

Roof Design Criteria

BCI® Joists can be used to create open roof voids in buildings by acting as free-spanning rafters between a ridge beam at the roof apex and the wallplate at eaves level.

BCI® Joist suppliers involved in roof applications assume a role similar to that of the trussed rafter designer, as outlined in BS5268-3:1998, clauses 6, 7 and 11. The Building Designer remains responsible for the roof design, including specification of all holding down fixings at support positions, and the stability and wind bracing systems, unless otherwise agreed or a roof designer has been employed. I-Joist roofs should be braced, or arranged, to form a coherent structure. The bracing can be in the form of a structural diaphragm (sarking) or triangulating members, the specification of which remains the responsibility of the Building Designer.

BCI® Joists are designed for roof applications using the principles of BS5268-2:2002 and the joist properties contained in BBA Certificate 99/3620. In general, it can be assumed that well-ventilated roofs in the UK will achieve a Service Class 2 moisture condition. Uniformly distributed dead and imposed loads will be assumed across the whole roof unless otherwise directed. For small buildings, as detailed in BS6399-3, imposed loads (snow loading) will generally be taken as 0.75 kN/m² (measured on plan) up to pitches of 30°, reducing linearly to zero at 60° pitch, unless specific guidance in the aforementioned code would suggest alternative imposed roof loadings may apply. Snow loading will be assumed to be of medium term duration. Dead loads from coverings may be taken from the schedule of standard tile weights tabulated to the right.

Schedule of Roof Covering Dead Loads


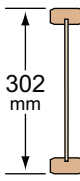
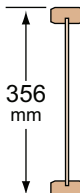
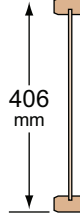
Tile Manufacturer and Product	Weight on Slope (inc. SW allowance of 110 N/m ²)
Marley Modern	659 N/m ²
Marley Plain	973 N/m ²
Marley Bold Roll	630 N/m ²
Redland Cambrian	306 N/m ²
Redland Renown	565 N/m ²
Redland Rosemary	767 N/m ²
Thatching (305mm Thick)	518 N/m ²

In practice, roof dead loads are often categorised as either light, standard or heavy, these being 0.434kN/m², 0.685kN/m² or 0.880kN/m², representing fibre-cement, concrete interlocking and plain concrete-type tiles, respectively. These values are measured along the rafter slope and include an allowance of 0.11kN/m² for felt, battens and rafter self weight.

Since ceiling finishes may often be directly applied to the underside of BCI® Joists used to create open roof voids, Boise Engineered Wood Products Engineering recommends that BCI® rafters be designed with a 0.25 kN/m² ceiling dead load, including further allowance for self weight of the rafter and a deflection limit of 0.3% x span under the total (dead + imposed) load. On this basis, maximum rafter spans are shown on pages 37 and 38 for a range of roof pitches for either light, standard or heavy roof coverings.



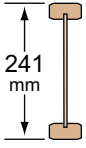
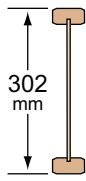
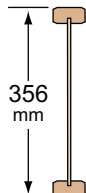
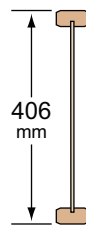
Roof Rafter Span Tables

