SPECIFIC DESIGN – TOP NOTCH PURLIN SYSTEM 2.4

DESIGN BASIS 2.4.1

Dimond Structural Top Notch Purlin Systems have been designed to comply with AS/NZS 4600:1996. Appropriate design limit state load combinations should be determined in accordance with AS/NZS 1170. It is recommended these be expressed as uniformly distributed bending loads (kN/m) for direct comparison with the tabulated data in this manual.

Self weight of the Top Notch Purlin System is not included in any load tables and must be calculated as part of the total dead load of the building elements supported by the purlin.

Top Notch Purlin Systems are typically used as purlins and girts in lightweight building applications, for example farm buildings and light commercial sheds.

DESIGN CONSIDERATIONS 2.4.2

Data presented in this manual is intended for use by structural engineers. Load situations other than uniformly distributed loads will require specific design.

Design capacities in the limit state format have been derived by the application of a capacity factor, ϕ_b = 0.90 for bending.

A design yield strength as outlined in Material Specification 2.4.6 has been used for the Top Notch Purlin System.

These tables are intended for use where roofing or cladding provides full restraint to the top flange of the Top Notch purlin or girt. Loads are assumed to be applied about the major axis of symmetry (X-X).

The fixing type and size is critical to achieve the outward design loads. Refer Connection Design in this section.

The Top Notch Purlin System does not require bracing to provide restraint. Therefore the loads are represented as inward and outward cases. However bracing battens can be fastened transversely along the underside of the purlins to enhance the performance of Top Notch purlins and are recommended where supports/restraints are further than 30 times the Top Notch purlin depth apart.

Gravity type loads can be assumed to act perpendicular to the roof plane for pitches up to 10 degrees. For pitches greater than 10 degrees, load components about the minor axis of symmetry (Y-Y) should also be considered.

When designing Top Notch purlins to be used as girts, it is assumed cladding and girt gravity loads are taken by a stiff eaves member such as a DHS Purlin.

Span Guide

As a guide, single spans are used most frequently for ease of installation. Deflections may govern on larger spans.

Double span configurations may be used where lower deflections are required.

Lapped end and lapped internal configurations are more economical on large purlin spans where better strength and lower deflections are required.

Deflection Guidelines

As a guide to acceptable deflection limits for serviceability of the Top Notch Purlin System, the following limits are recommended for wind load and dead load actions where there is no ceiling,

Deflection for $W_s \not> $ Span/150

Deflection for $G \not> $ Span/300

For further guidance on deflection limits, refer to AS/NZS 1170.

Specific Design

Specific design to AS/NZS 4600 is required where Top Notch purlins -

- are used as cantilever members.
- have suspended loads present (such as ducting and piping).
- have holes present.
- are subject to axial loading.
- are subject to combined loading.
- are subject to out of plane loading about the minor Y-Y axis.

Connection Design

Dimond Structural supply a range of self-drilling fasteners for fixing into both steel or timber.

- When fixing into mild steel, a Metal Tek with a hardened drill point should be used.
- When fixing into timber, a Type 17 self-drilling fastener should be used.

In order to achieve the loads shown in the Top Notch purlin design tables, the following size and number of self-drilling fasteners are required for the support condition and type of material.

Fixings

				Number of Fasteners/Fastener Gauge				
	Support Member			Top Notch Purlin Size				
Support Condition	Material	Grade	Minimum Thickness (mm)	60 x 0.75 60 x 0.95	100 x 0.75 100 x 0.95	120 x 0.75 120 x 0.95	150 x 0.95	150 x 1.15
End	Cold-formed Steel	G450	1.45	2/12g	2/12g	2/14g	2/14g	2/14g
	Steel	G300	3	2/12g	2/12g	2/14g	2/14g	2/14g
	Timber	G300	37*	2/12g	2/12g	2/14g	2/14g	2/14g
Internal	Cold-formed Steel	G450	1.45	4/12g	6/12g	6/14g	6/14g	8/14g
	Steel	G300	3	2/12g	4/12g	4/14g	4/14g	6/14g
	Timber	G300	37*	2/12g	4/12g	4/14g	4/14g	6/14g

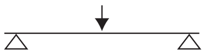
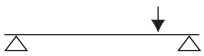
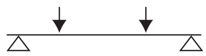
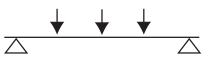
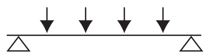
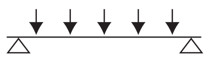
*Minimum fastener embedment into timber support.

Notes:
- Cold-formed Steel: Example 2/14g - 2 x 14 gauge fasteners connected to G450 cold-formed steel support member of 1.45mm minimum thickness.
- Steel: Example 2/14g - 2 x 14 gauge fasteners connected to G300 hot-rolled steel support member of 3.0mm minimum thickness.
- Timber: Example 2/14g - 2 x 14 gauge Type 17 x 50mm long fasteners connected into timber to achieve a minimum embedment of 37mm.
- Lap End Fasteners: 2 fasteners each end of the lap for 60 and 100 deep Top Notch purlins and 4 fasteners each end of the lap for 120 and 150 deep Top Notch purlins - to the same gauge (diameter) as fasteners recommended in the above table. The same rationale applies where 14 gauge fasteners are required.
- When the number of specified fixings above cannot be fixed into the Top Notch purlin and/or Top Notch purlin is being installed in cyclonic regions, an additional hold-down strap should be used. Refer CAD details on-line (**www.dimondstructural.co.nz/products/top-notch-purlins**).
- Specific Design is required where less fasteners or other types of support members are used.

