JAMES COOK CYCLONE STRUCTURAL TESTING STATION

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WITHDRAWAL STRENGTH OF GROOVED NAILS IN PINE

Part 2 — RECOMMENDATIONS as BATTEN / RAFTER JOINTS

TECHNICAL REPORT No. 17

DEPARTMENT OF CIVIL & SYSTEMS ENGINEERING
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CYCLONE TESTING STATION

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Part 2

Recommendations as Batten/Rafter Joints

G.F. Reardon

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WITHDRAWAL STRENGTH OF GROOVED NAILS IN PINE

Part 2 Recommendations as Batten/Rafter Joints

G.F. Reardon

ABSTRACT

This report continues on from Part 1 by making recommendations for the use of grooved nails to secure roofing battens to rafters. 75 mm nails manufactured by Able Staples, Bostitch, Jambro, National and Sidney Cooke were investigated. Allowable loads are given for pairs of nails driven through battens into seasoned pine rafters.

Recommendations are made for the use of grooved nails in terrain categories 1, 2 and 3 in both cyclone prone and non-cyclone areas, according to the provisions of the current Wind Loading Code.

Comparisons are made with the proposals in the draft edition of the new Code.

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1. INTRODUCTION

The joint between batten and rafter is usually the one most susceptable to damage from wind forces, provided the roofing material is properly secured to the battens. The weakness is inherent in the method of construction, driving one or two nails through the batten into the rafter. Uplift wind loads cause withdrawal forces to act on the nails, and the strength of nails is considerably less in withdrawal than in lateral loading.

There are other, stronger, ways of making batten-rafter joints, for example using framing anchors or metal straps. However these methods are usually more time consuming and therefore tend to be used only when it is very obvious that nails or screws are inadequate. As a lesser alternative to framing anchors or straps, grooved nails have been developed. The grooving increases the holding power the nails thus giving them greater strength as batten-rafter joints. There is a minor penalty in this development, as grooved nails are usually more difficult to drive, but this has not appeared to curtail their popularity. However there is no standard or industry specification defining the degree of grooving for nails. For this reason different nails have varying amounts of grooving and thus have different degrees of holding power. Unfortunately nail manufacturers do not quantify the holding power of their grooved nails, thus leaving the architect or the builder to estimate a value.

Seasoned pine is becoming used in increasing quantities throughout Australia. As the holding power of plain shank nails in pine is quite low, grooved nails offer a suitable alternative to achieve required structural strength.

2. DESIGN STRENGTHS OF DOUBLE NAILED JOINTS

The Cyclone Testing Station undertook a comprehensive investigation into the holding power of grooved nails in seasoned pine species. Details of the tests and results are given in Technical Report 16 (Reardon, 1983). Twenty replications of each of six different types of grooved nails, driven into seven different species of seasoned pine were tested.

2.1 Nail Types

The nails were all nominally 75 mm long and varied in diameter of ungrooved section from 3.15 mm to 3.75 mm. Figure 1 shows the nails tested. They were supplied by Mayne Industries (National nail), Sidney Cooke, Bostitch, Able Staples and Jambro. Two different nails were supplied by Jambro, a serrated nail of near square cross section referred to in this report as Jambro 1, and a well grooved annularly threaded nail referred to as Jambro 2.

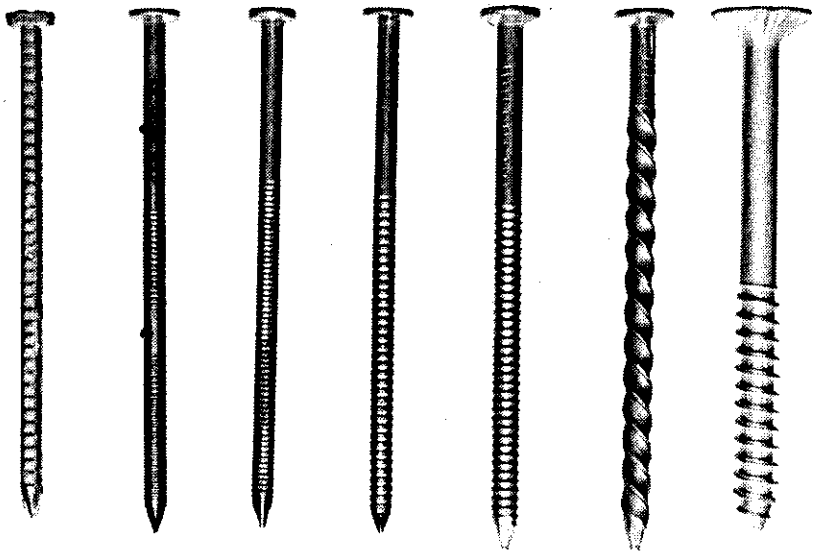


FIGURE 1 Fasteners used in test programme (l. to r. Jambro 1, Bostitch, Able Staples, Jambro 2, National, Sidney Cooke, Deutsher Screw).

As well as the grooved nails, a plain shank nail and a 75 x 14 mm "Type 17" screw were tested. They represented a lower and upper limit of pierce type of fastener as a batten-rafter joint.

The joints for test were made by driving two nails or one screw through a hardwood batten into the pine rafter. The battens were all dressed to a thickness of exactly 38 mm and the nails were driven exactly flush.

The pine rafters were either 70 x 35 mm or 90 x 35 mm. The intent in dressing the battens and driving the nails flush was to ensure that each nail had the same penetration into the pine. However this intent was somewhat thwarted because the actual length varied between nail types. The hand driven nails were 75 mm from point to bottom of the head. The power driven ones measured 75 mm to the top of the head. No attempt was made to correct this apparent anomoly as it did represent the actual situation, some nails were longer than others.

Table 1 gives details of each nail type.