Joist Depth	Joist Series	Maximum Rafter Spans (m) @ 400mm c/c (Medium duration loading, $k_3 = 1.25$)														
		Lightweight Tile Loading (0.434kN/m ² dead + 0.75kN/m ² imposed)					Standard Tile Loading (0.685kN/m ² dead + 0.75kN/m ² imposed)					Heavy Tile Loading (0.880kN/m ² dead + 0.75kN/m ² imposed)				
		15°	22.5°	30°	37.5°	45°	15°	22.5°	30°	37.5°	45°	15°	22.5°	30°	37.5°	45°
	5000s	5.19	5.09	4.93	4.94	4.86	4.90	4.79	4.64	4.60	4.48	4.71	4.61	4.46	4.39	4.25
	6000s	5.43	5.32	5.16	5.17	5.09	5.13	5.02	4.86	4.82	4.69	4.93	4.82	4.66	4.60	4.45
	6500s	5.62	5.50	5.34	5.34	5.27	5.30	5.18	5.02	4.98	4.85	5.09	4.98	4.82	4.75	4.60
	60s	5.88	5.76	5.59	5.60	5.52	5.55	5.43	5.26	5.22	5.09	5.33	5.21	5.04	4.98	4.82
	90s	6.72	6.59	6.39	6.41	6.32	6.34	6.20	6.01	5.97	5.82	6.09	5.95	5.76	5.69	5.52
	5000s	6.18	6.05	5.86	5.87	5.78	5.83	5.70	5.52	5.47	5.33	5.60	5.48	5.30	5.22	5.06
	6000s	6.46	6.33	6.13	6.14	6.05	6.09	5.96	5.77	5.72	5.58	5.86	5.73	5.54	5.46	5.29
	6500s	6.68	6.54	6.34	6.35	6.25	6.30	6.16	5.97	5.92	5.77	6.05	5.92	5.73	5.65	5.47
	60s	7.06	6.91	6.70	6.71	6.61	6.66	6.52	6.31	6.26	6.10	6.40	6.26	6.05	5.97	5.78
	90s	8.05	7.89	7.65	7.67	7.56	7.60	7.43	7.20	7.14	6.97	7.30	7.14	6.91	6.82	6.61
	5000s	7.00	6.85	6.64	6.65	6.55	6.60	6.46	6.25	6.20	6.04	6.35	6.21	6.00	5.92	5.73
	6000s	7.30	7.15	6.94	6.94	6.84	6.89	6.74	6.53	6.47	6.30	6.63	6.48	6.27	6.18	5.98
	6500s	7.55	7.40	7.17	7.18	7.07	7.13	6.97	6.75	6.69	6.52	6.85	6.70	6.48	6.39	6.19
	60s	8.04	7.87	7.63	7.64	7.52	7.58	7.42	7.18	7.12	6.94	7.29	7.13	6.89	6.80	6.58
	90s	9.16	8.97	8.70	8.71	8.59	8.64	8.46	8.19	8.12	7.92	8.30	8.12	7.86	7.75	7.51
	6000s	8.07	7.90	7.66	7.66	7.55	7.61	7.45	7.21	7.14	6.96	7.32	7.16	6.92	6.82	6.61
	6500s	8.34	8.16	7.92	7.92	7.80	7.87	7.70	7.45	7.39	7.20	7.56	7.40	7.15	7.05	6.83
	60s	8.90	8.71	8.45	8.45	8.33	8.40	8.22	7.95	7.88	7.68	8.07	7.89	7.63	7.53	7.29
	90s	10.14	9.93	9.63	9.64	9.50	9.56	9.36	9.06	8.98	8.76	9.19	8.99	8.69	8.58	8.31

Design Notes :

- 1 - All spans quoted are 'engineering spans' measured on plan between centres of bearings.
- 2 - Linear interpolation may be used for intermediate roof pitches between those tabulated.
- 3 - Spans assume rafters are restrained via battens at centres no greater than 400mm.
- 4 - Dead loads quoted are measured on slope and allow for standard fibre-cement, concrete interlocking and plain concrete tiles respectively plus felt, battens, rafter self-weight and plasterboard ceiling. **A ceiling dead load allowance of 0.25kN/m² has been assumed.**
- 5 - Imposed load assumed is 0.75kN/m² (measured on plan) up to 30° pitch, reducing linearly thereafter to zero at 60° pitch.
- 6 - All spans quoted relate to medium-term load duration. Refer to Boise Engineered Wood Products Engineering for long-term loading conditions.
- 7 - Deflection limited to 0.3% of the span.

