



Sizing rafters



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NZS 3604:2011 *TIMBER-FRAMED BUILDINGS* SETS OUT HOW TO SIZE RAFTERS IN TABLE 10.1. THE BRANZ TECHNICAL HELPLINE HAS RECEIVED QUERIES ON DOING THIS, SO LET'S STEP THROUGH SOME EXAMPLES.

TO USE TABLE 10.1 for a building, you need to know:

- wind zone
- light or heavy roof
- skillion or couple-close roof
- rafter span, taken along the pitch line of the rafter (see Figure 1)
- single span or continuous over two spans (without birdsmouth over mid support).

Example 1

In the first example, the building's parameters are:

- wind zone: low
- light, couple-close roof
- rafter span 3.000 m continuous over two spans.

Step 1 – Rafter spacing

The rafter span is 3.000 m, and because this is a light roof, the far right column of NZS 3604:2011 Table 10.1 *Rafters for all wind zones* (see Figure 2) can be used for rafter spacings at 1200 mm (see Note 4 in Table 10.1).

When choosing the rafter spacing, also consider the proposed roof type and the support it requires – battens, purlins or sarking. Is 1200 mm rafter spacing appropriate?

Step 2 – Rafter span multiplier

Table 10.1 has span length multipliers for 'Low and Medium' and 'High and Very High' wind zones.

This example is a light roof in a low wind zone, so the Low and Medium multiplier of 1.3 can be used.

Step 3 – Continuous rafter 10% increase

Table 10.1 Note 1 also allows rafter spans to be increased by 10% where rafters are continuous over two or more spans, and are not birdsmouth seated.

This rafter extends over two spans, so the 10% increase can also be used to select the most economic rafter.

Step 4 – Work out rafter span

Look at the values in the span column for 1200 mm rafter spacing.

Try 2.2 m span \times 1.3 multiplier = 2.86 m

Apply the additional 10% permitted in Note 1:

$2.86 + 10\%$ (0.286) = 3.146. This is more than the span in Figure 1, so a 2.2 m rafter span is suitable.

Step 5 – Rafter size

Read the rafter size in the left column of Table 10.1 for the 2.2 m span chosen. This indicates a 140 \times 45 mm rafter size.

Step 6 – Fixing

Read off the fixing type in the same row, in this case Type E (2/90 \times 3.15 mm skew nails + 2 wire dogs) or an alternative fixing of 4.7 kN. ➤

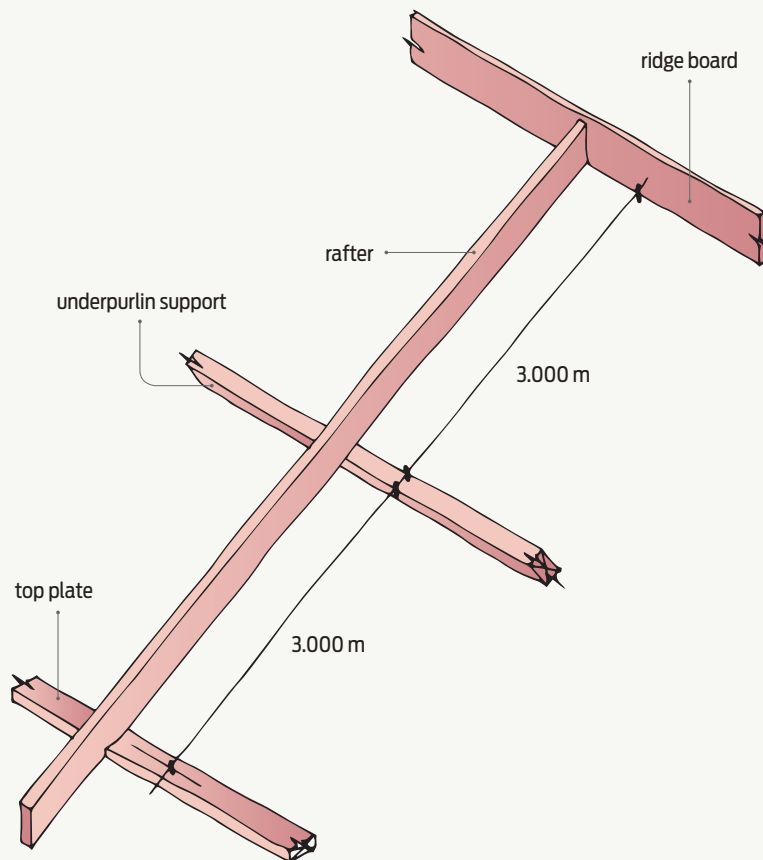


Figure 1 Example 1 – span continuous over two spans.

