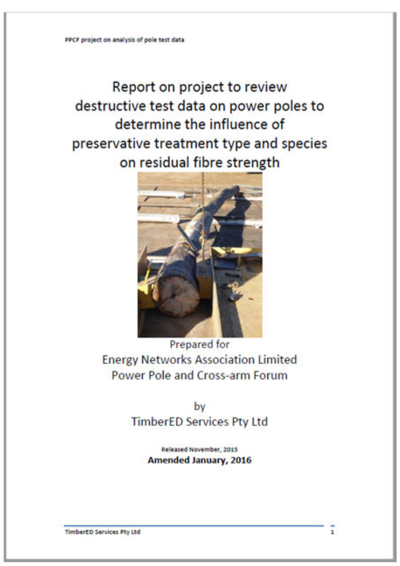
AS/NZS7000 review

Appendix F changes


PPCF project on analysis of pole test data

Report on project to review destructive test data on power poles to determine the influence of preservative treatment type and species on residual fibre strength

Prepared for
Energy Networks Association Limited
Power Pole and Cross-arm Forum

by
TimberED Services Pty Ltd

Released November, 2015
Amended January, 2016

TimberED Services Pty Ltd 1

In 2016 TimberED Services were engaged to use all available Australian timber pole destructive test data to determine the relationships between species or Strength Group, years in service and treatment on their residual strength. The project included data for 971 pole tests.

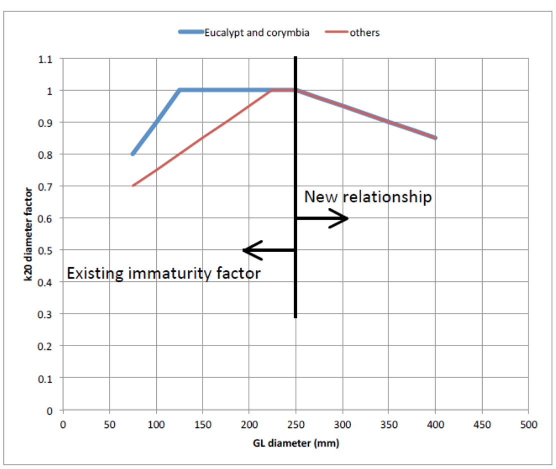
The findings of the project are detailed in ‘Report on project to review destructive test data on power poles to determine the influence of preservative treatment type and species on residual fibre strength’

Reduced timber strength

Modification of characteristic timber strengths to align with AS1720.1

Strength Group	Recommended design values (MPa)	Published design values (MPa)	
		AS/NZS 7000	AS 1720.1
S1	84	*100*	84
S2	67	*80*	67
S3	55	*65*	55
S4	42	*50*	42
S5	40	40	*36*
S6	35	35	*31*

Diameter factor k_{20}



Diameter factor k_{20}

Species	Factor k_{20} for capacities							
	Pole GL diameter (mm)							
	75	100	125	150	170	200	225	250
Eucalypt and corymbia	0.80	0.90	1.00	1.00	1.00	1.00	1.00	1.00
Others	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.00
	Pole GL diameter (mm)							
	250	300	350	400				
All species	1.00	0.95	0.90	0.85				

A diameter factor is proposed to model both the immaturity factor for small poles and size effects on larger poles. This factor would still be referred to as k20

The Outcome

			Design life (years)		50		
			Duration of load factor(k_1)		1		
			Load application distance from top		0.1		
						ULS Tip load	
Wood type	Provenance	Rated tip load (kN)	Pole length (m)	Embedded length (m)	Ground line diameter (mm)	P (kN) Proposed	P (kN) Current
S4	NZ-Electropole	12	11	1.8	335	9.9	10.5
S2	NSW-Koppers	12	11	1.9	386	28.9	38.4
S1	NSW-AHH	12	11	1.7	367	30.5	40.4
S2	NSW-AHH	12	11	1.7	388	28.8	38.1
S5	NSW-AHH	12	11	1.7	504	24.0	28.2
S1	QLD-Energex	12	11	1.7	303	18.2	22.8
S2	QLD-Energex	12	11	1.7	323	17.6	22.1

Proposed changes to pole markings

Standard for Distribution Line Design Overhead

Table 7-3 – V.P.I. Wood Poles Diameters and Maximum Masses

Pole Description			Minimum Pole Diameters and Maximum Masses							
			Strength Group S1 (Note 3)				Strength Group S2 (Note 3)			
Length (m)	Standard Setting Depth (m) (Note 1)	Strength Rating (kN) (Note 2)	Diameter 2m from Butt (mm)	Diameter at Head (mm)	Maximum Mass (kg)	Girth 2m from Butt (mm)	Diameter 2m from Butt (mm)	Diameter at Head (mm)	Maximum Mass (kg)	Girth 2m from Butt (mm)
8.0	1.40	3	165	105	290	518	175	115	330	550
		5	195	135	410	613	210	145	450	660
		8	230	165	545	723	245	175	590	770
		12	265	195	700	833	280	210	750	880
9.5	1.55	3	180	110	380	565	190	120	425	597
		5	210	135	545	660	225	150	595	707
		8	250	170	715	785	265	185	765	833
		12	285	200	905	895	300	215	960	942
11.0	1.70	3	190	110	485	597	200	120	535	628
		5	225	135	680	707	240	150	735	754
		8	265	170	875	833	280	175	965	880
		12	300	200	1100	942	320	220	1230	1005
12.5	1.85	3	200	115	610	628	215	125	650	675
		5	235	140	815	738	250	150	890	785
		8	275	170	1055	864	295	185	1155	927
		12	315	200	1350	990	335	215	1460	1052
14.0	2.00	3	210	120	780	660	220	130	870	691
		5	250	145	1025	785	265	165	1075	833
		8	290	170	1305	911	305	185	1360	958
		12	330	205	1615	1037	350	215	1750	1100
15.5	2.15	5	260	155	1275	817	275	165	1385	864
		8	300	180	1600	942	320	195	1720	1005
		12	345	210	2160	1084	365	230	2285	1147
		20	410	255	2830	1288	435	285	3105	1367
17.0	2.30	5	265	160	1445	833	285	170	1500	895
		8	310	190	1810	974	330	200	1935	1037
		12	355	220	2430	1115	380	235	2650	1194
		20	420	265	3210	1319	450	285	3585	1414
18.5	2.45	5	275	165	1735	864	290	175	1870	911
		8	320	195	2150	1005	340	210	2290	1068
		12	370	225	2855	1162	390	240	3085	1225
		20	435	270	3655	1367	465	290	4090	1461
20.0	2.60	5	285	170	2070	895	300	180	2220	942
		8	330	200	2540	1037	350	215	2780	1100
		12	380	230	3225	1194	400	250	3590	1257
		20	450	280	4450	1414	475	295	4510	1492
21.5	2.75	5	290	175	2450	911	310	185	2615	974
		8	340	205	3075	1068	360	220	3245	1131
		12	390	240	3975	1225	415	255	4265	1304
		20	460	285	4995	1445	490	305	5420	1539

17		18.5			20			21.5			23		
12	20	8	12	20	8	12	20	8	12	20	8	12	20
15039	15040	15041	15042	15043	15044	15045	15046	15047	15048	15049	15050	15051	15052
P17/12	P17/20	P18.5/8	P18.5/12	P18.5/20	P20/8	P20/12	P20/20	P21.5/8	P21.5/12	P21.5/20	P23/8	P23/12	P23/20
610	660	560	610	660	560	610	760	560	610	760	610	660	760
10.17	17.83	6.2	9.94	17.56	6.0	9.71	17.28	5.79	9.47	17.0	5.58	9.22	16.71
6.0	10.0	4.0	6.0	10.0	4.0	6.0	10.0	4.0	6.0	10.0	4.0	6.0	10.0
3.0	#	2.7	3.0	#	2.9	#	#	2.9	#	#	2.9	#	#
2.75	#	2.55	2.8	#	2.6	2.85	#	2.75	2.9	#	2.9	2.95	#
2.6	#	2.5	2.7	#	2.6	2.7	#	2.75	2.8	#	2.9	2.9	#
2.4	2.7	2.45	2.45	2.7	2.6	2.6	2.8	2.75	2.75	2.8	2.9	2.9	2.9
2.4	2.7	2.45	2.45	2.75	2.6	2.6	2.8	2.75	2.75	2.85	2.9	2.9	2.9
2.35	2.5	2.45	2.45	2.6	2.6	2.6	2.7	2.75	2.75	2.8	2.9	2.9	2.9
2.3	2.3	2.45	2.45	2.45	2.6	2.6	2.6	2.75	2.75	2.75	2.9	2.9	2.9

ired. (Civil design section)

on.

undation.

Note:
Where designs involve increasing tip loads of in-service poles by more than 1 kN (no wind condition), pole inspection is required. Refer 'Poles' 6945-A4.

