Civil & Structural Engineering Design Services Pty. Ltd.

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Civil and Structural Engineering Design Services Pty Ltd

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1.0 INTRODUCTION

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The following structural drawings and calculations are for the transportable tents

The frame consists of extruded aluminium (grade 6005 T5) connector, Leg outer, Leg Inner and Truss. The base plate is generally anchored in position with 10x30 mm steel stakes.

Please refer to the structural drawings for further information on the components and assembly of the tents.

2.0 DESIGN RESTRICTIONS AND LIMITATIONS

The erected structure is for temporary use only and is limited to 6 months maximum at any one site establishment.

It should be noted that if high gust wind speeds are anticipated or forecast in the locality of the tent. For forecast winds in excess of 80km/hr or 22m/s, all fabric shall be removed from the frames and the structure should be completely dismantled.

Please note that the locality squall or gust wind speed is affected by factors such as terrain exposure and site elevations.

Live load or occasional loads are limited to a single maximum suspended load of 140kg located at the ridge connection, unless noted otherwise note and if a larger load is required the Engineer should be notified so that a revision calculation may be carried out for approval.

The structure may only be erected in regions with wind classifications no greater than the limits specified on the attached wind analysis (Regional Wind Speed Region A (1-7).

The wind classifications are based upon the regional wind terrain category, topographical location and site shielding from adjacent structures. Please note that in many instances topographical factors such as a location on the crest of a hill or on top of an escarpment may yield a higher wind speed classification than that derived for a higher wind terrain category in a level topographical region. For this reason, particular regard shall be paid to the topographical location of the structure. For localities which do not conform to the standard prescribed descriptions for wind classes as defined above, a qualified structural engineer may be employed to determine an appropriate wind class for that the particular site.

For large scale projects, or where the site conditions approach the design limits for the structure, consideration should be given to pullout tests of the stakes and professional assessment of the appropriate wind classification for the site.

TENT BASE ANCHORAGE REQUIREMENTS

TENT SIZE	SOIL	Wind Classification	
		W80 km/hr (STAKES PER UPRIGHT)	W80 km/hr (WEIGHT PER UPRIGHT)
2.4.0x2.4 m (4 legs)	A	2	
	B	1	
	C	1	
	D	1	
	E	2	60 kg
3.0x3.0 m (4 legs)	A	2	
	B	1	
	C	1	
	D	1	
	E	2	75 kg
3.0x4.5 m (4 legs)	A	2	
	B	1	
	C	1	
	D	1	
	E	2	120 kg
3.0x6.0 m (6 legs)	A	2	
	B	1	
	C	1	
	D	1	
	E	2	100 kg
5.7x5.7 m (8 legs)	A	4	
	B	4	
	C	4	
	D	4	

	E	4	80 kg
4.0x4.0 m (4 legs)	A	4	
	B	4	
	C	4	
	D	4	
	E	4	100 kg
4.0x6.0 m (4 legs)	A	4	
	B	4	
	C	4	
	D	4	
	E	4	150 kg
4.0x8.0 m (6 legs)	A	4	
	B	4	
	C	4	
	D	4	
	E	4	130 kg

Table 1: Anchoring weights for different size tents in 80 km/hr wind

Definitions of soil types:

Type A: Loose sand such as dunal sand. Uncompacted site filling may also be included in this soil type.

Type B: Medium to stiff clays or silty clays.

Type C: Moderately compact sand or gravel e.g., alluvial origin.

Type D: Compact sand and gravel e.g., weathered sandstone or compacted quarry rubble hardstand.

Type E: Concrete slab on ground (see weighted column). Number Stated are for M16 Dynabolts, 70mm min embedment, 150mm min spacing, min edge distance on slab 80mm.