SECTION 10 – ROOF FRAMING

NZS 3604:2011

Table 10.1 – Rafters for all wind zones – SG 8 (see 10.2.1.3.2)

Step 1 but see Note 4 also

Rafter size (width x thickness)	Rafter spacing (mm)							
	480		600		900		1200 (see Note (4))	
	Span	Fixing	Span	Fixing	Span	Fixing	Span	Fixing
(a) Ordinary rafters for light and heavy roofs								
(mm x mm)	(m)	(type)	(m)	(type)	(m)	(type)	(m)	(type)
90 x 45	1.3	E	1.3	E	1.2	E	1.3	E
140 x 45	2.7	E	2.5	E	2.2	E	2.2	E
190 x 45	3.5	E	3.3	E	2.8	E	2.5	E
240 x 45	3.8	E	3.5	E	3.1	E	2.8	E
290 x 45	4.1	E	3.8	E	3.3	E	3.0	E
140 x 70	3.2	E	2.9	E	2.6	E	2.8	E
190 x 70	4.3	E	4.0	E	3.5	E	3.7	E
240 x 70	5.4	E	5.1	E	4.4	E	4.3	F
290 x 70	6.4	E	5.9	E	5.1	E	4.6	F
140 x 90	3.4	E	3.2	E	2.8	E	3.0	E
190 x 90	4.7	E	4.3	E	3.8	E	4.1	F
240 x 90	5.9	E	5.5	E	4.8	F	5.1	F
290 x 90	7.2	E	6.7	E	5.8	F	5.9	F

The table gives maximum spans for Extra high wind zone.
In other wind zones, span lengths shall be multiplied by the following factors:

Low and Medium:	1.3	High and Very high:	1.1
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Fixing type	Description	Alternative fixing capacity (kN)
E	2 / 90 x 3.15 skew nails + 2 wire dogs	4.7
F	2 / 90 x 3.15 skew nails + strap fixing (see figure 10.6)	7.0

NOTE –

- Rafter spans may be increased by 10 % for rafters continuous over 2 or more spans that have not been birdsmouth jointed at intermediate supports.
- Fixing types at intermediate supports for rafters running continuously over those supports shall have double the capacity of the fixing types given in this table.
- Members 90 mm thick may be substituted with built-up members sized and nailed in accordance with 2.4.4.7.
- Rafter spacing of 1200 mm does not include heavy roofs.

Step 5

Step 4
Step 6a
(see 6b for details)

Step 2

Step 6b

Step 3

Figure 2

Example 1 using NZS 3604:2011 Table 10.1. (Provided by Standards New Zealand under licence 001094.)

Example 2

We're changing the parameters in this second example to:

- wind zone: high
- heavy, skillion roof
- rafter span 3.000 m.

Step 1 – Rafter spacing

Choose rafter spacing from Table 10.1 – the options are 480, 600 or 900 mm. This is a heavy roof, so the 1200 mm column on the right side of the table is excluded – it only applies to light roofs.

This is a skillion roof, so consider roof cladding, how it will be fixed, whether it is to purlins, battens or sarking, and the proposed ceiling lining requirements.

The most likely choice here would be for 600 mm spacing or less, to accommodate ceiling battens and sheet linings (see Figure 4).

Step 2 – Rafter span multipliers

This example is in a high wind zone, so the 'High and Very High' multiplier of 1.1 can be used.

Step 3 – Continuous rafter 10% increase?

This rafter is a single span, so the 10% increase in span over two supports cannot be used.

Step 4 – Rafter span

Choosing 2.5 m span from the 600 mm spacing column:

2.5×1.1 multiplier = 2.75 m does not give the required span of 3.000 m.

The next option in Table 10.1 is 3.3 m. This exceeds the rafter span proposed without using the multiplier so is suitable.

Step 5 – Rafter size

Read the rafter size in the left column of Table 10.1 for the 3.3 m span chosen. This indicates a 190×45 mm rafter size.

