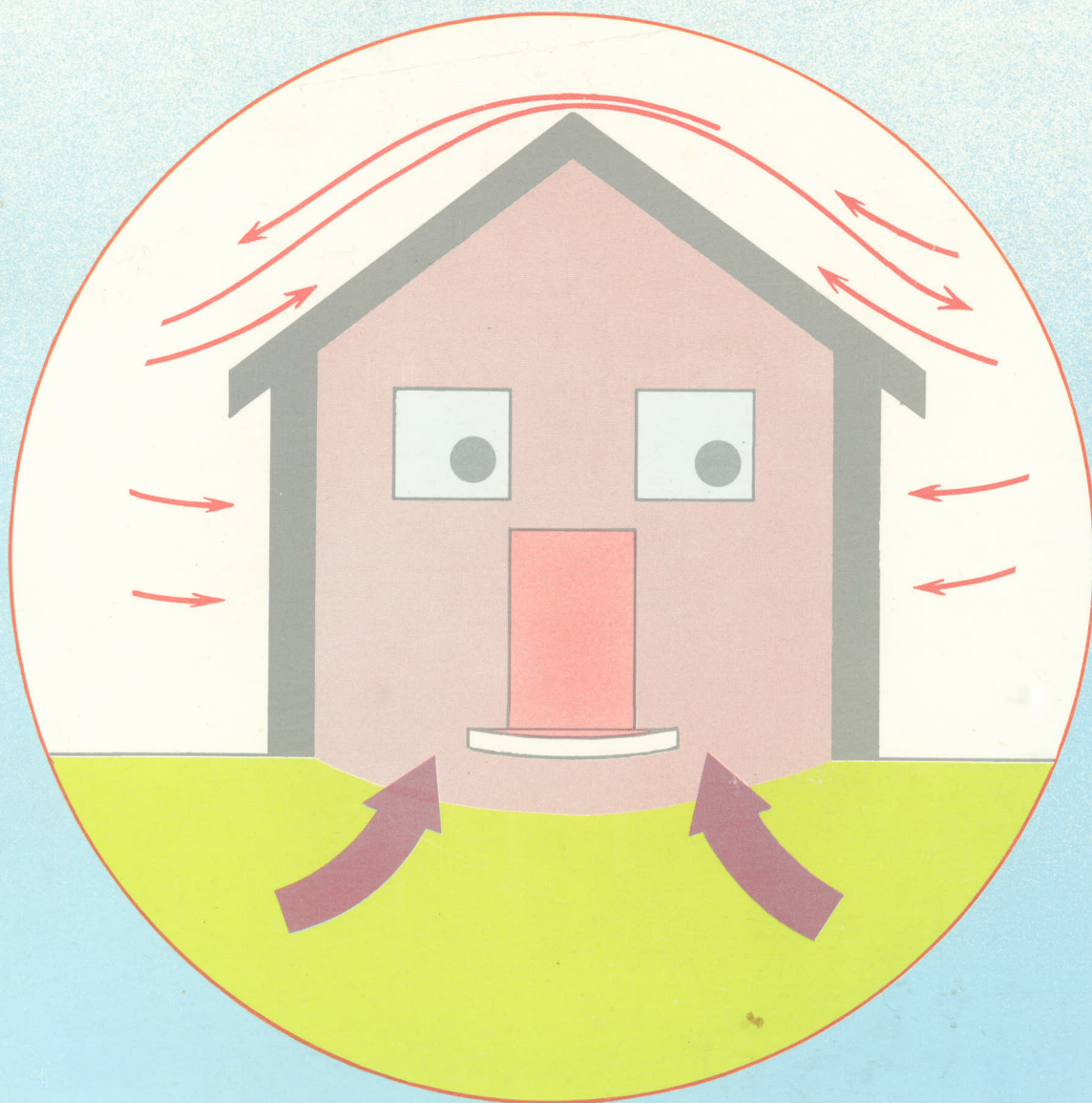


# HOME BUILDING MANUAL



**V a n u a t u**

# **HOME BUILDING MANUAL**

**VANUATU**

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## PREFACE

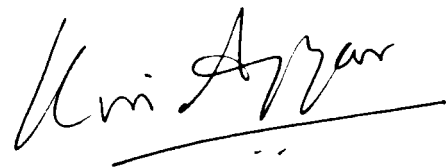
Houses have been built around the world for hundreds of years without the benefit of any formal structural analysis and design. It was only in the recent past, from about 20 years ago that many began to question the wisdom of this practice. Recurring cases of death and large-scale destruction of houses through natural disasters in many parts of the world began to demand urgent remedial action. There were two main reasons for the absence of any engineering design input for houses. Firstly, a house is an extremely complex structural system, far more complex than many other engineering structures. Secondly, the cost of performing the detailed structural design of an individual house is very substantial when compared to the rest of the cost.

The structural complexity of houses has been partially overcome by experimental research. Such research has progressively established a number of increasingly reliable mathematical relationships between the forces (such as from cyclonic winds) acting on a house and the resulting effect on various components of the house. Further, it is possible to spread the cost of detailed structural design by performing the design for a variety of systems in terms of a limited number of modular sub-systems. We have taken advantage of these to produce this Manual.

Similar manuals have been prepared by other ingenious individuals and organisations in the recent past. Well-known examples are the very popular TRADAC Manuals in Queensland, Australia and the New Zealand Standard for masonry buildings not requiring specific design. In the Pacific region the first such manual was the Fiji Pine Code. We have gratefully borrowed ideas and diagrams from these pioneers. However this Manual has for the first time in a single publication included extensive details of conventional timber and masonry construction, prepared to cater to the specific environmental constraints of Vanuatu. The Manual fully conforms to the structural requirements of the National Building Code of Vanuatu.

In preparing the Manual we have tried to retain as far as possible the current local building practices. We have also tried to ensure that the use of the Manual does not contribute to any material increase in the cost of houses. Where there is any marginal increase it will be substantially offset by an increase in the safety and durability of the house. Further, we have attempted to include some details for low-cost houses. We have not been able to give the structural details for vernacular forms of construction. Some useful advice is available in this connection in "Disaster-Resistant Construction for Traditional Bush Houses" prepared by Solomon Islands Architect Mr Charles Boyle and published by the Australian Overseas Disaster Response Organisation.

A manual such as this can only be useful within certain stated limitations. This one is no exception. However within these limitations it should be possible to use the Manual for the construction of safe, architecturally pleasing houses to reasonable levels of individual requirements.



Kris Ayyar  
Project Manager  
Pacific Building Standards Project

Suva : September 1990



## **ACKNOWLEDGEMENT**

We have received substantial assistance from many sources in the preparation of this Manual. For obvious reasons we are unable to acknowledge the help given by each of them. The following persons and the organisations they represent provided outstanding help.

### **IN VANUATU**

George Pakoa, First Secretary Ministry of Finance and Housing, and Chairman Building Advisory Committee and David Blaikie, Physical Planning Adviser and Secretary of the Committee made all the arrangements for the Committee meetings and detailed discussions. The members of the Committee actively encouraged us for the early completion of the Manual.

David Wood, Forest Utilisation Officer Department of Forestry gave us details of the properties of building timber produced in Vanuatu. He and Toby Whitworth, Small scale Sawmill Programme Manager were readily available for discussions.

Tony Lee, Principal Design Engineer and Martin Quaile, Chief Architect Public Works Department, and Peter Fagan, Engineer National Housing Corporation showed me details of typical houses in Port Vila, Santo and Tanna. Further, Peter espoused the cause of housing for the poor very strongly.

Andre François, Managing Director SELB, Geoffrey Feast, Resident Partner James Ferrie & Partners, and Ray Saunders, Structural Engineer Cameron McNamara were available for detailed discussions on the Manual.

### **IN FIJI**

Stefan Ali of Datacom looked after our computer system very well.

Robert Austin, Printing and Design Consultant, designed the cover and gave us other professional advice.

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### **IN AUSTRALIA**

Neville Keating, Executive Director Timber Research and Development Advisory Council of Queensland (TRADAC) granted us permission for the use of several diagrams from their TRADAC Manuals.

Colin MacKenzie, Engineer TRADAC who had pioneered their Manuals advised us on many issues.

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Greg Reardon, Technical Director Cyclone Testing Station at James Cook University provided us with very useful advice and information.

Dr George Walker, formerly Associate Professor of Civil Engineering at the James Cook University and currently Director National Building Technology Centre, Sydney was always willing to listen to our problems and gave us very useful help.

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Denis Ferrier, Director Standards Association of New Zealand gave his approval for the use of several of the diagrams and two tables from NZS 4229 Code of Practice for Concrete Masonry Buildings not requiring specific design. He and his officers were ever willing to help us.

David Barnard, General Manager Operations and Des Bull, Structural Engineer Cement and Concrete Association of New Zealand gave us approval for the use of some of the diagrams from their Concrete Masonry Manual. They were available for discussions during our visits to New Zealand.

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Mark Latham and Graham Nicholls, past and present Development Aid Counsellors in Suva helped us with constant encouragement and support.

Cathy Bennett, Keith Joyce and Greg Brooke, Secretaries, Development Assistance in Suva and their staff gave detailed day-to-day support and took us safely across several stretches of bureaucratic quicksand.

The Manual is essentially the result of exceptionally dedicated team work by the Project staff. Rohit Singh, Deputy Project Manager did the bulk of the technical work and led the team with single minded persistence. He was ably assisted in the production of the Manual by Hem Rao, Project Engineer who, apart from doing other work, did all the calculations for masonry construction. For a short time we also had the assistance of Isikeli Tuituku as a Project Engineer. The highly demanding task of laying out and editing the multitude of tables and diagrams was handled by Saras Prasad and Raveena Dutt for a good part of the time and Sashi Lata Pal for the full duration of the Project. Wati Ledua and Michael Arun Shankar performed all the administrative tasks including the production of several hundreds of bound copies of the Manual when it was in draft form.

Kris Ayyar



# INTRODUCTION

## Objective

The Manual is intended for the use of para-professionals and professionals in the building industry for the speedy design of simple houses which conforms to the structural requirements of the National Building Code. Approval authorities may use the Manual for the confirmation of the adequacy of the structural details given in the proposals submitted to them. The use of the Manual is subject to the limitations stated in Clauses A1 and C1 and C2.

## What is in the Manual?

The Manual gives simple directions in Section A to determine the design windspeed applicable to any specific location of a house. The applicable earthquake zones are shown in a map of Vanuatu. A knowledge of the design windspeed and of the earthquake zone number are necessary to use the Manual. Section B gives several tables and diagrams based on the design windspeed and/or the earthquake zone factor, to facilitate the design of timber framed houses and parts of houses. Section C does the same for masonry houses. Section D gives foundation details for both timber and masonry houses. Typical construction details are shown in Section E. Possible modes of failure of houses during cyclones or earthquakes are illustrated in Section F. These diagrams also explain how to prevent such damage.

Miscellaneous details such as for the design of window shutters, retaining walls, lean-to houses, window glass selection, etc. are given in Section G. Section H gives some details for the construction of low-cost houses. The room sizes in this section are kept small enough to avoid the use of purlins for the roof. The small sizes also permit the use of partially grouted masonry walls in all earthquake zones and for design windspeeds of up to 55 m/s. The Manual ends with an Appendix giving the design criteria used, typical calculations and details of timber classifications.

## How to use the Manual?

The several tables and diagrams might seem quite daunting to begin with. Simple flow charts are included in the Manual to guide the new user.

Knowledge of the following basic information is necessary in order to use the Manual :

- (i) The stress grades of the available timber. Where this information is not provided by the supplier or stamped on the pieces of timber an assessment of the stress grade can be made by using table B2. However in order to use this table sufficiently reliable information on the density of the timber must be available.
- (ii) A knowledge of the joint groups of different timber species used is required for designing bracing and/or tie-down systems. There is no simple relationship between joint groups and other basic properties such as density. Therefore where the joint group is not known advice must be sought from the Department of Forestry or a conservative estimate made.

Further, the user must gain practical familiarity with the simple rules given for determining the design windspeed. Once a few practical examples are tackled this should be relatively easy.

Where manufacturers of proprietary products are able to give test-based information on their products it may be used with the appropriate tables in the Manual.

## Format of the Manual

The Manual has been prepared with plenty of diagrams and tables and a minimum of text. These should convey the intent far more easily than words.



## ERRATA

We have discovered a few mistakes in the Manual after it was printed. Please correct all affected pages as follows:

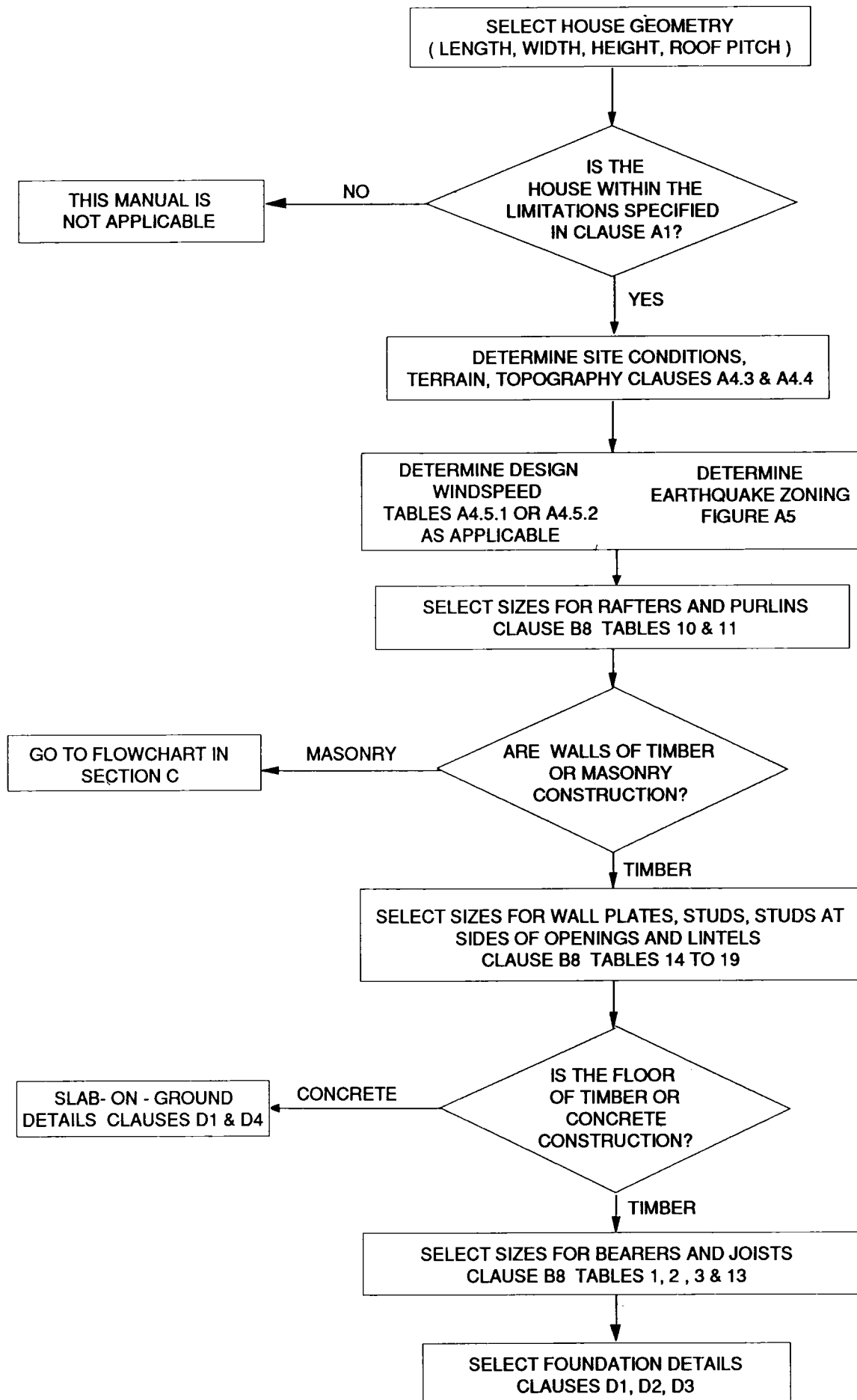
The following corrections apply to the Clauses, Figures or Tables as given below:

- 1 CLAUSE A4.4 "FIFURE A4.4 (a) should read "FIGURE A4.4(a)
- 2 TABLE 4 - 57 For a stress grade of F8, stud spacing 900 mm and stud height of 2700 mm, the size of member in the table should be 100 x 75 instead of 100 x 57.  
  
For a stress grade of F17, stud spacing 900 mm and stud height of 3000 mm, the size of member in the table should be 100 x 75 instead of 100 x 57.
- 3 TABLES 10 - 1 - 49, 10 - 1 - 53, 10 - 1 - 57 For a stress grade of F8, rafter spacing 1500 mm and rafter span of 4800 mm, the size of member in the table should be 220 x 45 instead of 220 x 54
- 4 CLAUSE B9.3.3 Line 2 "sotrey" to read "storey"
- 5 FIGURE B9.4.3 (A), (B), (C) "weatherbard" should read "weatherboard"  
FIGURE B9.4.3 (A) "ELE ENTS" should read "ELEMENTS"
- 6 FIGURES B9.4.3 (A - D) Values in the table are given in kilonewtons (kN)
- 7 TABLE B10.5.4 For the aspect ratio given, the value for roof pitch should be 10° instead of 25°
- 8 TABLE B10.6.3 for aspect ratio 0.5 the value for roof pitch should be = 10°  
for aspect ratio 1.0 the value for roof pitch should be = 15°
- 9 TABLE D3.3 heading  
TABLE D3.3 SIZE OF REINFORCED CONCRETE AND MASONRYPILES  
  
should be TABLE D3.3 SIZE OF REINFORCED CONCRETE AND MASONRY PILES
- 10 FIGURE E2.3 notes (ii) "..... smaller than 100 x 50" should read "..... smaller than 50 x 100"
- 11 FIGURE E3.7 the size of Top plate should be 50 x 100 instead of 100 x 50
- 12 FIGURE E3.14 "Continuous ..... Tables C3.6 or B ..." should read  
"Continuous ..... Tables C3.6A or C3.6B....."
- 13 CLAUSE G3, B part 5 "Tie beam to footing ..... B10.9(D)(II)" should read  
"Tie post to footing..... B10.9(D)(III)".
- 14 CLAUSE H7.4 The last sentence should read  
"..... the bedroom must be of timber or masonry construction."

SECTION A

GENERAL

# HOW TO USE THIS MANUAL



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# SECTION A GENERAL

## A1 LIMITATIONS

There is unlimited possibility for variation in the design and execution of houses. Site conditions, choice of materials, size, layout, location and a host of other factors can all vary. No manual can provide detailed information to cover all such variations. This manual is no exception. The following limitations therefore apply to the houses for which details are given:

- (a) Plan - rectangles or simple combinations of rectangles.
- (b) Height - not more than 6 m to eaves.
- (c) Width - not to exceed 9 m inclusive of covered verandahs but excluding eaves.
- (d) Eaves Overhang - limited to 900 mm.
- (e) Roof Pitch - 25° maximum.
- (f) Bracing Wall Spacing -
  - (i) Must not exceed 5 m for timber framed houses or storeys.
  - (ii) Must not exceed 5 m for masonry houses or storeys except as explained in clause C3.6 and Figure C3.6.
- (g) Roof construction - must be of a simple beam and rafter type with lightweight roof cladding.
- (h) Rafter Spacing - limited to 900 mm, 1200 mm and 1500 mm.
- (i) For masonry houses the floor area per storey must not exceed -
  - (i) 600 m<sup>2</sup> for single storey houses;
  - (ii) 200 m<sup>2</sup> for two-storey houses or a single storey supported on foundation walls; and
  - (iii) 300 m<sup>2</sup> for two-storey houses where the upper storey is of timber framing and the lower storey of masonry supported on a concrete slab-on-ground, or footings of concrete or masonry.
- (j) Windows MUST be protected from debris by means of shutters such as those shown in Figure G1.1.

## A2 BUILDING TERMINOLOGY

Figures A2.1, A2.2 and A2.3 illustrate the various members and components of timber framed and masonry houses.

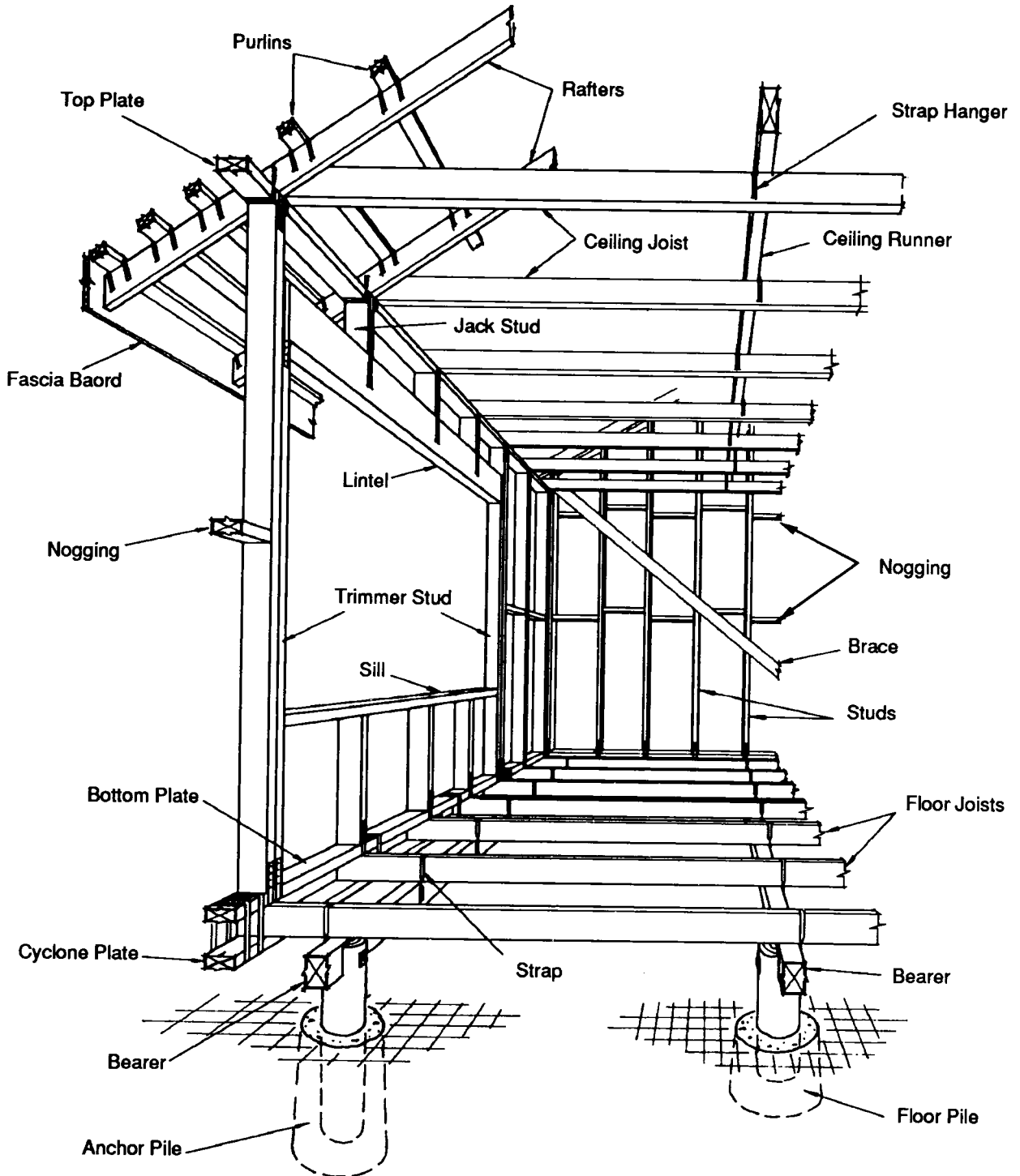
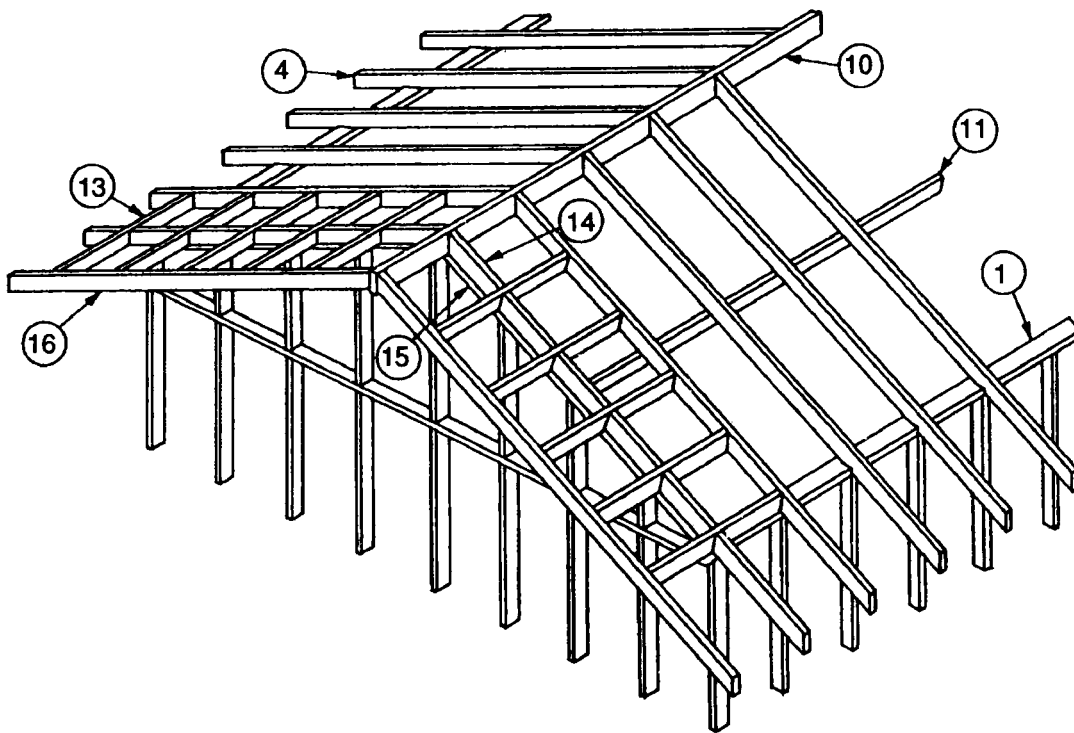
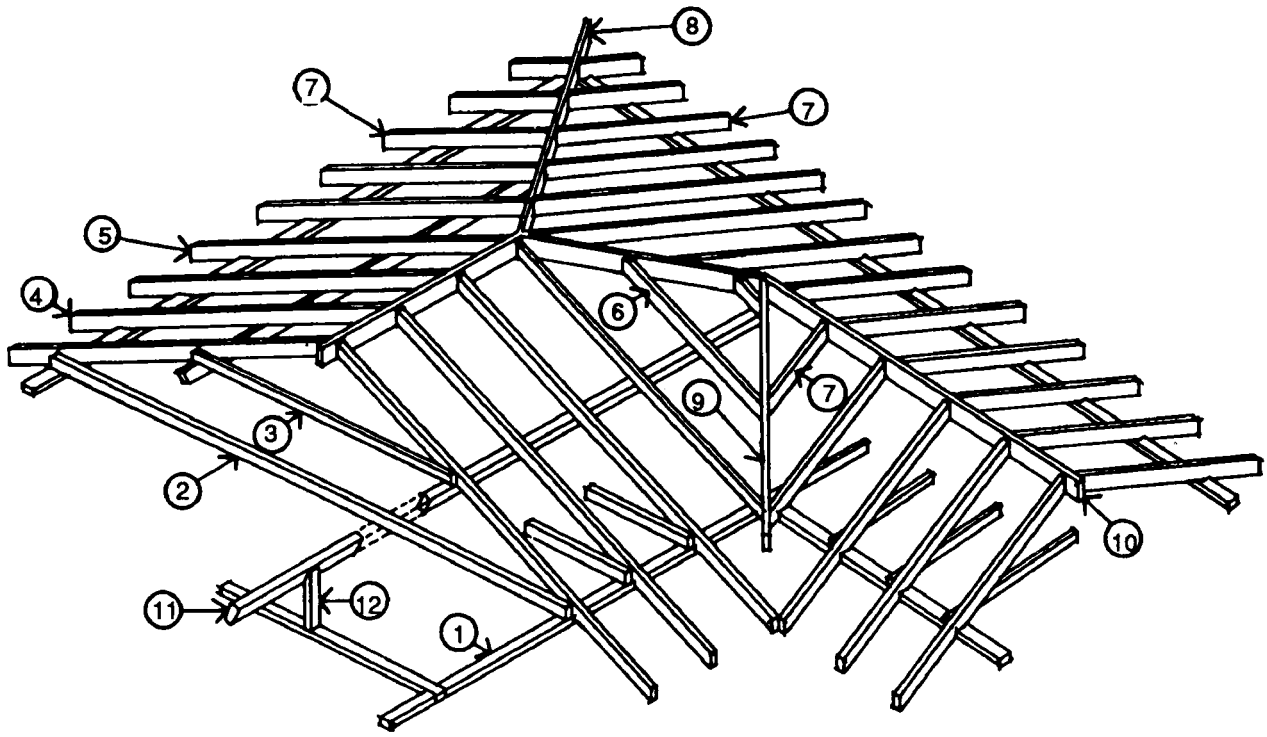


FIGURE A2.1 GENERAL FRAMING DETAILS FOR TIMBER HOUSES





- |    |               |     |                |     |                       |
|----|---------------|-----|----------------|-----|-----------------------|
| 1. | Top Plate     | 6.  | Cripple Rafter | 12. | Roof Strut            |
| 2. | Ceiling Joist | 7.  | Creeper Rafter | 13. | Outrigger             |
| 3. | Collar Tie    | 8.  | Hip Rafter     | 14. | Nogging               |
| 4. | Common Rafter | 9.  | Valley Rafter  | 15. | Raking Plate          |
| 5. | Jack Rafter   | 10. | Ridgeboard     | 16. | Barge or verge Rafter |
|    |               | 11. | Underpurlin    |     |                       |

FIGURE A2.2 ROOF FRAMING DETAILS

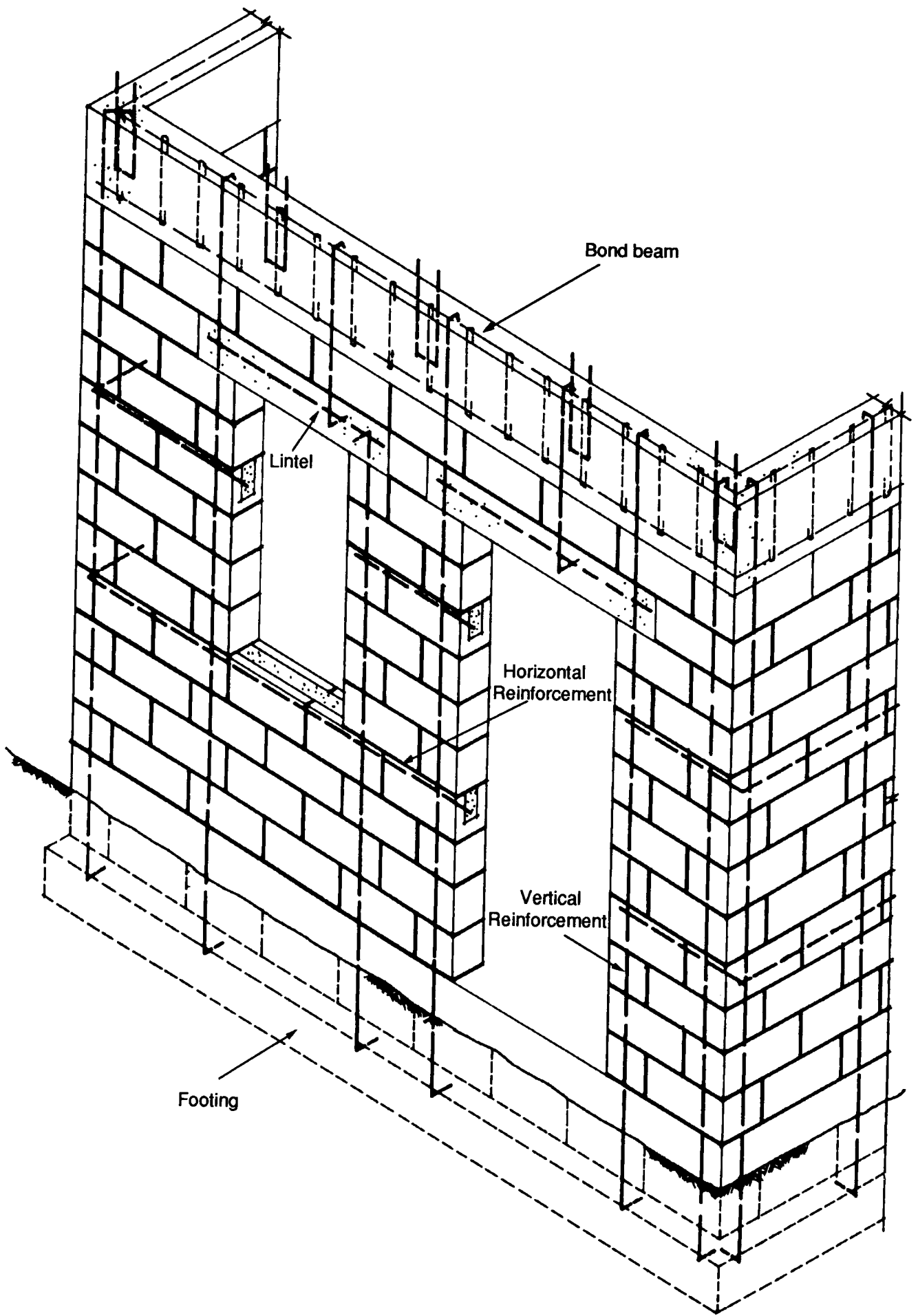


FIGURE A2.3 GENERAL CONSTRUCTION DETAILS FOR MASONRY HOUSES

### **A3 TERMS AND DEFINITIONS**

The following technical words found in the Manual have been used with the specific meaning given against each.

<b>BEARER</b>	a beam supported on foundation walls, piles, or piers and carrying floor joists.
<b>BLINDING</b>	a base course of compacted granular material or lean concrete to provide an even surface on which construction can proceed
<b>BOND, RUNNING</b>	the bond when the units of each course of masonry overlap the units in the preceding course by 50% of the length of the units.
<b>BRACE</b>	
<b>Diagonal Brace</b>	a member of a framed house fixed diagonally and used to resist tension or compression or both.
<b>Subfloor Brace</b>	a bracing element below the ground floor level.
<b>Wall Bracing</b>	a section of wall above the ground level which performs a bracing function.
<b>BRACING</b>	any method employed to provide lateral support to a house.
<b>Bracing Line</b>	a line along or across a house for controlling the distribution of wall bracing elements.
<b>Bracing Unit</b>	a measure of the performance of a wall bracing element. (100 BU's = 5kN)
<b>Bracing Panel ( Bracing Wall )</b>	a length of structural wall which is designed to resist the racking effects produced by lateral forces resulting from earthquakes or high winds. The capacity of a bracing panel to resist racking may be expressed in bracing units.
<b>CALL DIMENSIONS</b>	the dimensions by which timber is sold. These are usually marginally different from the actual dimensions.
<b>CLADDING</b>	the outside or exterior weathering surface of a house.
<b>COLLAR TIE</b>	a member connecting paired rafters together below the level of the ridge board in a roof.
<b>D</b>	refers to a deformed mild steel reinforcing bar of the stated diameter in millimeters.
<b>DAMP-PROOF COURSE</b>	durable waterproof material placed between masonry, stone or concrete and timber or metal as a protection against moisture; or placed between block or stone courses to prevent the passage of moisture from a lower part of the structure to an upper part bearing on it.
<b>DRAGON TIE</b>	a timber member fixed diagonally between two intersecting top plates to tie two walls together.
<b>FOOTING</b>	construction through which the weight of a house is transferred to the ground.
<b>FOUNDATION</b>	those parts of a house in direct contact with, and transmitting and distributing loads to the ground, through a footing.
<b>FRAMING TIMBER</b>	timber members to which lining, cladding, or decking is attached, which are depended upon for supporting the structure and for resisting forces applied to it.
<b>GABLE</b>	the triangular part of an outside wall between the planes of the roof and the line of the eaves
<b>GROUT</b>	the material used to fill cells or cavities in reinforced masonry.
<b>JOINT GROUP</b>	a group assigned to a piece or parcel of timber to indicate for purposes of joint design a set of basic working loads appropriate to that timber. Joint group is designated in the form of a number preceded by the letters J or JD indicating unseasoned or seasoned timber respectively.

<b>JOIST</b>	a horizontal framing member to which is fixed floor decking or ceiling linings and which is identified accordingly as a floor joist or ceiling joist.
<b>LINTEL</b>	a structural member over an opening in a wall to take the vertical downward and lateral loads above the opening and to transfer them to other structural members on either side of the opening.
<b>M</b>	refers to a bolt of the stated diameter in millimeters.
<b>MASONRY</b>	any construction using concrete blocks, laid to a bond and joined together with mortar.
<b>MORTAR</b>	the material in which masonry units are bedded and joined together.
<b>NOGGING</b>	a short member fixed between framing timbers.
<b>NOTCH</b>	trench or groove formed across the face of a piece of timber.
<b>PILE</b>	a column-like member used to transmit loads from the house and its contents to the ground.
<b>Anchor Pile</b>	a pile directly supporting a bearer, loadbearing walls and roof structures, which is embedded into the ground with concrete so as also to resist vertical uplift and horizontal forces.
<b>Braced Anchor Pile</b>	an anchor pile directly supporting a bearer and having a brace attached to it.
<b>Floor Pile</b>	a pile that does not have any brace attached to it and that is required to support one floor only but not load bearing walls.
<b>PLATE</b>	a timber member supported by a wall or bearers or joists to support and distribute the load from floors, walls, roofs or ceiling.
<b>Bottom Plate</b>	a plate placed under the ends of studs.
<b>Top Plate</b>	a plate placed over the ends of studs.
<b>PURLIN</b>	a horizontal member laid to span across rafters and to which the roof cladding is attached.
<b>R</b>	refers to a plain round reinforcing bar of the stated diameter in millimeters.
<b>RAFTER</b>	a framing timber normally parallel to the slope of the roof and providing a support for purlins, roof covering or sarking.
<b>REINFORCEMENT</b>	any form of reinforcing rod, bar, or welded fabric mesh used with concrete or masonry.
<b>REINFORCED MASONRY</b>	any masonry in which reinforcing steel is so bedded and bonded that the two materials act together in resisting forces.
<b>ROOF</b>	that surface of a house intended to shelter any other part, or any space below it, against the elements, and in particular to discharge rainwater outside the confines of the house or space below.
<b>SEASONSED TIMBER</b>	timber brought to a state of equilibrium moisture content. Equilibrium moisture content is the moisture content at which timber neither gains nor loses any moisture under constant conditions of temperature and humidity.
<b>SPACING</b>	the distance at which members are spaced measured centre to centre.
<b>SPAN</b>	the clear distance between supports measured along the member.
<b>STRESS GRADE</b>	a value assigned to a piece of timber to indicate, for purposes of structural design, the set of basic stresses appropriate to that piece. Stress grade is designated in the form of a number preceded by the letter ' F '.

<b>STRINGER</b>	a horizontal framing timber on edge fixed to the side of a concrete or masonry wall to support the ends of joists or rafters.
<b>STRUTTING</b>	short members fixed between joists to stiffen and prevent them from canting or buckling.
<b>STUD</b>	vertical timber, forming part of a wall or partition on to which cladding may be fastened.
<b>Loadbearing Stud</b>	a stud in a loadbearing wall.
<b>Trimming Stud</b>	a stud located on the side of an opening.
<b>Jack Stud</b>	a stud of shorter height than the height from top plate to bottom plate of the wall.
<b>THICKNESS</b>	unless otherwise specifically stated means the call dimension representing the narrow surface of a piece of timber (see also <b>WIDTH</b> )
<b>VAPOUR BARRIER</b>	sheet material through which only very little water vapour can pass. This is used to minimise water vapour penetration in houses.
<b>WALL</b>	
<b>External Wall</b>	an outer wall of a house.
<b>Foundation Wall</b>	that part of the foundation comprising a masonry or concrete wall supporting a house or part of a house, and not extending more than 2.0 m above the underside of the footing.
<b>Internal wall</b>	a wall other than an external wall, a partition.
<b>Loadbearing Wall</b>	a wall supporting vertical loads from floors, ceiling joists, roof, or any combination of these.
<b>Non Loadbearing wall</b>	a wall other than a loadbearing wall.
<b>Structural wall</b>	any wall which because of its position and shape is designed to contribute to the rigidity and strength of the house.
<b>WEATHERBOARDING</b>	an exterior overlapping timber strip cladding which is fixed either horizontally, vertically or diagonally, whether rough sawn or machined or formed to any special section.
<b>WIDTH</b>	unless otherwise specifically mentioned means the call dimension representing the wide surface of a piece of timber.

## **A4 DETERMINATION OF DESIGN WINDSPEED**

### **A4.1 Scope**

The procedure to determine the design windspeed for different terrain and topography is given.

### **A4.2 Application**

To determine the design windspeed applicable to a house, the following steps need to be followed.

1. Determine the category of the terrain in which the house is or will be built. (A4.3)
2. Determine the applicable topography. (A4.4)
3. Select the design windspeed relevant to the terrain and topography from Table A4.5.1 or A4.5.2 as appropriate.

### A4.3 Terrain Category

Terrain category refers to the degree of roughness due to features on the ground over which the wind-stream passes. When these features such as houses trees shrubs piles of rocks etc are more closely spaced, they give greater resistance to the passage of the wind-stream. The result is that the windspeed gets reduced. When the windspeed is high enough to produce sustained waves in the sea or over lakes the waves act as an obstruction and reduce the windspeed. Conversely with higher windspeeds trees get uprooted and/or cleared of their leaves and small branches. The obstruction due to the trees then becomes far less effective.

The reduction in windspeed is a maximum at levels closest to the obstruction. As the height above the obstruction increases the braking effect on the wind becomes less. The density and some other properties of air are very low. Hence the roughness of the terrain does not take full immediate effect on the windspeed. In fact it takes 2.5 km of terrain of any particular roughness before the full effect of that roughness is felt on the windspeed.

The roughness of the terrain has been divided into categories for convenience. Each category is considered to have specific levels of ability to reduce windspeed. For instance the lowest, category 1 has the least effect. This category corresponds to the roughness provided by undisturbed water surface, snow fields and the like. The next higher is category 2. This corresponds to the rough surface of water during high winds, uncut grass, air fields etc. Further up is category 3 corresponding to suburban housing and other closely spaced buildings, wooded country etc.

Vanuatu is composed of several small islands with the vast majority of housing located not far from the coast. There would be hardly any group of houses located farther than 2.5 km from the coast. Because of this and the fact that it takes 2.5 km transition distance for a terrain to have full effect in influencing windspeed, it would be appropriate to assume category 2 terrain for the design and checking of the vast bulk of houses and other structures in Vanuatu. In the heavily built-up areas of Port Vila and Santo with houses and other such wind-obstructions occupying part of the transition distance of 2.5 km from the coast, the effect of such category 3 terrain features would partly begin to take effect. For the ordinary use of this Manual this effect must be neglected for a distance inland over built-up areas of 1.25 km from the coast. Buildings from this point at 1.25 km from the coast may be taken as being influenced by the intermediate category  $2\frac{1}{2}$ . This is allowed only if all the area is well built-up or otherwise similarly rough from near the coast.

Tables A4.5.1 and A4.5.2 in this Manual give values for the effect of categories 2 and  $2\frac{1}{2}$ .

### A4.4 Topography

Topography refers to the shape of the ground over which the wind-stream passes. Common shapes are hills and ridges, escarpments, valleys etc. For the purpose of this Manual a hill or ridge must have a down wind slope of more than 1:20. For an escarpment the downwind slope is less than or equal to 1:20. In other words an escarpment is a ground shape where the upwind slope leads to a more-or-less flat plateau from the edge, downwind. (See Figures A4.4 (a) and A4.4 (b) )

When the wind-stream strikes against a hill or escarpment the shape of the ground restricts the area through which the steam of wind has to pass. This restriction in area increases the windspeed. Once again because of the low density (and other properties) of air, the increase in speed is a maximum close to the ground and it gradually reduces at higher levels above the ground. The increase in speed is also affected by the downwind slope. This is why hills produce a greater increase in speed than escarpments. The effect of some valleys is to funnel the wind and thereby increase the speed. However we do not have reliable data to include these effects in this Manual.

Tables A4.5.1 and A4.5.2 give the design windspeeds taking into account the effect of escarpments, and hills and ridges. Clauses A4.4.1 and A4.4.2 show the distances over which the topographic effect would persist.

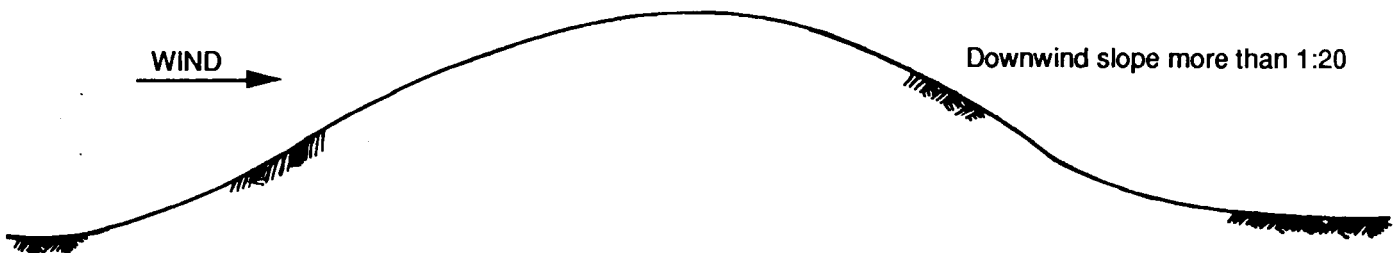


FIGURE A4.4(a) HILLS AND RIDGES



FIGURE A4.4 (b) ESCARPMENTS

A4.4.1 Distances upwind and downwind from crest of hills and ridges over which topographic multiplying factors must be applied are given in Figure A4.4.1 and Table A4.4.1.

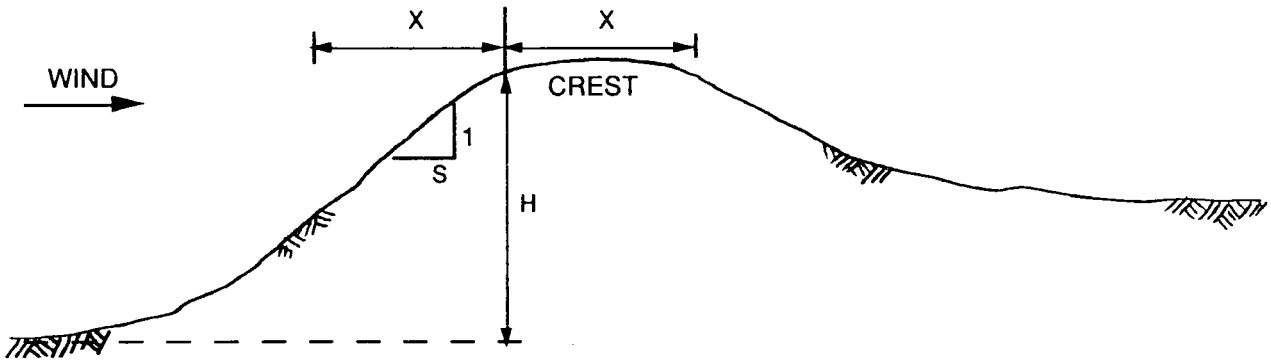


FIGURE A4.4.1

TABLE A4.4.1

UPWIND SLOPE 1 : S	UPWIND OR DOWNWIND DISTANCE, X
1 : 20	15 H
1 : 10	7.5 H
1 : 7	5 H
1 : 5	4 H

A4.4.2 Distances upwind and downwind from crest of escarpments over which topographic multiplying factors must be applied are given in Figure A4.4.2 and Table A4.4.2.

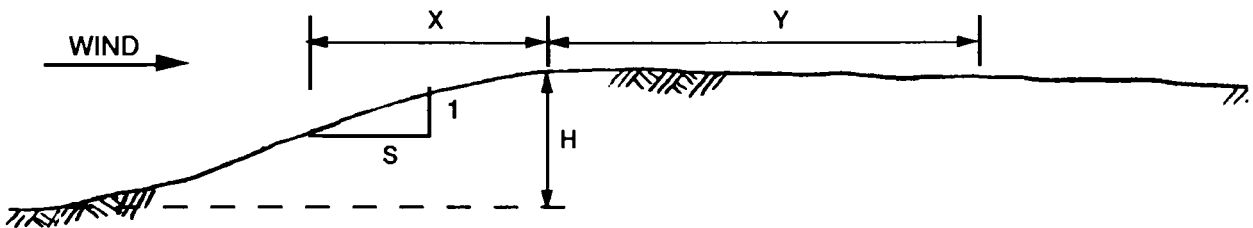


FIGURE A4.4.2

TABLE A4.4.2

UPWIND SLOPE 1 : S	UPWIND DISTANCE X	DOWNWIND DISTANCE Y
1 : 10	7.5 H	15 H
1 : 5	4 H	7.5 H
1 : 3.3	2.5 H	5 H

NOTE : i. The design windspeed decreases from the crest for a distance as given in Tables A4.4.1 and A4.4.2. Beyond distance X from the crest, the design windspeed for plain topography given in Tables A4.5.1 and A4.5.2 must be used.

#### A4.5 DESIGN WINDSPEEDS

Tables A4.5.1 and A4.5.2 give the design windspeeds for various combinations of terrain and topography. Table A4.5.1 is for houses with height to eaves less than 3 m (single storey) and A4.5.2 is for houses with height to eaves between 3 m and 6 m. Both tables are based on the prescribed basic windspeed of 57 m/s.

TABLE A4.5.1

DESIGN WINDSPEEDS (m/s) FOR HEIGHT TO EAVES OF 3 METRES								
TOPOGRAPHY =>	PLAIN	ESCARPMENTS			HILLS & RIDGES			
UPWIND SLOPE =>	N/A	1 in 10	1 in 5	1 in 3.3	1 in 20	1 in 10	1 in 7	1 in 5
TERRAIN CATEGORY 2	51	55	60	64	57	60	64	69
TERRAIN CATEGORY 2 1/2	49	53	57	60	53	57	60	69

TABLE A4.5.2

DESIGN WINDSPEEDS (m/s) FOR HEIGHT TO EAVES OF UP TO 6 METRES								
TOPOGRAPHY =>	PLAIN	ESCARPMENTS			HILLS & RIDGES			
UPWIND SLOPE =>	N/A	1 in 10	1 in 5	1 in 3.3	1 in 20	1 in 10	1 in 7	1 in 5
TERRAIN CATEGORY 2	55	60	64	69	60	64	69	74.5
TERRAIN CATEGORY 2 1/2	51	55	60	64	55	60	64	69

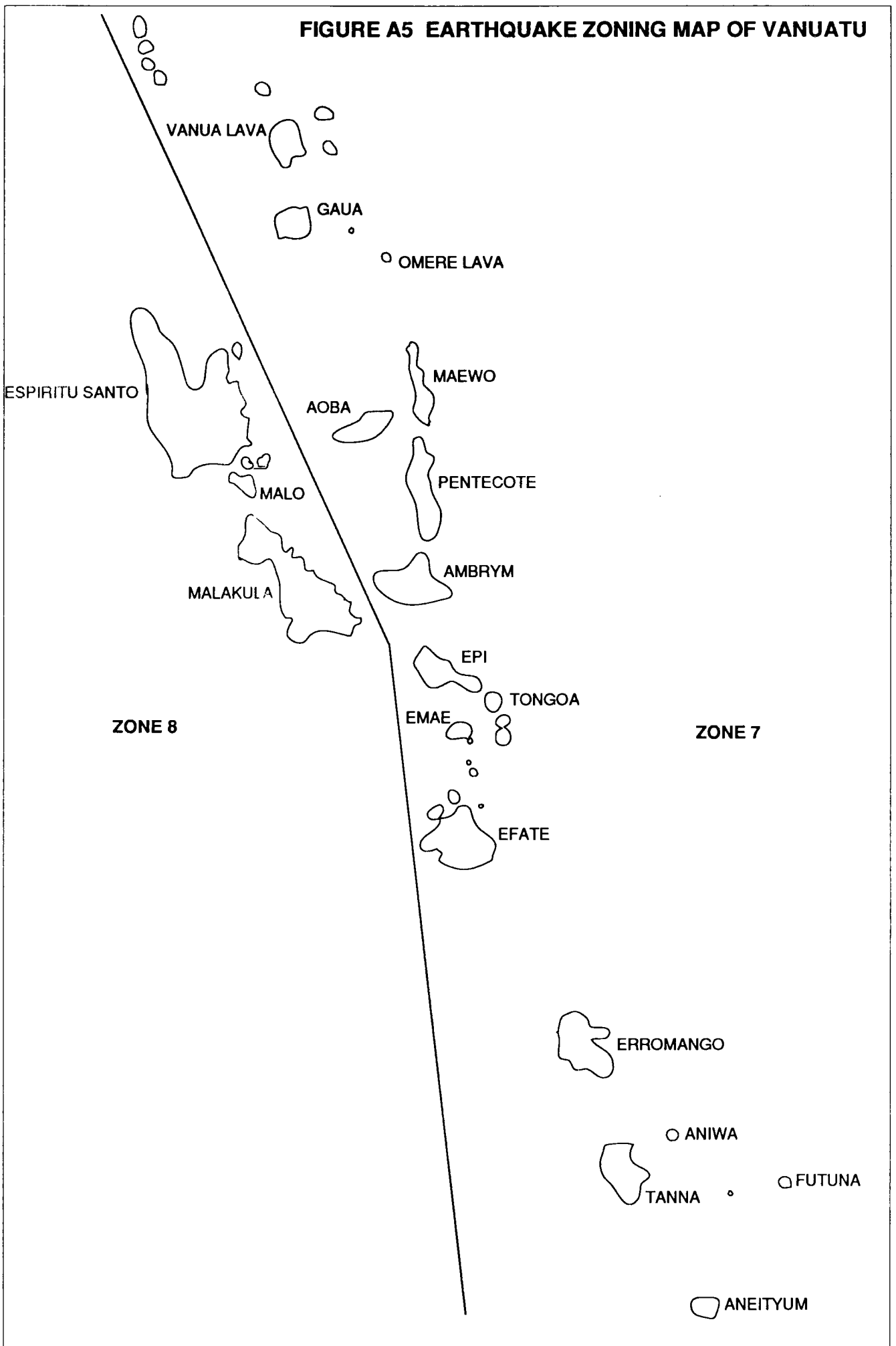
#### A5 EARTHQUAKE ZONING

Vanuatu has been divided into two earthquake zones, 7 and 8. These are illustrated in Figure A5. When referring to some of the Tables where earthquake loading is relevant, the appropriate zone values must be used.

Zone 8 is the most severe of the two zones. The zone factors are given in Appendix I.



