BuildcoTech Purlin Design Guide

C & Z STANDARD PURLINS

BuildcoTech GUIDE

Buildco

BuildcoTech STANDARD PURLINS & GIRTS DESIGN MANUAL

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GENERAL INFORMATION

APPLICATION

Buildco purlins and girts are primarily used in the design of sheds, industrial and commercial buildings. The sections are typically used to support roof and wall sheeting.

MATERIALS

Buildco - Tech purlins and girts are manufactured from hi-tensile G450, G500 or G550 galvanised steel, with a minimum Z275 (275 g/m^2) galvanised coating conforming to AS 1397.

INSTALLATION

Purlin and girt installation should be carried out in suitable weather conditions by experienced crews.

SHEET LENGTH & EXPANSION JOINTS

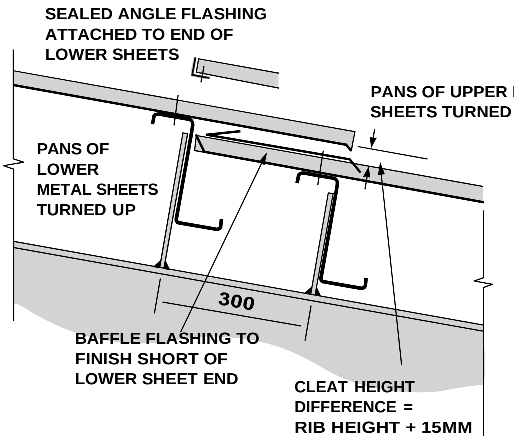
Roof sheeting lengths are limited by several issues - thermal expansion, transport limitations and practical handling are the main items governing maximum sheet lengths. The following table provides recommended maximum sheet lengths. Contact your Buildco - Tech team for more information.

MAXIMUM ROOF SHEET LENGTH

ROOF COLOUR	THROUGH FIX	CONCEALED FIX
Light	**25 m**	**33 m**
Dark	**17 m**	**25 m**

Where buildings are designed with roofing runs greater than the table above, expansion joints are necessary.

TYPICAL EXPANSION JOINT



WELDING

Welding of purlins, girts and bridging is not recommended. Welding any cold rolled, high tensile material affects the material properties and removes the galvanised coating. This can cause reduced life of the member.

SAFE WORK PRACTICE

Buildco - Tech purlins and girts are not designed for walking on. Residual oil from the manufacturing process may be present and slipping can occur. Appropriate lifting equipment and work platforms must be used.

As a minimum:

- Never walk on purlins or girts during installation. Use appropriate equipment.
- Never walk on bridging.
- Ensure safety mesh is in place.
- Always use approved safety harnesses and/or other suitable safety equipment during installation.

CORROSION PROTECTION & MATERIAL COMPATIBILITY

Some building materials and environmental conditions can be detrimental to coated steel products irrespective of the product thickness. This includes contact with or exposure to runoff from:

- Industrial, agricultural, marine or other aggressive atmospheric conditions
- Incompatible metals such as lead or copper
- Building materials subject to cycles of excessive moisture content such as non-seasoned timber
- Materials which have been treated with preservatives such as CCa or tanalith treated section.

The standard Z350 (350 g/m^2) galvanised coating will provide a long and trouble free life for enclosed buildings and open sided rural applications in non-aggressive environments. For more severe corrosive environments a Z450 (450 g/m^2) will be required. This heavier coated product is available subject to minimum order quantities and lead times.

ON-SITE STORAGE

If not required for immediate use, the Z or C sections or bundles should be neatly stacked clear of the ground. For extended outdoor storage duration, the sections should be stored with a small incline so that no water can pool.

Sections/bundles and accessories should not be left exposed in the open for extended periods of time. If unavoidable then protect the sections/bundles from moisture and rain with waterproof covers.

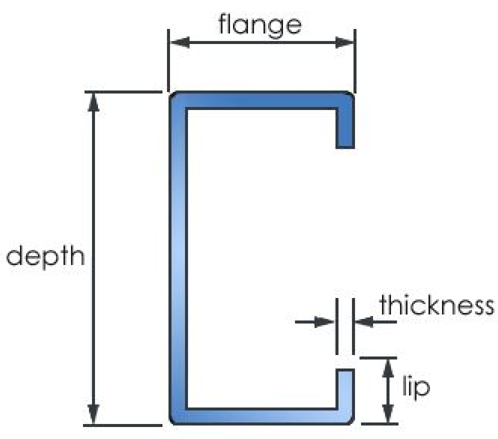
PRODUCT RANGE & PROPERTIES

C & Z SECTIONS

The following diagrams and tables illustrate the sizes and thicknesses readily available for purlins and girts. Shapes other than standard C and Z sections may be subject to minimum order requirements and extended lead times. Contact your Buildco-Tech team for more detail.