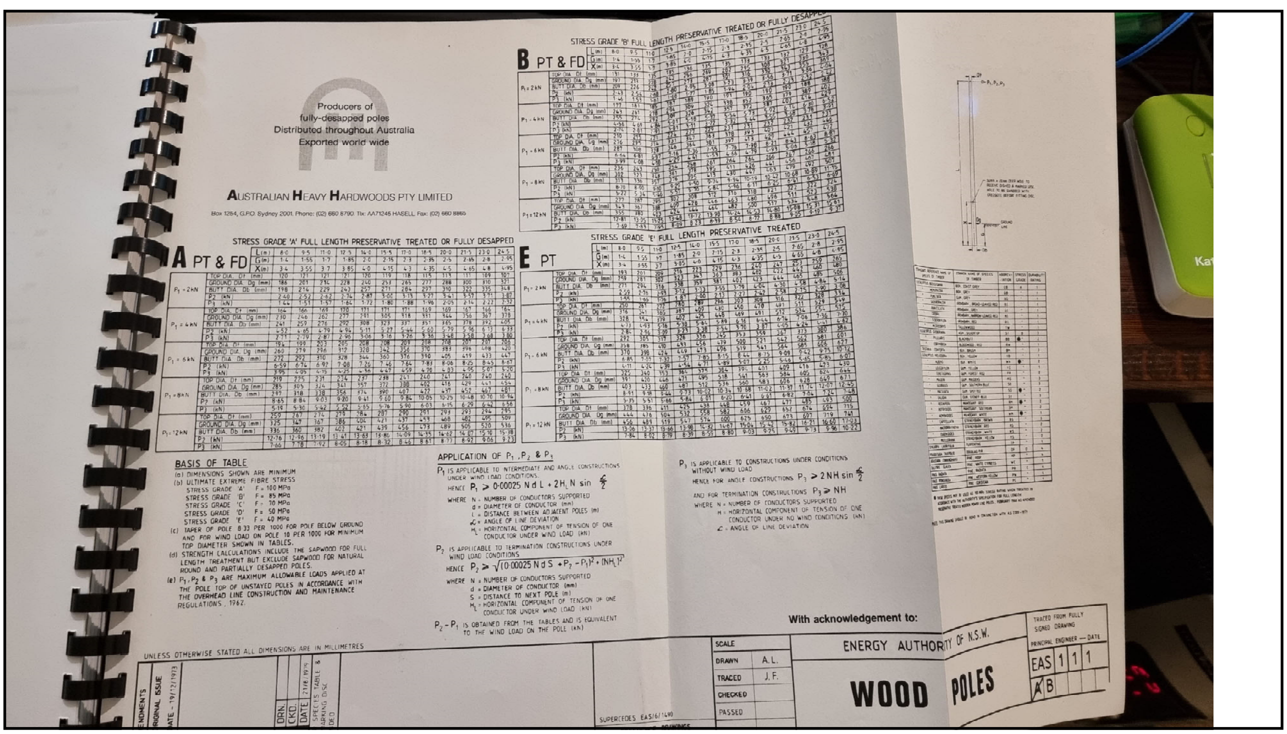
A ORIGINAL ISSUE

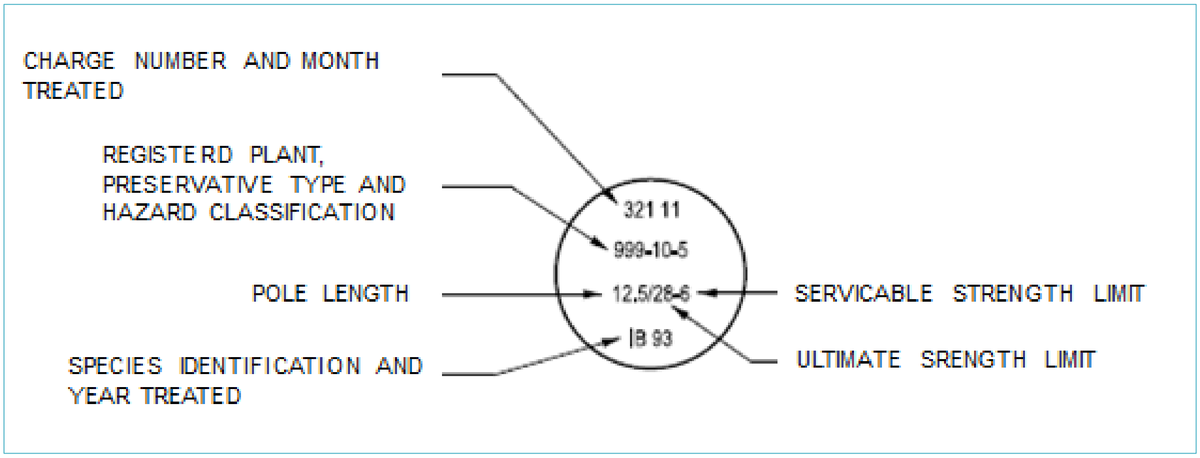
energex

SCALE	NTS
APP'D	
DATE	
REC'D	
CKD	
DRN	S.Hennessy
	CAD

POLES
WOOD POLE NEW (17-23m)
SIZE, RATED TIP LOAD & SINKING DEPTH

SHEET 2 OF 3 — FILE:DWG_ODM\6935\6940A4.DWG — 6940-A4 — A





F5 DESIGN CAPACITY

F5.1 Bending strength

The design capacity of poles in bending (ϕM) for the strength limit state, shall satisfy the following:

$$\phi M \geq M^* \qquad \text{... F4}$$

$$\phi M = \phi k_1\, k_{20}\, k_{21}\, k_{22}\, k_d \left(f'_b Z\right) \qquad \text{... F5}$$

k_1 = the duration of load factor

k_{12} = the stability factor for compression, determined in accordance with Paragraph F4.8

k_{20} = the immaturity factor

k_{21} = the shaving factor

k_{22} = the processing factor

k_d = the degradation factor

The calculation for the disc ULS value should be standardised:

- Pole top = 100mm below pole top
- Embedment = Standard embedment recommended by manufacturer
- Phi = As per table F3
- K_1 = 1
- K_d = As relevant for 50yr design life
- K_{20} = as applicable under table F6
- K_{21} = as applicable under table F7
- K_{22} = as applicable

8kN

9kN

10kN

11kN

12kN

13kN

14kN

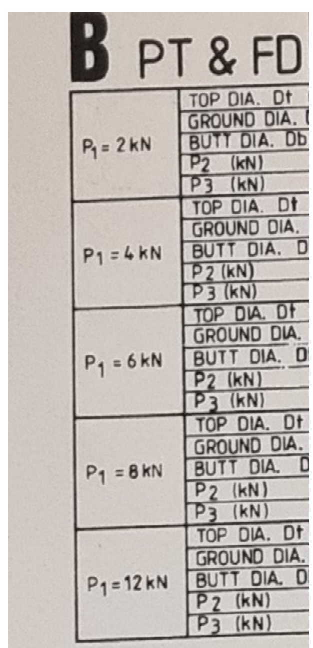
15kN

16kN

17kN

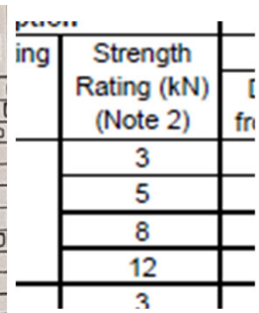
18kN

....