Point Load Conversion Guide

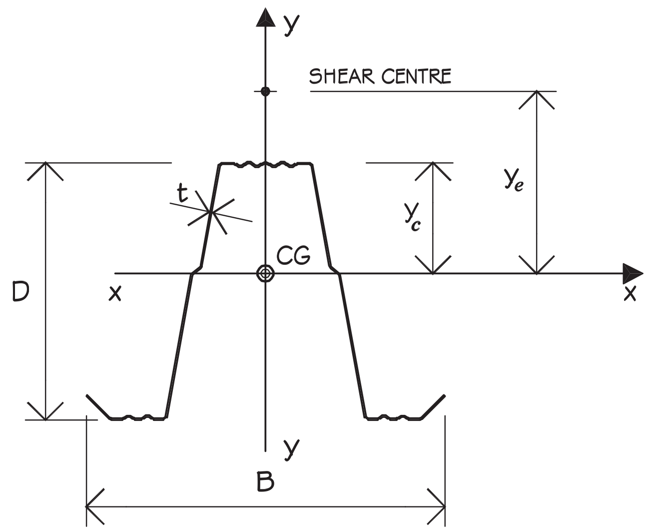
The following formula may be used as a guide in converting point loads to equivalent uniformly distributed bending loads specific to the Top Notch Purlin System.

Formula $W = F \times \frac{P}{L}$ Where
- W = Uniform bending load
- F = Factor "F" from table below
- P = Point load ↓
- L = Length of span

Type	Symbol	Factor "F"			
		Simple	End Span	Lapped End	Lapped Internal
One equidistant point load		2	2.25	2.25	2
One eccentric point load		1.5	2	2	1.5
Two equidistant point loads		2.67	3.25	3.25	2.25
Three equidistant point loads		4	4.25	4.25	3.5
Four equidistant point loads		4.8	5.5	5.5	4.25
Five equidistant point loads		6	6.75	6.75	5.5

Notes:
1. This conversion guide and factors (F) is only applicable to the Top Notch Purlin System.
2. The conversion factors (F) are an approximation to the pure derivation and are to be used as a guide only.
3. The conversion formula assumes all point loads are equal in magnitude.

TOP NOTCH PURLIN SYSTEM SECTION PROPERTIES



Top Notch Section	Depth D (mm)	Width B (mm)	Thickness t (mm)	Area A (mm^2)	Mass per unit length (kg/m)	Second Moment of Area (Full Section)		Section Modulus (Full Section)		Radius of Gyration		Centre of Gravity y_c (mm)	Shear Centre y_e (mm)	Torsion Constant J (mm^4)	Warping Constant I_w (10^6mm^6)	Monosymmetry Constant β_x (mm)
						I_x (10^6mm^4)	I_y (10^6mm^4)	Z_x (10^3mm^3)	Z_y (10^3mm^3)	r_x (mm)	r_y (mm)					
60 x 0.75	60	108	0.75	150	1.24	0.077	0.122	2.57	2.26	22.6	28.5	31.5	44.2	28.2	16.0	111
60 x 0.95	60	108	0.95	191	1.56	0.097	0.155	3.23	2.87	22.6	28.5	31.5	44.2	57.3	20.3	111
100 x 0.75	100	163	0.75	248	2.04	0.340	0.450	6.80	5.52	37.0	42.6	55.2	67.4	46.5	238.6	163
100 x 0.95	100	163	0.95	314	2.56	0.430	0.570	8.60	6.99	37.0	42.6	55.2	67.4	94.5	302.2	163
120 x 0.75	120	170	0.75	278	2.28	0.530	0.546	8.83	6.42	43.7	44.3	65.6	82.3	52.1	363.3	190
120 x 0.95	120	170	0.95	352	2.86	0.671	0.691	11.18	8.13	43.6	44.3	65.6	82.3	106.0	460.2	190
150 x 0.95	150	183	0.95	411	3.34	1.166	0.920	15.55	10.05	53.3	47.3	81.0	103.9	123.5	758.4	231
150 x 1.15	150	183	1.15	497	4.02	1.411	1.114	18.81	12.17	53.3	47.3	81.0	103.9	219.1	918.0	231

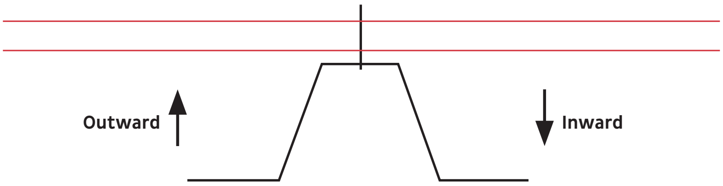
Note: Mass assumes a total coated weight for the standard zinc coating of 275g/m^2.

TOP NOTCH PURLIN SYSTEM LOAD SPAN TABLES

Uniformly loaded bending capacities (kN/m) are given for the Top Notch Purlin System for spans between 1.25m and 10.0m in the following configurations -

Inward	Ultimate - Load pushing inward on the Top Flange
Outward	Ultimate - Load pulling outward on the Top Flange
Ws	Serviceability - Load at which midspan deflection equates to span/150.

As deflection is proportional to loading, Ws loads may be factored by the deflection ratio for any deflection within the limit of the linear load capacities.