TABLE 1

DETAILS OF GROOVED NAILS

Brand	Hand or power driven	Type of grooves	Measurements (mm)			No. of grooves per 10 mm
			Length	Shank dia.	dia. on grooves	
Able Staple	power	annular	74	3.1	3.2	13
Bostitch	power	annular	75	3.2	3.4	13
Jambro 1	power	shallow serrations	73	-	3.1	5
Jambro 2	power	annular	75	3.2	3.5	8
National	hand	annular	75	3.75	4.15	8
Sidney Cooke	hand	helical	75	3.75	4.15	-*

*3 start, 13 mm pitch thread

2.2 Timber

The seven species of pine included in the programme were slash, radiata, hoop, caribbean, patula, loblolly and spruce-pine-fir mix. The first six were Australian grown, but the spruce-pine-fir (SPF) was imported. Technical Report 16 discusses the performance of individual timbers relative to each other and derives design loads for each nail type in each species of timber. While those results are interesting from the

research aspect, there is little practical value in recommending separate details for joints made from each of the pine species. For the builder, the classification "seasoned pine" is sufficient. This broad classification has been used throughout this publication.

2.3 Design Strengths

2.3.1 Grooved nails

The design strength for each type of nail was derived using the fastener code (SAA, 1974) and considering the effect of proposed amendments in the draft revision of the code (SAA, 1983). The design strengths are based on those samples whose measured density, irrespective of species, fell within a specific range of densities. For joint group JD4, which covers most species of seasoned pine, the density range for test was 475-520 kg/m^3.

TABLE 2

RECOMMENDED DESIGN STRENGTHS FOR
DOUBLE NAILED JOINTS IN SEASONED PINE (JD4).

Type of grooved nail	Design Strength (kN)
Able Staple	0.84
Bostitch	0.70
Jambro 1	0.32
Jambro 2	1.01
National	1.21
Sidney Cooke	1.22

Table 2 lists the calculated design strengths for batten-rafter joints for each nail type. It must be stressed that the strengths listed in Table 2 refer to double nailed joints, with a penetration of approximately 37 mm. Joints with one nail only would have half the listed strength. Nails driven through battens of thickness other than 38 mm would have a

different strength. However it is suggested that the values listed in Table 2 be used for battens that are nominally 38 mm thick, but they are unsuitable for battens nominally 50 mm thick.

2.3.2 Screws

Amendments proposed in the draft edition of the fastener code would lead to a significant increase in design strength for withdrawal of screws. The net result is an increase of about 40% over the recommendations of the current code. Because these recommendations are only in draft form at present, and are therefore liable to change, it is considered injudicious to use them as a basis for design. Conversely, it would be conservative to publish design strengths based on the 1974 code if it will soon be significantly altered in respect of screw withdrawal strength. Therefore it has been decided not to include recommendations for power driven screws in this report, but suffice to say that a joint made from one 75 x 14 mm "Type 17" screw can be assumed to be at least equivalent in strength to one made from the strongest pair of grooved nails given in Table 1.

3. DESIGN CRITERIA

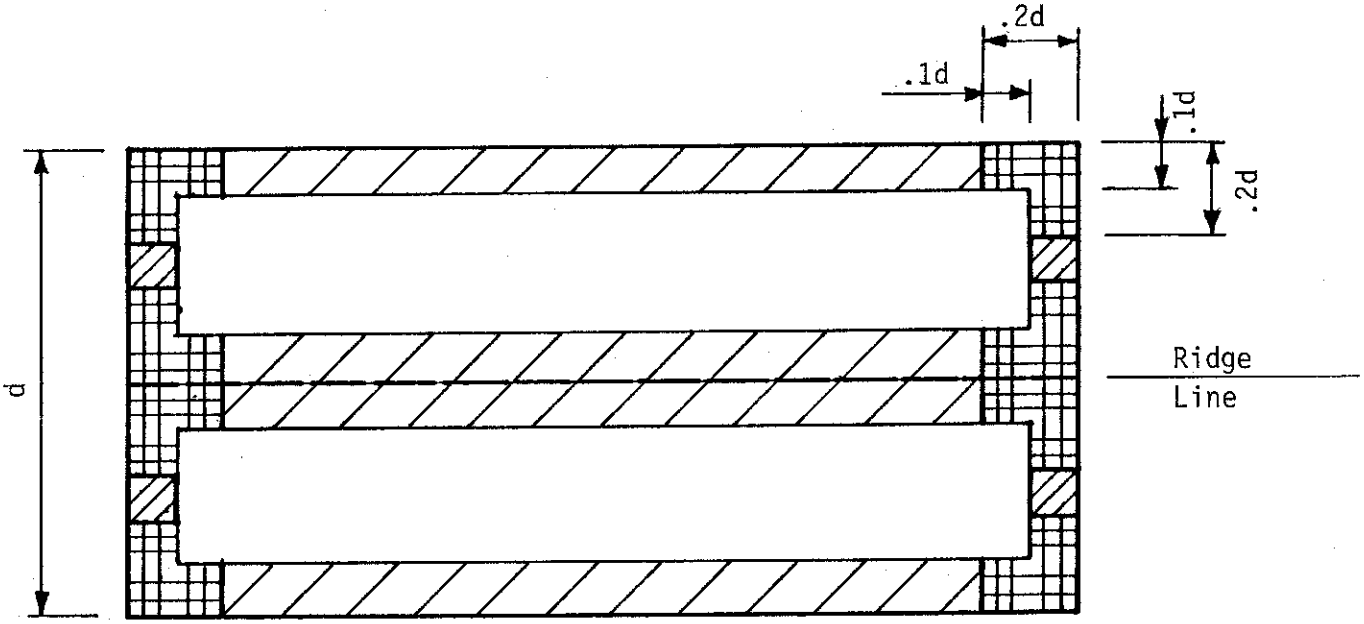
At the time of writing, the current Wind Loading Code is the 1981 edition, (SAA, 1981). However a draft revision is now in its final stages and will be published as the 1983 edition (SAA, 1983). Section 3.1 will discuss the requirements of the current code in respect of batten fixings, and section 3.2 will outline the ramifications of the draft. Tables in Appendix A listing suitable types of grooved nails satisfy the requirements of both editions of the code.