Roof Rafter Span Tables

Joist Depth	Joist Series	Maximum Rafter Spans (m) @ 600mm c/c (Medium duration loading, $k_3 = 1.25$)														
		Lightweight Tile Loading (0.434kN/m ² dead + 0.75kN/m ² imposed)					Standard Tile Loading (0.685kN/m ² dead + 0.75kN/m ² imposed)					Heavy Tile Loading (0.880kN/m ² dead + 0.75kN/m ² imposed)				
		15°	22.5°	30°	37.5°	45°	15°	22.5°	30°	37.5°	45°	15°	22.5°	30°	37.5°	45°
	5000s	4.50	4.40	4.27	4.28	4.22	4.24	4.15	4.02	3.99	3.89	4.07	3.98	3.85	3.81	3.69
	6000s	4.70	4.61	4.47	4.48	4.42	4.43	4.34	4.20	4.17	4.07	4.25	4.16	4.03	3.98	3.86
	6500s	4.86	4.76	4.62	4.63	4.57	4.58	4.48	4.34	4.31	4.21	4.40	4.30	4.16	4.11	3.99
	60s	5.08	4.98	4.84	4.85	4.79	4.79	4.69	4.54	4.51	4.41	4.60	4.50	4.36	4.30	4.18
	90s	5.80	5.69	5.52	5.54	5.48	5.46	5.35	5.19	5.16	5.04	5.24	5.13	4.97	4.91	4.77
	5000s	5.35	5.24	5.08	5.09	5.02	5.04	4.94	4.78	4.74	4.63	4.85	4.74	4.59	4.53	4.39
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	6500s	5.78	5.66	5.49	5.50	5.43	5.45	5.33	5.16	5.13	5.00	5.23	5.12	4.95	4.89	4.74
	60s	6.11	5.99	5.81	5.82	5.74	5.76	5.63	5.46	5.42	5.29	5.53	5.41	5.23	5.17	5.01
	90s	6.96	6.82	6.62	6.64	6.56	6.55	6.42	6.22	6.18	6.04	6.29	6.16	5.96	5.89	5.72
	5000s	6.06	5.94	5.76	5.77	5.69	5.72	5.59	5.42	5.38	5.24	5.49	5.37	5.20	5.13	4.97
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	60s	6.96	6.82	6.61	6.63	6.54	6.56	6.42	6.22	6.17	6.02	6.30	6.16	5.96	5.89	5.71
	90s	7.92	7.76	7.54	7.55	7.46	7.46	7.31	7.08	7.03	6.87	7.17	7.01	6.79	6.71	6.51
	6000s	6.99	6.85	6.64	6.65	6.56	6.59	6.45	6.25	6.20	6.04	6.33	6.19	5.99	5.91	5.73
	6500s	7.22	7.07	6.86	6.87	6.78	6.81	6.66	6.45	6.40	6.25	6.54	6.40	6.19	6.11	5.92
	60s	7.71	7.55	7.33	7.34	7.24	7.27	7.11	6.89	6.84	6.67	6.98	6.83	6.61	6.52	6.32
	90s	8.77	8.59	8.34	8.36	8.25	8.27	8.09	7.84	7.78	7.60	7.94	7.76	7.52	7.42	7.20

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- Linear interpolation may be used for intermediate roof pitches between those tabulated.
- Spans assume rafters are restrained via battens at centres no greater than 400mm.
- Dead loads quoted are measured on slope and allow for standard fibre-cement, concrete interlocking and plain concrete tiles respectively plus felt, battens, rafter self-weight and plasterboard ceiling. **A ceiling dead load allowance of 0.25kN/m² has been assumed.**
- Imposed load assumed is 0.75kN/m² (measured on plan) up to 30° pitch, reducing linearly thereafter to zero at 60° pitch.
- All spans quoted relate to medium-term load duration. Refer to Boise Engineered Wood Products Engineering for long-term loading conditions.
- Deflection limited to 0.3% of the span.

FOR INSTALLATION STABILITY -
See section on temporary BCI® Joist
bracing details given earlier

Roof covering to Building
Designers specification

Ridge beam
see R9 and R10.

Single run bracing
see R13a

Metal strap cross bracing
see R13.

Roof-light
trimmers
see R5.

Multiple BCI® Joists
may be required,
depending upon
opening size.

Masonry restraint
see R14.

Gable ladder
see R11.

NOTE: Unless otherwise noted,
all roof details are valid for
slopes of 45° or less.

Eaves fixings
see R1 to R4.