**FIGURE A5 EARTHQUAKE ZONING MAP OF VANUATU**

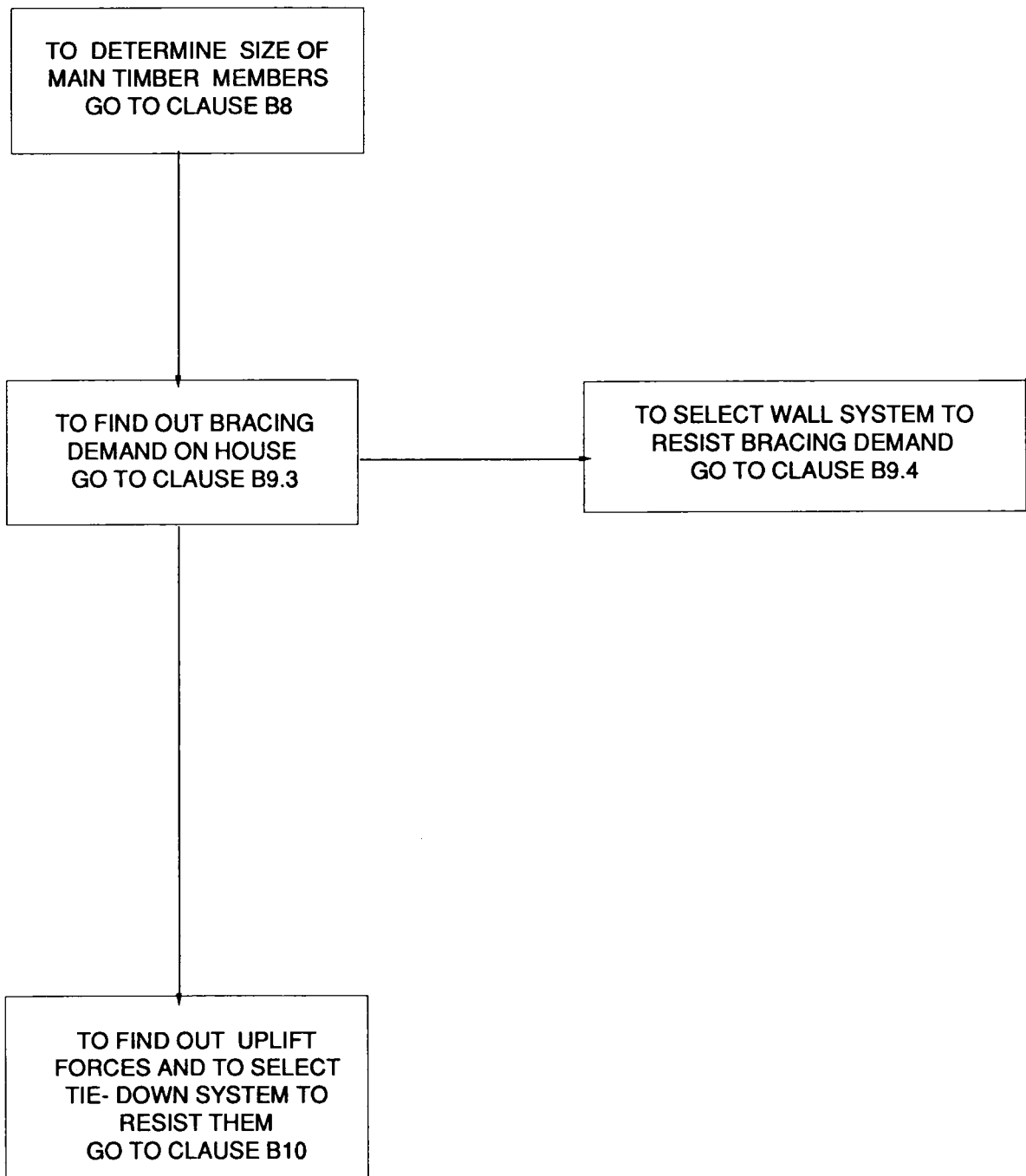


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# SECTION B

## TIMBER FRAMED HOUSES

# SECTION B TIMBER FRAMED HOUSES



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## SECTION B TIMBER FRAMED HOUSES

### B1 GENERAL

All timber members must be sized in accordance with Tables 1 to 20 as appropriate for the member, stress grade, and design situation. Care must be taken to ensure that the correct tables are used for the appropriate design windspeeds.

### B2 ASCERTAINING STRESS GRADE

Many of the tables in the Manual are based on a knowledge of the stress grade (see definition) of the timber used. Where timber is not stress graded mechanically or visually the approximate stress grade can be determined from the density of the timber. Table B2 gives these approximate values for different timber densities whether of softwood or hardwood. These values may be used in the absence of more precise information, to refer to all the other tables to use which the relevant stress grade is required.

TABLE B2 RELATIONSHIP BETWEEN DENSITY, STRENGTH GROUP AND STRESS GRADE

UNSEASONED TIMBERS							
MINIMUM DENSITY VALUES AT 12 PERCENT MOISTURE CONTENT	1180	1030	900	800	700	600	500
STRENGTH GROUP	S1	S2	S3	S4	S5	S6	S7
STRESS GRADE	F17	F14	F11	F8	F7	F5	F4*

SEASONED TIMBERS								
MINIMUM DENSITY VALUES AT 12 PERCENT MOISTURE CONTENT	1200	1080	960	840	730	620	520	420
STRENGTH GROUP	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
STRESS GRADE	F27	F22	F17	F14	F11	F8	F7*	F5*

\* Not applicable to hardwood timbers

### B3 JOINT GROUPS

A knowledge of the value of the joint group (see definition) of each timber member at any mechanical joint is required for the use of tables that relate to clauses B - 9 and B - 10. When this information is not readily available, it will be necessary to seek the guidance of the Department of Forestry or some other reliable source of information.

### B4 NOMINAL FIXINGS

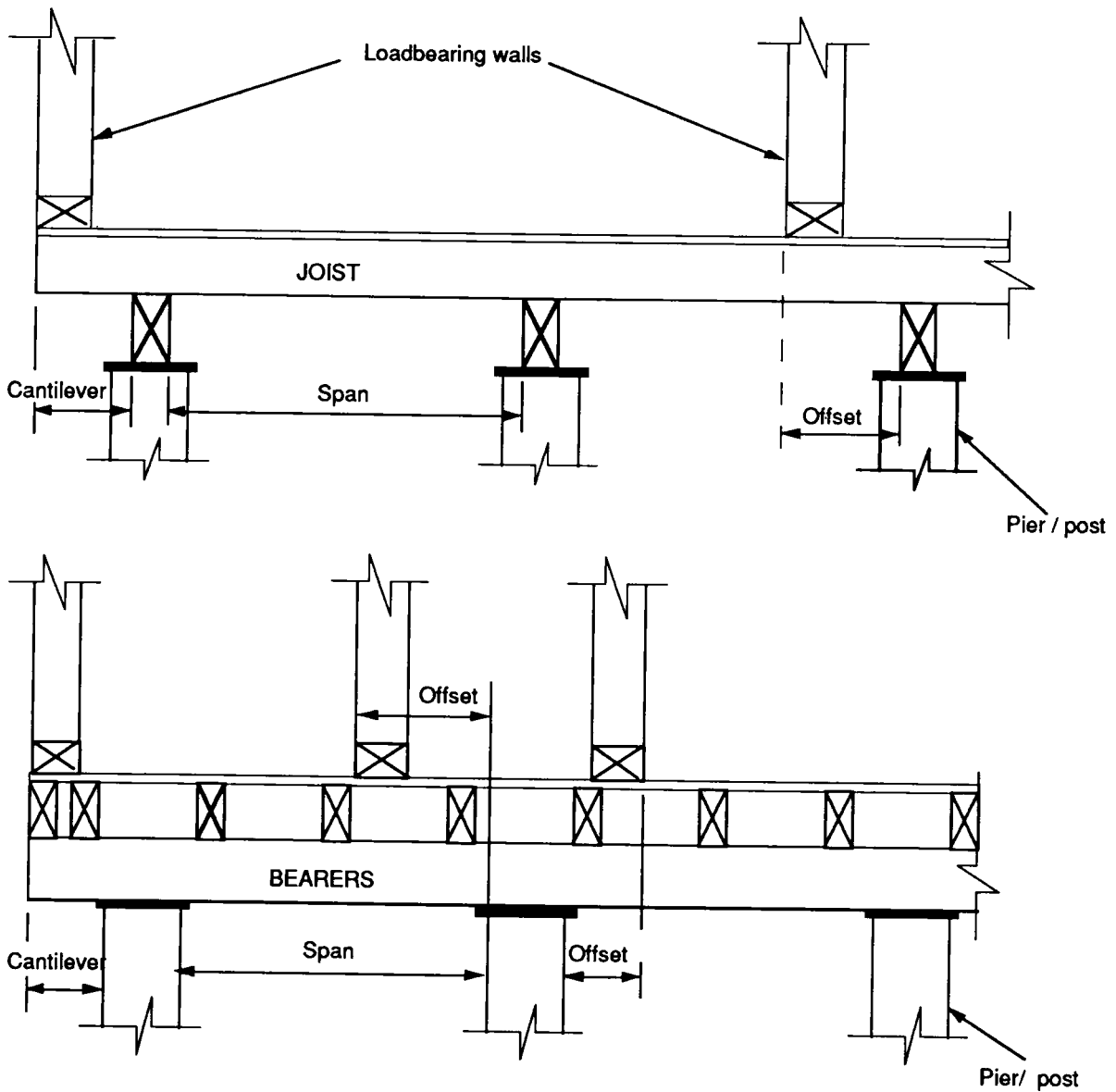
The minimum diameter of nails for use in nominal fixings must be 3.15 mm plain shank for hardwood, and 3.75 mm plain shank or 3.15 mm deformed shank for softwood. The minimum depth of penetration of nail into the final receiving member must be 10 times the nail diameter where driven into side grain and 15 times the nail diameter where driven into end grain. Not less than two nails must be provided at each joint unless shown otherwise in this Manual.

**B5 POSITION OF BEARERS, JOISTS AND NOGGINGS**

**B5.1 Allowable offsets for Bearers**

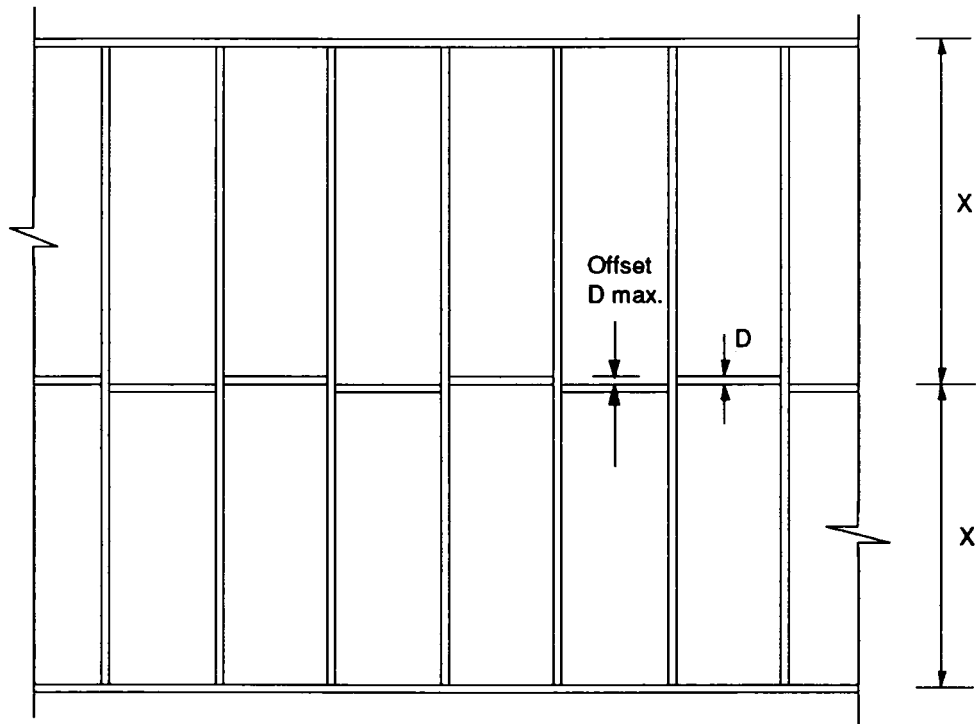
PERMISSIBLE CANTILEVERS AND OFFSETS FOR BEARERS AND JOISTS UNDER LOADBEARING WALLS		
Depth of Member (mm)	Maximum permissible cantilever as proportion of span (%)	Maximum permissible offset of internal loadbearing walls as proportion of span (%)
	Light Roof *	Light Roof *
< 125	10	20
125 - 200	15	30
201 - 275	17.5	35
> 275	20	37.5

\* eg. metal sheet roofing.



**FIGURE B5.1 CANTILEVERS AND OFFSETS**

## B5.2 Position of Noggings



Note : The value of 'X' must not exceed 1350 mm.

FIGURE B5.2 POSITION OF NOGGINGS

## B6 STIFFENING OF PLATES

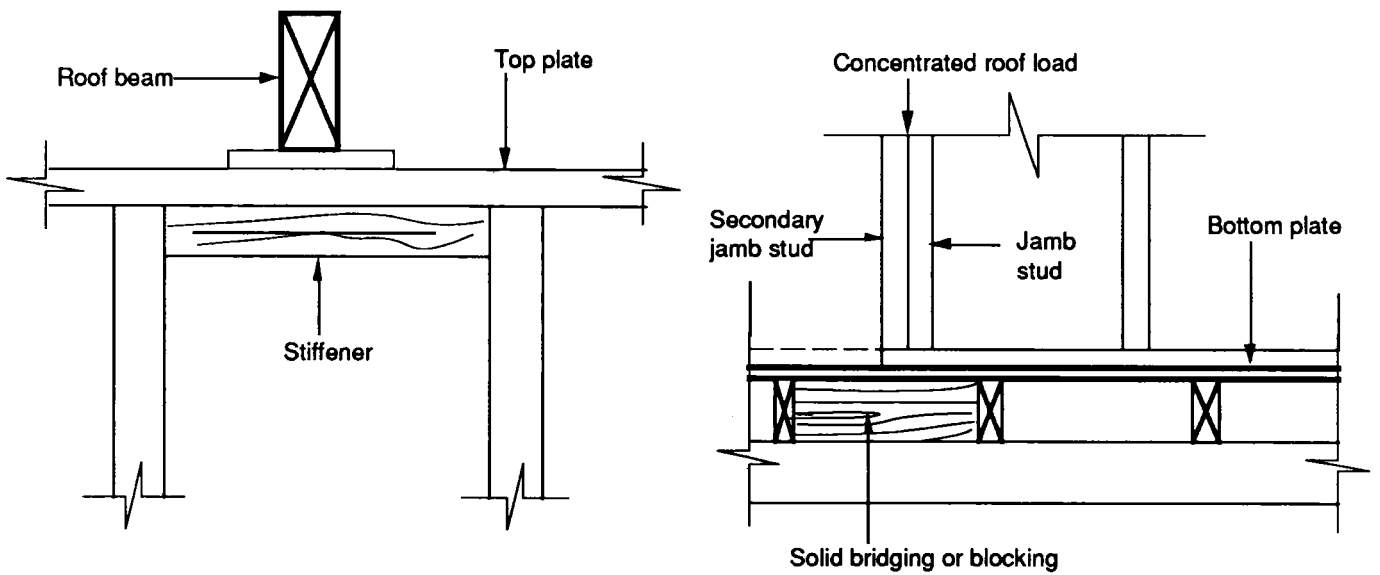
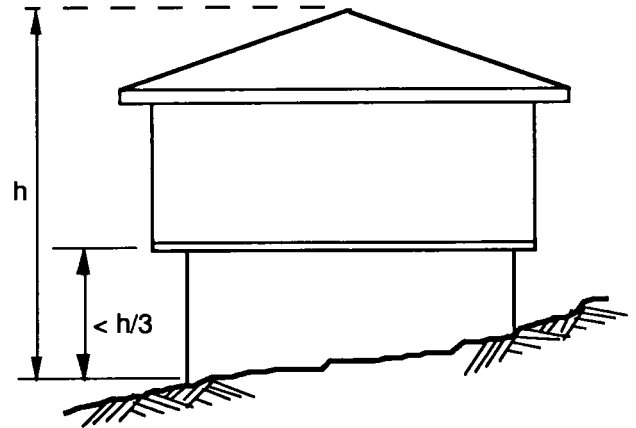
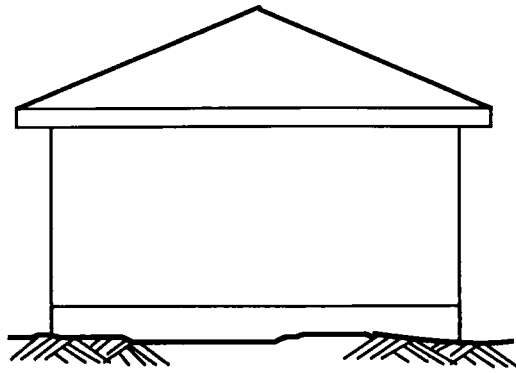


FIGURE B6 LOCAL STIFFENING OF PLATES





LOWSET (Single Storey)

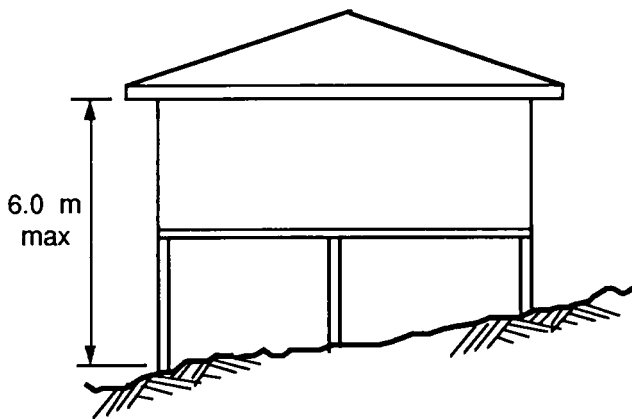
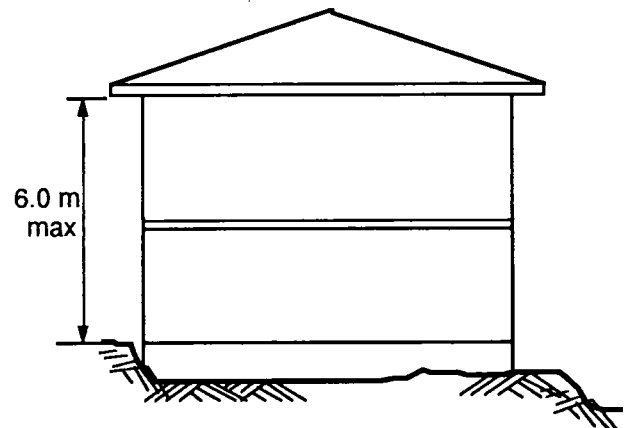
HIGH-SET  
(Open under)TWO STOREY  
(Enclosed under)

FIGURE B7 HOUSE TYPES

A highset house is an elevated house with a clear, unwallled space underneath the first floor level, with a height from ground to underside of floor of at least one-third of the total height of the house.

## B8 TIMBER MEMBER SIZES

### B8.1 General

The following sets of tables provide the sizes of timber members corresponding to design windspeeds determined from Section A. The tables are numbered 1 to 20 and each table contains the member size for the various components of a timber framed house.

The tolerances permitted for the sizes given in the tables are as follows

- for unseasoned timber of stress grades F4 to F7, not greater than 4 mm under the call dimension.
- for other unseasoned timber, not greater than 3 mm under the call dimension.
- for seasoned timber, negative tolerance is not permitted.

**B8.2** All timber dimensions are expressed with the value for depth first followed by that for the width. For example a purlin shown in any table as 50 x 75 means that it is laid flat with 50 mm depth and 75 mm width. If the reference is to 75 x 50, then the depth is 75 mm and width 50 mm.

### **B8.3 Application**

To determine the member size to be used, the following steps need to be followed

1. Determine the design windspeed (from Section A )
2. Select the table that corresponds to the design windspeed determined from step 1 for the member under consideration
3. Determine the options to be used from those given in the tables. ( eg. spacing, span, height, stress grade of timber, seasoning of timber etc. ).
4. Select the member size.

### **B8.4 Tables for Timber Members**

The following list gives the table numbers for the various timber members of a house.

Table 1	BEARERS SUPPORTING SINGLE OR UPPER STOREY LOADBEARING WALLS
Table 2	BEARERS SUPPORTING FLOOR JOISTS ONLY
Table 3	FLOOR JOISTS
Table 4	STUDS - SINGLE OR UPPER STOREY
Table 5	STUDS AT SIDES OF OPENINGS
Table 6	STUDS - INTERNAL LOADBEARING WALLS
Table 7	TOP PLATES - SINGLE OR UPPER STOREY
Table 8	BOTTOM PLATES - SINGLE OR UPPER STOREY
Table 9	LINTELS - SINGLE OR UPPER STOREY
Table 10	RAFTERS
Table 11	PURLINS
Table 12	VERANDAH POSTS
Table 13	BEARERS SUPPORTING TWO STOREY LOADBEARING WALLS
Table 14	STUDS- LOWER OF TWO STOREY
Table 15	STUDS - INTERNAL WALLS - LOWER OF TWO STOREY
Table 16	STUDS AT SIDES OF OPENINGS - LOWER OF TWO STOREY CONSTRUCTION
Table 17	TOP PLATES - LOWER OF TWO STOREY
Table 18	BOTTOM PLATES - LOWER STOREY WALLS
Table 19	LINTELS - LOWER OF TWO STOREY
Table 20	ROOF BEAMS - NON-TRAFFICABLE ROOFS

**Table 1**

**BEARERS SUPPORTING SINGLE OR UPPER STOREY LOADBEARING WALLS  
For All Design Windspeeds**

Maximum Building Width: 9000 mm

BEARER SPACING (mm)	BEARER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
1800	1500	150 x 75	150 x 75	125 x 75	125 x 75	125 x 75	125 x 75	125 x 75
	1800	175 x 75	175 x 75	150 x 75	150 x 75	150 x 75	150 x 75	125 x 75
	2100	200 x 75	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75	150 x 75
	2400	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	2700	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3000	275 x 75	275 x 75	250 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3300	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75
	3600	-	-	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75
3600	1500	175 x 75	150 x 75	150 x 75	150 x 75	125 x 75	125 x 75	125 x 75
	1800	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75	150 x 75	125 x 75
	2100	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75	150 x 75
	2400	250 x 75	225 x 75	225 x 75	225 x 75	200 x 75	175 x 75	175 x 75
	2700	275 x 75	250 x 75	250 x 75	250 x 75	225 x 75	200 x 75	200 x 75
	3000	300 x 75	275 x 75	275 x 75	275 x 75	250 x 75	225 x 75	225 x 75
	3300	-	300 x 75	300 x 75	300 x 75	275 x 75	250 x 75	250 x 75
	3600	-	-	-	-	300 x 75	275 x 75	275 x 75

BEARER SPACING (mm)	BEARER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
1800	1500	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70	90 x 70	90 x 70
	1800	170 x 70	140 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	2100	190 x 70	170 x 70	170 x 70	140 x 70	140 x 70	140 x 70	140 x 70
	2400	220 x 70	190 x 70	170 x 70	170 x 70	170 x 70	170 x 70	170 x 70
	2700	240 x 70	220 x 70	190 x 70	190 x 70	190 x 70	170 x 70	170 x 70
	3000	-	240 x 70	220 x 70	220 x 70	220 x 70	190 x 70	190 x 70
	3300	-	-	240 x 70	240 x 70	240 x 70	220 x 70	220 x 70
	3600	-	-	-	240 x 70	240 x 70	240 x 70	240 x 70
3600	1500	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	1800	190 x 70	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	2100	220 x 70	190 x 70	170 x 70	140 x 70	140 x 70	140 x 70	140 x 70
	2400	240 x 70	220 x 70	190 x 70	170 x 70	170 x 70	170 x 70	170 x 70
	2700	-	240 x 70	220 x 70	190 x 70	190 x 70	170 x 70	170 x 70
	3000	-	-	240 x 70	220 x 70	220 x 70	190 x 70	190 x 70
	3300	-	-	240 x 70	240 x 70	240 x 70	220 x 70	220 x 70
	3600	-	-	-	-	-	240 x 70	240 x 70

**Table 2**

**BEARERS SUPPORTING FLOOR JOISTS ONLY  
For All Design Windspeeds**

BEARER SPACING (mm)	BEARER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
1800	1500	125 x 75	125 x 75	100 x 75	100 x 75	100 x 75	100 x 75	100 x 75
	1800	150 x 75	125 x 75	125 x 75	125 x 75	125 x 75	100 x 75	100 x 75
	2100	175 x 75	150 x 75	150 x 75	150 x 75	125 x 75	125 x 75	125 x 75
	2400	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75	150 x 75	150 x 75
	2700	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	150 x 75	150 x 75
	3000	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3300	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600	300 x 75	250 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
2400	1500	150 x 75	125 x 75	125 x 75	125 x 75	100 x 75	100 x 75	100 x 75
	1800	175 x 75	150 x 75	150 x 75	125 x 75	125 x 75	125 x 75	125 x 75
	2100	200 x 75	175 x 75	150 x 75	150 x 75	150 x 75	150 x 75	125 x 75
	2400	225 x 75	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75	150 x 75
	2700	250 x 75	225 x 75	200 x 75	200 x 75	175 x 75	175 x 75	175 x 75
	3000	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3300	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3600	-	300 x 75	275 x 75	250 x 75	250 x 75	250 x 75	225 x 75
3000	1500	175 x 75	150 x 75	125 x 75	125 x 75	125 x 75	100 x 75	100 x 75
	1800	200 x 75	175 x 75	150 x 75	150 x 75	125 x 75	125 x 75	125 x 75
	2100	225 x 75	200 x 75	175 x 75	175 x 75	150 x 75	150 x 75	150 x 75
	2400	250 x 75	225 x 75	200 x 75	175 x 75	175 x 75	175 x 75	175 x 75
	2700	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	300 x 75	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	3300	-	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3600	-	-	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
3600	1500	175 x 75	150 x 75	150 x 75	150 x 75	125 x 75	125 x 75	125 x 75
	1800	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75	125 x 75	125 x 75
	2100	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	150 x 75	150 x 75
	2400	250 x 75	225 x 75	225 x 75	225 x 75	200 x 75	175 x 75	175 x 75
	2700	275 x 75	250 x 75	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3000	300 x 75	275 x 75	275 x 75	250 x 75	225 x 75	225 x 75	225 x 75
	3300	-	300 x 75	300 x 75	275 x 75	250 x 75	250 x 75	250 x 75
	3600	-	-	-	-	275 x 75	275 x 75	250 x 75

**Table 2 (continued)**

**BEARERS SUPPORTING FLOOR JOISTS ONLY  
For All Design Windspeeds**

BEARER SPACING (mm)	BEARER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
1800	1500	120 x 70	120 x 70	120 x 70	90 x 70	90 x 70	90 x 70	90 x 70
	1800	140 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	2100	170 x 70	170 x 70	140 x 70	140 x 70	140 x 70	120 x 70	120 x 70
	2400	190 x 70	170 x 70	170 x 70	170 x 70	140 x 70	140 x 70	140 x 70
	2700	220 x 70	190 x 70	190 x 70	170 x 70	170 x 70	170 x 70	170 x 70
	3000	240 x 70	220 x 70	220 x 70	190 x 70	190 x 70	170 x 70	170 x 70
	3300	-	240 x 70	240 x 70	220 x 70	220 x 70	190 x 70	190 x 70
	3600	-	-	240 x 70	240 x 70	240 x 70	240 x 70	220 x 70
2400	1500	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70	90 x 70	90 x 70
	1800	170 x 70	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	2100	190 x 70	170 x 70	170 x 70	140 x 70	140 x 70	140 x 70	120 x 70
	2400	220 x 70	220 x 70	190 x 70	170 x 70	170 x 70	170 x 70	140 x 70
	2700	240 X 70	240 x 70	220 x 70	190 x 70	190 x 70	170 x 70	170 x 70
	3000	-	240 X 70	220 x 70	220 x 70	220 x 70	190 x 70	190 x 70
	3300	-	-	240 x 70	240 x 70	240 x 70	220 x 70	190 x 70
	3600	-	-	-	-	240 x 70	240 x 70	220 x 70
3000	1500	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	1800	190 x 70	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	2100	220 x 70	190 x 70	170 x 70	140 x 70	140 x 70	140 x 70	140 x 70
	2400	240 X 70	220 x 70	190 x 70	170 x 70	170 x 70	170 x 70	170 x 70
	2700	-	240 X 70	220 x 70	190 x 70	190 x 70	170 x 70	170 x 70
	3000	-	-	220 X 70	220 x 70	220 x 70	190 x 70	190 x 70
	3300	-	-	240 X 70	240 X 70	240 x 70	220 x 70	220 x 70
	3600	-	-	-	-	-	240 x 70	240 x 70
3600	1500	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	1800	190 x 70	170 x 70	140 x 70	120 x 70	120 x 70	120 x 70	120 x 70
	2100	220 x 70	190 x 70	170 x 70	140 x 70	140 x 70	140 x 70	140 x 70
	2400	240 x 70	220 x 70	190 x 70	170 x 70	170 x 70	170 x 70	170 x 70
	2700	-	240 x 70	220 x 70	190 x 70	190 x 70	170 x 70	170 x 70
	3000	-	-	240 x 70	220 x 70	220 x 70	190 x 70	190 x 70
	3300	-	-	240 x 70	240 x 70	240 x 70	220 x 70	220 x 70
	3600	-	-	-	-	-	240 x 70	240 x 70

Table 3

## FLOOR JOISTS

For All Design Windspeeds

Joists spacing: 450 mm centres

MAX. SPAN (mm)	SPAN TYPE	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
1800	SINGLE	125 x 40	125 x 40	125 x 40	125 x 40	100 x 50	100 x 40	100 x 40
	CONT.	125 x 40	100 x 50	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
2100	SINGLE	150 x 40	125 x 50	125 x 50	125 x 40	125 x 40	100 x 50	100 x 50
	CONT.	125 x 40	125 x 40	125 x 40	125 x 40	100 x 50	100 x 40	100 x 40
2400	SINGLE	150 x 50	150 x 40	150 x 40	125 x 50	125 x 50	125 x 40	125 x 40
	CONT.	150 x 40	125 x 50	125 x 50	125 x 40	125 x 40	100 x 50	100 x 50
2700	SINGLE	175 x 40	150 x 50	150 x 50	150 x 50	150 x 40	125 x 50	125 x 50
	CONT.	150 x 50	150 x 40	150 x 40	125 x 50	125 x 40	125 x 40	125 x 40
3000	SINGLE	175 x 50	175 x 40	175 x 40	175 x 40	150 x 40	150 x 40	125 x 50
	CONT.	150 x 50	150 x 50	150 x 40	150 x 40	125 x 50	125 x 50	125 x 40
3300	SINGLE	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 40
	CONT.	175 x 50	175 x 50	150 x 50	150 x 50	150 x 40	125 x 50	125 x 40
3600	SINGLE	200 x 50	200 x 40	175 x 50	175 x 50	175 x 40	150 x 50	150 x 50
	CONT.	200 x 50	200 x 40	150 x 50	150 x 50	150 x 40	150 x 40	125 x 50

MAX. SPAN (mm)	SPAN TYPE	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
1800	SINGLE	120 x 35	120 x 35	120 x 35	120 x 35	120 x 35	90 x 45	90 x 45
	CONT.	120 x 35	120 x 35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
2100	SINGLE	140 x 35	120 x 45	120 x 45	120 x 35	120 x 35	120 x 35	90 x 45
	CONT.	120 x 35	120 x 35	120 x 35	120 x 35	120 x 35	90 x 45	90 x 45
2400	SINGLE	140 x 45	140 x 45	140 x 35	120 x 45	120 x 45	120 x 35	120 x 35
	CONT.	140 x 35	120 x 45	120 x 45	120 x 35	120 x 35	120 x 35	90 x 45
2700	SINGLE	190 x 35	190 x 35	140 x 45	140 x 45	140 x 35	120 x 45	120 x 45
	CONT.	140 x 45	140 x 35	140 x 35	120 x 45	120 x 45	120 x 35	120 x 35
3000	SINGLE	190 x 35	190 x 35	190 x 35	190 x 35	140 x 35	140 x 35	140 x 35
	CONT.	190 x 35	140 x 35	140 x 35	140 x 35	140 x 35	120 x 45	120 x 45
3300	SINGLE	190 x 35	190 x 35	190 x 35	190 x 35	190 x 35	140 x 45	140 x 45
	CONT.	190 x 35	190 x 35	190 x 35	140 x 45	140 x 35	140 x 35	120 x 45
3600	SINGLE	240 x 35	240 x 35	190 x 35	190 x 35	190 x 35	190 x 35	190 x 35
	CONT.	240 x 35	240 x 35	190 x 35	190 x 35	140 x 45	140 x 35	140 x 35

- Notes
- The sizes given apply only where roof loads are supported within the allowable offset distance for the joists.
  - Where roof loads occur outside the allowable offset, floor joists must be strengthened by placing a double joist, one size greater than the appropriate tabled value, at the points where roof loads are transferred to the floor.
  - For spans greater than 2400 mm, a floor joist size used at the maximum span given by the table may exhibit excessive "bounce". To avoid excessive "bounce", joists may be one size greater than the tabled values.

**Table 4 - 49**

**STUDS - SINGLE OR UPPER STOREY**

External walls including gable ends

**Design Windspeed: 49 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 40	100 x 40	75 x 50	75 x 40	75 x 40	75 x 40	75 x 40
	2700	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50	75 x 40
	3000	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
600	2400	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 40	75 x 40
	2700	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	3000	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
750	2400	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	2700	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	3000	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40
900	2400	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	2700	100 x 75	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40
	3000	-	-	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 35	90 x 35	70 x 45	70 x 45	70 x 35	70 x 35	70 x 35
	2700	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45
	3000	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
600	2400	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45	70 x 35
	2700	90 x 70	90 x 70	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	3000	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
750	2400	90 x 70	90 x 70	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	2700	-	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35
	3000	-	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
900	2400	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	2700	-	90 x 70	90 x 70	90 x 70	90 x 70	90 x 45	90 x 35
	3000	-	-	-	-	90 x 70	90 x 70	90 x 70

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

**Table 4 - 51**

**STUDS - SINGLE OR UPPER STOREY**

External walls including gable ends

**Design Windspeed: 51 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 40	100 x 40	75 x 50	75 x 50	75 x 40	75 x 40	75 x 40
	2700	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	3000	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
600	2400	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50	75 x 50
	2700	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	3000	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
750	2400	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	2700	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
900	2400	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	2700	-	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45	70 x 35	70 x 35
	2700	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45
	3000	90 x 70	90 x 70	90 x 70	90 x 45	90 x 35	90 x 35	90 x 35
600	2400	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45
	2700	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	3000	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 35
750	2400	90 x 70	90 x 70	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	2700	-	90 x 70	90 x 45	90 x 70	90 x 45	90 x 45	90 x 35
900	2400	-	90 x 70	90 x 45	90 x 45	90 x 45	90 x 35	90 x 35
	2700	-	-	90 x 45	90 x 70	90 x 70	90 x 45	90 x 45

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching



**Table 4 - 53**

**STUDS - SINGLE OR UPPER STOREY**

External walls including gable ends

**Design Windspeed: 53 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 40	100 x 40	100 x 40	75 x 50	75 x 40	75 x 40	75 x 40
	2700	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	3000	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
600	2400	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 40
	2700	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	3000	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
750	2400	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	2700	100 x 75	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40
	3000	-	-	100 x 75	100 x 75	100 x 75	100 x 50	100 x 40
900	2400	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	2700	-	100 x 75	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40
	3000	-	-	-	100 x 75	100 x 75	100 x 75	100 x 50
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45	70 x 35
	2700	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	3000	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35
600	2400	90 x 70	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45
	2700	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35
	3000	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
750	2400	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	2700	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	3000	-	-	-	90 x 70	90 x 70	90 x 70	90 x 70
900	2400	-	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35
	2700	-	-	-	90 x 70	90 x 70	90 x 70	90 x 45
	3000	-	-	-	-	-	90 x 70	90 x 70

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

**Table 4 - 55**

**STUDS - SINGLE OR UPPER STOREY**

External walls including gable ends

**Design Windspeed: 55 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50	75 x 40	75 x 40
	2700	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	3000	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
600	2400	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	2700	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	3000	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
750	2400	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	2700	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 50	100 x 40
900	2400	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	2700	-	-	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45	70 x 35
	2700	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	3000	90 x 70	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
600	2400	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	2700	90 x 70	90 x 70	90 x 70	90 x 70	90 x 45	90 x 35	90 x 35
	3000	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45
750	2400	-	90 x 70	90 x 70	90 x 45	90 x 35	90 x 35	90 x 35
	2700	-	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
900	2400	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	2700	-	-	-	90 x 70	90 x 70	90 x 70	90 x 45

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

**Table 4 - 57**

**STUDS - SINGLE OR UPPER STOREY**  
External walls including gable ends

**Design Windspeed: 57 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 40	75 x 40
	2700	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	3000	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
600	2400	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	2700	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	3000	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
750	2400	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	2700	-	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
	3000	-	-	-	100 x 75	100 x 75	100 x 75	100 x 50
900	2400	-	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40
	2700	-	-	100 x 75	100 x 57	100 x 75	100 x 50	100 x 40
	3000	-	-	-	-	100 x 75	100 x 75	10 x 75
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45	70 x 35
	2700	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	3000	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
600	2400	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	2700	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	3000	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45
750	2400	-	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35
	2700	-	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
	3000	-	-	-	-	90 x 70	90 x 70	90 x 70
900	2400	-	-	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	2700	-	-	-	-	90 x 70	90 x 70	90 x 70
	3000	-	-	-	-	-	-	90 x 70

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

**Table 4 - 60**

**STUDS - SINGLE OR UPPER STOREY**  
External walls including gable ends

**Design Windspeed: 60 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50	75 x 40
	2700	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	3000	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
600	2400	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	2700	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
	3000	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50
750	2400	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	2700	-	-	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
900	2400	-	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
	2700	-	-	-	100 x 75	100 x 75	100 x 75	100 x 50
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45
	2700	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 45	90 x 35
	3000	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
600	2400	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	2700	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
	3000	-	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70
750	2400	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	2700	-	-	-	90 x 70	90 x 70	90 x 70	90 x 45
900	2400	-	-	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
	2700	-	-	-	-	90 x 70	90 x 70	90 x 70

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

**Table 4 - 64**

**STUDS - SINGLE OR UPPER STOREY**

External walls including gable ends

**Design Windspeed: 64 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	2700	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	3000	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
600	2400	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	2700	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
	3000	-	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	2700	90 x 70	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	3000	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45
600	2400	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	2700	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 45	90 x 45
	3000	-	-	-	90 x 90	90 x 90	90 x 70	90 x 70

**Design Windspeed: 69 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	2700	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40	100 x 40
	3000	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50
600	2400	100 x 75	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40
	2700	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50
	3000	-	-	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	2700	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 35
	3000	-	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70
600	2400	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35
	2700	-	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70
	3000	-	-	-	-	90 x 90	90 x 90	90 x 70

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

**Table 4 - 75.5**

**STUDS - SINGLE OR UPPER STOREY**

External walls including gable ends

**Design Windspeed: 74.5 m/s**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	2700	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50	100 x 50	100 x 40
	3000	-	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50
600	2400	100 x 100	100 x 75	100 x 75	100 x 50	100 x 40	100 x 40	100 x 40
	2700	-	100 x 100	100 x 100	100 x 75	100 x 75	100 x 75	100 x 50
	3000	-	-	-	100 x 100	100 x 100	100 x 75	100 x 75
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45	90 x 35	90 x 35
	2700	-	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45
	3000	-	-	-	90 x 90	90 x 90	90 x 70	90 x 70
600	2400	90 x 90	90 x 90	90 x 70	90 x 70	90 x 70	90 x 45	90 x 45
	2700	-	-	-	90 x 90	90 x 90	90 x 70	90 x 70
	3000	-	-	-	-	-	90 x 90	90 x 90

- Notes
- i. Larger sizes may be made up from smaller sections i.e. 2/100 x 50 equals a 100 x 100.
  - ii. Studs supporting concentrations of load from beams and the like must be doubled common studs.
  - iii. No allowance has been made for notching

## STUDS AT SIDES OF OPENINGS

**Design Windspeed: 49 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	100 x 50	100x40	100 x 40	100 x 40	75 x 50	75 x 50	75 x 40
	1200	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	1500	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1800	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
2700	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45
	1200	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	1500	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	1800	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
2700	900	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	1200	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1800	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45

**Design Windspeed: 51 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	75 x 50	75 x 50	75 x 50
	1200	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1500	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 50	100 x 40
2700	900	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45
	1200	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	1500	2/120x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1800	2/120x45	2/90x35	2/90x35	2/90x35	90 x 35	90 x 35	90 x 35
2700	900	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
	1200	2/90x35	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1500	2/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1800	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45

**TABLE 9 - 9/99**  
**STUDS AT SIDES OF OPENINGS**

**Design Windspeed: 53 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1500	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
2700	900	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	1200	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
	1800	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
2700	900	2/90 x 35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1200	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1500	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45

**Design Windspeed: 55 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
2700	900	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1500	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1800	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	1200	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1800	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35
2700	900	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1200	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1500	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35



**TABLE 3 - 5/00**  
**STUDS AT SIDES OF OPENINGS**

**Design Windspeed: 57 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	2/100x50	100 x 50	100 x 40	100 x 40
2700	900	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1200	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1500	3/100x40	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40
	1800	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	1200	2/90x45	2/90x35	2/90x35	90 x 35	90 x 45	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1800	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
2700	900	2/90 x 45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35
	1200	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1500	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35

**Design Windspeed: 60 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
2700	900	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1200	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1500	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
	1800	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1200	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1500	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1800	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
2700	900	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1200	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	2/90x35	90 x 45
	1500	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35
	1800	3/90x45	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35

**Table 5 - 64/69**  
**STUDS AT SIDES OF OPENINGS**

**Design Windspeed: 64 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1200	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1500	3/100x40	2/100x50	2/100x40	2/100 x 40	100 x 50	100 x 50	100 x 40
	1800	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
2700	900	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1200	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
	1500	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1800	3/100x50	3/100x40	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35
	1200	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1500	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
2700	900	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1200	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
	1500	3/90x45	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35
	1800	4/90x45	4/90x35	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35

**Design Windspeed: 69 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1200	3/100x40	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1500	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
	1800	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
2700	900	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
	1200	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1500	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
	1800	-	3/100x50	3/100x50	3/100x50	2/100x50	2/100x40	2/100x40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35
	1200	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1500	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
	1800	4/90x35	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
2700	900	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
	1200	3/90x45	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
	1500	4/90x45	4/90x35	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35
	1800	4/90x45	4/90x45	4/90x35	3/90x45	3/90x35	3/90x35	2/90x45

**Table 5 - 74.5**  
**STUDS AT SIDES OF OPENINGS**

**Design Windspeed: 74.5 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	3/100x40	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1200	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
	1500	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1800	-	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
2700	900	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1200	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
	1500	-	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40
	1800	-	-	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	2/90x35	90 x 35
	1200	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	90 x 45
	1500	4/90x35	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
	1800	4/90x45	3/90x45	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35
2700	900	3/90x45	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
	1200	4/90x45	4/90x35	3/90x45	3/90x35	2/90x45	2/90x35	2/90x35
	1500	-	4/90x45	4/90x45	3/90x45	3/90x35	2/90x45	2/90x45
	1800	-	-	4/90x45	4/90x45	3/90x45	3/90x35	3/90x35

**Table 6**

**STUDS - INTERNAL LOADBEARING WALLS  
For All Design Windspeeds**

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	75 x 40						
	2700	100 x 40		75 x 50		75 x 40		
	3000	100 x 40				75 x 50		
	3300	100 x 50			100 x 40			
	3600	100 x 75			100 x 50		100 x 40	
	3900	2/100 x 50	100 x 75		100 x 50			
	4200	-	2/100 x 50		100 x 75			
600	2400	75 x 50		75 x 40				
	2700	100 x 40			75 x 50		75 x 40	
	3000	100 x 50		100 x 40				
	3300	100 x 75		100 x 50			100 x 40	
	3600	2/100 x 50	100 x 75			100 x 40		
	3900	-	2/100 x 50		100 x 75			
	4200	-				100 x 75		

STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	75 x 35						
	2700	90 x 35		70 x 45		70 x 35		
	3000	90 x 45		90 x 35			70 x 45	
	3300	90 x 70		90 x 45			90 x 35	
	3600	90 x 90		90 x 70			90 x 45	
	3900	-		90 x 90		90 x 70		
	4200	-				90 x 90		
600	2400	70 x 45	70 x 35					
	2700	90 x 45	90 x 35			70 x 45		
	3000	90 x 70	90 x 45		90 x 35		70 x 45	
	3300	-	90 x 70		90 x 45			
	3600	-		90 x 90	90 x 70		90 x 45	
	3900	-				90 x 70		
	4200	-				90 x 90		

- Notes
- i. Internal studs supporting concentrations of load from roof beams must be double the common stud taken from the above table.
  - ii. Studs are assumed to be not notched.

Table 7

TOP PLATES - SINGLE OR UPPER STOREY

For All Design Windspeeds

BUILDING WIDTH (mm)	RAFTER SPACING (mm)	UNSEASONED							
		F4	F5	F7	F8	F11	F14	F17	
7500	900	75 x 75	50 x 75						
		50 x 100							
9000	900	75 x 75		50 x 75					
		75 x 100	50 x 100						

BUILDING WIDTH (mm)	RAFTER SPACING (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
7500	900	70 x 90		45 x 70				
		70 x 90	45 x 90					
9000	900	70 x 70		45 x 70				
		70 x 90	45 x 90					

Table 8

BOTTOM PLATES - SINGLE OR UPPER STOREY

For All Design Windspeeds

BUILDING WIDTH (mm)	RAFTER SPACING (mm)	UNSEASONED TIMBER						
		F4	F5	F7	F8	F11	F14	F17
7500	900	75 x 75		50 x 75				
		50 x 100						
9000	900	75 x 75				50 x 75		
		75 x 100	50 x 100					

BUILDING WIDTH (mm)	RAFTER SPACING (mm)	SEASONED TIMBER						
		F4	F5	F7	F8	F11	F14	F17
7500	900	70 x 90				45 x 70		
		70 x 90	45 x 90					
9000	900	70 x 70				45 x 70		
		70 x 90	45 x 90					

Note Bottom plates fully supported by solid nogging or a concrete slab may be a minimum of 45 x 70 mm mm.

Table 9 - 49/51/53

LINTELS - SINGLE OR UPPER STOREY

Design Windspeed: 49 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	150 x 50	125 x 50		100 x 50			75 x 50
	1200	150 x 50		125 x 50		100 x 50		
	1500	150 x 50			125 x 50			
	1800	175 x 50			150 x 50			
9000	900	175 x 50	150 x 50	125 x 50		100 x 50		
	1200	200 x 50	175 x 50	150 x 50	125 x 50			
	1500	200 x 50	175 x 50	150 x 50			125 x 50	
	1800	225 x 50	200 x 50		175 x 50			150 x 50

Design Windspeed: 51 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	125 x 75	100 x 75			75 x 75		
	1200	125 x 75		100 x 75				
	1500	125 x 75				100 x 75		
	1800	175 x 75	150 x 75			125 x 75		
9000	900	150 x 75	125 x 75		100 x 75			
	1200	175 x 75	150 x 75	125 x 75		100 x 75		
	1500	150 x 75			125 x 75			
	1800	200 x 75	175 x 75		150 x 75			

Design Windspeed : 53 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	150 x 50	125 x 50		100 x 50			
	1200	175 x 50	150 x 50		125 x 50		100 x 50	
	1500	175 x 50	150 x 50			125 x 50		
	1800	200 x 50	175 x 50		150 x 50			
9000	900	175 x 50	150 x 50		125 x 50		100 x 50	
	1200	200 x 50	175 x 50		150 x 50	125 x 50		
	1500	200 x 50	175 x 50		150 x 50			125 x 50
	1800	250 x 50	225 x 50	200 x 50		175 x 50		150 x 50

Table 9 - 55/57/60

LINTELS - SINGLE OR UPPER STOREY

Design Windspeed: 55 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	125 x 75		100 x 75			100 x 75	
	1200	150 x 75	150 x 75		100 x 75			
	1500	150 x 75		125 x 75			100 x 75	
	1800	175 x 75		150 x 75			125 x 75	
9000	900	150 x 75		125 x 75		100 x 75		
	1200	175 x 75		125 x 75		100 x 75		
	1500	275 x 75	150 x 75		125 x 75			
	1800	200 x 75	150 x 75		150 x 75			

Design Windspeed: 57 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	175 x 50	150 x 50	125 x 50		100 x 50		
	1200	175 x 50		150 x 50	125 x 50		100 x 50	
	1500	175 x 50		150 x 50			125 x 50	
	1800	225 x 50	200 x 50	175 x 50			150 x 50	
9000	900	200 x 50	175 x 50	150 x 50		125 x 50		100 x 50
	1200	225 x 50	200 x 50	175 x 50	150 x 50		125 x 50	
	1500	225 x 50	200 x 50	175 x 50		150 x 50		
	1800	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50		

Design Windspeed: 60 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	150 x 75	125 x 75		100 x 75			
	1200	150 x 75		125 x 75		100 x 75		
	1500	150 x 75		125 x 75				
	1800	200 x 75	175 x 75		150 x 75			
9000	900	175 x 75	150 x 75		125 x 75	100 x 75		
	1200	200 x 75	175 x 75	150 x 75		100 x 75		
	1500	200 x 75	175 x 75	150 x 75			125 x 75	
	1800	225 x 75	200 x 75	175 x 75		150 x 75		

Table 9 - 64/69/74.5

LINTELS - SINGLE OR UPPER STOREY

Design Windspeed: 64 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	150 x 75	125 x 75		100 x 75			
	1200	175 x 75	150 x 75		125 x 75		100 x 75	
	1500	175 x 75	150 x 75			125 x 75		
	1800	200 x 75	175 x 75			150 x 75		
9000	900	175 x 75		150 x 75	125 x 75		100 x 75	
	1200	200 x 75	175 x 75		150 x 75	125 x 75		100 x 75
	1500	200 x 75	175 x 75		150 x 75			125 x 75
	1800	250 x 75	225 x 75	200 x 75	175 x 75			150 x 75

Design Windspeed: 69 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	175 x 75	150 x 75	125 x 75		100 x 75		
	1200	175 x 75		150 x 75	125 x 75		100 x 75	
	1500	175 x 75		150 x 75			125 x 75	
	1800	225 x 75	200 x 75	175 x 75			150 x 75	
9000	900	200 x 75	175 x 75	150 x 75		125 x 75		100 x 75
	1200	225 x 75	200 x 75	175 x 75	150 x 75		125 x 75	
	1500	225 x 75	200 x 75	175 x 75	150 x 75			
	1800	275 x 75	250 x 75	225 x 75	200 x 75	175 x 75		

Design Windspeed: 74.5 m/s

BUILDING WIDTH (mm)	OPENING WIDTH (mm)	STRESS GRADE OF TIMBER						
		F4	F5	F7	F8	F11	F14	F17
6000	900	175 x 75	150 x 75		125 x 75		100 x 75	
	1200	200 x 75	175 x 75	150 x 75		125 x 75		100 x 75
	1500	200 x 75	175 x 75	150 x 75			125 x 75	
	1800	225 x 75	200 x 75		175 x 75			150 x 75
9000	900	225 x 75	200 x 75	175 x 75	150 x 75		125 x 75	
	1200	250 x 75	225 x 75	200 x 75	175 x 75	150 x 75		125 x 75
	1500	250 x 75	225 x 75	200 x 75	175 x 75		150 x 75	
	1800	300 x 75	250 x 75	225 x 75	200 x 75			175 x 75



# RAFTER TABLES

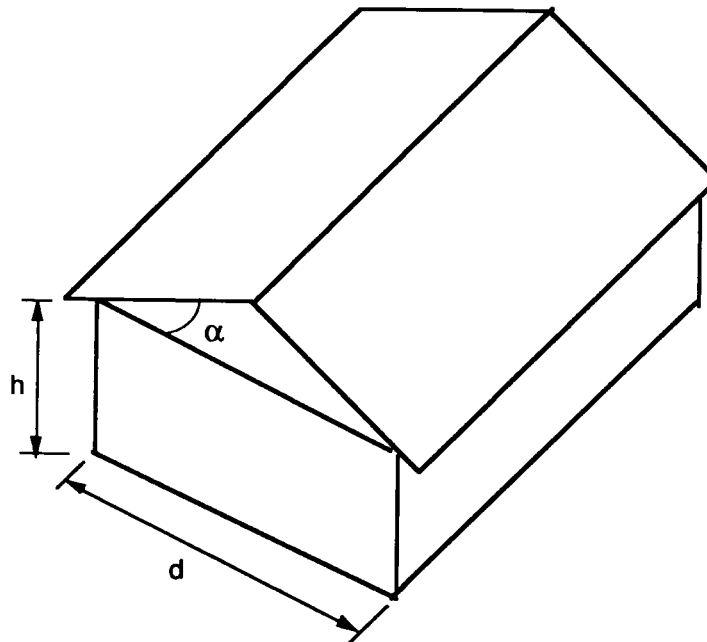


FIGURE B8.3.1

TABLE B8.3.1 APPROPRIATE TABLES FOR RAFTERS

APPROPRIATE TABLE	ASPECT RATIO h/d	ROOF PITCH $\alpha$
10 - 1	0.25 0.5 1.0	15°, 20°, 25° 20°, 25° 25°
10 - 2	0.25 0.5 1.0	10° 15° 20°
10 - 3	0.5 1.0	10° 15°
10 - 4	1.0	10°

Note Span of rafter is measured along the length of the rafter.

