

FIRMLOK[®] FLOORING SYSTEM

LYSAGHT

DESIGN AND INSTALLATION MANUAL

NON-CYCLONIC AREAS



LYSAGHT FIRMLOK® FLOORING SYSTEM

Introduction

LYSAGHT FIRMLOK® STRUCTURAL BEAMS

FIRMLOK® structural beams consist of two interlocking c-sections. They are light, strong and universal in their application. Arrangement of connections and accessories allows you to erect your floor with ease.

FIRMLOK® is uniform in quality, it doesn't warp or split and it doesn't need painting. Consistent straightness simplifies alignment. FIRMLOK® beams are available in three sizes 100mm, 150mm and 200mm deep depending on your application and aesthetic preference.

This publication demonstrates FIRMLOK® in its application as structural flooring system for a single level application for flat or sloped foundation.

The floor system consists of bearer and joist in the same plane where the tops of joist and bearer are flushed. The joist ends are connected to the webs of the bearers.

BACKGROUND

The research and development work into more efficient floor systems and sections is ongoing at BlueScope Building Components. Full scale testing of structural systems is being conducted at our NATA certified laboratory at Minchinbury, NSW.

The FIRMLOK® flooring system offers the latest design information utilising the latest limit state Australian Standards including AS/NZS 4600 and NASH manual.

The FIRMLOK® flooring system offers a simplified approach for the selection of members for domestic flooring systems.

FIRMLOK® flooring offers a range of options for joists and bearers. This is presented in the form of span tables which eliminate the need for engineering calculations. Guidance is given for the determination of load width for using these tables, and the design criteria are documented. Typical connection details are also provided to aid the incorporation of the flooring system to other flooring components.

COLOURS

FIRMLOK® beams are available in ZINCALUME® steel and a range of COLORBOND® steel colours.

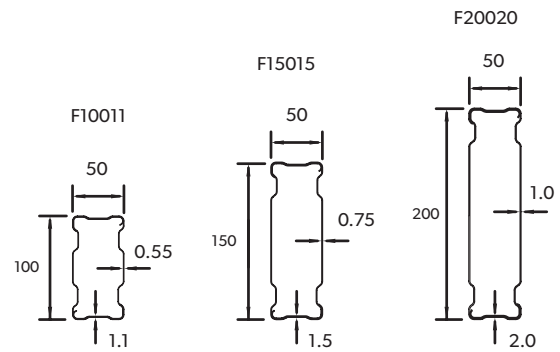
The FIRMLOK® universal brackets are also available powder coated to match the COLORBOND® steel colours.

LENGTHS

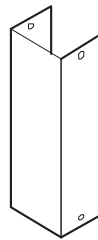
Stock lengths may vary from state to state. Please enquire at your local distribution outlet for available lengths. Alternatively, FIRMLOK® may be ordered to length (maximum length at 12000mm). Extended lead times may apply.

BEAM PROFILES

Figure 1



Mass	F10011	F15015	F20020
ZINCALUME®	1.87kg/m	3.13kg/m	4.95kg/m
COLORBOND®	1.90kg/m	3.17kg/m	5.00kg/m



Beam Size	F10011	F15015	F20020
Connection Bracket	CONB100	CONB150	CONB200

Fastener requirement: Class 4 hex head Metal Tek, refer to connection details for fastener size and length.

BEARER SPANS - SUPPORTING FLOOR LOAD ONLY (MM)

Table 1 - General Area (Indoor living area with 1.5 kPa live load)

Span Type	Bearer Size	Floor Load Width (m)						
		0.9	1.2	1.8	2.4	2.7	3	3.6
Single	F10011	1800	1640	1430	1300	1250	1210	1130
	F15015	2770	2520	2200	2000	1920	1850	1740
	F20020	3860	3500	3060	2780	2670	2580	2430
	2x F10011	2270	2070	1800	1640	1580	1520	1430
	2x F15015	3490	3170	2770	2520	2420	2340	2200
	2x F20020	4860	4410	3860	3500	3370	3250	3060
Continuous	F10011	2030	1840	1580	1180	1050	950	790
	F15015	3110	2830	2470	1920	1700	1530	1280
	F20020	4330	3930	3280	2460	2180	1970	1640
	2x F10011	2550	2320	2030	1840	1770	1710	1580
	2x F15015	3920	3560	3110	2830	2720	2630	2470
	2x F20020	5150	4800	4330	3930	3780	3650	3280

