

PART A: DESIGN

2

Design preliminaries

2.1 Product selection

When you design steel cladding into your building you have a wide range of profiles from which to choose. Whilst roofing and walling obviously have to keep out the weather, they also have significant effects on the looks, cost and durability of a building.

If you are unsure about any product feature, visit www.lysaght.com, call our information line or seek advice from the relevant specialists.

Other factors that affect selection are treated in Chapters 2 to 6.

Walls

The design of walling from a steel perspective is fairly straightforward. Once you have made the aesthetic decision of which profile to use, the main considerations are the support spacings (Section 2.3), fixing details (Chapter 3) and the details of flashing (Chapter 11).

Roofs

There are many factors in designing roofs including:

- the shape: is the roof to be 'flat' or pitched or curved?
- the supporting structure and support spacing;
- the wind forces that the roof must sustain;
- the pitch which affects the looks, the profile's ability to efficiently carry rain to the gutters, and fixing details;
- thermal expansion of long sheets (Chapter 10);
- the attributes of other materials used in the roof design.

This book doesn't attempt to cover the structural design details of supports or aesthetics: there are many other texts and Australian Standards that cover them.

This chapter gives tables of recommended support spacings, and the maximum roof length for pitch and rainfall intensity for steel roofing products.

The appropriate design will depend on your particular needs and circumstances. You should get advice from the relevant specialists where required.

2.2 Materials and finishes

Our most widely used cladding profiles are listed in Tables 2.3.1 and 2.3.2. They are available in COLORBOND® prepainted steel, or in unpainted ZINCALUME® aluminium/zinc alloy-coated steel.

COLORBOND® pre-painted steel has either a aluminium/zinc alloy-coated steel or stainless steel base metal, with a range of organic coatings to cope with exposure to a range of environments.

- COLORBOND® is prepainted steel for exterior roofing and walling. It is the most widely used.
- COLORBOND® METALLIC is prepainted steel for superior aesthetic qualities displaying a metallic sheen.
- COLORBOND® ULTRA is prepainted steel for severe coastal or industrial environments (generally within about 100 to 200 metres of the source).
- COLORBOND® STAINLESS is prepainted stainless steel for very severe coastal or industrial environments (generally within about 100 metres of the source). It is subject to availability and long lead times.

Check with your local BlueScope Lysaght office for availability of profiles, materials, finishes, colours, accessories; and for suitability of the product.

Tables 2.3.1 and 2.3.2 list general information for profile selection. Refer to our publications on specific products for detailed specifications. There are also publications on ZINCALUME® steel and COLORBOND® prepainted steel from our information line (Page 1).

Typical material specifications

- ZINCALUME® aluminium/zinc alloy-coated steel complying with AS 1397:2001. Minimum yield strengths are G550 (550MPa), or G300 (300MPa) depending on profile. Minimum coating mass is AZ150 (150g/m²)
- COLORBOND® is a pre-painted steel. The painting complies with AS/NZS 2728 and the steel base is an aluminium/zinc alloy-coated steel complying with AS 1397:2001. Minimum yield strengths are G550 (550MPa), or G300 (300MPa) depending on profile. Minimum coating mass is AZ150 (150g/m²)
- COLORBOND® Ultra is a pre-painted steel. The painting complies with AS/NZS 2728 and the steel base is an

aluminium/zinc alloy-coated steel complying with AS 1397:2001. Minimum yield strengths are G550 (550MPa), or G300 (300MPa) depending on profile. Minimum coating mass is AZ200 (200g/m²)

- COLORBOND® Stainless is a pre-painted steel. The painting complies with AS/NZS 2728 and the steel base is a stainless steel complying with AISI/ASTM Type 430; UNS No. S43000.

2.3 Support spacings

The maximum recommended support spacings are shown in Tables 2.3.1 and 2.3.2. They are based on data in accordance with AS 1562.1:1992 Design and installation of sheet roof and wall cladding: Metal, and AS 4040.1:1992 Methods of testing sheet roof and wall cladding—Resistance to concentrated loads.

The spacings in the tables are recommended to produce adequate performance of claddings under concentrated loading (incidental for maintenance).

For support spacings in wind conditions, refer to our publications on specific products for wind pressure data.

In all cases, cladding is fixed to a support of 1.0mm minimum base metal thickness (BMT) and minimum yield stress of G550. If you want to use metal battens thinner than 1.0mm, seek advice from our information line.

2.4 Maximum lengths of roofing

The valleys (or pans) of roofing have to carry water to the gutters. In heavy rain, the valleys overflow, water can flow into the roof through the side-laps and flashings.