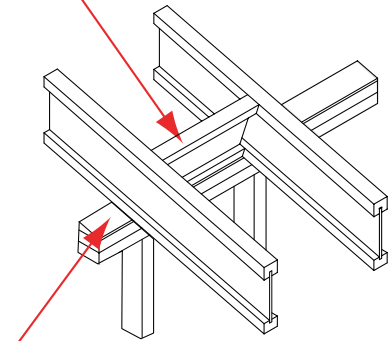
NOTE: Ventilation -
The 38mm, prestamped knockout
holes spaced at 305mm centres along
the BCI® Joist may all be knocked out
and used for ventilation

NOTE: Bracing is shown for illustrative purposes
only. The Building Designer remains responsible for
specifying all bracing to achieve roof stability.



R1 Bevel plate eave details

BCI® blocking between each rafter.



Bevelled plate fixed to wall to Building Designers specification.

R1a Bevel plate eaves detail (timber overhang)

3.75x75mm nails at 150mm centres.

38x89mm rafter extension one side.

Fit backer block behind rafter extension (Fix as R7a)

Timber block. (38x89mm min.)

1200mm horiz.

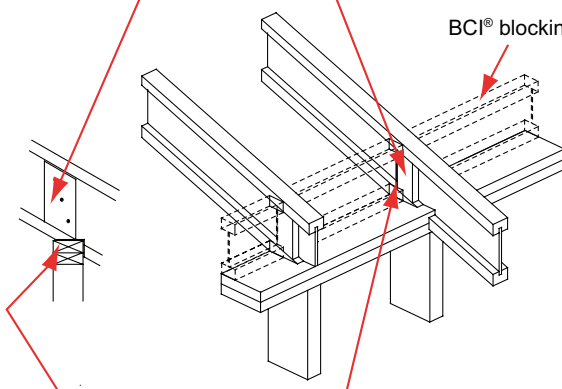
Blocking at support not shown for clarity.

750mm horiz.

R2 Birdsmouth eaves detail

Web stiffener required at each side.

BCI® blocking.



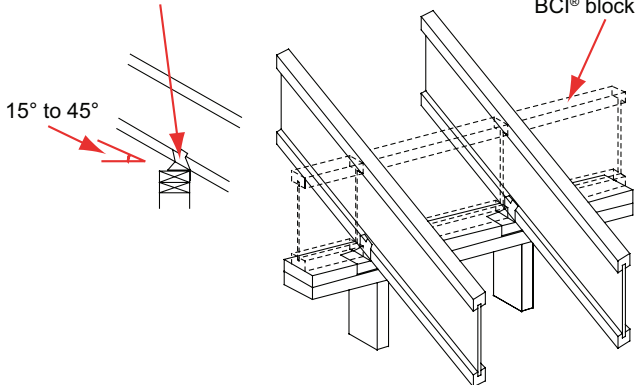
Flange of BCI® Joists may be birdsmouth cut only at the low end of the joist. Birdsmouth cut BCI® Joist must bear fully on plate, rather than overhanging the inside face of plate.

R3 Metal connector eaves detail

Variable pitch metal connector fixed strictly in accordance with manufacturers instructions.

BCI® blocking.

15° to 45°



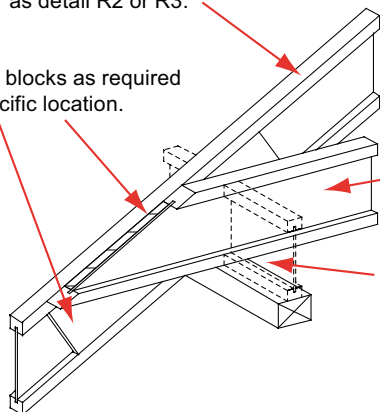
R4 Roof eaves & floor junction

BCI® Rafter fixed to wallplate as detail R2 or R3.

Timber blocks as required for specific location.

BCI® Joist.

BCI® blocking.