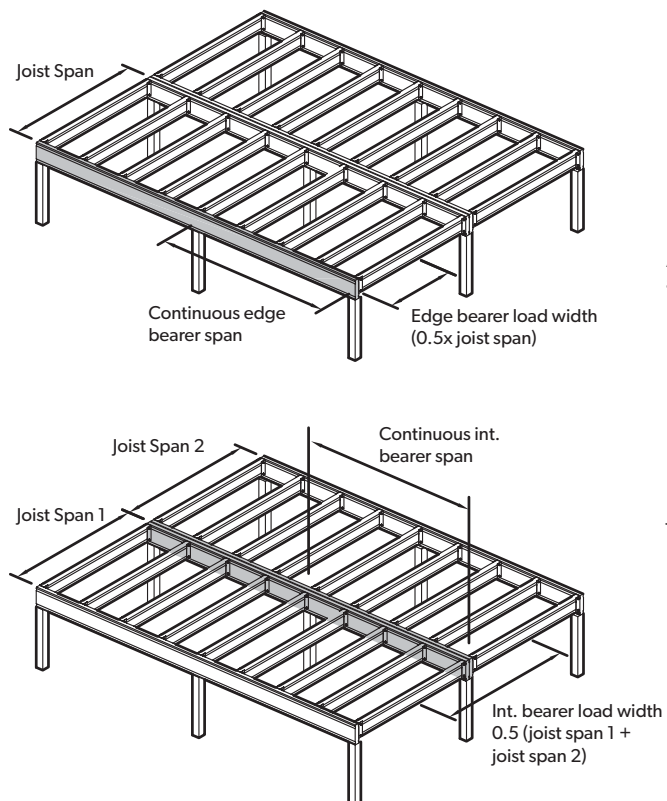
Table 2 - Other Area (Deck, landing area with 2.0 kPa live load)

Span Type	Bearer Size	Floor Load Width (m)						
		0.9	1.2	1.8	2.4	2.7	3	3.6
Single	F10011	1670	1520	1330	1210	1160	1120	1050
	F15015	2570	2340	2040	1850	1780	1720	1580
	F20020	3580	3250	2840	2580	2480	2400	2250
	2x F10011	2110	1920	1670	1520	1460	1410	1330
	2x F15015	3240	2950	2570	2340	2250	2170	2040
	2x F20020	4510	4100	3580	3250	3130	3020	2840
Continuous	F10011	1880	1710	1250	940	830	750	620
	F15015	2890	2630	2020	1520	1350	1210	1010
	F20020	4020	3650	2590	1940	1730	1560	1300
	2x F10011	2370	2150	1880	1710	1640	1500	1250
	2x F15015	3640	3310	2890	2630	2520	2430	2020
	2x F20020	5060	4600	4020	3650	3460	3110	2590