Factors affecting waterproof and drainage capacity of the laps of a profile include:

- the width and depth of the valleys or pans;
- the pitch of the roof—rain flows faster on a steeper pitch;
- rainfall intensity for the geographical area;
- the length of the roof from ridge to gutter; and
- penetrations that cause nearby valleys to carry extra rain diverted from valleys obstructed by the penetration (Figure 2.4.1).

The maximum recommended roof lengths for drainage for each profile are given in Table 2.4.1 at the end of this chapter.

2.5 Low roof pitches

Unless there is adequate positive fall in a roof, there is danger of ponding, which can lead to a reduced service life, particularly in coastal areas.

At low slopes, say around 1 in 50 (1°) slope, all roof supports must be in the one plane because slight variations can result in zero or negative fall. This may occur even after completion of the building as the result of settlement, timber warping or shrinking, or extra loadings (like air conditioners).

As a guide, wherever possible, you should design for a minimum slope of 1 in 30 (2°). Minimum recommended roof slopes are listed in Table 2.3.1.

2.6 Wind forces on roofs

Winds create considerable forces on both the top and the underside of roof cladding, and you must consider these forces in the design and fixing of any roof. The forces are:

- **inward forces** tending to collapse the roof cladding inwards, caused by wind acting directly on the windward side; and
- **outward forces** tending to lift the roof cladding from its framing, and the entire roof structure from the rest of the building. Outward forces can be caused both by uplift from negative wind pressures, outside the building; and by positive wind pressure inside the building.

Generally the greatest wind forces imposed on roofs are due to the outward forces. Because the dead weight of roofing materials is relatively small, the outward forces must be resisted by the roof fasteners.

It is very important that the battens and roof framing are adequately fixed to the rafters and walls, and that under extreme conditions the wall framing is anchored to the footings. Special anchoring provisions may apply in cyclonic areas. Specialist advice should be sought in these circumstances.

2.8 Codes and performance tests

AS 1562.1:1992 specifies the design and installation of sheet metal roof and wall cladding. Our roofing profiles satisfy all the requirements of this standard, including the ability of the roof to resist outward forces and concentrated loads. The testing is performed according to AS 4040.

Metal roofing products must comply with the performance specifications, and be checked by stringent tests, in accordance with the standard. Such tests have been carried out on all our claddings and the results have been used in the preparation of the fixing and installation recommendations in this manual.

2.9 Environmental conditions

Coated steel products can be damaged by some environmental conditions including industrial, agricultural, marine, intensive animal farming, swimming pools or other aggressive conditions.

If any of our products are to be used in these conditions, or unusually corrosive environments, seek advice from our information line (Page 1).

Keep the product dry and clear of the ground. If stacked or bundled product becomes wet for extended periods, separate it, wipe it with a clean cloth and stack it to dry thoroughly.

2.10 Metal and timber compatibility

Contact with, or runoff from, some materials can damage coated steel products. Buildings can also be susceptible to condensation on inside surfaces.

The materials include certain metals, treated timbers and chemicals.

- Don't allow any contact of coated steel products with incompatible materials. (Table 2.2.1)
- Don't allow discharge of rainwater from incompatible materials onto coated steel products. (Table 2.2.1)
- Ensure that supporting members are compatible with the coated steel products or, alternatively, appropriately coated.

If there are doubts about the compatibility of other products being used, seek advice from our information line.

Incompatible materials include:

- lead
- copper
- monel metal
- bare steel

- stainless steel (except with COLORBOND® stainless cladding)
- carbon (in pencils and some rubbers)
- green or some chemically-treated timber (like CCA or tanalith treatments)
- materials subject to cycles of dryness and wetness or which have excessive moisture content (such as improperly-seasoned timber)
- wet and dry concrete
- soils
- vegetable matter
- cleaning agents (e.g. brick cleaning)
- any material which will inhibit normal exposure to the atmosphere

2.11 Transportation

Because our roofing and walling is manufactured by continuous processes, sheet lengths can be supplied up to the limits of transport regulations, which vary from state to state.

KL-700HS is available in extra long lengths via an on-site mobile rollformer. This service is available nationally, subject to enquiry.

2.12 Paint and COLORBOND® finishes

COLORBOND® finishes can be damaged by some handling, installation or maintenance activities. If damage occurs to the COLORBOND® pre-painted finish, refer to Technical Bulletin TB-2, published by BlueScope Steel.

Replacement of severely damaged COLORBOND steel should consider that the replacement sheet may not match perfectly due to the possible long term fading of the installed sheets exposed to weathering.

You may overpaint whole roofs and paint accessories to match specific colours. The overpaint guidelines are also discussed in Technical Bulletin TB-2.