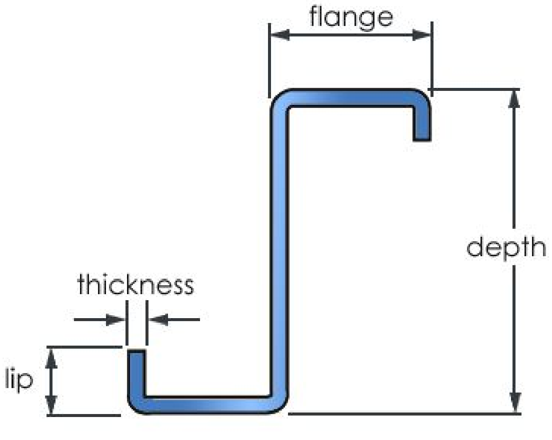
C SECTIONS

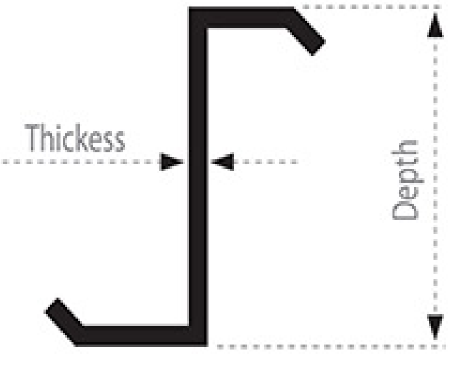
STANDARD



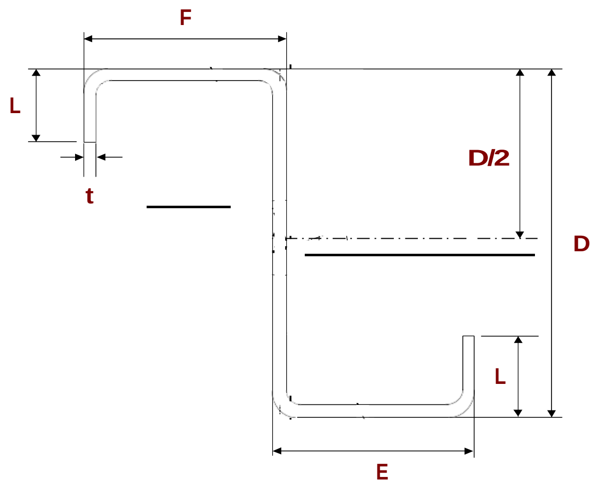
Z SECTIONS

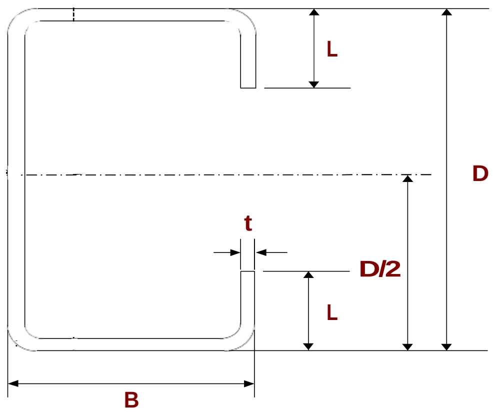
STANDARD Z





DIMENSIONS & PROPERTIES





C & Z PURLIN SIZE & MASS TABLE

Section	Thickness (t) mm	Height (D) mm	Z PURLINS			C PURLINS		Mass kg/m
			E	F	L	B	L	
100 10*	1.0	102	53	49	12.5	51	12.5	1.75
100 12	1.2	102	53	49	13	51	12.5	2.09
100 15	1.5	102	53	49	13.5	51	13.5	2.59
100 19	1.9	102	53	48	14.5	51	14.5	3.26
150 12	1.2	152	65	61	15.5	64	14.5	2.86
150 15	1.5	152	65	61	16.5	64	15.5	3.55
150 20	2.0	152	65	61	17.5	64	16.5	4.48
150 24	2.4	152	66	60	19.5	64	18.5	5.81
200 15	1.5	203	79	74	18	76	15.5	4.46
200 19	1.9	203	79	74	18.5	76	19	5.69
200 24	2.4	203	79	73	21.5	76	21	7.39
250 19	1.9	254	79	74	18	76	18.5	6.45
250 24	2.4	254	79	73	21	76	20.5	8.37
300 24	2.4	300	100	93	27	96	27.5	10.11
300 30	3.0	300	100	93	31	96	31.5	12.66
350 24*	2.4	350	129	121	30	125	30	12.23
350 30	3.0	350	129	121	30	125	30	15.15

*** Minimum order quantity and lead time may apply**

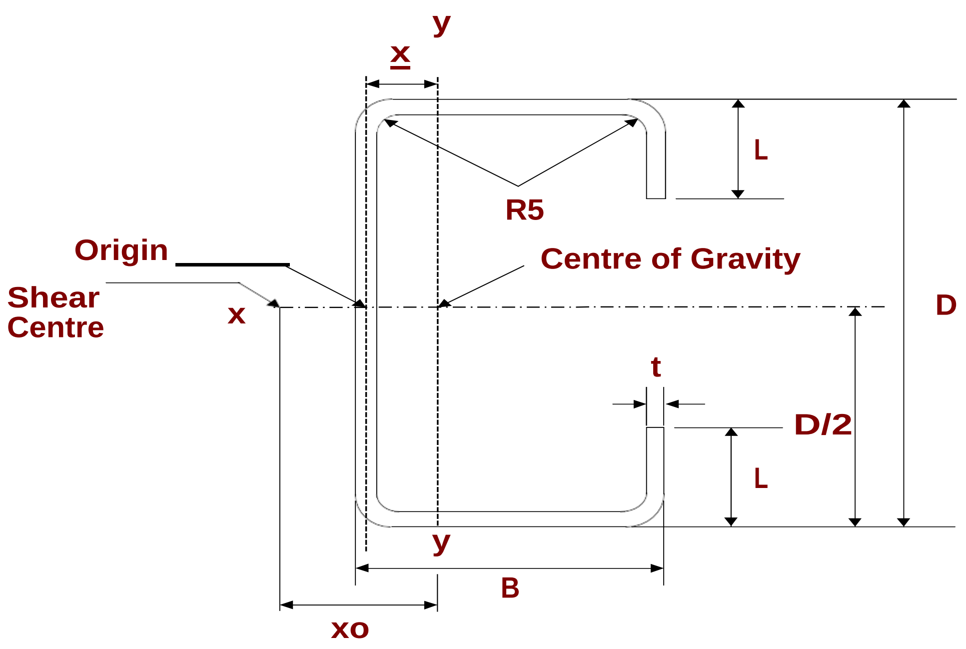
TOLERANCES

All sections will be produced with the following tolerances. Please contact Buildco-Tech team if any variation is required.

