2.12 VERANDAH BEAMS

2.12.1 Description

Verandah beams span between verandah posts and support roof loads imposed by rafters or trusses.

Verandah beams for single and continuous span applications are considered. Design considers roof load is applied to the top edge of verandah beams as a series of concentrated loads at 600 mm or 1200 mm centres corresponding to rafter (or truss) spacings (see Figure 2.12).

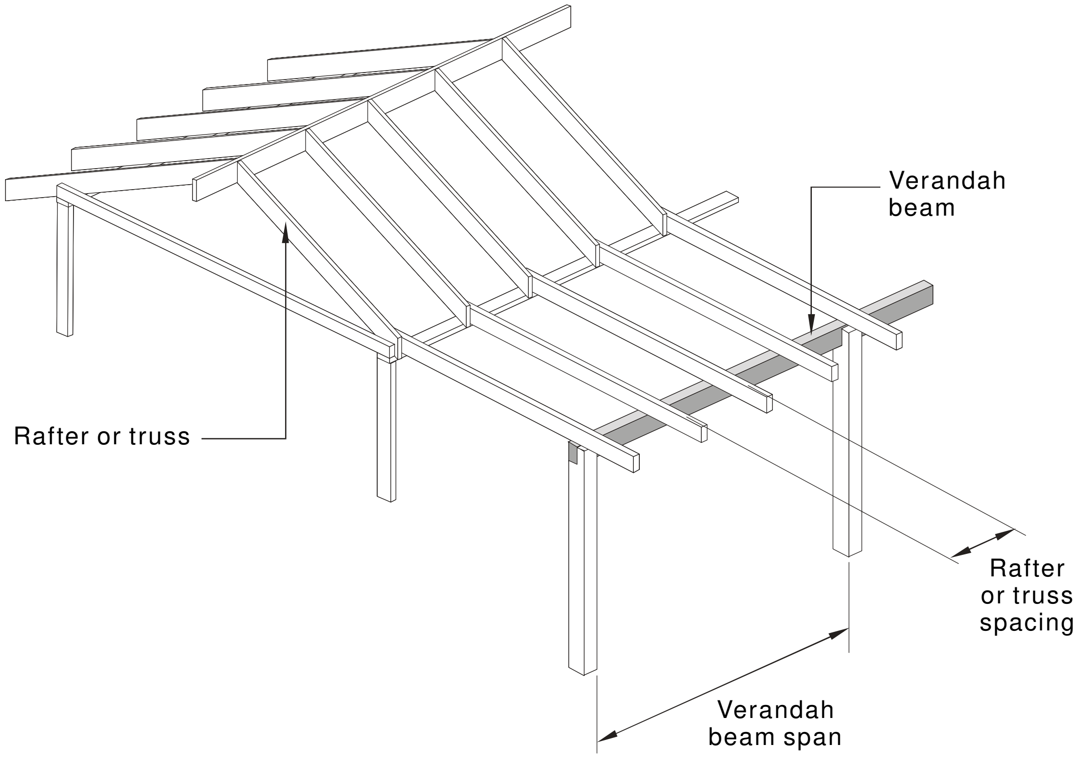


FIGURE 2.12 VERANDAH BEAM

2.12.2 Design for safety

2.12.2.1 *General consideration*

Design for safety includes consideration of the strength limit states in bending and shear.

2.12.2.2 *Loads*

The loads used for determination of the design action effects are determined as follows:

(a) *Dead loads* Dead loads include the self weight of the verandah beam, G_1 (in kN/m), and concentrated loads (G_2) imposed by the rafters. G_2 (in kN) is determined as follows:

$$G_2 = 0.01\,(RM)\,(RLW)\,S_R + 0.02\,(RLW)^2\,S_R \qquad \ldots 2.12.2(1)$$

where

RLW = roof load width for the verandah beam, in metres

RM = standardized roof mass, i.e. 10, 20, 40, 60 or 90 kg/m^2

S_R = rafter spacing, i.e. 0.6 m or 1.2 m

(b) *Live loads* Live loads imposed via rafters are considered as concentrated loads, Q (in kN), and calculated as follows:

$$Q = \frac{1.8}{N} + 0.12\, S_R (RLW) \text{ or } 0.25\, S_R\, (RLW)\text{, whichever is greater} \quad \ldots 2.12.2(2)$$

where

N = number of rafters supported — over one span for the single span case, or over two spans for the continuous span case