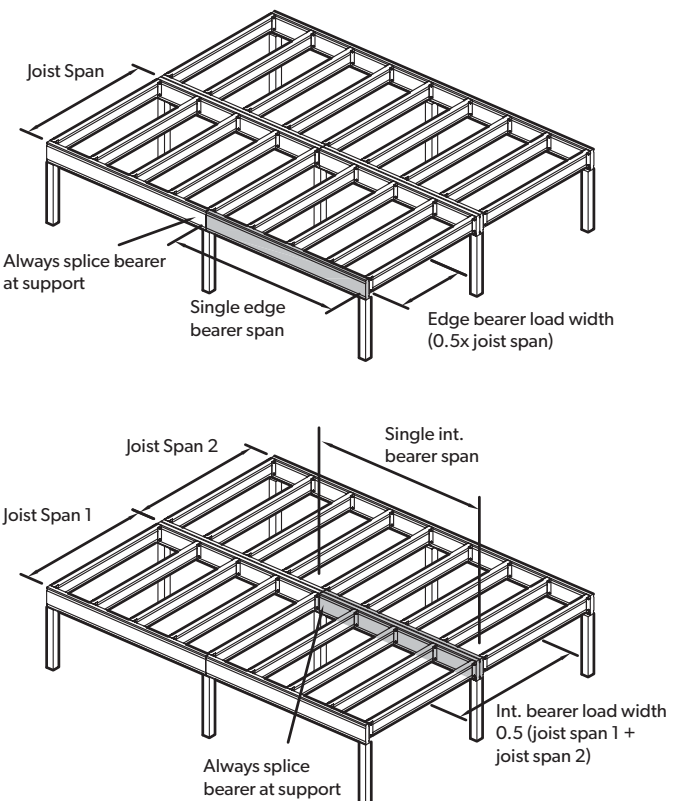
Figure 2

Beam span configurations.

Continous Span Bearers



Single Span Bearers



Note: For continuous bearer with unequal spans, always check the longer span.

BEARER SPANS - SUPPORTING FLOOR (GENERAL AREA) + WALL + ROOF LOADS (MM)

Table 3 - Tile Roof

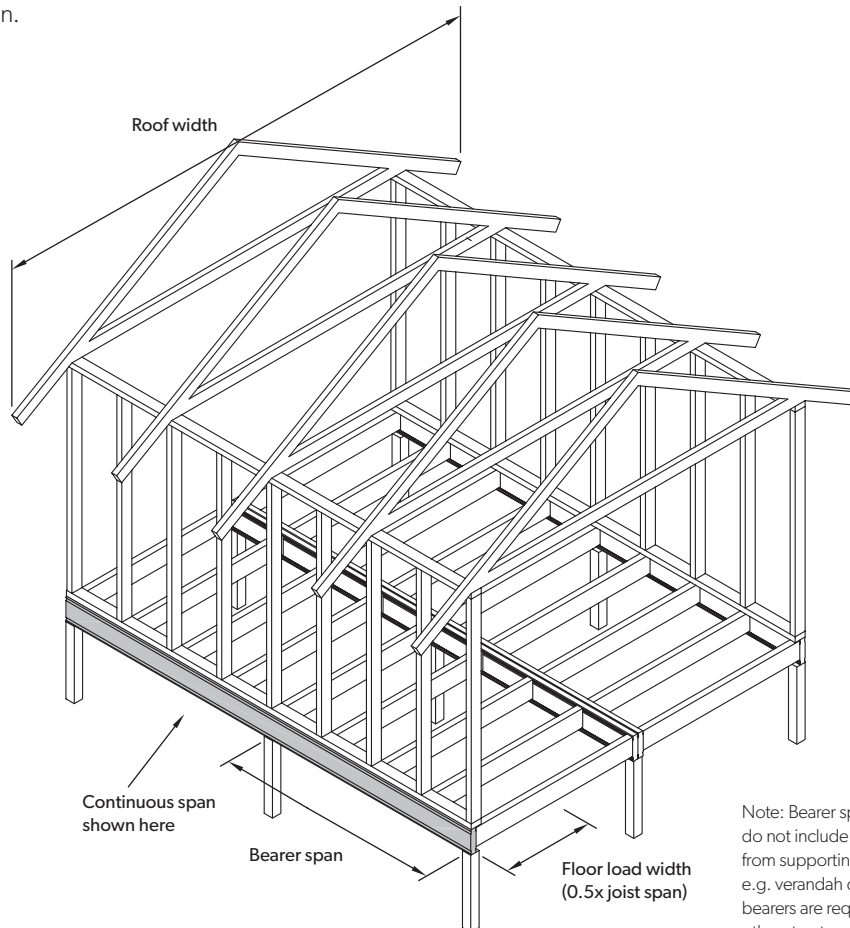
Roof Width (m)		9							12							16						
Floor Load Width (m)		0.9	1.2	1.8	2.4	2.7	3	3.6	0.9	1.2	1.8	2.4	2.7	3	3.6	0.9	1.2	1.8	2.4	2.7	3	3.6
Single	F10011	1140	1110	1060	1010	990	950	850	970	950	900	860	840	830	770	750	740	710	690	680	660	640
	F15015	1760	1710	1630	1540	1460	1380	1240	1400	1370	1310	1250	1220	1200	1120	1090	1070	1030	1000	980	960	930
	F20020	2440	2380	2260	2170	2130	2090	1970	2240	2180	2080	1990	1950	1910	1780	1740	1710	1650	1590	1560	1540	1480
	2x F10011	1440	1400	1330	1280	1250	1230	1190	1350	1320	1270	1220	1200	1180	1150	1260	1240	1200	1160	1140	1130	1100
	2x F15015	2210	2150	2050	1970	1930	1890	1830	2080	2030	1950	1880	1850	1820	1760	1940	1900	1840	1780	1760	1730	1690
	2x F20020	3080	2990	2850	2740	2680	2630	2550	2890	2830	2710	2610	2570	2530	2450	2700	2650	2560	2480	2450	2410	2350
Contin- uous	F10011	700	680	640	610	570	540	490	550	540	510	490	480	470	440	430	420	400	390	380	380	360
	F15015	1140	1100	1040	980	930	880	790	890	870	830	800	780	760	710	700	680	660	630	620	610	590
	F20020	1460	1420	1330	1260	1200	1130	1010	1150	1120	1070	1020	1000	980	910	890	880	840	810	800	790	760
	2x F10011	1410	1370	1290	1220	1150	1090	980	1110	1080	1030	990	960	940	880	860	850	810	790	770	760	730
	2x F15015	2280	2210	2090	1970	1870	1760	1580	1790	1750	1670	1600	1560	1530	1430	1400	1370	1320	1270	1250	1230	1190
	2x F20020	2920	2840	2670	2530	2400	2260	2030	2300	2250	2140	2050	2000	1960	1830	1790	1760	1690	1630	1610	1580	1530