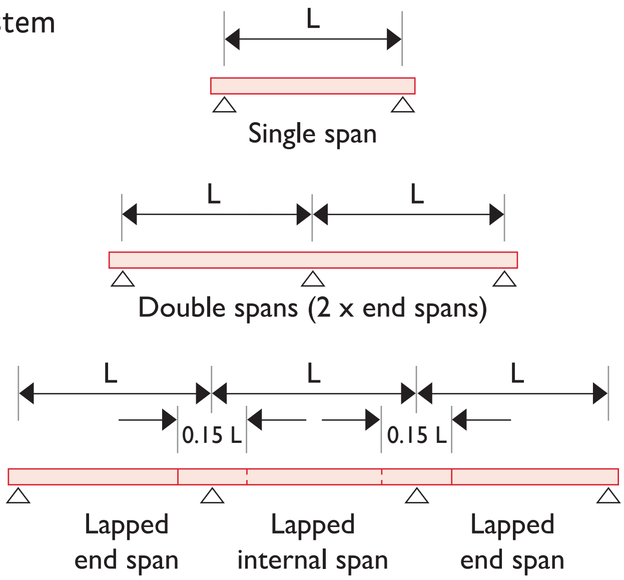


The following notes apply to the load tables in this section -

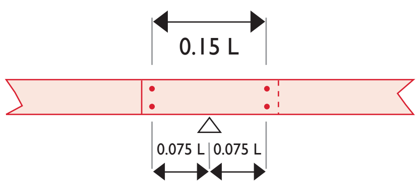
1. It is assumed that the top flange of the Top Notch purlin is continuously restrained by screw-fastened roof sheeting. If not, specific design to AS/NS 4600 is required.
2. Use of lapped end span tables with corresponding lapped internal span tables assumes that the lapped span is within plus 5% or minus 25% of the lapped internal spans, otherwise specific design to AS/NZS 4600 is required.
3. Outward loads are based on both section capability and the capability of the fastener connections, refer Connection Design in Section 2.4.2.
4. Shaded areas of the table relate to spans which will not support a point load of 1.4kN (refer AS/NZS 1170). This assumes no load sharing between purlins.
5. No member rotation has been allowed for at fixed ends.
6. Linear interpolation is permitted for Loads between intermediate Top Notch purlin spans.

Typical Top Notch Purlin System Span Configurations

L = Span length



All lap lengths are to be a minimum of 0.15 of the maximum span measured from fixing points each end of the lap, positioned equally each side of the portal rafter. Refer CAD Details on-line (**www.dimondstructural.co.nz/products/top-notch-purlins**).



TOP NOTCH PURLIN SYSTEM LOAD SPAN TABLES – SINGLE SPAN

Uniformly Loaded Bending Capacities (kN/m) $\phi_b W_{bx}$

	60 x 0.75			60 x 0.95			100 x 0.75			100 x 0.95			120 x 0.75			120 x 0.95			150 x 0.95			150 x 1.15		
Span (m)	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S
1.00																								
1.25	5.90	4.00	3.59																					
1.50	4.10	2.78	2.08	5.48	3.76	2.75																		
1.75	3.01	2.04	1.31	4.03	2.76	1.73																		
2.00	2.30	1.56	0.88	3.08	2.11	1.16	4.54	3.22	3.90															
2.25	1.82	1.23	0.62	2.44	1.67	0.81	3.59	2.55	2.74	5.37	3.56	3.74												
2.50	1.47	1.00	0.45	1.97	1.35	0.59	2.91	2.06	2.00	4.35	2.88	2.73	3.52	2.46	2.95	5.24	3.68	4.20						
2.75	1.22	0.83	0.34	1.63	1.12	0.45	2.40	1.70	1.50	3.60	2.38	2.05	2.91	2.03	2.22	4.33	3.07	3.15						
3.00				1.37	0.94	0.34	2.02	1.43	1.16	3.02	2.00	1.58	2.45	1.71	1.71	3.64	2.58	2.43	4.57	3.07	3.91			
3.25							1.72	1.22	0.91	2.57	1.70	1.24	2.08	1.45	1.34	3.10	2.19	1.91	3.90	2.70	3.08	5.39	2.83	4.09
3.50							1.48	1.05	0.73	2.22	1.47	0.99	1.80	1.25	1.08	2.68	1.89	1.53	3.36	2.33	2.46	4.65	2.63	3.28
3.75							1.29	0.92	0.59	1.93	1.28	0.81	1.57	1.09	0.87	2.33	1.65	1.24	2.93	2.03	2.00	4.05	2.45	2.66
4.00							1.14	0.81	0.49	1.70	1.13	0.67	1.38	0.96	0.72	2.05	1.45	1.02	2.57	1.78	1.65	3.56	2.30	2.19
4.25							1.01	0.71	0.41	1.51	1.00	0.56	1.22	0.85	0.60	1.81	1.28	0.85	2.28	1.58	1.38	3.15	2.16	1.83
4.50							0.90	0.64	0.34	1.34	0.89	0.47	1.09	0.76	0.51	1.62	1.14	0.72	2.03	1.41	1.16	2.81	2.00	1.54
4.75										1.21	0.80	0.40	0.98	0.68	0.43	1.45	1.03	0.61	1.82	1.26	0.99	2.52	1.79	1.31
5.00										1.09	0.72	0.34	0.88	0.61	0.37	1.31	0.93	0.52	1.65	1.14	0.85	2.28	1.62	1.12
5.25													0.80	0.56	0.32	1.19	0.84	0.45	1.49	1.03	0.73	2.07	1.47	0.97
5.50																1.08	0.77	0.39	1.36	0.94	0.63	1.88	1.34	0.84
5.75																0.99	0.70	0.34	1.25	0.86	0.56	1.72	1.22	0.74
6.00																0.91	0.64	0.30	1.14	0.79	0.49	1.58	1.12	0.65
6.25																			1.05	0.73	0.43	1.46	1.04	0.58
6.50																			0.97	0.67	0.38	1.35	0.96	0.51
6.75																			0.90	0.63	0.34	1.25	0.89	0.46
7.00																			0.84	0.58	0.31	1.16	0.83	0.41
7.25																						1.08	0.77	0.37
7.50																						1.01	0.72	0.33
7.75																						0.95	0.67	0.30
8.00																								
8.25																								
8.50																								
8.75																								
9.00																								
9.25																								
9.50																								
9.75																								
10.00																								

1. **Inward:** Load pushing inward on the top flange.
2. **Outward:** Load pulling outward on the top flange.
3. **Ws:** Load at a deflection of span/150.
4. ■ Shaded areas relate to spans which will not support a point load of 1.4kN (refer AS/NZS 1170).