**Table 10 - 1 - 49**  
**RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 49 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	225 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	250 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	275 x 50	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	240 x 45	220 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	240 x 45	220 x 45	190 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	270 x 45	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 1 - 51  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 51 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	225 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	250 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	275 x 50	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	240 x 45	220 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	240 x 45	220 x 45	190 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	270 x 45	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 1 - 53**  
**RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 53 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	225 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	250 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	275 x 50	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	240 x 45	220 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	270 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	270 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	290 x 45	270 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	290 x 45	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Table 10 - 1 - 55**  
**RAFTERS**

**Design Windspeed: 55 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	225 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	220 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	240 x 45	220 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	290 x 45	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 1 - 57  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 57 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 1 - 60**  
**RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 60 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	275 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	300 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45
1500	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 1 - 64  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 64 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	200 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	200 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	275 x 50	250 x 50	250 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	-	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	-	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45
1500	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45



**Table 10 - 1 - 69  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 69 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	-	300 x 50	275 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45
	4200	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
1500	3000	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45

**Table 10 - 1 - 74.5  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	15 20 25
0.5	20 25
1.0	25

**Design Windspeed: 74.5 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	200 x 50	175 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	-	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1500	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	300 x 50	275 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	225 x 50	225 x 50
	5400	-	-	-	-	300 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	240 x 45	220 x 45	220 x 45	170 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
1200	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
1500	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 50	270 x 45	240 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Table 10 - 2 - 49**  
**RAFTERS**

**Design Windspeed: 49 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	225 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	270 x 45	220 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	290 x 45	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 2 - 51  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Design Windspeed: 51 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	175 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	200 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	300 x 50	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	170 x 45
	4800	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45
	4800	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	270 x 45	240 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 2 - 53**  
**RAFTER**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Design Windspeed: 53 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	300 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	275 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50
	3600	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	300 x 50	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	270 x 45	240 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	290 x 45	270 x 45	220 x 45	220 x 45	220 x 45	190 x 45
1500	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 2 - 55  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Design Windspeed: 55 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	250 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	300 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	300 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	3600	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	220 x 45	220 x 45	190 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	290 x 45	270 x 45	220 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	190 x 45	170 x 45	170 x 45	170 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45
1500	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Table 10 - 2 - 57  
RAFTERS**

**Design Windspeed: 57 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	-	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	300 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	-	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45
1500	3000	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	270 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45

**Table 10 - 2 - 60  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Design Windspeed: 60 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	-	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	-	300 x 50	275 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	3600	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
1500	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45



**Table 10 - 2 - 64  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Design Windspeed: 64 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	200 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	-	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	-	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	275 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	-	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4800	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
1200	3000	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
1500	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	220 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Table 10 - 2 - 69**  
**RAFTERS**

**Design Windspeed: 69 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	225 x 50	200 x 50	175 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	300 x 50	275 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	-	300 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	125 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1500	3000	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	3600	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45*	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
1200	3000	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45
1500	3000	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	-	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	-	270 x 45	240 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.25	10
0.5	15
1.0	20

**Table 10 - 2 - 74.5  
RAFTERS**

**Design Windspeed: 74.5 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	225 x 50	200 x 50	200 x 50	175 x 50	150 x 50	125 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4800	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	5400	-	-	-	250 x 50	250 x 50	225 x 50	200 x 50
1200	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	-	300 x 50	275 x 50	225 x 50	225 x 50
	5400	-	-	-	-	300 x 50	250 x 50	225 x 50
1500	3000	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	3600	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4200	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	4800	-	-	-	-	300 x 50	275 x 50	250 x 50
	5400	-	-	-	-	-	300 x 50	275 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
1200	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45
1500	3000	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4200	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	4800	-	-	-	-	290 x 45	270 x 45	240 x 45
	5400	-	-	-	-	-	290 x 45	270 x 45

**Table 10 - 3 - 49  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 49 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	275 x 50	225 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	300 x 50	250 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	300 x 50	275 x 50	250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	300 x 50	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	170 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	140 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	4800	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45	170 x 45
	5400	-	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45
1500	3000	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	220 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	120 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	170 x 45	170 x 45
	5400	-	-	-	270 x 45	240 x 45	190 x 45	190 x 45

**Table 10 - 3 - 51  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 51 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	175 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	-	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	275 x 50	2250 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50
	4800	-	-	300 x 50	250 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	275 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	4200	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4800	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	170 x 45
	5400	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
1500	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45

**Table 10 - 3 - 53  
RAFTER**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 53 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 45	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	-	275 x 50	250 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	4200	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	4800	-	300 x 50	275 x 50	225 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	3600	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	4200	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4800	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
1500	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	220 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	140 x 45
	4800	-	-	290 x 45	270 x 45	240 x 45	220 x 45	170 x 45
	5400	-	-	-	290 x 45	270 x 45	240 x 45	190 x 45

**Table 10 - 3 - 55**  
**RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 55 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	300 x 50	275 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50	150 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	275 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
1500	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45

**Table 10 - 3 - 57  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 57 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	175 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50	150 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	250 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	-	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	300 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	-	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	170 x 45	170 x 45	120 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4800	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
1200	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
1500	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	270 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45



**Table 10 - 3 - 60**  
**RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 60 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	-	300 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1500	3000	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	3600	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
1200	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45
1500	3000	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	-	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	-	270 x 45	240 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Table 10 - 3 - 64  
RAFTERS**

**Design Windspeed: 64 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	125 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	4800	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	5400	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
1200	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	300 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	-	275 x 50	250 x 50	225 x 50
1500	3000	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	3600	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	-	300 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	-	300 x 50	250 x 50	225 x 50
	5400	-	-	-	-	-	300 x 50	275 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
	5400	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
1200	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45
1500	3000	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4200	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	4800	-	-	-	-	290 x 45	270 x 45	240 x 45
	5400	-	-	-	-	-	290 x 45	270 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Table 10 - 3 - 69  
RAFTERS**

**Design Windspeed: 69 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1200	3000	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	3600	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	-	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50
1500	3000	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	3600	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4200	-	-	-	-	275 x 50	250 x 50	225 x 50
	4800	-	-	-	-	-	275 x 50	250 x 50
	5400	-	-	-	-	-	300 x 50	275 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	290 x 45	270 x 54	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45
1200	3000	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	3600	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
	4800	-	-	-	-	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	-	270 x 45	270 x 45
1500	3000	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	3600	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	4200	-	-	-	-	290 x 45	240 x 45	220 x 45
	4800	-	-	-	-	-	290 x 45	270 x 45
	5400	-	-	-	-	-	-	290 x 45

**Table 10 - 3 - 74.5  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
0.5	10
1.0	15

**Design Windspeed: 74.5 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	300 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	-	300 x 50	250 x 50	225 x 50
1200	3000	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	3600	-	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50
	4200	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	4800	-	-	-	-	300 x 50	275 x 50	250 x 50
	5400	-	-	-	-	-	300 x 50	275 x 50
1500	3000	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	3600	-	-	-	300 x 50	275 x 50	225 x 50	225 x 50
	4200	-	-	-	-	300 x 50	275 x 50	250 x 50
	4800	-	-	-	-	-	300 x 50	275 x 50
	5400	-	-	-	-	-	-	300 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45
1200	3000	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4200	-	-	-	-	270 x 45	240 x 45	220 x 45
	4800	-	-	-	-	-	270 x 45	240 x 45
	5400	-	-	-	-	-	290 x 45	270 x 45
1500	3000	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	3600	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	4200	-	-	-	-	-	270 x 45	240 x 45
	4800	-	-	-	-	-	-	270 x 45
	5400	-	-	-	-	-	-	-

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 49  
RAFTERS**

**Design Windspeed: 49 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	200 x 50	200 x 50	200 x 50	175 x 50
	5400	-	300 x 50	275 x 50	225 x 50	225 x 50	225 x 50	200 x 50
1200	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	300 x 50	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	300, x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	4200	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4800	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	190 x 45
1200	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
1500	3000	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 51**  
**RAFTERS**

**Design Windspeed: 51 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	175 x 50	175 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	300 x 50	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	-	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	-	275 x 50	250 x 50	250 x 50	225 x 50
1500	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	300 x 50	250 x 50	225 x 50	225 x 50
	5400	-	-	-	-	275 x 50	250 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	4200	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	4800	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	5400	-	-	270 x 45	240 x 45	220 x 45	220 x 45	190 x 45
1200	3000	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45
	3600	240 x 45	220 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 54
	4200	-	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 54
	4800	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
1500	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 53**  
**RAFTER**

**Design Windspeed: 53 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	200 x 50	200 x 45	175 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	255 x 50	200 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	175 x 50
	4800	-	275 x 50	250 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	5400	-	-	275 x 50	250 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 45	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	225 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1500	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	300 x 50	275 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45	120 x 45	120 x 45
	3600	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	4200	290 x 45	270 x 45	220 x 45	220 x 45	170 x 45	170 x 45	140 x 45
	4800	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
1200	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
1500	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	-	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45

**Table 10 - 4 - 55  
RAFTERS**

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Design Windspeed: 55 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	225 x 50	200 x 50	175 x 50	150 x 50	125 x 50	125 x 50	125 x 50
	3600	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	150 x 50
	4200	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50	175 x 50	175 x 50
	4800	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	5400	-	-	300 x 50	275 x 50	225 x 50	225 x 50	200 x 50
1200	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50	125 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1200	3000	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50
	3600	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	190 x 45	170 x 45	140 x 45	120 x 45	120 x 45	120 x 45
	3600	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	290 x 45	270 x 45	240 x 45	20 x 45	190 x 45	170 x 45	170 x 45
	4800	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	290 x 45	270 x 45	240 x 45	220 x 45	220 x 45
1200	3000	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45
1500	3000	270 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	-	270 x 45	240 x 45	190 x 45
	5400	-	-	-	-	-	270 x 45	220 x 45



ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 57**  
**RAFTERS**

**Design Windspeed: 57 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	125 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	175 x 50	150 x 50	150 x 50	150 x 50
	4200	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4800	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	5400	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
1200	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	4200	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	-	275 x 50	250 x 50	225 x 50
1500	3000	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	3600	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	-	300 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	-	300 x 50	250 x 50	225 x 50
	5400	-	-	-	-	-	275 x 50	250 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	4200	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4800	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	5400	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
1200	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45
	4800	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	220 x 45
1500	3000	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	270 x 45	270 x 45	220 x 45	190 x 45	190 x 45
	4200	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	4800	-	-	-	-	290 x 45	270 x 45	240 x 45
	5400	-	-	-	-	-	290 x 45	270 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 60  
RAFTERS**

**Design Windspeed: 60 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	125 x 50	125 x 50
	3600	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	4200	-	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4800	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	5400	-	-	-	300 x 50	250 x 50	225 x 50	225 x 50
1200	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	300 x 50	275 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50
1500	3000	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	3600	-	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50
	4200	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	4800	-	-	-	-	300 x 50	275 x 50	250 x 50
	5400	-	-	-	-	-	300 x 50	275 x 50

RAFTER SPACING (mm)	RAFTER SPACING (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45	120 x 45
	3600	270 x 45	240 x 45	220 x 45	220 x 45	170 x 45	170 x 45	140 x 45
	4200	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	5400	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
1200	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	240 x 45	220 x 45	190 mx 45	170 x 45
	4200	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	-	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45
1500	3000	-	290 x 45	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45
	3600	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4200	-	-	-	-	270 x 45	240 x 45	220 x 45
	4800	-	-	-	-	-	270 x 45	240 x 45
	5400	-	-	-	-	-	-	270 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 64  
RAFTERS**

**Design Windspeed: 64 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50	150 x 50	125 x 50
	3600	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	4200	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4800	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	5400	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
1200	3000	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	3600	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	-	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	-	275 x 50	250 x 50
1500	3000	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	3600	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
	4200	-	-	-	-	300 x 50	250 x 50	225 x 50
	4800	-	-	-	-	-	300 x 50	275 x 50
	5400	-	-	-	-	-	-	300 x 50

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	270 x 45	220 x 45	220 x 45	190 x 45	170 x 45	140 x 45	140 x 45
	3600	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	4200	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4800	-	-	-	270 x 45	240 x 45	220 x 45	220 x 45
	5400	-	-	-	-	270 x 45	240 x 45	220 x 45
1200	3000	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	270 x 45	270 x 45	220 x 45	190 x 45	190 x 45
	4200	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	4800	-	-	-	-	290 x 45	270 x 45	240 x 45
	5400	-	-	-	-	-	290 x 45	270 x 45
1500	3000	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	3600	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	4200	-	-	-	-	290 x 45	270 x 45	240 x 45
	4800	-	-	-	-	-	290 x 45	270 x 45
	5400	-	-	-	-	-	-	290 x 45

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 69  
RAFTERS**

**Design Windspeed: 69 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50	150 x 50
	3600	-	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	4200	-	-	300 x 50	275 x 50	225 x 50	200 x 50	200 x 50
	4800	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	300 x 50	275 x 50	250 x 50
1200	3000	-	300 x 50	250 x 50	225 x 50	200 x 50	175 x 50	175 x 50
	3600	-	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50
	4200	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	4800	-	-	-	-	300 x 50	275 x 50	250 x 50
	5400	-	-	-	-	-	300 x 50	275 x 50
1500	3000	-	-	300 x 50	250 x 50	225 x 50	200 x 50	200 x 50
	3600	-	-	-	300 x 50	275 x 50	250 x 50	225 x 50
	4200	-	-	-	-	300 x 50	275 x 50	250 x 50
	4800	-	-	-	-	-	300 x 50	275 x 50
	5400	-	-	-	-	-	-	-

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45	140 x 45
	3600	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	4800	-	-	-	-	270 x 45	240 x 45	220 x 45
	5400	-	-	-	-	290 x 45	270 x 45	240 x 45
1200	3000	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	3600	-	-	-	270 x 45	240 x 45	220 x 45	190 x 45
	4200	-	-	-	-	270 x 45	240 x 45	220 x 45
	4800	-	-	-	-	-	270 x 45	270 x 45
	5400	-	-	-	-	-	-	290 x 45
1500	3000	-	-	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45
	3600	-	-	-	-	270 x 45	240 x 45	220 x 45
	4200	-	-	-	-	-	270 x 45	270 x 45
	4800	-	-	-	-	-	-	290 x 45
	5400	-	-	-	-	-	-	-

ASPECT RATIO h/d	ROOF PITCH (degrees)
1.0	10

**Table 10 - 4 - 74.5  
RAFTERS**

**Design Windspeed: 74.5 m/s**

RAFTER SPACING (mm)	RAFTER SPAN (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50	150 x 50
	3600	-	-	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	4200	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
	4800	-	-	-	-	275 x 50	250 x 50	225 x 50
	5400	-	-	-	-	-	275 x 50	250 x 50
1200	3000	-	300 x 50	275 x 50	250 x 50	225 x 50	200 x 50	175 x 50
	3600	-	-	-	300 x 50	250 x 50	225 x 50	200 x 50
	4200	-	-	-	-	300 x 50	275 x 50	250 x 50
	4800	-	-	-	-	-	300 x 50	275 x 50
	5400	-	-	-	-	-	-	300 x 50
1500	3000	-	-	-	275 x 50	250 x 50	225 x 50	200 x 50
	3600	-	-	-	-	300 x 50	275 x 50	250 x 50
	4200	-	-	-	-	-	300 x 50	275 x 50
	4800	-	-	-	-	-	-	300 x 50
	5400	-	-	-	-	-	-	-

RAFTER SPACING (mm)	RAFTER SPAN (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
900	3000	290 x 45	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45	170 x 45
	3600	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	4200	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	4800	-	-	-	-	290 x 45	270 x 45	240 x 45
	5400	-	-	-	-	-	290 x 45	270 x 45
1200	3000	-	-	270 x 45	240 x 45	220 x 45	190 x 45	170 x 45
	3600	-	-	-	290 x 45	270 x 45	240 x 45	220 x 45
	4200	-	-	-	-	290 x 45	270 x 45	240 x 45
	4800	-	-	-	-	-	290 x 45	270 x 45
	5400	-	-	-	-	-	-	-
1500	3000	-	-	-	290 x 45	270 x 45	220 x 45	220 x 45
	3600	-	-	-	-	290 x 45	270 x 45	240 x 45
	4200	-	-	-	-	-	-	270 x 45
	4800	-	-	-	-	-	-	-
	5400	-	-	-	-	-	-	-

# SUPPLEMENTARY PAGE

Table 11

PURLINS

Design Windspeed: Up to 60 m/s

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
1200	750	75 x 50					75 x 45				
	900	100 x 50	75 x 50				90 x 45	75 x 45			
	1200	100 x 50		75 x 50			90 x 45		75 x 45		
1500	750	100 x 50			75 x 50		90 x 45			70 x 45	
	900	100 x 50			75 x 50		-	90 x 45			
	1200	-	100 x 50				-		90 x 45		

Design Windspeed: 64 m/s

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
1200	750	100 x 50	75 x 50				90 x 45	70 x 45			
	900	100 x 50	75 x 50				90 x 45		70 x 45		
	1200	100 x 50			75 x 50		-	90 x 45		70 x 45	
1500	750	100 x 50			75 x 50		-	90 x 45		70 x 45	
	900	-	100 x 50				-	90 x 45			
	1200	-		100 x 50			-		90 x 45		

Design Windspeed: 69 m/s

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
1200	750	100 x 50	75 x 50				90 x 45	70 x 45			
	900	100 x 50		75 x 50			90 x 45		70 x 45		
	1200	-	100 x 50		75 x 50		-	90 x 45		70 x 45	
1500	750	-	100 x 50				-	90 x 45			
	900	-	100 x 50				-		90 x 45		
	1200	-		100 x 50			-		90 x 45		

Design Windspeed: 74.5 m/s

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
1200	750	100 x 50		75 x 50			90 x 45		70 x 45		
	900	100 x 50			75 x 50		-	90 x 45		70 x 45	
	1200	-	100 x 50				-		90 x 45		
1500	750	-	100 x 50				-		90 x 45		
	900	-		100 x 50			-		90 x 45		
	1200	-		100 x 50			-		90 x 45		

**Table 11**

**PURLINS**

**Design Windspeed: Up to 60 m/s**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
750	750	50 x 75		50 x 50			45 x 70			45 x 45	
	900										
	1200										
900	750	75 x 50		50 x 75		50 x 50	45 x 70			45 x 70	
	900										70 x 45
	1200					50 x 75					

**Design Windspeed: 64 m/s**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
750	750	50 x 75		50 x 50			45 x 70			45 x 45	
	900										
	1200						70 x 45	45 x 70			
900	750	75 x 50		50 x 75		50 x 50	45 x 70			45 x 70	
	900										70 x 45
	1200			75 x 50	50 x 75		90 x 45	70 x 45	70 x 45		

**Design Windspeed: 69 m/s**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED				
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11
750	750	50 x 75		50 x 50			45 x 70			45 x 45	
	900										
	1200	75 x 50	50 x 75		50 x 50		70 x 45	45 x 70			
900	750	75 x 50		50 x 75		50 x 50	45 x 70			45 x 70	
	900										
	1200	100 x 50	75 x 50		50 x 75		90 x 45	70 x 45			

**Design Windspeed: 74.5 m/s**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	UNSEASONED					SEASONED					
		F4	F5	F7	F8	F11	F4	F5	F7	F8	F11	
750	750	75 x 50		50 x 75	50 x 50			45 x 70			45 x 45	
	900											
	1200	75 x 50	50 x 75		50 x 50	70 x 45	45 x 70		45 x 70			
900	750	75 x 50		50 x 75		50 x 50	45 x 70			45 x 70		
	900											70 x 45
	1200	100 x 50	75 x 50	50 x 75		90 x 45	70 x 45					



**Table 12**

**VERANDAH POSTS  
For All Design Windspeeds**

POST HEIGHT (mm)	AREA OF ROOF SUPPORTED (square metres)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	5	100 x 100	100 x 100	100 x 100	100 x 100	75 x 75	75 x 75	75 x 75
	10	100 x 100	100 x 100	100 x 100	100 x 100	75 x 75	75 x 75	75 x 75
	20	-	100 x 100	100 x 100	100 x 100	100 x 100	100 x 100	100 x 100
2700	5	100 x 100	100 x 100	100 x 100	100 x 100	75 x 75	75 x 75	75 x 75
	10	100 x 100	100 x 100	100 x 100	100 x 100	100 x 100	75 x 75	75 x 75
	20	-	-	100 x 100	100 x 100	100 x 100	100 x 100	100 x 100

POST HEIGHT (mm)	AREA OF ROOF SUPPORTED (square metres)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	5	90 x 90	70 x 70	70 x 70	70 x 70	70 x 70	70 x 70	70 x 70
	10	90 x 90	90 x 90	90 x 90	70 x 70	70 x 70	70 x 70	70 x 70
	20	-	90 x 90	90 x 90	90 x 90	90 x 90	90 x 90	90 x 90
2700	5	90 x 90	70 x 70	70 x 70	70 x 70	70 x 70	70 x 70	70 x 70
	10	90 x 90	90 x 90	90 x 90	90 x 90	70 x 70	70 x 70	70 x 70
	20	-	-	90 x 90	90 x 90	90 x 90	90 x 90	90 x 90

**Table 13**

**BEARERS SUPPORTING TWO-STOREY LOAD BEARING WALLS  
For All Design Windspeeds**

BEARER SPACING (mm)	BEARER SPAN (mm)	STRESS GRADE						
		F4	F5	F7	F8	F11	F14	F17
1800	1500	200 x 75	175 x 75	150 x 75	150 x 75	150 x 75	150 x 75	125 x 75
	1800	225 x 75	200 x 75	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75
	2100	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75
	2400	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	2700	-	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75
	3000	-	-	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75
	3300	-	-	-	-	300 x 75	300 x 75	275 x 75
	3600	-	-	-	-	-	-	300 x 75
3600	1500	225 x 75	200 x 75	175 x 75	150 x 75	150 x 75	150 x 75	125 x 75
	1800	275 x 75	250 x 75	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75
	2100	-	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75	175 x 75
	2400	-	300 x 75	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	2700	-	-	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75
	3000	-	-	-	300 x 75	275 x 75	275 x 75	275 x 75
	3300	-	-	-	-	-	300 x 75	275 x 75
	3600	-	-	-	-	-	-	300 x 75

Table 14 - 51/55/50

STUDS - LOWER OF TWO STOREYS

Design Windspeed: 51 m/s

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 50	100 x 40					
	2700	100 x 75	100 x 50	100 x 40				
600	2400	100 x 75	100 x 50	100 x 40				
	2700	100 x 75	100 x 50		100 x 40			
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 45	90 x 35					
	2700	90 x 70	90 x 45	90 x 35				
600	2400	90 x 70	90 x 45	90 x 35				
	2700	90 x 70			90 x 45	90 x 35		

Design Windspeed: 55 m/s

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 50		100 x 40				
	2700	100 x 75	100 x 50	100 x 40				
600	2400	100 x 75	100 x 50	100 x 40				
	2700	100 x 75		100 x 50	100 x 40			
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 70	90 x 45	90 x 35				
	2700	90 x 70		90 x 45	90 x 35			
600	2400	90 x 70		90 x 45	90 x 35			
	2700	90 x 90	90 x 70			90 x 45	90 x 35	

Design Windspeed: 60 m/s

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 75	100 x 50		100 x 40			
	2700	100 x 75		100 x 50	100 x 40			
600	2400	100 x 75		100 x 50	100 x 40			
	2700	100 x 100	100 x 75		100 x 50		100 x 40	
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 70		90 x 45	90 x 35			
	2700	90 x 90	90 x 70		90 x 45		90 x 35	
600	2400	90 x 90	90 x 70		90 x 45	90 x 35		
	2700	-	90 x 90	90 x 70			90 x 45	

Table 14 - 64/69/74.5

STUDS - LOWER OF TWO STOREYS

Design Windspeed: 64 m/s

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 75		100 x 50	100 x 40			
	2700	100 x 100	100 x 75		100 x 50	100 x 40		
600	2400	100 x 100	100 x 75		100 x 50	100 x 40		
	2700	100 x 100		100 x 75		100 x 50		100 x 40
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 90	90 x 70	90 x 45		90 x 35		
	2700	90 x 90	90 x 70		90 x 45		90 x 35	
600	2400	90 x 90	90 x 70	90 x 45		90 x 35		
	2700	-	90 x 90		90 x 70			90 x 45

Design Windspeed: 69 m/s

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 100	100 x 75		100 x 50		100 x 40	
	2700	100 x 100	100 x 75			100 x 50	100 x 40	
600	2400	100 x 100	100 x 75			100 x 50	100 x 40	
	2700	-	100 x 100	100 x 75				100 x 50
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	90 x 90	90 x 70		90 x 45	90 x 35		
	2700	-	90 x 90	90 x 70			90 x 45	90 x 35
600	2400	-	90 x 90	90 x 70		90 x 45		90 x 35
	2700	-	-	90 x 90		90 x 70		

Design Windspeed: 74.5 m/s

STUD SPACING (mm)	STUD HEIGHT (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	100 x 100	100 x 75			100 x 50	100 x 40	
	2700	-	100 x 100	100 x 75			100 x 50	100 x 40
600	2400	-	100 x 100	100 x 75			100 x 50	100 x 40
	2700	-	-	100 x 100	100 x 75			100 x 50
STUD SPACING (mm)	STUD HEIGHT (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	2400	-	90 x 90	90 x 70		90 x 45	90 x 35	
	2700	-	90 x 90		90 x 70			90 x 45
600	2400	-	-	90 x 90	90 x 70		90 x 45	
	2700	-	-	-	90 x 90		90 x 70	

Table 15

**STUDS - INTERNAL WALLS - LOWER OF TWO STOREYS**  
**For All Design Windspeeds**

**75 mm Nominal Frame**

STUD HEIGHT (mm)	STUD SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	450	75 x 50	75 x 40					
	600	-	75 x 50			75 x 40		
2700	450	-	75 x 50			75 x 40		
	600	-			75 x 50		75 x 40	75 x 40

STUD HEIGHT (mm)	STUD SPACING (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	450	70 x 45	70 x 35					
	600	-	70 x 45			70 x 35		
2700	450	-	70 x 45			70 x 35		
	600	-			70 x 45		70 x 35	

**100 mm Nominal Frame**

STUD HEIGHT (mm)	STUD SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	450	100 x 40						
	600							
2700	450							
	600							

STUD HEIGHT (mm)	STUD SPACING (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	450	90 x 35						
	600							
2700	450							
	600							

**STUDS AT SIDES OF OPENINGS**  
**Lower of Two Storey Construction**

**Design Windspeed: 49 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	100 x 50	100x40	100 x 40	100 x 40	75 x 50	75 x 50	75 x 40
	1200	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	1500	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1800	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
2700	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	75 x 50
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45	70 x 45
	1200	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	1500	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	1800	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
2700	900	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	1200	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1800	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45

**Design Windspeed: 51 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	75 x 50	75 x 50	75 x 50
	1200	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1500	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 50	100 x 40
2700	900	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35	70 x 45
	1200	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	1500	2/120x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1800	2/120x45	2/90x35	2/90x35	2/90x35	90 x 35	90 x 35	90 x 35
2700	900	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
	1200	2/90x35	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1500	2/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1800	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45

**Table 16 - 53/55**  
**STUDS AT SIDES OF OPENINGS**  
**Lower of Two Storey Construction**

**Design Windspeed: 53 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50	75 x 50
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1500	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
2700	900	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	70 x 45
	1200	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35	90 x 35
	1800	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
2700	900	2/90 x 35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1200	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1500	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45

**Design Windspeed: 55 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
2700	900	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1500	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1800	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	1200	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1800	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35
2700	900	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1200	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1500	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35

**STUDS AT SIDES OF OPENINGS**  
**Lower of Two Storey Construction**

**Design Windspeed: 57 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	75 x 50
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x40	2/100x40	2/100x50	100 x 50	100 x 40	100 x 40
2700	900	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1200	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1500	3/100x40	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40
	1800	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35	90 x 35
	1200	2/90x45	2/90x35	2/90x35	90 x 35	90 x 45	90 x 35	90 x 35
	1500	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1800	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
2700	900	2/90 x 45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35
	1200	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1500	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35

**Design Windspeed: 60 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	1200	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	1500	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1800	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
2700	900	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1200	3/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1500	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
	1800	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35	90 x 35
	1200	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45	90 x 35
	1500	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1800	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
2700	900	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1200	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	2/90x35	90 x 45
	1500	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35
	1800	3/90x45	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35

**Table 16 - 64/69**  
**STUDS AT SIDES OF OPENINGS**  
**Lower of Two Storey Construction**

**Design Windspeed: 64 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x40	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1200	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40	100 x 40
	1500	3/100x40	2/100x50	2/100x40	2/100 x 40	100 x 50	100 x 50	100 x 40
	1800	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
2700	900	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1200	3/100x40	2/100x50	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50
	1500	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1800	3/100x50	3/100x40	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35	90 x 35
	1200	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 45
	1500	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1800	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
2700	900	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1200	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
	1500	3/90x45	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35	2/90x35
	1800	4/90x45	4/90x35	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35

**Design Windspeed: 69 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/100x50	2/100x40	2/100x40	100 x 50	100 x 40	100 x 40	100 x 40
	1200	3/100x40	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1500	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
	1800	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
2700	900	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
	1200	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1500	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
	1800	-	3/100x50	3/100x50	3/100x50	2/100x50	2/100x40	2/100x40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45	90 x 35
	1200	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35	90 x 45
	1500	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
	1800	4/90x35	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
2700	900	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	2/90x35
	1200	3/90x45	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
	1500	4/90x45	4/90x35	3/90x45	3/90x35	3/90x35	2/90x45	2/90x35
	1800	4/90x45	4/90x45	4/90x35	3/90x45	3/90x35	3/90x35	2/90x45



**Table 16 - 74.5**  
**STUDS AT SIDES OF OPENINGS**  
**Lower of Two Storey Construction**

**Design Windspeed: 74.5 m/s**

STUD HEIGHT (mm)	OPENING WIDTH (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	3/100x40	2/100x50	2/100x40	2/100x40	100 x 50	100 x 50	100 x 40
	1200	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50	100 x 50
	1500	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1800	-	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
2700	900	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40	100 x 50
	1200	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40	2/100x40
	1500	-	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40	2/100x40
	1800	-	-	3/100x50	3/100x50	3/100x40	2/100x50	2/100x40
STUD HEIGHT (mm)	OPENING WIDTH (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
2400	900	3/90x35	2/90x45	2/90x35	2/90x35	2/90x35	2/90x35	90 x 35
	1200	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35	90 x 45
	1500	4/90x35	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
	1800	4/90x45	3/90x45	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35
2700	900	3/90x45	3/90x45	3/90x35	2/90x45	2/90x45	2/90x35	2/90x35
	1200	4/90x45	4/90x35	3/90x45	3/90x35	2/90x45	2/90x35	2/90x35
	1500	-	4/90x45	4/90x45	3/90x45	3/90x35	2/90x45	2/90x45
	1800	-	-	4/90x45	4/90x45	3/90x45	3/90x35	3/90x35

**Table 17**

**TOP PLATES - LOWER OF TWO STOREYS  
For All Design Windspeeds**

Maximum Building Width : 9000 mm

**75 mm Nominal Frame**

MAX. JOIST SPACING (mm)	MAX. STUD SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	450	75 x 75		50 x 75				
	600							
600	450	75 x 75					50 x 75	
	600							

MAX. JOIST SPACING (mm)	MAX. STUD SPACING (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	450	70 x 70		45 x 70				
	600							
600	450	70 x 70					45 x 70	
	600							

**100 mm Nominal Frame**

MAX. JOIST SPACING (mm)	MAX. STUD SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	450	50 x 100	50 x 100					
	600	75 x 100						
600	450		75 x 100	50 x 100				
	600							

MAX. JOIST SPACING (mm)	MAX. STUD SPACING (mm)	SEASONED						
		F4	F5	F7	F8	F11	F14	F17
450	450	45 x 90	45 x 90					
	600	70 x 90						
600	450		70 x 90	45 x 90				
	600							

**Table 18**

**BOTTOM PLATES - LOWER STOREY WALLS  
For All Design Windspeeds**

Maximum Building Width: 9000 mm

Upper Floor Joist Spacing: 450 mm

F4	F5	F7	F8	F11	F14	F17
75 x 75		50 x 75				
75 x 75	50 x 100					

**Table 19**

**LINTELS - LOWER OF TWO STOREYS  
For All Design Windspeeds**

MAXIMUM WIDTH OF OPENING (mm)	UNSEASONED						
	F4	F5	F7	F8	F11	F14	F17
900	150 x 75	150 x 75	150 x 75	150 x 75	100 x 75	100 x 75	100 x 75
1200	150 x 75	150 x 75	150 x 75	150 x 75	100 x 75	100 x 75	100 x 75
1500	150 x 75	150 x 75	150 x 75	150 x 75	125 x 75	125 x 75	100 x 75
1800	200 x 75	175 x 75	175 x 75	175 x 75	150 x 75	150 x 75	150 x 75
2100	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75	150 x 75
2400	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75

MAXIMUM WIDTH OF OPENING (mm)	SEASONED						
	F4	F5	F7	F8	F11	F14	F17
900	140 x 70	120 x 45	120 x 45	120 x 45	120 x 45	120 x 45	120 x 45
1200	140 x 70	120 x 45	120 x 45	120 x 45	120 x 45	120 x 45	120 x 45
1500	190 x 70	140 x 70	140 x 70	120 x 45	120 x 45	120 x 45	120 x 45
1800	240 x 70	190 x 70	140 x 70	140 x 70	140 x 70	140 x 70	120 x 70
2100	240 x 70	190 x 70	190 x 70	190 x 70	140 x 70	140 x 70	140 x 70
2400	-	240 x 70	240 x 70	190 x 70	190 x 70	190 x 70	190 x 70

## VERANDAH BEAMS

Verandah beams sizes must be determined as for roof beams from Table 20. The spacing of the beam is determined as shown below.

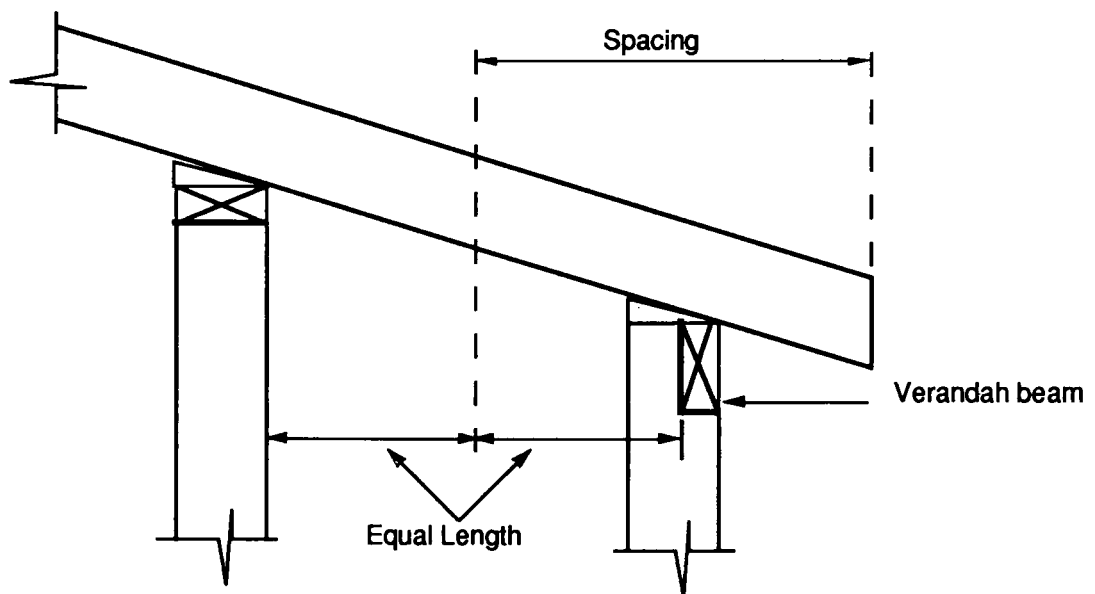


FIGURE B8.3.2 VERANDAH BEAM SPACING

## ROOF BEAMS - NON TRAFFICABLE ROOFS

## Design Windspeed: 49 m/s

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	4200	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
3600	2400	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3000	300 x 75	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3600	300 x 100	300 x 75	300 x 75	275 x 75	250 x 75	250 x 75	250 x 75
	4200	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75
4200	2400	300 x 100	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	3000	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75
	4200	-	-	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75

## Design Windspeed: 51 m/s

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	275 x 75	250 x 75	225 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	3600	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	4200	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
3600	2400	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3000	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3600	300 x 100	300 x 75	300 x 75	275 x 75	250 x 75	250 x 75	250 x 75
	4200	300 x 100	300 x 100	300 x 75	275 x 75	275 x 75	275 x 75	250 x 75
4200	2400	300 x 75	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75	225 x 75
	3000	-	300 x 100	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75
	4200	-	-	-	300 x 100	300 x 100	300 x 75	300 x 75

## Design Windspeed: 53 m/s

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600		250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	4200			250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
3600	2400	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3000	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3600	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	4200	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75
4200	2400	300 x 100	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	3000	-	300 x 100	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75
	4200	-	-	-	300 x 100	300 x 100	300 x 75	300 x 75

**ROOF BEAMS - NON TRAFFICABLE ROOFS**

**Design Windspeed: 55 m/s**

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	4200	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
3600	2400	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3000	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3600	300 x 100	300 x 75	300 x 75	275 x 75	250 x 75	250 x 75	250 x 75
	4200	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
4200	2400	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	3000	-	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75
	4200	-	-	-	300 x 100	300 x 100	300 x 75	300 x 75

**Design Windspeed: 57 m/s**

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600		275 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	4200			275 x 75	250 x 75	225 x 75	225 x 75	200 x 75
3600	2400	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3000	300 x 100	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75
	3600	-	300 x 100	300 x 75	275 x 75	250 x 75	250 x 75	250 x 75
	4200	-	300 x 100	300 x 75	275 x 75	275 x 75	275 x 75	250 x 75
4200	2400	300 x 100	300 x 75	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	3000	-	300 x 100	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	300 x 100	300 x 100	300 x 75	300 x 75	275 x 75
	4200	-	-	-	300 x 100	300 x 100	300 x 75	300 x 75

**Design Windspeed: 60 m/s**

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	300 x 75	275 x 75	225 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75	200 x 75
	4200	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	225 x 75	200 x 75
3600	2400	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75	225 x 75	200 x 75
	3000	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	225 x 75	225 x 75
	3600	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	4200	-	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
4200	2400	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	250 x 75
	3000	-	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	-	300 x 100	300 x 75	300 x 100	275 x 75
	4200	-	-	-	300 x 100	300 x 100	300 x 75	300 x 75

**ROOF BEAMS - NON TRAFFICABLE ROOFS**

**Design Windspeed: 64 m/s**

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75	175 x 75	175 x 75
	3000	275 x 75	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75	200 x 75
	3600	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75
	4200	-	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75
3600	2400	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75
	3000	-	300 x 100	300 x 75	275 x 75	250 x 75	250 x 75	225 x 75
	3600	-	-	300 x 100	300 x 75	275 x 75	250 x 75	250 x 75
	4200	-	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
4200	2400	-	-	300 x 100	300 x 75	275 x 75	250 x 75	250 x 75
	3000	-	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
	3600	-	-	-	300 x 100	300 x 75	300 x 75	275 x 75
	4200	-	-	-	-	300 x 100	300 x 75	300 x 75

**Design Windspeed: 69 m/s**

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75	175 x 75	175 x 75
	3000	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75	200 x 75
	3600	-	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75
	4200	-	-	300 x 100	300 x 75	250 x 75	225 x 75	200 x 75
3600	2400	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75	200 x 75
	3000	-	-	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75
	3600	-	-	-	300 x 75	275 x 75	250 x 75	250 x 75
	4200	-	-	-	300 x 100	300 x 75	275 x 75	250 x 75
4200	2400	-	-	300 x 100	300 x 75	275 x 75	275 x 75	250 x 75
	3000	-	-	-	300 x 100	300 x 75	275 x 75	275 x 75
	3600	-	-	-	-	300 x 100	300 x 75	275 x 75
	4200	-	-	-	-	-	300 x 100	300 x 75

**Design Windspeed: 74.5 m/s**

BEAM SPAN (mm)	BEAM SPACING (mm)	UNSEASONED						
		F4	F5	F7	F8	F11	F14	F17
3000	2400	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75	175 x 75
	3000	-	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75	200 x 75
	3600	-	-	300 x 75	275 x 75	250 x 75	225 x 75	225 x 75
	4200	-	-	300 x 100	300 x 75	275 x 75	250 x 75	225 x 75
3600	2400	-	-	300 x 100	275 x 75	250 x 75	225 x 75	225 x 75
	3000	-	-	300 x 100	300 x 75	300 x 75	275 x 75	225 x 75
	3600	-	-	-	300 x 100	300 x 75	275 x 75	250 x 75
	4200	-	-	-	-	300 x 100	300 x 75	275 x 75
4200	2400	-	-	-	300 x 100	300 x 75	275 x 75	250 x 75
	3000	-	-	-	-	300 x 100	300 x 75	275 x 75
	3600	-	-	-	-	300 x 100	300 x 100	275 x 75
	4200	-	-	-	-	-	300 x 100	300 x 100

## **B9 BRACING**

### **B9.1 Scope**

The following clauses give the bracing demand on walls due to wind and earthquake and provide connection details for walls as well as the bracing capacity of different wall systems.

### **B9.2 Application**

1. Determine bracing demand for the storey type and direction from clauses B9.3.2 and B9.3.3.
2. Select bracing capacity of sub-floor bracing from Figure B9.4.2
3. Select bracing capacity of walls from Figure B9.4.3

The total bracing capacity MUST be greater than or equal to the bracing demand required for that particular direction.

### **B9.3 Bracing Demand**

#### **B9.3.1 General**

Bracing demand is the force exerted by wind or earthquake on a house in the direction under consideration. The bracing demand due to wind is based on the area of wall against which the wind blows. The bracing demand due to earthquake is given on the basis of the floor area of the house. The applicable demand is derived in the following manner. Consider one direction at a time. Assume that wind at right angles to building length is 'direction A' and wind at right angles to building width is 'direction B'.

#### **B9.3.2 Determination of Bracing Demand for 'Direction A'**

- 1 Determine the design windspeed from Table A4.5.1 or A4.5.2 as appropriate.
- 2 Determine the earthquake zone from Figure A5.
- 3 From Table B9.3(A) determine the bracing demand for wind at right angles to building length for the storey type under consideration.

**COMMENT:**

The Table is for a design windspeed of 49 m/s. For design windspeeds other than 49 m/s, the bracing demand given in the table must be multiplied by the appropriate factor given below the table.

- 4 From Table B9.3(C) determine the bracing demand for earthquake for the same storey type.
- 5 The bracing demand for 'direction A' is the greater of the values derived from steps 3 and 4.

#### **B9.3.3 Determination of Bracing Demand for 'Direction B'**

- 1 Determine the design windspeed from Table A4.5.1 or A4.5.2 as appropriate.

**COMMENT:**

This speed could be different from the speed in step 1 of B9.3.2

- 2 From Table B9.3(B) determine the bracing demand for wind at right angles to building width for the storey type under consideration.

**COMMENT:**

Same as comment under B9.3.2 - 3

- 3 From Table B9.3(C) determine the bracing demand for earthquake for the same storey type.
- 4 The bracing demand for 'direction B' is the greater of the values derived from steps 2 and 3.



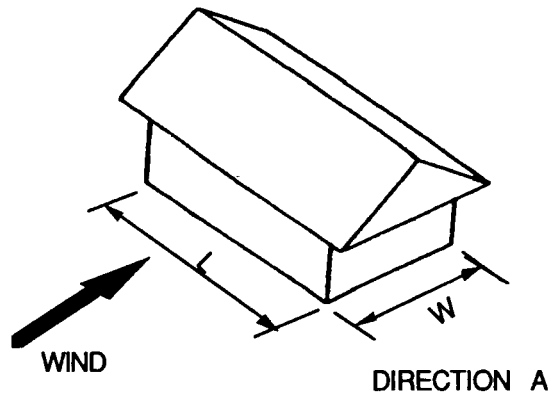
**Table B9.3(A)**

**BRACING DEMAND ( kN/m ) - WIND FORCES**  
**(TOTAL DEMAND = L x kN/m)**

The values in the Table are for a design windspeed of 49 m/s. For other speeds multiply by the factors given separately.

<b>WIND AT RIGHT ANGLES TO HOUSE LENGTH</b>					
STOREY TYPE	WIDTH W (m)	ROOF PITCH ( degrees )			
		≤10	15	20	25
Single storey (Lowset)	4	2.1	2.1	2.3	2.9
	6	2.1	2.1	2.4	3.1
	8	2.1	2.1	2.4	3.2
	10	2.1	2.1	2.4	3.4
	12	2.1	2.1	2.5	3.6
Upper storey of two Storey	4	2.1	2.1	2.3	2.9
	6	2.1	2.1	2.4	3.1
	8	2.1	2.1	2.4	3.2
	10	2.1	2.1	2.4	3.4
	12	2.1	2.1	2.5	3.6
Upper storey of highset or sub - floor	4	2.3	2.3	2.5	3.1
	6	2.3	2.3	2.6	3.3
	8	2.3	2.3	2.6	3.5
	10	2.3	2.3	2.6	3.6
	12	2.3	2.3	2.7	3.8
Lower storey of two storey	4	6.0	6.0	6.7	7.9
	6	6.0	6.0	6.7	8.3
	8	6.0	6.0	6.8	8.7
	10	6.0	6.0	6.9	9.1
	12	6.0	6.0	6.9	9.5

Design Windspeed	Multiplying Factor
49	1.00
51	1.08
53	1.17
55	1.26
57	1.35
60	1.50
64	1.71
69	1.98
74.5	2.31



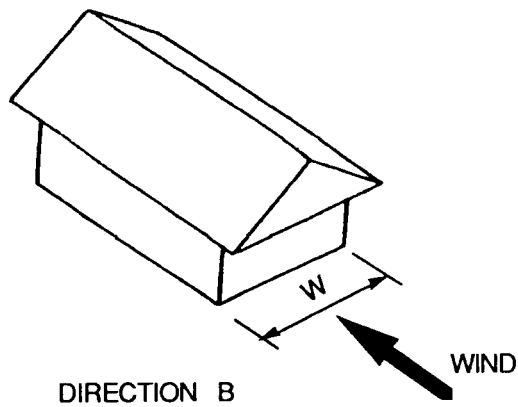
**Table B9.3(B)**

**TOTAL BRACING DEMAND ( kN ) - WIND FORCES**

The values in the Table are for a design windspeed of 49 m/s. For other speeds multiply by the factors given separately.

<b>WIND AT RIGHT ANGLES TO HOUSE WIDTH</b>					
STOREY TYPE	WIDTH W (m)	ROOF PITCH ( degrees )			
		≤10	15	20	25
Single storey (Lowset)	4	10.1	10.6	11.1	11.6
	6	16.0	17.1	18.2	19.3
	8	22.4	24.4	26.4	28.2
	10	29.4	32.5	35.5	38.5
	12	36.9	41.4	45.8	50.0
Upper storey of two Storey	4	10.1	10.6	11.1	11.6
	6	16.0	17.1	18.2	19.3
	8	22.4	24.4	26.4	28.2
	10	29.4	32.5	35.5	38.5
	12	36.9	41.4	45.8	50.0
Upper storey of highset or sub - floor	4	11.0	11.6	12.1	12.6
	6	17.5	18.7	19.9	21.0
	8	24.5	26.7	28.8	30.8
	10	32.1	35.5	38.8	42.0
	12	40.3	45.2	49.9	54.6
Lower storey of two storey	4	28.4	29.4	30.3	31.3
	6	44.2	46.5	48.6	50.7
	8	61.1	65.1	69.0	72.8
	10	79.1	85.4	91.4	97.3
	12	98.2	107.2	115.9	124.4

Design Windspeed	Multiplying Factor
49	1.00
51	1.08
53	1.17
55	1.26
57	1.35
60	1.50
64	1.71
69	1.98
74.5	2.31



**Table B9.3(C)**

**BRACING DEMAND (kN) - EARTHQUAKE**

**SINGLE STOREY HOUSE**

EARTHQUAKE ZONE *	FLOOR AREA OF BUILDING ( square metres )					
	20	40	60	80	100	150
7	3.30	6.61	9.91	13.22	16.52	24.78
8	3.78	7.55	11.33	15.10	18.88	28.32

**UPPER STOREY OF TWO STOREY HOUSE**

EARTHQUAKE ZONE *	FLOOR AREA OF HOUSE ( square metres )					
	20	40	60	80	100	150
7	5.29	10.58	15.88	21.17	26.46	39.69
8	6.05	12.10	18.14	24.19	30.24	45.36

**UPPER STOREY OF HIGHSET HOUSE**

EARTHQUAKE ZONE *	FLOOR AREA OF HOUSE ( square metres )					
	20	40	60	80	100	150
7	5.41	10.83	16.24	21.65	27.06	40.60
8	6.19	12.37	18.56	24.74	30.93	46.40

**LOWER STOREY OF TWO STOREY HOUSE**

EARTHQUAKE ZONE *	FLOOR AREA OF HOUSE ( square metres )					
	20	40	60	80	100	150
7	10.58	21.17	31.75	42.34	52.92	79.38
8	12.10	24.19	36.29	48.38	60.48	90.72

**SUB - FLOOR BRACING OF HIGHSET HOUSE**

EARTHQUAKE ZONE *	FLOOR AREA OF HOUSE ( square metres )					
	20	40	60	80	100	150
7	10.02	20.05	30.07	40.10	50.12	75.18
8	11.46	22.91	34.37	45.82	57.28	85.92

For floor areas not provided in the above table the bracing demand can be linearly interpolated

\* NOTE : FOR EARTHQUAKE ZONING REFER TO FIGURE A5

## **B9.4 Bracing Capacity**

### **B9.4.1 General**

The bracing demand derived from clause B9.3 for each of the two directions must be resisted by bracing walls in the matching direction as shown in Figure B9.4.1. The total bracing capacity of the walls for the direction under consideration must be equal to or greater than the bracing demand for that direction.

### **B9.4.2 Bracing capacity of sub - floor bracing types**

Bracing capacity of sub-floor bracing types is given in Figure B9.4.2

### **B9.4.3 Bracing capacity of wall systems**

Bracing capacities of various wall systems are given in Figure B9.4.3

## **B9.5 Fixing of Bracing Walls**

### **B9.5.1 Fixing of Top of Bracing Walls**

All timber framed bracing walls must be fixed to the roof frame and/or external wall frame with connections of equal or more strength to the bracing capacity of that wall. Refer to Figure B9.5.1 for details.

### **B9.5.2 Fixing of Bottom of Bracing Walls**

The bottom plate of all timber framed bracing walls must be fixed at their ends and intermediately at 1200 mm centres to the floor frame with an appropriate connection determined from Figure B9.5.2.

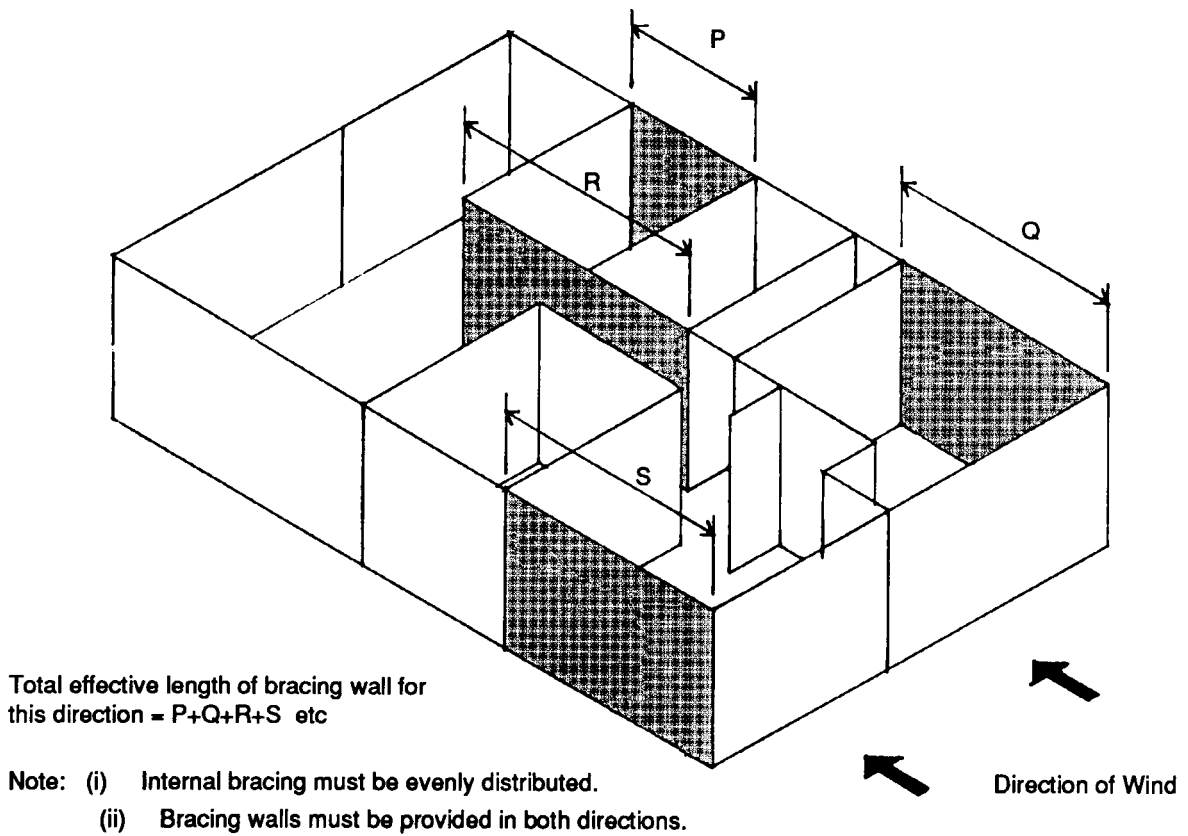
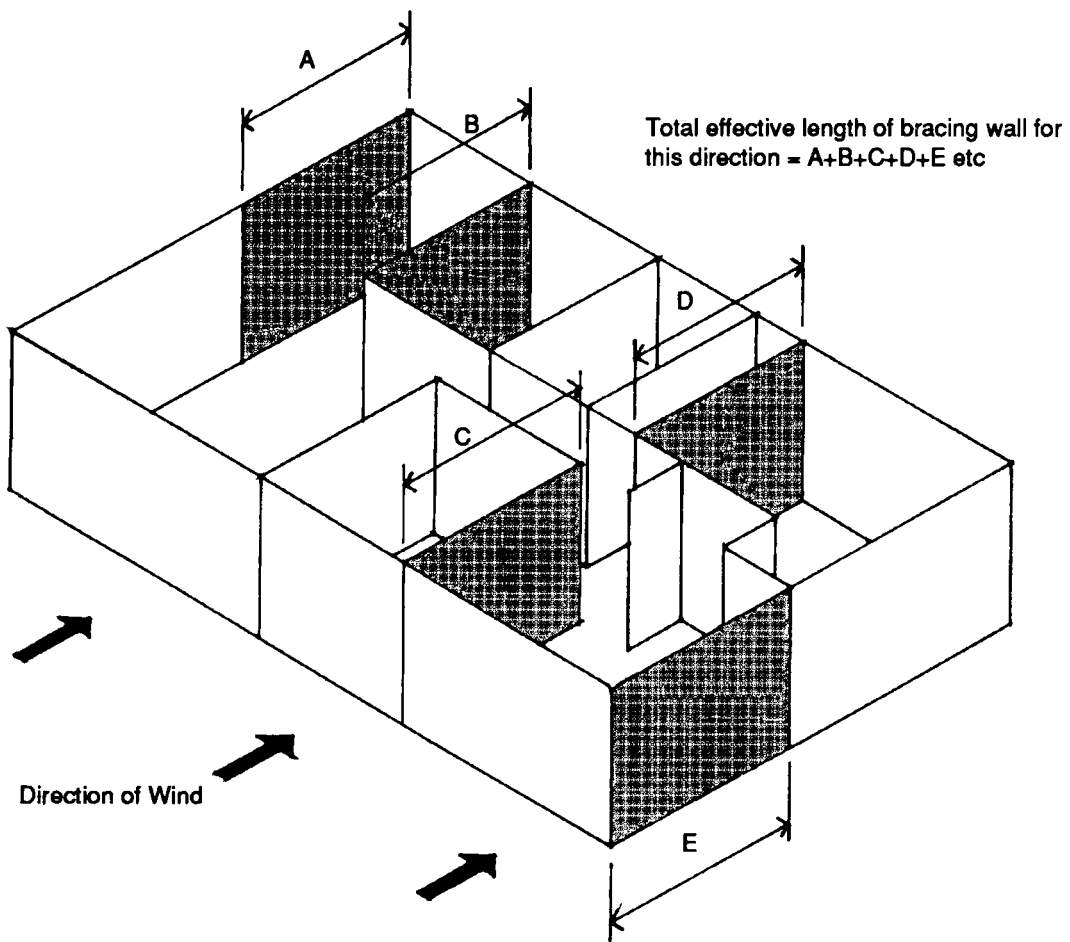


FIGURE B9.4.1(A) LOCATION OF BRACING WALL

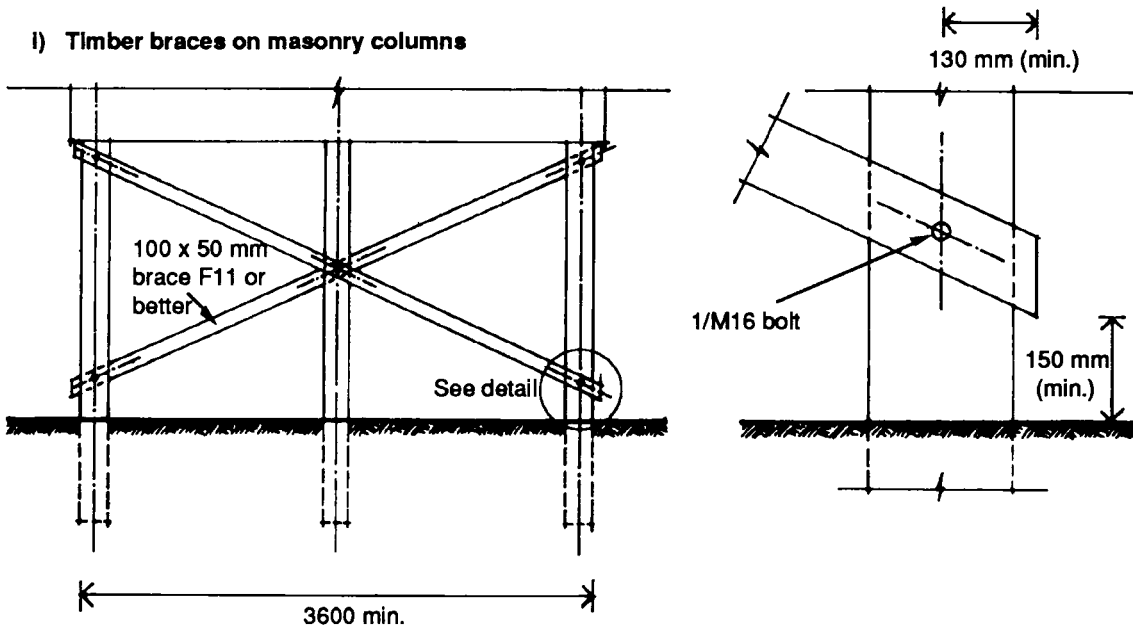
FIGURE B9.4.2

SUB-FLOOR BRACING TYPES

Bracing Capacity (kN)