3.0 TENT SPECIFICATIONS

	Material	Member	Height	Size
Explorer range	Aluminium T5 6005 grade	30x30x2 32x32x1,3	3.29	3x3 3x4.5 3x6
K2 range	Aluminium T5 6005 grade	37x37x2	3.29	3x3 3x4.5 3x6
Summit range	Aluminium T5 6005 grade	40x40x2	2.99 3.29 3.73 4.02	2.4x2.4 3x3 3x4.5 3x6 4x4 4x8 5.7
Tectonic range	Aluminium T5 6005 grade	57x50x2	2.99 3.29 3.73	2.4x2.4 3x3 3x4.5 3x6 4x4 4x6 4x8

Table 2: Tent Specifications

3.1 DESIGN WIND PRESSURE AND CALCULATION

TEDDS calculation version 1.0.05;

Regional wind speeds (cl. 3.2)

Regional wind speeds (V_R) for all directions based on 3 second gust wind data shall be as given in Table 3.1 AS/NZS 1170.2 for the regions shown in Figure 3.1 where R (average recurrence interval) is the inverse of the annual probability of exceedance of the wind speed. Refer to AS/NZS 1170.0 for information on values of annual probability of exceedance appropriate.

Inverse of annual probability of wind speed exceedance;

R = **1**

;

;

Regional wind speed, Region A (1 to 7); V_R = ;**30**; m/s

Multipliers

Wind direction multiplier (cl. 3.3)

The wind direction multiplier (M_d) shall be as follows for each cardinal direction (given in Table 3.2 AS/NZS 1170.2).

Region A2

North, north-east, east;	$M_{d.N} = M_{d.NE} = M_{d.E} = 0.8$
South-east, south-west, north-west;	$M_{d.SE} = M_{d.SW} = M_{d.NW} = 0.95$
South;	$M_{d.S} = 0.9$
West;	$M_{d.W} = M_d = 1.0$

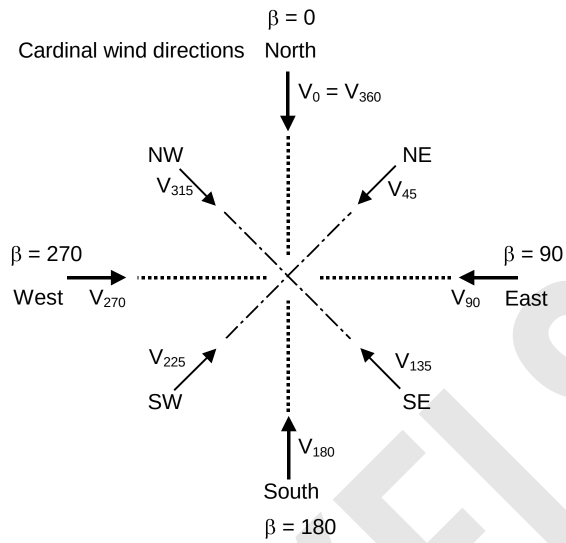
Terrain/height multiplier (cl. 4.2)

Terrain category;	$Terrain_{Cat}$ = **1** ;
Height;	z = **3.00** m
Terrain/height multiplier (Table 4.1(A));	M_{zcat1} = **0.99**
Shielding multiplier (cl. 4.3);	M_s = **1.00**
Topographic multiplier (cl. 4.4);	M_t = **1.00**

Site wind speed (cl. 2.2)

Site wind speed; $V_{sit.\beta} = V_R \times M_d \times (M_{z.cat} \times M_s \times M_t)$

The site wind speed is independent of the type or shape of structure.