TOP NOTCH PURLIN SYSTEM LOAD SPAN TABLES – DOUBLE SPAN

Uniformly Loaded Bending Capacities (kN/m) $\phi_b W_{bx}$

	60 x 0.75			60 x 0.95			100 x 0.75			100 x 0.95			120 x 0.75			120 x 0.95			150 x 0.95			150 x 1.15		
Span (m)	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S
1.00																								
1.25	5.90	3.73	7.88																					
1.50	4.10	3.11	4.56	5.48	3.55	5.95																		
1.75	3.01	2.66	2.87	4.03	3.04	3.75																		
2.00	2.30	2.30	1.92	3.08	2.66	2.51																		
2.25	1.82	1.82	1.35	2.44	2.37	1.76	5.09	2.99	5.92															
2.50	1.47	1.47	0.98	1.97	1.97	1.29	4.12	2.69	4.32	5.42	4.03	5.80	4.19	2.94	6.55									
2.75	1.22	1.22	0.74	1.63	1.63	0.97	3.41	2.40	3.24	4.48	3.60	4.35	3.81	2.68	4.92	5.82	4.01	6.73						
3.00	1.02	1.02	0.57	1.37	1.37	0.74	2.85	2.02	2.50	3.77	3.02	3.35	3.41	2.45	3.79	4.89	3.64	5.18	5.60	3.68	8.64			
3.25	0.87	0.87	0.45	1.17	1.17	0.59	2.38	1.72	1.97	3.21	2.57	2.64	2.91	2.08	2.98	4.17	3.10	4.08	5.17	3.40	6.79			
3.50	0.75	0.75	0.36	1.01	1.01	0.47	2.01	1.48	1.57	2.77	2.22	2.11	2.49	1.80	2.39	3.60	2.68	3.26	4.49	3.15	5.44			
3.75				0.88	0.88	0.38	1.71	1.29	1.28	2.39	1.93	1.72	2.13	1.57	1.94	3.13	2.33	2.65	3.82	2.93	4.42	5.35	3.93	5.67
4.00				0.77	0.77	0.31	1.46	1.14	1.05	2.05	1.70	1.42	1.84	1.38	1.60	2.75	2.05	2.19	3.28	2.57	3.64	4.66	3.56	4.67
4.25							1.26	1.01	0.88	1.76	1.51	1.18	1.59	1.22	1.33	2.41	1.81	1.82	2.83	2.28	3.04	4.02	3.15	3.89
4.50							1.09	0.90	0.74	1.52	1.34	0.99	1.39	1.09	1.12	2.10	1.62	1.54	2.45	2.03	2.56	3.48	2.81	3.28
4.75							0.94	0.81	0.63	1.32	1.21	0.85	1.22	0.98	0.95	1.84	1.45	1.31	2.13	1.82	2.18	3.03	2.52	2.79
5.00							0.82	0.73	0.54	1.15	1.09	0.72	1.07	0.88	0.82	1.62	1.31	1.12	1.86	1.65	1.87	2.64	2.28	2.39
5.25							0.72	0.66	0.47	1.00	0.99	0.63	0.94	0.80	0.71	1.43	1.19	0.97	1.62	1.49	1.61	2.31	2.07	2.07
5.50							0.64	0.60	0.41	0.90	0.90	0.54	0.83	0.73	0.62	1.26	1.08	0.84	1.42	1.36	1.40	2.02	1.88	1.80
5.75							0.58	0.55	0.35	0.82	0.82	0.48	0.74	0.67	0.54	1.12	0.99	0.74	1.29	1.25	1.23	1.83	1.72	1.57
6.00							0.54	0.50	0.31	0.76	0.76	0.42	0.65	0.61	0.47	0.99	0.91	0.65	1.19	1.14	1.08	1.68	1.58	1.38
6.25										0.70	0.70	0.37	0.59	0.56	0.42	0.88	0.84	0.57	1.09	1.05	0.96	1.55	1.46	1.22
6.50										0.64	0.64	0.33	0.55	0.52	0.37	0.78	0.78	0.51	1.01	0.97	0.85	1.44	1.35	1.09
6.75													0.51	0.48	0.33	0.73	0.72	0.45	0.94	0.90	0.76	1.33	1.25	0.97
7.00													0.47	0.45	0.30	0.67	0.67	0.41	0.87	0.84	0.68	1.24	1.16	0.87
7.25																0.63	0.62	0.37	0.81	0.78	0.61	1.15	1.08	0.78
7.50																0.59	0.58	0.33	0.76	0.73	0.55	1.08	1.01	0.71
7.75																0.55	0.55	0.30	0.71	0.69	0.50	1.01	0.95	0.64
8.00																			0.67	0.64	0.46	0.95	0.89	0.58
8.25																			0.63	0.60	0.42	0.89	0.84	0.53
8.50																			0.59	0.57	0.38	0.84	0.79	0.49
8.75																			0.56	0.54	0.35	0.79	0.74	0.45
9.00																			0.53	0.51	0.32	0.75	0.70	0.41
9.25																						0.71	0.67	0.38
9.50																						0.67	0.63	0.35
9.75																						0.64	0.60	0.32
10.00																						0.61	0.57	0.30

1. **Inward:** Load pushing inward on the top flange.
2. **Outward:** Load pulling outward on the top flange.
3. **Ws:** Load at a deflection of span/150.
4. ■ Shaded areas relate to spans which will not support a point load of 1.4kN (refer AS/NZS 1170).

