65	59	42	Eulo	41	38	27
Cooladdi	41	38	27	Eumindi	65	59	42
Coolangatta	52	47	33	Euramo	65	59	42
Coongoola	41	38	27	Farleigh	65	59	42
Cooran	65	59	42	Finch Hatton	65	59	42
Cooroy	65	59	42	Flaggy Rock	65	59	42
Cooyar	47	43	30	Forest Hill	49	45	32
Cordalba	65	59	42	Forsayth	44	40	28
Corfield	42	39	27	Fossilbrook	45	41	29
Cracow	45	41	29	Gatton	48	44	31
Crows Nest	48	44	31	Gayndah	46	42	30
Croydon	44	40	28	Georgetown	44	40	28
Cunnamulla	41	38	27	Gilliat	41	38	27
Daintree	65	59	42	Gin Gin	65	59	42
Dajarra	43	39	28	Giru	65	59	42
Dalby	46	42	30	Gladstone	65	59	42
Dallarnil	49	45	32	Glen Aplin	48	44	31
Dareel	43	39	28	Glenmorgan	44	40	28
Dayboro	50	46	32	Gogango	46	42	30
Daymar	44	40	28	Goombungee	46	42	30
Dingo	45	41	29	Goomeri	46	42	30
Dirranbandi	43	39	28	Goondiwindi	45	41	29
Dittmer	65	59	42	Gooroolba	46	42	30
Drillham	44	40	28	Goovigen	46	42	30
Duaringa	45	41	29	Gordonvale	65	59	42
Duchess	42	39	27	Gradule	44	40	28
Dulacca	44	40	28	Grantham	48	44	31

	Terrain Category 1	Terrain Category 2	Terrain Category 3		Terrain Category 1	Terrain Category 2	Terrain Category 3
Greenmount	47	43	30	Karumba	65	59	42
Gunalda	65	59	42	Keppel Sands	65	59	42
Gundiah	65	59	42	Kidston	44	40	28
Gurumba	46	42	30	Kilcoy	65	59	42
Gympie	65	59	42	Kilkivan	46	42	30
Halifax	65	59	42	Killarney	49	45	32
Harrisville	49	45	32	Kingaroy	45	41	29
Hebel	42	39	27	Kin Kin	65	59	42
Helidon	48	44	31	Koumala	65	59	42
Herberton	46	42	30	Kuranda	65	59	42
Hivesville	45	41	29	Kuridala	41	38	26
Home Hill	65	59	42	Kynuna	42	39	27
Howard	65	59	42	Laidley	49	45	32
Hughenden	42	39	27	Laura	46	42	30
Hungerford	41	38	27	Leyburn	46	42	30
Ilfracombe	41	38	27	Llilbie	65	59	42
Imbil	65	59	42	Longreach	41	38	27
Ingham	65	59	42	Lowmead	65	59	42
Inglewood	46	42	30	Lowood	49	45	32
Injune	43	39	28	Lucinda	65	59	42
Innisfail	65	59	42	Macalister	46	42	30
Ipswich	52	47	33	Mackay	65	59	42
Irvinebank	46	42	30	McKinlay	41	38	27
Isisford	41	38	27	Macknade	65	59	42
Jackson	44	40	28	Malanda	65	59	42
Jambin	46	42	30	Malbon	41	38	27
Jandowae	45	41	29	Maleny	65	59	42
Jericho	41	38	27	Many Peaks	65	59	42
Jondaryan	46	42	30	Mareeba	65	59	42
Julatten	65	59	42	Marian	65	59	42
Julia Creek	42	39	27	Marlborough	65	59	42
Jundah	42	39	27	Marmor	65	59	42
Kabra	65	59	42	Maroochydore	65	59	42
Kahmoomulga	41	38	27	Maryborough	65	59	42
Kairi	65	59	42	Mary Kathleen	40	37	27
Kajabbi	41	38	27				
Kalbar	50	46	32	Maryvale	48	44	31