S_R = rafter spacing, i.e. 0.6 m or 1.2 m

RLW = roof load width for the verandah beams, in metres

(c) *Wind loads* Wind loads are considered as concentrated loads W_u (in kN), imposed via the rafters and calculated as follows:

$$W_u = q_u\, C_{pt}\, S_R\, (RLW) \quad \ldots 2.12.2(3)$$

where

q_u = free stream dynamic gust pressure, in kPa, for the ultimate limit state; values of q_u are given in Table B2, Appendix B, for each wind classification

C_{pt} = net pressure coefficients given in Table 2.12.1

S_R = rafter spacing, i.e. 0.6 or 1.2 m

RLW = roof load width for the verandah beam, in metres

NOTE: Horizontal wind pressure on verandah beams is ignored.

TABLE 2.12.1

NET PRESSURE COEFFICIENTS FOR VERANDAH BEAMS

Wind classification	C_{pt}
N1 to N4 *or* C1 to C3	+0.4 or −1.2

2.12.2.3 *Structural models and load categories used for strength design*

The structural models used to determine the member design action effects are given in Table 2.12.2. Load combinations shown in Table 2.12.2 are divided into load categories that are used for the determination of member design capacity as specified in Clause 2.12.2.4.

2.12.2.4 *Member design capacity*

The requirements of AS 1720.1 are applied to determine member design capacities in bending and shear. The following assumptions and modification factors are used:

(a) *Load duration factor* The member design capacity includes the modification factor for load duration (k_1). Values of k_1 appropriate for each load category defined in Table 2.12.2 are given in Table 2.12.3.

(b) *Moisture content of timber:*

(i) *Unseasoned timber* — for load categories 2 and 3, values of k_4 appropriate for member thickness as given in AS 1720.1 are used. For load category 1, k_4 = 1.0.

(ii) *Seasoned timber* — k_4 = 1.0 for all load categories.

(c) *Strength sharing* Where multiple sections of scantling timber are nail-laminated, the strength sharing factor (k_9) is applied for the combined member, assuming n_{mem} = 1 and n_{com} = number of combined sections.

(d) *Member restraint* For the determination of bending capacity, the following assumptions related to lateral restraint are used:

(i) *At supports*—verandah beams are considered torsionally restrained at their supports.

(ii) *Between supports*:

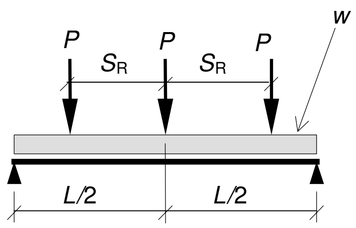
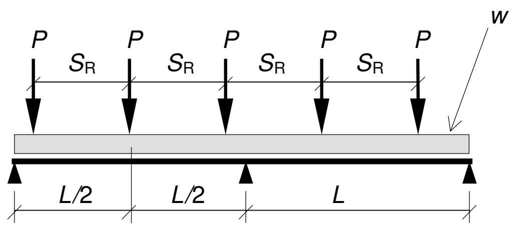
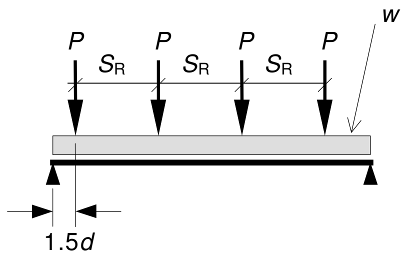
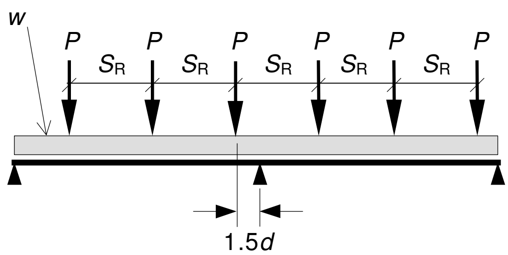
(A) The top edges of verandah beams are assumed restrained by rafters at 600 mm or 1200 mm centres as appropriate.