Table 2.2.1

Acceptability of drainage from upper surface onto a lower metal surface and direct contact

COMPATIBILITY OF DIRECT CONTACT BETWEEN METALS OR ALLOYS

ROOF DRAINAGE SYSTEM COMPONENTS & ANY CLADDING MATERIAL	ACCESSORIES OR FASTENER OR (UPPER SURFACE)								
	ZINCALUME®	GALVANISED (ZINC COATED STEEL)	ZINC	COLORBOND®, COLORBOND® ULTRA, COLORBOND® METALLIC	COLORBOND® STAINLESS	STAINLESS STEEL	ALUMINIUM ALLOYS	COPPER & COPPER ALLOYS ⁽¹⁾	LEAD
ZINCALUME®	YES	YES	YES	YES	NO	NO	YES	NO	NO
GALVANISED (ZINC COATED STEEL)	YES	YES	YES	YES	NO	NO	YES	NO	NO
ZINC	YES	YES	YES	YES	NO	NO	YES	NO	NO
COLORBOND®, COLORBOND® ULTRA, COLORBOND® METALLIC	YES	YES	YES	YES	NO	NO	YES	NO	NO
COLORBOND® STAINLESS	NO	NO	NO	NO	YES	YES	NO	NO	NO
STAINLESS STEEL	NO	NO	NO	NO	YES	YES	NO	NO	NO
ALUMINIUM ALLOYS	YES	YES	YES	YES	NO	NO	YES	NO	NO
COPPER & COPPER ALLOYS ⁽¹⁾	NO	NO	NO	NO	NO	NO	NO	YES	NO
LEAD	NO	NO	NO	NO	NO	NO	NO	YES	YES

(1) MONEL - COPPER/NICKEL ALLOY
 (2) FOR FURTHER GUIDANCE REFER TO AS/NZS 3500.3: 2003




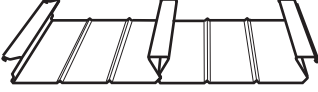

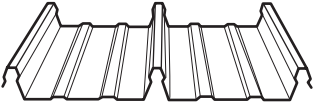





ACCEPTABILITY OF DRAINAGE FROM AN UPPER SURFACE TO A LOWER METAL SURFACE

LOWER ROOF DRAINAGE SYSTEM MATERIAL	UPPER CLADDING OR ROOF DRAINAGE SYSTEM MATERIAL									
	ZINCALUME®	GALVANISED (ZINC COATED STEEL)	ZINC	COLORBOND®, COLORBOND® ULTRA, COLORBOND® METALLIC	COLORBOND® STAINLESS	STAINLESS STEEL	ALUMINIUM ALLOYS	COPPER & COPPER ALLOYS ⁽¹⁾	LEAD	GLAZED ROOF TILES, GLASS & PLASTIC
ZINCALUME®	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES
GALVANISED (ZINC COATED STEEL)	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO
ZINC	NO	YES	YES	NO	NO	NO	NO	NO	YES	NO
COLORBOND®, COLORBOND® ULTRA, COLORBOND® METALLIC®	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES
COLORBOND® STAINLESS STEEL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
STAINLESS STEEL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
ALUMINIUM ALLOYS	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES
COPPER & COPPER ALLOYS ⁽¹⁾	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
LEAD	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