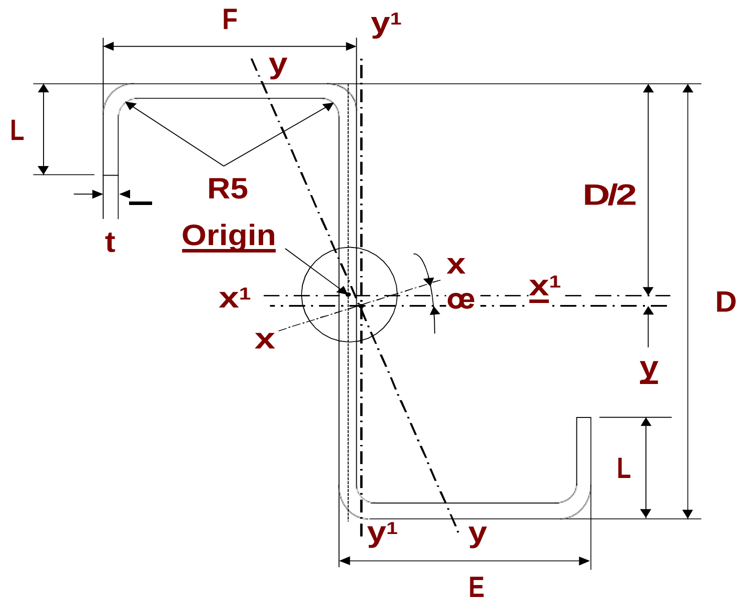
Overall Length ±5mm
Flange Width ±1mm
Depth ±1mm
Hole Centres ±1.5mm

C PURLIN DIMENSIONS & PROPERTIES

NOTE: x and y axes coincide with x^1 and y^1 axes (respectively)



Z PURLIN DIMENSIONS & PROPERTIES



C SECTION PROPERTIES

Section	Area mm^2	Second Moment of Area (x10^6 mm4)		Form Factor	Torsion Constant mm4	Warping Constant (x10^9 mm6)	Monosymmetry Constant mm	Shear Centre mm	Centre of Gravity
		Ix	Iy	Q	J	Iw	by	xo	x
C100 10	215	0.361	0.075	0.644	71.7	0.158	123.3	-39.85	16.03
C100 12	258	0.429	0.088	0.731	123.8	0.186	122.8	-39.61	15.93
C100 15	321.7	0.531	0.111	0.824	241.3	0.238	122	-39.9	16
C100 19	408.5	0.667	0.41	0.879	491.6	0.307	121.7	-40.28	16.18
C150 12	354	1.28	0.186	0.573	169.9	0.835	170.7	-46.38	18.22
C150 15	441.4	1.593	0.234	0.671	331	1.059	170.1	-46.7	18.3
C150 20	560.5	2.009	0.297	0.76	674.5	1.358	169.8	-47.07	18.49
C150 24	708	2.527	0.382	0.813	1359.4	1.79	168.5	-47.93	18.82
C200 15	555	3.509	0.393	0.557	416.3	3.042	223.2	-51.54	19.89
C200 19	710.7	4.472	0.522	0.647	855.2	4.157	220.8	-53.4	20.7
C200 24	901.5	5.642	0.673	0.726	1722.8	5.483	218.8	-54.2	21
C250 19	807.5	7.585	0.557	0.574	971.7	6.82	276.4	-48.46	18.1
C250 24	1020	9.577	0.716	0.645	1958.4	8.859	273.9	-49.21	18.39
C300 24	1260	16.919	1.504	0.592	2419.2	26.671	319.8	-65.97	24.99
C300 30	1590	21.253	1.948	0.672	4770	35.487	315.8	-67.88	25.74
C350 24	1545	29.12	3.18	0.52	3015	77.379	386.9	-91.11	34.07
C350 30	1905	35.708	3.799	0.596	5715	89.651	378.4	-86.24	33.18