Table 4 - Metal Sheet Roof

Roof Width (m)		9							12							16						
Floor Load Width (m)		0.9	1.2	1.8	2.4	2.7	3	3.6	0.9	1.2	1.8	2.4	2.7	3	3.6	0.9	1.2	1.8	2.4	2.7	3	3.6
Single	F10011	1310	1260	1180	1110	1080	1060	1020	1260	1210	1140	1080	1060	1030	980	1040	1020	970	920	900	880	840
	F15015	2020	1940	1810	1710	1670	1630	1500	1910	1850	1740	1640	1590	1550	1420	1510	1470	1400	1330	1300	1270	1220
	F20020	2810	2700	2520	2380	2320	2270	2170	2690	2600	2440	2320	2260	2210	2130	2410	2350	2230	2130	2080	2030	1940
	2x F10011	1660	1590	1490	1400	1370	1340	1280	1590	1530	1440	1370	1330	1300	1250	1510	1460	1380	1320	1290	1270	1220
	2x F15015	2550	2450	2280	2160	2100	2050	1970	2440	2350	2210	2100	2050	2010	1930	2320	2250	2130	2030	1990	1950	1880
	2x F20020	3540	3400	3180	3000	2920	2860	2740	3390	3270	3080	2920	2850	2790	2680	3220	3130	2960	2820	2760	2710	2610
Contin- uous	F10011	940	900	840	780	730	670	590	750	730	680	640	630	610	560	590	580	550	520	510	500	480
	F15015	1530	1470	1360	1260	1180	1090	960	1220	1180	1110	1050	1020	990	910	960	940	890	850	830	810	780
	F20020	1960	1880	1740	1620	1510	1400	1230	1570	1520	1420	1340	1300	1270	1160	1240	1200	1140	1090	1070	1040	1000
	2x F10011	1860	1790	1670	1560	1460	1350	1180	1510	1460	1370	1290	1260	1220	1120	1190	1160	1100	1050	1030	1010	960
	2x F15015	2860	2750	2560	2420	2360	2190	1920	2450	2370	2220	2100	2040	1980	1820	1930	1880	1790	1710	1670	1630	1560
	2x F20020	3920	3760	3480	3240	3030	2810	2460	3140	3040	2850	2690	2610	2540	2330	2480	2410	2290	2190	2140	2090	2000

Figure 3

Load width and bearer span.



Note: Bearer spans in Table 3 & 4 do not include any additional load from supporting add-on structure e.g. verandah deck. Additional bearers are required to support other structures using Tables 1-5.

JOIST SPANS – SUPPORTING FLOOR LOAD ONLY (MM)

Figure 4

Joist configuration.