3.1 From AS 1170/2 - 1981

Using the current code, the calculation of uplift design wind pressures is a relatively easy task. Appendix B gives details of pressure coefficients and local pressure factors which should be used.

3.1.1 External pressure coefficients

It has been decided to make recommendations for two ranges of roof pitch, those below 20° and those equal to or above 20°. The external pressure coefficients are therefore -0.9 for roof slopes below 20° and -0.75 for those slopes equal to or above 20°. This presumes that the height of building is always less than or equal to its width. The negative sign of the pressure coefficient denotes pressure acting away from the roof surface, a positive sign denotes pressure acting towards the surface.



Zone where local pressure factor does not apply

Zone where local pressure factor = 1.5

Zone where local pressure factor = 2.0

Figure 2. Local pressure zones for roofs (AS 1170/2 - 1981)

The external pressure coefficients that cause uplift or suction forces to act on the surface of a building are sometimes increased by a local pressure factor. This factor is designed to take account of severe

local zones of suction that occur near corners or at abrupt changes in slope. Figure 2 broadly indicates the Wind Loading Code requirements for roofs of low rise buildings in this regard. The sketch assumes the wind acting normal to the length of the building, and dimension "d" is the building width.

The area shown is a roof plan, and the dimensions of the local pressure zones are measured from the edges of the roof. In areas marked with single slope hatching, a local pressure factor of 1.5 should be applied. In the corners, the areas marked with cross hatching require a local pressure factor of 2.0. Thus at the edges the uplift pressure coefficient is effectively -1.35 for roofs below 20° pitch and -1.1 for roofs above 20° pitch. At the corners the effective pressure coefficients are -1.8 and -1.5 respectively.

3.1.2 Internal pressure coefficients

Interpretation of the Wind Loading Code in respect of internal pressures is not as clear as for external pressures. The external pressures are related to building geometry, that is length, width, height and roof pitch, and angle of approach of wind. Internal pressures are a function of the ratio of openings on the windward wall to openings on all the other walls. Whilst this may seem clear enough debate can arise over the situation likely to prevail at the time of the wind storm, that is, are windows or doors likely to be open or closed? Even if the windows are closed, what is the probability of their being broken?

During a cyclone there may be a considerable amount of flying debris, which is likely to break windows. Wind tunnel tests (Holmes, 1978) have shown that even a relatively small opening in the windward wall is sufficient to cause maximum internal pressure within a house if there are no other openings in the walls. Therefore the Cyclone Testing Station recommends that for cyclone-prone areas the design of houses with unprotected glazing be made using an internal pressure coefficient of +0.8 when designing for strength. If the windows are protected against breakage by suitable screens or some other means, a lower pressure coefficient may be appropriate. In respect of roofing battens, it is considered that the internal pressure within the house lifts the manhole cover and

and pressurizes the roof space.

The relatively short duration of wind squalls associated with thunderstorm activity means that the probability of windbourne debris from the other buildings is small. Therefore, in areas not likely to be affected by tropical cyclones it is reasonable to expect house windows to remain intact during a wind storm. The internal pressure in such cases is much below the maximum used in the design for cyclone areas. For the calculations in this report an internal pressure coefficient of +0.2 has been used. This factor is appropriate for the case when the windward wall and the opposite wall have equal permeability.

Local pressure factors do not apply to internal pressures.

3.1.3 Total pressure coefficients

TABLE 3

PRESSURE COEFFICIENTS FOR ROOFS
(from AS 1170/2 - 1981)

Roof pitch	Roof area code	Non cyclonic (Cp_i = 0.2)	Cyclonic (Cp_i = 0.8)
< 20°	□	1.1	1.7
	▨	1.55	2.15
	▦	2.0	2.60
⩾ 20°	□	0.95	1.55
	▨	1.3	1.9
	▦	1.7	2.3

For roof surfaces the total pressure acting is the sum of uplift acting on the top surface and the pressure acting underneath. Thus the total

pressure coefficient is the arithmetic sum of the two coefficients. Table 3 summarizes total pressure coefficients for roofs, according to the provisions of AS 1170/2 - 1981.

3.1.4 Design wind speeds

Table 4 lists the basic wind speeds for a fifty year return period for the capital cities of Australia, together with the design wind speeds for 6 m height in terrain categories 1, 2 and 3.

TABLE 4

WIND SPEEDS FOR CAPITAL CITIES

City	Basic wind speed (m/s)	Design Wind Speeds (m/s) at 6 m height for		
		Terrain Category 3	Terrain Category 2	Terrain Category 1
Adelaide	42	28	40	43
Brisbane	50	33	47	52
Darwin*	55	42	60	65
Hobart	41	27	39	42
Melbourne	39	26	37	40
Perth	40	26	38	41
Sydney	44	29	41	45

*Cyclone prone area.

Appendix A contains tables recommending suitable grooved nails for use with design wind speeds listed in Table 4. For non-cyclone areas, the range of design wind speeds for category 3 terrain is relatively small, therefore only tables for 33 m/s are given. This is the design wind speed used for the SAA Timber Framing Code (SAA, 1979). There is greater variation of design wind speeds for category 2 terrain, therefore tables for 41 m/s and 47 m/s are given. Of course the recommendations of these tables are not restricted to category 2 terrain. The tables for 41 m/s are suitable for terrain category 1 in Melbourne or Perth, and those for 47 m/s are suitable terrain

category 2 in Brisbane and terrain category 1 in the other cities in the non-cyclonic area.

The appropriate tables for use in country towns or provincial cities can be determined in a manner similar to the use of Table 4. For cyclone-prone areas, wind speeds listed for Darwin are appropriate.