Z SECTION PROPERTIES

Section	Area mm^2	Second Moment of Area (x10^6 mm4)				Form Factor	Torsion Constant mm4	Warping Constant (x10^9 mm6)	Monosymmetry Constant mm		Shear Centre mm		Centre of Gravity		Angle (Deg)
		Ix^{1}	Iy^{1}	Ix	Iy	Q	J	Iw	ßx	ßy	xo	yo	x	y	œ
Z100 10	215	0.361	0.13	1.448	0.043	0.644	71.7	0.213	9.9	11.8	-1.94	-4.73	1.11	-0.94	27.6
Z100 12	258	0.429	0.153	0.532	0.051	0.731	123.8	0.25	9.9	11.8	-1.94	-4.75	1.11	-0.94	27.5
Z100 15	322.5	0.533	0.194	0.663	0.064	0.826	241.9	0.317	9.9	11.8	-1.95	-4.75	1.11	-0.94	27.8
Z100 19	408.5	0.667	0.248	0.833	0.081	0.879	491.6	0.404	9.9	11.7	-1.96	-4.77	1.12	-0.94	28
Z150 12	352.4	1.274	0.3	1.46	0.114	0.576	169.2	1.145	12.4	12.7	-1.9	-5.9	1	-1	21.7
Z150 15	441.4	1.586	0.379	1.822	0.144	0.676	331	1.447	12.4	12.6	-1.9	-5.9	1	-1	21.9
Z150	559.2	1.995	0.482	2.294	0.181	0.725	672.9	1.839	12.5	12.6	-1.9	-5.9	1	-1	22
Z150 24	705.9	2.506	0.625	2.897	0.235	0.811	1363.3	2.381	18.6	18.5	-2.9	-8.8	1.5	-1.5	22.4
Z200 15	555	3.512	0.616	3.876	0.253	0.555	416.3	4.235	17.6	17.1	-2.26	-8.3	1.17	-1.36	18.5
Z200 19	712.5	4.496	0.837	4.994	0.339	0.647	857.4	5.795	17.4	16.8	-2.3	-8.24	1.19	-1.34	19.1
Z200 24	900	5.673	1.089	6.324	0.438	0.726	1728	7.58	21	19.8	-2.79	-9.94	1.45	-1.6	19.4
Z250 19	805.4	7.808	0.916	8.318	0.407	0.57	969.2	10.235	25.8	23.4	-2.7	-12.1	1.3	-1.9	14.7
Z250 24	1023.5	9.572	1.074	10.158	0.487	0.643	1952.5	12.261	26.9	23.4	-2.6	-12.8	1.3	-1.8	14.3
Z300 24	1260	17.117	2.381	18.471	1.027	0.59	2419.2	37.465	20.9	17.2	-1.99	-10.19	0.94	-1	16.2
Z300 30	1590	21.513	3.119	23.3	1.332	0.672	4770	49.318	21.3	16.9	-2.02	-10.42	0.94	-0.94	16.6
Z350 24	1545	29.1	4.98	32.02	2.07	0.52	2965	101	21.1	18.6	-2.1	-10.4	1.87	-2.16	18.2
Z350 30	1905	36.03	6.069	39.583	2.516	0.596	5715	126.23	21.6	19.1	-2.38	-10.49	1.16	-1.19	18

USING THIS MANUAL

When selecting purlins real applied loads must be considered along with the stated capacities in this manual. All spans are considered loaded concurrently and no allowance has been made for uneven or skip loading. Where this is likely, or where loading conditions vary from those designed for in this manual, a structural engineer should verify compliance independently with AS/NZS 4600:2005.

While real loading may be less than the stated capacity in this manual, this may not necessarily ensure competency of the selected system. Member adequacy is dependent on the maximum moments applied and the moment profile within the member span.

These design actions can vary widely under real, project specific, applied loads and it is the responsibility of the project design engineer to verify their purlin selection is compliant with AS/NZS 4600:2005 and AS/NZS 1170 Assessed Loading.

DESIGN ASSUMPTIONS

The tables in this brochure are for limit state capacity, which means that any load beyond the tabulated loads will prevent the member from fulfilling its intended function. This may mean reaching a limit state for collapse or loss of structural integrity. The limit state capacity tables for various purlin combinations in this publication provide economic design solutions for most projects. In special projects a more optimal design can be obtained by varying combinations, such as:

- Material specifications
- Bolt specifications & quantity
- Lap length
- Bridging quantity
- Span range
- Reduced or enlarged end spans
- Cantilevers at one or both ends of the configuration
- Loading

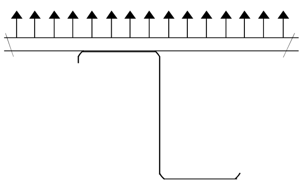
Design calculations are based on AS/NZS 4600:2005 Cold Formed Steel Structures, and follow criteria established by industry best practice.

Assumptions inherent in the code provisions and validated by them include:

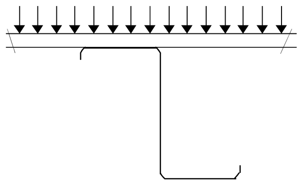
- The Z shaped section behaves as an equivalent C shaped channel.
- Consistent with the above the section may be seen as acting with and as physically attached to the sheeting incurring the loads, in regard to its initial displacement.
- For INWARD loading full compressive bending stress is allowable on the flange attached to sheeting as shown in the following diagram. That is the centre span condition.
- For OUTWARD loading full compressive bending stress is allowable on the flange attached to the sheeting as shown in the following diagram. That is the span support condition.
- For sections/lengths under distortional buckling effects, both bending moment magnitude and gradient are taken into account.
- For all systems, loading is assumed as uniformly distributed and acting on all spans simultaneously.
- All section properties have been calculated with the holes deducted from the web.

LOADING CONDITIONS

OUTWARD LOAD



INWARD LOAD



DESIGN ASSUMPTIONS DISCLAIMER

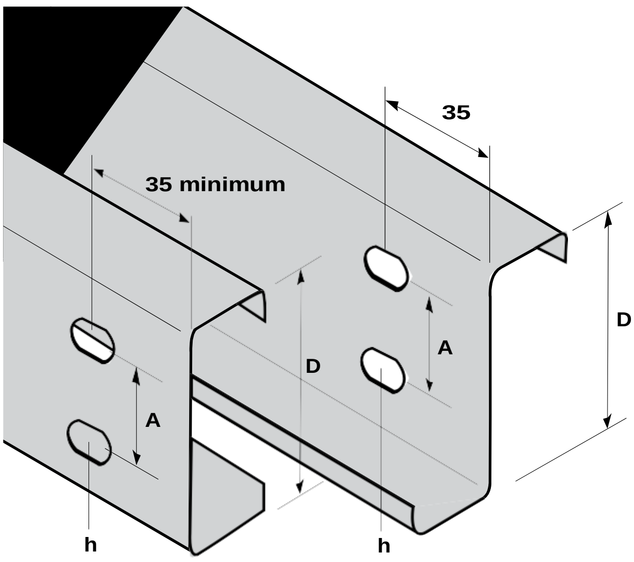
This publication is intended to provide accurate information with regard to Buildco C & Z purlins. It does not constitute a complete description of the goods, nor an explicit statement about suitability for any particular purpose. Data is provided as a guide only. Buildco Lanka (Pvt) Ltd do not accept any liability for loss or damage suffered from the use of data in this publication.