B) BRACING SETS

i) Timber braces on masonry columns

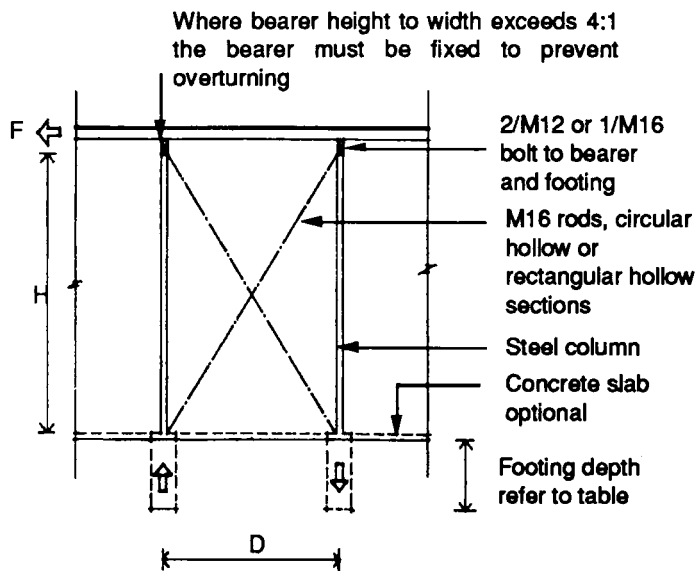


10 kN per set

Notes

- i) Where bearer height to width ratio exceeds 4:1, the bearer must be fixed to prevent overturning.
- ii) Braces fixed to the same side of the posts must be half checked at crossing.

ii) Steel Braces on timber or steel columns

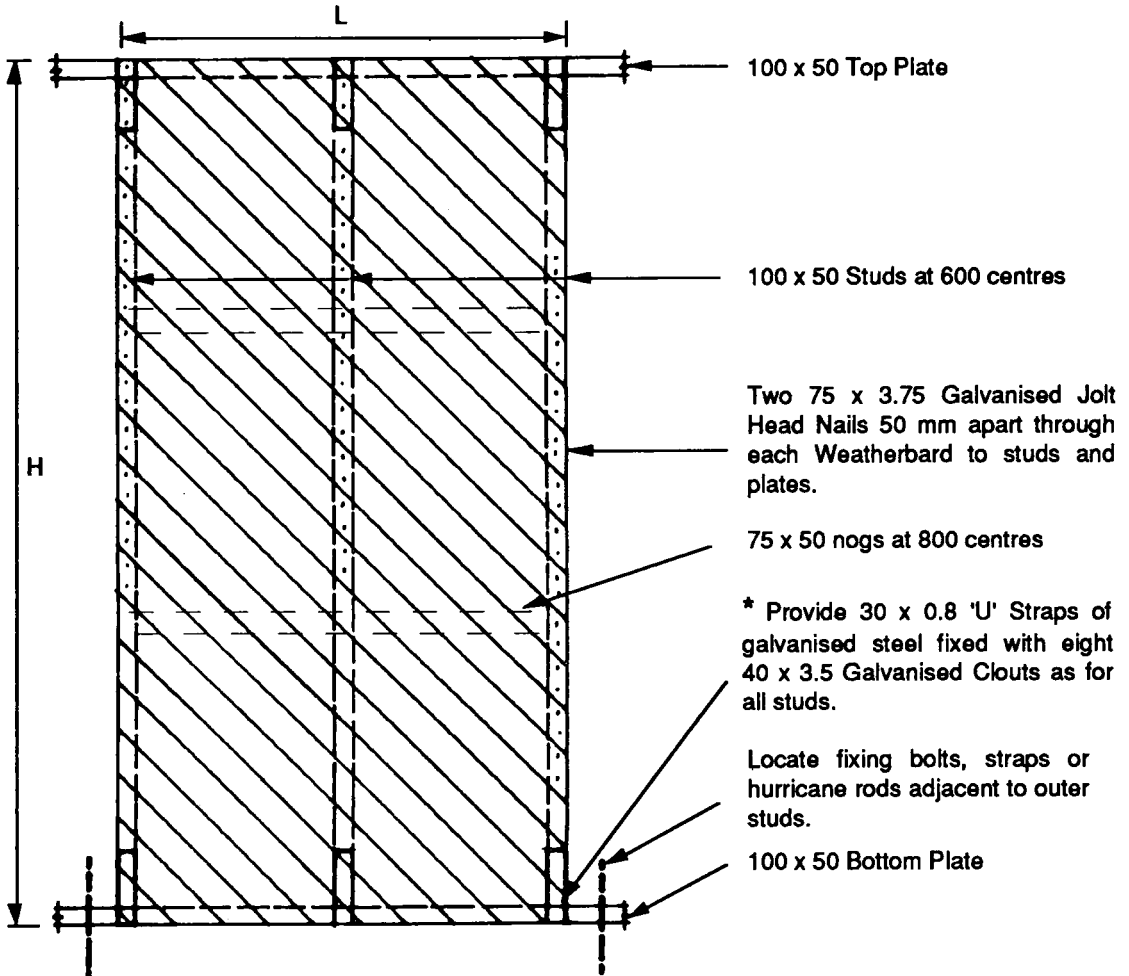


FOOTING DEPTH (mm)	MAX. TIE-DOWN FORCE 'U' (kN)
500	8.3
1000	15.0

**FIGURE B9.4.3**

**WALL BRACING TYPES**

**(A)**



**WALL BRACING ELEMENTS CLAD WITH DIAGONAL WEATHERBOARDS**

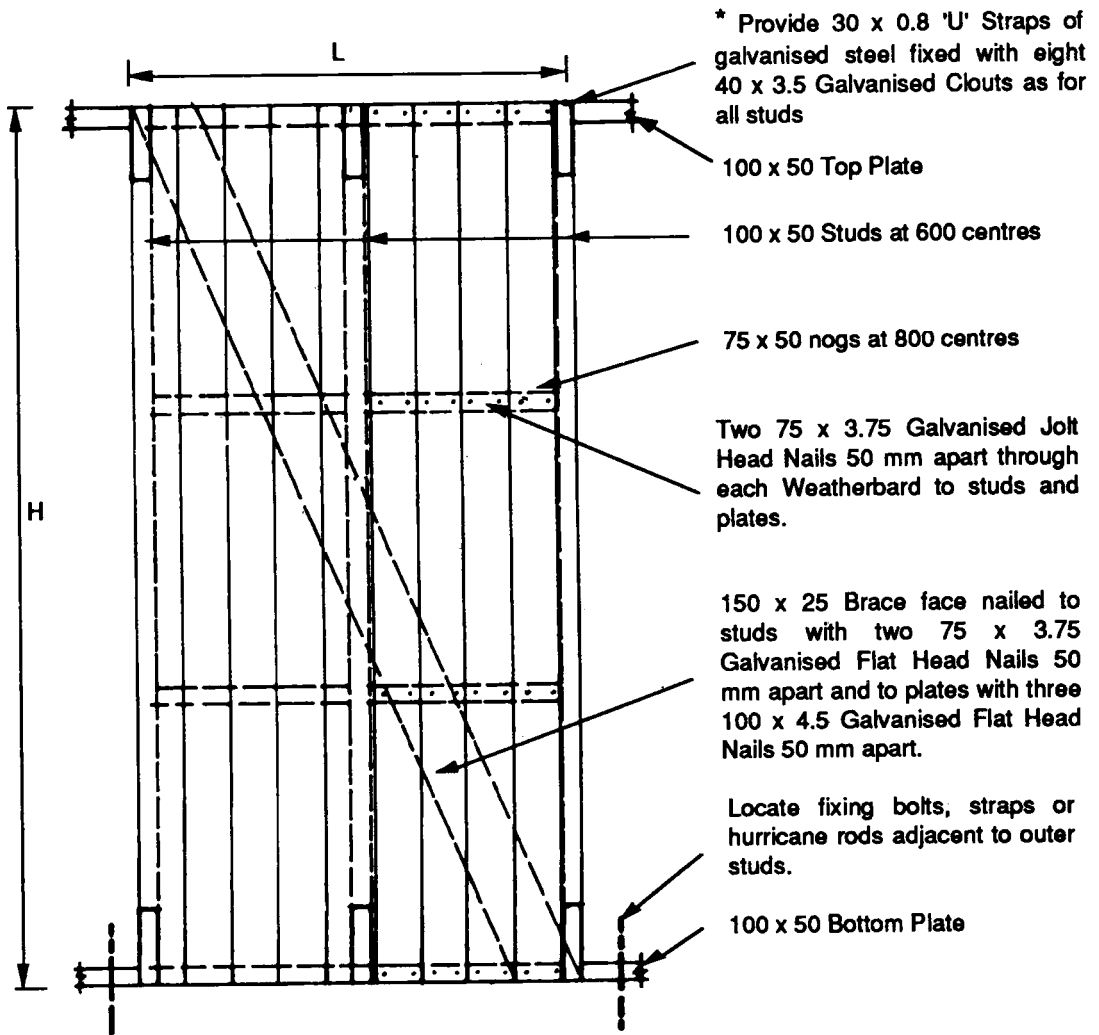
**Bracing capacity of wall system (kN)**

WALL HEIGHT (H) (mm)	WALL LENGTH (L) (mm)	
	1200	2400
≤ 1800	2.0	8.0
2100	1.7	7.0
2400	1.5	6.0
2700	1.3	5.3
3000	1.2	4.8

\* Stud ties may be used as an alternative to galvanised steel 'U' straps.

WALL BRACING TYPES

(B)



WALL BRACING ELEMENTS CLAD WITH VERTICAL WEATHERBOARDS

Bracing capacity of wall system

Bracing capacity of wall system (kN)

WALL HEIGHT (H) (mm)	WALL LENGTH (L) (mm)	
	1200	2400
≤ 1800	2.0	5.3
2100	1.7	4.6
2400	1.5	4.0
2700	1.3	3.6
3000	1.2	3.2

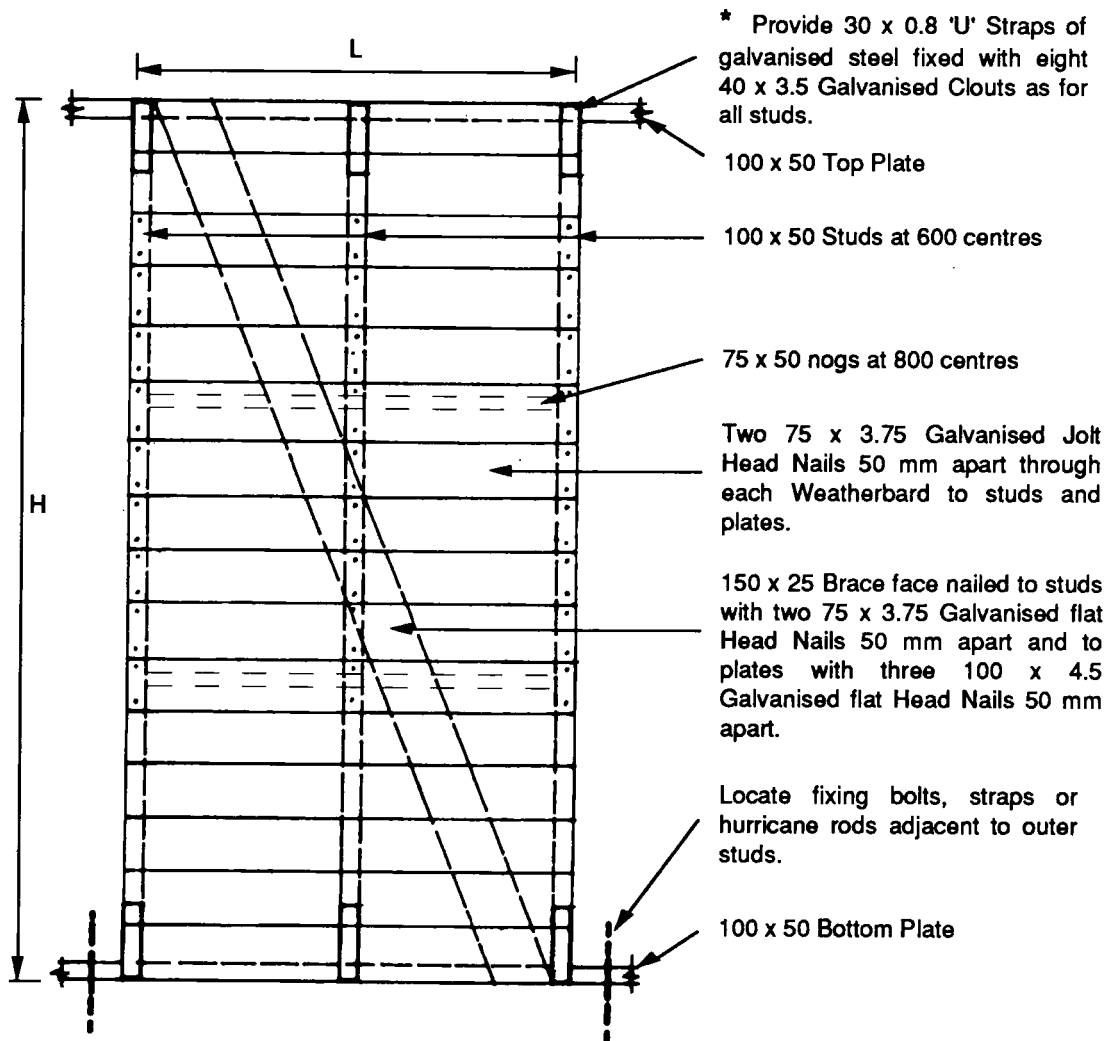
\* Stud ties may be used as an alternative to galvanised steel straps.



FIGURE B9.4.3 continued

WALL BRACING TYPES

(C)



WALL BRACING ELEMENTS CLAD WITH VERTICAL WEATHERBOARDS

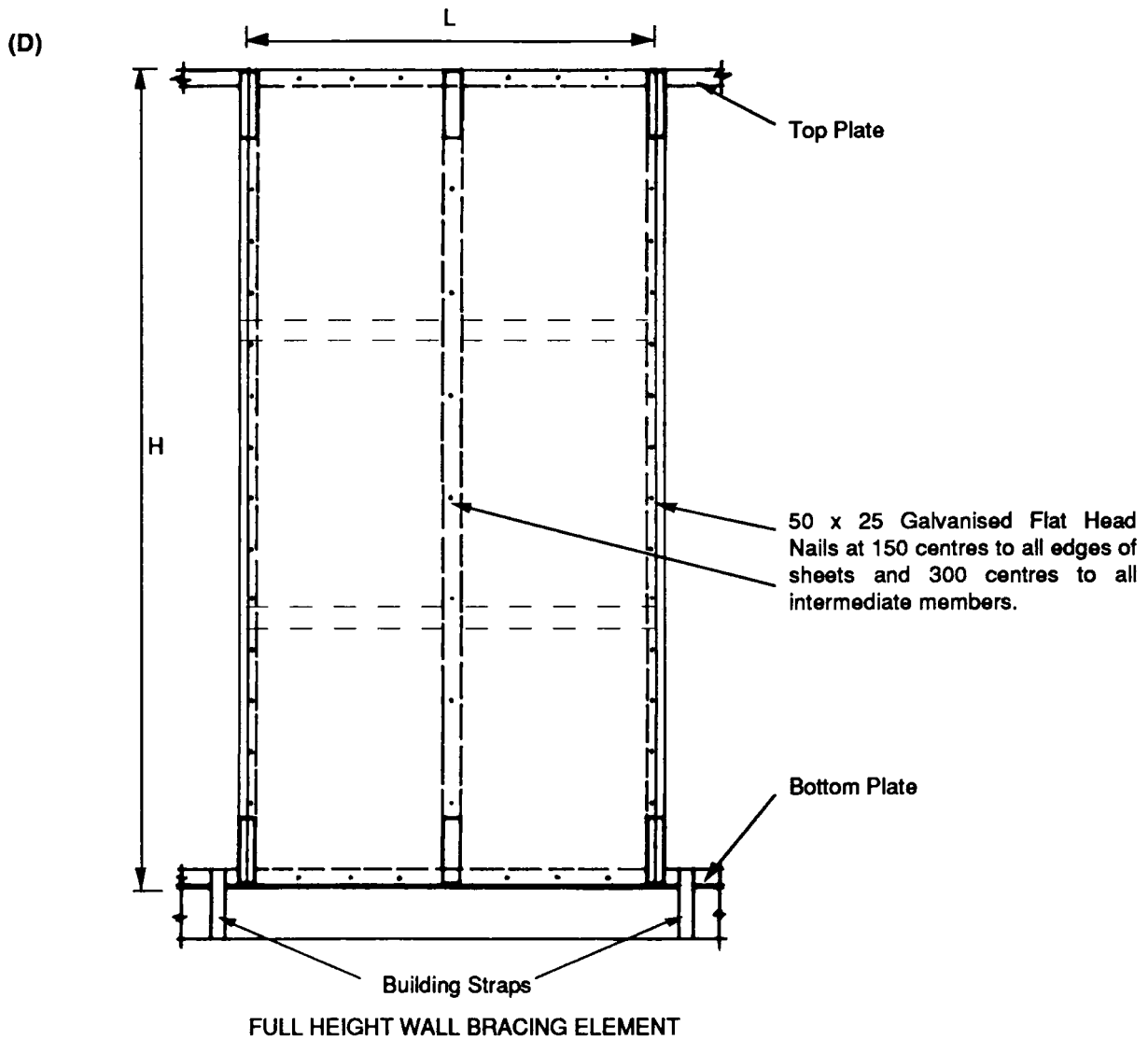
Bracing capacity of wall system (kN)

WALL HEIGHT (H) (mm)	WALL LENGTH (L) (mm)	
	1200	2400
≤ 1800	2.0	5.3
2100	1.7	4.6
2400	1.5	4.0
2700	1.3	3.6
3000	1.2	3.2

\* Studs ties may be used as an alternative to galvanised steel straps.

FIGURE B9.4.3 continued

WALL BRACING TYPES



SHEET WALL BRACING ELEMENTS (PLYWOOD, PARTICLE BOARD AND FIBRE CEMENT)

Bracing capacity of wall system

Bracing capacity of wall system (kN)

WALL HEIGHT (H) (mm)	WALL LENGTH (L) (mm)	
	1200	2400
≤ 1800	5.3	12.8
2100	4.6	11.0
2400	4.0	9.6
2700	3.6	8.5
3000	3.2	7.7

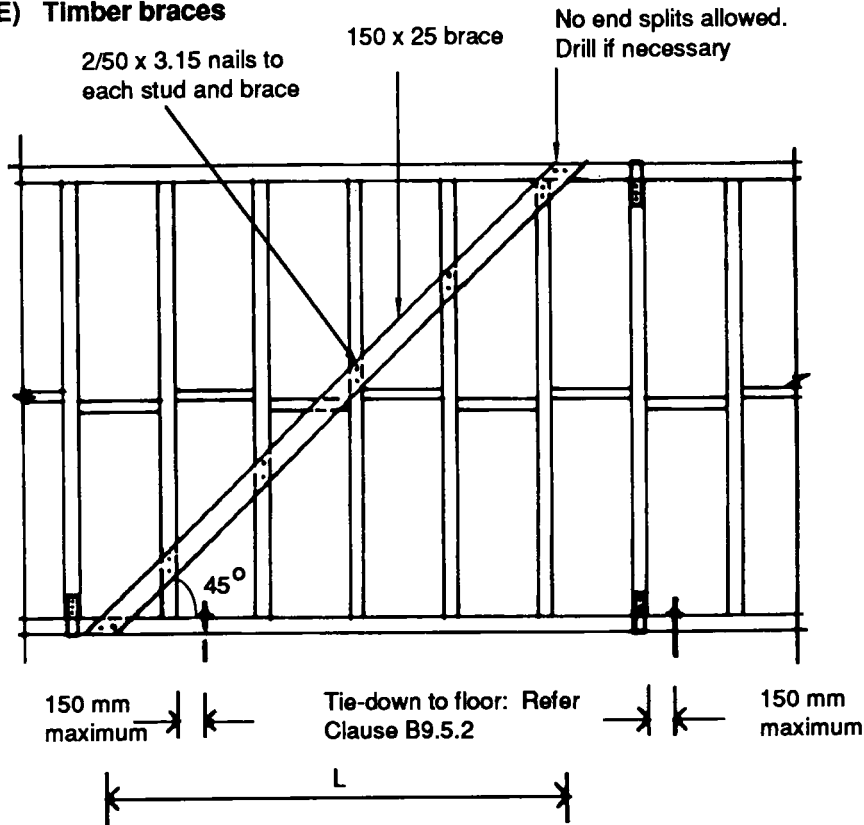
MINIMUM THICKNESS OF SHEET BRACING ELEMENTS

1. Plywood 7.5 mm
2. Fibre Cement Board 7.5 mm
3. Wood Based Products
  - Density 600 to 800 kg/m<sup>3</sup> 9.0 mm
  - Density greater than 800 kg/m<sup>3</sup> 4.5 mm

FIGURE B9.4.3 continued

BRACING TYPES

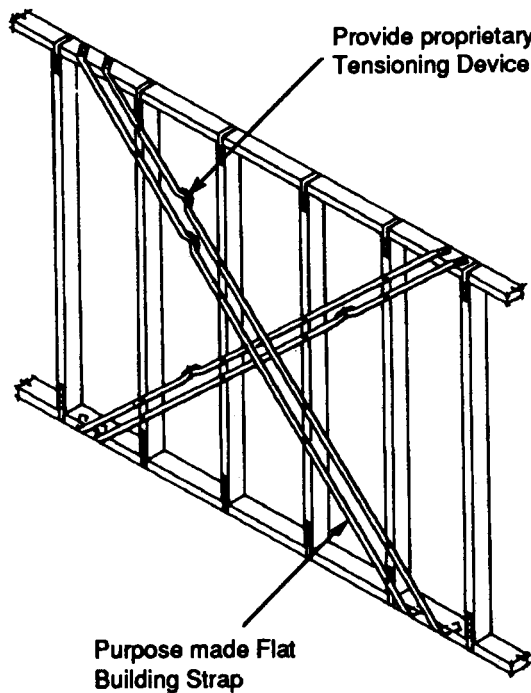
E) Timber braces



LENGTH OF BRACE (L) (mm)	BRACING CAPACITY (kN)
2400	2.4
2700	2.7

- Notes:**
- i) The maximum depth of notch or sawcut must not exceed 20mm.
  - ii) Sawcuts are to be deemed to be notches.
  - iii) Cut-in braces may only be used on internal non-loadbearing bracing walls.

F) Metal braces



A number of metal braces are readily available at hardware stores. These are produced by various manufacturers who have had their products tested by the relevant Authorities. To obtain design strengths of these braces, refer to manufacturers specifications.

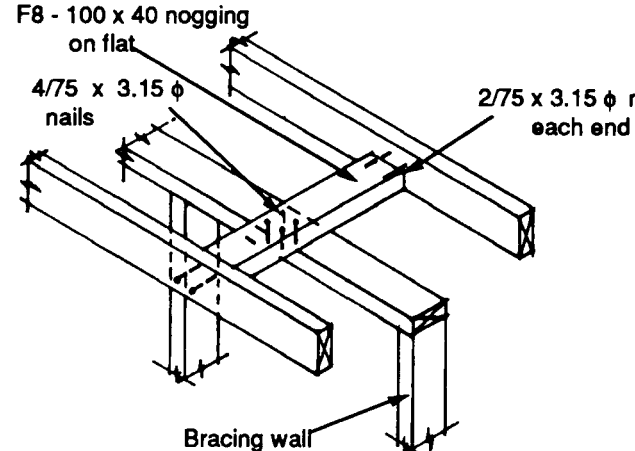
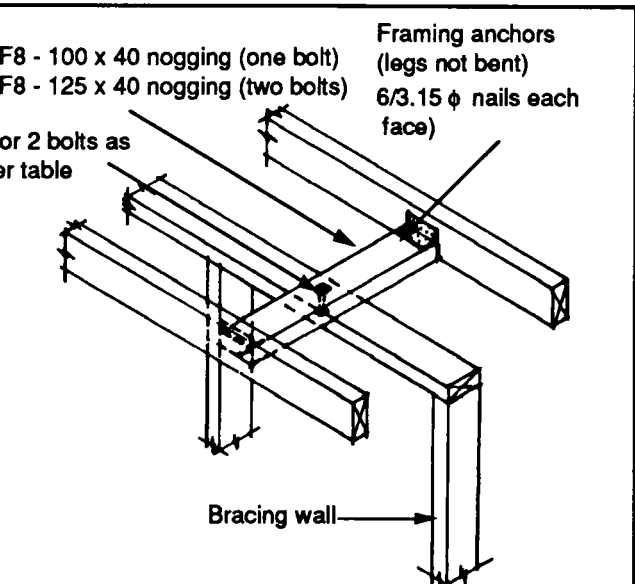
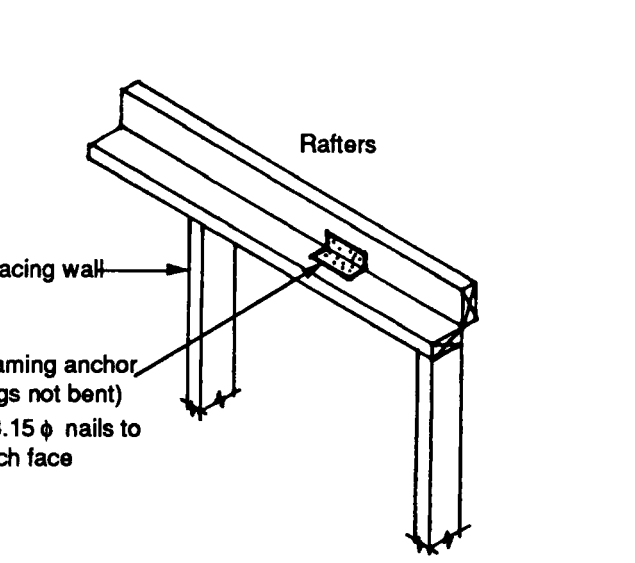
<b>FIGURE B9.5.1</b>  <b>FIXING OF BRACING WALLS TO ROOF FRAME, OR TO EXTERNAL WALL FRAME</b>		<b>Design Strength (kN)</b>									
		Unseasoned timber			Seasoned timber						
		J2	J3	J4	JD2	JD3	JD4				
<b>Rafters or Trusses parallel to Bracing Wall</b>											
<b>I)</b>  <p>           F8 - 100 x 40 nogging on flat            4/75 x 3.15 <math>\phi</math> nails            2/75 x 3.15 <math>\phi</math> nails each end            Bracing wall         </p>		1.8	1.3	0.94	2.3	1.8	1.3				
	<b>II)</b>  <p>           F8 - 100 x 40 nogging (one bolt)            F8 - 125 x 40 nogging (two bolts)            1 or 2 bolts as per table            Framing anchors (legs not bent)            6/3.15 <math>\phi</math> nails each face            Bracing wall         </p>	<b>Bolt Size</b>									
	M10	3.9	2.5	1.6	4.6	3.5	2.6				
	M12	4.6	3.0	1.9	5.6	4.2	3.1				
	M16	6.2	4.0	2.5	7.6	5.6	4.2				
	2/M10	7.8	5.0	3.2	8.0	7.0	5.2				
	2/M12	8.0	6.0	3.8	8.0	8.0	6.2				
<b>III)</b>  <p>           Rafters            Bracing wall            Framing anchor (legs not bent)            6/3.15 <math>\phi</math> nails to each face         </p>		4.9	3.5	2.5	6.6	5.2	3.7				

FIGURE B9.5.1 continued

**FIXING OF BRACING WALLS TO ROOF FRAME, OR TO EXTERNAL WALL FRAME**

**Design Strength (kN)**

Unseasoned Timber

Seasoned Timber

J2

J3

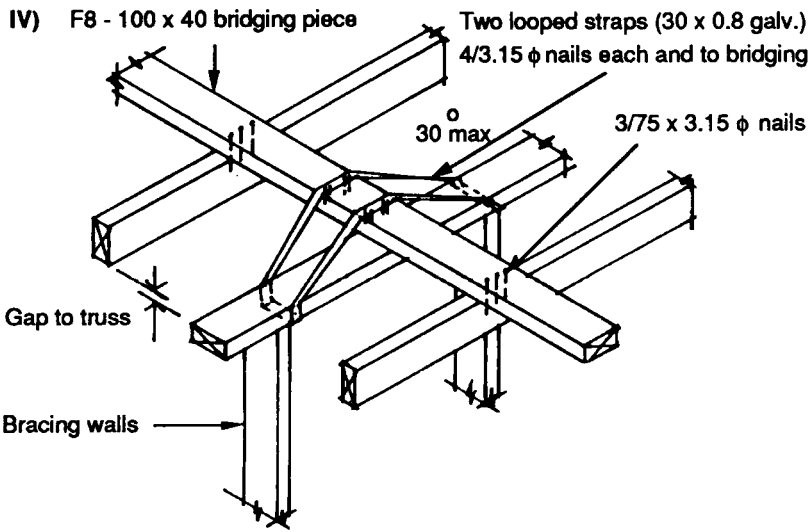
J4

JD2

JD3

JD4

**Rafters or Trusses parallel to Bracing Wall (cont.)**



6.2

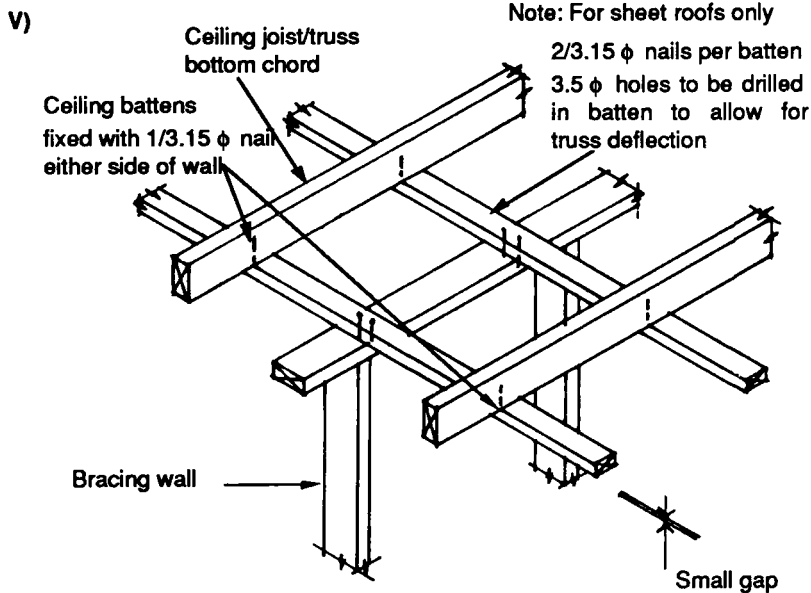
4.4

3.1

8.6

6.7

4.8



1.5

1.1

0.8

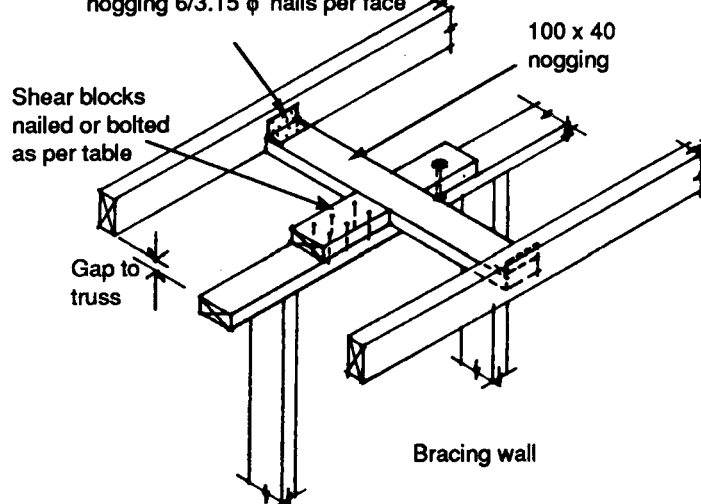
2.0

1.5

1.1

PER BATTEN

VI) Nailing plates or framing anchor (legs not bent) to either end of nogging 6/3.15  $\phi$  nails per face



Nails

4/3.15

4/3.75

6/3.15

Bolt Size

M10

M12

M16

3.1

2.2

1.6

3.9

3.1

2.2

4.2

3.0

2.1

5.3

4.2

3.0

4.1

2.9

2.1

5.4

4.3

3.1

4.6

4.0

3.2

5.4

4.6

3.7

6.6

5.0

4.0

7.0

5.4

4.4

8.4

6.7

5.3

9.3

7.3

5.9

FIGURE B9.5.1 Continued

**FIXING OF BRACING WALLS TO ROOF FRAME, OR TO EXTERNAL WALL FRAME**

**Design Strength (kN)**

Unseasoned timber

Seasoned timber

J2

J3

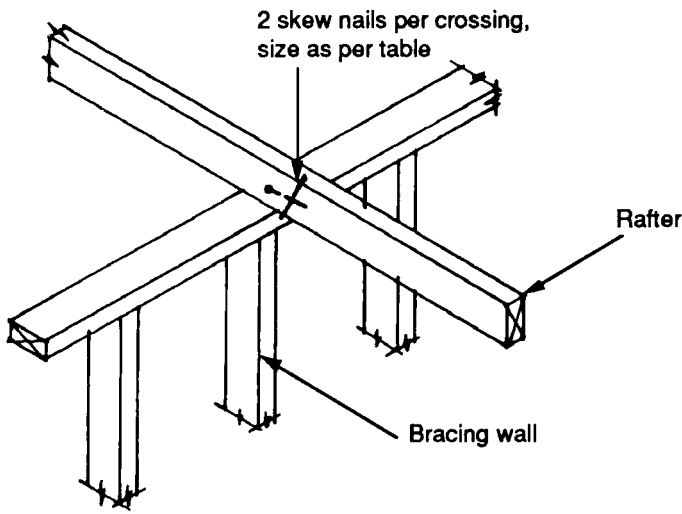
J4

JD2

JD3

JD4

VII)



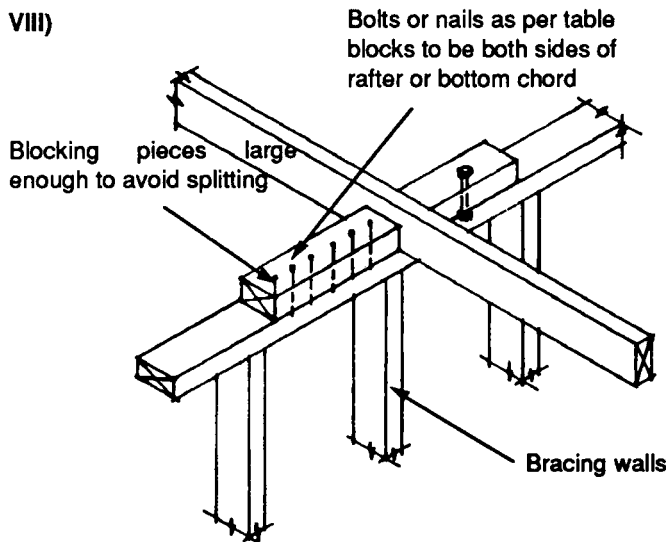
Nails

2/3.15

2/3.75

2/3.15	1.5	1.1	0.8	1.1	0.9	0.7
2/3.75	2.1	1.5	1.1	2.7	2.1	1.5

VIII)



Nails

4/3.15

4/3.75

6/3.15

Bolt Size

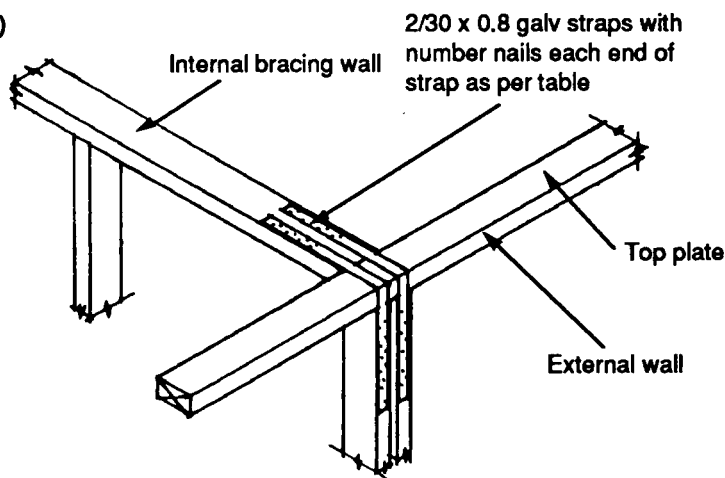
M10

M12

M16

4/3.15	3.1	2.2	1.6	3.9	3.1	2.2
4/3.75	4.2	3.0	2.1	5.3	4.2	3.0
6/3.15	4.1	2.9	2.1	5.4	4.3	3.1
Bolt Size						
M10	4.6	4.0	3.2	5.4	4.6	3.7
M12	6.6	5.0	4.0	7.0	5.4	4.4
M16	8.4	6.7	5.3	9.3	7.3	5.9

IX)



Nails

4/3.15

6/3.15

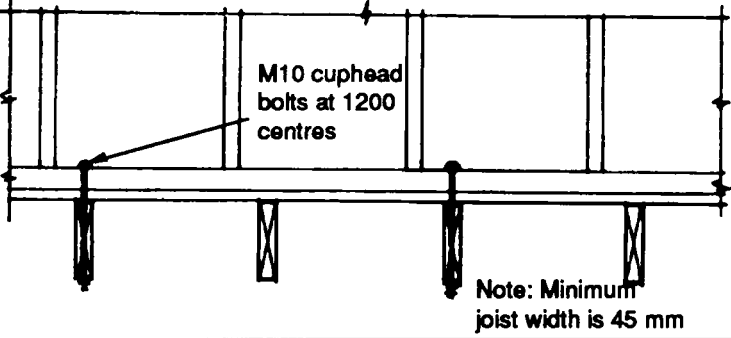
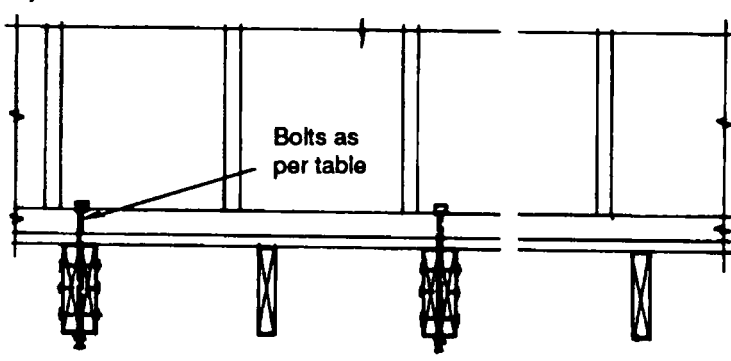
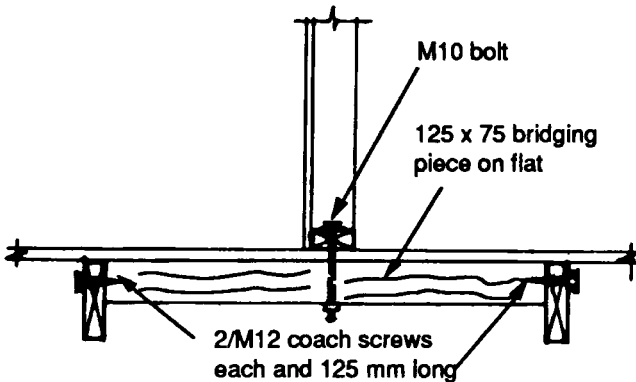
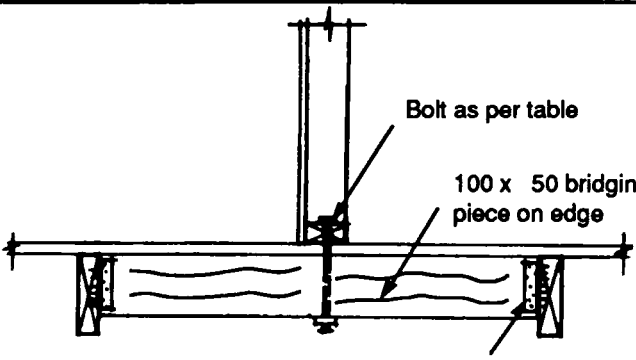
4/3.15	7.4	5.3	3.7	9.4	5.3	4.4
6/3.15	9.7	7.0	4.9	13	10.3	7.4

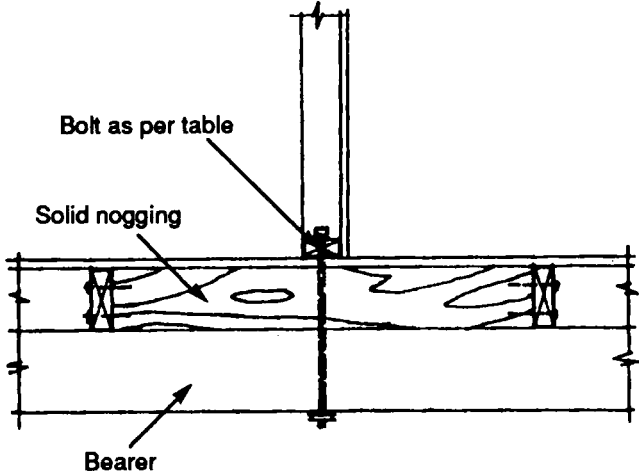
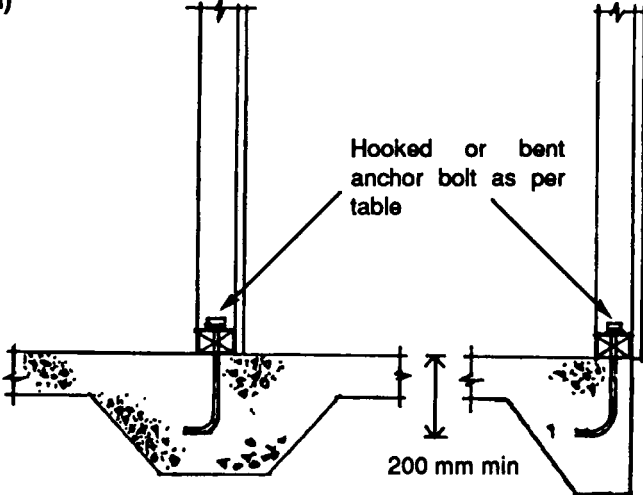
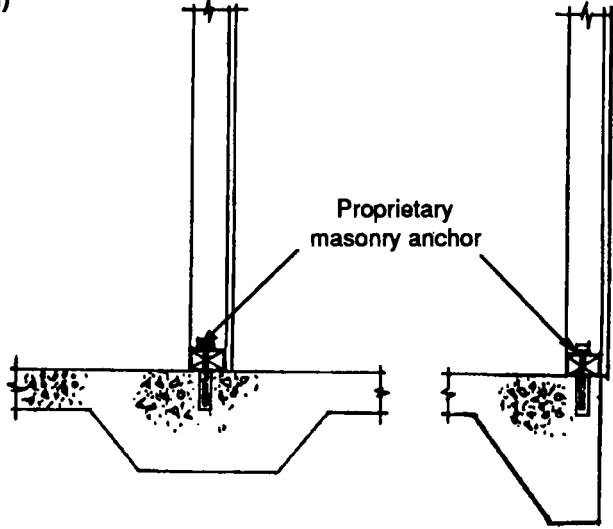
Note: Where one strap is used, loads may be half of those tabled.

**FIGURE B9.5.2**

**TIE-DOWN: BOTTOM OF BRACING WALLS**

**Design Strength (kN)**

	Bolts	Unseasoned timber		Seasoned timber				
		J2	J3	J4	JD2	JD3	JD4	
		<p>I)</p>  <p>M10 cuphead bolts at 1200 centres</p> <p>Note: Minimum joist width is 45 mm</p>		M10 Cup-head	8.6	5.6 Per	3.5 Bolt	11.3
<p>II)</p>  <p>Bolts as per table</p> <p>Double joist or 450 mm long full length cleat nailed to joist with 6/75 x 3.15 <math>\phi</math> nails</p>		M10	11.5	10.6	6.7	11.5	11.5	11.5
		M12	17	16.5	10.5	17	17	17
<p>III)</p>  <p>M10 bolt</p> <p>125 x 75 bridging piece on flat</p> <p>2/M12 coach screws each and 125 mm long</p>			11.5	10.6	6.7	11.5	11.5	11.5
<p>IV)</p>  <p>Bolt as per table</p> <p>100 x 50 bridging piece on edge</p> <p>2 nailing plates each end of bridging, legs not bent with 6/3.15 <math>\phi</math> nails to each face</p>		M10	11.5	10.6	6.7	11.5	11.5	11.5
		M12	17	14	10	17	17	15

<b>FIGURE B9.5.2 continued</b>  <b>TIE-DOWN: BOTTOM OF BRACING WALLS</b>		<b>Design Strength (kN)</b>						
		<b>Bolts</b>	<b>Unseasoned timber</b>			<b>Seasoned timber</b>		
			<b>J2</b>	<b>J3</b>	<b>J4</b>	<b>JD2</b>	<b>JD3</b>	<b>JD4</b>
<b>V)</b>  	<b>M10</b>	11.5	10.6	6.7	11.5	11.5	11.5	
	<b>M12</b>	17	16.5	10.5	17	17	17	
<b>VI)</b>  	<b>M10</b>	11.5	10.6	6.7	11.5	11.5	11.5	
	<b>M12</b>	17	16.5	10.5	17	17	17	
<b>VII)</b>  	<b>REFER TO MANUFACTURERS SPECIFICATIONS</b>							



## B10 TIE-DOWN

### B10.1 Scope

This clause provides for structural connections to resist uplift and shear forces on floor, wall and roof framings. These details are in addition to nominal fixing.

Continuity of tie-down must be provided from the roof sheeting to the foundations.

### B10.2 Application

To determine an appropriate structural tie-down detail, the following general steps are to be followed:

- (i) From Fig. B10.3(A) determine the appropriate dimension 'A' for the member or joint considered.
- (ii) From Tables B10.5.1 to B10.11.4 determine the uplift forces to be resisted by each joint considered.
- (iii) Determine the appropriate joint group for the joint under consideration.
- (iv) Enter the appropriate design strength figure and establish a suitable tie-down detail.

### B10.3 Dimension 'A'

Dimension 'A' must be used to determine the tie-down requirements for each structural joint in floor framing, wall framing and roof framing excluding purlins.

- Notes :**
1. dimension 'A' is **NOT** to be used for determination of timber member sizes.
  2. dimension 'S' is at right angles to dimension 'A' and the method of measurement is shown in Figure B10.9(A)

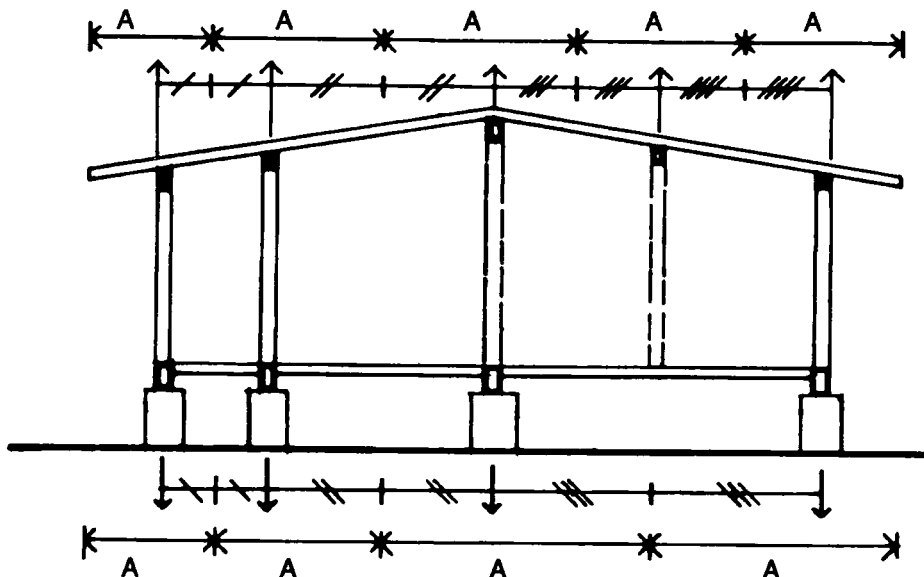


FIGURE B10.3(A) DIMENSION 'A' - RAFTERED ROOF

**Note :** To determine dimension 'A' for floor joists and bearers, consideration should be given to the sharing of uplift load through internal partitions. The dimensions 'A' illustrated above for bearers and floor joists take this into account.

## B10.4 General Connection Requirements

### B10.4.1 Steel Washers

Bolt $\phi$ ( mm )	Washer Size ( mm )	
	Square	Round
M10 bolt	40 x 40 x 2.5 mm	45 mm dia. x 2.5 mm
M12 bolt	50 x 50 x 3 mm	55 mm dia. x 3 mm
M16 bolt	57 x 57 x 4 mm	65 mm dia. x 4 mm
M20 bolt	65 x 65 x 5 mm	75 mm dia. x 5 mm

### B10.4.2 Drilling for Bolts

- (i) Bolt holes in timber must be 1-2 mm greater in diameter than the bolt diameter.
- (ii) Bolt holes in steel must provide a snug fit, i.e. not greater than 0.5 mm larger than bolt diameter.

### B10.4.3 Drilling for Coach Screws

- (i) Hole for Shank = Shank Diameter + 1 mm.
- (ii) Hole for Thread = Root Diameter.

## B10.5 Uplift Forces on Bearers

The uplift forces on bearers must be determined from Tables B10.5.1 to B10.5.4. For typical details and design strengths refer to Figure B10.5.

## B10.6 Uplift Forces on Floor Joists

The uplift forces on floor joists are determined from Table B10.6.1 to B10.6.4. For typical details and design strengths, refer to Figure B10.6.

## B10.7 Bracing Demand on Walls

The bottom plate of all walls must be fixed to the floor frame or concrete slab in a manner sufficient to resist the bracing demand on the walls. Refer to Figure B9.5.2 for details.

## B10.8 Uplift Forces on Rafters

The uplift forces on rafters are determined from Tables B10.8.1 to B10.8.4 and tie-down details to resist the uplift from Figures B10.8(A), B10.8(B), or B10.8(C) as appropriate.

## B10.9 Uplift Forces on Roof Beams, Lintels, Verandah Beams and Verandah Posts

The uplift forces on roof beams, lintels, verandah beams and verandah posts are determined from Tables B10.9.1 to B10.9.4. The dimensions 'A' and 'S' required for using the tables are shown in Figures B10.3(A) and B10.9(A). For typical tie-down details and design strengths refer Figure B10.9(B) to B10.9(D).

## B10.10 Uplift Forces on Purlins

The uplift forces on purlins are determined from Tables B10.10.1 to B10.10.4. For typical purlin to rafter tie-down details and design strengths refer to Figure B10.10.

## B10.11 Uplift Forces on Cladding fasteners

The uplift forces on cladding fasteners are determined from Tables B10.11.1 to B10.11.4 and the tie-down details to resist the uplift, from Figure B10.11.