3.2 Draft AS 1170/2 - 1983

As the Cyclone Testing Station is represented on the SAA committee formulating amendments to the Wind Loading Code, it is reasonably confident of the contents of the 1983 edition of the code. However it does not intend to divulge those contents, but merely to highlight changes that will affect the design of roofing batten joints.

3.2.1 External pressure coefficients

In general the pressure coefficients on roofs have been reduced, especially those acting on the leeward slope of low pitched roofs where Cp has been reduced from -0.7 to -0.2 in some cases. On the windward slope the roof pitch most affected is 15° where for a $^{h}/_{d}$ ratio below 0.25 Cp = -0.4 instead of -0.9. However for buildings with high $^{h}/_{d}$ ratios and low roof pitch the values of Cp have been increased as high as -1.3.

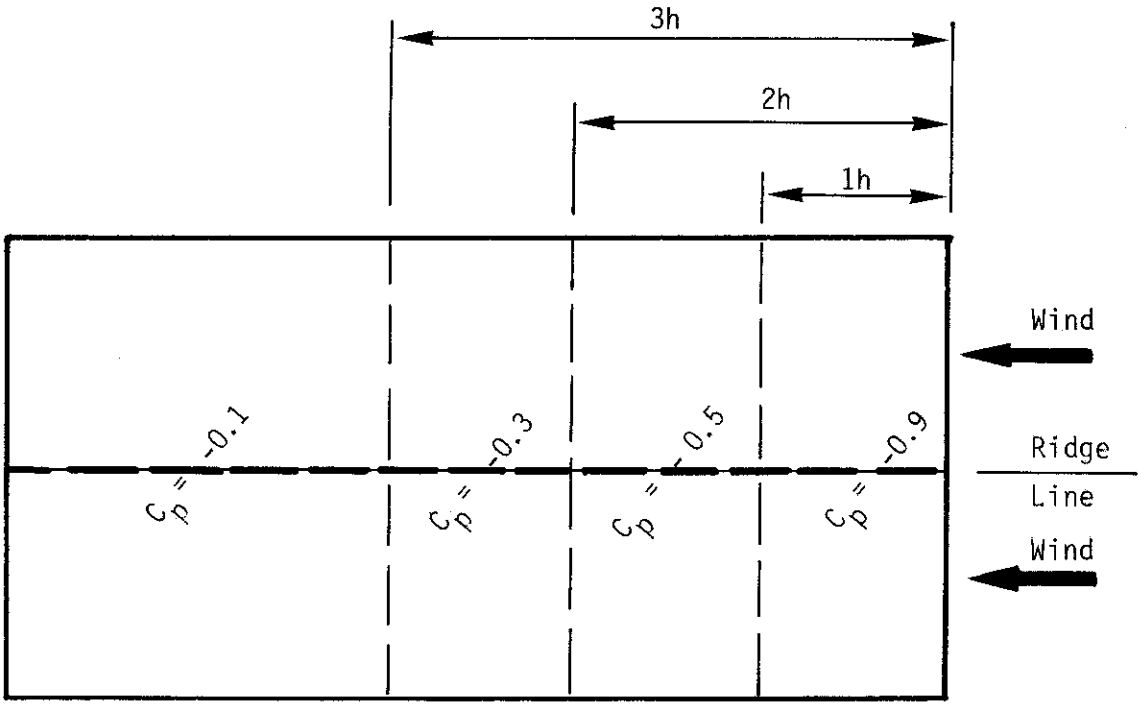


Figure 3. Reduction in pressure coefficients for wind parallel to ridge line

The draft clarifies an anomoly in the current code in respect of wind acting parallel to the length of the building. It allows progressive reduction in Cp values along the roof of low buildings irrespective of roof pitch. Figure 3 shows the allowable reduction in pressure coefficients for a low rise building. For clarity, the effect of local pressure factors have been omitted from the sketch. In the sketch 'h' is the height to eaves.

A significant change that affects the design of battens and batten joints relates to local pressure factors. The draft introduces the concept of roving patches of high pressure. There is a large patch having a local pressure factor of 1.5 and a small patch having a local pressure factor of 2.0. Figure 4 illustrates the concept and gives the size of the patch. One edge of each patch must contact either the ridge, the eaves or the gable end, but if the roof pitch is equal to or less than 10° local pressure factors need not be applied to the roof area adjacent to the ridge.

The net result of this proposal is that all the edges of the roof, and sometimes the ridge, now have to be designed for the same pressure coefficients as the corners in the 1981 code, and much of the roof surface has to be designed for the 1.5 local pressure factor.

3.2.2 Wind velocities and internal pressure coefficients

There are no proposed amendments to basic wind velocities for major centres, velocity multipliers for terrain categories or internal pressure coefficients. Therefore design wind speeds given in Table 4 will also apply for the new wind code.

3.2.3 Design pressure coefficients

In the draft, the table of pressure coefficients for roofs represents a more accurate assessment of the real situation than was given in the 1981 code. However in doing so it gives different Cp values for almost every combination of $^{h}/_{d}$ and roof pitch, when the wind acts normal to the length of the building. It is therefore too much of a generalization to use a single value for roof pitches less than 20°, as was suitable for

the 1981 code. More attention must be given to the building dimensions as there are significant increases in pressure coefficient with increased $^{h}/_{d}$ ratio. Further, clarification of the case for wind acting parallel to the ridge adds a complication to the analysis of pressures on roofs. Design must be based on the worse situation resulting from wind in either direction.