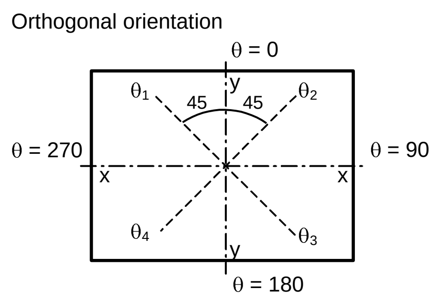


Ultimate limit state and serviceability limit state for regions A(1 to 7) and W

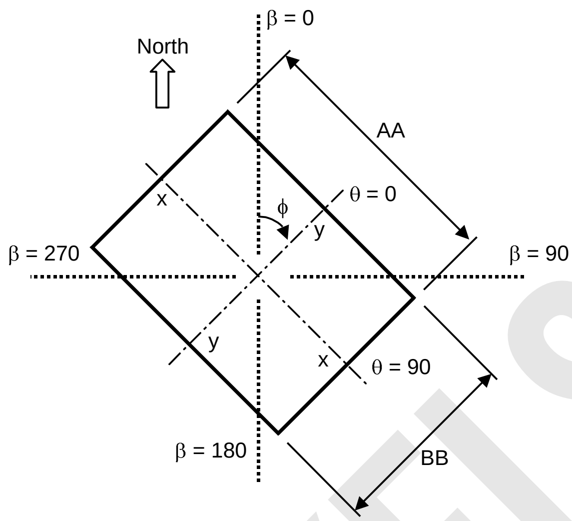
North;	$V_0 = V_{360} = V_{sit.N} = V_R \times M_{d.N} \times (M_{zcat1} \times M_s \times M_t) =$ **23.76** m/s
North-east;	$V_{45} = V_{sit.NE} = V_R \times M_{d.NE} \times (M_{zcat1} \times M_s \times M_t) =$ **23.76** m/s
East;	$V_{90} = V_{sit.E} = V_R \times M_{d.E} \times (M_{zcat1} \times M_s \times M_t) =$ **23.76** m/s
South-east;	$V_{135} = V_{sit.SE} = V_R \times M_{d.SE} \times (M_{zcat1} \times M_s \times M_t) =$ **28.22** m/s
South;	$V_{180} = V_{sit.S} = V_R \times M_{d.S} \times (M_{zcat1} \times M_s \times M_t) =$ **26.73** m/s
South-west;	$V_{225} = V_{sit.SW} = V_R \times M_{d.SW} \times (M_{zcat1} \times M_s \times M_t) =$ **28.22** m/s
West;	$V_{270} = V_{sit.W} = V_R \times M_{d.W} \times (M_{zcat1} \times M_s \times M_t) =$ **29.70** m/s
North-west;	$V_{315} = V_{sit.NW} = V_R \times M_{d.NW} \times (M_{zcat1} \times M_s \times M_t) =$ **28.22** m/s

Design wind speed (cl. 2.3)

The design wind speed ($V_{des.\theta}$) equals the maximum value of site wind speed in the range $\theta = \beta$ +/- 45° where β is the cardinal direction clockwise from true North and θ is the angle to the building orthogonal axes. The design wind speed considers directional effects and variations with height.



Orientate building; $\phi =$ **90.0**° ; (angle between $\beta = 0°$ and $\theta = 0°$)



Using cardinal coordinates; θ_1 = if(ϕ < 45, (ϕ - 45) + 360, ϕ - 45) = **45.0**°

θ_2 = if(ϕ > 315, (ϕ + 45) - 360, ϕ + 45) = **135.0**°

θ_3 = if(ϕ > 225, (ϕ + 135) - 360, ϕ + 135) = **225.0**°

θ_4 = if(ϕ > 135, (ϕ + 225) - 360, ϕ + 225) = **315.0**°

Site wind speed in the range θ = β +/- 45°

$V_{\theta 1} = V_{45} - (V_{45} - V_{90}) \times (45 - \theta_1) / -45$ = **23.76** m/s

$V_{\theta 2} = V_{135} - (V_{135} - V_{180}) \times (135 - \theta_2) / -45$ = **28.22** m/s

$V_{\theta 3} = V_{225} - (V_{225} - V_{270}) \times (225 - \theta_3) / -45$ = **28.22** m/s

$V_{\theta 4} = V_{315} - (V_{315} - V_{360}) \times (315 - \theta_4) / -45$ = **28.22** m/s