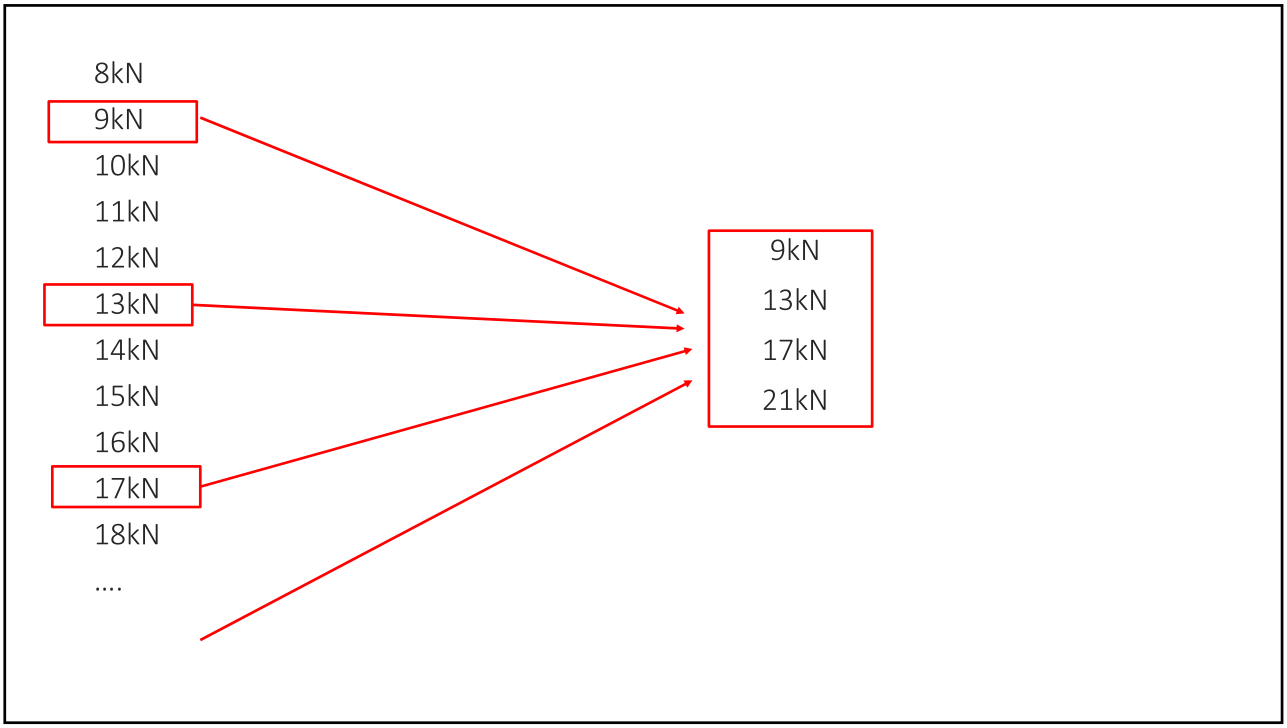


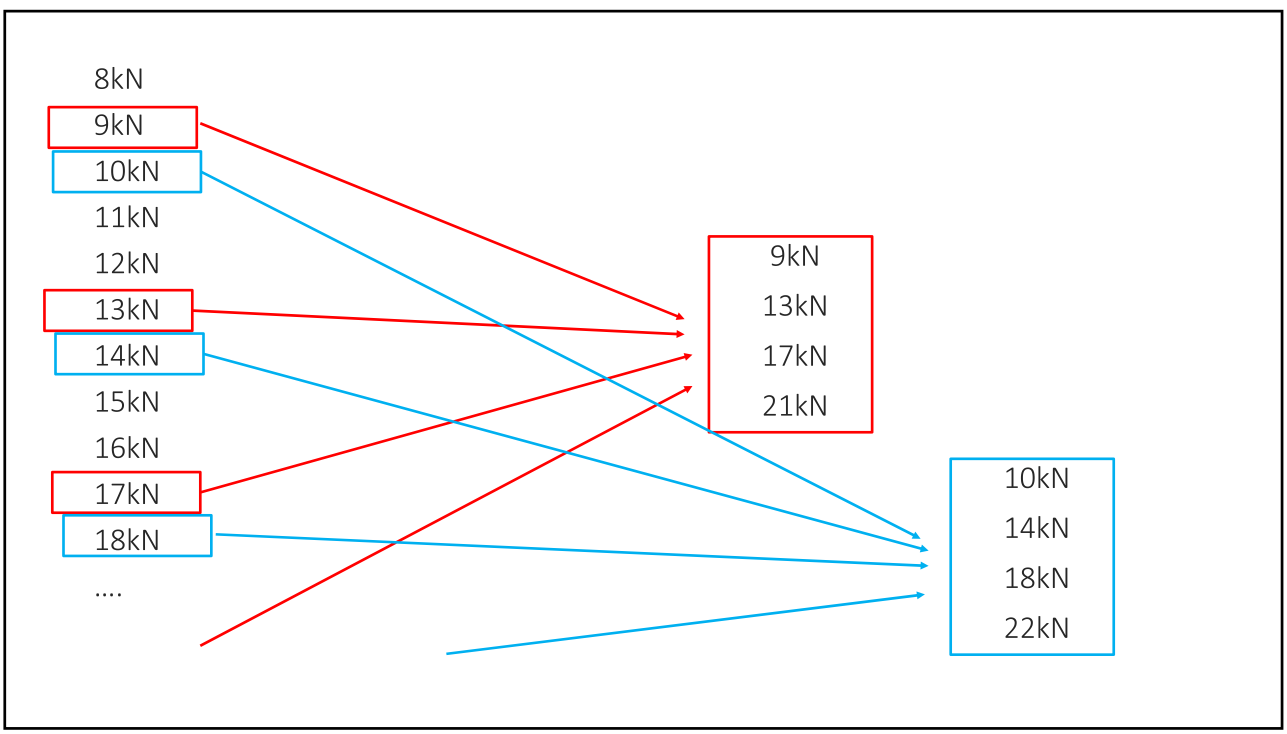
B PT & FD

P_1 = 2 kN	TOP DIA. Dt
	GROUND DIA.
	BUTT DIA. Db
	P2 (kN)
	P3 (kN)
P_1 = 4 kN	TOP DIA. Dt
	GROUND DIA.
	BUTT DIA. D
	P2 (kN)
	P3 (kN)
P_1 = 6 kN	TOP DIA. Dt
	GROUND DIA.
	BUTT DIA. D
	P2 (kN)
	P3 (kN)
P_1 = 8 kN	TOP DIA. Dt
	GROUND DIA.
	BUTT DIA. D
	P2 (kN)
	P3 (kN)
P_1 = 12 kN	TOP DIA. Dt
	GROUND DIA.
	BUTT DIA. D
	P2 (kN)
	P3 (kN)

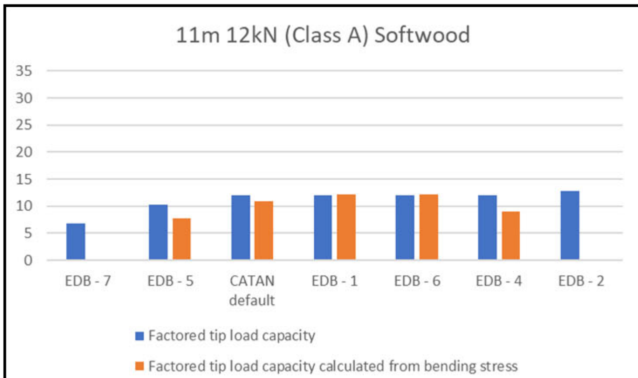


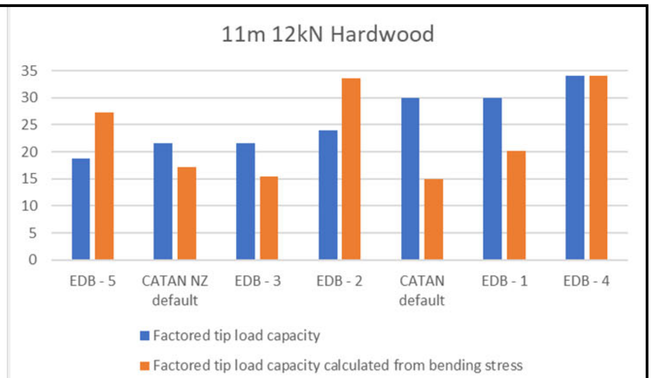
ing	Strength Rating (kN) (Note 2)	[illegible] fr
	3	
	5	
	8	
	12	
	3	


8kN
9kN
10kN
11kN
12kN
13kN
14kN
15kN
16kN
17kN
18kN
....
9kN
13kN
17kN
21kN


8kN
9kN
10kN
11kN
12kN
13kN
14kN
15kN
16kN
17kN
18kN
....
9kN
13kN
17kN
21kN
10kN
14kN
18kN
22kN

CATAN File review



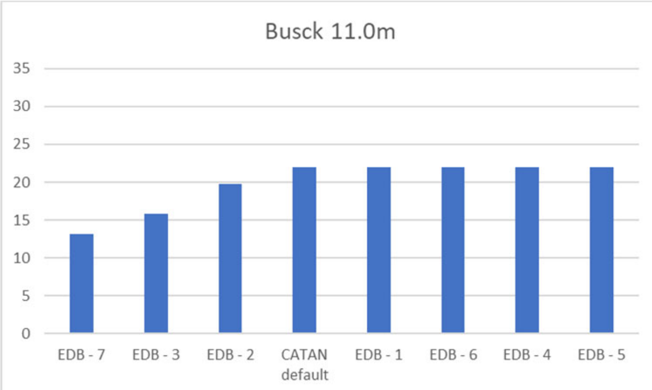


11m 12kN (Class A) Softwood

Organisation	Factored tip load capacity	Factored tip load capacity calculated from bending stress
EDB - 7	6.8	
EDB - 5	10.2	7.8
CATAN default	12	10.9
EDB - 1	12	12.2
EDB - 6	12	12.2
EDB - 4	12	9.0
EDB - 2	12.8	

11m 12kN Hardwood

Organisation	Factored tip load capacity	Factored tip load capacity calculated from bending stress
EDB - 5	18.7	27.3
CATAN NZ default	21.6	17.2
EDB - 3	21.6	15.4
EDB - 2	24	33.6
CATAN default	30	15.0
EDB - 1	30	20.2
EDB - 4	34.07	34.0



Busck 11m

Organisation	Factored tip load capacity
EDB - 7	13.2
EDB - 3	15.84
EDB - 2	19.8
CATAN default	22
EDB - 1	22
EDB - 6	22
EDB - 4	22
EDB - 5	22

AS/NZS7000 review

Changes to AS/NZS1170.2

AS/NZS 1170.2:2021 (Standard) **Published on**: 2021-07-30	Current	English - pdf
AS/NZS 1170.2:2011 Amd 5:2017 (Amendment) **Published on**: 2017-06-30 **(Historical)**	Superseded	English - pdf
AS/NZS 1170.2:2011 Amd 4:2016 (Amendment) **Published on**: 2016-08-10 **(Historical)**	Superseded	English - pdf
AS/NZS 1170.2:2011 (Standard) **Published on**: 2011-03-30 **(Historical)**	Superseded	English - pdf
AS/NZS 1170.2:2011 AMDT 1 (Amendment) **Published on**: 2011-01-01 **(Historical)**	Superseded	English - pdf
AS/NZS 1170.2:2011 AMDT 2 (Amendment) **Published on**: 2011-01-01 **(Historical)**	Superseded	English - pdf
AS/NZS 1170.2:2011 AMDT 3 (Amendment) **Published on**: 2011-01-01 **(Historical)**	Superseded	English - pdf
AS/NZS 1170.2:2002 (Standard) **Published on**: 2002-06-04 **(Historical)**	Available Superseded	English - pdf
AS/NZS 1170.2:2002 AMDT 1 (Amendment) **Published on**: 2002-01-01 **(Historical)**	Available Superseded	English - pdf

.govt.nz/resources/asnzs-1170-22021/#!#resource-detail

Building CodeHub

About this portal Latest updates

Resource detail Citations

S/NZS 1170.2:2021 Structural Design Actions, Part 2: Wind Actions

bbreviation:	AS/NZS 1170.2:2021
alid from:	30/07/2021
eplaces:	AS/NZS 1170.2:2011
formation provider:	Standards New Zealand
uthor:	Standards New Zealand, Standards Au
formation type:	New Zealand Standard
ormat:	PDF, Hard copy

New wind loading standard released

On 30 July, Standards NZ released **AS/NZS1170.2:2021 – Structural design actions – Part 2: Wind actions**. Key updates are:

- regional wind speeds and their multipliers have changed
- lee effect multipliers have changed for parts of the country
- wind calculations have changed – this is particularly relevant for large structures
- there's more information around design loadings for solar panels, for both roofs and those on the ground.