DESIGN & SPECIFICATION

HOLE PUNCHING

Buildco -Tech C and Z purlin sections are normally supplied with holes punched to the AISC guide.

Holes are required at cleat supports, laps bridging points or as specified on detail sheets supplied prior to manufacture. The preferred method of dimensioning is hole centre to hole centre rather than referenced from one end. An overall purlin length is required to provide for a data entry dimensional check.



HOLE CENTRES

PURLIN SIZE	AISC CENTRES	
D mm	A mm	h mm
100	40	18 x 22
150	60	18 x 22
200	110	18 x 22
250	160	18 x 22
300	210	22 round
350	260	22 round
400	310	25 round

Alternative hole sizes, shapes and centres are available. Please enquire with your Buildco - Tech team

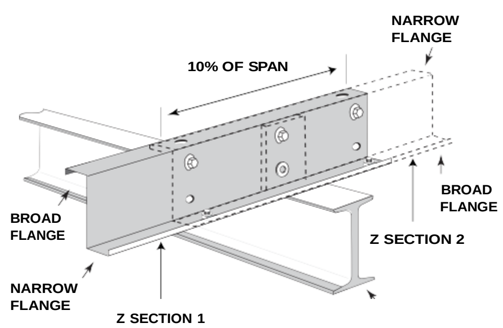
STRUCTURAL LAP LENGTHS

A feature of Buildco - Tech Z sections is one broad and one narrow flange proportioned so that two sections of the same size, when one is rotated by 180 degrees, bolt snugly together making them suitable for lapping. Structural continuity results in better economy but lapping provides two thicknesses of material over interior supports, increasing the strength of the sections where bending moments and shears are maximum, improving the load capacity and rigidity of the system. C sections cannot be lapped.

The bending moments, deflection and reaction coefficients vary with the length of the lap. These have been determined by a nominal lap of 10% span in all lapped spans. In the final analysis, where a mixed combination of lighter gauge section in an Internal Span to that in the End Span is made, the difference may be across two section thicknesses maximum. In three or four lapped span configurations with mixed thicknesses the greater thickness is in the end spans. The structural lap at the interior supports of lapped configurations must provide adequate structural continuity. Each end of the lap must be bolted with one bolt through the flanges furthermost from the cladding and one bolt through the webs near the flanges connected to the cladding. The required structural lap length is shown in the table. The size of the bolts depends on the section size.

Z sections of the same and different thicknesses can be lapped in any required combination. Z sections may also be used over simple spans and for shorter spans they may be used continuously over two or more spans without laps. Z sections with one lip turned outward may be used in simple or continuous spans with the ends butted. These sections cannot be overlapped.

LAP LENGTHS Nominal Section Size (mm)	Span (mm)	Lap Length (mm)
100	≤6000	600
	>6000	900
150, 200, 250	≤ 9000	900
	>9000 ≤12000	1200
	>1200	1800
300, 350	≤9000	900
	>9000 ≤12000	1200
	>1200 ≤18000	1800
	>18000	2400



BRIDGING

The limit state capacity tables provide design solutions for an equal number of rows of bridging in each span. Provision is made for 0, 1, 2 or 3 rows.

In some combinations of span configuration and loading there is no benefit in increasing the number of bridging rows.

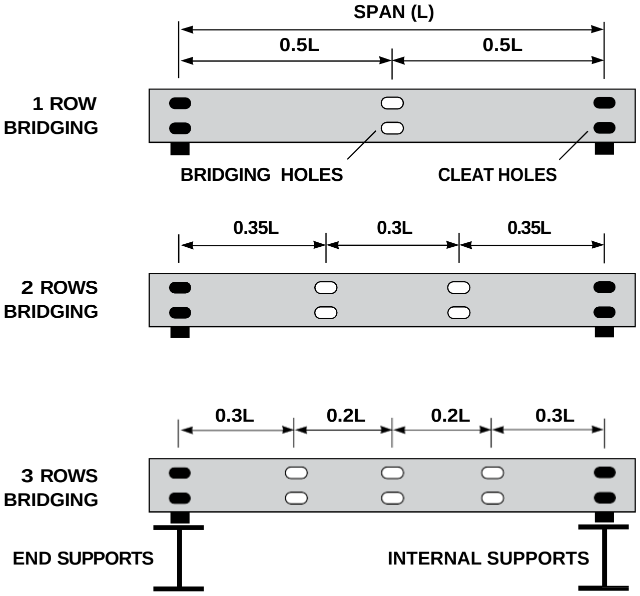
Buildco recommends that bridging is installed such that the maximum un-braced length is 20xD (D=purlin web height), or 4000mm, whichever is the least. In addition to enhancing purlin performance this requirement assists with the installation of roof sheeting. Location of the bridging must be as shown below (to the nearest 50mm), or as determined by the design engineer.