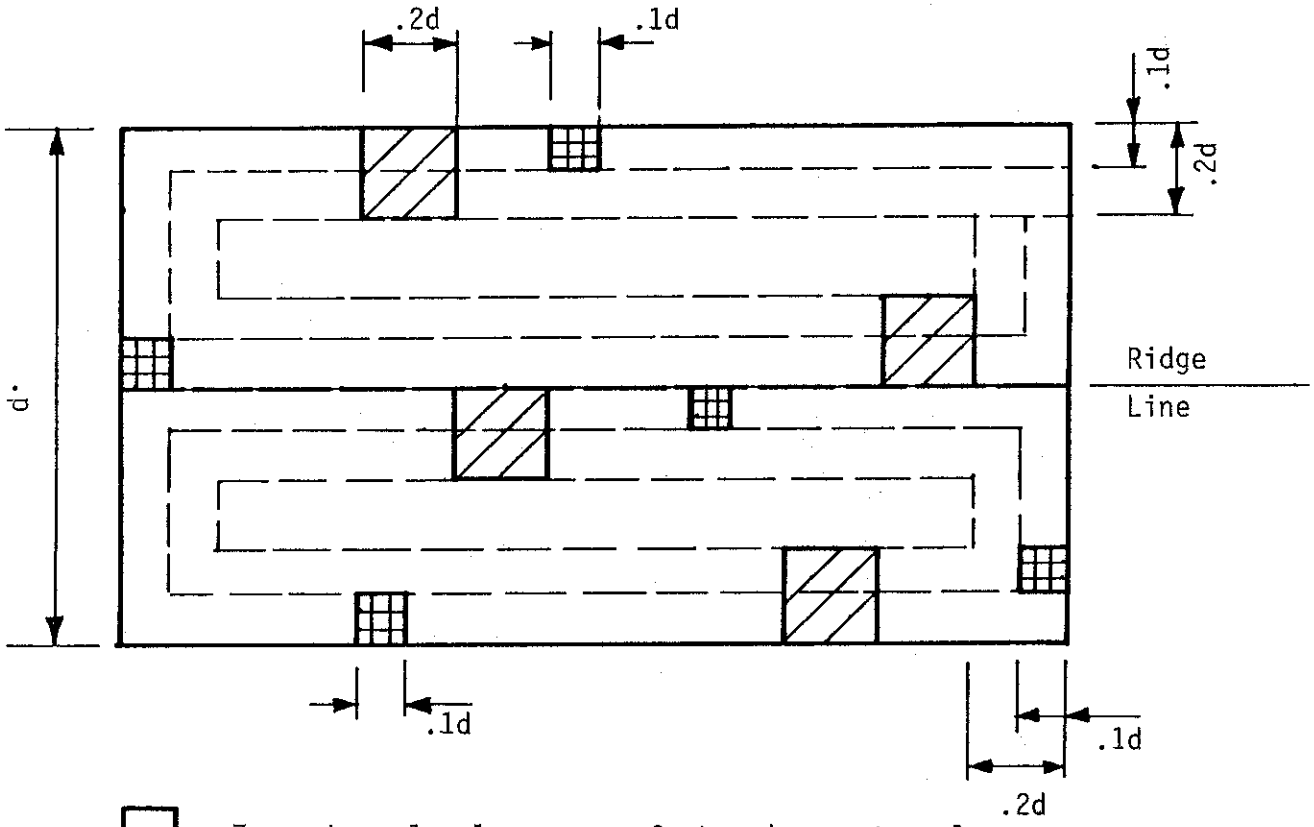


Figure 4. Local pressure zones for roofs (draft AS 1170/2 - 1983)

Table 5 lists calculated pressure coefficients for three different building heights and three different roof pitches, for buildings in cyclone areas and non-cyclone areas. The ratios of building dimensions were chosen to

TABLE 5

PRESSURE COEFFICIENTS FOR ROOFS
(from draft AS 1170/2 - 1983

Parameters (for θ = 0°)	Roof pitch	Roof area code (see Figure 3)	Non cyclonic (Cp_i = 0.2) Cp for roof area at distance			Cyclonic (Cp_i = 0.8) Cp for roof area at distance		
			1h from end	2h from end	3h from end	1h from end	2h from end	3h from end
$h/d = 3/8$ $l = 2d$ (single storey)	10°	□	1.1	1.1	1.1	1.7	1.7	1.7
		▨	1.55	1.55	1.55	2.15	2.15	2.15
		▦	2.0	2.0	2.0	2.6	2.6	2.6
	15°	□	1.1	0.7	0.6	1.7	1.3	1.2
		▨	1.55	0.95	0.8	2.15	1.55	1.4
		▦	2.0	1.2	1.0	2.6	1.8	1.6
	20°	□	1.1	0.7	0.5	1.7	1.3	1.1
		▨	1.55	0.95	0.65	2.15	1.55	1.25
		▦	2.0	1.2	0.8	2.6	1.8	1.4
$h/d = 0.7$ $l = 2d$ (two storey)	10°	□	1.3	1.3		1.9	1.9	
		▨	1.9	1.9		2.5	2.5	
		▦	2.4	2.4		3.0	3.0	
	15°	□	1.1	1.0		1.7	1.6	
		▨	1.55	1.4		2.15	2.0	
		▦	2.0	1.8		2.6	2.4	
	20°	□	1.1	0.7		1.7	1.3	
		▨	1.55	0.95		2.15	1.55	
		▦	2.0	1.2		2.6	1.8	
$h/d = 1.0$ $l = 2d$ (three storey)	10°	□	1.5			2.1		
		▨	2.15			2.75		
		▦	2.8			3.4		
	15°	□	1.2			1.8		
		▨	1.7			2.3		
		▦	2.2			2.8		
	20°	□	1.1			1.7		
		▨	1.55			2.15		
		▦	2.0			2.6		

represent typical cases. The single storey building is equivalent to a house 7 x 14 m with wall height 2.7 m above ground.

The table illustrates the influence of both transverse and longitudinal wind on the pressure coefficients. For low pitch roofs, the design pressures are those due to transverse winds, illustrated by the fact that the pressure coefficient does not diminish towards the centre of the building. Conversely, the design pressures for sleeper roof pitches are due to longitudinal wind and allow a reduction of roof uplift pressure at a distance from the end walls.