Design wind speed (maximum value of site wind speed in the range θ = β +/- 45°);

At 0 degrees; $V_{des.\theta 0} = \max(V_{\theta 1}, V_{90}, V_{135}, V_{\theta 2})$ = **28.22** m/s

At 90 degrees; $V_{des.\theta 90} = \max(V_{\theta 2}, V_{180}, V_{225}, V_{\theta 3})$ = **28.22** m/s

At 180 degrees; $V_{des.\theta 180} = \max(V_{\theta 3}, V_{270}, V_{315}, V_{\theta 4})$ = **29.70** m/s

At 270 degrees; $V_{des.\theta 270} = \max(V_{\theta 4}, V_{360}, V_{45}, V_{\theta 1})$ = **28.22** m/s

Wind pressure (cl. 2.4)

Density of air; ρ_{air} = **1.2** kg/m^3

Design wind pressure; $p = 0.5 \times \rho_{air} \times V_{des.\theta}^2 \times C_{fig} \times C_{dyn}$

Wind pressure

At 0 degrees; $p_{\theta 0} = 0.5 \times \rho_{air} \times V_{des.\theta 0}^2$ = **0.48** kPa

At 90 degrees; $p_{\theta 90} = 0.5 \times \rho_{air} \times V_{des.\theta 90}^2$ = **0.48** kPa

At 180 degrees; $p_{\theta 180} = 0.5 \times \rho_{air} \times V_{des.\theta 180}^2$ = **0.53** kPa

At 270 degrees; $p_{\theta 270} = 0.5 \times \rho_{air} \times V_{des.\theta 270}^2$ = **0.48** kPa

Aerodynamic shape factor for enclosed building (cl. 5.2a)

The following calculations collate the internal and external pressure coefficients for an enclosed rectangular building.

The coefficients have been combined with wind pressures for each orthogonal direction. The combination of the external and internal pressures needs to be conducted separately. When combining the pressures, the Combination factors, $K_{c,e}$ & $K_{c,i}$ (refer to Table 5.5 for appropriate values of $K_{c,e}$ & $K_{c,i}$), and the Area reduction factor, K_a, need to be included. The Area reduction factor, K_a, makes the pressure applicable to the specific structural element and force being considered.

No local pressure factor (K_l) has been included in the following calculations and this should be considered separately.

No consideration or reduction has been made for permeable cladding (K_p) in the calculation.

External pressures; $C_{fig} = C_{p.e} \times K_a \times K_{c,e} \times K_l \times K_p$

Internal pressures; $C_{fig} = C_{p.i} \times K_{c,i}$

External pressure coefficients for enclosed rectangular buildings (cl. 5.4)

Building dimensions; h = **3.1** m

AA = **8.0** m

BB = **4.0** m

Roof slope; α = **45.0** °

Ratios for θ = 0/180; $d\_on\_b_{\theta 0}$ = BB / AA = **0.50**

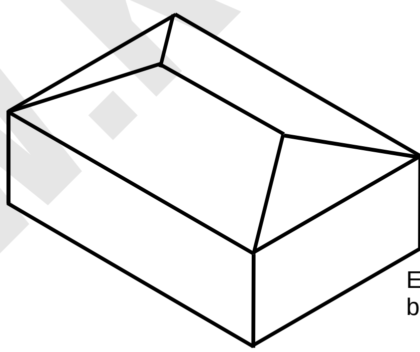
$h\_on\_d_{\theta 0}$ = h / BB = **0.76**

$\alpha_{\theta 0} = \alpha$

Ratios for θ = 90/270; $d\_on\_b_{\theta 90}$ = AA / BB = **2.00**

$h\_on\_d_{\theta 90}$ = h / AA = **0.38**

$\alpha_{\theta 90} = \alpha$



Enclosed rectangular buildings - hip roofs

Coefficients for Hip roof when $\alpha \geq 10°$;