The Standard isn't yet mandated by MBIE – so is currently an alternative solution. We expect it'll become part of regulation in November 2022, with a 12 month grace period. It'll affect all Kiwi engineers' work and represents the best available information.

We'll be providing information about the changes and how they are applied in the coming weeks. And as a member, did you know you get discounts when you purchase standards from Standards New Zealand?

FIND OUT MORE

Scope exclusion

The scope of AS/NZS1170.2 now specifically excludes power transmission and distribution structures, including supporting poles and towers

Yet AS/NZS7000 specifically refers to AS/NZS1170.2, this should be continue. Note 4 states that excluded structures may draw on the standard for some aspects of wind load determination.

1.1 SCOPE

This Standard sets out procedures for determining wind speeds and resulting wind actions to be used in the structural design of structures subjected to wind actions other than those caused by tornadoes.

The Standard covers structures within the following criteria:

(a) Buildings less than or equal to 200 m high.

(b) Structures with maximum unsupported roof spans of less than 100 m.

(c) Structures other than offshore structures, bridges and transmission towers.

2011

1.1 Scope

This Standard sets out procedures for determining wind speeds and resulting wind actions to be used in the structural design of structures subjected to wind actions other than those caused by tornadoes.

The Standard covers structures within the following criteria:

(a) Buildings and towers less than or equal to 200 m high.

(b) Structures with unsupported roof spans of less than 100 m.

(c) Offshore structures within 30 km from the nearest coastline.

(d) Other structures apart from: offshore structures more than 30 km from the nearest coastline, bridges, windfarm structures and power transmission and distribution structures, including supporting towers and poles.

2021

NOTE 4 For structures excluded by (d), wind loads are specified by other Australian or New Zealand Standards (bridges and power transmission and distribution structures), or by international standards (structures more than 30 km offshore, and windfarm structures). These may draw on this Standard for some aspects of wind load determination.

Wind region changes (section 3.2)

Introduces significant wind speed changes for New Zealand

Action: modify AS/NZS7000 Appendix B to change the NZ map in Figure B2

Action: modify AS/NZS7000 section B4 heading to reference regions NZ2 and NZ4 instead of A7

Action: Various changes to the handbook will be required

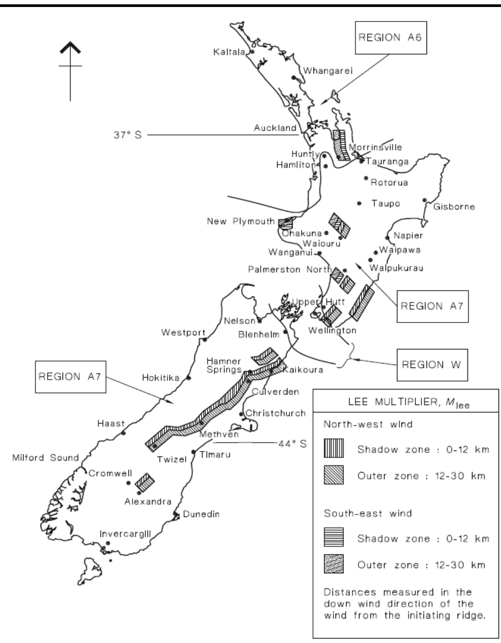


FIGURE B2 WIND REGIONS FOR NEW ZEALAND

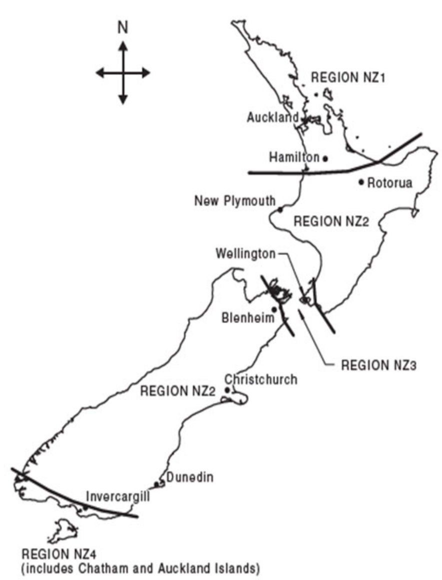


Figure 3.1(B) — Wind regions — New Zealand

2011 → 2021

AS/NZS1170.2:2011

TA

REGIONA

Regional wind speed (m/s)		Non-cyclonic
	A (1 to 7)	W
V_1	30	34
V_5	32	39
V_{10}	34	41
V_{20}	37	43
V_{25}	37	43
V_{50}	39	45
V_{100}	41	47
V_{200}	43	49
V_{250}	43	49
V_{500}	45	51
V_{1000}	46	53
V_{2000}	48	54
V_{2500}	48	55
V_{5000}	50	56
V_{10000}	51	58
V_R ($R \geq 5$ years)	$67-41R^{-0.1}$	$104-70R^{-0.045}$

AS/NZS1170.2:2021

Table 3.1(B) — Regional wind speeds — New Zealand

Regional wind speed (m/s)	Region		
	NZ (1 to 2)	NZ3	NZ4
V_1	31	37	38
V_5	35	42	42
V_{10}	37	44	43
V_{20}	39	46	44
V_{25}	39	46	45
V_{50}	41	48	46
V_{100}	42	50	47
V_{200}	43	51	48
V_{250}	44	51	49
V_{500}	45	53	50
$V_{1\,000}$	46	54	50
$V_{2\,000}$	47	55	51
$V_{2\,500}$	47	55	52
$V_{5\,000}$	48	56	52
$V_{10\,000}$	49	57	53
V_R	$61-30R^{-0.1}$	$71-34R^{-0.1}$	$63-25R^{-0.1}$

Wind pressure change based on regional wind velocity changes only

Wind pressure change

Design life 25 years	NZ1	NZ2	NZ3	NZ4
I	111%	111%	114%	145%
II	107%	107%	112%	138%
III	105%	105%	111%	132%

Wind pressure change

Design life 50 years	NZ1	NZ2	NZ3	NZ4
I	107%	107%	112%	138%
II	105%	105%	111%	132%
III	102%	102%	109%	127%

Wind pressure change

Design life 100 years	NZ1	NZ2	NZ3	NZ4
I	105%	105%	111%	132%
II	102%	102%	109%	127%
III	100%	100%	107%	123%

Wind direction multipliers (section 3.3)

Introduces significant changes to wind direction multipliers for both New Zealand and Australia

Now states in section 3.3 that a M_d of 1.0 shall be used on circular and polygonal poles. Possibly this is part of the reason why OHLs were excluded. It should not apply for OHLs since generally a significant portion of the windage is direction sensitive.

Action: Significant change to the handbook will be required

Action: Add a statement to the standard and handbook that clause 3.3(b) does not apply for OHLs

Wind direction multiplier changes

r (M_d)

Cardinal directions	Region A6	Region A7	Region W
N	0.85	0.90	1.00
NE	0.95	0.90	0.95
E	1.00	0.80	0.80
SE	0.95	0.90	0.90
S	0.85	0.90	1.00
SW	0.95	0.90	1.00
W	1.00	1.00	0.90
NW	0.95	1.00	0.95
Any direction	1.00	1.00	1.00

Table 3.2(B) — Wind direction multiplier (M_d) — New Zealand

Cardinal directions	Region NZ1	Region NZ2	Region NZ3	Region NZ4
N	0.90	0.95	1.00	0.95
NE	0.95	0.90	0.75	0.75
E	0.95	0.80	0.75	0.75
SE	0.95	0.90	0.85	0.75
S	0.90	0.95	0.95	0.85
SW	1.00	1.00	0.95	0.95
W	1.00	1.00	0.90	1.00
NW	0.95	1.00	1.00	1.00

NOTE In all New Zealand regions, extra-tropical synoptic winds are dominant.

AS/NZS1170.2:2011

AS/NZS1170.2:2021

Climate change multiplier (M_c) (section 3.4)

A new climate change multiplier has been introduced

It only affects Australian regions B2, C and D

It represents a 5% wind speed velocity (10% pressure) increase

Otherwise this site wind speed equation stays the same

Action: modify Appendix B to include the climate change multiplier variable in the site wind speed equation

AS/NZS1170.2:2011

2.2 SITE WIND SPEED

The site wind speeds ($V_{sit,\beta}$) defined for the 8 cardinal directions (β) at the reference height (z) above ground (see Figure 2.1) shall be as follows:

$$V_{sit,\beta} = V_R M_d (M_{z,cat} M_s M_t) \quad \ldots 2.2$$

where

V_R = regional gust wind speed, in metres per second, for annual probability of exceedence of 1/R, as given in Section 3

M_d = wind directional multipliers for the 8 cardinal directions (β) as given in Section 3

$M_{z,cat}$ = terrain/height multiplier, as given in Section 4

M_s = shielding multiplier, as given in Section 4

M_t = topographic multiplier, as given in Section 4

Generally, the wind speed is determined at the average roof height (h). In some cases this varies, as given in the appropriate sections, according to the structure.