Whilst it is an interesting exercise to calculate the different pressure coefficients, it is most unlikely that a domestic building with a roof of 20° pitch would be designed for the nine different pressure coefficients. It is anticipated that the building industry would rationalize the situation and decide upon two or three zones of different pressure to be the design case. This rationalization will probably occur with any roof pitch, as the concept of dividing the roof slope from eaves to ridge into five strips seems quite impracticable. It is possible, given a narrow house, for there to be only one batten in each zone, therefore each batten would be resisting an uplift force different from the batten adjacent to it.

4. RECOMMENDATIONS

As explained in Section 3.2.3, the draft code produces different design pressures for various areas on the roof, and they vary with $^{h}/_{d}$ ratio. It is therefore no longer practicable to produce a table of uplift pressures based on roof pitch and wind speed. The only suitable form of table must now be based on wind speeds and pressure coefficients.

Appendix A contains a set of tables recommending suitable types of grooved nails for different roofing types, batten and rafter spacing and position on roof. To use the tables, one must either know the design wind speed or use Table 4 to determine it for the appropriate terrain category. Where Appendix A does not have a table for the design wind speed required, the table relating to the next speed greater than the design must be used.

In an attempt to simplify the tables in the appendix, each table refers to a set of pressure coefficients as listed in Tables 3 and 5, such as 1.1, 1.55 and 2.0, which relate to the one roof. This does mean that there is repetition of values within the tables, but it is considered satisfactory to have that repetition for the sake of simplification.

To eliminate confusion between tables of similar wind speeds, those referring to cyclone prone areas are printed on yellow paper. For additional information, tables for a cyclone wind speed of 51 m/s have been included, representing terrain category 2½ as specified in the Wind Loading Code.

5. CONCLUSIONS

Pairs of grooved nails are suitable for securing battens to pine rafters in many different wind environments.

In non-cyclone areas the nails are suitable for battens on single storey buildings in most exposures, although stronger fasteners may be required near the edge of the roof. For taller buildings some grooved nails are suitable for sheltered terrain or away from the edge of the roof in exposed terrain. Otherwise stronger fasteners are necessary.

For cyclone-prone areas some grooved nails are satisfactory for securing battens to pine rafters of single storey buildings in sheltered terrain, but stronger fasteners may be necessary at the edge of the roof. Generally the fasteners are not satisfactory for exposed terrain in a cyclone prone area.

6. ACKNOWLEDGEMENTS

The Cyclone Testing Station is grateful to the Timber Research and Development Advisory Council (TRADAC) who requested and funded the initial research to establish design loads for the different grooved nails. It is also grateful to the following fastener manufacturers for co-operating in the test programme and agreeing to the publication of the test results.

Able Staples Pty Ltd
Bostitch Textron

W.A. Deutsher Pty Ltd
Jambro Pty Ltd
Mayne Industries
Sidney Cooke Fasteners Pty Ltd

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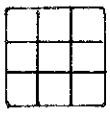
TABLE A1

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 33 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

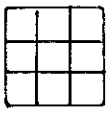
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.7	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	A
	sheet	600	A	A	A	A
	sheet	900	A	A	A	B
	sheet	1200	A	A	B	B
 Cp = 0.95	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	A
	sheet	600	A	A	A	B
	sheet	900	A	A	B	B
	sheet	1200	A	B	B	C
 Cp = 1.2	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	A
	sheet	600	A	A	B	B
	sheet	900	A	B	B	C
	sheet	1200	B	B	C	E

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A2

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 33 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

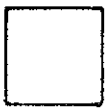
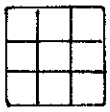
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.95	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	A
	sheet	600	A	A	A	B
	sheet	900	A	A	B	B
	sheet	1200	A	B	B	C
 Cp = 1.3	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	A	B	B
	sheet	900	A	B	B	D
	sheet	1200	B	B	D	E
 Cp = 1.7	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	B	B	C
	sheet	900	B	B	C	E
	sheet	1200	B	C	E	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A3

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 33 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

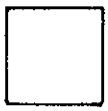
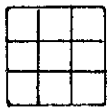
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.1	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	A
	sheet	600	A	A	B	B
	sheet	900	A	B	B	C
	sheet	1200	B	B	C	D
 Cp = 1.55	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	A	B	B
	sheet	900	B	B	C	E
	sheet	1200	B	B	E	NS
 Cp = 2.0	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	D
	sheet	900	B	B	E	NS
	sheet	1200	B	D	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A4

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 33 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

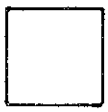
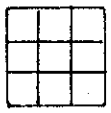
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.5	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	A	B	B
	sheet	900	B	B	C	D
	sheet	1200	B	B	D	NS
 Cp = 2.15	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	A	B	C	D
	sheet	900	B	C	E	NS
	sheet	1200	C	D	NS	NS
 Cp = 2.8	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	NS
	sheet	900	C	D	NS	NS
	sheet	1200	D	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A5

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 41 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

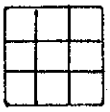
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.7	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	A
	sheet	600	A	A	A	A
	sheet	900	A	A	B	B
	sheet	1200	A	B	B	D
 Cp = 0.95	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	A	B	B
	sheet	900	A	B	C	D
	sheet	1200	B	B	D	NS
 Cp = 1.2	heavy tile	330	A	A	A	A
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	C
	sheet	900	B	B	D	NS
	sheet	1200	B	C	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A6

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 41 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

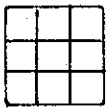
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.95	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	A	B	B
	sheet	900	B	B	C	D
	sheet	1200	B	B	D	NS
 Cp = 1.3	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	D
	sheet	900	B	B	E	NS
	sheet	1200	B	D	NS	NS
 Cp = 1.7	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	E
	sheet	900	B	D	NS	NS
	sheet	1200	D	E	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A7

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 41 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