**Table B10.5.1**

<b>THIS TABLE VALID FOR</b>			
<b>Aspect Ratio ( height/d )</b>	<b>0.25</b>	<b>0.5</b>	<b>1.0</b>
<b>Roof Pitch ( Degrees )</b>	<b>15, 20, 25</b>	<b>20, 25</b>	<b>25</b>

**UPLIFT FORCES ON BEARERS FOR LOWSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )									
		49	51	53	55	57	60	64	69	74.5	
3000	1800	<b>NO UPLIFT</b>							0.16	1.23	2.51
	2400								0.21	1.64	3.35
	3000								0.26	2.05	4.19
	3600								0.31	2.47	5.02
3600	1800								0.19	1.48	3.01
	2400								0.25	1.97	4.02
	3000								0.31	2.47	5.02
	3600								0.37	2.96	6.03
4200	1800								0.22	1.73	3.52
	2400								0.29	2.30	4.69
	3000								0.36	2.88	5.86
	3600								0.44	3.45	7.03
4800	1800								0.25	1.97	4.02
	2400								0.33	2.63	5.36
	3000								0.41	3.29	6.70
	3600								0.50	3.95	8.04

**UPLIFT FORCES ON BEARERS FOR HIGHSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	1800	3.63	4.48	5.35	6.26	7.20	8.68	10.77	13.57	16.90
	2400	4.84	5.97	7.14	8.35	9.61	11.58	14.36	18.10	22.53
	3000	6.06	7.46	8.92	10.44	12.01	14.47	17.95	22.62	28.16
	3600	7.27	8.95	10.70	12.52	14.41	17.37	21.54	27.15	33.80
3600	1800	4.36	5.37	6.42	7.51	8.65	10.42	12.93	16.29	20.28
	2400	5.81	7.16	8.56	10.02	11.53	13.89	17.24	21.72	27.04
	3000	7.27	8.95	10.70	12.52	14.41	17.37	21.54	27.15	33.80
	3600	8.72	10.74	12.84	15.03	17.29	20.84	25.85	32.58	40.55
4200	1800	5.09	6.27	7.49	8.77	10.09	12.16	15.08	19.00	23.66
	2400	6.78	8.35	9.99	11.69	13.45	16.21	20.11	25.34	31.54
	3000	8.48	10.44	12.49	14.61	16.81	20.26	25.14	31.67	39.43
	3600	10.17	12.53	14.98	17.53	20.17	24.31	30.16	38.01	47.31
4800	1800	5.81	7.16	8.56	10.02	11.53	13.89	17.24	21.72	27.04
	2400	7.75	9.55	11.42	13.36	15.37	18.52	22.98	28.96	36.05
	3000	9.69	11.93	14.27	16.70	19.21	23.16	28.73	36.20	45.06
	3600	11.63	14.32	17.12	20.04	23.06	27.79	34.47	43.43	54.07

**Table B10.5.2**

<b>THIS TABLE VALID FOR</b>			
Aspect Ratio ( height/d )	0.25	0.5	1.0
Roof Pitch ( Degrees )	10	15	20

**UPLIFT FORCES ON BEARERS FOR LOWSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )									
		49	51	53	55	57	60	64	69	74.5	
3000	1800	<b>NO UPLIFT</b>				0.38	0.89	1.68	2.81	4.32	6.11
	2400		0.51	1.18	2.25	3.75	5.76	8.14			
	3000		0.63	1.48	2.81	4.68	7.20	10.18			
	3600		0.76	1.78	3.37	5.62	8.64	12.22			
3600	1800		0.46	1.07	2.02	3.37	5.18	7.33			
	2400		0.61	1.42	2.70	4.50	6.91	9.77			
	3000		0.76	1.78	3.37	5.62	8.64	12.22			
	3600		0.91	2.13	4.04	6.74	10.36	14.66			
4200	1800		0.53	1.24	2.36	3.93	6.05	8.55			
	2400		0.71	1.66	3.14	5.24	8.06	11.40			
	3000		0.89	2.07	3.93	6.56	10.08	14.25			
	3600		1.07	2.49	4.72	7.87	12.09	17.10			
4800	1800		0.61	1.42	2.70	4.50	6.91	9.77			
	2400		0.81	1.90	3.59	5.99	9.21	13.03			
	3000		1.02	2.37	4.49	7.49	11.51	16.29			
	3600		1.22	2.84	5.39	8.99	13.82	19.55			

**UPLIFT FORCES ON BEARERS FOR HIGHSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	1800	5.19	6.16	7.17	8.22	9.31	11.02	13.43	16.66	20.49
	2400	6.92	8.21	9.56	10.96	12.41	14.69	17.90	22.21	27.33
	3000	8.65	10.27	11.95	13.70	15.52	18.36	22.38	27.76	34.16
	3600	10.38	12.32	14.34	16.44	18.62	22.03	26.85	33.32	40.99
3600	1800	6.23	7.39	8.61	9.87	11.17	13.22	16.11	19.99	24.59
	2400	8.30	9.86	11.47	13.15	14.90	17.63	21.48	26.65	32.79
	3000	10.38	12.32	14.34	16.44	18.62	22.03	26.85	33.32	40.99
	3600	12.45	14.79	17.21	19.73	22.34	26.44	32.22	39.98	49.19
4200	1800	7.26	8.63	10.04	11.51	13.03	15.42	18.80	23.32	28.69
	2400	9.69	11.50	13.39	15.35	17.38	20.56	25.06	31.10	38.26
	3000	12.11	14.38	16.73	19.18	21.72	25.70	31.33	38.87	47.82
	3600	14.53	17.25	20.08	23.02	26.07	30.84	37.59	46.64	57.38
4800	1800	8.30	9.86	11.47	13.15	14.90	17.63	21.48	26.65	32.79
	2400	11.07	13.14	15.30	17.54	19.86	23.50	28.64	35.54	43.72
	3000	13.84	16.43	19.12	21.92	24.83	29.38	35.80	44.42	54.65
	3600	16.60	19.71	22.95	26.31	29.79	35.25	42.96	53.31	65.58

**Table B10.5.3**

<b>THIS TABLE VALID FOR</b>		
<b>Aspect Ratio ( height/d )</b>	<b>0.5</b>	<b>1.0</b>
<b>Roof Pitch ( Degrees )</b>	<b>10</b>	<b>15</b>

**UPLIFT FORCES ON BEARERS FOR LOWSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	1800	1.30	1.95	2.62	3.32	4.05	5.18	6.79	8.95	11.50
	2400	1.73	2.60	3.49	4.43	5.40	6.91	9.05	11.93	15.34
	3000	2.17	3.25	4.37	5.54	6.74	8.64	11.32	14.91	19.17
	3600	2.60	3.89	5.24	6.64	8.09	10.37	13.58	17.89	23.01
3600	1800	1.56	2.34	3.15	3.99	4.86	6.22	8.15	10.73	13.80
	2400	2.08	3.12	4.19	5.31	6.47	8.29	10.87	14.31	18.40
	3000	2.60	3.89	5.24	6.64	8.09	10.37	13.58	17.89	23.01
	3600	3.12	4.67	6.29	7.97	9.71	12.44	16.30	21.47	27.61
4200	1800	1.82	2.73	3.67	4.65	5.67	7.26	9.51	12.52	16.10
	2400	2.43	3.63	4.89	6.20	7.55	9.68	12.68	16.70	21.47
	3000	3.03	4.54	6.12	7.75	9.44	12.10	15.85	20.87	26.84
	3600	3.64	5.45	7.34	9.30	11.33	14.52	19.01	25.05	32.21
4800	1800	2.08	3.12	4.19	5.31	6.47	8.29	10.87	14.31	18.40
	2400	2.77	4.15	5.59	7.08	8.63	11.06	14.49	19.08	24.54
	3000	3.46	5.19	6.99	8.86	10.79	13.82	18.11	23.86	30.67
	3600	4.16	6.23	8.39	10.63	12.95	16.59	21.73	28.63	36.81

**UPLIFT FORCES ON BEARERS FOR HIGHSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	1800	7.52	8.69	9.90	11.16	12.47	14.52	17.41	21.29	25.89
	2400	10.03	11.59	13.20	14.88	16.62	19.35	23.21	28.38	34.52
	3000	12.54	14.48	16.50	18.60	20.78	24.19	29.01	35.48	43.15
	3600	15.05	17.38	19.80	22.32	24.94	29.03	34.82	42.57	51.78
3600	1800	9.03	10.43	11.88	13.39	14.96	17.42	20.89	25.54	31.07
	2400	12.04	13.90	15.84	17.86	19.95	23.22	27.85	34.06	41.42
	3000	15.05	17.38	19.80	22.32	24.94	29.03	34.82	42.57	51.78
	3600	18.05	20.85	23.77	26.79	29.92	34.84	41.78	51.09	62.13
4200	1800	10.53	12.16	13.86	15.63	17.46	20.32	24.37	29.80	36.24
	2400	14.04	16.22	18.48	20.84	23.27	27.10	32.49	39.73	48.33
	3000	17.55	20.27	23.10	26.04	29.09	33.87	40.62	49.67	60.41
	3600	21.06	24.33	27.73	31.25	34.91	40.64	48.74	59.60	72.49
4800	1800	12.04	13.90	15.84	17.86	19.95	23.22	27.85	34.06	41.42
	2400	16.05	18.54	21.12	23.81	26.60	30.97	37.14	45.41	55.23
	3000	20.06	23.17	26.41	29.76	33.25	38.71	46.42	56.76	69.04
	3600	24.07	27.80	31.69	35.72	39.90	46.45	55.71	68.12	82.84

**Table B10.5.4**

THIS TABLE VALID FOR	
Aspect Ratio ( height/d )	1.0
Roof Pitch ( Degrees )	25

**UPLIFT FORCES ON BEARERS FOR LOWSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	1800	3.63	4.48	5.35	6.26	7.20	8.68	10.77	13.57	16.90
	2400	4.84	5.97	7.14	8.35	9.61	11.58	14.36	18.10	22.53
	3000	6.06	7.46	8.92	10.44	12.01	14.47	17.95	22.62	28.16
	3600	7.27	8.95	10.70	12.52	14.41	17.37	21.54	27.15	33.80
3600	1800	4.36	5.37	6.42	7.51	8.65	10.42	12.93	16.29	20.28
	2400	5.81	7.16	8.56	10.02	11.53	13.89	17.24	21.72	27.04
	3000	7.27	8.95	10.70	12.52	14.41	17.37	21.54	27.15	33.80
	3600	8.72	10.74	12.84	15.03	17.29	20.84	25.85	32.58	40.55
4200	1800	5.09	6.27	7.49	8.77	10.09	12.16	15.08	19.00	23.66
	2400	6.78	8.35	9.99	11.69	13.45	16.21	20.11	25.34	31.54
	3000	8.48	10.44	12.49	14.61	16.81	20.26	25.14	31.67	39.43
	3600	10.17	12.53	14.98	17.53	20.17	24.31	30.16	38.01	47.31
4800	1800	5.81	7.16	8.56	10.02	11.53	13.89	17.24	21.72	27.04
	2400	7.75	9.55	11.42	13.36	15.37	18.52	22.98	28.96	36.05
	3000	9.69	11.93	14.27	16.70	19.21	23.16	28.73	36.20	45.06
	3600	11.63	14.32	17.12	20.04	23.06	27.79	34.47	43.43	54.07

**UPLIFT FORCES ON BEARERS FOR HIGHSET BUILDINGS (kN)**

Dimension "A" (mm)	Bearer Span (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	1800	9.86	11.22	12.63	14.10	15.63	18.01	21.39	25.91	31.28
	2400	13.14	14.96	16.84	18.80	20.83	24.02	28.52	34.55	41.71
	3000	16.43	18.70	21.05	23.50	26.04	30.02	35.65	43.19	52.14
	3600	19.71	22.43	25.26	28.20	31.25	36.03	42.78	51.83	62.57
3600	1800	11.83	13.46	15.16	16.92	18.75	21.62	25.67	31.10	37.54
	2400	15.77	17.95	20.21	22.56	25.00	28.82	34.22	41.46	50.05
	3000	19.71	22.43	25.26	28.20	31.25	36.03	42.78	51.83	62.57
	3600	23.66	26.92	30.32	33.85	37.50	43.23	51.33	62.19	75.08
4200	1800	13.80	15.70	17.69	19.74	21.88	25.22	29.94	36.28	43.80
	2400	18.40	20.94	23.58	26.32	29.17	33.63	39.93	48.37	58.40
	3000	23.00	26.17	29.48	32.90	36.46	42.03	49.91	60.47	73.00
	3600	27.60	31.41	35.37	39.49	43.75	50.44	59.89	72.56	87.59
4800	1800	15.77	17.95	20.21	22.56	25.00	28.82	34.22	41.46	50.05
	2400	21.03	23.93	26.95	30.08	33.34	38.43	45.63	55.28	66.74
	3000	26.28	29.91	33.69	37.61	41.67	48.04	57.04	69.10	83.42
	3600	31.54	35.90	40.42	45.13	50.00	57.65	68.45	82.92	100.11

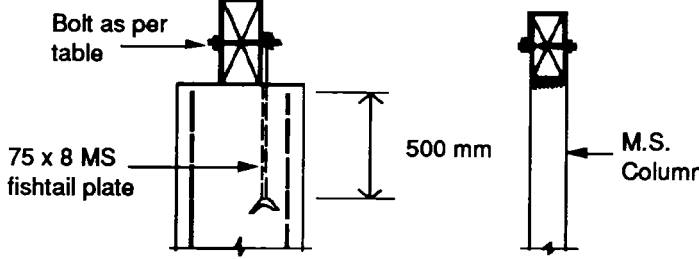
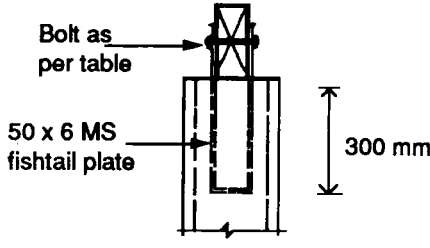
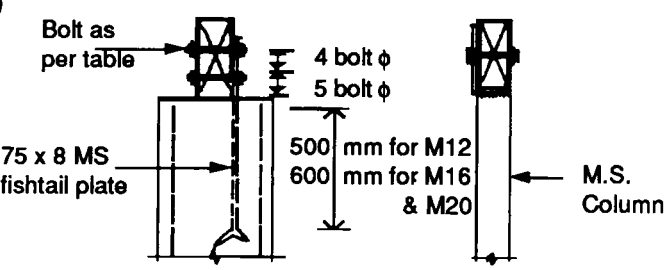
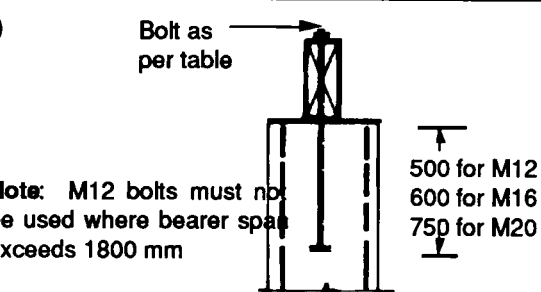
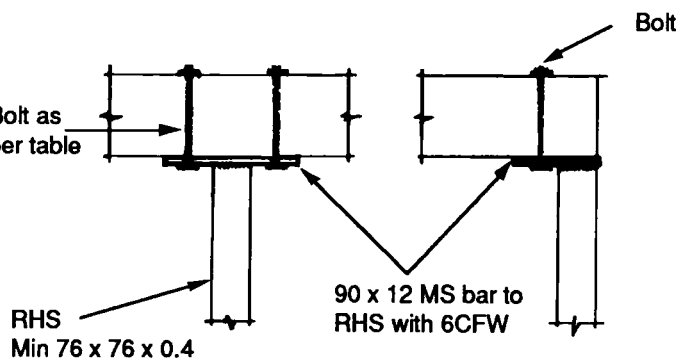
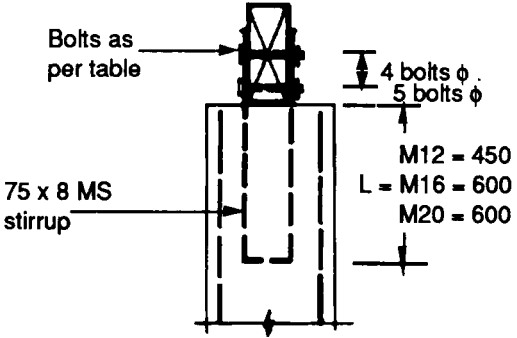
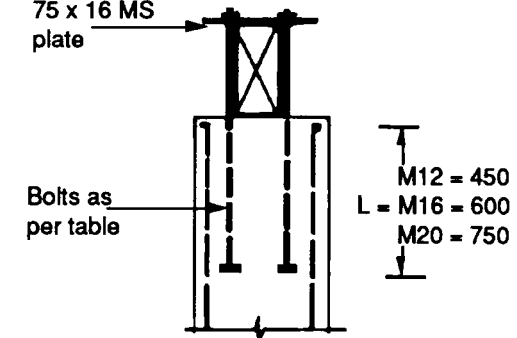
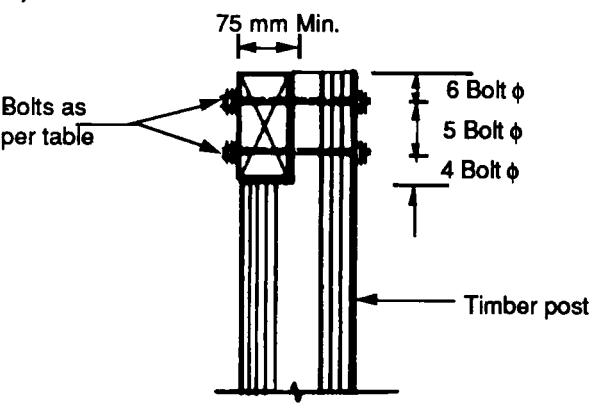
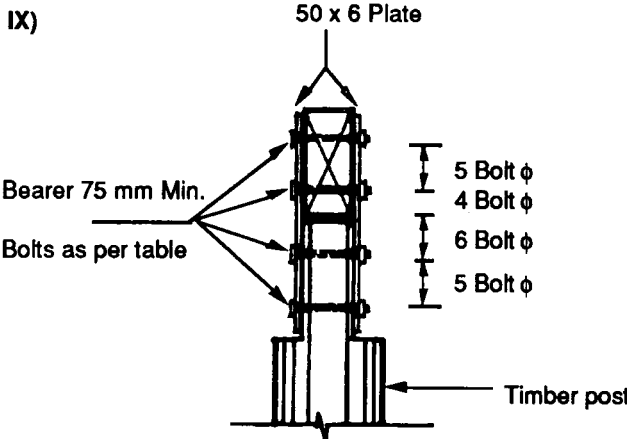
<b>FIGURE B10.5</b>  <b>TIE-DOWN:</b> <b>BEARERS TO STUMPS/PIERS/POSTS</b>		Design Strength (kN)					
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD2	JD3	JD4
<b>I)</b>  <p>75 x 8 MS fishtail plate</p> <p>500 mm</p> <p>M.S. Column</p>	M10	4.7	3.8	2.7	6.0	5.8	4.8
	M12	6.2	5.0	3.6	7.9	7.4	6.2
	M16	8.0	6.4	4.6	10.3	9.6	8.0
	M20	11	9.0	6.4	14.4	13.4	10.4
<b>II)</b>  <p>50 x 6 MS fishtail plate</p> <p>300 mm</p>	M10	7.8	5.0	3.2	9.2	7.0	5.2
	M12	9.2	6.0	3.8	11.2	8.4	6.2
	M16	12.4	8.0	5.0	15	11	8.4
	M20	15.6	10	6.3	19	14	10.4
<b>III)</b>  <p>75 x 8 MS fishtail plate</p> <p>4 bolt <math>\phi</math> 5 bolt <math>\phi</math></p> <p>500 mm for M12 600 mm for M16 &amp; M20</p> <p>M.S. Column</p>	2/M10	9.4	7.6	5.4	12	11.6	9.6
	2/M12	12.4	10	7.2	16	15	12.4
	2/M16	16	12.8	9.2	20.6	19	16
	2/M20	22	17.6	12.8	29	27	14.4
<b>IV)</b>  <p>Note: M12 bolts must not be used where bearer span exceeds 1800 mm</p> <p>500 for M12 600 for M16 750 for M20</p>	M10	11.5	10.6	6.7	11.5	11.5	11.5
	M12	17	16.5	10.5	17	17	17
	M16	32	21.5	14	32	24	17
	M20	22	17.6	13	29	27	21
<b>V)</b>  <p>Bolt</p> <p>Bolt as per table</p> <p>RHS Min 76 x 76 x 0.4</p> <p>90 x 12 MS bar to RHS with 6CFW</p>	M10	11.5	10.6	6.7	11.5	11.5	11.5
	2/M10	23	21	13.4	23	23	23
	M12	17	16.5	10.5	17	17	17
	2/M12	34	33	21	34	34	34
	M16	32	21.5	14	32	24	24
	2/M16	64	45	27.4	64	64	48
	M20	44	28	18	50	42	31
	2/M20	88	56	36	100	85	63

FIGURE B10.5 continued

**TIE-DOWN:  
BEARERS TO STUMPS / PIERS / POSTS**

	Bolts	Design Strength (kN)					
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD2	JD3	JD4
<b>VI)</b> 	2/M12	18.4	12	7.6	22.4	17	12.4
	2/M16	25	16	10	30.4	22.4	17
	2/M20	31	20	12.6	37.6	28	21
<b>VII)</b> 	2/M10	23	23	23	23	23	23
	2/M12	34	34	24	34	34	34
	2/M16	59	37	24	64	53	39
	2/M20	59	37	24	70	53	39
<b>VIII)</b> 	M10	4.7	3.8	2.7	6.0	5.8	4.8
	M12	6.2	5.0	3.6	7.9	7.4	6.2
	M16	8.0	6.4	4.6	10.3	9.6	8.0
	M20	11	8.8	6.4	14.4	13.4	10.4
	2/M10	9.4	7.6	5.4	12	11.6	9.6
	2/M12	12.4	10	7.2	16	15	12.4
	2/M16	16	13	9.2	21	19.2	16
	2/M20	22	17.6	13	29	27	21
<b>IX)</b> 	2/M10	15.6	10	6.4	18.4	14	10.4
	2/M12	18.4	12	7.6	22.4	17	12.4
	2/M16	25	16	10	30.4	22.4	17
	2/M20	31	20	12.6	38	28	21



**Table B10.6.1**

THIS TABLE VALID FOR			
Aspect Ratio ( h/d )	0.25	0.5	1
Roof Pitch ( Degrees )	15, 20, 25	20, 25	25

**UPLIFT FORCES ON JOISTS FOR LOWSET BUILDINGS (kN)**

DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )									
		49	51	53	55	57	60	64	69	74.5	
3000	450	<b>NO UPLIFT</b>							0.04	0.31	0.63
3600									0.05	0.37	0.75
4200									0.05	0.43	0.88
4800									0.06	0.49	1.00

**UPLIFT FORCES ON JOISTS FOR HIGHSET BUILDINGS (kN)**

DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	0.91	1.12	1.34	1.57	1.80	2.17	2.69	3.39	4.22
3600		1.09	1.34	1.61	1.88	2.16	2.60	3.23	4.07	5.07
4200		1.27	1.57	1.87	2.19	2.52	3.04	3.77	4.75	5.91
4800		1.45	1.79	2.14	2.50	2.88	3.47	4.31	5.43	6.76

**Table B10.6.2**

THIS TABLE VALID FOR			
Aspect Ratio ( h/d )	0.25	0.5	1
Roof Pitch ( Degrees )	10	15	20

**UPLIFT FORCES ON JOISTS FOR LOWSET BUILDINGS (kN)**

DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	<b>NO UPLIFT</b>			0.10	0.22	0.42	0.70	1.08	1.53
3600					0.11	0.27	0.51	0.84	1.30	1.83
4200					0.13	0.31	0.59	0.98	1.51	2.14
4800					0.15	0.36	0.67	1.12	1.73	2.44

**UPLIFT FORCES ON JOISTS FOR HIGHSET BUILDINGS (kN)**

DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	1.30	1.54	1.79	2.06	2.33	2.75	3.36	4.16	5.12
3600		1.56	1.85	2.15	2.47	2.79	3.30	4.03	5.00	6.15
4200		1.82	2.16	2.51	2.88	3.26	3.86	4.70	5.83	7.17
4800		2.08	2.46	2.87	3.29	3.72	4.41	5.37	6.66	8.20

**Table B10.6.3**

THIS TABLE VALID FOR		
Aspect Ratio ( h/d )	0.5	1
Roof Pitch ( Degrees )	20, 25	25

**UPLIFT FORCES ON JOISTS FOR LOWSET BUILDINGS (kN)**

DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	0.32	0.49	0.66	0.83	1.01	1.30	1.70	2.24	2.88
3600		0.39	0.58	0.79	1.00	1.21	1.56	2.04	2.68	3.45
4200		0.45	0.68	0.92	1.16	1.42	1.81	2.38	3.13	4.03
4800		0.52	0.78	1.05	1.33	1.62	2.07	2.72	3.58	4.60

**UPLIFT FORCES ON JOISTS FOR HIGHSET BUILDINGS (kN)**

Dimension "A" (mm)	Joist Spacing (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	1.88	2.17	2.48	2.79	3.12	3.63	4.35	5.32	6.47
3600		2.26	2.61	2.97	3.35	3.74	4.35	5.22	6.39	7.77
4200		2.63	3.04	3.47	3.91	4.36	5.08	6.09	7.45	9.06
4800		3.01	3.48	3.96	4.46	4.99	5.81	6.96	8.51	10.36

**Table B10.6.4**

THIS TABLE VALID FOR	
Aspect Ratio ( h/d )	1
Roof Pitch ( Degrees )	10

**UPLIFT FORCES ON JOISTS FOR LOWSET BUILDINGS (kN)**

DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	0.91	1.12	1.34	1.57	1.80	2.17	2.69	3.39	4.22
3600		1.09	1.34	1.61	1.88	2.16	2.60	3.23	4.07	5.07
4200		1.27	1.57	1.87	2.19	2.52	3.04	3.77	4.75	5.91
4800		1.45	1.79	2.14	2.50	2.88	3.47	4.31	5.43	6.76

**UPLIFT FORCES ON JOISTS FOR HIGHSET BUILDINGS (kN)**

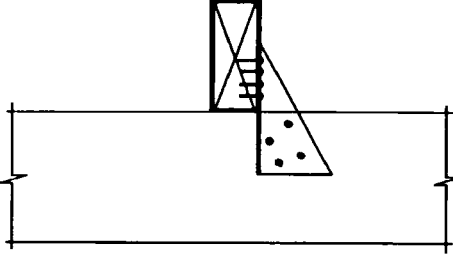
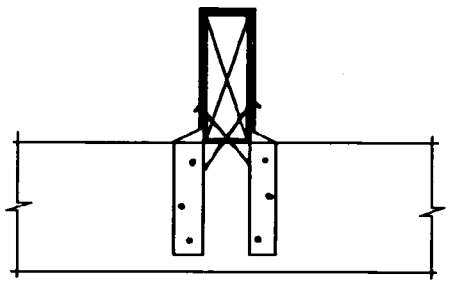
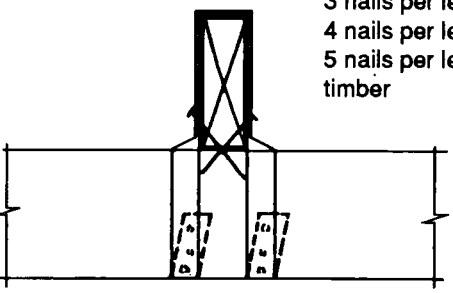
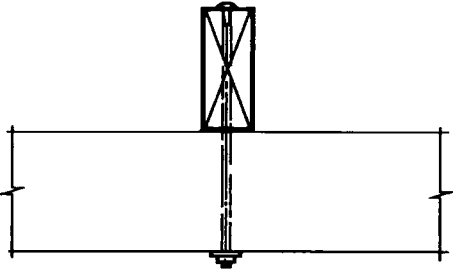
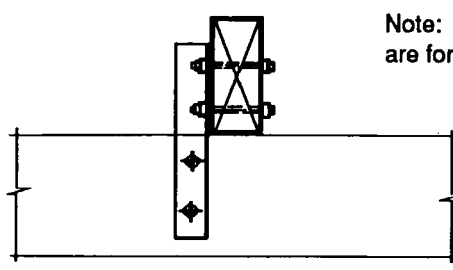
DIMENSION "A" (mm)	JOIST SPACING (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
3000	450	2.46	2.80	3.16	3.53	3.91	4.50	5.35	6.48	7.82
3600		2.96	3.37	3.79	4.23	4.69	5.40	6.42	7.77	9.39
4200		3.45	3.93	4.42	4.94	5.47	6.31	7.49	9.07	10.95
4800		3.94	4.49	5.05	5.64	6.25	7.21	8.56	10.37	12.51

**FIGURE B10.6**

**TIE-DOWN:  
FLOOR JOISTS TO BEARERS**

**Design Strength (kN)**

Unseasoned Timber      Seasoned Timber

		Design Strength (kN)					
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD2	JD3	JD4
<b>I)</b>  <p>No. Framing Anchors</p> <p>1 framing anchor with 4/3.15 φ nails each leg</p>	1	3.7	2.6	1.9	4.7	3.7	2.6
	2	6.2	4.4	3.1	8.6	6.8	4.8
	4	11.4	8.1	5.8	16.4	13	9.2
<b>II)</b>  <p>30 x 0.8 strap with 3/3.15 φ nails each end</p>	No. of straps						
	1	4.9	3.5	2.5	6.6	5.2	3.7
	2	8.8	6.3	4.4	12.6	10	7.0
<b>III)</b>  <p>3 nails per leg for J2 timber 4 nails per leg for J3 &amp; JD4 timber 5 nails per leg for J4, JD5 &amp; JD6 timber</p> <p>30 x 0.8 G.I. strap 3.15 φ nails</p>		7.2	7.2	7.2	7.2	7.2	7.2
<b>IV)</b>  <p>M10 cuphead bolt</p> <p>Note: Joist to be 45 mm minimum width</p>		8.6	5.6	3.5	11.3	8.4	6.2
<b>V)</b>  <p>Note: These design strengths are for 50 mm wide joists.</p> <p>50 x 50 x 4MS angle with bolts each end as per table</p>	2/M10	9.5	7.5	5.0	12	10.6	8.0
	2/M12	12.5	9.5	6.0	16	13	9.6

**Table B10.8.1**

THIS TABLE VALID FOR			
Aspect Ratio ( h/d )	0.25	0.5	1
Roof Pitch ( Degrees )	15, 20, 25	20, 25	25

**UPLIFT FORCES ON RAFTERS (kN)**

Dimension "A" (mm)	Rafter Spacing (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
1800	900	1.38	1.54	1.70	1.87	2.04	2.31	2.70	3.22	3.83
	1200	1.84	2.05	2.26	2.49	2.72	3.08	3.60	4.29	5.11
	1500	2.30	2.56	2.83	3.11	3.40	3.86	4.50	5.36	6.38
2400	900	1.84	2.05	2.26	2.49	2.72	3.08	3.60	4.29	5.11
	1200	2.46	2.73	3.02	3.32	3.63	4.11	4.80	5.72	6.81
	1500	3.07	3.41	3.77	4.15	4.53	5.14	6.00	7.15	8.51
3000	900	2.30	2.56	2.83	3.11	3.40	3.86	4.50	5.36	6.38
	1200	3.07	3.41	3.77	4.15	4.53	5.14	6.00	7.15	8.51
	1500	3.84	4.27	4.72	5.18	5.67	6.43	7.50	8.93	10.64
3600	900	2.76	3.07	3.40	3.73	4.08	4.63	5.40	6.43	7.66
	1200	3.68	4.10	4.53	4.98	5.44	6.17	7.20	8.58	10.21
	1500	4.60	5.12	5.66	6.22	6.80	7.71	9.00	10.72	12.77
4200	900	3.22	3.59	3.96	4.35	4.76	5.40	6.30	7.50	8.94
	1200	4.30	4.78	5.28	5.81	6.35	7.20	8.40	10.01	11.92
	1500	5.37	5.98	6.60	7.26	7.93	9.00	10.50	12.51	14.89
4800	900	3.68	4.10	4.53	4.98	5.44	6.17	7.20	8.58	10.21
	1200	4.91	5.46	6.04	6.64	7.25	8.23	9.60	11.44	13.62
	1500	6.14	6.83	7.55	8.29	9.07	10.28	12.00	14.29	17.02

Note: Tie-down over internal walls must be taken directly to floor frame or concrete slab.

**Table B10.8.2**

THIS TABLE VALID FOR			
Aspect Ratio ( h/d )	0.25	0.5	1
Roof Pitch ( Degrees )	10	15	20

**UPLIFT FORCES ON RAFTERS (kN)**

Dimension "A" (mm)	Rafter Spacing (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
1800	900	1.85	2.04	2.24	2.45	2.67	3.01	3.50	4.14	4.91
	1200	2.46	2.72	2.99	3.27	3.56	4.02	4.66	5.52	6.55
	1500	3.08	3.40	3.74	4.09	4.45	5.02	5.83	6.90	8.18
2400	900	2.46	2.72	2.99	3.27	3.56	4.02	4.66	5.52	6.55
	1200	3.28	3.63	3.99	4.36	4.75	5.36	6.21	7.36	8.73
	1500	4.11	4.54	4.99	5.45	5.94	6.70	7.77	9.20	10.91
3000	900	3.08	3.40	3.74	4.09	4.45	5.02	5.83	6.90	8.18
	1200	4.11	4.54	4.99	5.45	5.94	6.70	7.77	9.20	10.91
	1500	5.13	5.67	6.23	6.82	7.42	8.37	9.71	11.50	13.64
3600	900	3.70	4.08	4.49	4.91	5.34	6.03	6.99	8.28	9.82
	1200	4.93	5.45	5.98	6.54	7.13	8.04	9.32	11.04	13.09
	1500	6.16	6.81	7.48	8.18	8.91	10.04	11.65	13.81	16.36
4200	900	4.31	4.77	5.24	5.73	6.23	7.03	8.16	9.66	11.45
	1200	5.75	6.35	6.98	7.64	8.31	9.37	10.87	12.89	15.27
	1500	7.19	7.94	8.73	9.54	10.39	11.72	13.59	16.11	19.09
4800	900	4.93	5.45	5.98	6.54	7.13	8.04	9.32	11.04	13.09
	1200	6.57	7.26	7.98	8.73	9.50	10.71	12.43	14.73	17.45
	1500	8.21	9.08	9.97	10.91	11.88	13.39	15.53	18.41	21.82

Note: Tie-down over internal walls must be taken directly to floor frame or concrete slab.

**Table B10.8.3**

THIS TABLE VALID FOR		
Aspect Ratio ( h/d )	0.5	1
Roof Pitch ( Degrees )	10	15

**UPLIFT FORCES ON RAFTERS (kN)**

Dimension "A" (mm)	Rafter Spacing (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
1800	900	2.55	2.80	3.06	3.34	3.62	4.06	4.69	5.53	6.53
	1200	3.40	3.73	4.08	4.45	4.83	5.42	6.25	7.37	8.70
	1500	4.25	4.67	5.11	5.56	6.03	6.77	7.82	9.22	10.88
2400	900	3.40	3.73	4.08	4.45	4.83	5.42	6.25	7.37	8.70
	1200	4.53	4.98	5.45	5.93	6.43	7.22	8.34	9.83	11.60
	1500	5.66	6.22	6.81	7.41	8.04	9.03	10.42	12.29	14.51
3000	900	4.25	4.67	5.11	5.56	6.03	6.77	7.82	9.22	10.88
	1200	5.66	6.22	6.81	7.41	8.04	9.03	10.42	12.29	14.51
	1500	7.08	7.78	8.51	9.27	10.05	11.29	13.03	15.36	18.13
3600	900	5.10	5.60	6.13	6.67	7.24	8.13	9.38	11.06	13.05
	1200	6.79	7.47	8.17	8.90	9.65	10.83	12.51	14.75	17.41
	1500	8.49	9.34	10.21	11.12	12.06	13.54	15.63	18.43	21.76
4200	900	5.95	6.53	7.15	7.78	8.45	9.48	10.94	12.90	15.23
	1200	7.93	8.71	9.53	10.38	11.26	12.64	14.59	17.20	20.31
	1500	9.91	10.89	11.91	12.97	14.08	15.80	18.24	21.51	25.38
4800	900	6.79	7.47	8.17	8.90	9.65	10.83	12.51	14.75	17.41
	1200	9.06	9.96	10.89	11.86	12.87	14.45	16.67	19.66	23.21
	1500	11.32	12.45	13.62	14.83	16.09	18.06	20.84	24.58	29.01

Note: Tie-down over internal walls must be taken directly to floor frame or concrete slab.

**Table B10.8.4**

THIS TABLE VALID FOR	
Aspect Ratio ( h/d )	1
Roof Pitch ( Degrees )	10

**UPLIFT FORCES ON RAFTERS (kN)**

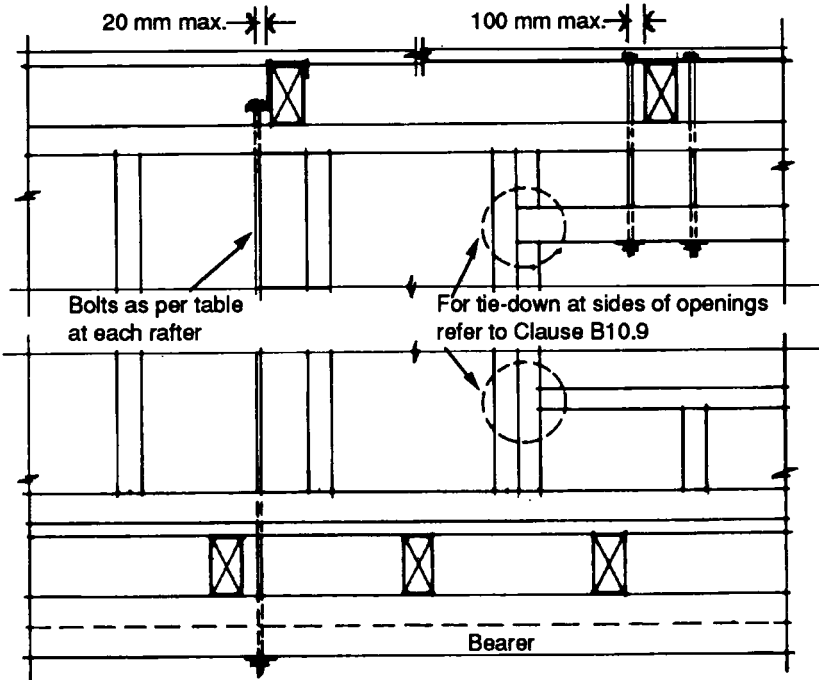
Dimension "A" (mm)	Rafter Spacing (mm)	DESIGN WINDSPEED ( m/s )								
		49	51	53	55	57	60	64	69	74.5
1800	900	3.25	3.56	3.88	4.22	4.57	5.11	5.88	6.92	8.15
	1200	4.33	4.75	5.18	5.62	6.09	6.82	7.85	9.22	10.86
	1500	5.41	5.93	6.47	7.03	7.61	8.52	9.81	11.53	13.58
2400	900	4.33	4.75	5.18	5.62	6.09	6.82	7.85	9.22	10.86
	1200	5.77	6.33	6.90	7.50	8.12	9.09	10.46	12.30	14.48
	1500	7.22	7.91	8.63	9.37	10.15	11.36	13.08	15.37	18.10
3000	900	5.41	5.93	6.47	7.03	7.61	8.52	9.81	11.53	13.58
	1200	7.22	7.91	8.63	9.37	10.15	11.36	13.08	15.37	18.10
	1500	9.02	9.89	10.78	11.72	12.69	14.20	16.34	19.22	22.63
3600	900	6.50	7.12	7.77	8.44	9.13	10.23	11.77	13.84	16.29
	1200	8.66	9.49	10.35	11.25	12.18	13.63	15.69	18.45	21.72
	1500	10.83	11.86	12.94	14.06	15.22	17.04	19.61	23.06	27.15
4200	900	7.58	8.30	9.06	9.84	10.66	11.93	13.73	16.14	19.01
	1200	10.10	11.07	12.08	13.12	14.21	15.91	18.31	21.52	25.34
	1500	12.63	13.84	15.10	16.41	17.76	19.88	22.88	26.90	31.68
4800	900	8.66	9.49	10.35	11.25	12.18	13.63	15.69	18.45	21.72
	1200	11.55	12.65	13.80	15.00	16.24	18.18	20.92	24.60	28.96
	1500	14.44	15.82	17.26	18.75	20.30	22.72	26.15	30.75	36.20

Note: Tie-down over internal walls must be taken directly to floor frame or concrete slab.

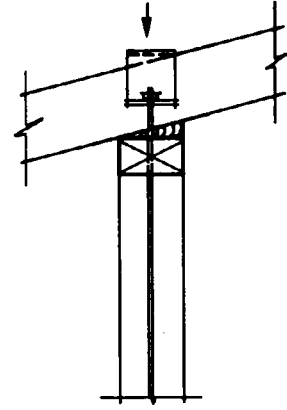
**FIGURE B10.8 (A)**

**TIE-DOWN: RAFTERS OR TRUSSES TO WALL FRAME/FLOOR FRAME/OR SLAB**

Bolts	Design Strength (kN)					
	Unseasoned Timber			Seasoned Timber		
	J2	J3	J4	JD2	JD3	JD4
M10	11.5	10.6	6.7	11.5	11.5	11.5
M12	17	16.5	10.5	17	17	17
M16	32	22	14	32	32	24
2/M10	23	21	13.4	23	23	23
2/M12	34	33	21	34	34	34



75 wide x 8 MS bracket



76 x 38 x 6.0 MS angle

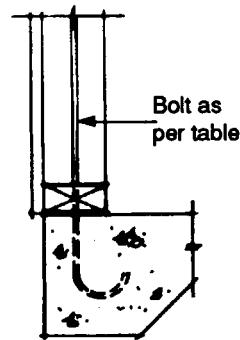
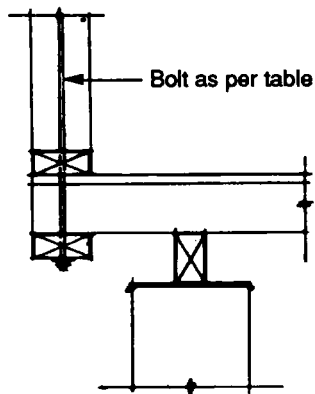
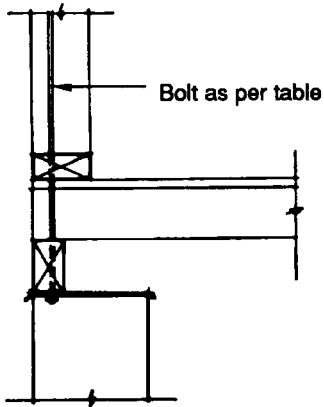
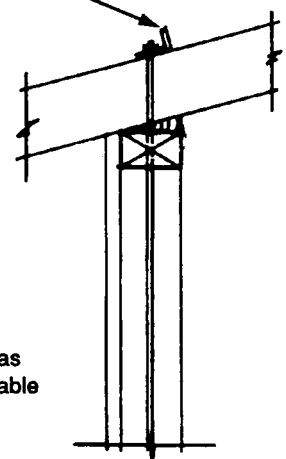




FIGURE B10.8 (B)  TIE-DOWN: RAFTER OR TRUSSES TO WALL FRAME/FLOOR FRAME/SLAB	Design Strength (kN)					
	Unseasoned Timber			Seasoned Timber		
	J2	J3	J4	JD2	JD3	JD4
30 x 0.8 G.I. Strap 3/3.15 $\phi$ nails each end 30 x 0.8 G.I. Strap 4/3.15 $\phi$ nails each end	4.9 6.2	3.5 4.4	2.5 3.1	6.6 8.6	5.2 6.8	3.7 4.8
1 Framing Anchor 4/3.15 $\phi$ nails each end 2 Framing Anchors 4/3.15 $\phi$ nails each end	3.7 6.2	2.6 4.4	1.9 3.1	4.7 8.6	3.7 6.8	2.6 4.8
* M10 Cuphead bolt	8.6	5.6	3.5	11.3	8.4	6.2
* M10 bolt	11.5	10.6	6.7	11.5	11.5	11.5
*M12 bolt	17	16.5	10.5	17	17	17
30x0.8 G.I. Looped Strap-nails required each end are: 3/3.15 $\phi$ for J2, JD2, JD3, 4/3.15 $\phi$ for J3 & JD4, 5/3.15 $\phi$ for J4	7.2	7.2	7.2	7.2	7.2	7.2
<p>* Note : Metal straps tying studs to plate may limit strength of tie-down</p>						

**FIGURE B10.8 (C)**

**TIE-DOWN: RAFTERS OR TRUSSES TO ROOF BEAMS, LINTELS, VERANDAH BEAMS AND INTERNAL WALLS**

**Design Strength (kN)**

Unseasoned Timber      Seasoned Timber

J2   J3   J4   JD2   JD3   JD4

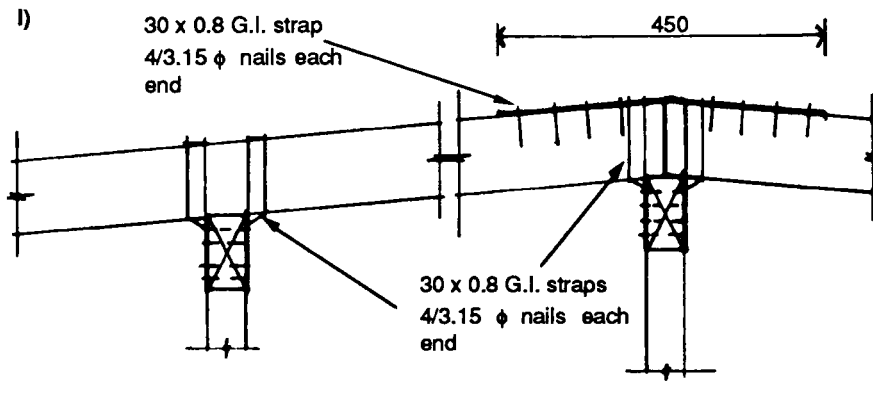
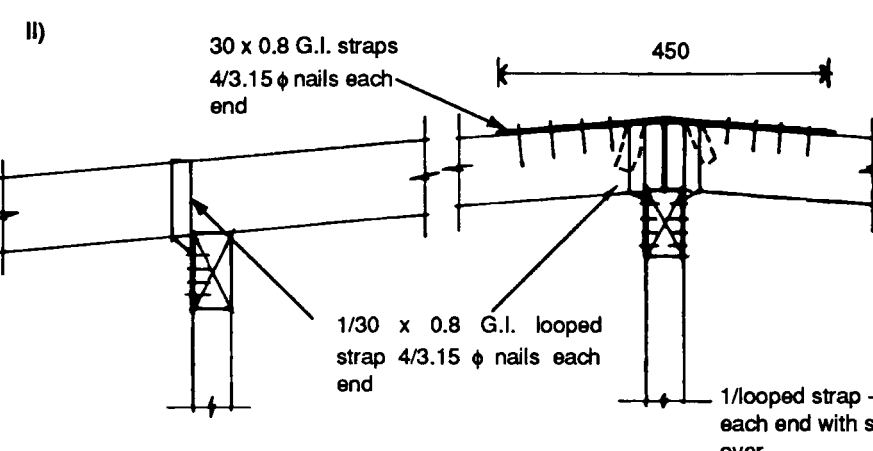
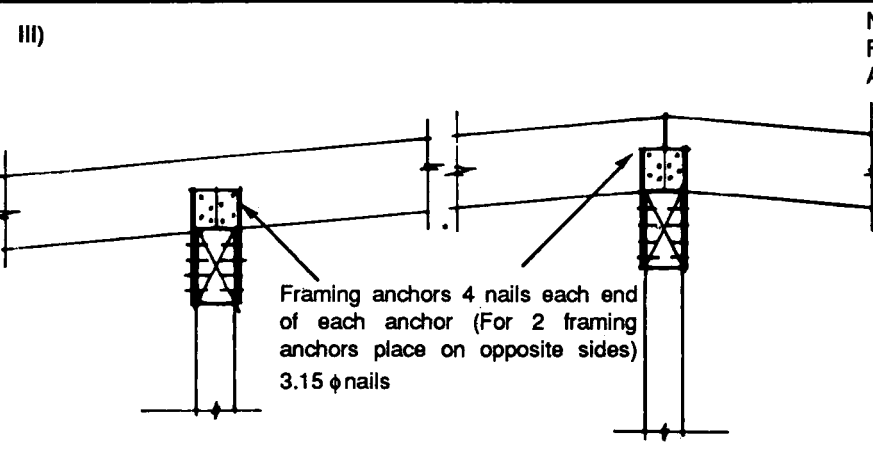
		Design Strength (kN)					
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD2	JD3	JD4
<p>I)</p>  <p>30 x 0.8 G.I. strap 4/3.15 <math>\phi</math> nails each end</p> <p>30 x 0.8 G.I. straps 4/3.15 <math>\phi</math> nails each end</p>	No. of Straps						
	1	6.2	4.4	3.0	8.6	7.0	4.8
	2	11.4	8.0	5.8	16.4	13	9.2
<p>II)</p>  <p>30 x 0.8 G.I. straps 4/3.15 <math>\phi</math> nails each end</p> <p>1/30 x 0.8 G.I. looped strap 4/3.15 <math>\phi</math> nails each end</p> <p>1/looped strap - 4 nails each end with strap over</p>							
		7.2	7.2	7.2	7.2	7.2	7.2
<p>III)</p>  <p>Framing anchors 4 nails each end of each anchor (For 2 framing anchors place on opposite sides) 3.15 <math>\phi</math> nails</p>	No. of Framing Anchors						
	2	6.2	4.4	3.0	8.6	7.0	4.8
	4	11.4	8.0	5.8	16.4	13	9.2

FIGURE B10.8 (C) continued

TIE-DOWN: RAFTERS OR TRUSSES TO ROOF BEAMS, LINTELS, VERANDAH BEAMS AND INTERNAL WALLS

Design Strength (kN)

Unseasoned Timber			Seasoned Timber		
J2	J3	J4	JD2	JD3	JD4

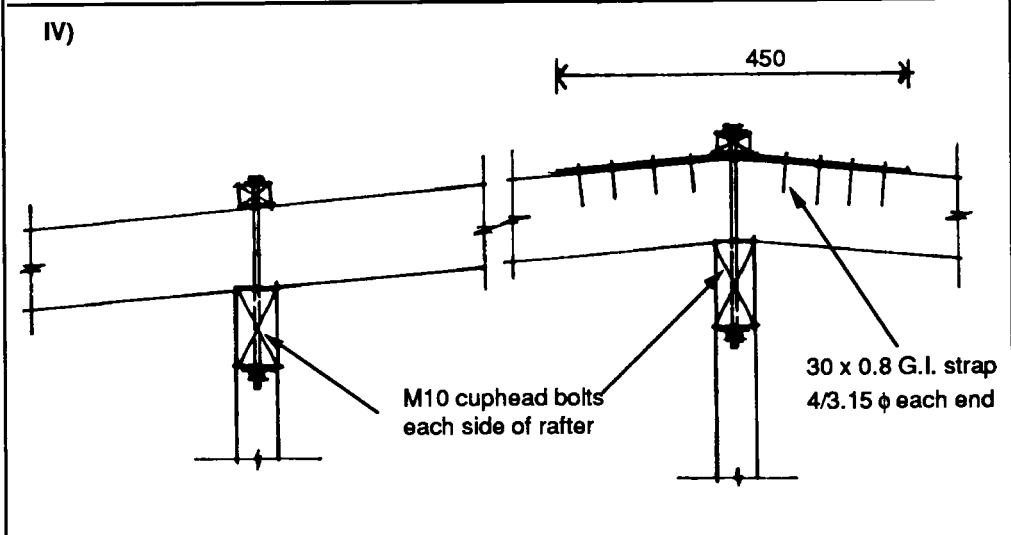
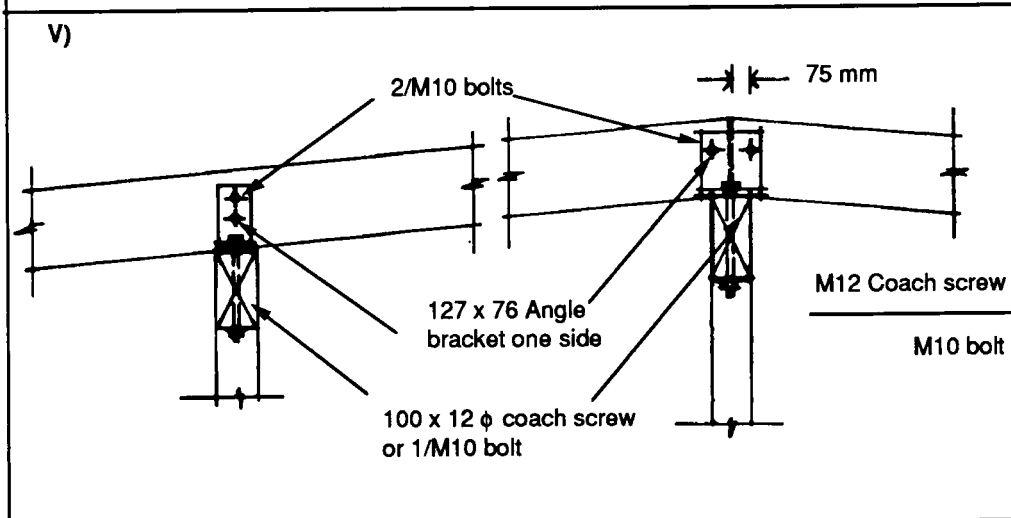
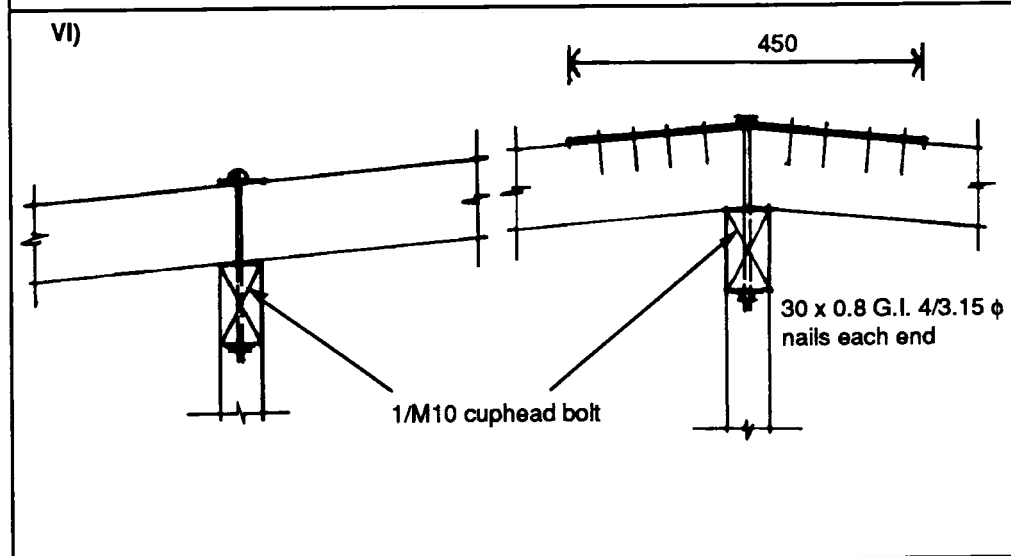
<p>IV)</p> 	17	11	7.0	22.6	17	12.4
<p>V)</p> 	8.2	6.0	4.0	10	7.5	5.1
<p>VI)</p> 	8.8	5.6	3.5	11.3	8.4	6.2

FIGURE B10.8 (C) continued

TIE-DOWN: RAFTERS OR TRUSSES TO ROOF BEAMS, LINTELS, VERANDAH BEAMS AND INTERNAL WALLS

Design Strength (kN)

Unseasoned Timber

Seasoned Timber

J2

J3

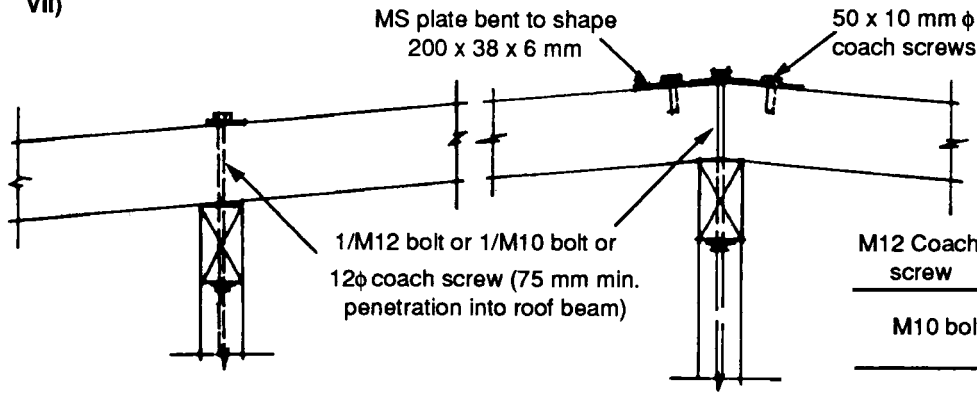
J4

JD2

JD3

JD4

VII)



M12 Coach screw

M10 bolt

M12 bolt

8.4

6.7

3.6

6.7

4.3

2.8

11.5

10.6

6.7

11.5

11.5

11.5

17

16.5

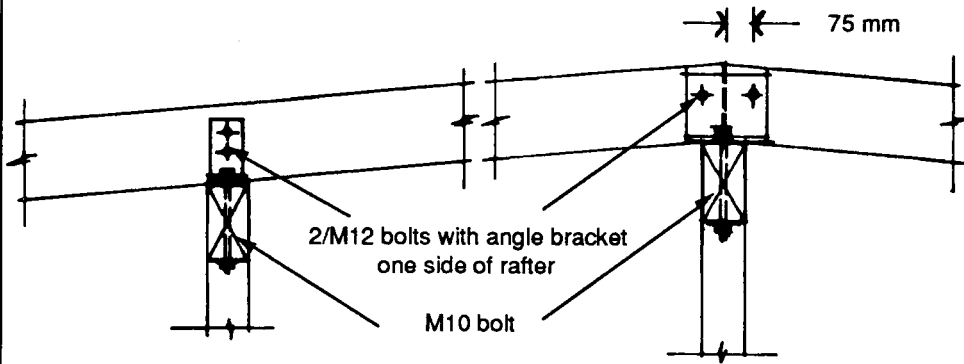
10.5

17

17

17

VIII)



10.4

8.0

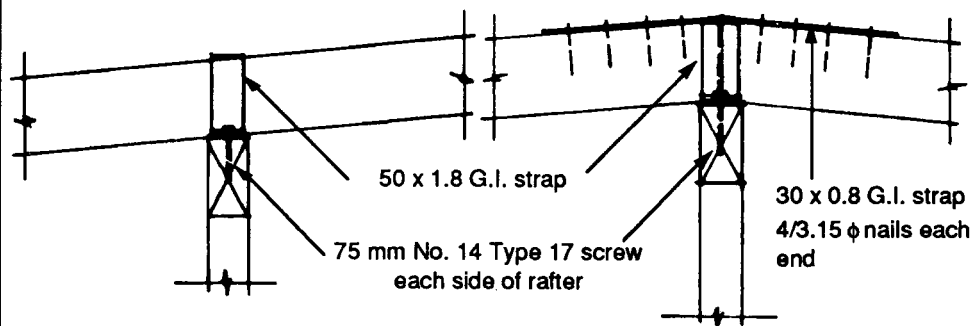
5.0

11.5

11

8.0

IX)



7.0

5.0

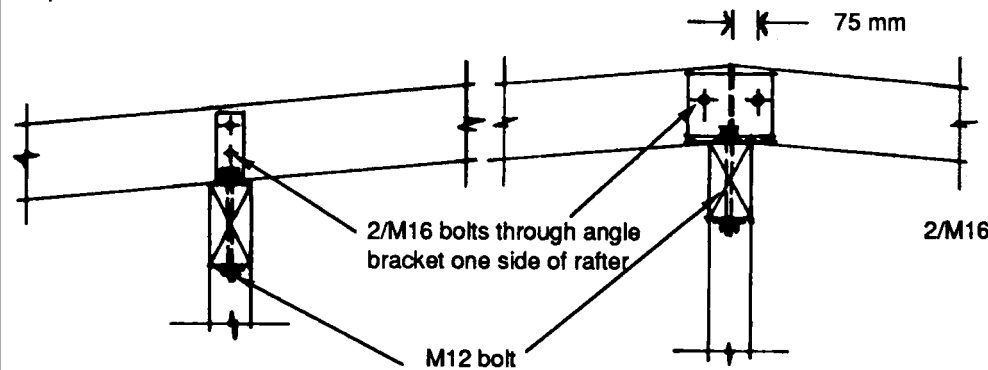
3.6

8.5

6.1

5.0

X)