RECOMMENDED MAX. BRIDGING SPACING

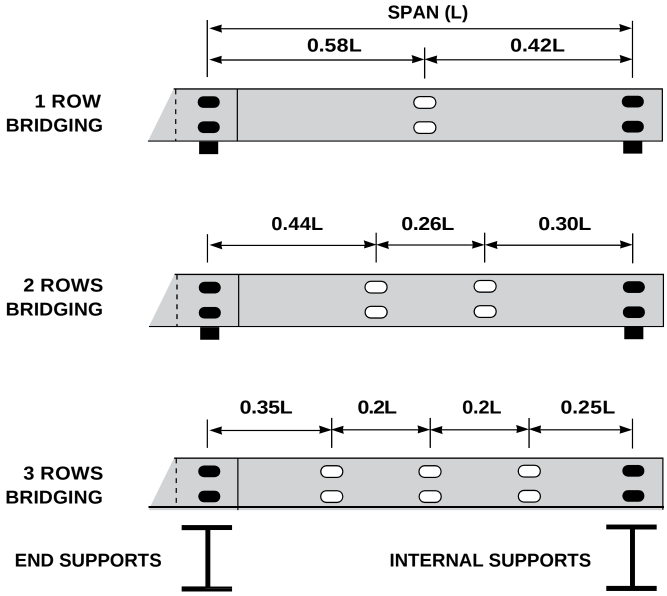
PURLIN SIZE MM	MAX. BRIDGING SPACING MM
100	2000
150	3000
200,250,300,350,400	4000

BRIDGING HOLE LOCATIONS

SINGLE OR INTERNAL SPANS



DOUBLE OR END SPANS



MEMBER WEIGHT

All limit state loads are in kN/m. Limit state loads make no allowance for the mass of the member. In some cases, limit state loads are limited by the bolting.

DEFLECTION

There are no specific rules governing acceptable deflections, though structural codes give guidance. One needs to consider the specific requirements of any structure. It may be necessary to design under more than one load combination. Load stated is calculated to produce a deflection of Span/150 for the critical span. Solutions for other deflection ratios may be obtained using linear proportioning. Where a suspended ceiling is to be installed, such as in residential and commercial construction, more stringent deflection limits may be necessary to prevent damage to the ceiling components or joints. Both the end span and the internal span must be considered in the analysis of lapped and continuous spans.

CLEAT CONNECTIONS

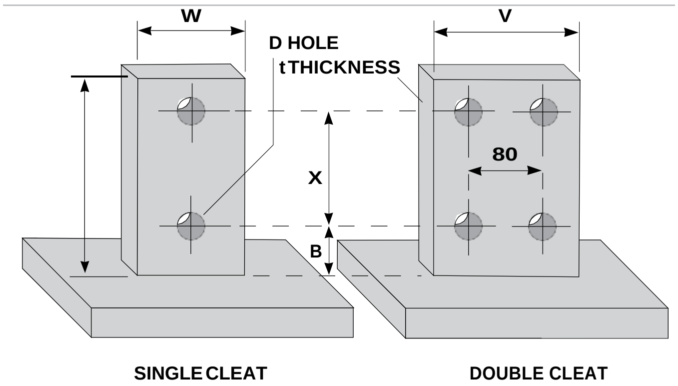
The limit state capacity tables are based on the sections being fastened through the web to the cleats so that the load is via the web of the sections.

The connections may be single section thickness such as in end connections, or the internal support connection of continuous configurations. Connections with double section thickness occur at the internal support of lapped configurations.

Each connection consists of two bolts. The bolt specifications (size and grade) will depend on the section size and design load. In some cases, eliminating cleats and bolting directly through the bottom flange for the Z and C sections could save on the number of bolts required. The number of bolts is halved compared with those in conventional cleated connections.

Single cleats are most commonly used with Z sections and double cleats with C sections. Double cleats can also be used in applications with a high reaction load to reduce bolt stress and sheer. Extra care is required with hole detailing in double cleat application to a single purlin. The following table illustrates industry standard cleat sizes including purlin clearances.

CLEAT NOMINAL DIMENSIONS - MM



SIZE	X	B+	Y+	t	GAP	hd	W	V
100	40	40	105	8	10	18	50	130
150	60	55	145	8	10	18	60	140
200	110	55	195	8	10	18	60	140
250	160	55	245	8	10	18	60	140
300	210	65	305	12	20	22	60	140
350	260	65	355	12	20	22	60	140

+ When using down turned lip purlins or girts the lip length must be added to the dimension B and Y. Cleat lengths may be increased in some design situations (e.g. above an expansion joint).
As a guide, increase the cleat thickness by 2mm for each 40mm of additional length.

BOLTS

The fastening of sections to cleats is normally by standard Buildco purlin bolts. In the limit state capacity tables, where high strength bolts govern the capacity the loads are marked accordingly. In these situations the section capacity is not fully utilised and it may be more economical to select another configuration or change the spacing of the section
or increase the bolt number of specification.

Purlin laps must be bolted in the top web hole and the lower flange holes at both ends of the lap. Bolting only the web of lapped purlins does not provide full structural integrity and excessive loads can be placed on the roofing screws that penetrate both purlin thickness in the lap region. The correct size and grade of purlin bolts nominated by the design engineer should be used at all times. Bolts should be fully tightened prior to roof installation and before any loads are applied to the purlins, girts or bridging.

Bolts to be snug tightened to a nominal torque of 54Nm.