3.4 Climate change multiplier (M_c)

The climate change multiplier (M_c) shall be as given in Table 3.3.

Table 3.3 — Climate change multiplier (M_c)

Region	M_c
A (0 to 5)	1.0
B1	1.0
B2	1.05
C	1.05
D	1.05
NZ (1 to 4)	1.0

NOTE The climate change multiplier allows for possible changes in climate affecting extreme winds during the life of structures designed by this Standard. Values of M_c may be adjusted in future amendments, depending on observed or predicted trends.

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The site wind speeds ($V_{sit,\beta}$) defined for the 8 cardinal directions (β) at the reference height (z) above ground (see Figure 2.1) shall be calculated from Equation 2.2:

$$V_{sit,\beta} = V_R M_c M_d \left(M_{z,cat} M_s M_t\right) \quad 2.2$$

where

V_R = regional gust wind speed, in metres per second, for average recurrence interval of R years, as given in Section 3

M_c = climate change multiplier, as given in Section 3

M_d = wind directional multipliers for the 8 cardinal directions (β) as given in Section 3

$M_{z,cat}$ = terrain/height multiplier, as given in Section 4

M_s = shielding multiplier, as given in Section 4

M_t = topographic multiplier, as given in Section 4

Generally, the wind speed is determined at the average roof height (h). In some cases, this varies according to the structure.

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$$V_{sit,\beta} = V_R M_d M_{z,cat} M_s M_t \quad \ldots B1$$

where

$M_{z,cat}$ = gust wind speed multiplier for terrain category at height z. See AS/NZS 1170.2, for all regions use Table 4.1(A)

M_d wind direction multiplier. See AS/NZS 1170.2

M_s = shielding multiplier. See AS/NZS 1170.2

M_t = topographic multiplier for gust wind speed. See AS/NZS 1170.2

V_R = basic regional wind velocity for the region corresponding to the selected return period wind. See AS/NZS 1170.2

Designers should be aware that changing land usage may alter the terrain category.

z for the conductors shall be taken as the average conductor height or the average attachment height.

z for structures under 50 m in height may be taken at the 2/3 structure height or at the centre of each panel in lattice towers.

$M_d < 1.0$ may be applied when determining design loads for sections of lines.

M_s is normally taken as 1.0.

Terrain category changes (section 4.2.1)

Terrain category 1.5 has been removed. Terrain category 1 and 2.5 have been redefined.

Terrain category descriptions

4.2 TERRAIN/HEIGHT MULTIPLIER ($M_{z,cat}$)

4.2.1 Terrain category definitions

Terrain, over which the approach wind flows towards a structure, shall be assessed on the basis of the following category descriptions:

(a) *Terrain Category 1 (TC1)* Very exposed open terrain with few or no obstructions and enclosed, limited-sized water surfaces at serviceability and ultimate wind speeds in all wind regions, e.g. flat, treeless, poorly grassed plains; rivers, canals and lakes; and enclosed bays extending less than 10 km in the wind direction.

(b) ~~*Terrain Category 1.5 (TC1.5)* Open water surfaces subjected to shoaling waves at serviceability and ultimate wind speeds in all wind regions, e.g. near-shore ocean water; large unenclosed bays on seas and oceans; lakes; and enclosed bays extending greater than 10 km in the wind direction. The terrain-height multipliers for this terrain category shall be obtained by linear interpolation between the values for TC1 and TC2 in Table 4.1.~~

(c) *Terrain Category 2 (TC2)* Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare, e.g. farmland and cleared subdivisions with isolated trees and uncut grass.

(d) *Terrain Category 2.5 (TC2.5)* Terrain with a few trees or isolated obstructions. This category is intermediate between TC2 and TC3 and represents the terrain in developing outer urban areas with scattered houses, or large acreage developments with fewer than ten buildings per hectare. The terrain-height multipliers for this terrain category shall be obtained by linear interpolation between the values for TC2 and TC3 in Table 4.1.

(e) *Terrain Category 3 (TC3)* Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare, e.g. suburban housing, light industrial estates or dense forests.

(f) *Terrain Category 4 (TC4)* Terrain with numerous large, high (10 m to 30 m tall) and closely-spaced constructions, such as large city centres and well-developed industrial

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→

4.2 Terrain/height multiplier ($M_{z,cat}$)

4.2.1 Terrain category definitions

Terrain, over which the approach wind flows towards a structure, shall be assessed on the basis of the following category descriptions:

(a) *Terrain Category 1 (TC1)* — Very exposed open terrain with very few or no obstructions, and all water surfaces (e.g. flat, treeless, poorly grassed plains; open ocean, rivers, canals, bays and lakes).

(b) *Terrain Category 2 (TC2)* — Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare (e.g. farmland and cleared subdivisions with isolated trees and uncut grass).

(c) *Terrain Category 2.5 (TC2.5)* — Terrain with some trees or isolated obstructions, terrain in developing outer urban areas with scattered houses, or large acreage developments with more than two and less than 10 buildings per hectare.

(d) *Terrain Category 3 (TC3)* — Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare (e.g. suburban housing, light industrial estates or dense forests).

(e) *Terrain Category 4 (TC4)* — Terrain with numerous large, high (10 m to 30 m tall) and closely-spaced constructions, such as large city centres and well-developed industrial complexes.

Selection of the terrain category shall be made with due regard to the permanence of the obstructions that constitute the surface roughness.

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Terrain height multiplier (section 4.2.2)

The $M_{z,cat}$ numbers for terrain category 1 have changed

Terrain height multipliers

TABLE 4.1

TERRAIN/HEIGHT MULTIPLIERS FOR GUST WIND SPEEDS IN FULLY DEVELOPED TERRAINS—ALL REGIONS

Height (z) m	Terrain/height multiplier ($M_{z,cat}$)			
	Terrain category 1	Terrain category 2	Terrain category 3	Terrain category 4
≤3	0.99	0.91	0.83	0.75
5	1.05	0.91	0.83	0.75
10	1.12	1.00	0.83	0.75
15	1.16	1.05	0.89	0.75
20	1.19	1.08	0.94	0.75
30	1.22	1.12	1.00	0.80
40	1.24	1.16	1.04	0.85
50	1.25	1.18	1.07	0.90
75	1.27	1.22	1.12	0.98
100	1.29	1.24	1.16	1.03
150	1.31	1.27	1.21	1.11
200	1.32	1.29	1.24	1.16

NOTE: For intermediate values of height z and terrain category, use linear interpolation.

Table 4.1 — Terrain/height multipliers for gust wind speeds in fully developed terrains — All regions except A0

Height (z) (m)	Terrain/height multiplier ($M_{z,cat}$)				
	Terrain Category 1	Terrain Category 2	Terrain Category 2.5	Terrain Category 3	Terrain Category 4
≤ 3	0.97	0.91	0.87	0.83	0.75
5	1.01	0.91	0.87	0.83	0.75
10	1.08	1.00	0.92	0.83	0.75
15	1.12	1.05	0.97	0.89	0.75
20	1.14	1.08	1.01	0.94	0.75
30	1.18	1.12	1.06	1.00	0.80
40	1.21	1.16	1.10	1.04	0.85
50	1.23	1.18	1.13	1.07	0.90
75	1.27	1.22	1.17	1.12	0.98
100	1.31	1.24	1.20	1.16	1.03
150	1.36	1.27	1.24	1.21	1.11
200	1.39	1.29	1.27	1.24	1.16

NOTE 1 In Region A0, use $M_{z,cat\ 2}$ for all $z \leq 100$ m in all terrains. For 100 m < $z \leq 200$ m, take $M_{z,cat}$ as 1.24 in all terrains.

NOTE 2 For all other regions, for intermediate terrains use linear interpolation.

NOTE 3 For intermediate values of height z, use linear interpolation.

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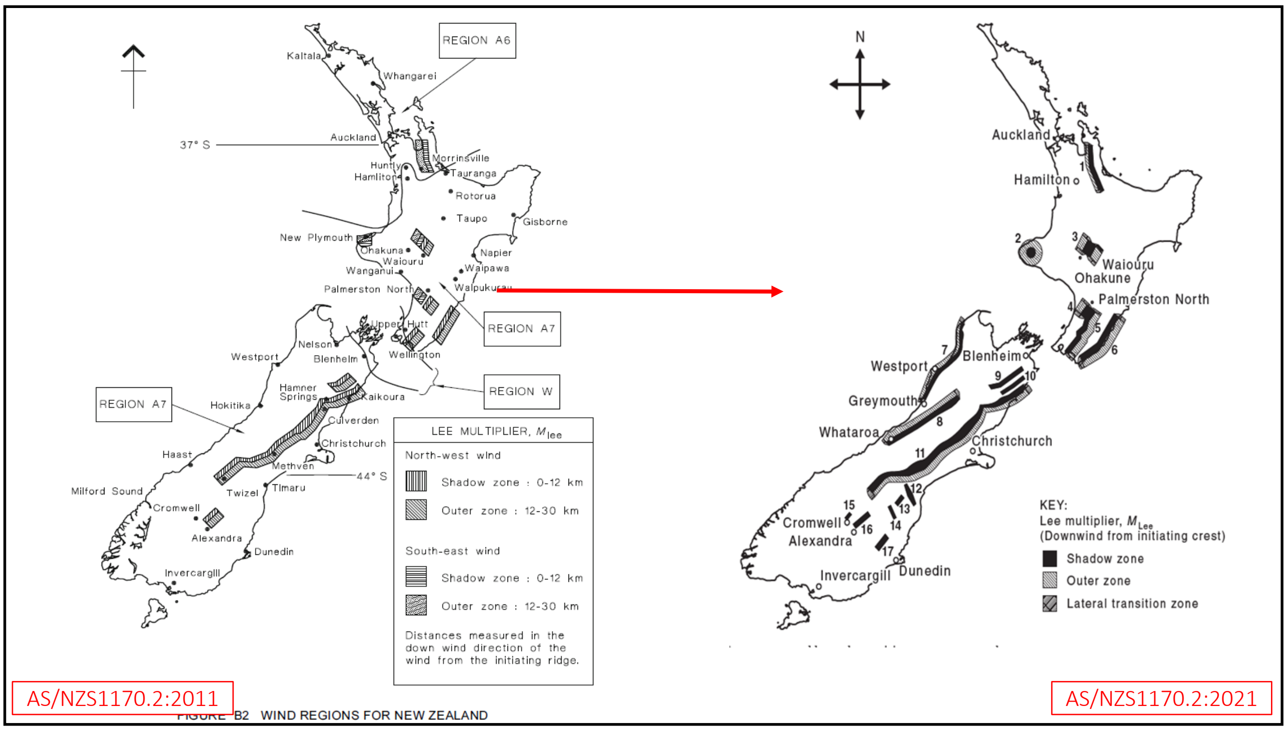
New Zealand lee zone changes (section 4.4.3)