2/M16

16

13

9.0

17

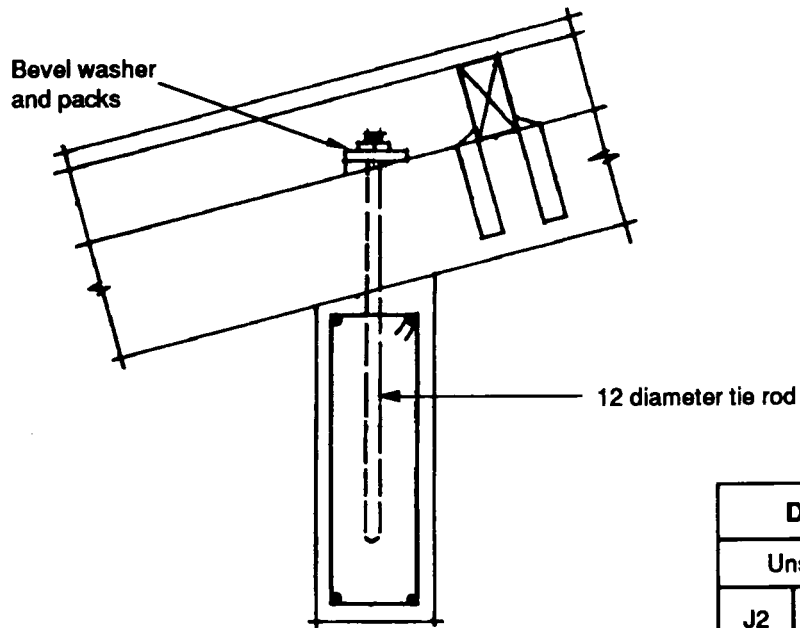
17

16

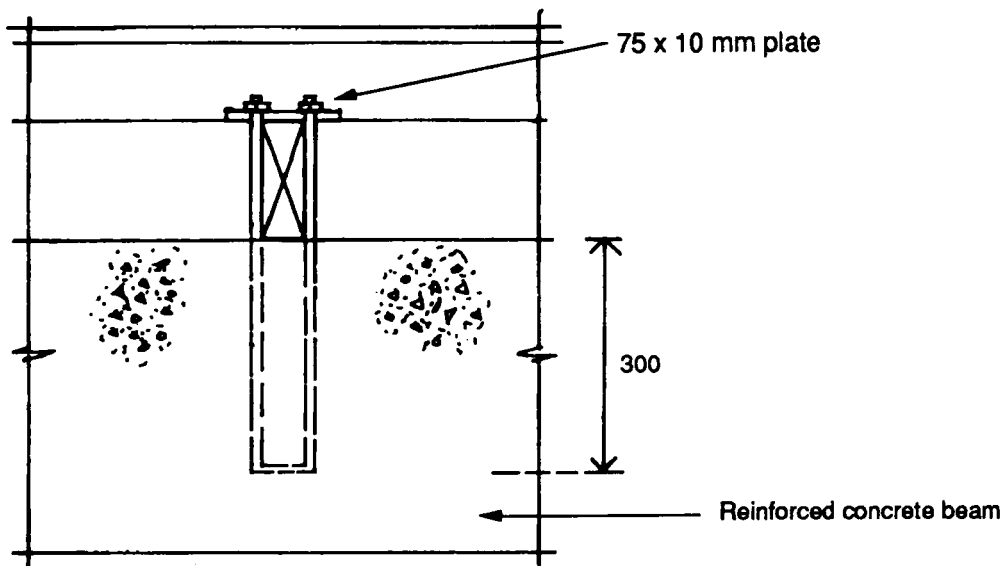
FIGURE B10.8 (C) continued

TIE-DOWN OF RAFTER TO MASONRY WALL

XI)

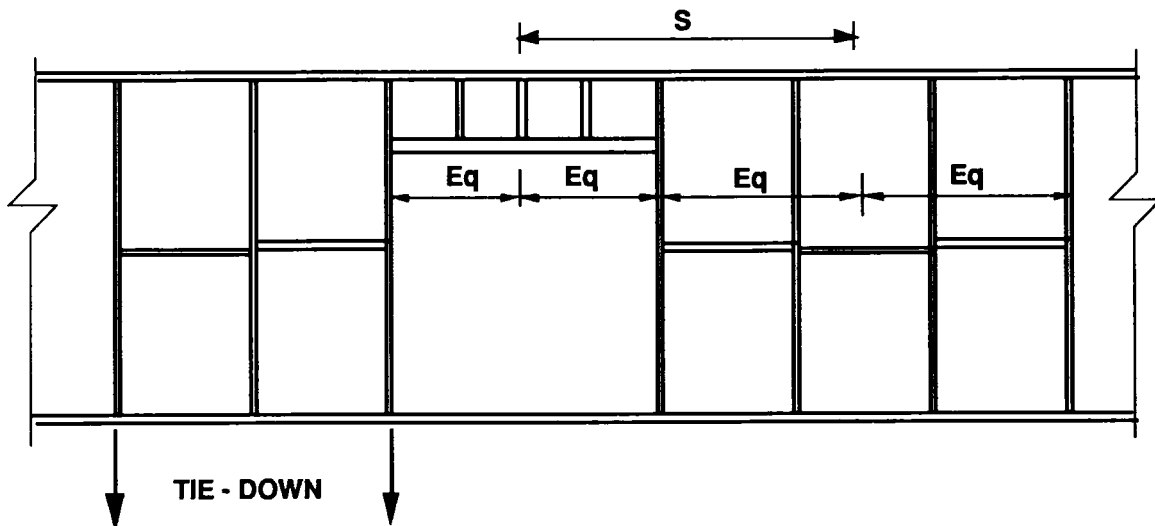


	Design Strength (kN)					
	Unseasoned			Seasoned		
	J2	J3	J4	JD2	JD3	JD4
2/M10	23	21	13.4	23	23	23
2/M12	34	33	21	34	34	34

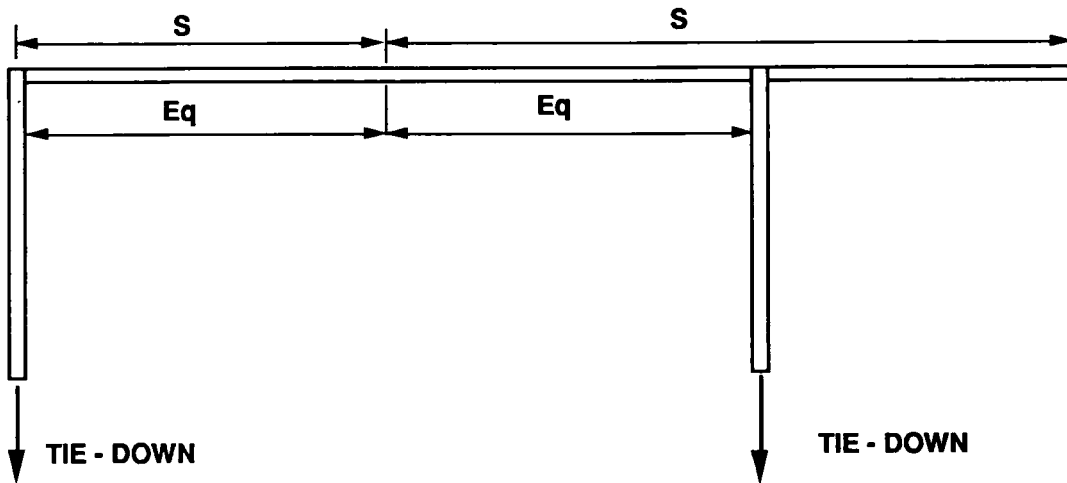


**FIGURE B10.9 (A)**

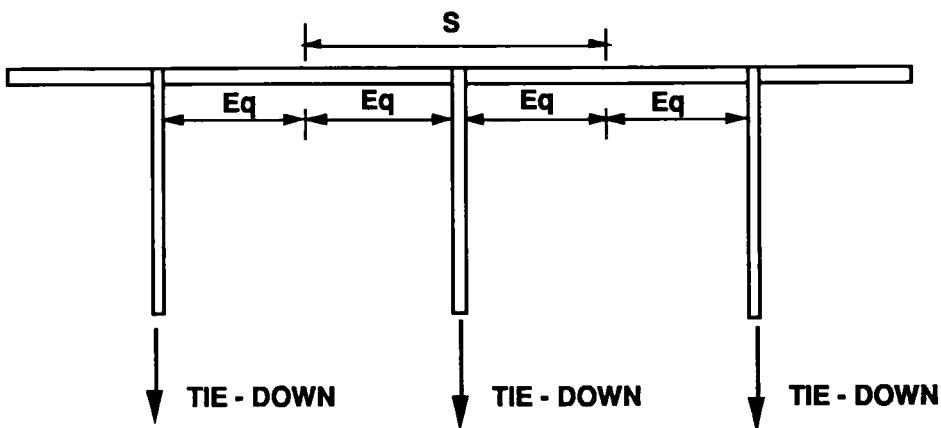
**DIMENSION "S" FOR ROOF BEAMS, LINTELS, AND VERANDAH BEAMS**



**( I ) TIE - DOWN AT JAMB STUDS**



**( II ) TIE - DOWN OF ROOF BEAMS AND VERANDAH BEAMS**



**( III ) TIE - DOWN FOR CONTINUOUS SPANS**

**Note:** Dimension 'A' is at right angles to dimension 'S' and the method of measurement is shown in Figure B10.3(A)

**Table B10.9.1**

THIS TABLE IS VALID FOR			
Aspect Ratio ( h/d )	0.25	0.5	1
Roof Pitch ( Degrees )	15, 20, 25	20, 25	25

AREA OF ROOF TO BE TIED DOWN DIMENSION "A" x DIMENSION "S"	UPLIFT FORCES ON ROOF BEAMS, LINTELS, AND VERANDAH PLATES								
	DESIGN WINDSPEED ( m/s )								
	49	51	53	55	57	60	64	69	74.5
1	0.85	0.95	1.05	1.15	1.26	1.43	1.67	1.99	2.36
1.5	1.28	1.42	1.57	1.73	1.89	2.14	2.50	2.98	3.55
2	1.70	1.90	2.10	2.30	2.52	2.86	3.33	3.97	4.73
2.5	2.13	2.37	2.62	2.88	3.15	3.57	4.17	4.96	5.91
3	2.56	2.85	3.14	3.46	3.78	4.28	5.00	5.96	7.09
4	3.41	3.79	4.19	4.61	5.04	5.71	6.66	7.94	9.46
5	4.26	4.74	5.24	5.76	6.30	7.14	8.33	9.93	11.82
6	5.11	5.69	6.29	6.91	7.56	8.57	10.00	11.91	14.18
7	5.97	6.64	7.34	8.06	8.82	10.00	11.66	13.90	16.55
8	6.82	7.59	8.39	9.22	10.08	11.42	13.33	15.88	18.91
9	7.67	8.54	9.43	10.37	11.34	12.85	14.99	17.87	21.28
10	8.52	9.48	10.48	11.52	12.60	14.28	16.66	19.85	23.64
11	9.38	10.43	11.53	12.67	13.85	15.71	18.33	21.84	26.01
12	10.23	11.38	12.58	13.82	15.11	17.14	19.99	23.82	28.37

**Table B10.9.2**

THIS TABLE IS VALID FOR			
Aspect Ratio ( h/d )	0.25	0.5	1
Roof Pitch ( Degrees )	10	15	20

AREA OF ROOF TO BE TIED DOWN DIMENSION "A" x DIMENSION "S"	UPLIFT FORCES ON ROOF BEAMS, LINTELS, AND VERANDAH PLATES								
	DESIGN WINDSPEED ( m/s )								
	49	51	53	55	57	60	64	69	74.5
1	1.14	1.26	1.39	1.52	1.65	1.86	2.16	2.56	3.03
1.5	1.71	1.89	2.08	2.27	2.47	2.79	3.24	3.83	4.55
2	2.28	2.52	2.77	3.03	3.30	3.72	4.32	5.11	6.06
2.5	2.85	3.15	3.46	3.79	4.12	4.65	5.39	6.39	7.58
3	3.42	3.78	4.16	4.55	4.95	5.58	6.47	7.67	9.09
4	4.56	5.04	5.54	6.06	6.60	7.44	8.63	10.23	12.12
5	5.70	6.30	6.93	7.58	8.25	9.30	10.79	12.78	15.15
6	6.84	7.56	8.31	9.09	9.90	11.16	12.95	15.34	18.18
7	7.98	8.82	9.70	10.61	11.55	13.02	15.10	17.90	21.21
8	9.12	10.08	11.08	12.12	13.20	14.88	17.26	20.45	24.24
9	10.27	11.35	12.47	13.64	14.84	16.74	19.42	23.01	27.27
10	11.41	12.61	13.85	15.15	16.49	18.60	21.58	25.57	30.30
11	12.55	13.87	15.24	16.67	18.14	20.46	23.73	28.12	33.33
12	13.69	15.13	16.62	18.18	19.79	22.32	25.89	30.68	36.36

**Table B10.9.3**

<b>THIS TABLE IS VALID FOR</b>		
Aspect Ratio ( h/d )	0.5	1
Roof Pitch ( Degrees )	10	15

AREA OF ROOF TO BE TIED DOWN DIMENSION " A " x DIMENSION " S "	<b>UPLIFT FORCES ON ROOF BEAMS, LINTELS, AND VERANDAH PLATES</b>								
	DESIGN WINDSPEED ( m/s )								
	49	51	53	55	57	60	64	69	74.5
1	1.57	1.73	1.89	2.06	2.23	2.51	2.89	3.41	4.03
1.5	2.36	2.59	2.84	3.09	3.35	3.76	4.34	5.12	6.04
2	3.15	3.46	3.78	4.12	4.47	5.02	5.79	6.83	8.06
2.5	3.93	4.32	4.73	5.15	5.59	6.27	7.24	8.53	10.07
3	4.72	5.19	5.67	6.18	6.70	7.52	8.68	10.24	12.09
4	6.29	6.92	7.56	8.24	8.94	10.03	11.58	13.65	16.12
5	7.86	8.64	9.46	10.30	11.17	12.54	14.47	17.07	20.15
6	9.44	10.37	11.35	12.36	13.41	15.05	17.37	20.48	24.18
7	11.01	12.10	13.24	14.42	15.64	17.56	20.26	23.90	28.20
8	12.58	13.83	15.13	16.48	17.87	20.06	23.16	27.31	32.23
9	14.16	15.56	17.02	18.54	20.11	22.57	26.05	30.72	36.26
10	15.73	17.29	18.91	20.60	22.34	25.08	28.95	34.14	40.29
11	17.30	19.02	20.80	22.65	24.58	27.59	31.84	37.55	44.32
12	18.87	20.75	22.69	24.71	26.81	30.10	34.74	40.96	48.35

**Table B10.9.4**

<b>THIS TABLE IS VALID FOR</b>	
Aspect Ratio ( h/d )	1
Roof Pitch ( Degrees )	10

AREA OF ROOF TO BE TIED DOWN DIMENSION " A " x DIMENSION " S "	<b>UPLIFT FORCES ON ROOF BEAMS, LINTELS, AND VERANDAH PLATES</b>								
	DESIGN WINDSPEED ( m/s )								
	49	51	53	55	57	60	64	69	74.5
1	2.00	2.20	2.40	2.60	2.82	3.16	3.63	4.27	5.03
1.5	3.01	3.30	3.59	3.91	4.23	4.73	5.45	6.41	7.54
2	4.01	4.39	4.79	5.21	5.64	6.31	7.26	8.54	10.06
2.5	5.01	5.49	5.99	6.51	7.05	7.89	9.08	10.68	12.57
3	6.01	6.59	7.19	7.81	8.46	9.47	10.90	12.81	15.08
4	8.02	8.79	9.59	10.42	11.28	12.62	14.53	17.08	20.11
5	10.02	10.98	11.98	13.02	14.10	15.78	18.16	21.35	25.14
6	12.03	13.18	14.38	15.62	16.91	18.94	21.79	25.62	30.17
7	14.03	15.38	16.78	18.23	19.73	22.09	25.43	29.89	35.20
8	16.04	17.58	19.17	20.83	22.55	25.25	29.06	34.16	40.23
9	18.04	19.77	21.57	23.44	25.37	28.40	32.69	38.44	45.25
10	20.05	21.97	23.97	26.04	28.19	31.56	36.32	42.71	50.28
11	22.05	24.17	26.36	28.64	31.01	34.72	39.95	46.98	55.31
12	24.06	26.36	28.76	31.25	33.83	37.87	43.59	51.25	60.34



FIGURE B10.9 (B)  TIE-DOWN: LINTELS		Design Strength (kN)						
		Unseasoned Timber			Seasoned Timber			
		J2	J3	J4	JD2	JD3	JD4	
I)		4 nails each end of strap	6.2	4.4	3.1	8.6	6.8	4.8
		6 nails each end of strap	8.8	6.3	4.4	12.6	10	7.0
II)		4 nails each end of strap	11.4	8.1	5.8	16.4	13	9.2
		(M10 Bolt)	11.5	10.6	6.7	11.5	11.5	11.5
		6 nails each end of strap	16.6	12	8.4	24	19	13.5
		(M12 Bolt)	17	16.5	10.5	17	17	17
III)		Bolt Size						
		M10	11.5	10.6	6.7	11.5	11.5	11.5
		M12	17	16.5	10.5	17	17	17
		M16	32	21.5	14	32	32	24
		M20	44	28	18	50	42	31

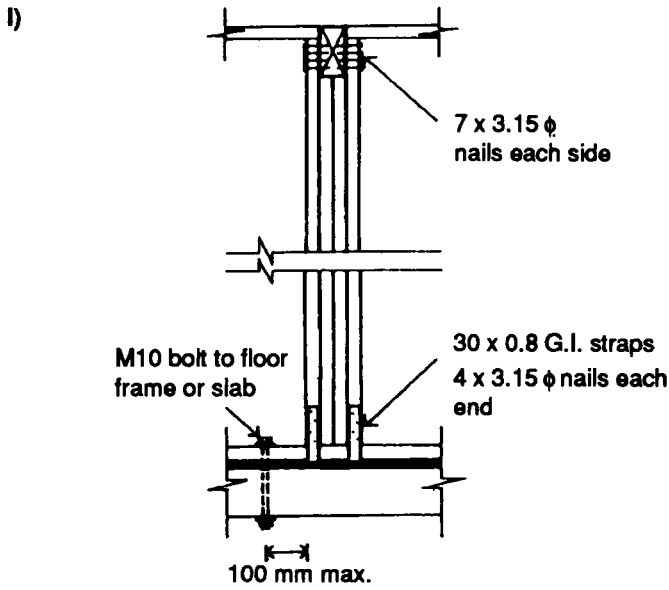
**FIGURE B10.9 (C)**

**TIE-DOWN: ROOF BEAMS**

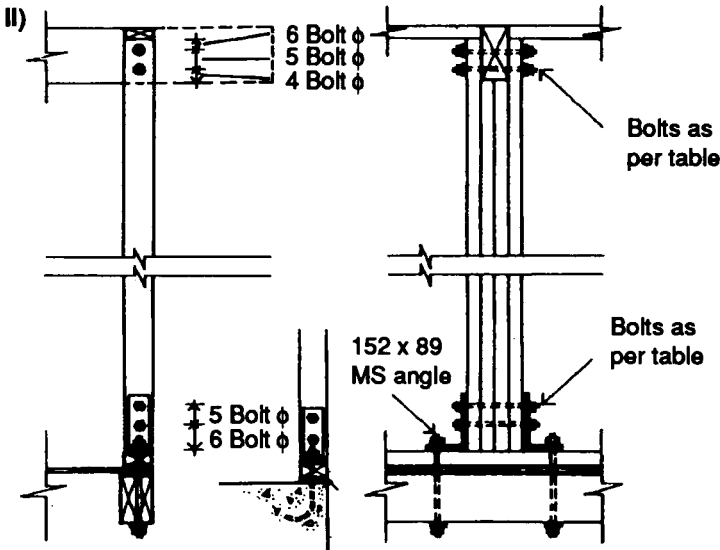
**Design Strength (kN)**

Unseasoned Timber      Seasoned Timber

J2    J3    J4    JD2    JD3    JD4

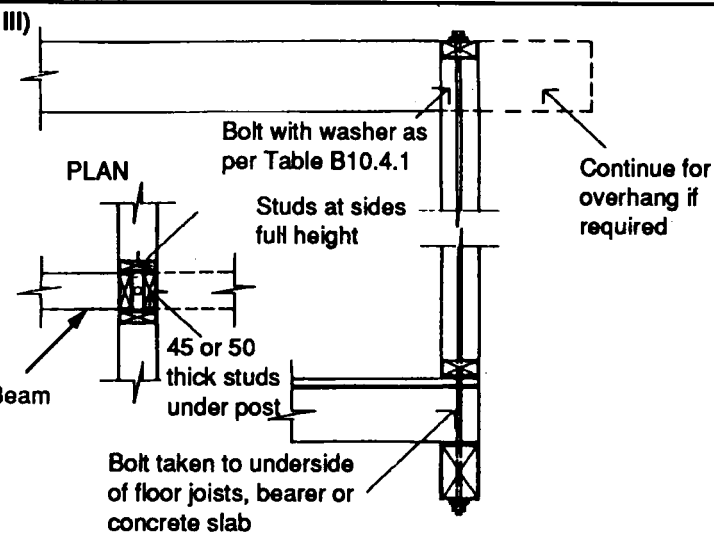


11.4    8.0    5.8    16.4    13    9.2



2/M10    15.6    10    6.4    18.4    14    10.4

2/M12    18.4    12    7.6    22    17    12.4



M10    11.5    10.6    6.7    11.5    11.5    11.5

M12    17    16.5    10.5    17    17    17

M16    32    21.5    14    32    32    24

M20    44    28    18    50    42    31

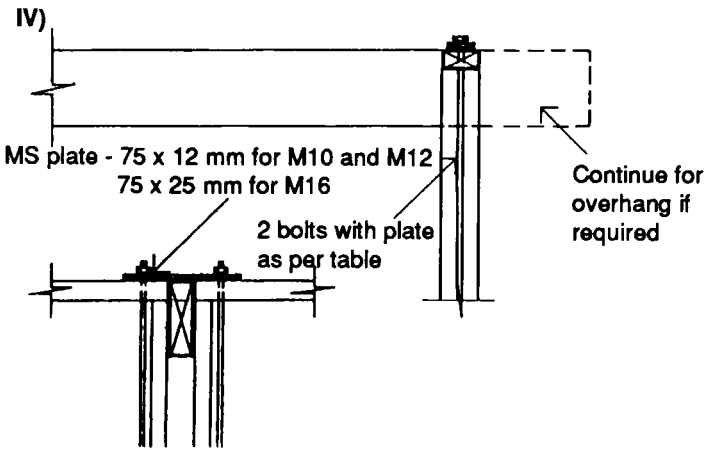
FIGURE B10.9 (C) continued

TIE-DOWN: ROOF BEAMS

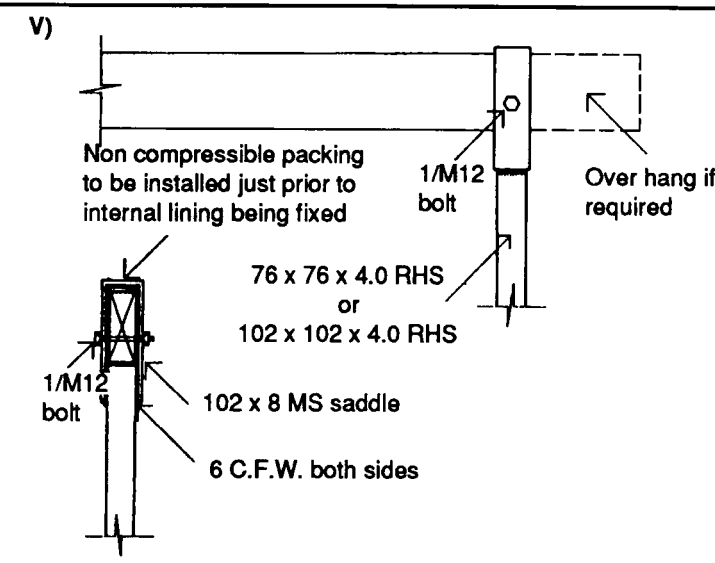
Design Strength (kN)

Unseasoned Timber      Seasoned Timber

J2    J3    J4      JD2    JD3    JD4



2/M10	23	21	13	23	23	23
2/M12	34	33	21	34	34	34
2/M16	59	37	24	64	53	39
2/M20	59	37	24	70	53	39



79	50	32	92	68	51
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FIGURE B10.9 (D)

TIE-DOWN: VERANDAH BEAMS

Design Strength (kN)

Bolts

Unseasoned Timber

Seasoned Timber

J2

J3

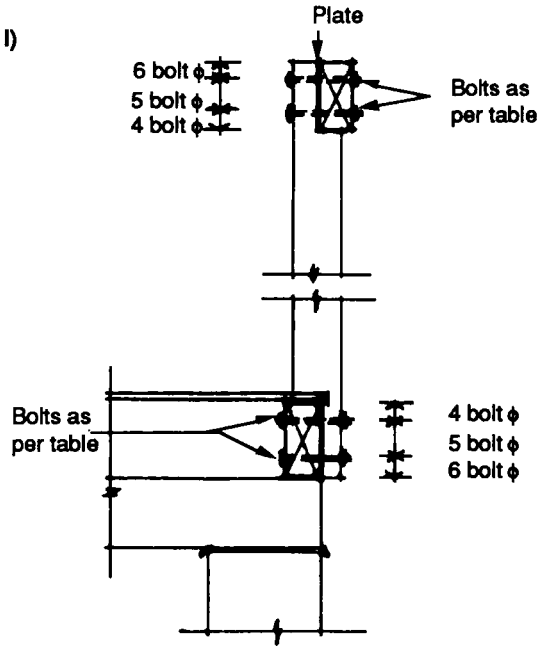
J4

JD2

JD3

JD4

I)



M10

4.7

3.8

2.7

6.0

5.8

4.8

M12

6.2

5.0

3.6

7.9

7.4

6.2

M16

8.0

6.4

4.6

10

9.6

8.0

2/M10

9.4

7.6

5.4

12

11.6

9.6

2/M12

13

10

7.2

15.8

14.8

12.4

2/M16

16

13

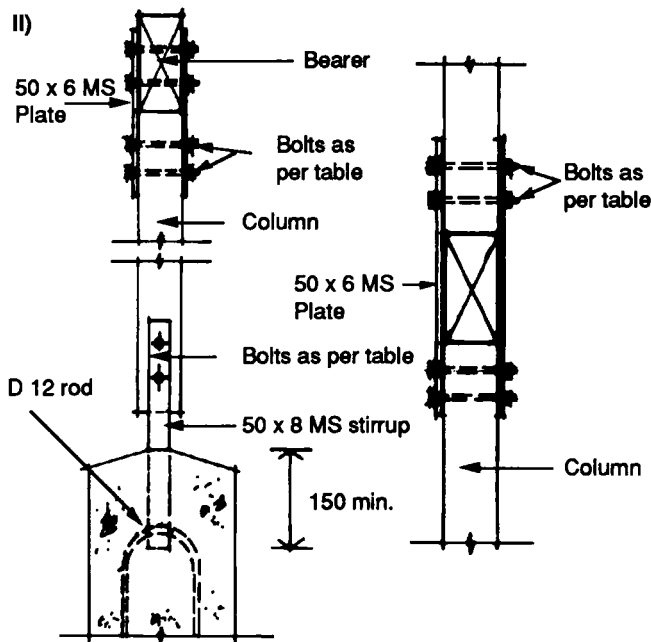
9.2

20.6

19

16

II)



M10

7.8

5.0

3.2

9.2

7.0

5.2

M12

9.2

6.0

4.0

11.2

8.4

6.2

M16

12.4

8.0

5.0

15

11

8.4

2/M10

15.6

10

6.4

18.4

14

10.4

2/M12

18.4

12

7.6

22.4

17

12.4

2/M16

25

15

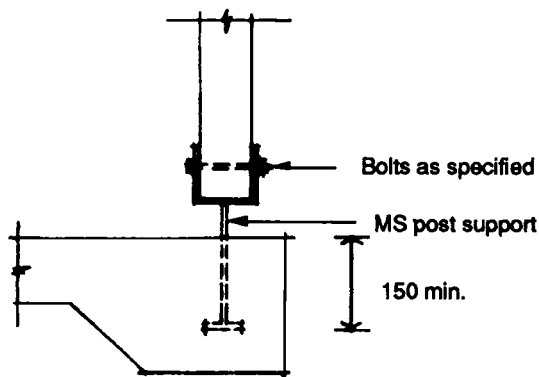
10

30.4

22.4

17

III)



REFER TO MANUFACTURERS SPECIFICATIONS

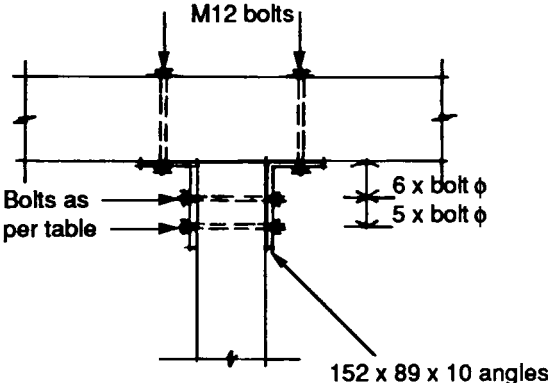
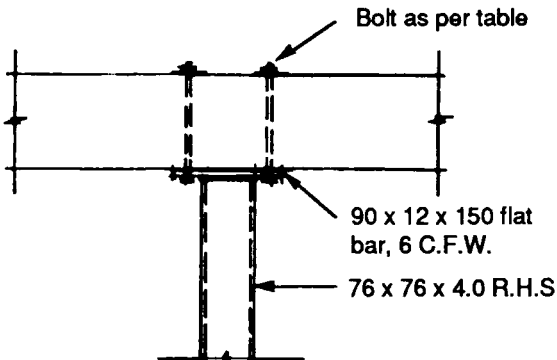
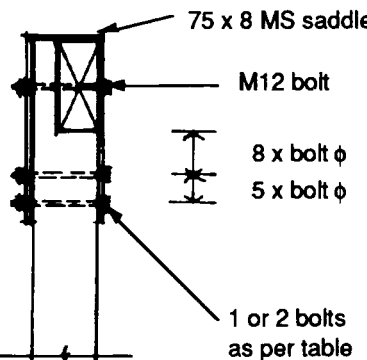
FIGURE B10.9 (D) continued		Design Strength (kN)						
		Unseasoned Timber			Seasoned Timber			
		J2	J3	J4	JD2	JD3	JD4	
<b>TIE-DOWN: VERANDAH BEAMS</b>								
IV)	 <p>M12 bolts</p> <p>Bolts as per table</p> <p>6 x bolt <math>\phi</math></p> <p>5 x bolt <math>\phi</math></p> <p>152 x 89 x 10 angles</p>	2/M12	26.4	24	19	33.6	30	24
		2/M16	46.4	43	21	34	34	34
<p><b>Note:</b> The same or an equivalent detail is required at the bottom of the post</p>								
V)	 <p>Bolt as per table</p> <p>90 x 12 x 150 flat bar, 6 C.F.W.</p> <p>76 x 76 x 4.0 R.H.S.</p>	2/M10	23	23	13.4	23	23	23
		2/M12	34	33	21	34	34	34
		2/M16	64	43	28	64	64	48
		2/M20	88	56	36	100	85	63
<p><b>Note:</b> The same or an equivalent detail is required at the bottom of the post</p>								
VI)	 <p>75 x 8 MS saddle</p> <p>M12 bolt</p> <p>8 x bolt <math>\phi</math></p> <p>5 x bolt <math>\phi</math></p> <p>1 or 2 bolts as per table</p>	M10	9.0	8.4	6.6	11.6	10.4	8.4
		2/M10	18	17	13	23	21	17
		M12	13	12	9.6	17	15	12
		2/M12	26.4	24	19	33.6	29.6	24
		M16	23	21.6	17	29.6	27	21.6
		2/M16	46.4	37	24	59	53	39
		M20	36.4	33.6	24	46.4	41.6	33.6
		2/M20	59	37	24	70	53	39
<p><b>Note:</b> The same or an equivalent detail is required at the bottom of the post</p>								

Table B10.10.1  
UPLIFT FORCES ON PURLINS (kN)

RAFTER SPACING (mm)	PURLIN SPACING (mm)	DESIGN WINDSPEED (m/s)												THIS TABLE IS VALID FOR	
		49			51			53			55			Aspect Ratio h/d	Roof Pitch (Degrees)
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *		
900	750	0.68	1.16	0.74	1.27	0.81	1.38	0.88	1.49	0.25	15, 20, 25				
	900	0.81	1.40	0.89	1.52	0.97	1.65	1.05	1.79						
	1200	1.08	1.86	1.19	2.03	1.29	2.20	1.41	2.39						
1200	750	0.90	1.55	0.99	1.69	1.08	1.84	1.17	1.99	0.50	20, 25				
	900	1.08	1.86	1.19	2.03	1.29	2.20	1.41	2.39						
	1200	1.44	2.48	1.58	2.71	1.73	2.94	1.87	3.18						
1500	750	1.13	1.94	1.24	2.11	1.35	2.30	1.46	2.49	1.00	25				
	900	1.35	2.33	1.48	2.54	1.62	2.76	1.76	2.98						
	1200	1.80	3.10	1.98	3.38	2.16	3.67	2.34	3.98						
DESIGN WINDSPEED (m/s)															
RAFTER SPACING (mm)	PURLIN SPACING (mm)	57			60			64			69			74.5	
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *
		900	750	0.95	1.61	1.07	1.79	1.23	2.06	1.44	2.41	1.70	2.82	1.70	2.82
900	1.14		1.93	1.28	2.15	1.47	2.47	1.73	2.89	2.04	3.39	2.04	3.39		
1200	1.52		2.57	1.70	2.87	1.96	3.29	2.31	3.85	2.72	4.51	2.72	4.51		
1200	750	1.27	2.15	1.42	2.39	1.63	2.74	1.92	3.21	2.26	3.76	2.26	3.76		
	900	1.52	2.57	1.70	2.87	1.96	3.29	2.31	3.85	2.72	4.51	2.72	4.51		
	1200	2.03	3.43	2.27	3.83	2.62	4.38	3.07	5.13	3.62	6.02	3.62	6.02		
1500	750	1.59	2.68	1.78	2.99	2.04	3.43	2.40	4.01	2.83	4.70	2.83	4.70		
	900	1.90	3.22	2.13	3.59	2.45	4.11	2.88	4.81	3.39	5.64	3.39	5.64		
	1200	2.54	4.29	2.84	4.78	3.27	5.48	3.84	6.41	4.53	7.52	4.53	7.52		

Notes: i. It has been assumed that all glazed openings are protected by means of shutters such as those shown in section G.

ii. \* Local Pressure Region is that area of the roof that is subject to higher wind uplift forces than the general roof area. Local Pressure region is within 900 mm of the edges of the roof and within 900 mm of either side of the ridge of the roof. Local Pressure is not applicable to the ridge of roofs with a pitch of less than 10 degrees.

**Table B10.10.2  
UPLIFT FORCES ON PURLINS (kN)**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	DESIGN WINDSPEED (m/s)												THIS TABLE IS VALID FOR		
		49			51			53			55			Aspect Ratio h/d	Roof Pitch (Degrees)	
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *			
900	750	0.87	1.55	0.95	1.69	1.04	1.83	1.12	1.98	0.25	10					
	900	1.05	1.86	1.14	2.03	1.24	2.20	1.35	2.38							
	1200	1.39	2.48	1.52	2.70	1.66	2.93	1.80	3.17							
1200	750	1.16	2.07	1.27	2.25	1.38	2.44	1.50	2.64	0.50	15					
	900	1.39	2.48	1.52	2.70	1.66	2.93	1.80	3.17							
	1200	1.86	3.31	2.03	3.60	2.21	3.91	2.40	4.23							
1500	750	1.45	2.59	1.59	2.82	1.73	3.05	1.87	3.30	1.00	20					
	900	1.74	3.10	1.90	3.38	2.07	3.67	2.25	3.96							
	1200	2.32	4.14	2.54	4.51	2.76	4.89	3.00	5.28							
<b>DESIGN WINDSPEED (m/s)</b>																
RAFTER SPACING (mm)	PURLIN SPACING (mm)	57			60			64			69			74.5		
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	
		900	750	1.21	2.14	1.36	2.38	1.56	2.72	1.83	3.18	2.15	3.72			
900	1.46		2.56	1.63	2.85	1.87	3.26	2.19	3.81	2.58	4.46					
1200	1.94		3.42	2.17	3.80	2.49	4.35	2.92	5.08	3.43	5.95					
1200	750	1.62	2.85	1.81	3.17	2.08	3.63	2.44	4.24	2.86	4.96					
	900	1.94	3.42	2.17	3.80	2.49	4.35	2.92	5.08	3.43	5.95					
	1200	2.59	4.56	2.89	5.07	3.32	5.80	3.90	6.78	4.58	7.94					
1500	750	2.02	3.56	2.26	3.96	2.60	4.53	3.04	5.29	3.58	6.20					
	900	2.43	4.27	2.71	4.75	3.12	5.44	3.65	6.35	4.29	7.44					
	1200	3.24	5.70	3.62	6.34	4.15	7.25	4.87	8.47	5.72	9.92					

**Notes:** i. It has been assumed that all glazed openings are protected by means of shutters such as those shown in section G.

ii. \* Local Pressure Region is that area of the roof that is subject to higher wind uplift forces than the general roof area. Local Pressure region is within 900 mm of the edges of the roof and within 900 mm of either side of the ridge of the roof. Local Pressure is not applicable to the ridge of roofs with a pitch of less than 10 degrees.

**Table B10.10.3  
UPLIFT FORCES ON PURLINS (kN)**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	DESIGN WINDSPEED (m/s)												THIS TABLE IS VALID FOR	
		49			51			53			55			Aspect Ratio h/d	Roof Pitch (Degrees)
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *		
900	750	1.16	2.14	1.27	2.32	1.38	2.52	1.49	2.72	0.50	10				
	900	1.40	2.56	1.52	2.79	1.65	3.02	1.79	3.26						
	1200	1.86	3.42	2.03	3.71	2.20	4.02	2.39	4.35						
1200	750	1.55	2.85	1.69	3.10	1.84	3.35	1.99	3.62	1.00	15				
	900	1.86	3.42	2.03	3.71	2.20	4.02	2.39	4.35						
	1200	2.48	4.56	2.71	4.95	2.94	5.37	3.18	5.80						
1500	750	1.94	3.56	2.11	3.87	2.30	4.19	2.49	4.53	74.5					
	900	2.33	4.27	2.54	4.64	2.76	5.03	2.98	5.43						
	1200	3.10	5.69	3.38	6.19	3.67	6.71	3.98	7.24						
DESIGN WINDSPEED (m/s)															
RAFTER SPACING (mm)	PURLIN SPACING (mm)	57			60			64			69			Aspect Ratio h/d	Roof Pitch (Degrees)
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *		
		900	750	1.61	2.93	1.79	3.25	2.06	3.71	2.41	4.33	0.50	10		
900	1.93		3.51	2.15	3.90	2.47	4.46	2.89	5.20						
1200	2.57		4.68	2.87	5.20	3.29	5.94	3.85	6.93						
1200	750	2.15	3.90	2.39	4.34	2.74	4.95	3.21	5.78	1.00	15				
	900	2.57	4.68	2.87	5.20	3.29	5.94	3.85	6.93						
	1200	3.43	6.24	3.83	6.94	4.38	7.92	5.13	9.25						
1500	750	2.68	4.88	2.99	5.42	3.43	6.19	4.01	7.22	74.5					
	900	3.22	5.85	3.59	6.50	4.11	7.43	4.81	8.67						
	1200	4.29	7.80	4.78	8.67	5.48	9.90	6.41	11.56						

Notes: i. It has been assumed that all glazed openings are protected by means of shutters such as those shown in section G.

ii. \* Local Pressure Region is that area of the roof that is subject to higher wind uplift forces than the general roof area. Local Pressure region is within 900 mm of the edges of the roof and within 900 mm of either side of the ridge of the roof. Local Pressure is not applicable to the ridge of roofs with a pitch of less than 10 degrees.



**Table B10.10.4  
UPLIFT FORCES ON PURLINS (kN)**

RAFTER SPACING (mm)	PURLIN SPACING (mm)	DESIGN WINDSPEED (m/s)												THIS TABLE IS VALID FOR	
		49			51			53			55			Aspect Ratio h/d	Roof Pitch (Degrees)
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	1	10		
900	750	1.45	2.72	1.58	2.95	1.72	3.20	1.86	3.45	900	1	10			
	900	1.75	3.26	1.90	3.54	2.06	3.84	2.23	4.14						
	1200	2.33	4.35	2.53	4.73	2.75	5.12	2.97	5.52						
1200	750	1.94	3.62	2.11	3.94	2.29	4.26	2.48	4.60	1200	1	10			
	900	2.33	4.35	2.53	4.73	2.75	5.12	2.97	5.52						
	1200	3.10	5.80	3.38	6.30	3.67	6.82	3.97	7.36						
1500	750	2.42	4.53	2.64	4.92	2.86	5.33	3.10	5.75	1500	1	10			
	900	2.91	5.44	3.17	5.91	3.44	6.40	3.72	6.90						
	1200	3.88	7.25	4.22	7.88	4.58	8.53	4.96	9.20						
900	PURLIN SPACING (mm)	DESIGN WINDSPEED (m/s)												74.5	
		57			60			64			69				
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *		
1200	750	2.00	3.32	2.23	4.13	2.55	4.71	2.98	5.49	1200	1	10			
	900	2.40	3.98	2.68	4.95	3.06	5.65	3.58	6.59						
	1200	3.21	5.31	3.57	6.60	4.08	7.54	4.77	8.78						
1500	750	2.67	4.43	2.98	5.50	3.40	6.28	3.98	7.32	1500	1	10			
	900	3.21	5.31	3.57	6.60	4.08	7.54	4.77	8.78						
	1200	4.28	7.08	4.76	8.80	5.45	10.05	6.37	11.71						
1500	750	3.34	5.53	3.72	6.88	4.25	7.85	4.97	9.15	1500	1	10			
	900	4.01	6.64	4.46	8.25	5.11	9.42	5.97	10.98						
	1200	5.34	8.85	5.95	11.01	6.81	12.56	7.96	14.64						

**Notes:** i. It has been assumed that all glazed openings are protected by means of shutters such as those shown in section G.

ii. \* Local Pressure Region is that area of the roof that is subject to higher wind uplift forces than the general roof area. Local Pressure region is within 900 mm of the edges of the roof and within 900 mm of either side of the ridge of the roof. Local Pressure is not applicable to the ridge of roofs with a pitch of less than 10 degrees.

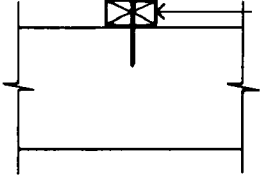
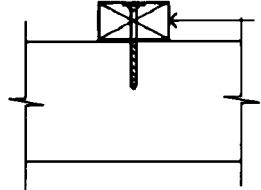
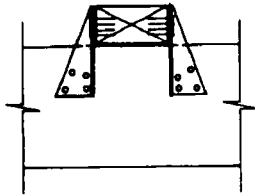
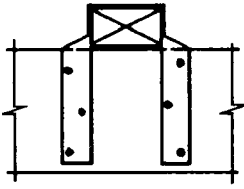
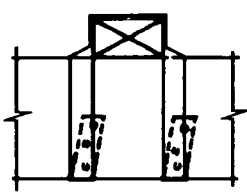
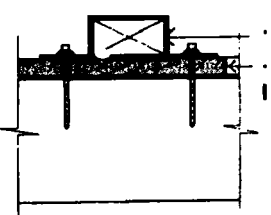
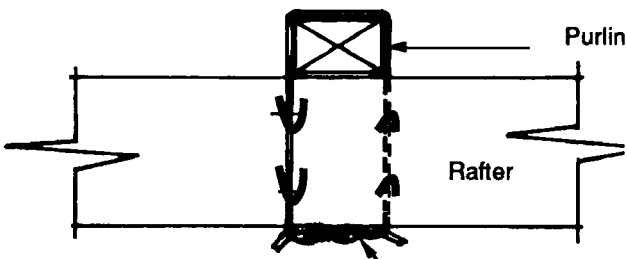
FIGURE B10.10  FIXING OF PURLIN TO RAFTER		Design Strength ( kN )					
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD2	JD3	JD4
I)   <p>75 x 50 purlin</p> <p>1/100 x 3.75 φ nail ( 50 mm penetration into receiving member )</p>							
	0.65	0.55	0.50	0.85	0.55	0.37	
II)   <p>75 x 50 purlin</p> <p>1/90 mm No. 14 Type 17 screw ( 40 mm penetration into receiving member )</p>							
	2.8	2.0	1.6	3.5	2.5	2.0	
III)   <p>No. of Framing Anchors</p> <p>1 framing anchor with 4 / 3.15 φ nails each leg</p>	1	3.7	2.6	1.9	4.7	3.7	2.6
	2	6.2	4.4	3.1	8.6	6.8	4.0
	4	11.4	8.1	5.8	16.4	13	9.2
IV)   <p>No. of nails each end of strap</p> <p>30 x 0.8 G.I. strap with 3.15 φ nails each end of strap</p>	3	4.9	3.5	2.5	6.6	5.2	3.7
	4	6.2	4.4	3.1	8.6	6.8	4.8

FIGURE B10.10 continued  FIXING OF PURLIN TO RAFTER		Design Strength ( kN )					
		Unseasoned Timber			Seasoned Timber		
		J2	J3	J4	JD2	JD3	JD4
v)   <p>30 x 0.8 G.I. looped strap with 3.15 <math>\phi</math> nails each end of strap</p> <p>3 nails each end for J2 timber 4 nails each end for J3 &amp; JD4 timber 5 nails each end for J4, JD5 &amp; JD6 timber</p>							
	7.2	7.2	7.2	7.2	7.2	7.2	
vi)   <p>75 x 50 purlin 19 mm lining</p> <p>30 x 1.8 G.I. strap 1/75 mm No. 14 Type 17 screw at each end</p>							
	7.0	5.0	3.6	8.5	6.1	5.0	
vii)   <p>Purlin</p> <p>Rafter</p> <p>No. 8 wire tightly knotted under rafter and held in place by 'U' nails</p>							
	No. of loops						
	1	2.6	2.6	2.6	2.6	2.6	
	2	5.2	5.2	5.2	5.2	5.2	

**Table B10.11.1  
UPLIFT FORCES PER CLADDING FASTENER ( KN )**

PURLIN SPACING ( mm )	FASTENER SPACING ( mm )	DESIGN WINDSPEED ( m/s )												THIS TABLE IS VALID FOR	
		49			51			53			55			Aspect Ratio ( h/d )	Roof Pitch ( Degrees )
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *				
750	76	0.07	0.11	0.07	0.12	0.08	0.12	0.08	0.12	0.08	0.12	0.08	0.13	0.25	15, 20, 25
	190	0.16	0.27	0.18	0.29	0.19	0.31	0.19	0.31	0.21	0.33	0.21	0.34		
	203	0.18	0.29	0.19	0.31	0.21	0.33	0.21	0.33	0.22	0.36	0.22	0.36		
900	76	0.08	0.13	0.09	0.14	0.09	0.14	0.09	0.14	0.10	0.15	0.10	0.16	0.5	20, 25
	190	0.20	0.32	0.21	0.35	0.23	0.37	0.23	0.37	0.25	0.40	0.25	0.40		
	203	0.21	0.34	0.23	0.37	0.25	0.40	0.25	0.40	0.27	0.43	0.27	0.43		
1200	76	0.11	0.17	0.11	0.19	0.12	0.20	0.12	0.20	0.13	0.22	0.13	0.22	1	25
	190	0.26	0.43	0.28	0.46	0.31	0.50	0.31	0.50	0.33	0.54	0.33	0.54		
	203	0.28	0.46	0.30	0.49	0.33	0.53	0.33	0.53	0.35	0.57	0.35	0.57		
PURLIN SPACING ( mm )	FASTENER SPACING ( mm )	DESIGN WINDSPEED ( m/s )												74.5	
		57			60			64			69			General Area of Roof	Local Pressure Region *
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *				
750	76	0.09	0.14	0.10	0.16	0.11	0.18	0.11	0.18	0.13	0.21	0.13	0.21	0.15	0.25
	190	0.22	0.36	0.25	0.40	0.28	0.46	0.28	0.46	0.33	0.53	0.33	0.53		
	203	0.24	0.39	0.26	0.43	0.30	0.49	0.30	0.49	0.35	0.57	0.35	0.57		
900	76	0.11	0.17	0.12	0.19	0.13	0.22	0.13	0.22	0.16	0.25	0.16	0.25	0.18	0.30
	190	0.27	0.43	0.30	0.48	0.34	0.55	0.34	0.55	0.39	0.64	0.39	0.64		
	203	0.28	0.46	0.32	0.51	0.36	0.58	0.36	0.58	0.42	0.68	0.42	0.68		
1200	76	0.14	0.23	0.16	0.26	0.18	0.29	0.18	0.29	0.21	0.34	0.21	0.34	0.24	0.39
	190	0.36	0.58	0.39	0.64	0.45	0.73	0.45	0.73	0.52	0.85	0.52	0.85		
	203	0.38	0.62	0.42	0.68	0.48	0.78	0.48	0.78	0.56	0.90	0.56	0.90		

**NOTES:** i. Fastener spacing of 76 mm is equivalent to fastening every crest of a corrugated iron roof.

ii. Fastener spacing of 190 mm is equivalent to fastening every crest of a trimdek roof.

iii. Fastener spacing of 203 mm is equivalent to fastening every crest of a kliplok roof.

iv. It has been assumed that all glazed openings are protected by means of shutters such as those shown in Section G

v. \* Refer to note under Table B10.10

Table B10.11.2  
UPLIFT FORCES PER CLADDING FASTENER ( kN )

PURLIN SPACING (mm)	FASTENER SPACING (mm)	DESIGN WINDSPEED ( m/s )												THIS TABLE IS VALID FOR		
		49			51			53			55			Aspect Ratio ( h/d )	Roof Pitch ( Degrees )	
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *					
750	76	0.08	0.14	0.09	0.15	0.10	0.16	0.10	0.16	0.10	0.18	0.25	10			
	190	0.21	0.35	0.22	0.38	0.24	0.41	0.26	0.44	0.26	0.44					
	203	0.22	0.37	0.24	0.40	0.26	0.44	0.28	0.47	0.28	0.47					
900	76	0.10	0.17	0.11	0.18	0.12	0.20	0.12	0.20	0.12	0.21	0.5	15			
	190	0.25	0.42	0.27	0.45	0.29	0.49	0.31	0.53	0.31	0.53					
	203	0.26	0.45	0.29	0.48	0.31	0.52	0.33	0.56	0.33	0.56					
1200	76	0.13	0.22	0.14	0.24	0.15	0.26	0.17	0.28	0.17	0.28	1	20			
	190	0.33	0.56	0.36	0.60	0.38	0.65	0.41	0.70	0.41	0.70					
	203	0.35	0.60	0.38	0.65	0.41	0.70	0.44	0.75	0.44	0.75					
DESIGN WINDSPEED ( m/s )																
750	FASTENER SPACING (mm)	57			60			64			69			74.5		
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	
		0.11	0.19	0.12	0.21	0.14	0.24	0.16	0.28	0.14	0.24	0.16	0.28	0.19	0.32	
900	FASTENER SPACING (mm)	0.28	0.47	0.31	0.52	0.35	0.60	0.41	0.69	0.35	0.60	0.41	0.69	0.47	0.81	
		0.30	0.50	0.33	0.56	0.37	0.64	0.43	0.74	0.37	0.64	0.43	0.74	0.51	0.86	
		0.13	0.23	0.15	0.25	0.17	0.29	0.20	0.33	0.17	0.29	0.20	0.33	0.23	0.39	
1200	FASTENER SPACING (mm)	0.33	0.57	0.37	0.63	0.42	0.71	0.49	0.83	0.42	0.71	0.49	0.83	0.57	0.97	
		0.36	0.61	0.39	0.67	0.45	0.76	0.52	0.89	0.45	0.76	0.52	0.89	0.61	1.03	
		0.18	0.30	0.20	0.33	0.22	0.38	0.26	0.44	0.22	0.38	0.26	0.44	0.30	0.52	
1200	FASTENER SPACING (mm)	0.44	0.76	0.49	0.84	0.56	0.95	0.65	1.11	0.56	0.95	0.65	1.11	0.76	1.29	
		0.47	0.81	0.53	0.89	0.60	1.02	0.70	1.18	0.60	1.02	0.70	1.18	0.81	1.38	

NOTES: i. Fastener spacing of 76 mm is equivalent to fastening every crest of a corrugated iron roof.

ii. Fastener spacing of 190 mm is equivalent to fastening every crest of a trimdek roof.

iii. Fastener spacing of 203 mm is equivalent to fastening every crest of a kiplok roof.

iv. It has been assumed that all glazed openings are protected by means of shutters such as those shown in Section G

v. \* Refer to note under Table B10.10

**Table B10.11.3  
UPLIFT FORCES PER CLADDING FASTENER ( kN )**

PURLIN SPACING ( mm )	FASTENER SPACING ( mm )	DESIGN WINDSPEED ( m/s )												THIS TABLE IS VALID FOR	
		49			51			53			55			Aspect Ratio ( h/d )	Roof Pitch ( Degrees )
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *				
750	76	0.11	0.19	0.12	0.20	0.12	0.22	0.13	0.24	0.5	10				
	190	0.27	0.47	0.29	0.51	0.31	0.55	0.34	0.59						
	203	0.29	0.50	0.31	0.55	0.33	0.59	0.36	0.64						
900	76	0.13	0.23	0.14	0.25	0.15	0.27	0.16	0.29	1	15				
	190	0.32	0.57	0.35	0.61	0.37	0.66	0.40	0.71						
	203	0.34	0.61	0.37	0.66	0.40	0.71	0.43	0.76						
1200	76	0.17	0.30	0.19	0.33	0.20	0.35	0.22	0.38	74.5					
	190	0.43	0.76	0.46	0.82	0.50	0.88	0.54	0.95						
	203	0.46	0.81	0.49	0.87	0.53	0.94	0.57	1.02						
750	FASTENER SPACING ( mm )	DESIGN WINDSPEED ( m/s )												74.5	Local Pressure Region *
		57			60			64			69				
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *				
900	76	0.14	0.26	0.16	0.28	0.18	0.32	0.21	0.37	0.62	1.09				
	190	0.36	0.64	0.40	0.71	0.46	0.81	0.53	0.94						
	203	0.39	0.68	0.43	0.76	0.49	0.86	0.57	1.00						
1200	76	0.17	0.31	0.19	0.34	0.22	0.39	0.25	0.45	0.74	1.31				
	190	0.43	0.77	0.48	0.85	0.55	0.97	0.64	1.12						
	203	0.46	0.82	0.51	0.91	0.58	1.03	0.68	1.20						
1200	76	0.23	0.41	0.26	0.45	0.29	0.52	0.34	0.60	0.99	1.75				
	190	0.58	1.02	0.64	1.13	0.73	1.29	0.85	1.50						
	203	0.62	1.09	0.68	1.21	0.78	1.38	0.90	1.60						

**NOTES:** i. Fastener spacing of 76 mm is equivalent to fastening every crest of a corrugated iron roof.

ii. Fastener spacing of 190 mm is equivalent to fastening every crest of a trimdek roof.

iii. Fastener spacing of 203 mm is equivalent to fastening every crest of a klapdek roof.

iv. It has been assumed that all glazed openings are protected by means of shutters such as those shown in Section G

v. \* Refer to note under Table B10.10

**Table B10.11.4  
UPLIFT FORCES PER CLADDING FASTENER ( kN )**

PURLIN SPACING ( mm )	FASTENER SPACING ( mm )	DESIGN WINDSPEED ( m/s )												THIS TABLE IS VALID FOR	
		49			51			53			55			Aspect Ratio ( h/d )	Roof Pitch ( Degrees )
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *		
750	76	0.13	0.24	0.14	0.26	0.15	0.28	0.17	0.30	1	10				
	190	0.33	0.60	0.36	0.64	0.38	0.70	0.41	0.75						
	203	0.35	0.64	0.38	0.69	0.41	0.74	0.44	0.80						
900	76	0.16	0.29	0.17	0.31	0.18	0.33	0.20	0.36						
	190	0.39	0.71	0.43	0.77	0.46	0.84	0.50	0.90						
	203	0.42	0.76	0.46	0.83	0.49	0.89	0.53	0.96						
1200	76	0.21	0.38	0.23	0.41	0.25	0.45	0.26	0.48						
	190	0.53	0.95	0.57	1.03	0.61	1.11	0.66	1.20						
	203	0.56	1.02	0.61	1.10	0.66	1.19	0.71	1.28						
DESIGN WINDSPEED ( m/s )															
750	FASTENER SPACING ( mm )	57			60			64			69			74.5	
		General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *	General Area of Roof	Local Pressure Region *
		76	0.18	0.32	0.20	0.36	0.22	0.41	0.26	0.47	0.30	0.55			
900	190	0.44	0.81	0.49	0.89	0.56	1.02	0.65	1.18	0.76	1.38				
	203	0.47	0.86	0.53	0.95	0.60	1.09	0.70	1.26	0.81	1.47				
	76	0.21	0.39	0.24	0.43	0.27	0.49	0.31	0.57	0.36	0.66				
1200	190	0.53	0.97	0.59	1.07	0.67	1.22	0.78	1.42	0.91	1.65				
	203	0.57	1.03	0.63	1.14	0.72	1.30	0.84	1.51	0.97	1.76				
	76	0.28	0.52	0.32	0.57	0.36	0.65	0.42	0.76	0.49	0.88				
1200	190	0.71	1.29	0.79	1.43	0.90	1.62	1.04	1.89	1.21	2.20				
	203	0.76	1.38	0.84	1.53	0.96	1.74	1.11	2.02	1.30	2.35				

- NOTES:**
- i. Fastener spacing of 76 mm is equivalent to fastening every crest of a corrugated iron roof.
  - ii. Fastener spacing of 190 mm is equivalent to fastening every crest of a trimdek roof.
  - iii. Fastener spacing of 203 mm is equivalent to fastening every crest of a kliplok roof.
  - iv. It has been assumed that all glazed openings are protected by means of shutters such as those shown in Section G
  - v. \* Refer to note under Table B10.10

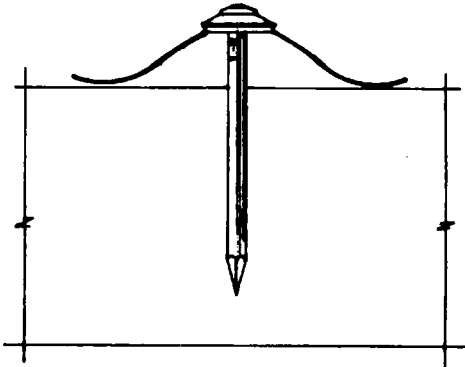
FIGURE B10.11

FIXING OF ROOF CLADDING TO PURLINS

Design Withdrawal strength ( kN )

Unseasoned Timber			Seasoned Timber		
J2	J3	J4	JD2	JD3	JD4

I)



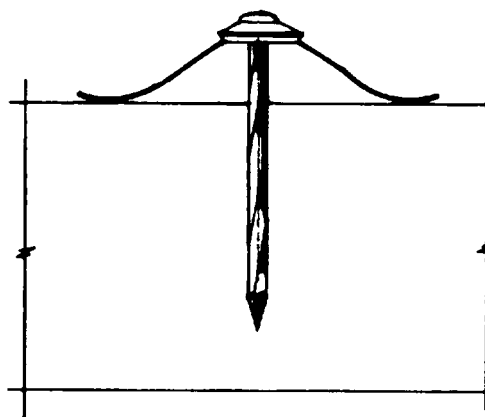
1/65 x 3.75  $\phi$  plain shank nail ( 45 mm penetration into receiving member )

1/75 x 3.75  $\phi$  plain shank nail ( 55 mm penetration into receiving member )

\* Applicable only to cladding of 0.42 base metal thickness or greater.