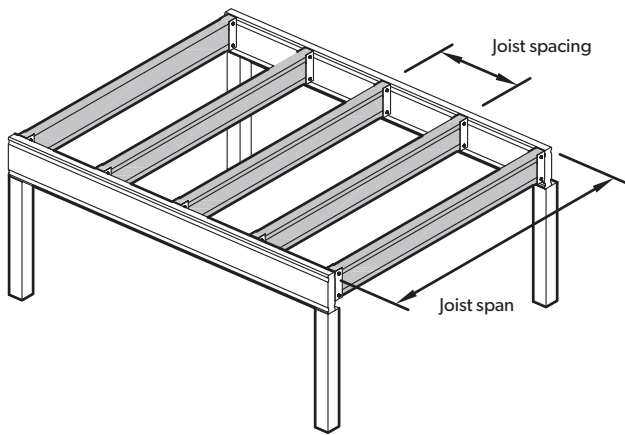


Table 5

Joist Spacing	450mm		600mm	
	General	Other	General	Other
F10011	2280	2120	2070	1920
F15015	3510	3250	3190	2960
F20020	4880	4530	4430	4110

Note: General: indoor living area with 1.5 kPa live load.
Other: Deck & landing with 2.0 kPa live load.

DESIGN EXAMPLE

DESIGN DETAILS

Figure 5 shows a typical house located in a non-cyclonic region of Australia e.g. Sydney. The local council has advised that the site wind classification is N2. The overall building dimensions are 12m long by 7.2m wide, the wall height is 2.7m, the roof has a slope of 15° with 450mm eave overhang, the roof material is metal cladding. For simplicity, there are no internal load-bearing walls in the building.

Let's use the Firmlok joist and bearer span tables to select the suitable beam sizes and support spacings for this design example. There will be several possible floor layout, we'll try out a few to arrive at an economic and practical design.

There are 2 types of floor bearers. The edge bearers will support the roof, wall and floor loads, the internal bearers will support floor load only. The floor is assumed to have general area loading.

STEP 1 - SELECTING INTERNAL BEARER

The building plan dimensions are 12000mm x 7200mm. Try 1 row of internal bearer, the load width is $7.2\text{m}/2 = 3.6\text{m}$, from Table 1, with bearer continuous over supports, the following options are available:

F20020 spans 1640mm, → 8x 1500mm spans.
2x F15015 spans 2470mm, → 5x 2400mm spans.
2x F20020 spans 3280mm, → 4x 3000mm spans.

Now try 2 rows of internal bearers, the load width is $7.2\text{m}/3 = 2.4\text{m}$, from Table 1, with bearer continuous over supports, using the same selection method from before:

F20020 spans 2460mm, → 5x2400mm spans.
2x F15015 spans 2830mm, → 5x2400mm spans.
2x F20020 spans 3930mm, → 4x3000mm spans.

STEP 2 - SELECTING EDGE BEARER

The bearer span tables are suitable for design wind clad up to N3 (suitable for N2 in this example). Use Table 4 to select the span, since the roof material is metal cladding.

The roof width is $7.2\text{m} + 0.45\text{m} + 0.45\text{m} = 8.1\text{m}$, use 9m. If 1 row of internal bearer is used, the load width for edge bearer is $3.6\text{m}/2 = 1.8\text{m}$ and the continuous spans available are:

F20020 spans 1740mm, → 7x 1714mm spans.
2x F15015 spans 2560mm, → 5x 2400mm spans.
2x F20020 spans 3480mm, → 4x 3000mm spans.

If 2 rows of internal bearers are used, load width for edge bearer is $2.4\text{m}/2 = 1.2\text{m}$ and the continuous spans available are:

F20020 spans 1880mm, → 7x1714mm spans.
2x F15015 spans 2750mm, → 5x2400mm spans.
2x F20020 spans 3760mm, → 4x3000mm spans.

From step 1 and 2, both bearer support spacings can be either 2400mm or 3000mm. for uniformity, we'll select a square grid of 2400mm, therefore the bearers will be spaced at 2400mm with supports (post/piers) spaced at 2400mm as well. To achieve the uniform bearer depth, 2x F15015 (double bearer) is selected for both edge and internal.