(1) MONEL - COPPER/NICKEL ALLOY
 (2) FOR FURTHER GUIDANCE REFER TO AS/NZS 3500.3: 2003

2.13 Specifications - roofing

Table 2.3.1
Specifications of roofing & walling profiles

	BMT mm	Mass ¹ kg/m ²	Width overall approx. mm	Cover width mm	Rib depth mm	Roof pitch minimum ² degrees	Maximum recommended spacing of supports								
							ROOFS					WALLS			Over- hang mm
							Single	End	Internal	Eaves Overhang ³		Single	End	Internal	
mm	mm	mm	Unstiff- ened mm	Stiff- ened mm	mm	mm	mm	mm	mm	mm					
CUSTOM ORB ⁴ 	0.42	4.3	838	762	16	5° (1 in 12)	700	900	1200	200	300	1800	2500	2700	200
	0.48	4.9	838	762	16	5° (1 in 12)	800	1300	1700	250	350	1800	2700	2700	250
CUSTOM BLUE ORB ⁴ 	0.60	6.1	838	762	17	5° (1 in 12)	1600	1600	1800	200	300	2400	3000	3300	200
	0.80	8.0	838	762	17	5° (1 in 12)	1800	1800	2600	400	600	2400	3200	3600	400
FLATDEK ⁵ 	0.42	6.0	272	250	45	2° (1 in 30)	2000	2600	3000	-	-	-	-	-	-
FLATDEK II ⁵ 	0.42	5.2	642	620	45	2° (1 in 30)	2400	2800	3200	-	-	-	-	-	-
INTEGRITY 820 	0.42	4.6	895	820	48	2° (1 in 30)	2100	2300	2800	150	300	2600	3400	3600	150
	0.48	5.2	895	820	48	1° (1 in 50)	2500	2550	3050	200	350	2700	3600	3600	200
KLIP-LOK 406 	0.48	5.6	432	406	41	1° (1 in 50)	1500	1800	2100	200	600	-	-	-	-
KLIP-LOK 700 HI-STRENGTH 	0.42	4.7	710	700	43	2° (1 in 30)	1650	1750	2200	150	450	2600	3200	3850	150
	0.48	5.3	710	700	43	1° (1 in 50)	2050	2350	2800	200	500	3000	3450	3900	200
	0.60	6.6	710	700	43	1° (1 in 50)	2350	3000	3600	250	550	3300	3600	3900	250
LONGLINE 305 (not tapered) 	0.70	9.7	310	305	48	1° (1 in 50)	1800	2000	2500	150	450	-	2700	2700	450
SPANDEK ⁶ 	0.42	4.7	754	700	24	3° (1 in 20)	1300	1800	2400	300	600	2500	3000	3300	300
	0.48	5.3	754	700	24	3° (1 in 20)	2000	2200	3000	400	700	3000	3000	3300	400
SPANRIB 	0.42	4.6	895	820	48	2° (1 in 30)	2100	2300	2800	150	300	2600	3400	3600	150
	0.48	5.2	895	820	48	1° (1 in 50)	2500	2550	3050	200	350	2700	3600	3600	200
TRIMDEK 	0.42	4.3	816	762	29	2° (1 in 30)	1100	1300	1900	150	300	2400	3000	3000	150
	0.48	4.9	816	762	29	2° (1 in 30)	1600	1850	2600	200	350	2700	3000	3000	200

¹ Masses are for unpainted ZINCALUME steel.

² See Section 2.5.

³ See Section 10.6 for explanation of 'stiffened'.

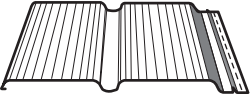
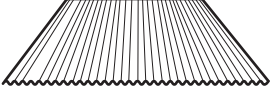





⁴ With 5 fasteners per sheet, per support

⁵ FLATDEK & FLATDEK II are Home Improvement profiles. Please refer to the brochures for more installation details..

⁶ With 4 fasteners per sheet, per support

2.14 Specifications - walling

Table 2.3.2
Specifications of profiles for walling only

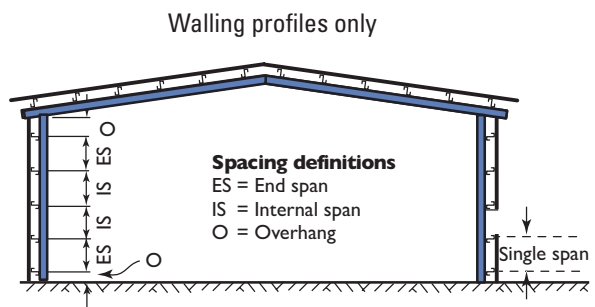
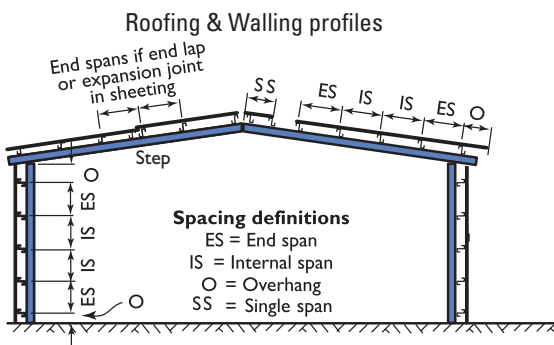
	BMT mm	Mass ¹ kg/m ²	Width overall approx. mm	Cover width mm	Rib depth mm	Maximum recommended spacing of wall supports			
						Single mm	End mm	Internal mm	Overhang mm
EASY-CLAD 	0.42	4.5	330	300	19	-	1500	1500	100
MINI ORB⁷ 	0.42	4.0	841	820	6	1200	1500	1500	100
	0.48	4.5	841	820	6	1500	1500	1500	125
MULTICLAD 	0.35	3.3	880	840	12	1400	1800	1800	150
	0.42	3.9	880	840	12	1700	1800	1800	150
PANELRIB⁶ 	0.35	3.2	915	850	4	1100	1200	1200	150
	0.42	3.7	915	850	4	1200	1200	1200	150
TRIMWALL 	0.35	3.6	816	762	29	2100	2900	3000	150
WALLCLAD⁴ 	0.35	3.6	838	762	16	2100	2400	2400	150
WEATHERBOARD 	0.42	4.1	272	260	12	-	1000	1000	n/a

¹ Masses are for unpainted ZINCALUME steel.