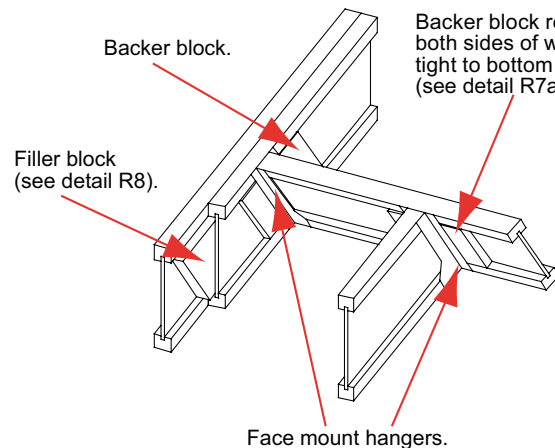
R5 Roof-light trimming

Backer block.

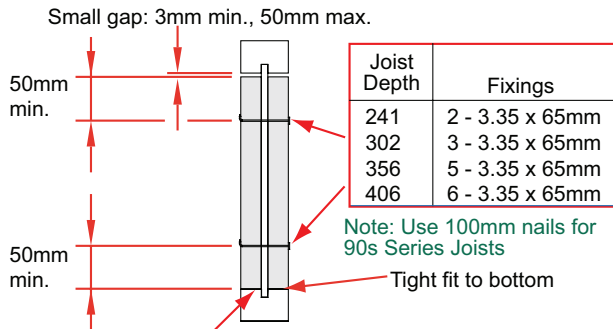
Backer block required on both sides of web. Install tight to bottom flange (see detail R7a).

Filler block (see detail R8).

Face mount hangers.



R6 Web stiffener attachment



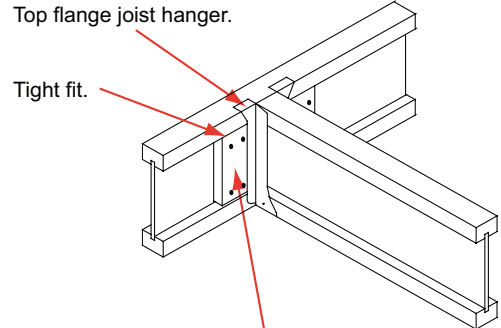
OSB or Plywood Web Stiffener:

5000s Series	18x60mm min.
6000s Series	22x60mm min.
6500s Series	25x60mm min.
60s Series	22x60mm min.
90s Series	38x60mm min.

Note: Web stiffeners are not required for BCI® Joists unless used in hangers that do not extend up to restrain the top flange of the BCI® Joist or as required by design.

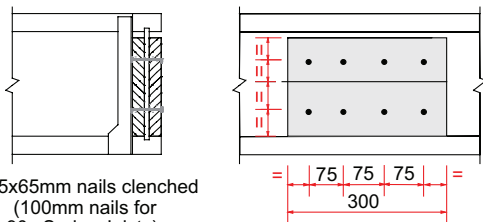
R7 Backer block application

Note: Fix backer block using 8-No 3.35x65mm nails clenched (see detail R7a). Use 100mm nails for 90s series joist.



With top flange hangers, backer block must be installed tight to the underside of top flange. Backer block required on both sides of web.

R7a Backer block (fixing & specification)



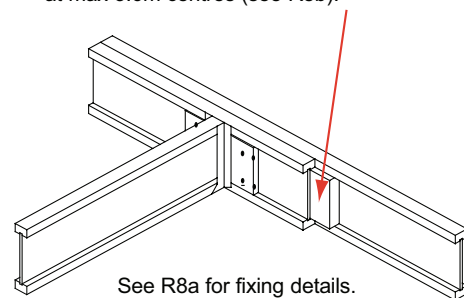
3.35x65mm nails clenched (100mm nails for 90s Series Joists).

Where nails are clenched, all nails can be driven from near side.

Series	Backer Block Thickness	Depth	Backer Block Depths
5000s	20mm wood panel	241mm	147mm
6000s	25mm wood panel	302mm	219mm
6500s	27mm wood panel	356mm	269mm
60s	25mm wood panels	406mm	319mm
90s	18mm + 22mm wood panels		

R8 Filler block application

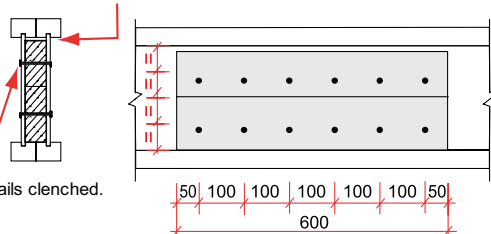
Fix 2-ply BCI® Joists together using filler blocks at all bearing points, at incoming load positions and at max 3.6m centres (see R8b).