Introduces significant changes for some New Zealand areas

Action: modify AS/NZS7000 Appendix B to change the NZ map in Figure B2 (as above)



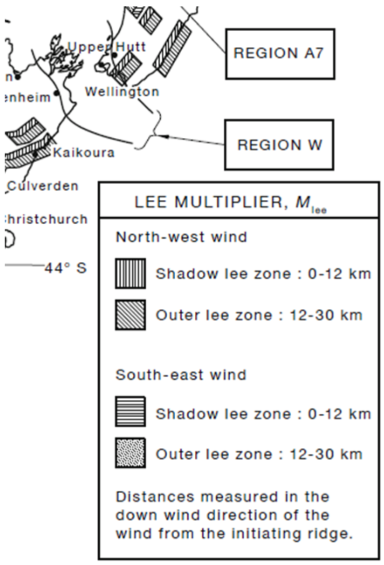


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Table 4.4 — New Zealand lee zones direction and extent of shadow and outer zones

Range		Direction	M_{lee}	Shadow (km)	Outer (km)
North Island					
1.	Kaimai	E&SE	1.20	0 to 8	8 to 20
2.	Taranaki	Any, taken to be 90° sector from mountain top downwind to location	1.35	0 to 12	12 to 30
3.	Ruapehu	NW and SE	1.35	0 to 12	12 to 30
4.	Tararua	SE	1.20	0 to 8	8 to 20
5.	Tararua and Orongorongo	NW	1.20	0 to 8	8 to 20
6.	Coastal Wairarapa	NW			
South Island					
7.	West Coast North	E and SE	1.20	0 to 8	8 to 20
8.	West Coast Alps	SE	1.35	0 to 12	12 to 30
9.	Awatere	NW	1.35	0 to 12	(within Inland Kaikoura)
10.	Inland Kaikoura	NW	1.35	0 to 12	(within Southern Alps)
11.	Southern Alps	NW	1.35	0 to 12	12 to 30
12.	Hunter	SW	1.20	0 to 8	8 to 20
13.	Hakataramea	NW	1.20	0 to 8	8 to 20
14.	St Mary's	SW	1.20	0 to 8	8 to 20
15.	Pisa	NW	1.20	0 to 8	8 to 20
16.	Dunstan	NW	1.20	0 to 8	8 to 20
17.	Rock and Pillar	NW	1.20	0 to 8	8 to 20

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Pole dynamic response factors (section 6)

Introduces dynamic response factors for poles with natural frequencies less than 1Hz in section 6. Generally overhead lines have natural frequencies greater than 1Hz so this change may be ignored

Changes to the standard

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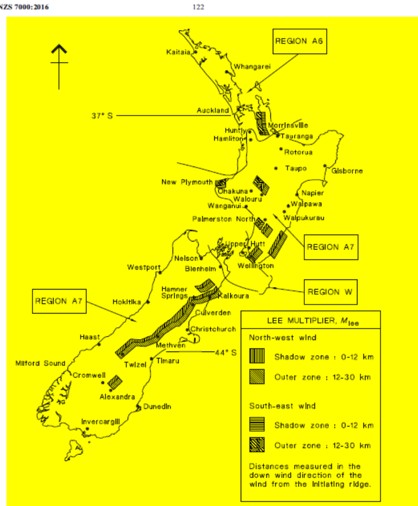

FIGURE B2 WIND REGIONS FOR NEW ZEALAND

Remove or replace with new map

B3 SYNOPTIC WIND REGIONS (AUSTRALIA ZONE I AND ZONE III AND ALL ZEALAND REGIONS)

All structures shall be designed for a peak gust regional wind speed for the relevant return period wind as defined in AS/NZS 1170.2.

Cyclonic wind amplification factors F_c and F_d provided in AS/NZS 1170 shall be taken as 1.0 for all overhead lines, based on performance of overhead lines in cyclonic areas over time.

Remove paragraph

The calculation of wind forces on structural elements is based on the wind pressure on the structural element and the net drag coefficient for the element. AS/NZS 1170.2 deals with the calculation of wind velocities (for synoptic conditions) and drag coefficients for the more common structural shapes. The equations presented here are intended to provide a context for the drag (or force) coefficients that are of particular relevance to overhead lines. Designers are referred to AS/NZS 1170.2 as appropriate.

The selection of the regional wind speed should be based on the line's location. Variations in wind loading may be required to take into account variations in terrain, topography and exposure along the length of line. The site design wind speed is the basic regional wind speed modified for the effects of the topography and terrain that the line traverses.

AS/NZS 1170.2 provides regional wind speeds for various return periods.

The design site wind speed shall be taken as—

$$V_{sit,\beta} = V_R\, M_d\, M_{z,cat}\, M_s\, M_t \qquad \ldots B1$$

Replace with new equation

where

$M_{z,cat}$ = gust wind speed multiplier for terrain category at height z. See AS/NZS 1170.2, for all regions use Table 4.1(A)

M_d wind direction multiplier. See AS/NZS 1170.2

M_s = shielding multiplier. See AS/NZS 1170.2

M_t = topographic multiplier for gust wind speed. See AS/NZS 1170.2

V_R = basic regional wind velocity for the region corresponding to the selected return period wind. See AS/NZS 1170.2

Add description for Mc

Designers should be aware that changing land usage may alter the terrain category.

z for the conductors shall be taken as the average conductor height or the average attachment height.

z for structures under 50 m in height may be taken at the 2/3 structure height or at the centre of each panel in lattice towers.

M_d < 1.0 may be applied when determining design loads for sections of lines.

Add statement: ", including for poles with circular or polygonal cross-sections."

M_s is normally taken as 1.0.

B4 DOWNDRAFT WIND REGIONS (AUSTRALIA ZONE II AND ZONE III AND NEW ZEALAND REGIONS A7)

Change A7 to NZ2

B4.1 General

Convective downdraft wind gust sometimes referred to as high intensity winds (HIW) are generated by severe thunderstorms and are the dominant design winds that occur across most regions of Australia and New Zealand. They take the form of downdrafts associated with cold air and hail columns, meso–cyclonic cells and tornadoes within storm front systems or mature subtropical thunderstorm cells. Evidence from the damage of many severe storms across Australia and New Zealand suggests that these events are responsible for many of the wind-related failures on overhead lines.

They occur in both coastal and inland regions and are associated with, and embedded in, many severe thunderstorms.

B4.2 Downdraft winds

Downdraft winds, more commonly referred to as downbursts, macrobursts, or microbursts; are high velocity wind columns of cold air that can form within a thunderstorm cell, usually but not always associated with a hail column. The cold air column falls vertically from great height and strikes the ground, causing the wind draft to radiate from the impact site. The translational velocity of the storm is added vectorially to the radial wind velocity. The resulting gust widths can vary in width from typically a hundred metres to a kilometre.

These gusts create damage swaths in vegetation at ground level and the wind can envelop one or more spans simultaneously and render the application of the synoptic wind based span reduction factors inappropriate.

A span reduction factor shall be applied as provided in Figure B6.

Studies have indicated that downdraft winds can have significant variability in direction due to their association with hail and cold air downdrafts and are also influenced by large scale topographical features. The maximum velocity also has been observed in recent failures to be generally above a plane at approximately 15 m above ground as a result of the localized influence of vegetation and ground surface roughness.

The return periods in AS/NZS 1170.2 Table 3.1 are appropriate to individual structures affected by either wind types. The return periods will not reflect the probability of a relatively small scale convective downdraft event crossing a long overhead line. However, where the scale of the event is large (e.g. cyclones), the return period reflects the probability that some structures will be subjected to the maximum wind speeds.

AS/NZS 1170.2 regions C and D are based on cyclonic wind data. Region B boundaries reflect the transition between the cyclonic and non-cyclonic zones. At this time there is no evidence that small scale convective type events, such as downdrafts, are more severe in regions B, C or D. Therefore, AS/NZS 1170.2 wind speeds for these regions shall not be used for the downdraft wind design. Region A wind speeds shall be used for downdraft wind design.

In AS/NZS7000 the section B4 heading specifically refers to region A7 (not regions A6 or W), yet here within the text generally refers to region A having downdrafts. The highlighted sentence needs to be changed to Regions A0-A5 and NZ2 wind speeds shall be used for downdraft wind design".