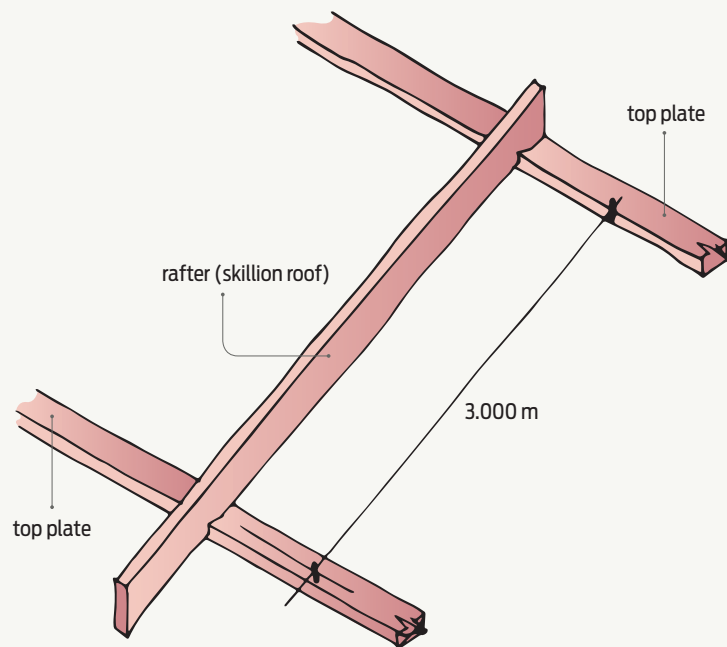


Figure 3

Example 2 – single span rafter and skillion roof.

Note: The 140×70 mm rafter size permitted to span 2.9 m could also have been used (since 2.9×1.1 multiplier = 3.19 m), but this is not a stock size so was not chosen.

Step 6 – Fixing

The corresponding fixing type is Type E but this is a skillion roof, and Table 10.18 (see Figure 5) refers to Table 10.1 for rafters except for skillion roofs, so Type E fixing is not suitable.

Table 10.18 references clause 10.2.1.3.7, which directs readers to Figure 10.6. This shows a 7 kN fixing for rafters to top plate when a skillion roof.

So Type F ($2/90 \times 3.15$ mm skew nails + strap fixing) or an alternative fixing of 7 kN is required.

Valley rafters

Valley rafters are covered in Table 10.1(b) page 10-10.

There are no multipliers or percentage increases for multiple spans, so simply use the span and fixings from the table. ◀

SECTION 10 – ROOF FRAMING

NZS 3604:2011

Table 10.1 – Rafter for all wind zones – SG 8 (see 10.2.1.3.2)

Rafter size (width x thickness)	Rafter spacing (mm)							
	480		600		900		1200 (see Note (4))	
	Span	Fixing	Span	Fixing	Span	Fixing	Span	Fixing
(a) Ordinary rafters for light and heavy roofs								
(mm x mm)	(m)	(type)	(m)	(type)	(m)	(type)	(m)	(type)
90 x 45	1.3	E	1.3	E	1.2	E	1.3	E
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190 x 45	3.5	E	3.3	E	2.8	E	2.5	E
240 x 45	3.8	E	3.5	E	3.1	E	2.8	E
290 x 45	4.1	E	3.8	E	3.3	E	3.0	E
140 x 70	3.2	E	2.9	E	2.6	E	2.8	E
190 x 70	4.3	E	4.0	E	3.5	E	3.7	E
240 x 70	5.4	E	5.1	E	4.4	E	4.3	F
290 x 70	6.4	E	5.9	E	5.1	E	4.6	F
140 x 90	3.4	E	3.2	E	2.8	E	3.0	E
190 x 90	4.7	E	4.3	E	3.8	E	4.1	F
240 x 90	5.9	E	5.5	E	4.8	F	5.1	F
290 x 90	7.2	E	6.7	E	5.8	F	5.9	F

The table gives maximum spans for Extra high wind zone.
In other wind zones, span lengths shall be multiplied by the following factors:

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NOTE –

- Rafter spans may be increased by 10% for rafters continuous over 2 or more spans that have not been birdsmouth jointed at intermediate supports.
- Fixing types at intermediate supports for rafters running continuously over those supports shall have double the capacity of the fixing types given in this table.
- Members 90 mm thick may be substituted with built-up members sized and nailed in accordance with 2.4.4.7.
- Rafter spacing of 1200 mm does not include heavy roofs.

Step 1

Step 4

Step 6a (but E not suitable for skillion roof)

Step 5

Step 2

Step 6c

Step 3

Figure 4

Example 2 using NZS 3604:2011 Table 10.1. (Provided by Standards New Zealand under licence 001094.)

SECTION 10 – ROOF FRAMING

NZS 3604:2011

Table 10.18 – Nailing schedule for hand-driven and power-driven nails (see 10.5.1)

Joint	Hand-driven nails		Power-driven nails	
	Length (mm) x diameter (mm) and type	Number/ Location	Length (mm) x diameter (mm) and type	Number/ Location
Roof framing				
Rafter or jack rafter to ridge board or top plate (except skillion roofs) (see 10.2.1.3.7)	See table 10.1	See table 10.1	See table 10.1	See table 10.1
Truss to top plate of external wall	See tables 10.14 and 10.15	See tables 10.14 and 10.15	See tables 10.14 and 10.15	See tables 10.14 and 10.15
			90 x 3.15	2

Step 6b

Figure 5

NZS 3604:2011 Table 10.18. (Provided by Standards New Zealand under licence 001094.)