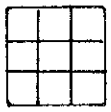
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.1	heavy tile	330	A	A	A	A
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	C
	sheet	900	B	B	D	E
	sheet	1200	B	C	E	NS
 Cp = 1.55	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	C	E
	sheet	900	B	C	E	NS
	sheet	1200	C	E	NS	NS
 Cp = 2.0	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	D
	sheet	600	B	B	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A8

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 41 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

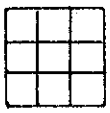
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.5	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	C	E
	sheet	900	B	C	E	NS
	sheet	1200	C	E	NS	NS
 Cp = 2.15	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	D
	sheet	600	B	C	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 2.8	heavy tile	330	A	B	C	D
	metal tile	370	B	B	D	E
	sheet	600	C	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A9

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 47 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

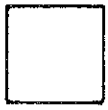
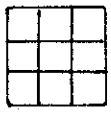
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.7	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	A	B	B
	sheet	900	A	B	B	D
	sheet	1200	B	B	D	NS
 Cp = 0.95	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	D
	sheet	900	B	B	E	NS
	sheet	1200	B	D	NS	NS
 Cp = 1.2	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	C	E
	sheet	900	B	C	NS	NS
	sheet	1200	C	E	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A10

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 47 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

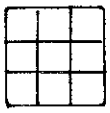
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.95	heavy tile	330	A	A	A	A
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	D
	sheet	900	B	B	D	NS
	sheet	1200	B	D	NS	NS
 Cp = 1.3	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	E
	sheet	900	B	D	NS	NS
	sheet	1200	D	E	NS	NS
 Cp = 1.7	heavy tile	330	A	B	B	D
	metal tile	370	A	B	D	E
	sheet	600	B	D	NS	NS
	sheet	900	B	NS	NS	NS
	sheet	1200	E	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A11

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 47 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

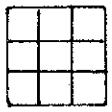
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.1	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	C	E
	sheet	900	B	C	E	NS
	sheet	1200	C	E	NS	NS
 Cp = 1.55	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	D
	sheet	600	B	C	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 2.0	heavy tile	330	A	B	B	D
	metal tile	370	B	B	D	E
	sheet	600	B	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A12

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 47 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

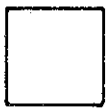
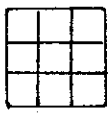
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.5	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 2.15	heavy tile	330	A	B	C	D
	metal tile	370	B	B	D	NS
	sheet	600	C	E	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.8	heavy tile	330	B	B	D	NS
	metal tile	370	B	C	E	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 13

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 52 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

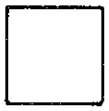
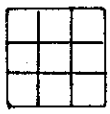
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.7	heavy tile	330	A	A	A	A
	metal tile	370	A	A	A	B
	sheet	600	A	B	B	C
	sheet	900	B	B	D	E
	sheet	1200	B	C	E	NS
 Cp = 0.95	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	C	E
	sheet	900	B	C	NS	NS
	sheet	1200	C	E	NS	NS
 Cp = 1.2	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	C	D	NS
	sheet	900	C	D	NS	NS
	sheet	1200	D	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 14

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 52 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

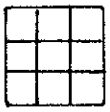
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 0.95	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	C	E
	sheet	900	B	C	E	NS
	sheet	1200	C	E	NS	NS
 Cp = 1.3	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	D
	sheet	600	B	C	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 1.7	heavy tile	330	A	B	B	D
	metal tile	370	B	B	D	E
	sheet	600	B	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 15

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 52 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

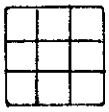
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.1	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	NS
	sheet	900	B	D	NS	NS
	sheet	1200	D	NS	NS	NS
 Cp = 1.55	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	E
	sheet	600	B	D	NS	NS
	sheet	900	D	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.0	heavy tile	330	B	B	C	E
	metal tile	370	B	B	E	NS
	sheet	600	D	E	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A16

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 52 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

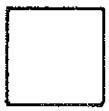
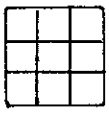
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.5	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	E
	sheet	600	B	C	NS	NS
	sheet	900	D	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.15	heavy tile	330	B	B	D	NS
	metal tile	370	B	C	E	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.8	heavy tile	330	B	C	NS	NS
	metal tile	370	C	D	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A17

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 42 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

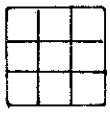
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.3	heavy tile	330	A	A	A	B
	metal tile	370	A	A	B	B
	sheet	600	A	B	B	D
	sheet	900	B	B	E	NS
	sheet	1200	B	D	NS	NS
 Cp = 1.55	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	E
	sheet	900	B	D	NS	NS
	sheet	1200	D	E	NS	NS
 Cp = 1.8	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	NS
	sheet	900	C	D	NS	NS
	sheet	1200	D	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 18

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 42 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

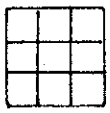
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.55	heavy tile	330	A	A	B	B
	metal tile	370	A	A	B	B
	sheet	600	B	B	D	E
	sheet	900	B	D	NS	NS
	sheet	1200	D	E	NS	NS
 Cp = 1.9	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	D
	sheet	600	B	B	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 2.3	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	E
	sheet	600	B	D	NS	NS
	sheet	900	D	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 19

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 42 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

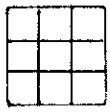
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.7	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	C
	sheet	600	B	B	D	NS
	sheet	900	B	D	NS	NS
	sheet	1200	D	NS	NS	NS
 Cp = 2.15	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	D
	sheet	600	B	C	E	NS
	sheet	900	D	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 2.6	heavy tile	330	A	B	B	D
	metal tile	370	B	B	D	E
	sheet	600	C	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 20

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 42 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

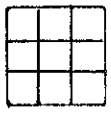
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 2.1	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	D
	sheet	600	B	C	E	NS
	sheet	900	D	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 2.75	heavy tile	330	B	B	C	D
	metal tile	370	B	B	D	NS
	sheet	600	C	E	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 3.4	heavy tile	330	B	B	D	NS
	metal tile	370	B	C	NS	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 21

