2.3 SPECIFIC DESIGN – DHS PURLINS

2.3.1 INTRODUCTION

Dimond Hi-Span (DHS) Purlin Systems have been designed to comply with AS/NZS 4600:1996, based on physical testing and analysis carried out by the University of Sydney, who are recognised for their international expertise in the area of cold form design. The structural analysis software consisted of several modules including cross-sectional analysis, an AS/NZS 4600:1996 design module, in-plane structural analysis, and finite element laterial buckling analysis.

Methods in AS/NZS 4600:1996 for determining pure shear, combined bending/shear, lateral buckling and distortional buckling have, in some cases, resulted in lower purlin capacities than previously published. These are included in the design tables in this manual.

Appropriate design load combinations for each Limit State should be determined in accordance with AS/NZS 1170:2002. It is recommended these be expressed as uniformly distributed bending loads (kN/m) and axial compression loads (kN) for direct comparison with the tabulated data in this manual.

Self weight of the DHS Purlin Systems 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.

2.3.2 DESIGN CONSIDERATIONS

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

Design Capacities in the Limit State format have been derived by the application of a capacity factor, f:

Bending	f_b	=	0.90
Compression	f_c	=	0.85

A design yield strength of 500 MPa has been used for DHS purlins and girts. This is in line with the minimum specified yield for G500 material and is significantly less than the consistent minimum yield stress in the G450 material used in manufacture.

Design capacity of the DHS Purlin System is largely dependent on the amount of restraint provided to the purlin section. These design tables assume that bracing prevents both lateral movement and rotation of the section at that point.

It is also assumed that screw-fixed cladding significantly prevents lateral movement of the flange to which it is attached. Where this assumption does not hold, it is recommended that the number of braces required is specified such that the purlin load capacity, $f_b W_{bx}$ is not less than the capacity for the Fully Restrained case (FR).

Uniformly loaded bending capacities (kN/m) and axial compression capacities (kN) are given for purlins and girts with 1, 2 or 3 braces. The Fully Restrained (FR) case may be used when the compression flange is fully restrained against lateral movement.

The Serviceability Linear Load, W_s (kN/m), is the load at which midspan deflection equates to span/150. As deflection is proportional to loading, W_s loads may be factored by the deflection ratio for any deflection within the limit of the linear load capacities.

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2.3.2 DESIGN CONSIDERATIONS *continued*

As a guide to acceptable deflection limits for serviceability of DHS used as purlins or girts, for wind and dead load actions, Dimond recommend the following limits:

- Where there is no ceiling:
  – Deflection for $W_s \leq$ Span/150
  – Deflection for G $\leq$ Span/300
- Where there is a ceiling:
  – Deflection for $W_s \leq$ Span/200
  – Deflection for G $\leq$ Span/360.

For specific deflection limits reference must be made to AS/NZS 1170.0:2002.

These tables are intended for use where roofing or cladding is attached to one DHS purlin or girt flange. Loads are assumed to be applied about the major axis of symmetry (X-X). Loads for intermediate spans may be calculated by linear interpolation.

For roofs, the dead load of roofing and purlins is assumed to be tied across the ridge or into the ridge beam for monoslope roofs. This avoids purlins sagging out of plane down the roof slope.

For walls, the following table gives the maximum allowable wall heights for Dimond bracing systems, where the dead load of cladding and girts is assumed to be carried in tension to an eaves beam by Fastbrace or brace channels. Specific design of the brace system and connections is required for wall heights greater than the limits shown or where the bracing is designed to carry compression loads.

	Maximum Wall Height	
Purlin Thickness BMT (mm)	**Fastbrace**	**Bolted Channel Bracing**
1.15, 1.25	5.0m	15.0m
1.45	6.5m	15.0m
1.75	8.0m	15.0m
1.95	–	15.0m

Basis to Table

1. Spacing between bracing lines and/or portal frames not greater than 3.5m.
2. Weight of cladding not greater than 6.7kg/m^2.

In order to minimise deflections in the girt member, we recommend a maximum spacing between bracing lines and/or portal frames of 3.5 metres.

Gravity type loads can be assumed to act perpendicular to the roof plane for roof pitches up to 10 degrees provided the DHS purlins are placed with their flanges facing up the slope. For pitches greater than 10 degrees, load components about the minor axis of symmetry (Y-Y) should also be considered.

Specific design is required for loads suspended from DHS purlin systems (such as ducting and piping). Hangers must be connected to the web of the purlins or to the bottom flange within 25mm of the web. Under no circumstances should loads be hung off the purlin lips.

Specific design is required to AS/NZS 4600 when designing DHS purlins as truss or portal members.

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2.3.2 DESIGN CONSIDERATIONS *continued*

The following table lists design capacities and distortional buckling stresses that were used in determining the load span tables.

Distortional Buckling Stresses and Design Capacities in Compression, Bending and Shear

	Compression	Bending			Shear	
DHS size	$f_c N_s$ (kN)	$f_b M_{sx}$ (kNm)	$f_{odx(TW)}$ (MPa)	$f_b M_{bdx}$ (kNm)	k_v	$f_v V_{vy}$ (kN)
DHS 150/12	94.7	6.93	413	5.82	7.80	14.03
DHS 150/15	133.4	9.60	526	7.93	7.53	27.27
DHS 200/12	101.2	9.85	321	8.62	7.62	10.06
DHS 200/15	142.8	14.15	409	11.82	7.45	19.78
DHS 200/18	188.9	18.96	498	15.21	7.33	34.31
DHS 250/13	123.3	15.00	290	13.36	8.03	10.75
DHS 250/15	153.6	18.82	339	16.40	7.89	16.53
DHS 250/18	203.3	25.29	412	21.18	7.73	28.54
DHS 300/15	161.9	23.85	271	21.39	8.00	13.83
DHS 300/18	214.6	31.89	330	27.74	7.83	23.85
DHS 350/18	222.4	38.37	301	33.48	7.70	19.97
DHS 400/20	270.1	53.28	300	45.29	7.51	23.50

- $f_c N_s$: Design section capacity in pure compression, determined in accordance with AS/NZS 4600:1996 Clause 3.4.1 with $f_c = 0.85$.
- $f_b M_{sx}$: Design section capacity in pure bending about the major (*x*) axis, determined in accordance with AS/NZS 4600:1996 Clause 3.3.2 with $f_b = 0.95$ and the web modelled as a single stiffened flat element.
- $f_b M_{bdx}$: Design member capacity in pure bending about the major (*x*) axis based on failure by distortional buckling, determined in accordance with AS/NZS 4600:1996 Clause 3.3.3.3 with $f_b = 0.90$. The corresponding distortional buckling stress ($f_{odx(TW)}$) is determined using a rational elastic buckling analysis of the whole cross-section.
- k_v: Shear buckling coefficient for the web following the procedures outlined in Section R6.2 of the ECCS document entitled *European Recommendations for Steel Construction: The Design of Profiled Sheeting* (ECCS, 1983). The ECCS procedures provide a sound basis for determining k_v where a stiffening swage is present in the web.
- $f_v V_{vy}$: Design shear capacity for a shear force in the direction of the *y*-axis, determined in accordance with AS/NZS 4600:1996 Clause 3.3.5 with $f_v = 0.90$.