(B) Continuous span verandah beams are assumed restrained against buckling at the points of contraflexure taken as one quarter of the span from an intermediate support.

NOTE: Where nail-laminated members are used, the breadth of member used to derive the slenderness coefficient (S_1) is taken as the breadth of an individual lamination and not the overall breadth.

TABLE 2.12.2

STRUCTURAL MODELS AND LOAD CATEGORIES—STRENGTH

<table>
<tr><th rowspan="2">Design action effect</th><th colspan="2">Structural models</th></tr>
<tr><th>Single span</th><th>Continuous span</th></tr>
<tr><td>In bending</td><td>
</td><td>
</td></tr>
<tr><td>In shear</td><td>
</td><td>
</td></tr>
</table>

Load category	Design loads
1	$w = 1.25G_1$ and $P = 1.25G_2$
2	$w = 1.25G_1$ and $P = (1.25G_2 + 1.5Q)$
3	$w = 1.25G_1$ and $P = (1.25G_2 + W_u\downarrow)$ $w = 0.8\ G_1$ and $P = (0.8G_2 + W_u\uparrow)$

NOTES:

1 S_R is rafter spacing, either 0.6 m or 1.2 m.

2 The number of concentrated loads considered will vary according to span, rafter spacing and locations of concentrated loads.

3 Loads within 1.5d of supports are ignored in the determination of the design action effect in shear.

TABLE 2.12.3

LOAD DURATION FACTORS FOR STRENGTH

Load category	Load duration factor (k_1)
1	0.57
2	0.94
3	1.15

2.12.3 Design for serviceability

2.12.3.1 *Loads*

The loads used for the serviceability limit states are given as follows:

(a) *Dead loads* Dead loads are determined as described in Clause 2.12.2.2.

(b) *Live loads* Concentrated live loads, Q (in kN), are determined as follows:

$$Q = 0.7\left[\frac{1.8}{N} + 0.12\, S_{\mathrm{R}}\,(RLW)\right] \text{ or } 0.25\, S_{\mathrm{R}}\,(RLW)\text{, whichever is greater} \quad \ldots 2.12.3(1)$$

where

N = number of rafters supported over one span for both the single and continuous span cases

S_{R} = rafter spacing, i.e.0.6 m or 1.2 m

RLW = roof load width for the verandah beam, in metres

(c) *Wind loads* Wind load is considered applied by the rafters as a series of concentrated loads, W_{s} (in kN), and calculated as follows:

$$W_{\mathrm{s}} = q_{\mathrm{s}}\, C_{\mathrm{pt}}\, S_{\mathrm{R}}\,(RLW) \quad \ldots 2.12.3(2)$$

where

q_{s} = free stream dynamic gust pressure, in kPa, for the serviceability limit state; values of q_{s} are given in Table B2, Appendix B, for each wind classification