See R8a for fixing details.

R8a Filler block (fixing & specification)

Gap required to avoid forced fit.

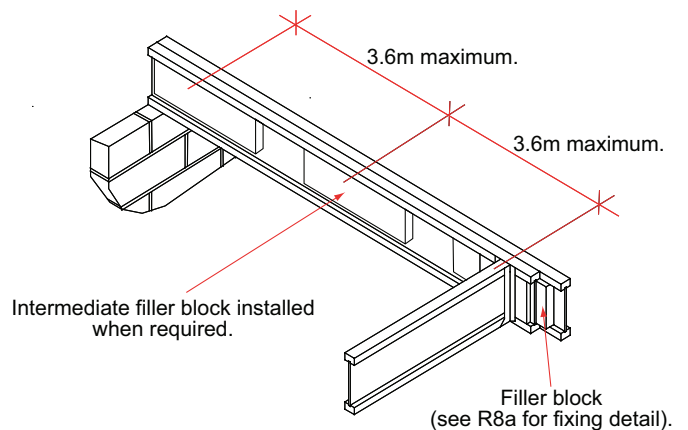


3.35x65mm nails clenched.

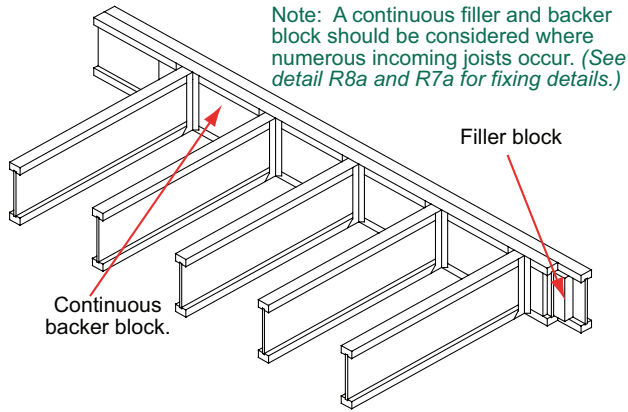
Diagram showing dimensions for filler block placement: 50, 100, 100, 100, 100, 100, 50. Total width: 600.

R8b Intermediate filler blocks

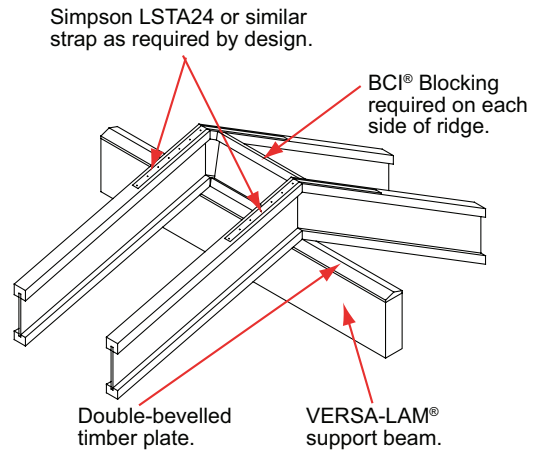
Note: Maximum spacing between filler blocks to be 3.6 metres. Intermediate filler blocks should be installed between bearing and incoming load positions.