Note that there is numerous possible solutions, it may be worthwhile to trial out different combination of bearer spacings and support spacings to arrive at the best solution.

STEP 3 - SELECTING JOIST

With the bearer spacing confirmed at 2400mm, this is also the span for the floor joist. Assuming the joists are spaced at 450mm, from Table 5, the joist size can be F15015 since it can span 3510mm.

Figure 5

Typical house.

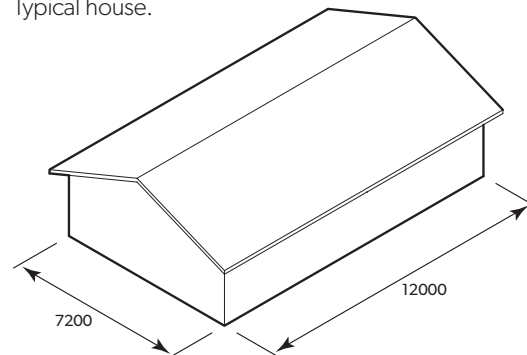
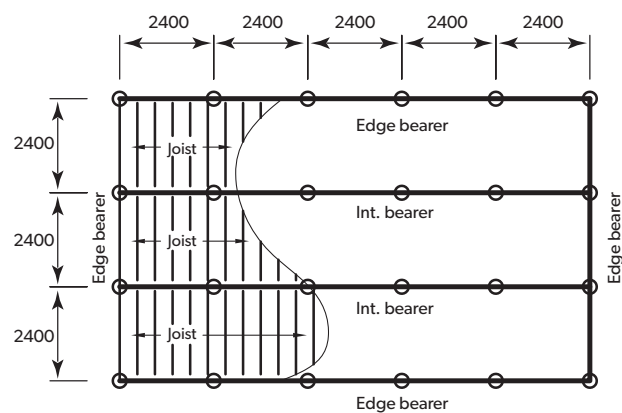


Figure 6

Floor framing layout.



SELECTION SUMMARY

Internal bearer: 2F15015 @ 2400mm, support spacing = 2400mm

Edge bearer: 2F15015 @ 2400mm, support spacing = 2400mm

Joist: F15015 @ 450mm spacing, span = 2400mm

COMMON CONNECTION DETAILS

Figure 7

Bearer capping.

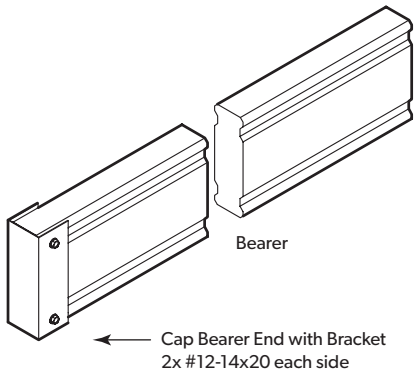


Figure 8

Joist to bearer connection.

Joist to bracket
4x #12-14x20 Metal Tekes
Bracket to bearer
4x #12-14x20 Metal Tekes
(8 in total)

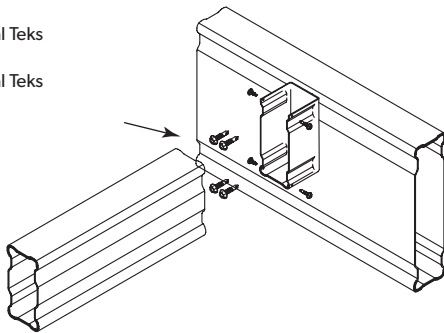
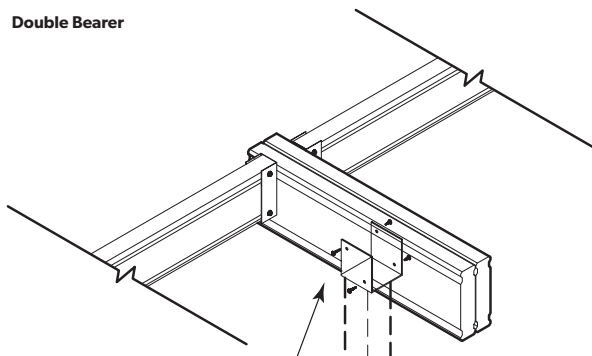


Figure 9

Bearer to support connection.