.59	.50	.45	.77	.50	.33
.72	.61	.55	.94	.61	.41

II)



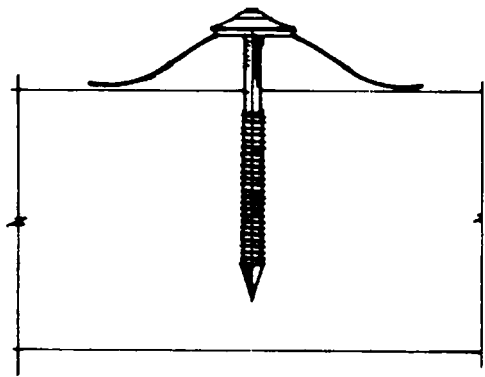
1/65 x 3.75  $\phi$  twisted shank nail ( 45 mm penetration into receiving member )

1/75 x 3.75  $\phi$  twisted shank nail ( 55 mm penetration into receiving member )

\* Applicable only to cladding of 0.42 base metal thickness or greater.

.59	.50	.45	.77	.50	.33
.72	.61	.55	.94	.61	.41

III)



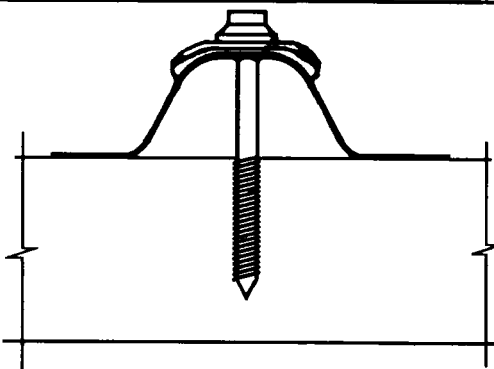
1/65 x 3.75  $\phi$  annular grooved nail ( 45 mm penetration into receiving member )

1/75 x 3.75  $\phi$  annular grooved nail ( 55 mm penetration into receiving member )

\* Applicable only to cladding of 0.42 base metal thickness or greater.

1.2	1.0	.95	1.6	1.0	.72
1.4	1.3	1.2	1.9	1.3	.88

IV)



No. 14 Type 17 screw with cyclone washer assembly ( 45 mm penetration into receiving member )

3.2	2.3	1.8	3.9	2.8	2.3
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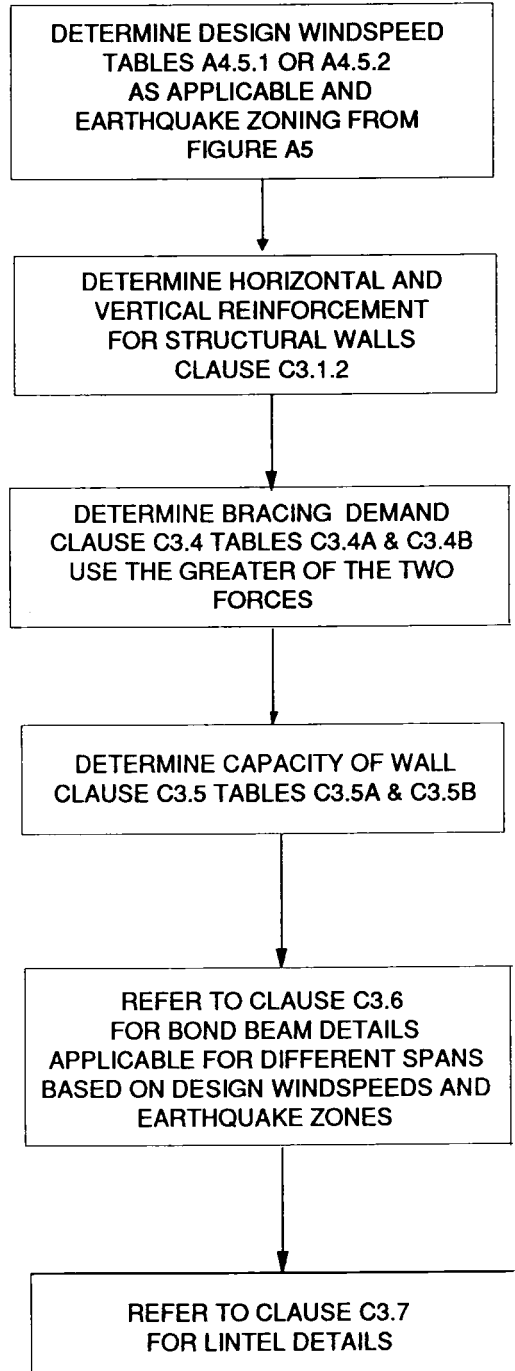


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SECTION C

MASONRY  
HOUSES

# SECTION C MASONRY HOUSES



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# SECTION C MASONRY HOUSES

## C1 TYPES OF HOUSES

### C1.1 General

Masonry houses considered are restricted to 2 storeys in height and consist of the following:

- (a) The footings can either be of reinforced masonry or of reinforced concrete.
- (b) Some or all of the walls in any storey must be of fully grouted concrete cored block masonry of 150 or 200 mm nominal thickness with the following limitations -
  - (i) timber framed walls must not vertically support masonry walls; and
  - (ii) no masonry wall must be of lesser thickness than any masonry wall above it.
- (c) Walls which are not of masonry must be of light timber framing to Section B.
- (d) Ceilings, roof framing and upper storey floor must be of timber to Sections B and E, except that the ground floor may be of concrete slab-on-ground to Section D5.

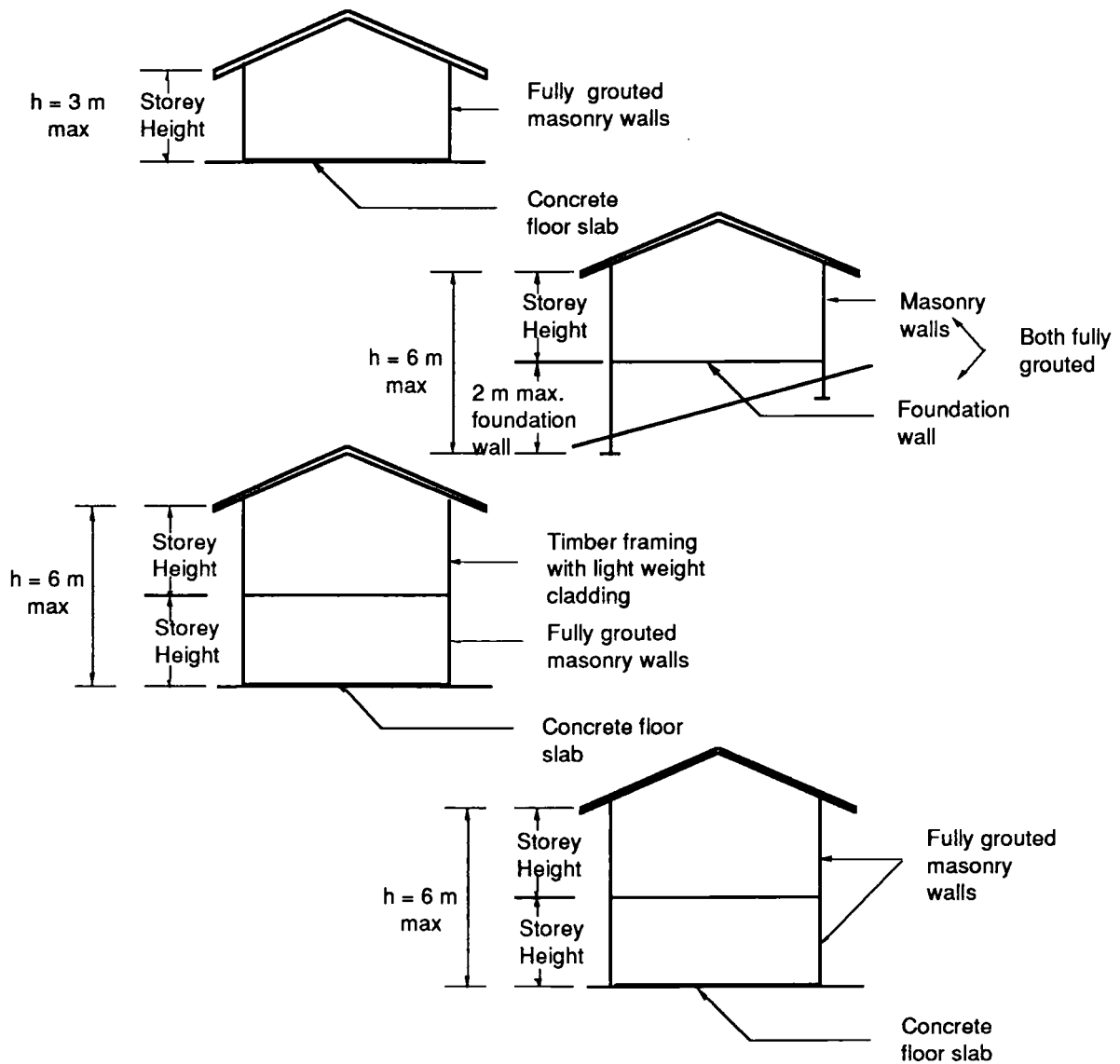


FIGURE C1.2 TYPES OF MASONRY HOUSES CONSIDERED

## C1.2 Types of Houses

The types of houses considered are shown in Figure C1.2. These consist of walls of-

- (a) fully grouted masonry for both storeys or for a single storey or for a foundation wall and the single storey supported by it;
- (b) timber framed and lightly clad walls for the upper storey, supported on a lower storey of fully grouted masonry.

## C2 MATERIALS AND WORKMANSHIP

### C2.1 Materials

- (a) All concrete must be 17.5 MPa but 10MPa concrete may be used for sub-footing. Mix ratios are given in Table C2.1 for locally produced 10 MPa and 17.5 MPa concrete.
- (b) Concrete blocks must have a minimum compressive strength of 9 MPa over the nett area. The actual dimensions of the concrete blocks must be 10 mm less than the nominal dimensions of 150 x 400 x 200, and 200 x 400 x 200 to allow for the thickness of mortar.
- (c) All steel reinforcement and other embedded steel must be cleaned of any rust, dirt and oil before use. The epoxy coating of reinforcement and of all embedded steel is strongly recommended in areas close to the sea and other corrosive environment. The use of galvanised reinforcement and other embedded steel to retard corrosion must depend on an assurance that the cement used for the grout and mortar is free of calcium hydroxide. If this chemical is present it would attack the galvanising. Another precaution with the use of galvanised steel is that every item of steel used must be galvanised. This includes even wire ties. If this is not done galvanic corrosion can take place.

**Note:** A patented chemical additive Z-12/C, is available for use with sea water and unwashed saline aggregate for making concrete of good quality and durability. Reinforcing bars do not easily corrode and destroy the concrete as would ordinarily be the case when using sea water and saline aggregates. The product is manufactured by Concrete Hitech (Holdings) Ltd., 15 Avenue Victor Hugo, 75116, Paris, France.

- (d) The grout used must develop a compressive strength of 17.5 MPa at 28 days after pouring. The use of fine grout (only cement, sand and water) is allowed only for grout spaces of less than 60 mm. All larger grout spaces must be grouted with coarse grout consisting of cement, sand and 5 to 13 mm or 4 to 19 mm aggregate, and water. Coarse grout may contain suitable admixtures to improve workability. Mix ratio for 17.5 MPa grout is given in Table C2.1.
- (e) Mortar for masonry must consist of 1 part of cement, 3 parts of sand and sufficient water. It may also contain hydrated lime or a suitable admixture to improve workability. If lime is added, the sand-lime mixture must be allowed to stand for 24 hours before the cement is added and the mortar used. Mortar must not be used once 1 1/2 hours have passed after the addition of cement to the mix. To produce mortar of consistently the right quality, the volumes of materials must be measured using buckets or gauge boxes and not shovelled direct from the stockpile or cement bag into the mixer. A dry bucket must be reserved for measuring cement quantities. The water must be added carefully from a measured container and not directly from the end of a hose pipe.

TABLE C2.1 MIX RATIOS FOR CEMENT AND GROUT

COMPRESSIVE STRENGTH	MIX RATIOS BY VOLUME			
	WATER	CEMENT	SAND	COARSE AGGREGATE
10 MPa concrete	1	1	2.5	3 of 20 mm agg.
17.5 MPa concrete	0.9	1	3.2	3.3 of 20 mm agg.
17.5 MPa grout	1.1	1	3	2.7 of 10 mm agg.

The quantity of water given is the maximum allowable and must be reduced with increase in moisture content of sand or aggregate.

## **C2.2 Workmanship**

The quality of workmanship must be of a standard conforming to good trade practice.

The accurate positioning of starter bars is very important in order to maintain the quality of the finished masonry.

Clean-out openings are desirable at the bottom row of blocks in the cells containing reinforcement. The strength of the masonry, particularly of bracing walls is very much dependent on the quality of grouting. The clean-out pocket would allow thorough cleaning of the cells before grouting.

Grouting must be done only after the mortar joints have gained enough strength to withstand the pressure of the grout and to allow thorough cleaning. The grout must be so rodded and worked that it fully fills the cavities without segregation. Horizontal grout joints must be 20 mm below the uppermost masonry units. The upper surface of the grout must be protected from weather.

The maximum lift of grout must be limited to 1200 mm if the grout space is not less than 50 mm in the least dimension. Otherwise the lift should be restricted to 400 mm.

Temporary bracing as required must be provided for masonry walls to resist lateral loads during construction.

In very hot and dry conditions the masonry blocks may be kept lightly damp before use. Mortar and grout must not be mixed in quantities that would dry out before use. The work may be kept damp by a light fog spray for 24 hours after laying.

## **C3 WALLS**

### **C3.1 General**

Walls serve the following functions:

- (a) Provide an envelope to the living space and therefore privacy and protection from the elements; and
- (b) Where so designed (known as structural walls), take vertical downward loads from the roof and suspended floors, vertical uplift loads from wind acting through the roof membrane and horizontal loads from earthquake and wind effects.

**C3.1.1** The limitations on the number and height of storeys for 150 mm and 200 mm walls, are as follows:

- (a) 150 mm fully grouted walls can be used only for single storey houses or for the top storey of 2 storey houses throughout Vanuatu.
- (b) 200 mm fully grouted walls can be used up to a height of 2 storeys.
- (c) partially grouted walls are not allowed in Vanuatu.
- (d) The height of any storey must not exceed 3 m.

**C3.1.2** All structural walls (see C3.2) must be centrally reinforced both vertically and horizontally to the details given in Table C3.1.2. It must be noted that there are further restrictions on the spacing of reinforcement for bracing panels (see C3.5 and Figure C3.5B).

Vertical bars must be provided :-

- (a) at all corners and ends of walls,
- (b) on each side of all wall openings 400 mm wide or more (see Fig. C3.1.2 A & B), and
- (c) at either side of shrinkage control joints (see Fig. C3.1.3 A).

TABLE C3.1.2 REINFORCEMENT FOR STRUCTURAL WALLS

FULLY GROUTED 150 mm WALL				
Design Windspeed (m/s)	Vertical Reinforcement		Horizontal Reinforcement	
	ZONE 7	ZONE 8	ZONE 7	ZONE 8
≤ 51	D12 @ 600 mm	D12 @ 600 mm	D12 @ 600 mm	D12 @ 600 mm
52 - 60	D12 @ 600 mm	D12 @ 600 mm	D12 @ 600 mm	D12 @ 600 mm
61 - 74.5	D16 @ 600 mm	D16 @ 600 mm	D12 @ 600 mm	D16 @ 600 mm

FULLY GROUTED 200 mm WALL				
Design Windspeed (m/s)	Vertical Reinforcement		Horizontal Reinforcement	
	ZONE 7	ZONE 8	ZONE 7	ZONE 8
≤ 51	D12 @ 600 mm	D12 @ 600 mm	D16 @ 600 mm	D16 @ 600 mm
52 - 60	D12 @ 600 mm	D16 @ 600 mm	D16 @ 600 mm	D16 @ 600 mm
61 - 74.5	D16 @ 600 mm	D16 @ 600 mm	D16 @ 600 mm	D16 @ 600 mm

**Note**

In bracing panels (see C3.5) of fully grouted masonry the spacing of horizontal reinforcement must be the minimum of -

- (i) half the panel's length or height, and
- (ii) the values in this table.



Vertical reinforcement must be located in the cells containing starter reinforcement from footings or from the lower structural wall. It must extend from the footing to the bond beam next above and from the lower to the upper bond beams.

Horizontal reinforcement is required just below all openings. This is also required above small openings over which lintels are not provided. Such horizontal reinforcement above and below openings must extend at least 600 mm beyond either side of the opening (see Fig. C3.1.2 A & B).

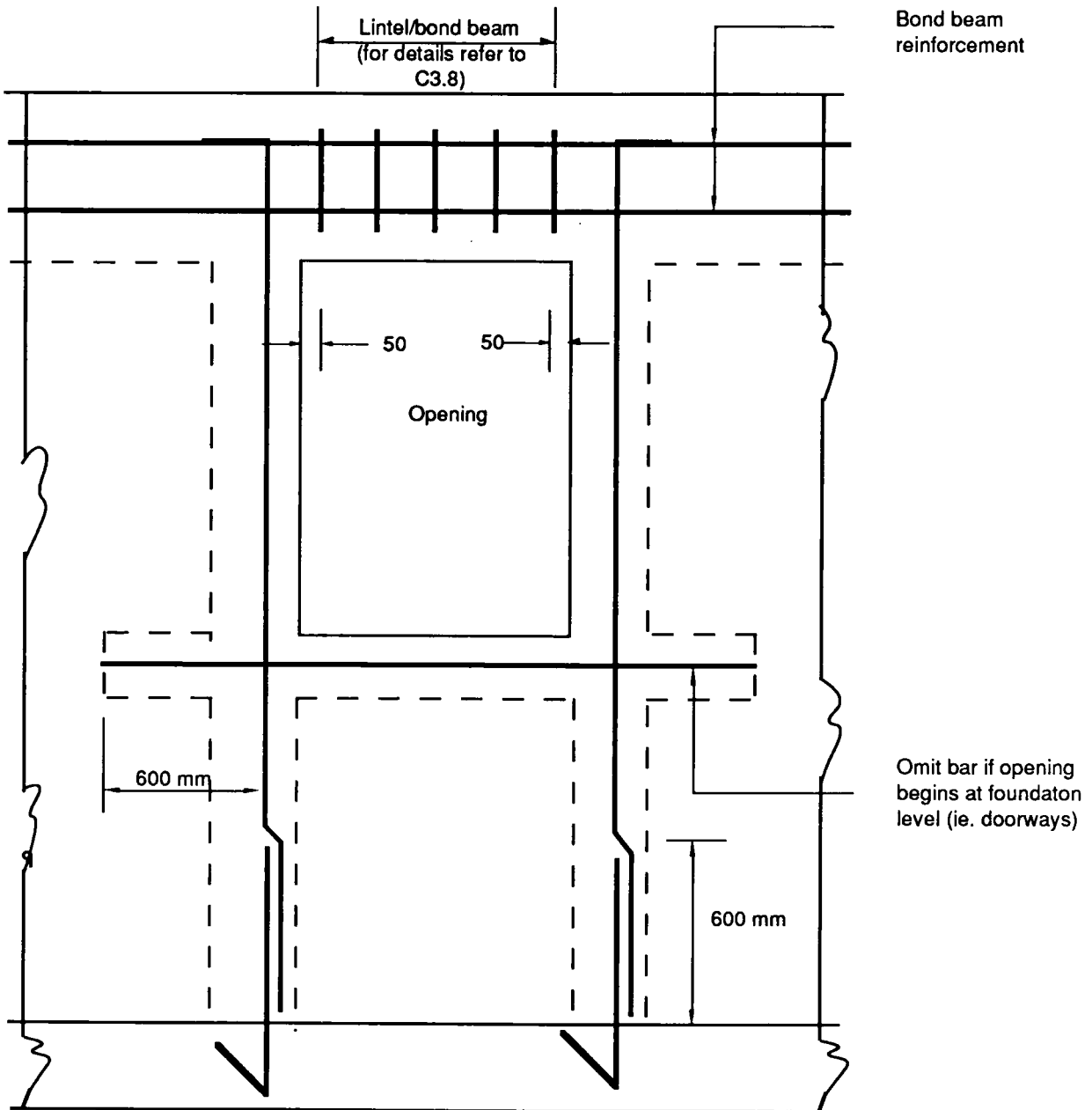


FIGURE C3.1.2A REINFORCEMENT DETAILS AROUND OPENINGS IN WALLS

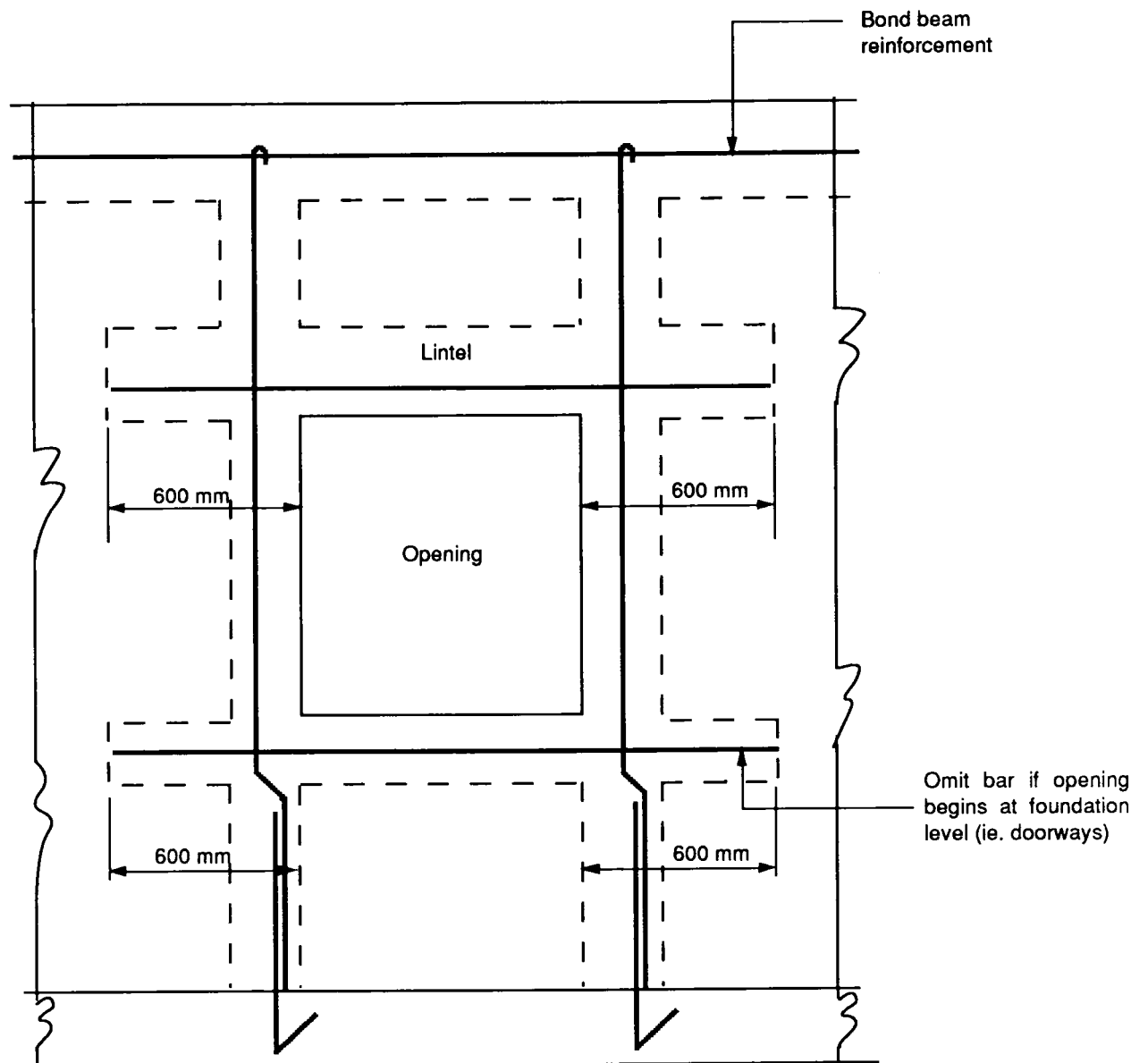
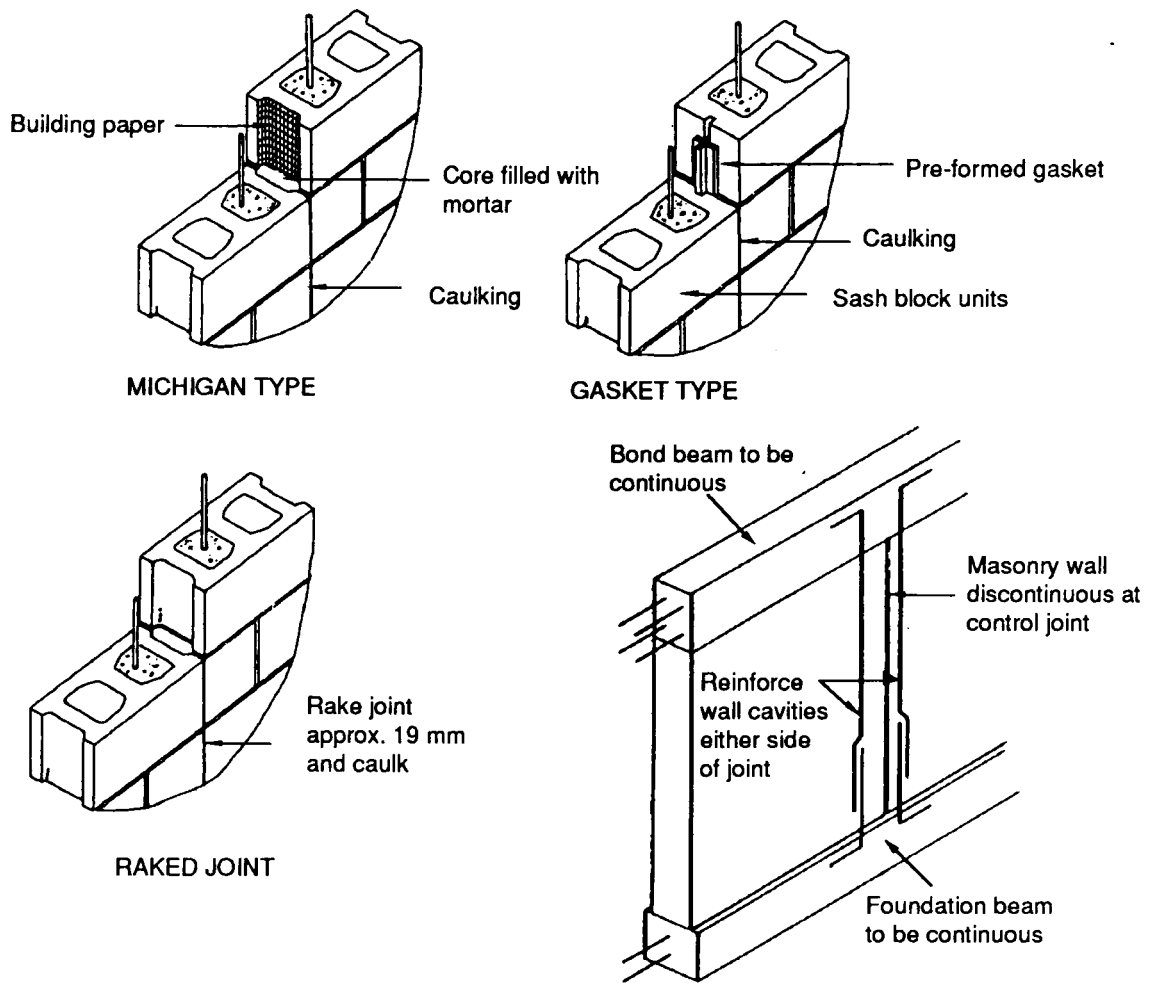


FIGURE C3.1.2B REINFORCEMENT DETAILS AROUND OPENINGS IN WALLS

**C3.1.3** Any wall in excess of 8 m length must have shrinkage control joints to the details of Figure C3.1.3A



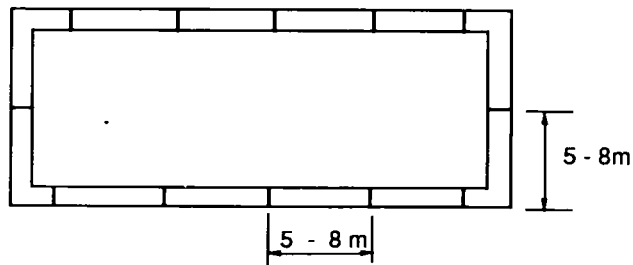
**FIGURE C3.1.3A** SOME METHODS OF PROVIDING SHRINKAGE CONTROL JOINTS

The cavity on each side of the joint must be reinforced and grouted. The horizontal reinforcement for the wall must be discontinued at the joint. However, the horizontal reinforcement of bond beams and lintels must be continuous across the joint. The control joints on external walls must be weather and vermin proof.

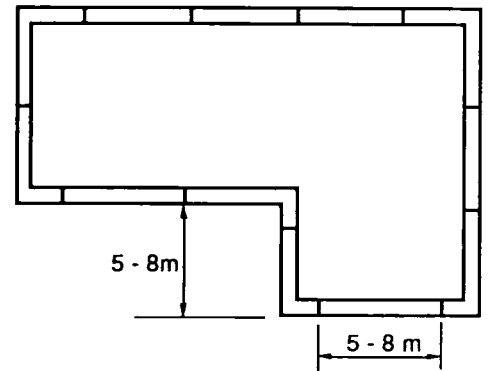
Shrinkage control joints are to be located at

- intervals of 5 to 8 m along straight walls
- major changes in wall height
- near return angles of walls in the case of floor plans other than a simple rectangle or square
- near wall intersections
- changes in wall thickness.

Some of these locations are illustrated in Figure C3.1.3B.



RECTANGULAR BUILDING PLAN



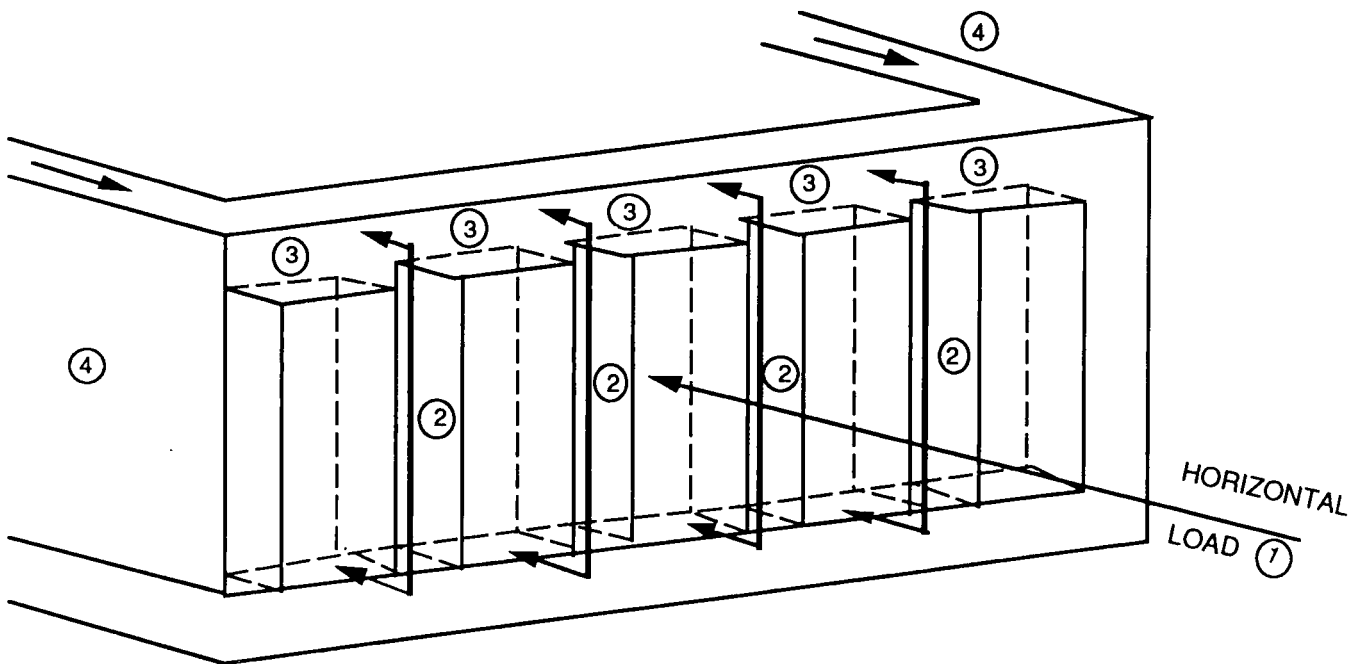
IRREGULAR BUILDING PLAN

FIGURE C3.1.3B LOCATION OF CONTROL JOINTS AGAINST SHRINKAGE

### C3.2 Structural Walls

Structural walls including foundation walls are designed to take horizontal loads and need to have bond beams and bracing panels built into them. The function of the bond beam is to transfer horizontal loads to the bracing walls. These are walls containing bracing panels. The panels resist the racking loads transferred by the bond beams. Figure C3.2 explains the role of bond beams and bracing walls.

The details of walls in this manual are such that once the provisions for horizontal loads have been met by using the appropriate tables the walls would safely carry the required vertical loads, both downward and wind uplift.



- ① Horizontal load (Earthquake, Wind)
- ② Vertical steel and associated concrete blocks transfer load to bond beam ③
- ③ Bond beam transfers load to bracing walls ④

Note - When the direction of the horizontal load changes by 90°, the roles of the bracing wall and the braced wall are reversed.

FIGURE C3.2 ROLE OF BOND BEAMS AND BRACING WALLS

### **C3.3 Materials for Structural Walls**

The materials considered for structural walls are reinforced masonry of 150 mm or 200 mm nominal thickness hollow core concrete blocks. The walls are fully grouted.

### **C3.4 Bracing Demand**

The demand for bracing arises from earthquake or wind loads. Table C3.4 A gives the bracing demand for earthquake in terms of bracing units. (100 bracing units are equal to a strength of 5 kN. There is no need to apply this information in the use of this Manual ).

Table C3.4 B similarly gives the bracing demand for wind loads, again expressed in bracing units.

**C3.4.1** In order to calculate the bracing demand for earthquake for any proposed (or existing) house, use the following procedure :-

#### **STEP 1**

Match the type of the storey or the house to the particular combination of seismic zone (7 or 8), type of partitions used (light timber or masonry), and the type and location of storey (upper, lower or foundation wall) to Table C3.4A. This gives the bracing demand per square metre for the storey.

#### **STEP 2**

Multiply the bracing demand per square metre from Step 1 by the plan area of the storey being considered. This will give the total bracing demand for that storey.

#### **COMMENT**

This total bracing demand must be met in each of the two principal directions, along and across the building.

#### **STEP 3**

Determine the local bracing demand separately for each line of external wall and internal walls. For the lines of external walls, the demand for each line of wall is calculated by multiplying its length in meters by 2 m and further multiplying the product by the bracing demand per square metre found from Step 1.

For internal lines of wall, this is done by multiplying the length of each line in metres by 4 m and further multiplying the product by the bracing demand per square metre.

**C3.4.2** The bracing demand for wind has to be calculated separately for the two principal directions of the building. Use the following steps for these calculations :-

#### **STEP 1**

Select from Table C3.4B the appropriate value of bracing demand per meter length of wall, depending on the type of storey, the roof slope and the design windspeed (determined from either Tables A4.5.1 or A4.5.2)

#### **COMMENT**

The design windspeed in the two principal directions of the building could be different in some cases. For example a house located on top of an escarpment will usually face the steeply sloping face of the escarpment in one direction and a relatively flat ground in the other direction at right angles. The two design windspeeds would then be different. If so select the bracing demand for each windspeed and apply it for the relevant direction.

#### **STEP 2**

Multiply the appropriate value of unit bracing demand from Step 1, with the length in metres of the external wall facing the wind in each direction. This will give the total bracing demand for wind for each of the two directions.

TABLE C3.4A

## BRACING DEMAND (BRACING UNITS) - EARTHQUAKE

SINGLE STOREY					
Masonry Wall Thickness	Location of Storey	Bracing units required per square meter for zones			
		7	8	7	8
150 mm	Single storey	(Light Timber Frame Partitions)		(Internal Masonry Walls)	
		25	29	39	44
200 mm	Single storey	31	36	50	58

SINGLE STOREY WITH FOUNDATION WALL					
Masonry Wall Thickness	Location of Storey	Bracing units required per square meter for zone			
		7	8	7	8
150 mm	Single storey	(Light Timber Frame Partition)		(Internal Masonry Walls)	
	32	36	47	55	
200 mm	Foundation wall	54	62	77	88
	Single storey	40	45	61	70
	Foundation wall	67	76	98	112

DOUBLE STOREY - TIMBER FRAMING ON TOP STOREY AND MASONRY BELOW					
Masonry Wall Thickness	Location of Storey	Bracing units required per square meter for zone			
		7	8	7	8
150 mm	Lower storey	(Light Timber Frame Partitions)		(Internal Masonry Walls)	
		35	40	45	52
200 mm	Lower storey	40	46	55	63

DOUBLE STOREY - MASONRY ON UPPER & LOWER STOREYS					
Masonry Wall Thickness	Location of Storey	Bracing units required per square meter for zone			
		7	8	7	8
150 mm	Top storey	(Light Timber Frame Partitions)		(Internal Masonry Walls)	
	34	39	52	60	
200 mm	Lower storey	64	73	98	112
	Top storey	42	48	68	77
	Lower storey	80	91	126	145

- Notes
- This set of tables applies only to houses with a light roof (timber framing and metal roofing sheets) with a maximum slope of 25°
  - In the case of double storey houses with timber framing for the top storey, refer to Section B for the determination of the details for the top storey.

TABLE C3.4B

## BRACING DEMAND (BRACING UNITS) - WIND

Location of Storey	Maximum Slope of Roof (degrees)	Minimum bracing units required per metre when exposed to design windspeed (m/s) of			
		≤ 51	52 - 60	61 - 69	70 - 74.5
Single or top storey	10	45	62	81	95
	15	45	62	81	95
	20	53	73	97	113
	25	77	106	141	164
Foundation wall of one storey	10	70	96	128	149
	15	70	96	128	149
	20	83	115	152	177
	25	120	167	220	257
Lower of two storeys	10	129	179	236	275
	15	129	179	236	275
	20	153	212	281	327
	25	223	306	408	475

### STEP 3

Multiply the appropriate value of the unit bracing demand from Step 1 with twice the length of each line of external wall and four times the length of each line of internal wall. The resulting figures would give the local bracing demand for the external and internal walls.

### STEP 4

Compare the total bracing demand for earthquake with the total demand for wind in each of the two directions. Whichever is higher has to be satisfied by adequate capacity of bracing walls. It is possible that in one direction the earthquake demand might govern and in the other the wind demand.

Compare the local bracing demand for each line of external and internal walls for earthquake and wind. Again whichever is higher has to be met by ensuring adequate bracing capacity for each line of wall concerned.

The manner of checking to see if the total and local bracing demands are met is explained in the latter part of C3.5.

### **C3.5 Bracing Panels**

Table C3.5 A gives details of the capacity of bracing panels. The bracing capacity in these tables is expressed in bracing units. (Like in Tables C3.4A and C3.4B for the bracing demand). The total bracing capacity of walls in any storey in each direction must match or exceed the maximum bracing demand for that storey for the two directions. The maximum bracing demand may be either due to earthquake or due to wind loads. In the case of earthquake, the value of the bracing demand is the same for the two directions. However for wind loads, the demand is usually different for the two directions.

In using the Table C3.5A for the calculations of the total bracing capacity of a wall, the following procedure is adopted:

- (a) For each storey each length of wall between shrinkage control joints is divided into bracing panels.
- (b) Where there are no openings (openings of less than 400 mm x 400 mm spaced at not less than 1.8 m are neglected) in a wall for the full length between the control joints, the height of the wall in the storey to the underside of the bond beam is considered to be the height of the panel and the length of the panel taken as the length between the control joints.
- (c) Where there are openings between control joints such as doors and windows, the length of each panel is the length between adjacent openings. The height of each panel is the minimum height of the opening adjoining that panel.
- (d) The points mentioned in (a), (b) and (c) are illustrated in an example in Figure C3.5 A. The calculation of the bracing capacity of the total wall in the figure is as follows:
  - (i) Assuming that the nominal wall thickness is 150 mm, the capacity of each panel and of the total wall are as follows:

	length x height	bracing units
Panel 1	1.2 x 2.0	450
Panel 2	1.6 x 1.2	1500
Panel 3	2.0 x 1.2	2400
Panel 4	3.0 x 1.6	$(3400 + 3850)/2 = 3625$
Panel 5	1.8 x 1.6	$(1500 + 2400)/2 = 1950$
Panel 6	6.0 x 2.8	5950
Total for 150 mm fully grouted wall		= <u>15875</u> bracing units

In order for a panel to qualify for the bracing capacity given in Table 3.5A, the spacing of the horizontal reinforcement must be to the detail given in Figure C3.5B. The other details of reinforcement are as given in Table C3.1.2.

In order to check if the bracing capacity is adequate to meet the bracing demand, the following procedure must be followed:-

#### STEP 1

Calculate the bracing capacity of each line of external and internal walls as illustrated earlier in this clause.

#### STEP 2

Check to see if the capacity of each line is more than the local demand for that line as was determined in the second part of Step 4 at Clause C3.4.2.

#### COMMENT

If the capacity provided is not adequate, it may be increased by increasing wall thickness, eliminating some openings or reducing their size, or a permitted combination of these.

#### STEP 3

Check to see if the sum of the capacity of all the lines of bracing walls in each principal direction is more than the demand for that direction as determined in the first part of Step 4 at Clause C3.4.2.

#### COMMENT

If the capacity is not adequate, it can be increased by corrective steps suggested in the comment on Step 2 and also by providing more bracing walls by rearranging the layout of the house.

It must be ensured that both the total bracing demand and the local demand are met.



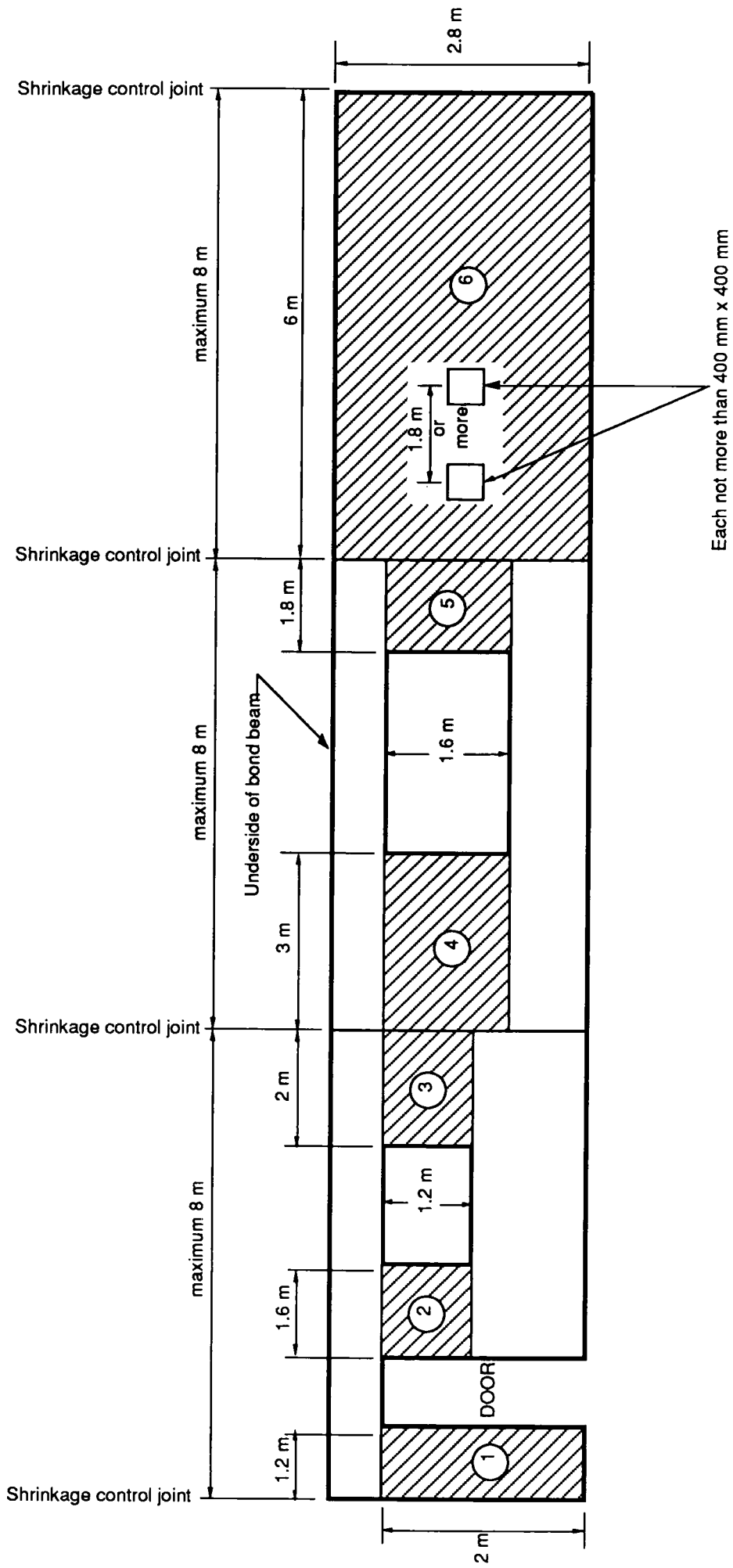
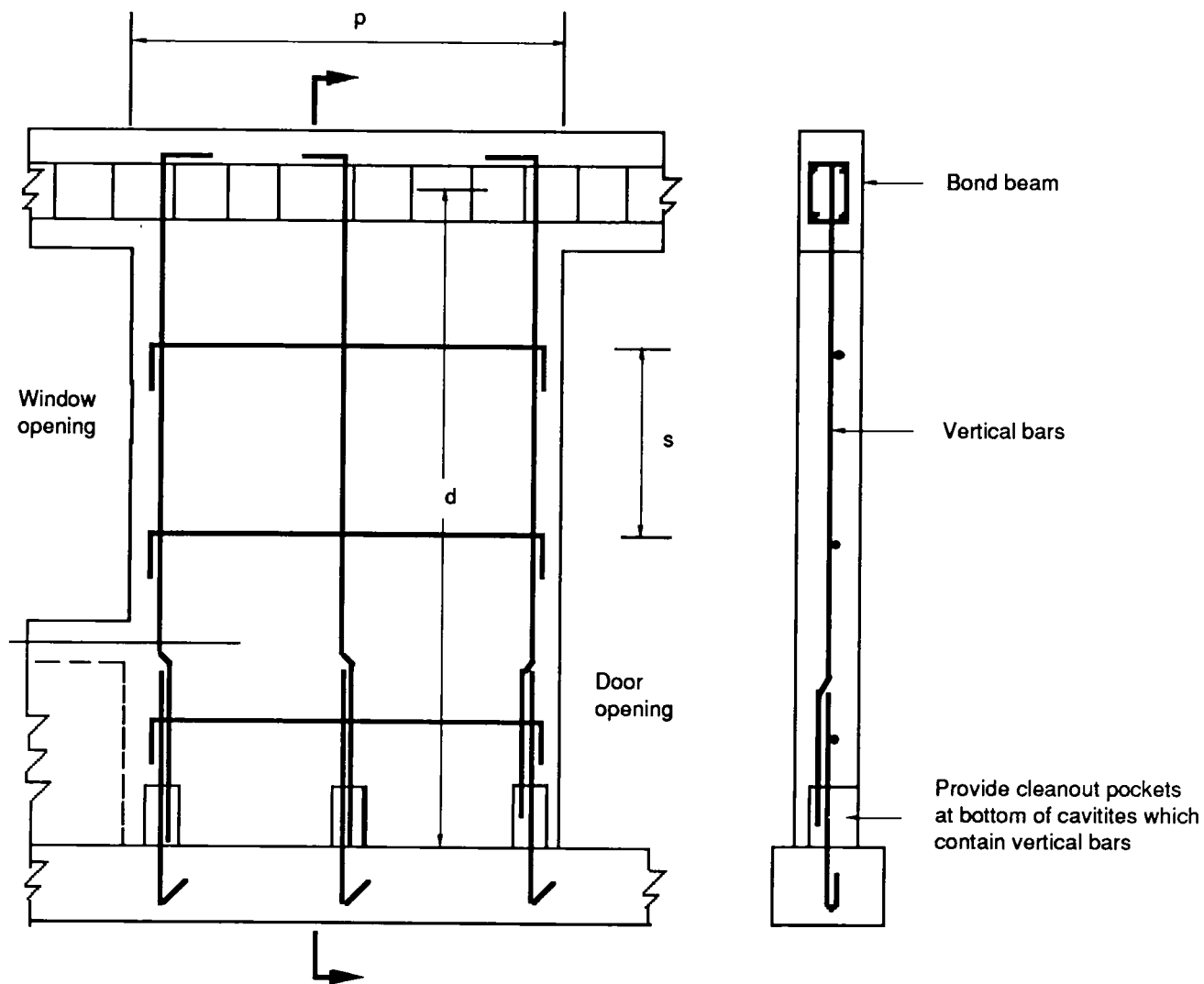


FIGURE C3.5 A EXAMPLES OF BRACING PANELS



**Note:** The value of  $s$ , the spacing of the horizontal bars in the panel must be no more than the least of  $p/2$  or  $d/2$  or the value given in Table C3.1.2

**FIGURE C3.5B BRACING PANEL IN FULLY GROUTED MASONRY BETWEEN DOOR AND WINDOW OPENINGS**

TABLE C3.5A CAPACITY OF FULLY GROUTED WALL BRACING PANELS IN BRACING UNITS

		Wall thickness 150 mm																		
Panel height (m)		Length of panel (m)																		
		0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.0
0.8		1300	1600	2400	2900	3400	3850	4300	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600	
1.0		1100	1550	2400	2900	3400	3850	4700	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600	
1.2		1000	1500	2400	2900	3400	3850	4300	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600	
1.4		400	750	1300	2400	2900	3400	3850	4300	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600
1.6		300	650	1150	2400	2900	3400	3850	4300	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600
1.8		200	550	1000	1900	2750	3400	3850	4300	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600
2.0		150	450	950	1550	2250	3000	3750	4300	4800	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600
2.2		100	350	750	1250	1850	2500	3200	3900	4650	5300	5750	6250	6700	7200	7700	8150	8650	9100	9600
2.4		100	300	600	1000	1550	2100	2750	3400	4050	4700	5400	6050	6700	7200	7700	8150	8650	9100	9600
2.6		50	250	500	850	1300	1800	2350	2950	3550	4150	4750	5400	6000	6600	7250	7850	8450	9050	9600
2.8 (max)		50	200	400	700	1100	1550	2050	2550	3100	3650	4250	4800	5400	5950	6550	7100	7650	8250	8800
		Wall thickness 200 mm																		
0.8		1100	1600	2300	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
1.0		950	1500	2150	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
1.2		750	1300	2000	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
1.4		600	1000	1750	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
1.6		400	900	1550	3250	3900	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
1.8		300	750	1300	2600	3700	4550	5200	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
2.0		200	600	1250	2100	3050	4050	5100	5850	6500	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
2.2		150	500	1000	1700	2500	3400	4350	5300	6300	7150	7800	8450	9100	9750	10400	11100	11750	12400	13050
2.4		150	400	800	1400	2100	2850	3700	4600	5500	6400	7300	8200	9100	9750	10400	11100	11750	12400	13050
2.6		100	300	650	1150	1750	2450	3200	4000	4800	5600	6450	7300	8150	9000	9800	10650	11450	12300	13050
2.8		100	250	550	950	1500	2100	2750	3450	4200	4950	5750	6500	7300	8100	8850	9650	10400	11200	11950
3.0		50	200	450	800	1250	1800	2390	3050	3700	4400	5100	5850	6550	7300	8050	8750	9500	10200	10900

### C3.6 Bond Beams

Bond beams serve the following purpose:

- (a) tie the masonry wall together
- (b) transfer lateral loads on the walls in which they are located, to bracing walls at right angles to them.
- (c) provide the anchorage required for roof and floor members.

Bond beams must be provided at the top of all masonry walls and at lower levels corresponding to the location of the suspended floor in a two-storey house or a house with foundation walls. A bond beam is considered to be a "top bond beam" if it is not overlain by any masonry, timber frame, floor or other superstructure. Other bond beams are known as intermediate bond beams, such as on top of foundation walls.