TOP NOTCH PURLIN SYSTEM LOAD SPAN TABLES – LAPPED END SPAN

Uniformly Loaded Bending Capacities (kN/m) $\phi_b W_{bx}$

	60 x 0.75			60 x 0.95			100 x 0.75			100 x 0.95			120 x 0.75			120 x 0.95			150 x 0.95			150 x 1.15		
Span (m)	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S
1.00																								
1.25																								
1.50	6.00	3.55	4.70																					
1.75	4.34	3.04	2.96	5.88	3.04	3.87																		
2.00	3.19	2.54	1.98	4.33	2.66	2.59																		
2.25	2.40	2.00	1.39	3.26	2.37	1.82	5.84	4.48	5.50															
2.50	1.84	1.62	1.02	2.51	2.13	1.33	4.73	4.26	4.45															
2.75	1.43	1.34	0.76	1.95	1.82	1.00	3.91	3.67	3.34	5.84	3.67	4.49	4.49	4.01	4.42									
3.00	1.13	1.13	0.59	1.53	1.53	0.77	3.28	3.28	2.58	4.91	3.36	3.46	3.97	3.97	3.91	5.92	4.27	5.34						
3.25	0.96	0.96	0.46	1.30	1.30	0.60	2.80	2.80	2.03	4.18	3.10	2.72	3.39	3.39	3.07	5.04	3.40	4.20						
3.50	0.83	0.83	0.37	1.12	1.12	0.48	2.41	2.41	1.62	3.61	2.88	2.18	2.92	2.92	2.46	4.35	3.15	3.37	5.46	3.66	5.23			
3.75				0.98	0.98	0.39	2.10	2.10	1.32	3.14	2.69	1.77	2.54	2.54	2.00	3.79	2.94	2.74	4.76	2.94	4.56			
4.00				0.86	0.86	0.32	1.85	1.85	1.09	2.76	2.52	1.46	2.24	2.24	1.65	3.33	2.76	2.25	4.18	2.76	3.76	5.78	3.68	4.82
4.25							1.64	1.64	0.91	2.45	2.37	1.22	1.98	1.98	1.37	2.95	2.60	1.88	3.70	2.60	3.13	5.12	3.46	4.02
4.50							1.46	1.46	0.76	2.18	2.17	1.02	1.77	1.77	1.16	2.63	2.45	1.58	3.30	2.45	2.64	4.57	3.27	3.38
4.75							1.31	1.31	0.65	1.96	1.95	0.87	1.59	1.59	0.98	2.36	2.32	1.35	2.96	2.32	2.24	4.10	3.10	2.88
5.00							1.18	1.18	0.56	1.77	1.76	0.75	1.43	1.43	0.84	2.13	2.13	1.15	2.68	2.21	1.92	3.70	2.94	2.47
5.25							1.07	1.07	0.48	1.60	1.59	0.65	1.30	1.30	0.73	1.93	1.93	1.00	2.43	2.10	1.66	3.36	2.80	2.13
5.50							0.98	0.98	0.42	1.45	1.45	0.56	1.18	1.18	0.63	1.76	1.76	0.87	2.21	2.01	1.45	3.06	2.68	1.85
5.75							0.89	0.89	0.37	1.33	1.33	0.49	1.08	1.08	0.56	1.61	1.61	0.76	2.02	1.92	1.26	2.80	2.56	1.62
6.00							0.82	0.82	0.32	1.22	1.22	0.43	0.99	0.99	0.49	1.48	1.48	0.67	1.86	1.84	1.11	2.57	2.45	1.43
6.25										1.12	1.12	0.38	0.92	0.92	0.43	1.36	1.36	0.59	1.71	1.71	0.99	2.37	2.36	1.26
6.50										1.04	1.04	0.34	0.85	0.85	0.38	1.26	1.26	0.53	1.58	1.58	0.88	2.19	2.19	1.12
6.75										0.96	0.96	0.30	0.79	0.79	0.34	1.17	1.17	0.47	1.47	1.47	0.78	2.03	2.03	1.00
7.00													0.73	0.73	0.31	1.09	1.09	0.42	1.37	1.37	0.70	1.89	1.89	0.90
7.25																1.01	1.01	0.38	1.27	1.27	0.63	1.76	1.76	0.81
7.50																0.95	0.95	0.34	1.19	1.19	0.57	1.65	1.65	0.73
7.75																0.89	0.89	0.31	1.11	1.11	0.52	1.54	1.54	0.66
8.00																			1.05	1.05	0.47	1.45	1.45	0.60
8.25																			0.98	0.98	0.43	1.36	1.36	0.55
8.50																			0.93	0.93	0.39	1.28	1.28	0.50
8.75																			0.87	0.87	0.36	1.21	1.21	0.46
9.00																			0.83	0.83	0.33	1.14	1.14	0.42
9.25																			0.78	0.78	0.30	1.08	1.08	0.39
9.50																						1.03	1.03	0.36
9.75																						0.97	0.97	0.33
10.00																						0.93	0.93	0.31

1. **Inward:** Load pushing inward on the top flange.
2. **Outward:** Load pulling outward on the top flange.
3. **Ws:** Load at a deflection of span/150.
4. ■ Shaded areas relate to spans which will not support a point load of 1.4kN (refer AS/NZS 1170).