BOLT SPECIFICATION

NOMINAL SECTION SIZE MM	BOLT SPECIFICATION
100, 150, 200, 250	Standard M12 Purlin Bolt High Strength M12 Purlin Bolt
300, 350, 400	Standard M16 Purlin Bolt High Strength M16 Purlin Bolt

POINT LOADS

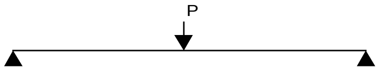
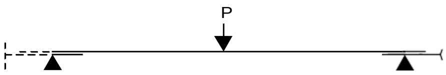
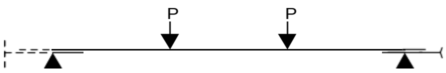
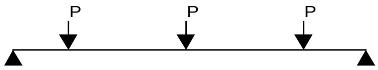
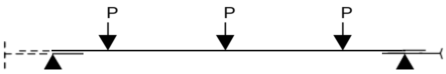
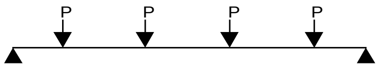
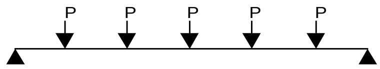
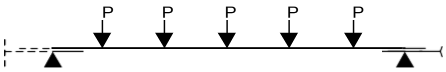
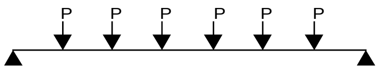
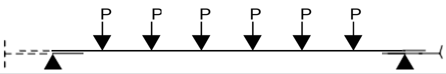
(SEE TABLE OVER PAGE)

The limit state loads specified in the tables are essentially uniformly distributed. It is inferred that all design loads will be converted into uniformly distributed values. In some applications the design loads are point loads. All design loads must be converted to uniformly distributed loads. The point-loaded configuration has been equated with uniformly loaded configuration for conversion formulae for single spans and lapped span configurations and are provided as a guide in the table on the following page. For continuous unlapped configurations a separate set of conversion formulae is applicable.

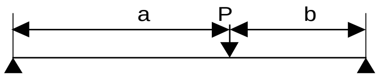
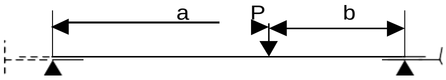
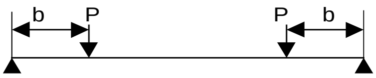
For single spans the formulae given are accurate conversions. For lapped spans, the conversion depends upon the number of spans, the position in the continuity and the lapping ratio. The lapped span formulae tabulated have been given the worst loading condition and can be safely used for interior spans, ends spans and any lapping ratio greater than 0:10. A separate set of conversion formulae would be required for deflection determination.

POINT LOADS

SYMMETRICAL EQUIDISTANT POINT LOADS

LOADING CONDITION		DIAGRAM	CONVERSION FORMULA
SINGLE LOAD	Simple		$w = \frac{2P}{L}$
	Lapped		$w = \frac{2.22P}{L}$
2 LOADS	Simple		$w = \frac{2.67P}{L}$
	Lapped		$w = \frac{3.16P}{L}$
3 LOADS	Simple		$w = \frac{4P}{L}$
	Lapped		$w = \frac{3.78P}{L}$
4 LOADS	Simple		$w = \frac{4.80P}{L}$
	Lapped		$w = \frac{5.12P}{L}$
5 LOADS	Simple		$w = \frac{6P}{L}$
	Lapped		$w = \frac{6.65P}{L}$
6 OR MORE LOADS	Simple		$w = \frac{1.14P}{L}$
	Lapped		$w = \frac{1.22P}{L}$

SINGLE ECCENTRIC & TWO SYMMETRICAL POINT LOADS

SINGLE ECCENTRIC POINT LOAD	Simple		$w = \frac{8abP}{L^3}$
	Lapped		$w = \frac{17.76ab^2P}{L^4}$
TWO SYMMETRICAL POINT LOADS	Simple		$w = \frac{8bP}{L^2}$
	Lapped		$w = \frac{9.45(2L-3b)P}{L^3}$

P = Single Point Load (kN)

L = Span (m)

a = Larger distance from support (m)

b = Smaller distance from support (m)

w = Equivalent uniform load (kN/m)

N = Number of Point Loads over one span

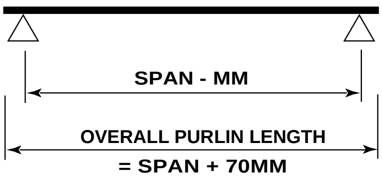
PURLIN DESIGN CAPACITY TABLES

HOW TO USE THE TABLES

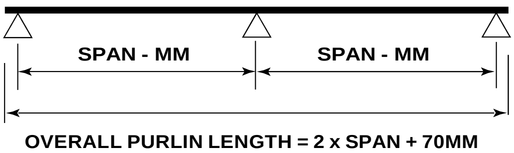
The tables indicate the maximum limit state capacity of the sections. Capacities are based on uniformly distributed loads and any point loads need to be converted.

Required loads are established by a project designer using the appropriate building codes and standards. Once the purlin and girt outwards and inwards loads are determined the preferred span configuration can be checked using the tables.