C_{pt} = net pressure coefficients give in Table 2.12.4

S_{R} = rafter spacing, i.e. 0.6 m or 1.2 m

RLW = roof load width for verandah beam, in metres

TABLE 2.12.4

NET PRESSURE COEFFICIENTS FOR VERANDAH BEAMS

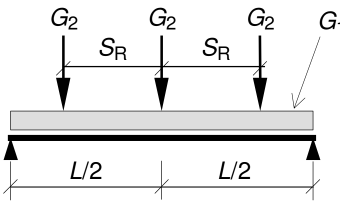
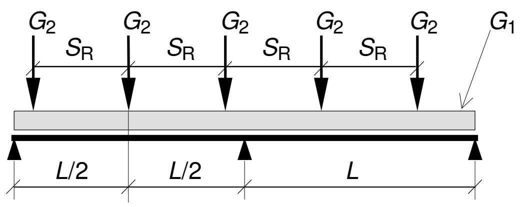
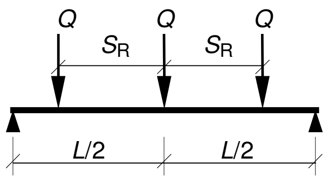
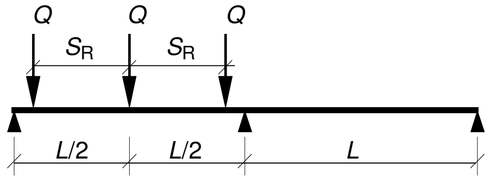
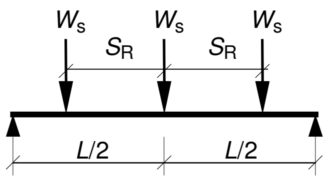
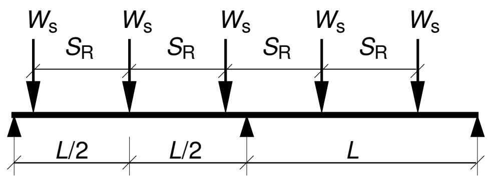
Wind classification	C_{pt}
N1 to N4	+0.4, −1.2
C1 to C3	+0.4, −1.2

2.12.3.2 *Structural models and load categories for serviceability design*

The structural models for which deflections are calculated are given in Table 2.12.5. Load cases given in Table 2.12.5 are divided into load categories for the purpose of allowing for duration of load on stiffness as specified in Clause 2.12.3.4.

TABLE 2.12.5

STRUCTURAL MODELS AND LOAD CATEGORIES—SERVICEABILITY

Load category	Structural models	
	Single span	**Continuous span**
1		
2		
3		

NOTE: S_R = rafter spacing—0.6 m or 1.2 m

2.12.3.3 *Calculation of deflection*

The requirements of AS 1720.1 for the calculation of deflection are applied using the duration of load factor for creep deformation as given in Table 2.12.6.

TABLE 2.12.6

LOAD DURATION FACTORS FOR DEFORMATION

Initial moisture content	Load duration factor (j_2)	
	Load category 1	**Load categories 2 and 3**
Seasoned	2.0	1.0
Unseasoned	3.0	1.0

2.12.3.4 *Serviceability limits*

The limits on deflection used to define the serviceability limit states are given in Table 2.12.7.

TABLE 2.12.7

LIMITS ON DEFLECTION

Load category	Deflection limits
1	Span/400 or 10 mm max.
2	Span/250 or 12 mm max.
3	Span/200

SECTION 3 DESIGN OF WALL MEMBERS

3.1 POSTS

3.1.1 Description

Posts are vertical loadbearing columns designed to support axial loads arising from the vertical support given to roofs and floors.

Posts may be incorporated within or installed separate from walls. Posts are not used to replace common studs in external walls and are, therefore, not designed to support lateral loads.

Posts are assumed laterally supported only at points of attachment to floor and roof members (see Figure 3.1).