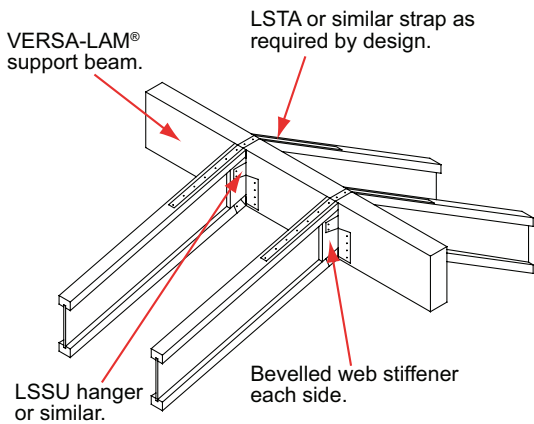
R8c Continuous filler block



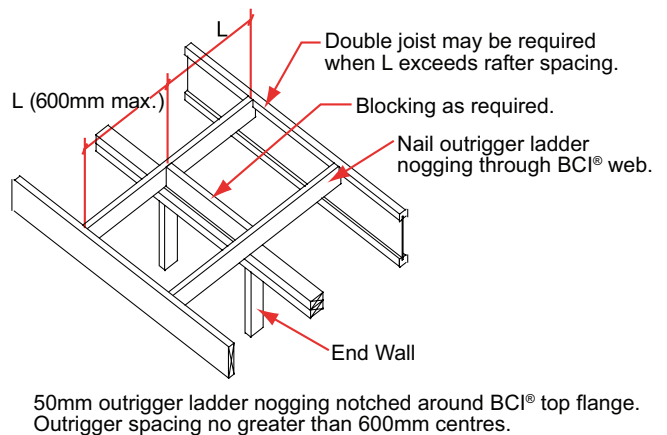
R9 Downstand ridge beam



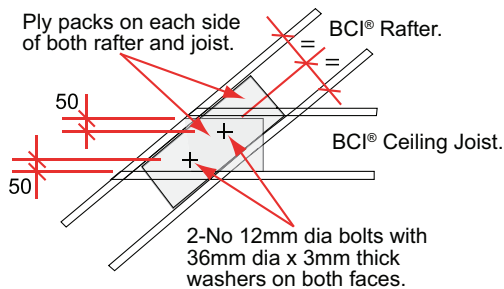
R10 Flush ridge beam



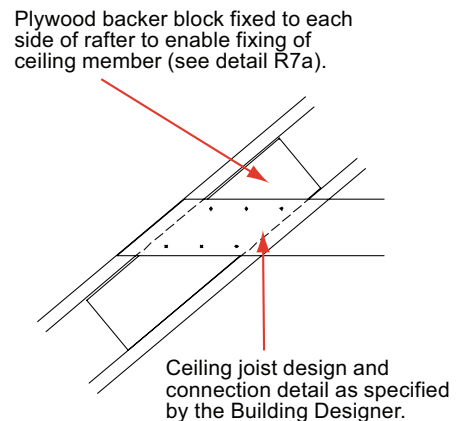
R11 Gable ladder



R12 Raised ceiling junction (BCI®)

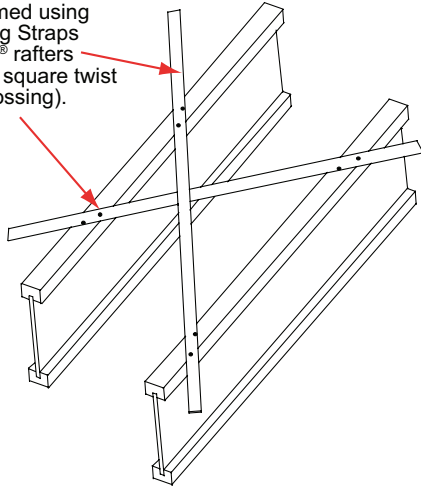


R12a Raised ceiling junction (timber)



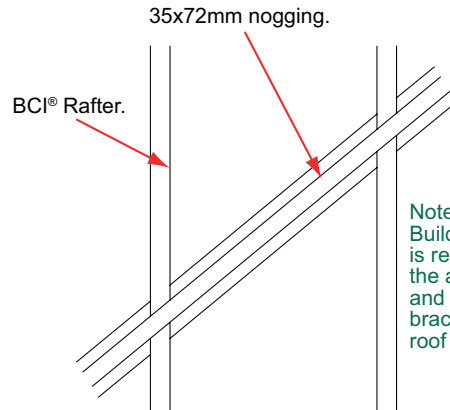
R13 Metal strap cross bracing

Cross bracing formed using 1.0mm Steel Fixing Straps fixed to top of BCI® rafters using 3.75x32mm square twist nails (2-No per crossing).



Note: The Building Designer is responsible for the arrangement and quantity of bracing to provide roof stability.