TOP NOTCH PURLIN SYSTEM LOAD SPAN TABLES – LAPPED INTERNAL SPAN

Uniformly Loaded Bending Capacities (kN/m) $\phi_b W_{bx}$

	60 x 0.75			60 x 0.95			100 x 0.75			100 x 0.95			120 x 0.75			120 x 0.95			150 x 0.95			150 x 1.15		
Span (m)	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S	Inward	Outward	W_S
1.00																								
1.25																								
1.50																								
1.75	6.00	3.81	5.38																					
2.00	4.42	3.33	3.61	5.99	3.33	4.71																		
2.25	3.33	2.78	2.53	4.52	2.96	3.31																		
2.50	2.55	2.25	1.85	3.47	2.66	2.41																		
2.75	1.98	1.86	1.39	2.69	2.42	1.81	5.41	4.58	5.41															
3.00	1.56	1.56	1.07	2.11	2.11	1.39	4.54	4.20	4.54															
3.25	1.33	1.33	0.84	1.80	1.80	1.10	3.87	3.87	3.68	5.79	3.88	4.95	4.03	4.03	4.03									
3.50	1.15	1.15	0.67	1.55	1.55	0.88	3.34	3.34	2.95	4.99	3.60	3.96	3.74	3.74	3.96	6.00	3.94	6.00						
3.75	1.00	1.00	0.55	1.35	1.35	0.71	2.91	2.91	2.40	4.35	3.36	3.22	3.50	3.50	3.50	5.24	3.68	4.97	5.60	3.68	5.60			
4.00	0.88	0.88	0.45	1.19	1.19	0.59	2.56	2.56	1.98	3.82	3.15	2.65	3.10	3.10	3.00	4.61	3.45	4.10	5.25	3.45	5.25			
4.25	0.78	0.78	0.38	1.05	1.05	0.49	2.26	2.26	1.65	3.39	2.96	2.21	2.74	2.74	2.50	4.08	3.25	3.42	4.94	3.25	4.94			
4.50				0.94	0.94	0.41	2.02	2.02	1.39	3.02	2.80	1.86	2.45	2.45	2.11	3.64	3.07	2.88	4.57	3.07	4.57			
4.75				0.84	0.84	0.35	1.81	1.81	1.18	2.71	2.65	1.58	2.20	2.20	1.79	3.27	2.91	2.45	4.10	2.91	4.08	5.68	3.87	5.23
5.00				0.76	0.76	0.30	1.64	1.64	1.01	2.45	2.43	1.36	1.98	1.98	1.54	2.95	2.76	2.10	3.70	2.76	3.50	5.13	3.68	4.48
5.25							1.48	1.48	0.87	2.22	2.20	1.17	1.80	1.80	1.33	2.68	2.63	1.81	3.36	2.63	3.02	4.65	3.50	3.87
5.50							1.35	1.35	0.76	2.01	2.01	1.02	1.64	1.64	1.15	2.44	2.44	1.58	3.06	2.51	2.63	4.24	3.35	3.37
5.75							1.24	1.24	0.67	1.84	1.84	0.89	1.50	1.50	1.01	2.23	2.23	1.38	2.80	2.40	2.30	3.88	3.20	2.95
6.00							1.14	1.14	0.59	1.69	1.69	0.79	1.38	1.38	0.89	2.05	2.05	1.21	2.57	2.30	2.02	3.56	3.07	2.59
6.25							1.05	1.05	0.52	1.56	1.56	0.70	1.27	1.27	0.79	1.89	1.89	1.07	2.37	2.21	1.79	3.28	2.94	2.30
6.50							0.97	0.97	0.46	1.44	1.44	0.62	1.17	1.17	0.70	1.75	1.75	0.96	2.19	2.12	1.59	3.03	2.83	2.04
6.75							0.90	0.90	0.41	1.33	1.33	0.55	1.09	1.09	0.62	1.62	1.62	0.85	2.03	2.03	1.42	2.81	2.73	1.82
7.00							0.83	0.83	0.37	1.24	1.24	0.50	1.01	1.01	0.56	1.50	1.50	0.76	1.89	1.89	1.27	2.62	2.62	1.63
7.25							0.78	0.78	0.33	1.16	1.16	0.45	0.94	0.94	0.50	1.40	1.40	0.69	1.76	1.76	1.15	2.44	2.44	1.47
7.50							0.73	0.73	0.30	1.08	1.08	0.40	0.88	0.88	0.45	1.31	1.31	0.62	1.65	1.65	1.04	2.28	2.28	1.33
7.75										1.01	1.01	0.36	0.82	0.82	0.41	1.23	1.23	0.56	1.54	1.54	0.94	2.13	2.13	1.20
8.00										0.95	0.95	0.33	0.77	0.77	0.37	1.15	1.15	0.51	1.45	1.45	0.85	2.00	2.00	1.09
8.25										0.89	0.89	0.30	0.73	0.73	0.34	1.08	1.08	0.47	1.36	1.36	0.78	1.88	1.88	1.00
8.50													0.69	0.69	0.31	1.02	1.02	0.43	1.28	1.28	0.71	1.77	1.77	0.91
8.75																0.96	0.96	0.39	1.21	1.21	0.65	1.67	1.67	0.84
9.00																0.91	0.91	0.36	1.14	1.14	0.60	1.58	1.58	0.77
9.25																0.86	0.86	0.33	1.08	1.08	0.55	1.50	1.50	0.71
9.50																0.82	0.82	0.31	1.03	1.03	0.51	1.42	1.42	0.65
9.75																			0.97	0.97	0.47	1.35	1.35	0.60
10.00																			0.93	0.93	0.44	1.28	1.28	0.56

1. **Inward:** Load pushing inward on the top flange.
2. **Outward:** Load pulling outward on the top flange.
3. **Ws:** Load at a deflection of span/150.
4. ■ Shaded areas relate to spans which will not support a point load of 1.4kN (refer AS/NZS 1170).

TOP NOTCH PURLIN SYSTEM DESIGN EXAMPLES

EXAMPLE: SINGLE SPAN AND LAPPED SPAN

Loadings

Dead Load, G = 0.12kPa Live Load, Q = 0.25kPa Snow Load, S_u = 0.5kPa

Outward Limit State Wind Loads, W_u = – 0.95kPa (ultimate state) and W_s = – 0.66kPa (serviceability state).