Double Bearer



Fix bearer to support fin plates thru webs
Min. 2x #12-14x20 Tekes per bearer,
min. 4 in total
Min. fin plate dimensions:
0.5D x 75mm x 3mm
(Pre-drilling of holes in fin plate may be required)

Single Bearer

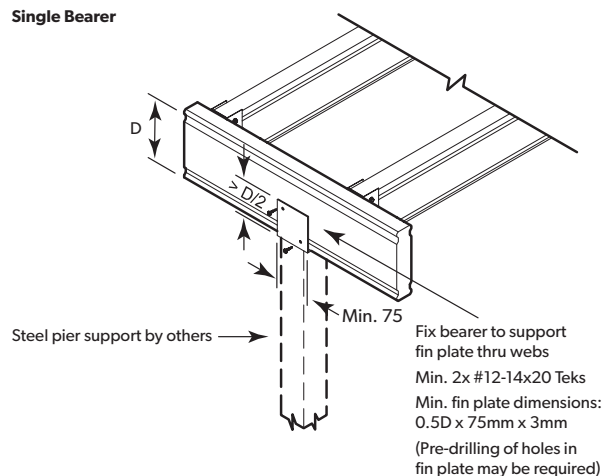


Figure 10

Bearer splice connection.

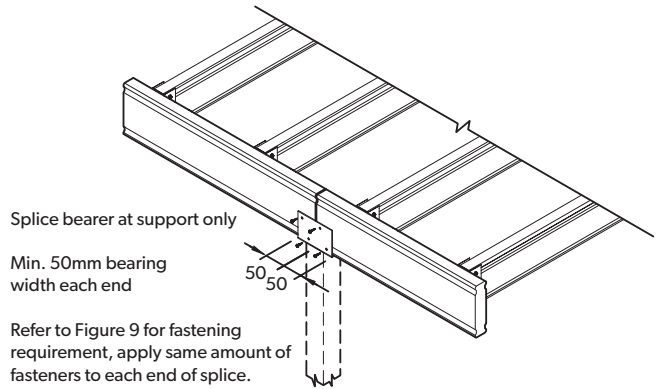


Figure 11

Double bearer stitching detail. (2 beams side by side).

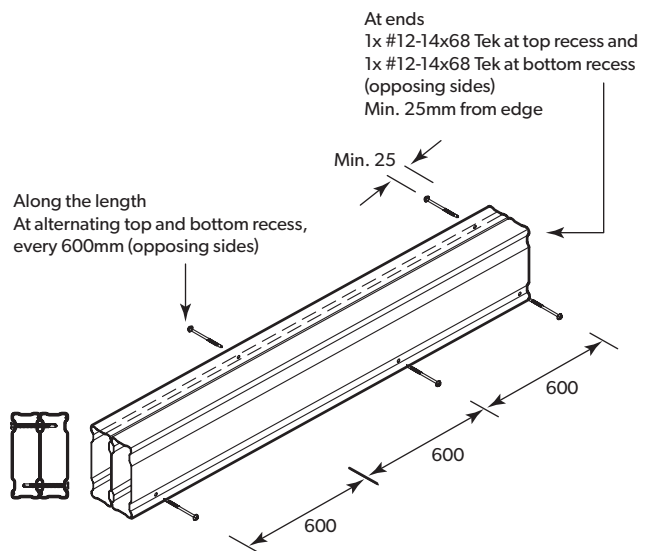
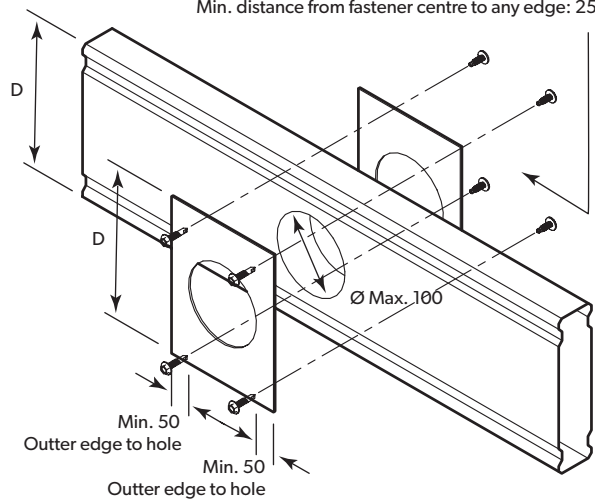


Figure 12

Penetration stiffening requirement.