Roof	Orthogonal direction			
	0/180		90/270	
T5.3B (U)	$C_{p.e.U1\theta 0}$	$C_{p.e.U2\theta 0}$	$C_{p.e.U1\theta 90}$	$C_{p.e.U2\theta 90}$

	0.00	**0.57**	**0.00**	**0.57**
T5.3C (D) & (R)	$C_{p.e.D1\theta 0}$		$C_{p.e.D1\theta 90}$	
	-0.60		**-0.60**	

Pressure for Hip roof when $\alpha \geq 10°$;

Roof	Orthogonal direction			
	0 (kPa)		180 (kPa)	
(U)	$p_{U1\theta 0}$	$p_{U2\theta 0}$	$p_{U1\theta 180}$	$p_{U2\theta 180}$
	0.00	**0.27**	**0.00**	**0.30**
(D) & (R)	$p_{D1\theta 0}$		$p_{D1\theta 180}$	
	-0.29		**-0.32**	

Roof	Orthogonal direction			
	90 (kPa)		270 (kPa)	
(U)	$p_{U1\theta 90}$	$p_{U2\theta 90}$	$p_{U1\theta 270}$	$p_{U2\theta 270}$
	0.00	**0.27**	**0.00**	**0.27**
(D) & (R)	$p_{D1\theta 90}$		$p_{D1\theta 270}$	
	-0.29		**-0.29**	

Coefficients for Windward and Leeward walls in each orthogonal direction;

Walls	Orthogonal direction			
	0	90	180	270
Windward T5.2A (W);	$C_{p.e.W\theta 0}$	$C_{p.e.W\theta 90}$	$C_{p.e.W\theta 180}$	$C_{p.e.W\theta 270}$
	0.70	**0.70**	**0.70**	**0.70**
Leeward T5.2B (L);	$C_{p.e.L\theta 0}$	$C_{p.e.L\theta 90}$	$C_{p.e.L\theta 180}$	$C_{p.e.L\theta 270}$
	-0.50	**-0.50**	**-0.50**	**-0.50**

Pressure for Windward and Leeward walls in each orthogonal direction;

Walls	Orthogonal direction			
	0 (kPa)	90 (kPa)	180 (kPa)	270 (kPa)
Windward T5.2A (W);	$p_{W\theta 0}$	$p_{W\theta 90}$	$p_{W\theta 180}$	$p_{W\theta 270}$
	0.33	**0.33**	**0.37**	**0.33**
Leeward T5.2B (L);	$p_{L\theta 0}$	$p_{L\theta 90}$	$p_{L\theta 180}$	$p_{L\theta 270}$
	-0.24	**-0.24**	**-0.26**	**-0.24**

Coefficients for Side walls in each orthogonal direction;

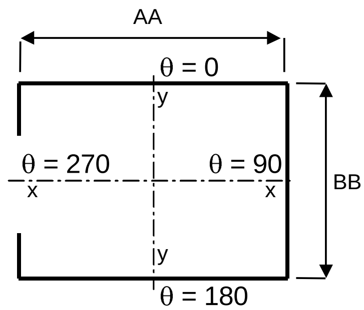
Horizontal distance from windward edge	T5.2C - Side walls (S)			
	Orthogonal direction			
	0	90	180	270
0 to 1h	$C_{p.e.S.0\_1h\theta 0}$	$C_{p.e.S.0\_1h\theta 90}$	$C_{p.e.S.0\_1h\theta 180}$	$C_{p.e.S.0\_1h\theta 270}$
	-0.65	-0.65	-0.65	-0.65
1h to 2h	$C_{p.e.S.1\_2h\theta 0}$	$C_{p.e.S.1\_2h\theta 90}$	$C_{p.e.S.1\_2h\theta 180}$	$C_{p.e.S.1\_2h\theta 270}$
	-0.5	-0.5	-0.5	-0.5
2h to 3h	$C_{p.e.S.2\_3h\theta 0}$	$C_{p.e.S.2\_3h\theta 90}$	$C_{p.e.S.2\_3h\theta 180}$	$C_{p.e.S.2\_3h\theta 270}$
	-0.3	-0.3	-0.3	-0.3
>3h	$C_{p.e.S.3h\theta 0}$	$C_{p.e.S.3h\theta 90}$	$C_{p.e.S.3h\theta 180}$	$C_{p.e.S.3h\theta 270}$
	-0.2	-0.2	-0.2	-0.2