In keeping with observation on the effects of event scale, it is recommended that in region B until more definitive data is available, designers should select one higher level of line security for convective winds to achieve comparable overhead line reliability in all zones.

Wind pressures are to be calculated as for synoptic winds except for modification to M_z and M_t factors as provided below.

Terrain-Height Multiplier $M_{z,cat}$ shall be calculated in accordance with Figure B3 and the following rules:

Height (m)	$M_{z,cat}$	
0–50	1.0	
50–100	$1.0 - \frac{0.5 \times (H - 50)}{50}$	... B2
Above 100	0.5	

Changes to the handbook

8.2 Wind loading

AS/NZS 7000 Clause 7.2.2 sets out the wind loading requirements for wind storm types as they impact on the structure.

A complete coverage of wind loading is given in AS/NZS 7000 Appendix B.

Some simplification of wind loads can be made. The following sets out an approach that could be adopted for the various wind regions.

Based on information contained in AS/NZS 7000 Appendix B the design site wind speed is taken as in the following equation:

$$V_z = V_{RP} \times M_d \times M_{z,cat} \times M_s \times M_t$$

where

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$M_{z,cat}$ = gust winds speed multiplier for terrain category at height z (refer to AS/NZS 1170.2—2011 Table 4.1 for all regions)

M_d = wind direction multiplier

M_s = shielding multiplier

M_t = topographic multiplier for gust wind speed

V_{RP} = basic regional wind velocity for the region corresponding to the selected return period wind (refer to AS/NZS 1170.2)

Replace with new equation

Add description for Mc

Table 8.1 — Wind pressures for types of equipment (for 50 year return period wind)

Equipment	Comment	Region	A1–A7	W1	B	C	D
		Base wind speed (m/s)	39	45	44	52	60
		Base wind pressure (Pa)	913	1215	1162	1622	2160
Equipment	Comment	Suggested C_d factor	Common wind pressures for types of equipment (Pa)				
Round Poles Smooth		1.0	913	1215	1162	1622	2160
Round Poles Rough		1.3	1186	1580	1510	2109	2808
"I" Section prestressed concrete pole (or Stobie) with chamfered edges	Wide face	1.6	1460	1944	1859	2596	3456
	Narrow face	1.0	913	1215	1162	1622	2160
Octagonal pole		1.4	1278	1701	1626	2271	3024
Transformers		1.5	1369	1823	1742	2434	3240
Regulators		1.2	1095	1458	1394	1947	2592
Conductors	Assumed SRF = 1	1.0	913	1215	1162	1622	2160
Crossarms	End	1.2	1095	1458	1394	1947	2592
	Wide face	1.6	1460	1944	1859	2596	3456
Insulators	Post/pin	1.2	1095	1458	1394	1947	2592
	Strain/ string	1.2	1095	1458	1394	1947	2592

NOTE 1 A factor of 1 has been used for $M_{z,cat}$, M_d, M_s, M_t and depending on the location of the line, these factors may vary.

NOTE 2 C_d for a stranded conductor is assumed to be 1.0 (can be lower for compacted or smooth bodied conductors).

Replace table 8.1 with the following tables to reflect the updated wind speeds

Design life = 50 years		Region	A1–A5	B1	B2	C	D	NZ1,NZ2	NZ3	NZ4
Security Level = I		Base wind speed (m/s)	39	44	44	52	60	41	48	46
Wind return period = 50 years		Climate change multiplier (Mc)	1.00	1.00	1.05	1.05	1.05	1.00	1.00	1.00
		Maximum wind direction multiplier (Md)	1.00	0.95	0.90	0.90	0.90	1.00	1.00	1.00
		Base wind pressure (Pa)	913	1,048	1,037	1,449	1,929	1,009	1,382	1,270
Equipment	Comment	Suggested C_d factor	Common wind pressures for types of equipment (Pa)							
Round Poles	Smooth	1	913	1,048	1,037	1,449	1,929	1,009	1,382	1,270
	Rough	1.3	1,186	1,363	1,349	1,883	2,508	1,311	1,797	1,650
"I" Section concrete pole (or Stobie) with chamfered edges	Wide face	1.6	1,460	1,677	1,660	2,318	3,086	1,614	2,212	2,031
	Narrow face	1	913	1,048	1,037	1,449	1,929	1,009	1,382	1,270
Octagonal pole		1.4	1,278	1,468	1,452	2,028	2,701	1,412	1,935	1,777
Transformers		1.5	1,369	1,573	1,556	2,173	2,893	1,513	2,074	1,904
Regulators		1.2	1,095	1,258	1,245	1,739	2,315	1,210	1,659	1,524
Conductors		1	913	1,048	1,037	1,449	1,929	1,009	1,382	1,270
Crossarms	End	1.2	1,095	1,258	1,245	1,739	2,315	1,210	1,659	1,524
	Wide face	1.6	1,460	1,677	1,660	2,318	3,086	1,614	2,212	2,031
Insulators	Post/pin	1.2	1,095	1,258	1,245	1,739	2,315	1,210	1,659	1,524
	Strain/string	1.2	1,095	1,258	1,245	1,739	2,315	1,210	1,659	1,524

NOTE 1: A factor of 1.0 for M_{zcat}, M_s and M_t, and a worst case value of M_d, have been assumed for calculation of wind pressures in this table. Factors applicable to a specific design are likely to differ as a function of line location and geometry.

NOTE 2: The C_d for stranded conductor of 1.0 (can be lower for compact or smooth body conductors) and a span reduction factor of 1.0 have been assumed for calculation of wind pressures in this table.

Design life = 50 years		Region	A1–A5	B1	B2	C	D	NZ1,NZ2	NZ3	NZ4
Security Level = II		Base wind speed (m/s)	41	48	48	56	66	42	50	47
Wind return period = 100 years		Climate change multiplier (Mc)	1.00	1.00	1.05	1.05	1.05	1.00	1.00	1.00
		Maximum wind direction multiplier (Md)	1.00	0.95	0.90	0.90	0.90	1.00	1.00	1.00
		Base wind pressure (Pa)	1,009	1,248	1,235	1,680	2,334	1,058	1,500	1,325
Equipment	**Comment**	**Suggested C_d factor**	**Common wind pressures for types of equipment (Pa)**							
Round Poles	Smooth	1	1,009	1,248	1,235	1,680	2,334	1,058	1,500	1,325
	Rough	1.3	1,311	1,622	1,605	2,184	3,034	1,376	1,950	1,723
"I" Section concrete pole (or Stobie) with chamfered edges	Wide face	1.6	1,614	1,996	1,975	2,689	3,734	1,693	2,400	2,121
	Narrow face	1	1,009	1,248	1,235	1,680	2,334	1,058	1,500	1,325
Octagonal pole		1.4	1,412	1,747	1,728	2,352	3,268	1,482	2,100	1,856
Transformers		1.5	1,513	1,871	1,852	2,520	3,501	1,588	2,250	1,988
Regulators		1.2	1,210	1,497	1,481	2,016	2,801	1,270	1,800	1,590
Conductors		1	1,009	1,248	1,235	1,680	2,334	1,058	1,500	1,325
Crossarms	End	1.2	1,210	1,497	1,481	2,016	2,801	1,270	1,800	1,590
	Wide face	1.6	1,614	1,996	1,975	2,689	3,734	1,693	2,400	2,121
Insulators	Post/pin	1.2	1,210	1,497	1,481	2,016	2,801	1,270	1,800	1,590
	Strain/string	1.2	1,210	1,497	1,481	2,016	2,801	1,270	1,800	1,590

NOTE 1: A factor of 1.0 for M_{zcat}, M_s and M_t, and a worst case value of M_d, have been assumed for calculation of wind pressures in this table. Factors applicable to a specific design are likely to differ as a function of line location and geometry.
NOTE 2: The C_d for stranded conductor of 1.0 (can be lower for compact or smooth body conductors) and a span reduction factor of 1.0 have been assumed for calculation of wind pressures in this table.

8.6.2 New Zealand

Apart from the probability in some areas of turbulent effects near large mountains, the majority of New Zealand is within Region A7 of AS/NZS 1170.2. Some caution needs to be applied to locations on hills in close proximity to sea coasts.

Change A7 to NZ2

8.6.3 Synoptic wind regions

In AS/NZS 7000 Clause B3, wind direction multipliers M_d as provided in AS/NZS 1170.2—2011 Table 3.2 are taken as 1.0, to provide for multiple changes in overhead line route direction. Where a line route is in a predominate direction for its entire route and the line design is unique for that line only, consideration should arguably be given for a lower value direction multiplier. However, once created, line designs frequently have repeat applications on other line projects. These could have multidirectional characteristics and extreme caution should be exercised if applying reduced values of M_d.

This statement is incorrect and should be removed. Clause B3 does not state this. It is also incorrect since 1.0 is no longer the highest Md value in regions B, C and D. Remove the first sentence.

Cyclonic wind amplification factors F_c and F_d provided in AS/NZS 1170.2 Table 3.1 are to be taken as 1.0 for all overhead lines, based on performance of overhead lines in cyclonic areas over time. These factors are provided in AS/NZS 1170.2 to apply additional security due to some uncertainty with wind velocities in the light of the incidence of several major Category 5 events since 2005.

Performance of major transmission lines in these regions since the 1960s has been very good, despite some structure failures occurring. Distribution line network failures in such extreme events occur regardless of magnitude of wind velocities primarily as a result of airborne vegetation and building debris. Hence the value of 1.0 has been applied for all lines in these areas.