Inward Wind Loading is not significant for this roof.

Building Constraints

Portal Spacing, L_P	=	5m	Rafter Length, L_R	=	10.0m (distance from eaves purlin to ridge purlin)
Roof Pitch, a	=	10 degrees	Cladding Profile	=	Styleline x 0.40mm BMT

Critical Design Load Combinations for the Ultimate Limit State (from AS/NZS 1170)

i)	W^*_{ULS}	=	1.2G + 1.5Q	=	(1.2 x 0.12) + (1.5 x 0.25)	=	0.52kPa
ii)	W^*_{ULS}	=	$1.2G + S_u + \psi_l Q$	=	(1.2 x 0.12) + 0.5 + (0.0 x 0.25)	=	0.64kPa
iii)	W^*_{ULS}	=	$0.9G + W_u$	=	(0.9 x 0.12) – 0.95	=	– 0.84kPa (outward)

Critical Design Load Combinations for the Serviceability Limit State (from AS/NZS 1170)

i)	W^*_{SLS}	=	$L_P/300$ under $G + \psi_l Q$	=	[0.12 + (0.0 x 0.25)] x 300/150	=	0.24kPa
ii)	W^*_{SLS}	=	$L_P/150$ under W_s	=	– 0.66	=	– 0.66kPa (outward)

For i) we have converted the load by a factor of 300/150 in order to compare the load directly with W_s in the Top Notch purlin load span tables as these are based on span/150.

Optimise Roofing Profile Spans

In this case we have a restricted access roof where the point load requirement limits the intermediate span of the Styleline x 0.40mm BMT profile to 1.6m. End spanning capability of the roofing is reduced to 1.05m, i.e. two thirds of the intermediate span. Generally these spans will not 'fit' the rafter length exactly, hence the requirement to optimise.

The optimised roofing profile intermediate span is based on the rafter length and the number of purlins, NP (assuming at least four) and is given by the term: $PS_i = L_R / [NP - 1.66]$ where PS_i is the internal purlin spacing and purlins at each end are two thirds of PS_i.

Try 7 Purlins,	$PS_i = 10.0/(7 - 1.66) =$	1.87m	No good
Try 9 Purlins,	$PS_i = 10.0/(9 - 1.66) =$	1.36m	Not controlling
Try 8 Purlins,	$PS_i = 10.0/(8 - 1.66) =$	1.58m	Intermediate spans and 1.05m edge spans

From this, 8 purlins are required and the purlin spacings may be rationalised to 1.6m intermediate spans and 1.0m spans at the sheet ends.

The Top Notch purlin load span tables assume the top flange of the Top Notch purlin is continuously restrained by screw-fastened roof sheeting (if not, specific design to AS/NZS 4600 is required).

1. Single Span Purlin Design

All Bays (5m span)

Check design capacities (using Top Notch Purlin System Load Span Tables - Single Span): $W^*_{ULS} < \phi_b W_{bx}$

$W^*_{ULS}\downarrow$	=	1.6 x 0.64	=	1.02kN/m	cf. 1.31kN/m for a 120 x 0.95
$W^*_{ULS}\uparrow$	=	1.6 x –0.84	=	–1.34kN/m	cf. 1.62kN/m for a 150 x 1.15

Check deflections

W^*_{SLS}	=	1.6 x 0.66	=	1.06kN/m	cf. 1.12kN/m for a 150 x 1.15

Both outward wind load and deflection govern and a 150 x 1.15 Top Notch purlin is required.

Therefore use 150 x 1.15 Top Notch purlins single span at 1.6m intermediate spacings and 1.0m at sheet ends.
Typically for multiple bay structures it would be more efficient to use a lapped purlin system as shown next.

2. Lapped Span Purlin Design

Check End Bays (5m span)

Check design capacities (using Top Notch Purlin System Load Span Tables - Lapped End Span): $W^*_{ULS} < \phi_b W_{bx}$

$W^*_{ULS}\downarrow$ = 1.6 x 0.64 = 1.02kN/m cf. 1.18kN/m for a 100 x 0.75

$W^*_{ULS}\uparrow$ = 1.6 x −0.84 = −1.34kN/m cf. 1.76kN/m for a 100 x 0.95

Check deflections

W^*_{SLS} = 1.6 x 0.66 = 1.06kN/m cf. 1.15kN/m for a 120 x 0.95

Deflection wind load governs the end span and a 120 x 0.95 lapped Top Notch purlin is required.

Check Internal Bays (5m span)

Check design (using Top Notch Purlin System Load Span Tables - Lapped Internal Span): $W^*_{ULS} < \phi_b W_{bx}$

$W^*_{ULS}\downarrow$ = 1.6 x 0.64 = 1.02kN/m cf. 1.64kN/m for a 100 x 0.75

$W^*_{ULS}\uparrow$ = 1.6 x −0.84 = −1.34kN/m cf. 1.64kN/m for a 100 x 0.75

Check deflections

W^*_{SLS} = 1.6 x 0.66 = 1.06kN/m cf. 1.36kN/m for a 100 x 0.95

Deflection wind load governs the internal span and a 100 x 0.95 lapped Top Notch purlin is required.

Therefore use Top Notch 120 x 0.95 lapped purlins at 1.6m intermediate spacings and 1.0m at sheet ends (governed by the end bays).

Top Notch purlins must have the same depth on all bays to keep the roofing in the same plane and different thicknesses are not mixed when specifying Top Notch purlins for practical reasons.