Pressure for Side walls in each orthogonal direction;

Horizontal distance from windward edge	Orthogonal direction			
	0 ($C_{p.e.S} \times p_{\theta 0}$) kPa	90 ($C_{p.e.S} \times p_{\theta 90}$) kPa	180 ($C_{p.e.S} \times p_{\theta 180}$) kPa	270 ($C_{p.e.S} \times p_{\theta 270}$) kPa
0 to 1h	$p_{S.0\_1h\theta 0}$	$p_{S.0\_1h\theta 90}$	$p_{S.0\_1h\theta 180}$	$p_{S.0\_1h\theta 270}$
	-0.31	**-0.31**	**-0.34**	**-0.31**
1h to 2h	S.1_2hθ0	S.1_2hθ90	S.1_2hθ180	S.1_2hθ270
	-0.24	**-0.24**	**-0.26**	**-0.24**
2h to 3h	$p_{S.2\_3h\theta 0}$	$p_{S.2\_3h\theta 90}$	$p_{S.2\_3h\theta 180}$	$p_{S.2\_3h\theta 270}$
	-0.14	**-0.14**	**-0.16**	**-0.14**
>3h	$p_{S.3h\theta 0}$	$p_{S.3h\theta 90}$	$p_{S.3h\theta 180}$	$p_{S.3h\theta 270}$
	-0.10	**-0.10**	**-0.11**	**-0.10**

Internal pressure coefficients (cl. 5.3)

From Table 5.1(b) - internal pressure coefficients for buildings with open interior plan
- dominant openings on one surface



Coefficients where ratio of dominant opening to total open area is 0.5 or less

Minimum C_{pi}; $C_{p.i.1\theta0} = C_{p.i.1\theta90} = C_{p.i.1\theta180} = C_{p.i.1\theta270} = -0.3$

Maximum C_{pi}; $C_{p.i.2\theta0} = C_{p.i.2\theta90} = C_{p.i.2\theta180} = C_{p.i.2\theta270} = 0.0$

Internal coefficients and pressure for each orthogonal direction;

Orthogonal direction	Internal pressure coefficients (cl. 5.3)	
0	$C_{p.i.1\theta0}$	$C_{p.i.2\theta0}$
	-0.30	**0.00**
	$p_{i.1\theta0}$ (kPa)	$p_{i.2\theta0}$ (kPa)
	-0.14	**0.00**
90	$C_{p.i.1\theta90}$	$C_{p.i.2\theta90}$
	-0.30	**0.00**
	$p_{i.1\theta90}$	$p_{i.2\theta90}$
	-0.14	**0.00**
180	$C_{p.i.1\theta180}$	$C_{p.i.2\theta180}$
	-0.30	**0.00**
	$p_{i.1\theta180}$	$p_{i.2\theta180}$
	-0.16	**0.00**
270	$C_{p.i.1\theta270}$	$C_{p.i.2\theta270}$
	-0.30	**0.00**
	$p_{i.1\theta270}$	$p_{i.2\theta270}$
	-0.14	**0.00**