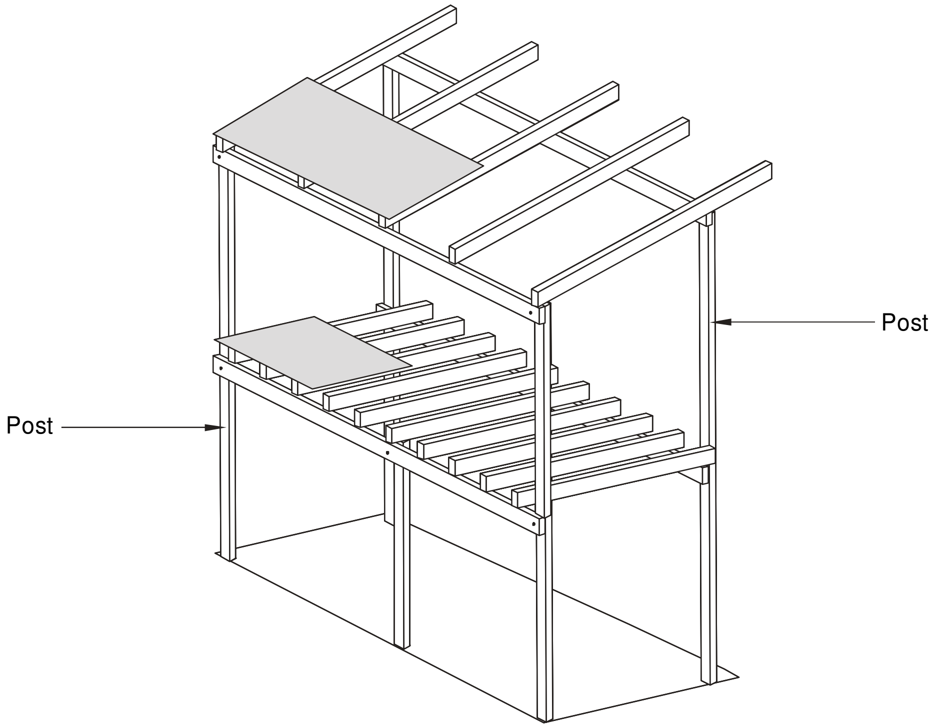


FIGURE 3.1 POSTS SUPPORTING ROOF AND/OR FLOOR LOADS

3.1.2 Design for safety

3.1.2.1 *General consideration*

Design for safety includes consideration of the strength limit states in tension and compression.

3.1.2.2 *Loads*

The loads used for the determination of the design action effects are determined as follows:

(a) *Dead loads* Dead load is determined as the sum of the dead loads from supported roof and floor areas. Expressions used for the determination of concentrated dead load (G) are given in Table 3.1.1.

TABLE 3.1.1

DEAD LOADS

Source of load	Dead load, G (kN)
Floor	0.4 A_F
Roof: Tile Sheet	 0.9 A_R 0.4 A_R

NOTE: A_F = area of floor supported in square metres
A_R = area of roof supported in square metres

(b) *Live loads* Concentrated live loads, Q_1, Q_2 and Q_3 (all in kN), arising from support given to floor and roof areas are determined as follows:

(i) *For posts supporting floor area (A_F)*:

(A) *Permanent live load*—Q_1 = 0.5 A_F.

(B) *Transient live load*—Q_2 = 1.5 A_F.

(ii) *For posts supporting roof area (A_R)*—Q_3 = (1.8 + 0.12 A_R) or 0.25 A_R, whichever is greater.

NOTES:

1 Live loads Q_2 and Q_3 are not considered to act simultaneously.

2 Units for areas A_F and A_R are square metres.

(c) *Wind loads* The concentrated wind load, W_u (in kN), applicable for the strength limit state arising from support given to roof areas is calculated as follows:

$$W_u = q_u \, C_{pt} \, A_R \qquad \ldots 3.1.2$$

where

q_u = free stream dynamic gust pressure, in kPa, for the ultimate limit state; values of q_u are given in Table B2, Appendix B, for each wind classification

C_{pt} = net pressure coefficients for roof areas supported by posts, as given in Table 3.1.2

A_R = roof area supported, in square metres

TABLE 3.1.2

NET PRESSURE COEFFICIENTS FOR ROOF AREAS SUPPORTED BY POSTS—STRENGTH

Wind classification	C_{pt}
N1 to N4 *or* C1 to C3	+ 0.4 or −1.2

3.1.2.3 *Structural models and load categories for strength design*

Posts are designed as simple columns supporting an axial concentrically applied load. Load combinations used to determine the design action effects in compression (N_c^*) and tension (N_t^*) are given in Table 3.1.3. Design action effects given in Table 3.1.3 are divided into load categories that are used for the determination of the corresponding member design capacity as specified in Clause 3.1.2.4.

TABLE 3.1.3

DESIGN ACTION EFFECTS AND LOAD CATEGORIES—STRENGTH

Load categories	Design action effects
1	$N^*_c = 1.25\ (G + Q_1)$
2	$N^*_c = 1.25\ G + 1.5\ Q_2$
3	$N^*_c = 1.25\ (G + Q_1) + 1.5\ Q_3$
4	$N^*_c = 1.25\ (G + Q_1) + W_u\downarrow$ $N^*_t = 0.8\ G + W_u\uparrow$

3.1.2.4 *Member design capacity*

The requirements of AS 1720.1 are applied to determine member design capacities in compression and tension. The following assumptions and modification factors are used:

(a) *Load duration factor* The member design capacity includes the modification factor for load duration (k_1). Values of k_1 appropriate for each load category, as defined in Table 3.1.3, are given in Table 3.1.4.