8.6.4 Downdraft wind regions (Australia Zone II, Zone III and New Zealand Region A7)

Change A7 to NZ2

AS/NZS 7000 provides for all structures to be designed for a minimum design wind return period. The

8.6.6.4 Wind pressures on conductors

The Span Reduction Factor for each wind climate region is a significant issue for design of structures. In Australia in wind Zones II and III and most parts of New Zealand, both downdraft SRF as well as synoptic SRF should be given consideration in design. When downdraft conditions apply, a SRF of 1.0 is recommended for spans less than 200 m.

In the 2016 amendment of AS/NZS 7000 it was stated that there was no evidence that downdraft winds are more severe in wind regions B, C or D, and that Region A wind speeds should be used for downdraft wind design. For downdraft wind design in region B it was recommended that one higher level of security should be used for convective winds to achieve comparable overhead line reliability.

Change the highlighted to read "that A0-A5 and NZ2 wind speeds shall be used for downdraft wind design".

15.6.2 Design data

The conductor is AAAC (Fluorine) with diameter = 9 mm, weight = 0.135 kg/m and CBL = 11.8 kN. The line is in terrain category 2.5 of Region B and the wind non-directional.

Use a RP of 50 years.

Conductor tensions for 7/3.00 AAAC (FLUORINE) strung at 20 % CBL at 15 °C

(Ruling span of 300 m)

The calculations for a range of load combinations are given in Table 15.7.

Table 15.7 — Calculations for a range of load combinations

Load condition	Load
Everyday load condition Temperature = 15 °C, Wind = 0 kPa	F_t = 2.36 kN
Sustained load condition Temperature = 5 °C, Wind = 0 kPa	F_t = 2.55 kN
Short duration load condition Temperature = 15 °C, Terrain category = 2.5, mean conductor height = 8 m, Height multiplier $M_{z,cat}$ = 0.91, M_t = 1, M_d = 1 (refer to AS/NZS 1170.2—2011Section 3) Regional wind speed V50 = 44 m/s Design site wind speed = 44 × 0.91 = 40.04 m/s Dynamic wind pressure = 0.962 kPa SRF = 0.59 (refer to AS/NSZ 7000 Equation B11) Ultimate wind pressure on conductor for tension calculation = 0.962 × 0.59 = 0.568 kPa	F_t = 6.2 kN
Failure containment loads (refer to AS/NZS 7000 Clause 7.2.7.1) Temperature = 15 °C, Wind pressure = 0.24 kPa	F_c = 3.79 kN F_t = 3.79 kN

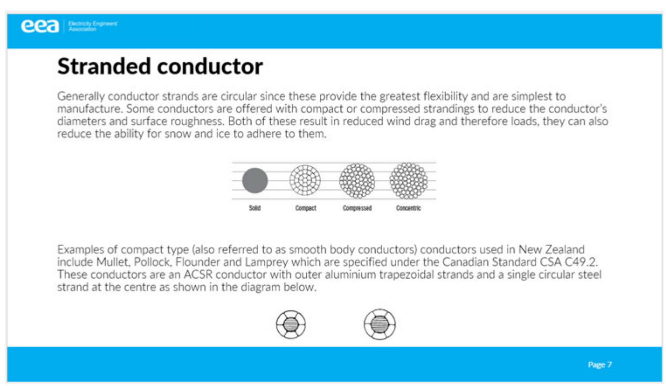
NOTE The conductor loads below exclude the weight of insulators and ancillaries.

This plus subsequent calcs will be affected

EEA Conductor Micro-credential

Topics include conductor:

- Types
- Parameters
- Hardware
- Calculations
- Engineering design
- Deliverables
- New assignment format



Conductor calculations – Sag - Tension

Example. Use equation R12 to calculate the tension of 7/3.00 AAAC Fluorine conductor with a sag of 2m and a span of 100m. Fluorine has a unit mass of 135kg/km. The unit mass can be converted to N/m as follows:

135kg/km / 1000m x 1km x 9.81m/s² = 1.324N/m

The numbers can then be put into Equation R12 to calculate the horizontal tension:

$$H = \frac{WL^2}{8D} = \frac{1.324N/m \times (100m)^2}{8 \times 2m} = 827.5N = 0.83kN$$

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Worked examples

Questions

Conductor calculations – Sag - Tension

Question – A Lineman has used sag-boards to determine that a 127m span of 7/3.00 AAAC Fluorine conductor has a sag 627mm. Given that Fluorine conductor has a mass 1.324N/m what would the horizontal tension be?:

- A – 828N
- B – 1,436N
- C – 2,975N
- D – 3.45kN
- E – 4,257N

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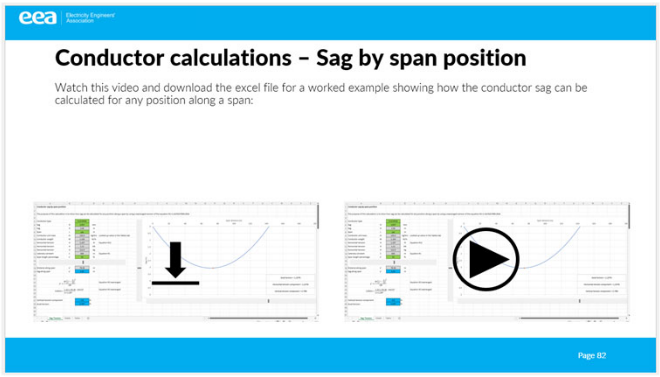
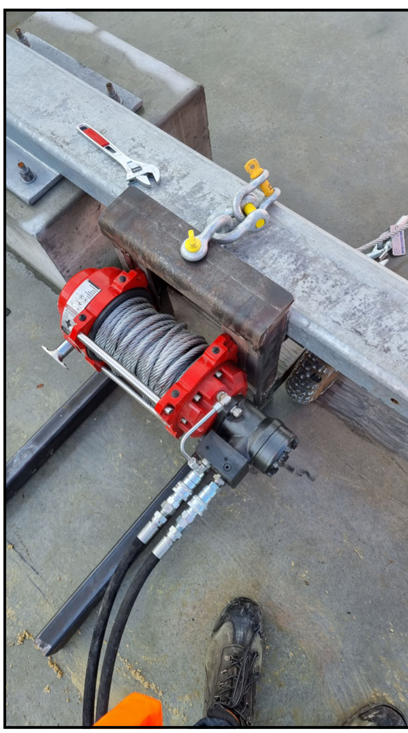
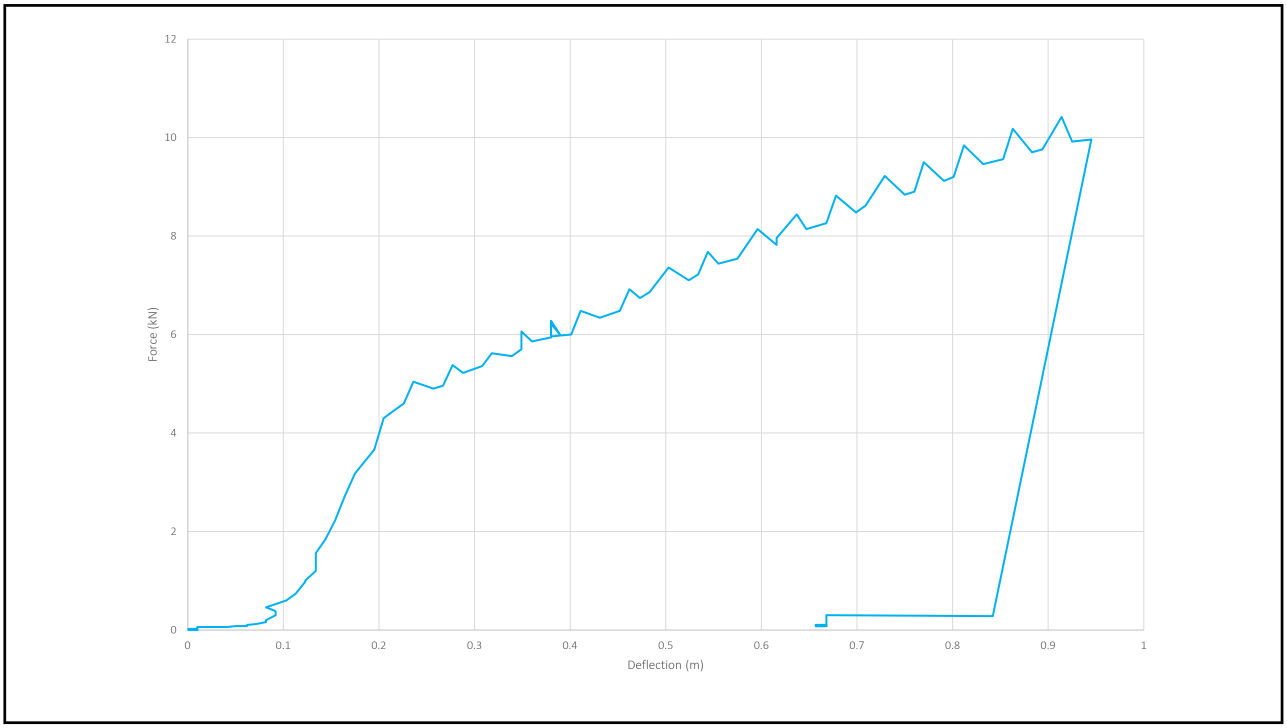


Downloadable interactive spreadsheet examples

Pole test facility




File
Set Pole Number
Set HX711 Ref
Cleanup
Close
e ID: 123456
Force: 0kg
Force: 0kN
Deflection: 0m
Start Logging
Stop Logging



Force (kN)
Deflection (m)
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1