3.2.4 Summary

SUMMARY OF ALLOWABLE WIND SPEEDS FOR FOLDING RANGE - 15/12/2011

TYPE OF STRUCTURE		4 walls closed		3 walls closed		2 walls closed		1 wall closed		Roof Only	
		Unbraced	Braced	Unbraced	Braced	Unbraced	Braced	Unbraced	Braced	Unbraced	Braced
Explorer	3x3	30 km/hr	40 km/hr	30 km/hr	40 km/hr	30 km/hr	40 km/hr	40 km/hr	50 km/hr	70 km/hr	80 km/hr
	3x4.5	30 km/hr	40 km/hr	30 km/hr	40 km/hr	30 km/hr	40 km/hr	40 km/hr	50 km/hr	70 km/hr	80 km/hr
	3x6	10 km/hr	20 km/hr	10 km/hr	20 km/hr	10 km/hr	20 km/hr	20 km/hr	30 km/hr	30 km/hr	30 km/hr
K2	3x3	40 km/hr	50 km/hr	40 km/hr	50 km/hr	40 km/hr	50 km/hr	50 km/hr	60 km/hr	80 km/hr	80 km/hr
	3x4.5	40 km/hr	50 km/hr	40 km/hr	50 km/hr	40 km/hr	50 km/hr	50 km/hr	60 km/hr	80 km/hr	80 km/hr
	3x6	20 km/hr	30 km/hr	20 km/hr	30 km/hr	20 km/hr	30 km/hr	30 km/hr	40 km/hr	80 km/hr	80 km/hr
Summit	2.4x2.4	50 km/hr	60 km/hr	50 km/hr	60 km/hr	50 km/hr	60 km/hr	60 km/hr	70 km/hr	80 km/hr	80 km/hr
	3x3	50 km/hr	60 km/hr	50 km/hr	60 km/hr	50 km/hr	60 km/hr	60 km/hr	70 km/hr	80 km/hr	80 km/hr
	3x4.5	50 km/hr	60 km/hr	50 km/hr	60 km/hr	50 km/hr	60 km/hr	40 km/hr	50 km/hr	80 km/hr	80 km/hr
	3x6	30 km/hr	40 km/hr	30 km/hr	40 km/hr	30 km/hr	40 km/hr	40 km/hr	50 km/hr	80 km/hr	80 km/hr
	4x4	30 km/hr	40 km/hr	30 km/hr	40 km/hr	30 km/hr	40 km/hr	40 km/hr	50 km/hr	80 km/hr	80 km/hr
	4x8	10 km/hr	20 km/hr	10 km/hr	20 km/hr	10 km/hr	20 km/hr	30 km/hr	40 km/hr	60 km/hr	60 km/hr
	5.7x5.7	30 km/hr	30 km/hr	40 km/hr	40 km/hr	40 km/hr	40 km/hr	40 km/hr	40 km/hr	60 km/hr	60 km/hr
Tectonic	2.4x2.4	50 km/hr	60 km/hr	50 km/hr	60 km/hr	50 km/hr	60 km/hr	60 km/hr	70 km/hr	80 km/hr	80 km/hr
	3x3	50 km/hr	60 km/hr	50 km/hr	60 km/hr	50 km/hr	60 km/hr	60 km/hr	70 km/hr	80 km/hr	80 km/hr
	3x4.5	50 km/hr	60 km/hr	40 km/hr	50 km/hr	50 km/hr	60 km/hr	50 km/hr	60 km/hr	80 km/hr	80 km/hr
	3x6	40 km/hr	50 km/hr	40 km/hr	50 km/hr	40 km/hr	50 km/hr	50 km/hr	60 km/hr	80 km/hr	80 km/hr
	4x4	40 km/hr	50 km/hr	40 km/hr	50 km/hr	40 km/hr	50 km/hr	50 km/hr	60 km/hr	80 km/hr	80 km/hr
	4x6	30 km/hr	40 km/hr	30 km/hr	40 km/hr	40 km/hr	50 km/hr	50 km/hr	60 km/hr	80 km/hr	80 km/hr
	4x8	30 km/hr	40 km/hr	30 km/hr	40 km/hr	30 km/hr	40 km/hr	50 km/hr	60 km/hr	70 km/hr	70 km/hr