⁴ With 5 fasteners per sheet, per support

⁶ With 4 fasteners per sheet, per support

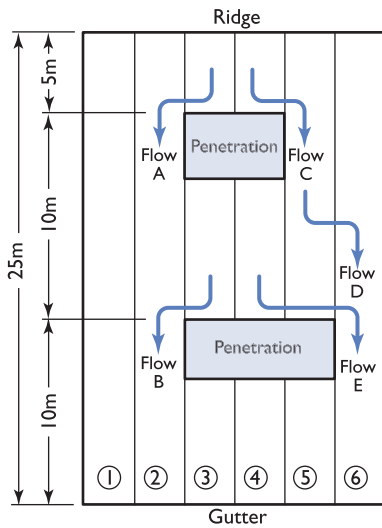
⁷ With 6 fasteners per sheet, per support



2.15 maximum roof lengths for drainage

Table 2.4.1

Maximum roof lengths for drainage measured from ridge to gutter (m) Penetrations alter the flow of water on a roof. Thus, for design, you need to use an effective roof length (Figure 2.4.1).



Valley	Effective length
1	25m (Base length)
2	Base length + A + B = 25 + 5 + 10 = 40m
6	Base length + C + D + E = 25 + 5 + 15 + 10 = 55m (Worst case used for design)

Figure 2.4.1

Example of calculating effective roof lengths where penetrations alter the flow of water on a roof.

NOTE: A suitably qualified engineer is recommended for calculating/checking roof design and flow design.

	Peak rainfall intensity mm/hr	Roof slope					Peak rainfall intensity mm/hr	
		1 in 50 (1°)	1 in 30 (2°)	1 in 20 (3°)	1 in 12 (5°)	1 in 7.5 (7.5°)		1 in 6 (10°)
CUSTOM ORB CUSTOM BLUE ORB	100				29	34	38	100
	150				20	23	25	150
	200				15	17	19	200
	250				12	14	15	250
	300				10	11	13	300
	400				7	8	10	400
500				6	7	8	500	
INTEGRITY 820 SPANRIB	100		410	480	598	713	820	100
	150		273	320	399	476	547	150
	200		205	240	299	357	410	200
	250		164	192	239	285	328	250
	300		137	160	199	238	273	300
	400		102	120	150	178	205	400
500		82	96	120	143	164	500	
KLIP-LOK 406	100	375	467	548	682	813	934	100
	150	250	311	365	454	542	623	150
	200	188	234	274	341	406	467	200
	250	150	187	219	273	325	374	250
	300	125	156	183	227	271	311	300
	400	94	117	137	170	203	234	400
500	75	93	110	136	163	187	500	
KLIP-LOK 700 HI-STRENGTH	100	344	428	502	624	745	856	100
	150	229	285	334	416	496	571	150
	200	172	214	251	312	372	428	200
	250	137	171	201	250	298	342	250
	300	115	143	167	208	248	285	300
	400	86	107	125	156	186	214	400
500	69	86	100	125	149	171	500	
LONGLINE 305 (not tapered)	100	219	273	320	398	475	546	100
	150	146	182	213	265	317	364	150
	200	110	136	160	199	237	273	200
	250	88	109	128	159	190	218	250
	300	73	91	107	133	158	182	300
	400	55	68	80	100	119	136	400
500	44	55	64	80	95	109	500	
SPANDEK	100			111	133	154	173	100
	150			74	89	103	115	150
	200			55	67	77	86	200
	250			44	53	62	69	250
	300			37	44	51	58	300
	400			28	33	39	43	400
500			22	27	31	35	500	
TRIMDEK	100		220	257	320	382	439	100
	150		146	172	214	255	293	150
	200		110	129	160	191	220	200
	250		88	103	128	153	176	250
	300		73	86	107	127	146	300
	400		55	64	80	96	110	400
500		44	51	64	76	88	500	

- Some lengths in this table may exceed the maximum allowable transport length.
- Data are based on work of CSIRO and BlueScope Lysaght.
- For peak rainfall intensities in your locality, see Chapter 6.
- LYSAGHT FLATDEK and FLATDEK II are recommended for home improvement use only (carports/verandahs) where weathertightness is not of primary importance. Drainage figures are therefore not supplied.



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