(b) *Moisture content of timber:*

(i) *Unseasoned timber*—for load categories 2, 3 and 4, values of k_4 appropriate for thickness as given in AS 1720.1 are used. For load category 1, k_4 = 1.0.

(ii) *Seasoned timber*—k_4 = 1.0 for all load categories.

(c) *Strength sharing* Strength sharing is not considered to apply for posts, i.e. k_9 = 1.0.

(d) *Member restraint* For the determination of the compressive capacity of posts the effective length for buckling about either axis is taken as 0.85 times the post height. Post height is the distance between supports and points of attachment to supported floor and roof members, which are assumed to provide lateral restraint for both axes of buckling.

NOTE: Nail-laminated posts are not considered in this Standard.

TABLE 3.1.4

LOAD DURATION FACTORS FOR STRENGTH

Load category	Load duration factor (k_1)
1	0.57
2	0.80
3	0.94
4	1.15

3.1.3 Design for serviceability

Axial deformation of posts under the applicable loadings is small and for this reason serviceability design for posts is disregarded.

3.2 LOADBEARING WALL STUDS

3.2.1 Description

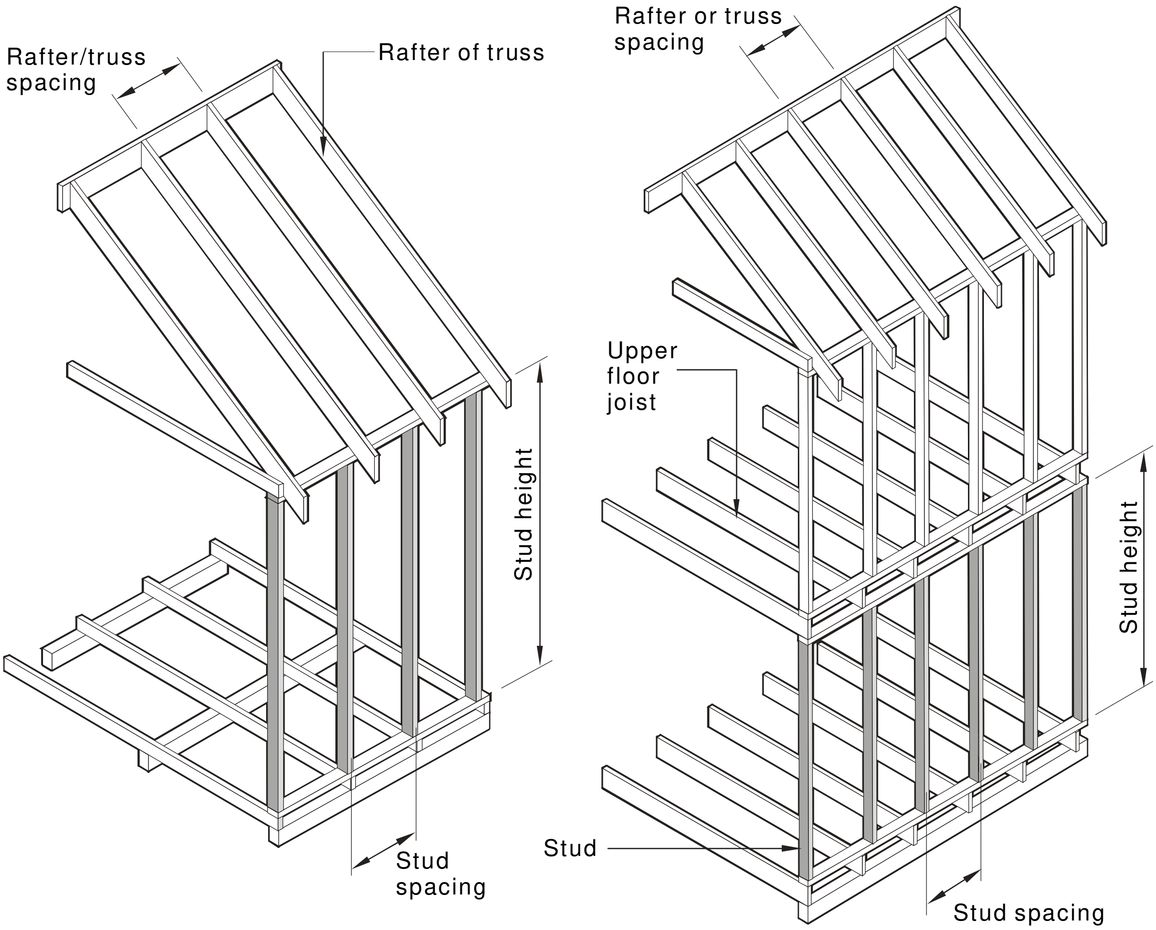
Loadbearing wall studs are the vertical components of a loadbearing wall required to transfer tension or compression loads from supported floors or roofs and to transfer horizontal wall loads, in bending, to the top and bottom wall supports.