	Terrain Category 1	Terrain Category 2	Terrain Category 3		Terrain Category 1	Terrain Category 2	Terrain Category 3
Maxwelton	42	39	27	Nambour	65	59	42
Meandarra	44	40	28	Nanango	46	42	30
Merinda	65	59	42	Nebo	46	42	30
Middleton	42	39	27	Nelia	42	39	27
Miles	44	40	28	Nobby	47	43	30
Milla Milla	47	43	30	Noosa	65	59	42
Millmerran	46	42	30	Normanton	65	59	42
Mingela	46	42	30	Nymbool	45	41	29
Mirani	65	59	42	Oakey	46	42	30
Miriam Vale	65	59	42	Ogmore	65	59	42
Mitchell	43	39	28	Ord	45	41	29
Miva	55	50	35	Palmwoods	65	59	42
Monto	46	42	30	Peeramon	65	59	42
Mooloolaba	65	59	42	Pentland	44	40	28
Moonie	45	41	29	Peranga	46	42	30
Moranbah	45	41	29	Petrie	52	47	33
Morven	42	39	27	Pialba	65	59	42
Mossman	65	59	42	Pioneer	65	59	42
Moura	45	41	29	Pittsworth	46	42	30
Mourilyan	65	59	42	Pomona	65	59	42
Mt. Coolon	45	41	29	Port Douglas	65	59	42
Mt. Garnet	45	41	29	Prairie	42	39	27
Mt. Isa	42	39	27	Pratten	46	42	30
Mt. Larcom	65	59	42	Proserpine	65	59	42
Mt. Molloy	65	59	42	Proston	45	41	29
Mt. Morgan	52	47	33	Quamby	40	37	27
Mt. Perry	46	42	30	Quilpie	41	38	27
Mt. Surprise	44	40	28	Raglan	65	59	42
Muckadilla	43	39	28	Rannes	46	42	30
Mulgildie	46	42	30	Rathdowney	52	47	33
Mundabbera	45	41	29	Ravenshoe	48	44	31
Mungalla	42	39	27	Ravenswood	46	42	30
Mungana	45	41	29	Redcliff	52	47	33
Mungindi	44	40	28	Reid River	65	59	42
Murgon	46	42	30	Richmond	42	39	27
Muttaburra	41	38	27	Rockhampton	65	59	42
Nagoorin	65	59	42	Rolleston	44	40	28

	Terrain Category 1	Terrain Category 2	Terrain Category 3		Terrain Category 1	Terrain Category 2	Terrain Category 3
Roma	43	39	28	Tingoora	46	42	30
Rosedale	65	59	42	Tirroan	65	59	42
Rosewood	49	45	32	Tolga	65	59	42
Rubyvale	43	39	28	Toobeah	44	40	28
Sarina	65	59	42	Toogoolawah	48	44	31
Scottville	46	42	30	Toompine	41	38	27
Sellheim	46	42	30	Toowoomba	46	42	30
Selwyn	41	38	27	Torbanlea	65	59	42
Silkwood	65	59	42	Torrens Creek	43	39	28
Southport	52	47	33	Townsville	65	59	42
Springsure	44	40	28	Tullanaringa	65	59	42
Stamford	42	39	27	Tully	65	59	42
Stanthorpe	48	44	31	Ubobo	65	59	42
Stanwell	52	47	33	Urandangi	43	39	28
Stonehenge	41	38	27	Urangan	65	59	42
Sth Johnstone	65	59	42	Walkerston	65	59	42
St. George	43	39	28	Wallaville	65	59	42
St. Lawrence	65	59	42	Wallumbilla	44	40	28
Stuart	65	59	42	Wandoan	44	40	28
Surat	44	40	28	Warra	45	41	29
Talwood	44	40	28	Warwick	48	44	31
Tambo	41	38	27	Weipa	65	59	42
Tamborine Mt	52	47	33	Westwood	46	42	30
Tangorin	42	39	27	Windorah	42	39	27
Tara	45	41	29	Winton	42	39	27
Taroom	44	40	28	Wondai	46	42	30
Tarzali	65	59	42	Woodford	65	59	42
Tewantin	65	59	42	Woolooga	48	44	31
Texas	46	42	30	Woombye	65	59	42
Thallon	44	40	28	Wooroolin	46	42	30
Thargomindah	41	38	27	Wowan	46	42	30
The Caves	65	59	42	Wyandra	41	38	27
Theebine	65	59	42	Yaamba	65	59	42
Theodore	45	41	29	Yandaran	65	59	42
Thoongool	46	42	30	Yandina	65	59	42
Tiaro	65	59	42	Yangan	48	44	31
Tin Can Bay	65	59	42	Yaraka	41	38	27

	Terrain Category 1	Terrain Category 2	Terrain Category 3		Terrain Category 1	Terrain Category 2	Terrain Category 3
Yarraman	46	42	30	Yetman	46	42	30
Yarwun	65	59	42	Yuleba	44	40	28
Yelarbon	45	41	29	Yungaburra	65	59	42
Yeppoon	65	59	42				