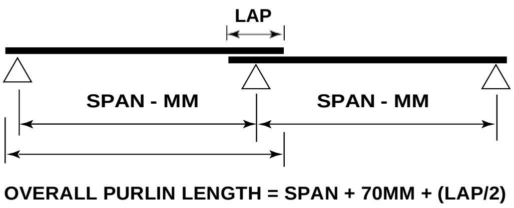
SINGLE SPAN



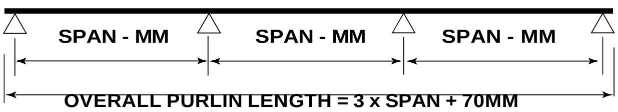
2 SPAN CONTINUOUS UNLAPPED



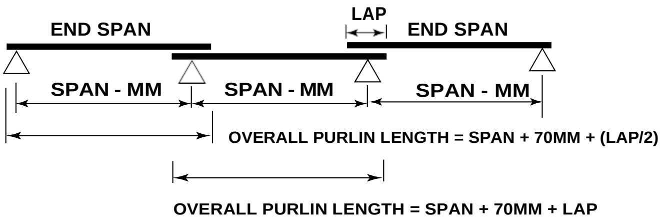
2 SPAN LAPPED



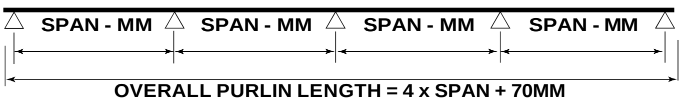
3 SPAN CONTINUOUS UNLAPPED



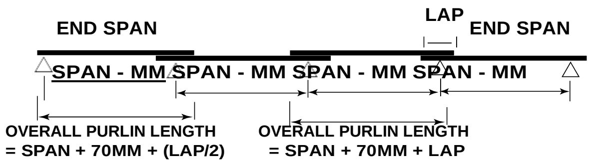
3 SPAN LAPPED

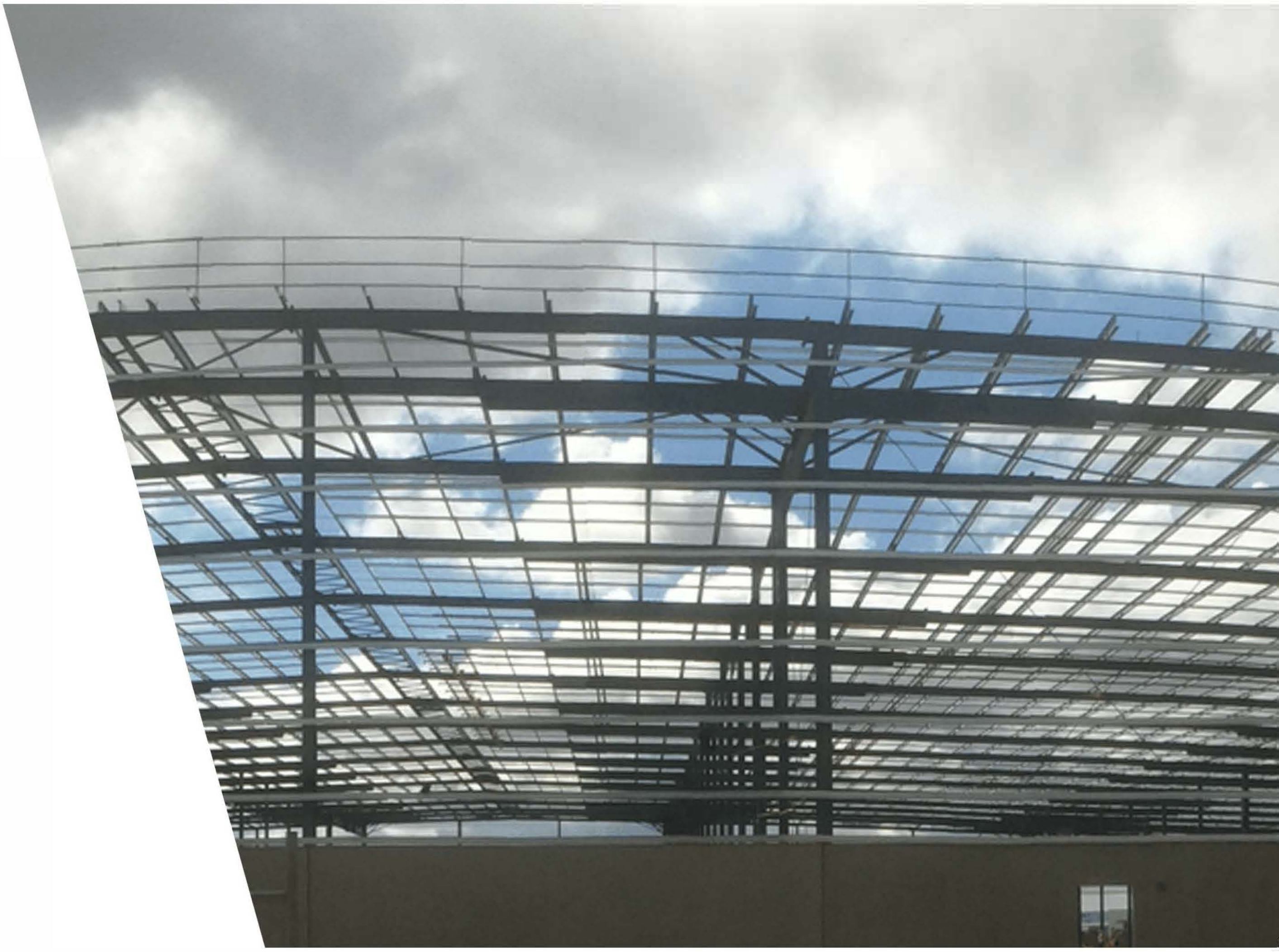


4 SPAN CONTINUOUS UNLAPPED



4 SPAN LAPPED





Buildco

Buildco Lanka (Pvt) Ltd,
No 37E, Watareka,Meegoda,
Sri Lanka.
T. +(94) 11 208 5386 F. +(94) 11 218 4427
E. info@buildcolanka.com
www.buildcolanka.com