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 51 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

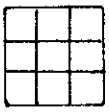
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.3	heavy tile	330	A	A	B	B
	metal tile	370	A	B	B	D
	sheet	600	B	B	E	NS
	sheet	900	C	E	NS	NS
	sheet	1200	E	NS	NS	NS
 Cp = 1.55	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	E
	sheet	600	B	D	NS	NS
	sheet	900	D	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.8	heavy tile	330	A	B	C	D
	metal tile	370	B	B	D	E
	sheet	600	C	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 22

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 51 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

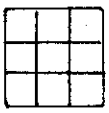
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.55	heavy tile	330	A	B	B	C
	metal tile	370	B	B	C	E
	sheet	600	B	D	NS	NS
	sheet	900	D	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.9	heavy tile	330	B	B	C	D
	metal tile	370	B	B	D	NS
	sheet	600	C	E	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.3	heavy tile	330	B	B	D	NS
	metal tile	370	B	C	E	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 23

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 51 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

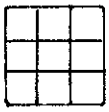
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.7	heavy tile	330	A	B	B	D
	metal tile	370	B	B	D	E
	sheet	600	B	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.15	heavy tile	330	B	B	D	E
	metal tile	370	B	C	E	NS
	sheet	600	D	E	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.6	heavy tile	330	B	C	E	NS
	metal tile	370	B	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 24

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 51 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

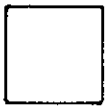
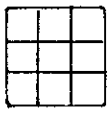
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 2.1	heavy tile	330	B	B	D	E
	metal tile	370	B	C	E	NS
	sheet	600	D	E	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.75	heavy tile	330	B	C	E	NS
	metal tile	370	B	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 3.4	heavy tile	330	C	D	NS	NS
	metal tile	370	D	E	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 25

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 60 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

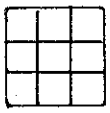
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.3	heavy tile	330	A	B	B	D
	metal tile	370	B	B	D	E
	sheet	600	C	D	NS	NS
	sheet	900	E	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.55	heavy tile	330	B	B	D	E
	metal tile	370	B	C	E	NS
	sheet	600	D	E	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.8	heavy tile	330	B	B	D	NS
	metal tile	370	B	C	NS	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 26

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 60 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

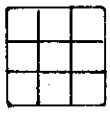
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.55	heavy tile	330	B	B	D	E
	metal tile	370	B	C	E	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.9	heavy tile	330	B	C	E	NS
	metal tile	370	B	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.3	heavy tile	330	B	D	NS	NS
	metal tile	370	C	E	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 27

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 60m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

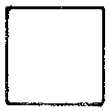
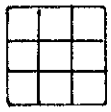
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.7	heavy tile	330	B	B	D	NS
	metal tile	370	B	C	E	NS
	sheet	600	D	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.15	heavy tile	330	B	C	NS	NS
	metal tile	370	C	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.6	heavy tile	330	C	D	NS	NS
	metal tile	370	D	E	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 28

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 60 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

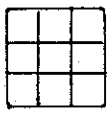
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 2.1	heavy tile	330	B	C	E	NS
	metal tile	370	C	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.75	heavy tile	330	C	E	NS	NS
	metal tile	370	D	NS	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 3.4	heavy tile	330	D	NS	NS	NS
	metal tile	370	E	NS	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 29

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 65 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

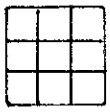
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.3	heavy tile	330	B	B	C	E
	metal tile	370	B	C	E	NS
	sheet	600	D	E	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.55	heavy tile	330	B	C	E	NS
	metal tile	370	B	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.8	heavy tile	330	B	C	NS	NS
	metal tile	370	C	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 30

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 65 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

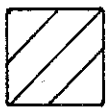
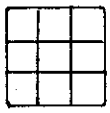
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.55	heavy tile	330	B	B	E	NS
	metal tile	370	B	C	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 1.9	heavy tile	330	B	D	NS	NS
	metal tile	370	C	E	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.3	heavy tile	330	C	E	NS	NS
	metal tile	370	D	NS	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 31

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 65 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

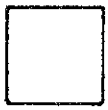
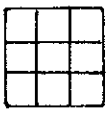
Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 1.7	heavy tile	330	B	C	E	NS
	metal tile	370	B	D	NS	NS
	sheet	600	E	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.15	heavy tile	330	C	D	NS	NS
	metal tile	370	D	E	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.6	heavy tile	330	D	E	NS	NS
	metal tile	370	E	NS	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable

TABLE A 32

SUITABLE TYPES OF GROOVED NAILS
(two nails/batten into seasoned JD4 pine rafters)

Design Wind Speed = 65 m/s (see Table 4)
(For appropriate pressure coefficient, see Table 3 or Table 5)

Roof area Code (see Fig. 2 or Fig. 3)	Type of Roofing	Batten Spacing (mm)	Joint Type* for Rafter Spacing of (mm) 450	600	900	1200
 Cp = 2.1	heavy tile	330	C	D	NS	NS
	metal tile	370	D	E	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 2.75	heavy tile	330	D	NS	NS	NS
	metal tile	370	E	NS	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS
 Cp = 3.4	heavy tile	330	E	NS	NS	NS
	metal tile	370	NS	NS	NS	NS
	sheet	600	NS	NS	NS	NS
	sheet	900	NS	NS	NS	NS
	sheet	1200	NS	NS	NS	NS

* A: Sidney Cooke, National, Jambro 2, Able, Bostitch, Jambro 1 or plain
B: Sidney Cooke, National, Jambro 2, Able or Bostitch
C: Sidney Cooke, National, Jambro 2, or Able
D: Sidney Cooke, National or Jambro 2
E: Sidney Cooke or National
NS: Grooved nails in pine rafters are not suitable