Common studs support the vertical loads applied to the top wall plate by rafters, ceiling joists or floor joists and the horizontal loads due to wind.

Jamb studs are studs each side of opening, which support loads from the lintel over the opening and horizontal wind loads related to the width of the opening.

Studs supporting concentrated loads are studs installed in the wall in addition to common studs (or jamb studs) required to carry concentrations of vertical load arising from support for principal roof or floor supporting members.

Special consideration is given for studs notched for the installation of bracing. For notched studs, notches are assumed in either face of the wall penetrating to a maximum depth of 20 mm in the depth of the studs (see Figure 3.2).



(a) Single or upper storey (b) Lower storey

FIGURE 3.2 LOADBEARING WALL STUDS

3.2.2 Design for safety

3.2.2.1 *General consideration*

Design for safety includes consideration of the strength limit states in compression, tension, bending, combined bending and compression and combined bending and tension. For notched studs the strength limit state for combined bending and shear at the assumed notch location is also determined.

3.2.2.2 *Loads*

The loads used for the determination of the design action effects are determined as follows:

(a) *Dead loads* The concentrated dead loads (G) considered axially applied to common studs, jamb studs and studs supporting concentrated loads in upper or single storey walls or lower storey of two-storey walls are determined as given in Table 3.2.1.

TABLE 3.2.1

AXIAL DEAD LOADS SUPPORTED BY STUDS

Application	Common studs	Jamb studs	Studs supporting concentrated loads
	Axial dead loads, G (kN)		
Upper storey or single storey walls—			
(a) sheet roof	$0.4\ (RLW)S_1$	$0.4\ (RLW)\ (W_o/2 + 0.3)$	$0.4\ A_R$
(b) tile roof	$0.9\ (RLW)S_1$	$0.9\ (RLW)\ (W_o/2 + 0.3)$	$0.9\ A_R$
Lower storey walls of two-storey construction—			
(a) Roof, upper wall and floor:			
—sheet roof	$[0.4\ (RLW) + 0.4 + 0.4\ (FLW) + 0.025\ (FLW)^2]\ S_2$	$[0.4(RLW) + 0.4 + 0.4\ (FLW) + 0.025\ (FLW)^2]\ (W_o/2 + 0.3)$	—
—tile roof	$[0.9\ (RLW) + 0.4 + 0.4\ (FLW) + 0.025\ (FLW)^2]\ S_2$	$[0.9\ (RLW) + 0.4 + 0.4\ (FLW) + 0.025\ (FLW)^2]\ (W_o/2 + 0.3)$	—
(b) Floor only	$[0.4\ (FLW) + 0.025\ (FLW)^2]\ S_2$	$[0.4\ (FLW) + 0.025\ (FLW)^2]\ (W_o/2 + 0.3)$	$0.4\ A_F$

LEGEND:

S_1 = the greater of the rafter (truss) or stud spacing in the wall, in metres

S_2 = the greater of the floor joist or stud spacing in the lower wall, in metres

W_o = width of opening in the wall, in metres

A_R = area of roof supported by the stud, in square metres

A_F = area of floor supported by the stud, in square metres

RLW = roof load width supported by the wall, in metres

FLW = floor load width supported by the wall, in metres