R13a Single run bracing

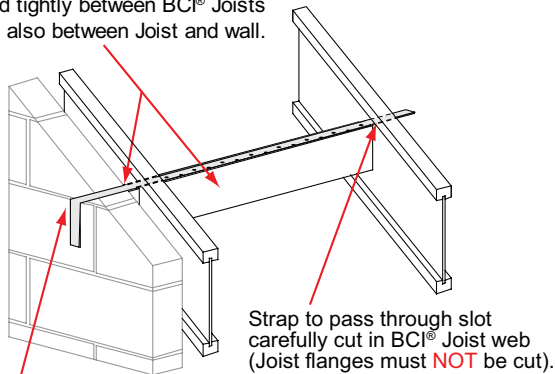


Note: The Building Designer is responsible for the arrangement and quantity of bracing to provide roof stability.

Roof stability provided by installing 35x72mm timber noggings between the rafters, cut to ensure a tight fit. Secure to rafters using 1-No 3.35x65mm lg nail per end. Continuity of bracing provided by installing 1.0mm MS Fixing Strip over noggings, nailed continuously. Bracing to be installed at approximately 45 deg to rafters on the roof slope.

R14 Masonry wall restraint

35x145mm C16 noggings to be fixed tightly between BCI® Joists and also between Joist and wall.

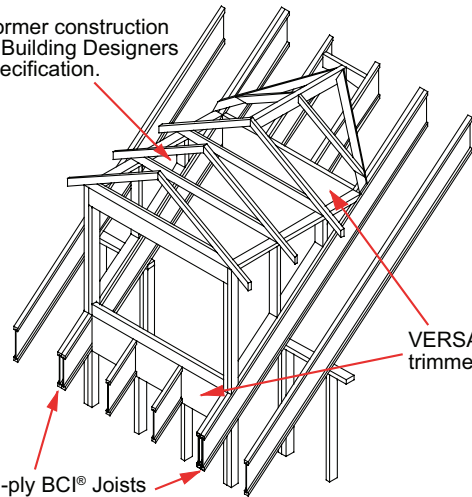


Restraint strap to be fixed to uncut block.

Strap to pass through slot carefully cut in BCI® Joist web (Joist flanges must NOT be cut).

R15 Dormer construction

Dormer construction to Building Designers specification.



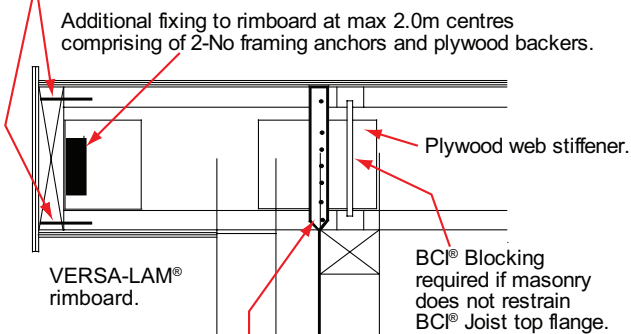
Multi-ply BCI® Joists under dormer cheeks.

VERSA-LAM® trimmers.

R16 Flat roof over-hanging eaves

Rimboard fixed to each joist using 1-No 3.35 x 65 lg galv (or improved) wire nail to each joist flange.

Additional fixing to rimboard at max 2.0m centres comprising of 2-No framing anchors and plywood backers.



VERSA-LAM® rimboard.

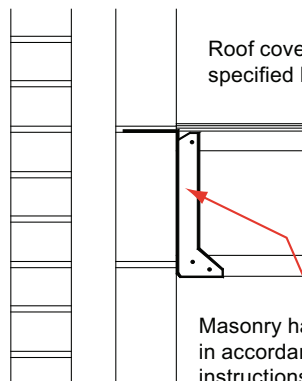
BCI® Blocking required if masonry does not restrain BCI® Joist top flange.

Holding-down strap by Builder to Building Designers specification.

Roof covering and gutter details as specified by the Building Designer.

R17 Flat roof parapet eaves

Parapet wall.



Roof covering and gutter details as specified by the Building Designer.

Masonry hanger installed into wall in accordance with manufacturer's instructions.

The Builder is to ensure that there is sufficient masonry above the hanger to meet the manufacturer's specifications.