Stiffening plates both sides of penetration,
Min. 1.5mm thick grade G450.
Fix to beam web with 4x #12-14x20 Tekes per plate
Min. distance from fastener centre to any edge: 25mm



Penetration is prohibited in regions directly over support. Penetration should be located at the flat region of FIRMLOK® beam.

Technical Data

MATERIAL SPECIFICATIONS

Next generation ZINCALUME® aluminium/zinc/magnesium alloy coated steel complies with AS 1397:2011. The minimum material yield strength is G550 (550 MPa minimum yield stress, the minimum coating mass is AM125 (125g/m²).

COLORBOND® is the most widely used pre-painted steel for exterior environment in Australia. The painting complies with AS/NZS 2728:2013 and the steel base is an aluminium/zinc alloy-coated steel complying with AS 1397:2011. The minimum material yield strength is G550 (550 MPa minimum yield stress, the minimum coating mass is AM100 (100g/m²).

The base metal thicknesses are 0.55, 0.75 and 1.00mm.

Some building materials and environmental conditions can be detrimental to coated steel products. These include contact with, or exposure to runoff from:

- Industrial, agricultural, marine or other aggressive atmospheric conditions
- Incompatible metals (e.g. lead or copper)
- Building material subject to cycle of dryness/wetness, or which have excessive moisture contents (such as improperly seasoned timber)
- Materials which have been treated with preservatives (e.g. CCA or tanalith-treated timbers)

Please visit the BlueScope online technical library for more detailed guidance or direct any queries relating to appropriate use of BlueScope products to your local BlueScope representative.

GENERATE NOTES

- For a continuous span table to be applicable, the larger span must be no more than 30% longer than the adjacent span
- Interpolation is NOT permitted in the span tables. Always use the next larger load width
- The maximum overhang span for bearer is the minimum of 600mm or 10% of back span, e.g. back span = 2400mm, allowable overhang = 240mm
- Bracing of supports for floor framing (post/piers) shall not be connected to the bearers or joists. The bearers and joists spans are not designed to take floor bracing actions. Floor bracing should be designed taking into account of support spacing, height and relevant loading
- End of bearer must be laterally restrained by a joist or an edge bearer.

COMPLIANCE REFERENCES

The joist and bearer spans are designed based on the criteria of the following Australian standards and industries guide:

- AS/NZS 1170.0: 2002 Structural Design Actions Part 0: General Principles
- AS/NZS 1170.1: 2002 Structural Design Actions Part 1: Permanent, Imposed & Other Actions
- AS 4055: 2012 Wind Loads For Housing
- AS4600: 2005 Cold-Formed Steel Structures
- NASH Handbook 2009
- NASH Standard - Residential and Low-rise Steel Framing, Part 1: Design Criteria

DESIGN ASSUMPTIONS

- Permanent actions (dead load):
 - Floor mass is 0.5 kPa, including self-weight of joist, floor sheathing, services, attachments and plumbing
 - Roof mass for metal sheet is 0.4 kPa and for tile 0.9 kPa
 - Wall mass is 0.3 kPa x wall height (up to 3m)
- Imposed actions (live load) are 0.25 kPa for roof and 1.5 kPa for general floor area or 2 kPa for other floor area
- Serviceability deflection limit is the minimum of span/500 (mm) or 12mm
- Minimum floor natural frequency for vibration performance is 8 Hz
- Joist is assumed to be full restrained by floor
- Bearer is assumed to be laterally restrained by floor joist
- A concentrated live load of 1.8 kN was considered in the span design. (The span tables are not applicable for joist/bearer supporting load bearing column or any structural component design to carry concentrated load > 1.8 kN)
- Wind class of N3 is used to determined table 3 & 4
- Roof pitch range: up to 22.5 degrees
- Roof width is the plan width of the whole roof perpendicular to the bearer under design, including any eave overhangs.
- The maximum wall height is limited up to 3m

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