3. Lapped Reduced-End Span Purlin Design

The dependable strength characteristics are higher for internal spans on continuously lapped span purlin systems. Therefore typically a reduction in the end bay spacings of 20% to 30% will result in a more efficient purlin optimisation. Try reducing the end bay span by 20% to 4 metres.

Check End Bays (4m span)

Check design capacities (using Top Notch Purlin System Load Span Tables - Lapped End Span): $W^*_{ULS} < \phi_b W_{bx}$

$W^*_{ULS}\downarrow$ = 1.6 x 0.64 = 1.02kN/m cf. 1.85kN/m for a 100 x 0.75

$W^*_{ULS}\uparrow$ = 1.6 x −0.84 = −1.34kN/m cf. 1.85kN/m for a 100 x 0.75

Check deflections

W^*_{SLS} = 1.6 x 0.66 = 1.06kN/m cf. 1.09kN/m for a 100 x 0.75

All design cases require a 100 x 0.75 lapped Top Notch.

Check Internal Bays (5m span)

As for the Internal Bays in Example 2 above, a 100 x 0.95 lapped Top Notch purlin is required.

Therefore use Top Notch 100 x 0.95 lapped purlins at 1.6m intermediate spacings and 1.0m at sheet ends, on end and internal bays.

The above examples use the same wind load on the end bays and the internal bays. However a more rigorous wind load analysis is likely to have different wind loads on the end and internal bays.

In the calculation of wall elements, optimisation follows the same logic as illustrated for roofing with the exception that foot traffic limitations do not apply, leaving the spanning ability of the cladding dependent on face loads caused by wind.

2.4.6

TOP NOTCH PURLIN SYSTEM MATERIAL SPECIFICATION

Dimond Structural Top Notch Purlins are manufactured by roll forming galvanised steel coil produced to AS 1397.

Base Metal Thickness (BMT) (mm)	Steel Grade	Yield Strength, f_y (MPa)	Zinc Weight, Z (g/m^2)
0.75	G550	550	275
0.95	G550	550	275
1.15	G500	500	275

Z450 galvanised zinc coil can be supplied with order lead times of up 12 weeks. Contact Dimond Structural on 0800 Dimond (0800 346 663).

Tolerances

Length:		±6mm
Depth/Width:	60 Top Notch purlin:	±1mm
	100/120 Top Notch purlin:	±2mm
	150 Top Notch purlin:	±3mm
Top Flange Width:		±1mm

2.4.7

TOP NOTCH PURLIN SYSTEM SHORT FORM SPECIFICATION

The light steel section will be Dimond Structural **(1)** Top Notch **(2)** mm BMT to a galvanised zinc weight of **(3)** g/m^2.

The sizes, lengths, span configuration, lap length where required and thickness variations are as shown on the drawing.

Fixings to rafters to be **(4) (5)** self-drilling fasteners.

(1) Choose from: 60, 100, 120, 150

(2) Choose from: 0.75, 0.95 (for 60, 100 and 120 Top Notch Purlins) - 0.95, 1.15 (for 150 Top Notch Purlins).

(3) Choose from: 275 or 450

(4) Choose from: 2 – 12g, 4 – 12g, 6 – 12g, 2 – 14g, 4 – 14g, 6 – 14g or 8 – 14g

(5) Choose from: Type 17 (timber), Metal Teks (steel).

2.4.8

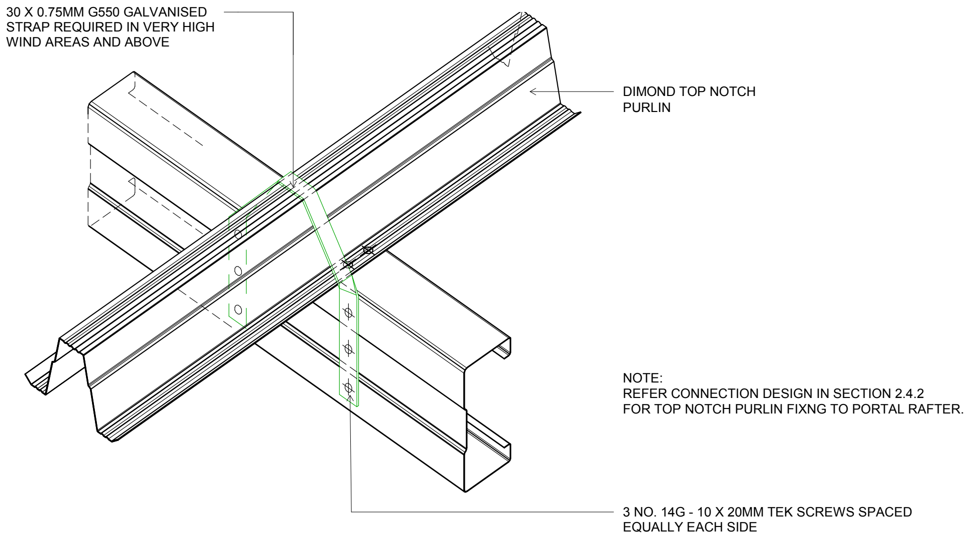
TOP NOTCH PURLIN SYSTEM COMPONENTS

2.4.8.1

SUPPORT STRAP

Additional hold-down straps are required in very high wind zones and above for Top Notch purlins in a continuous internal span configuration, as specified by the design engineer.

Manufactured from 0.75mm BMT x 30mm galvanised steel strip, which is tied over the Top Notch purlin and fastened each side into the support structure as detailed below.



TOP NOTCH PURLIN SYSTEM CAD DETAILS

For the latest Top Notch CAD details, please download from the Dimond Structural website
www.dimondstructural.co.nz/products/top-notch-purlins

Please note, the Top Notch CAD details are to be used as a guide only and are not intended for construction. Specific design details are required to be provided by the design engineer.