The requirements for intermediate bond beams are more stringent than for top bond beams.

The maximum span of a bond beam is normally 5 m. The span is the spacing of the bracing walls to which the bond beam transfers horizontal loads. However, a line of bracing walls is considered to function in a line if there is no offset greater than 2 m between panels in the same line of internal walls. (See Figure C3.6). When this happens, the maximum allowable span can be up to 7 m.

The details of top and intermediate bracing beams are given in Table C3.6 for different earthquake zones and design windspeeds. In using this table it must be remembered that the details of a top beam suitable for a particular design windspeed in a particular earthquake zone can be used for top beams of smaller spans or for lower design windspeeds in the same earthquake zone. The same applies for intermediate beams.

Sloping bond beams must be provided at the top of gable shaped walls and be continuous with adjoining bond beams. The intersection of bond beams must be detailed as for footings shown in Figure D4.6

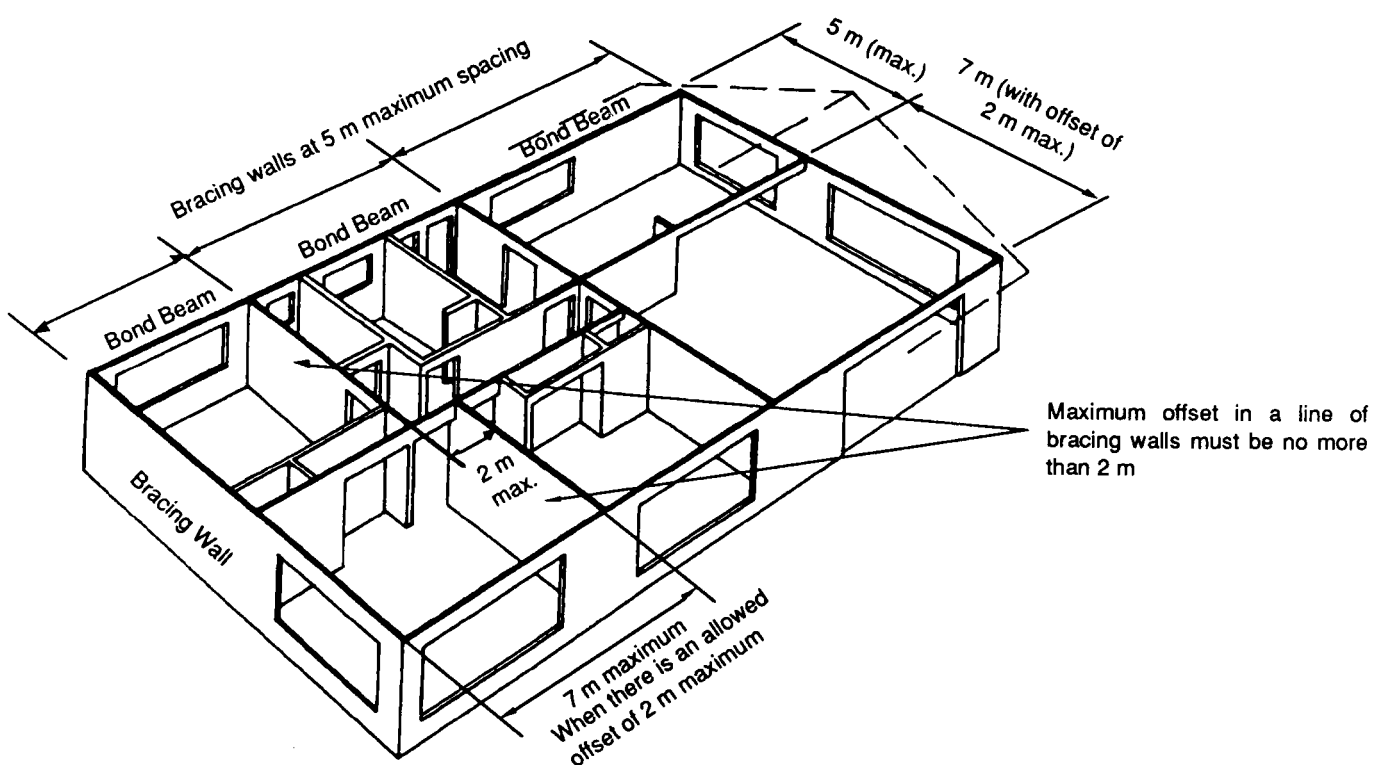


FIGURE C3.6 BRACING BEAMS AND BRACING WALLS

TABLE C3.6

**BOND BEAM SIZES FOR ALL EARTHQUAKE ZONES AND FOR DIFFERENT DESIGN WINDSPEEDS  
HEIGHT OF 3.0 m BETWEEN BOND BEAMS**

Span (m)	Design Windspeed (m/s)					
	Top Bond Beam		Intermediate Bond Beam			
	≤ 51	61 - 69	70 - 74.5	52 - 60	61 - 69	70 - 74.5
2	C 150 x 200 2 D12	or C 200 x 200 2 D12	M/C 150 x 400 2 D16 or M/C 200 x 200 2 D16	C 150 x 200 2 D12	or C 200 x 200 2 D12	
3	C 150 x 200 2 D12	or C 200 x 200 2 D12	M/C 150 x 400 2 D16 or M/C 200 x 200 2 D16	C 150 x 200 2 D12 or C 200 x 200 2 D12	M/C 150 x 400 2 D16 or M/C 200 x 200 2 D16	
4	M/C 150 x 400 2 D16 or M/C 200 x 200 2 D16	M/C 150 x 400 4 D12 or C 200 x 400 4 D12	C 150 x 400 4 D16 or C 200 x 400 4 D16	M/C 150 x 400 2 D16 or M/C 200 x 200 2 D16	M/C 150 x 400 4 D16 or M/C 200 x 400 4 D16	
5	M/C 200 x 400 4 D12 or C 150 x 400 4 D12	C 200 x 400 4 D12 or M/C 150 x 400 4 D16	C 150 x 400 4 D16 or C 200 x 400 4 D16	M/C 150 x 400 2 D16 or M/C 200 x 200 2 D16	M/C 150 x 400 4 D16 or M/C 200 x 400 4 D16	M/C 150 x 400 4 D20 or C 200 x 400 4 D16
6*	C 150 x 400 4 D16 or C 200 x 400 4 D16	C 150 x 400 4 D20 or C 200 x 400 4 D16	C 150 x 400 4 D16 or C 200 x 400 4 D16	C 150 x 400 4 D20 or C 200 x 400 4 D16	C 150 x 400 4 D16 or C 200 x 400 4 D16	
7*	C 150 x 400 4 D20 or C 200 x 400 4 D16					

\* Refer to Clause 3.6

Note: M stands for masonry bond beam

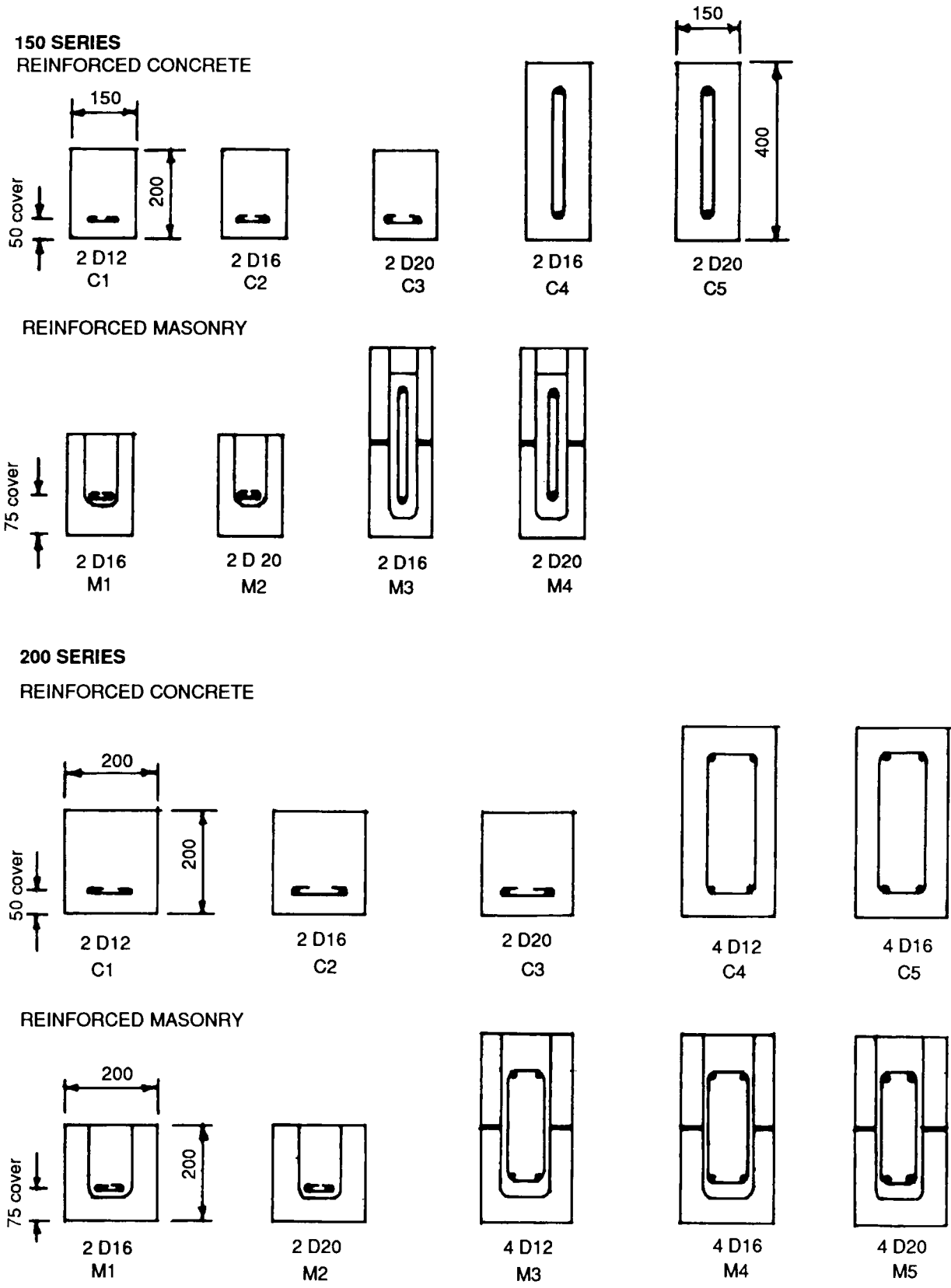
C stands for concrete (17.5 MPa) bond beam



All reinforcement to be placed as in sketch

### C3.7 Lintels

Lintels must be provided over all openings such as doors and windows. The width of the lintel must be the same as the thickness of the wall. Lintels must bear at their ends for 200 mm. The span of the lintel is the clear width of the opening. Tables C3.7A to C3.7E and Figure C3.7 give the dimensions and reinforcement for lintels of various spans for different design windspeeds.



200 deep lintels must have R6 ties at 600 mm

400 deep lintels must have R6 ties at 200 mm

FIGURE C3.7 REINFORCED CONCRETE AND MASONRY DETAILS.

**TABLE C3.7A**

<b>LINTEL SUPPORTING LIGHT ROOF ONLY</b>					
Width of Lintel (mm)	Maximum Span of Lintel (mm)	DESIGN WINDSPEED (m/s)			
		≤51	52 - 60	61 - 69	70 - 74.5
150	1600	C1/M1	C2/M1	C2/M2	C3/M3
	2000	C2/M1	C2/M2	C3/M2	C3/M3
	2600	C2/M2	C4/M3	C4/M4	C4/M4
	3000	C4/M3	C4/M4	C5/M4	C5/M4
200	1600	C1/M1	C1/M1	C2/M1	C2/M2
	2000	C1/M1	C2/M1	C3/M2	C3/M3
	2600	C2/M2	C3/M2	C4/M3	C4/M4
	3000	C4/M3	C4/M4	C5/M4	C5/M5

**TABLE C3.7B**

<b>LINTEL SUPPORTING LIGHT ROOF AND LIGHT TIMBER FRAMED WALL</b>					
Width of Lintel (mm)	Maximum Span of Lintel (mm)	DESIGN WINDSPEED (m/s)			
		≤ 51	52 - 60	61 - 69	70 - 74.5
150	1600	C1/M1	C1/M1	C2/M1	C2/M2
	2000	C1/M1	C2/M1	C3/M2	C3/M3
	2600	C2/M2	C3/M2	C3/M3	C4/M4
	3000	C3/M2	C4/M3	C4/M4	C5/M4
200	1600	C1/M1	C1/M1	C2/M1	C2/M2
	2000	C1/M1	C2/M2	C3/M2	C3/M3
	2600	C2/M2	C3/M3	C4/M3	C4/M4
	3000	C4/M3	C4/M4	C5/M4	C5/M5

**TABLE C3.7C**

<b>LINTEL SUPPORTING LIGHT ROOF, LIGHT TIMBER FRAMED WALL AND FLOOR</b>					
Width of Lintel (mm)	Maximum Span of Lintel (mm)	DESIGN WINDSPEED (m/s)			
		≤ 51	52 - 60	61 - 69	70 - 74.5
150	1600	C1/M1	C1/M1	C2/M1	C2/M2
	2000	C1/M1	C2/M1	C3/M2	C4/M3
	2600	C2/M1	C3/M2	C3/M3	C4/M4
	3000	C3/M2	C3/M3	C4/M4	C5/M4
200	1600	C1/M1	C1/M1	C2/M1	C2/M2
	2000	C2/M2	C3/M2	C3/M3	C4/M3
	2600	C3/M2	C3/M3	C4/M3	C4/M4
	3000	C3/M3	C4/M3	C4/M4	C5/M5

**TABLE C 3.7D**

<b>LINTEL SUPPORTING LIGHT ROOF AND MASONRY WALL ONLY</b>					
Width of Lintel	Maximum Span of Lintel	DESIGN WINDSPEED (m/s)			
		≤ 51	52 - 60	61 - 69	70 - 74.5
150	1600	C2/M1	C2/M1	C2/M2	C2/M2
	2000	C2/M1	C2/M2	C2/M2	C3/M3
	2600	C2/M2	C2/M2	C4/M3	C4/M4
	3000	C4/M3	C4/M3	C5/M4	C5/M4
200	1600	C1/M1	C1/M1	C2/M1	C2/M2
	2000	C2/M1	C2/M1	C2/M2	C3/M3
	2600	C3/M2	C3/M3	C3/M3	C4/M3
	3000	C4/M3	C4/M4	C4/M4	C5/M4

**TABLE C 3.7E**

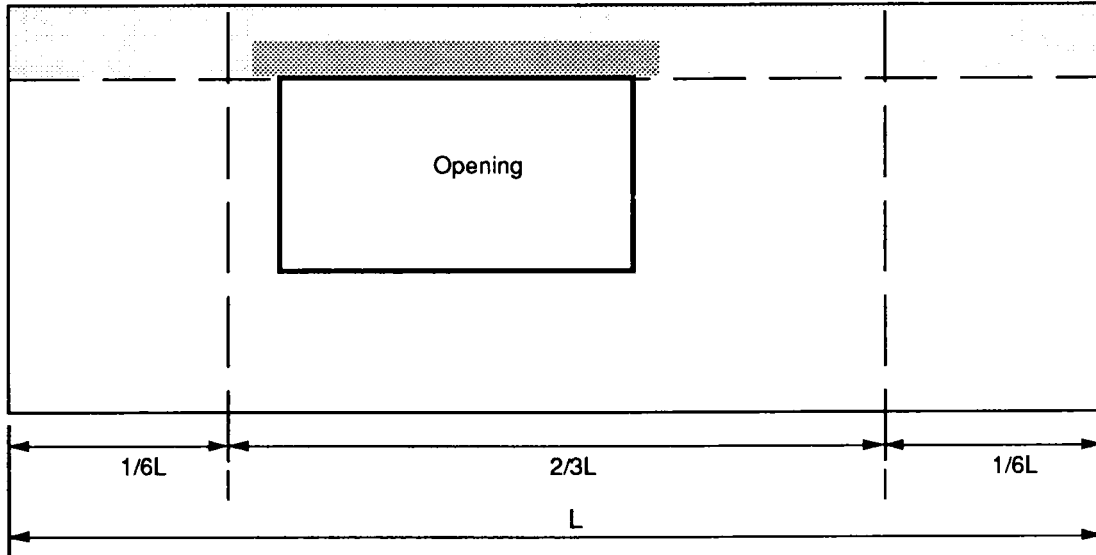
<b>LINTEL SUPPORTING LIGHT ROOF, MASONRY WALL AND TIMBER FLOOR</b>					
Width of Lintel	Maximum Span of Lintel	DESIGN WINDSPEED (m/s)			
		≤ 51	52 - 60	61 - 69	70 - 74.5
150	1600	C1/M1	C2/M1	C2/M2	C2/M2
	2000	C2/M1	C2/M1	C2/M2	C3/M3
	2600	C2/M2	C2/M2	C3/M2	C4/M3
	3000	C4/M3	C4/M4	C5/M4	C5/M4
200	1600	C2/M2	C2/M2	C2/M2	C2/M2
	2000	C2/M2	C3/M2	C3/M3	C3/M3
	2600	C3/M2	C3/M3	C4/M3	C4/M4
	3000	C4/M3	C4/M4	C5/M4	C5/M5



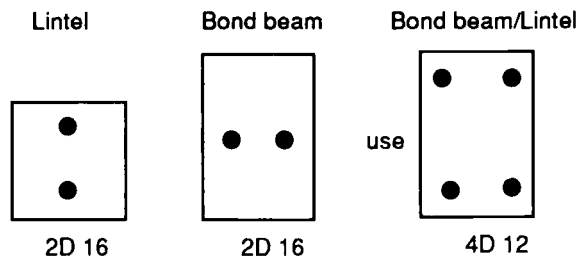
### C3.8 Combination of lintels and bond beams

In some cases it may become necessary to combine a bond beam and a lintel. Where the lintel is completely located within the middle 2/3 of the span of the bond beam, the combined beam/lintel must be of the larger of the two individual sizes and must have not less than the maximum of the reinforcement for either. The disposition of the reinforcement must be similar to the example shown in Figure C3.8 A so that the combination beam can take either the horizontal loads of the bond beam or the vertical loads of the lintel.

If the lintel is located in part or whole outside the middle 2/3 of the span of the bond beam, the reinforcement provided must be the sum of the reinforcement required for the bond beam and lintel. The disposition of the reinforcement must be as shown in Figure C3.8B.



OPENING WITHIN 2/3L, WHERE L IS THE LENGTH OF THE WALL

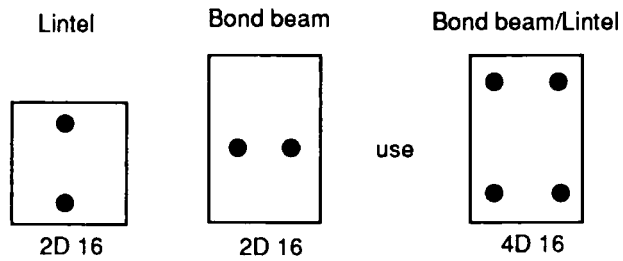
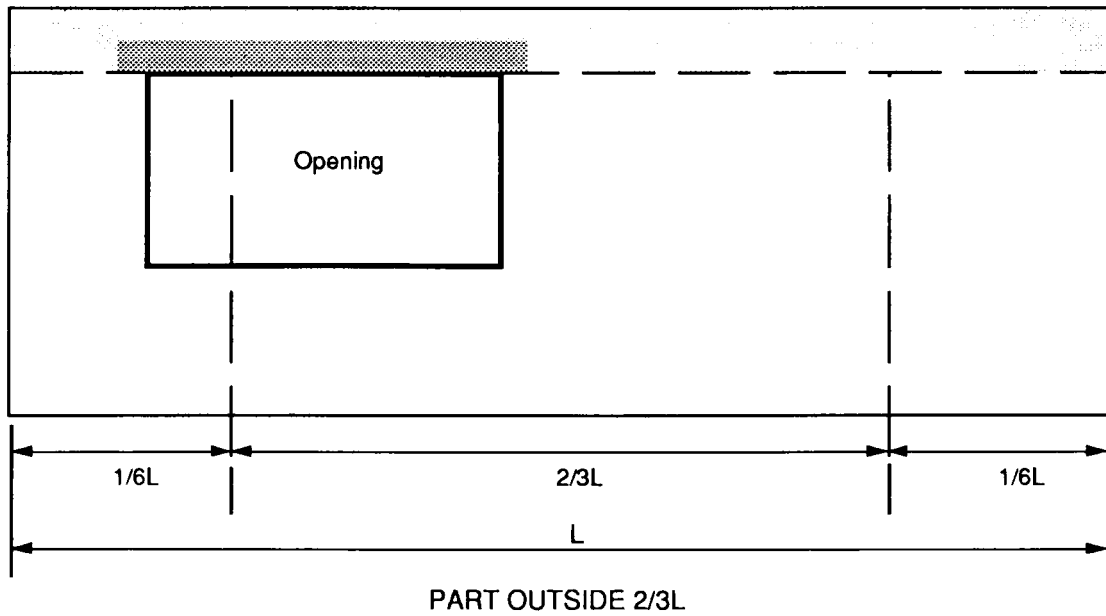


$$A_{st} (2D16) \sim A_{st} (4D12)$$

Note:  
These cross-sections are only examples

Steel required is the maximum of either for lintel or bond beam  
Steel must be located at the correct depth dictated by the lintel and correct horizontal position dictated by bond beam.

FIGURE C3.8A WHOLE OF LINTEL LOCATED WITHIN MIDDLE 2/3 OF BOND BEAM SPAN



Note:  
These cross-sections  
are only examples

Steel required is the sum of that for the lintel and the bond beam.  
Minimum steel required by lintel must be located at the correct depth.

FIGURE C3.8B PART OF LINTEL LOCATED OUTSIDE MIDDLE 2/3 OF BOND BEAM SPAN

**SECTION D**

**FOUNDATIONS**

## SECTION D FOUNDATIONS

### D1. GENERAL

#### D1.1 FOR TIMBER FLOORS

- (i) The foundation and sub-floor framing system to resist vertical loads must be such that the ground floor joists are directly supported on bearers which are fixed to piles embedded in concrete into the ground.
- (ii) Anchor piles must be provided under all load bearing walls, so as to resist wind uplift loads.
- (iii) Floor piles must be used under all areas supporting only a floor.
- (iv) Dimensions of anchor piles and floor piles are given in Table D3.1.
- (v) It has been assumed that the minimum bearing capacity of the soil is 100 kPa. (ie 1 Ton per sq. foot)

#### D1.2 FOR CONCRETE FLOORS AND FOOTINGS

- (i) Footings must be provided under all walls as described in Section D4.
- (ii) Compacted granular fill must be provided under footings and slab on ground floors.
- (iii) Dimensions and reinforcement details for footings are given in Section D4.
- (iv) Details for slab on ground floors are given in Section D5.

### D2 SITE REQUIREMENTS

The site must be well drained and cleared of all organic material. The foundation must be well compacted and consist principally of granular material. Houses must not be built in potentially unstable locations such as in or near slopes which might slide during heavy rains or earth tremors.

In uneven but stable ground the base of any footing (or sub-footing) must be so located that it is at least 1.0 m horizontally away from the finished ground surface (see Figure D2.1).

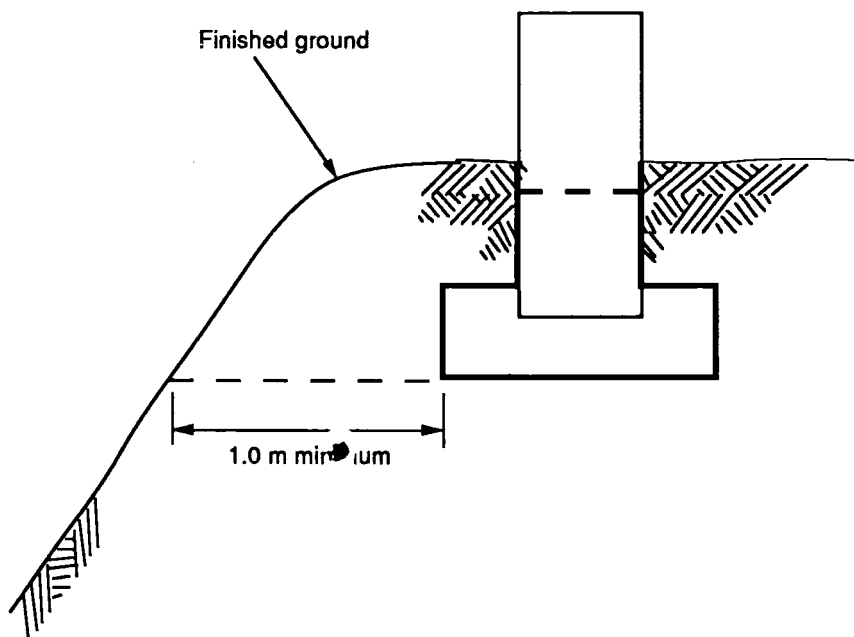


FIGURE D2.1 LOCATION OF FOOTINGS IN UNEVEN GROUND

Soil earth etc must not be allowed to bear against any wall unless the wall and the associated footings have been specifically designed as retaining walls.

### D3 ANCHOR PILES AND FLOOR PILES

Dimensions for anchor piles and floor piles are given below. An anchor pile is required to resist uplift loads and must be placed under all loadbearing walls. A floor pile is required to carry floor loads only.

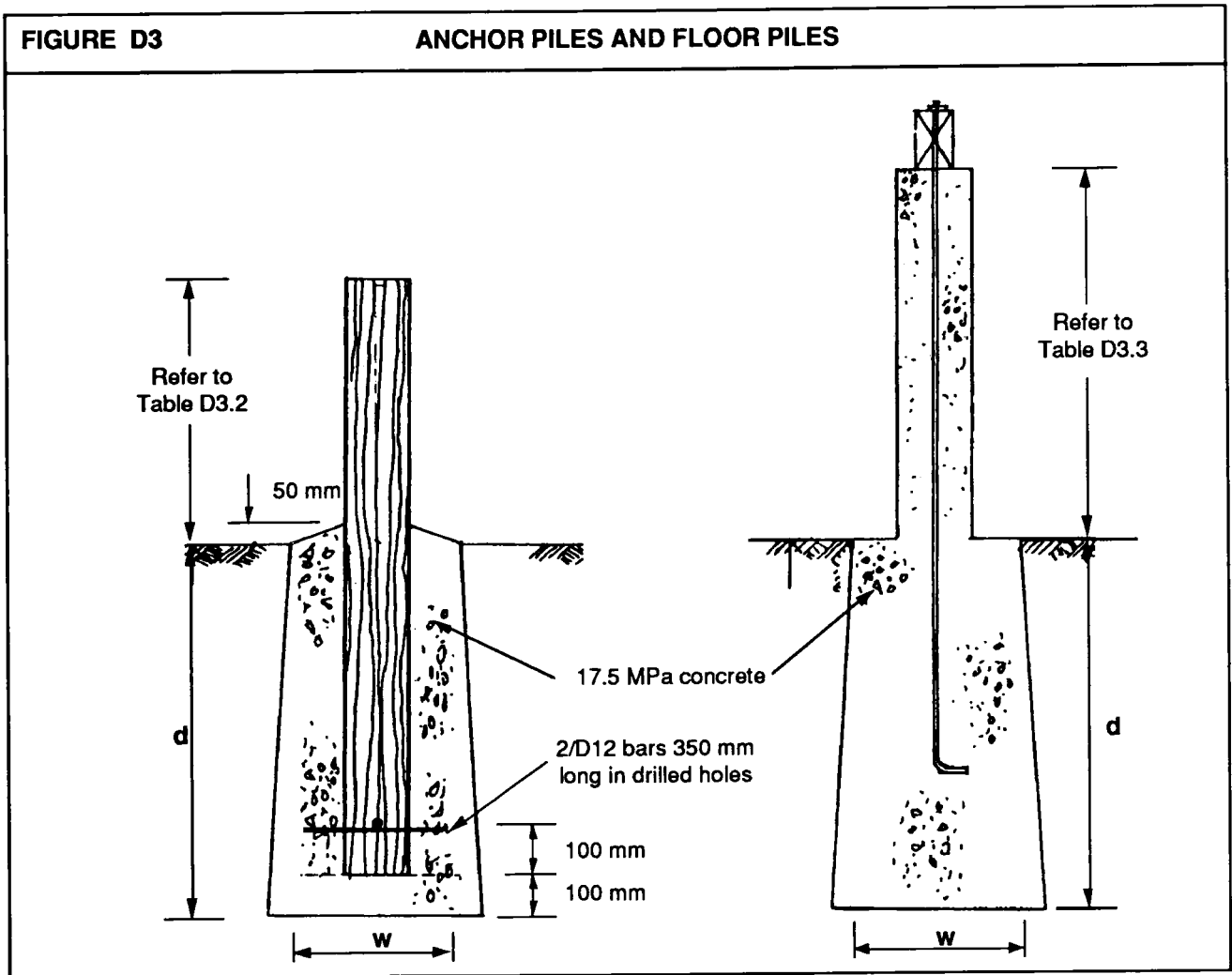


TABLE D3.1

SIZE OF ANCHOR PILES AND FLOOR PILES FOR MAXIMUM BEARER SPACING OF 3 METRES					
DESIGN WINDSPEED (m/s)	MAXIMUM BUILDING WIDTH (m)	SINGLE STOREY		TWO STOREY	
		SIZE OF ANCHOR PILE d x w	SIZE OF FLOOR PILE d x w	SIZE OF ANCHOR PILE d x w	SIZE OF FLOOR PILE d x w
≤ 51	9	500 x 450	500 x 450	500 x 450	500 x 450
52 - 55	9	750 x 450	500 x 450	750 x 450	500 x 450
56 - 57	9	750 x 450	500 x 450	1000 x 450	500 x 450
58 - 64	9	1000 x 450	500 x 450	1000 x 450	1000 x 450
65 - 69	6	1000 x 500	1000 x 450	1200 x 500	1000 x 450
	9	1000 x 600	500 x 450	1000 x 500	1000 x 450
70 - 74.5	4	1000 x 500	1000 x 450	N/A	N/A
	6	1000 x 600	1000 x 450	1200 x 600	1000 x 450
	9	1200 x 600	500 x 450	1200 x 600	1000 x 450

TABLE D3.2 SIZE OF ROUND TIMBER PILES

COLUMN HEIGHT ABOVE GROUND LEVEL (mm)	COLUMN DIAMETER (mm)
1000	150
1800	200
2400	225

NOTE : Timber posts to be treated in accordance with Local Preservative treatment requirements.

TABLE D3.3 SIZE OF REINFORCED CONCRETE AND MASONRY PILES

HEIGHT OF COLUMN ABOVE GROUND LEVEL (mm)	PLAN SIZE OF COLUMN (mm x mm)	REINFORCEMENT
≤ 2400	C 200 x 200 M 300 x 300	4 R10

#### D4 FOOTINGS

All masonry walls must be fully supported by a footing of reinforced masonry or reinforced concrete. The dimensions of reinforced concrete footings are given in Figure D4.1 and Table D4.1. The minimum thickness of footings must be 175 mm.

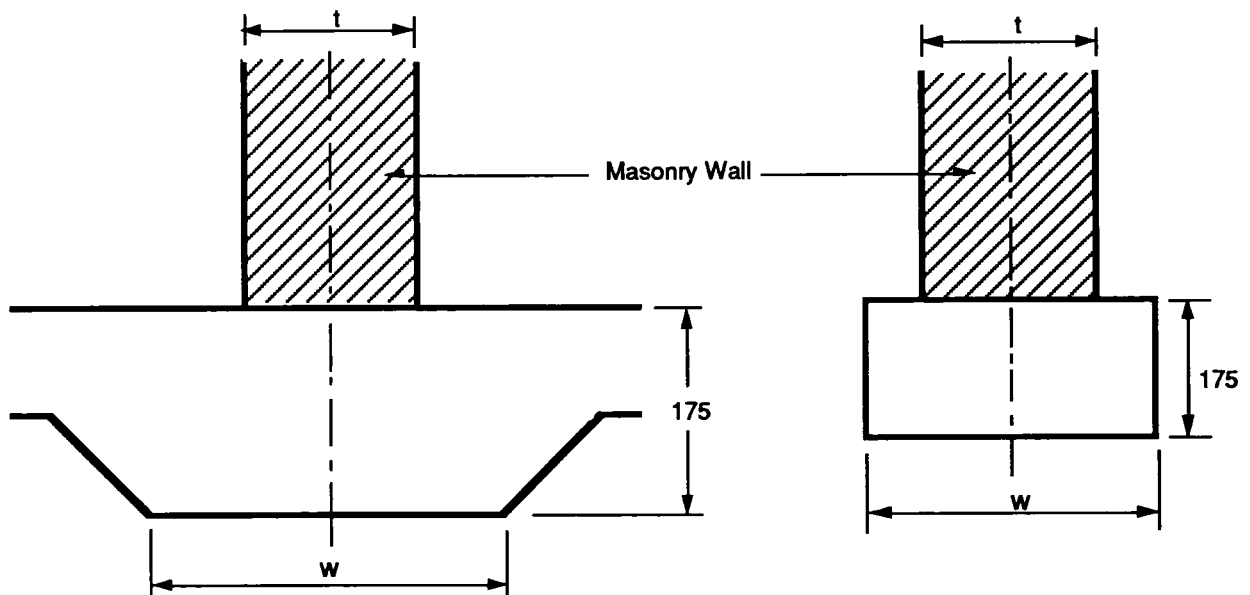


FIGURE D4.1 REINFORCED CONCRETE FOOTINGS

TABLE D4.1 REINFORCED CONCRETE FOOTING DIMENSIONS

Wall thickness $t$ (mm)	Footing width $w$ (mm)	
	Single Storey	Double Storey
150	300	300
200	300	400

Dimensions of reinforced masonry footings are given in Figure D4.2

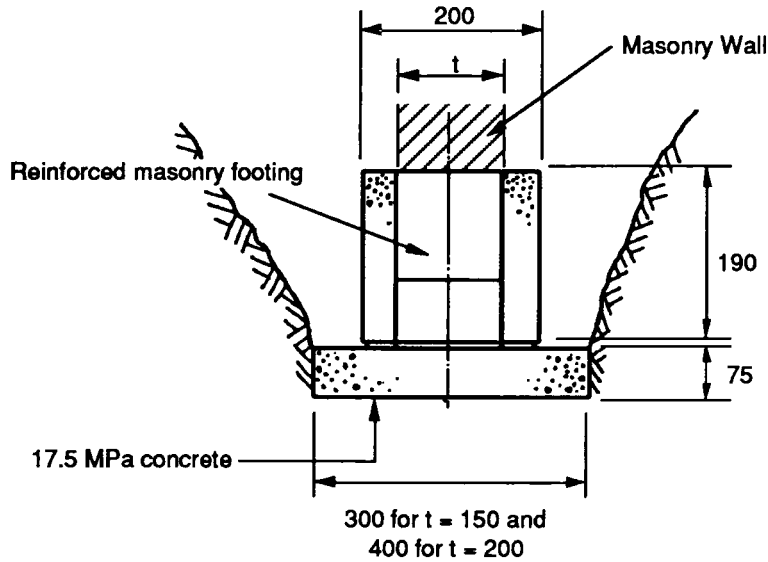


FIGURE D4.2 REINFORCED MASONRY FOOTING

Some site conditions may call for a sub-footing. When sub-footings are used, the dimensions of the main footings are altered. Dimensions of sub-footings in 10 MPa concrete are given in Figure D4.3. The figure also shows the changes to the dimensions of the main footings.

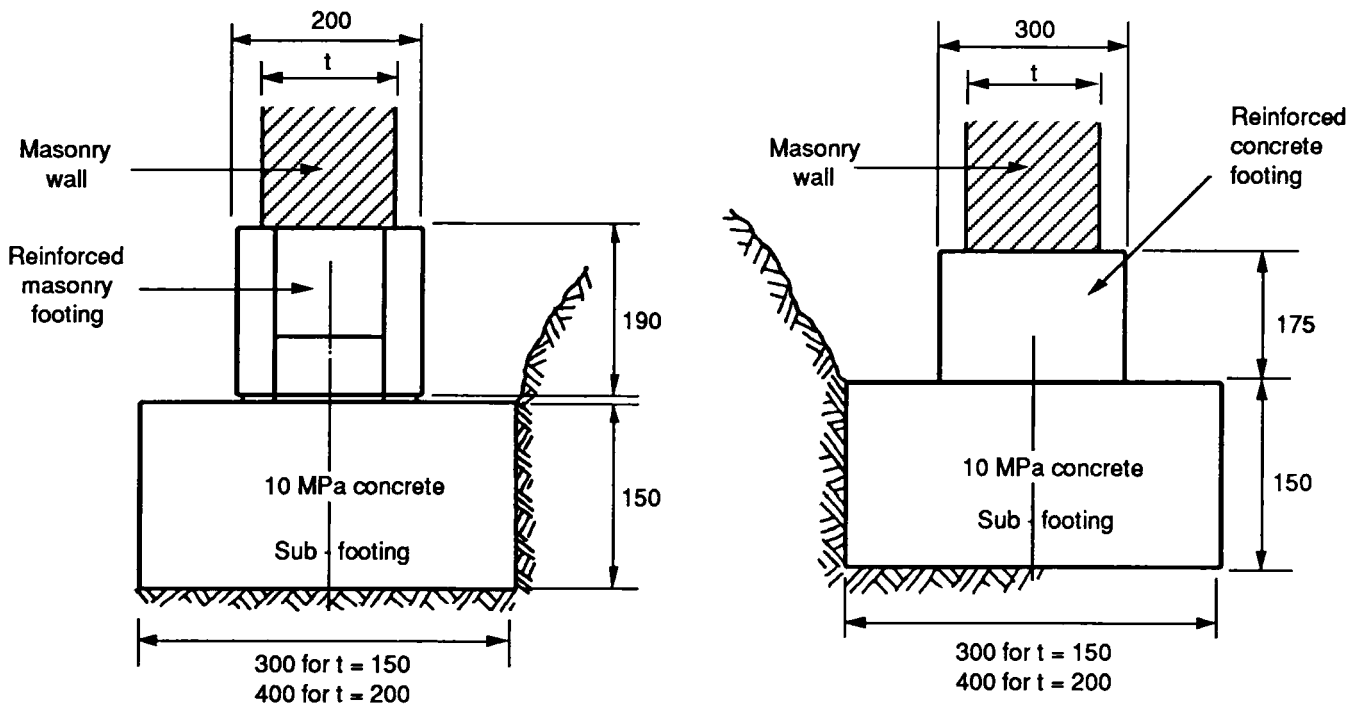


FIGURE D4.3 MASS CONCRETE SUB-FOOTING

The reinforcement to be provided for the footings is detailed in Figure D4.4. The reinforcement must be tied with R6 ties at 600 mm centres. The clear cover of 75 mm shown in the figures may be reduced to 50 mm in the case of masonry footings. The lap length of bars must be not less than 40 bar diameters for reinforced concrete and 60 bar diameters for masonry footings.

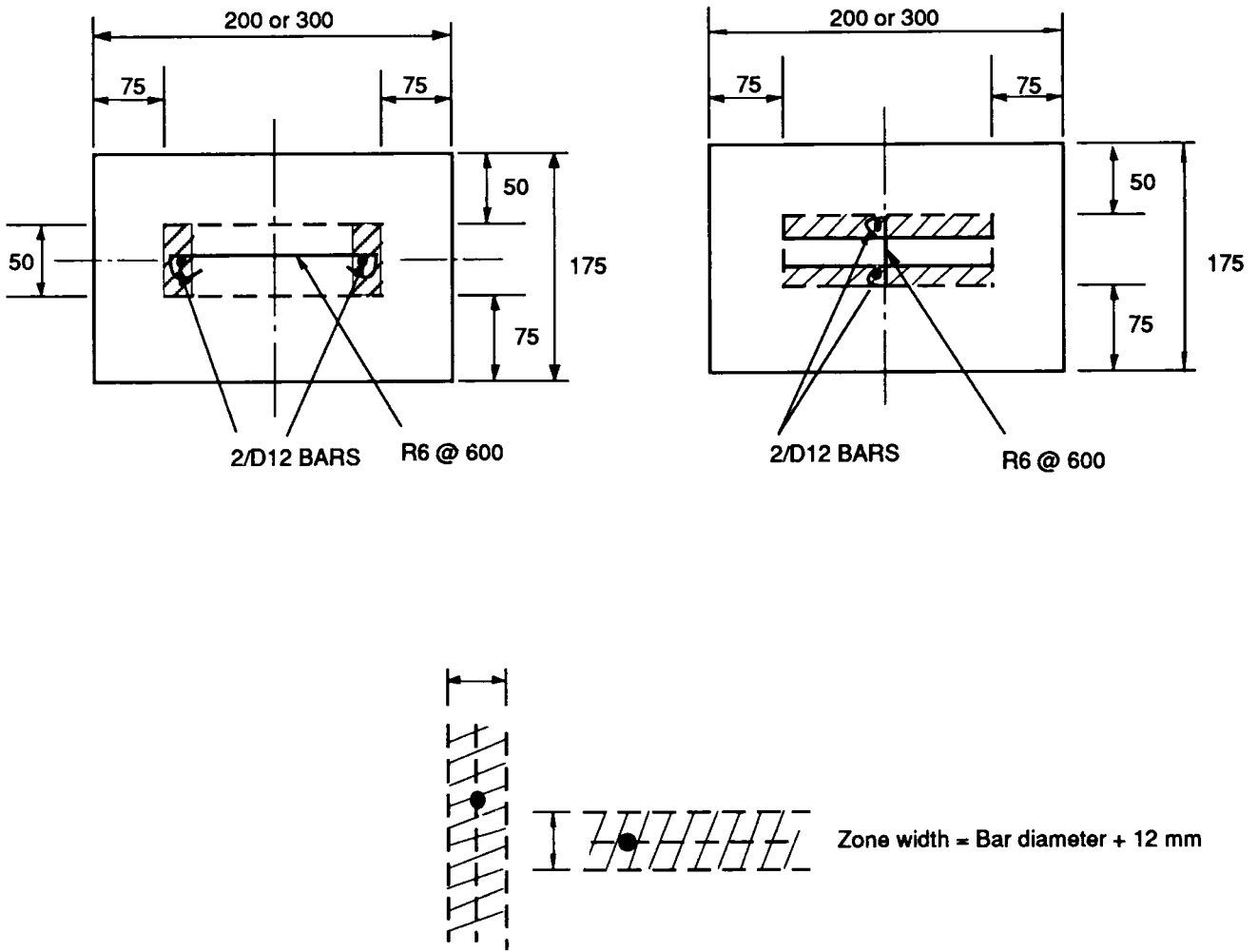


FIGURE D4.4 REINFORCEMENT DETAILS



Where steps in footings are required, the reinforcement must be as detailed in Figure D4.5.

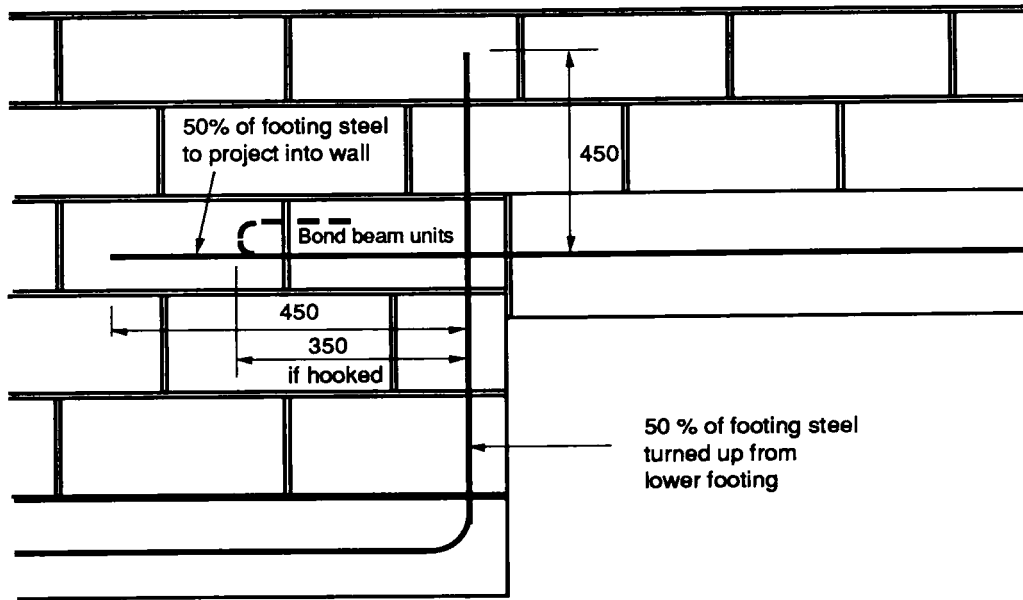


FIGURE D4.5 STEPPED FOOTING

At intersection of footings the arrangement of reinforcement must be as detailed in Figure D4.6.

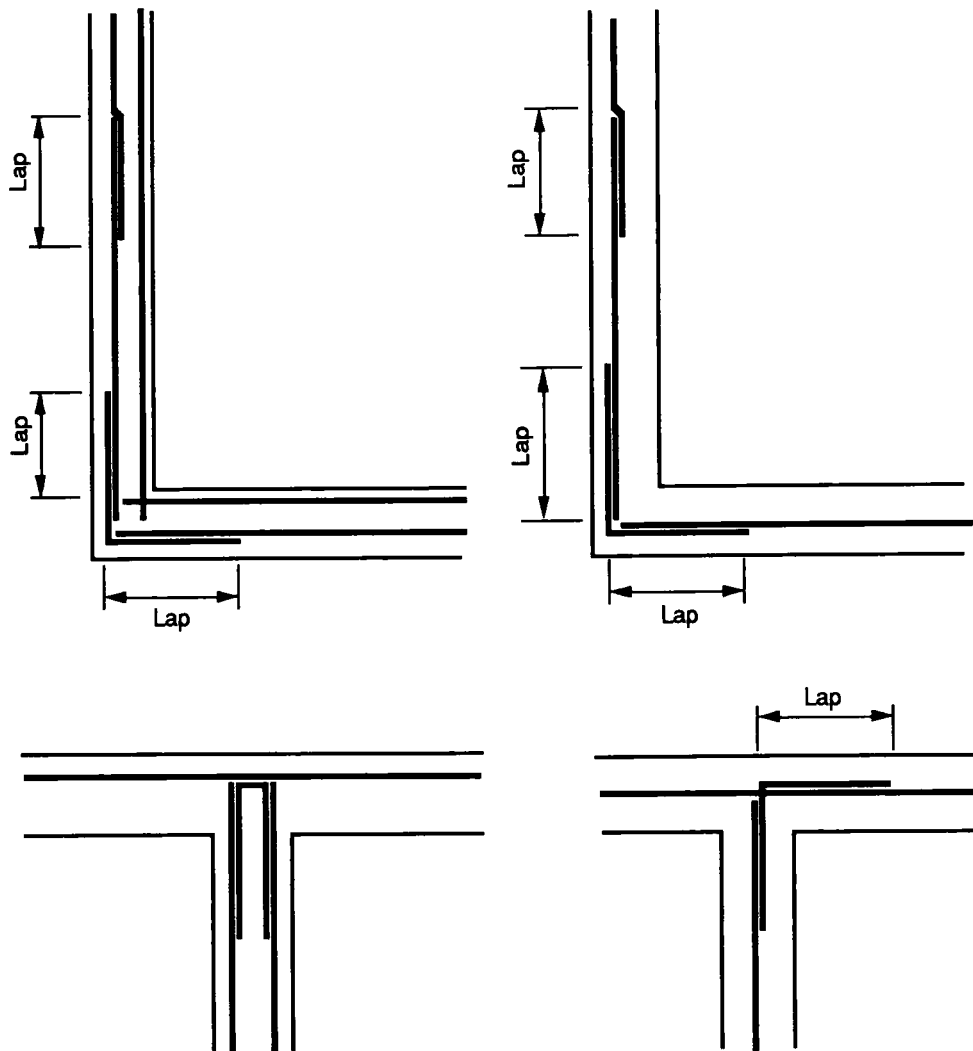


FIGURE D4.6 REINFORCEMENT AT FOOTING INTERSECTIONS

Vertical starter reinforcement of the diameter, type and spacing matching the wall reinforcement must be provided in every footing to a free standing height of not less than 600 mm. The starter reinforcement must be anchored and tied to the footing reinforcement with at least one 90° bend.

The footing of an isolated structural wall must be extended beyond the line of the wall till it becomes the footing of at least another masonry wall. For instance in the case of a transverse masonry bracing wall with one end free, the footing at the free end must continue till it supports another masonry wall (Fig. D4.7).

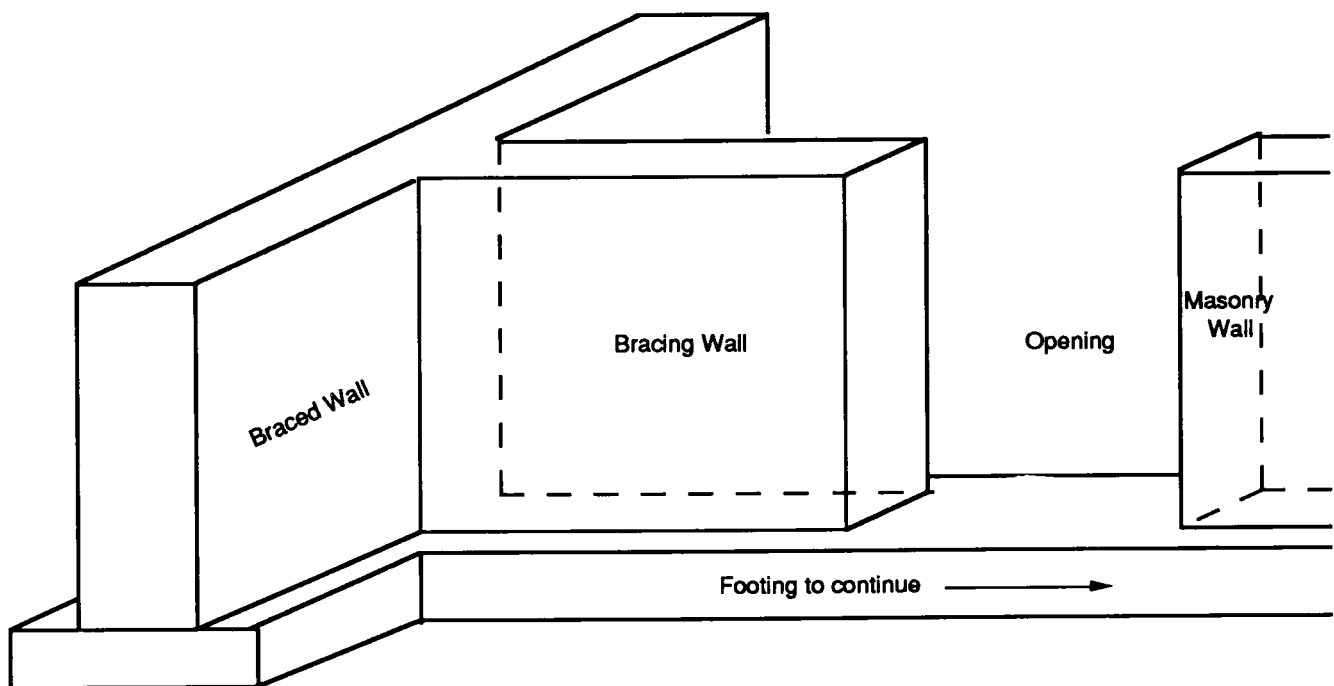


FIGURE D4.7 EXAMPLE OF FOOTING OF ISOLATED STRUCTURAL WALL

In the case of structural walls isolated at both ends, the footings must be not less than 300 mm wide and 400 mm deep and reinforced with 4D16 bars and R10 ties at 200 mm.

## D5 CONCRETE SLAB-ON-GROUND FLOORS

### D5.1 General

- D5.1.1 The finished level of a concrete slab-on-ground floor must be a minimum height of 150 mm above the adjoining finished ground level for unpaved surfaces and 100 mm above the adjoining finished ground level for paved surfaces.
- D5.1.2 The finished ground level adjoining the concrete slab-on-ground must be formed with a fall away from the building of not less than 1 in 25 for a distance of at least 1 m.
- D5.1.3 Concrete slab-on-ground floors must have their edges thickened (see Fig. D5.1.5) along the entire perimeter of the wall.
- D5.1.4 The grade of concrete for slab-on-ground concrete floors must be a minimum of 17.5 MPa.
- D5.1.5 Slab-on-ground floors must have a continuous vapour barrier between the ground and the slab as shown in Figure D5.1.5.

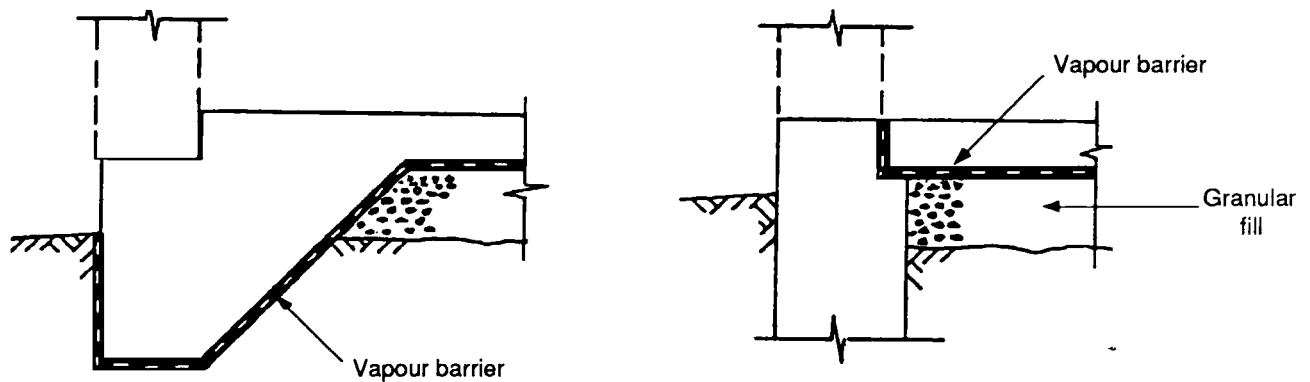


FIGURE D5.1.5 EDGE THICKENING OF CONCRETE SLAB-ON-GROUND FLOORS

**D5.1.6** The vapour barrier must be:

- (a) of acceptable durability and strength to withstand the conditions of installation and end use,
- (b) laid on a suitably prepared surface for the type of material used as barrier.

Various vapour barriers are available. Typical examples are polyethylene sheet, reinforced polyethylene sheet, bituminous sheets, asphalt and rubber emulsions.

## D5.2 Edge thickening

The edge thickening of ground slabs must comply with the requirements of Clause D4. In addition it must be reinforced at the top with at least one D12 bar.

## D5.3 Granular base

**D5.3.1** Granular fill material where required must be placed in layers not exceeding 100 mm thick over the area beneath the proposed ground slab so that the total thickness of the granular base is not less than 100 mm nor more than 600 mm.

**D5.3.2** Granular fill material must be gravel, or crushed rock or hard coral.

**D5.3.3** The top surface of the granular base must be treated as necessary to protect the vapour barrier from damage.

**D5.3.4** The rise of sub-soil water by capillary action must not be allowed to approach the ground slab. Where the depth to the sub-soil water level is less than 3.5 m in clay or silt, 2.25 m in fine sand or 0.8 m in coarse sand, it will be necessary to provide a capillary break beneath the ground slab. If the material beneath the slab is all gravel, crushed rock or hard coral to a minimum thickness of 100 mm and action is taken to prevent soil from clogging the pores between the pieces of gravel, there is no risk of capillary rise of water. If this is not the case, the capillary break provided must have the following grading:

< 5.5 % to pass a 2.2 mm sieve.

100 % to pass a 19 mm sieve for any depth of fill or pass a 37.5 mm sieve for fill thickness in excess of 150 mm.

## D5.4 Ground slabs

**D5.4.1** Except as required for edge thickening and by D5.5 beneath internal loadbearing walls, the minimum thickness of a domestic ground slab must be:

- (a) 100 mm when placed on a vapour barrier laid directly on the granular fill, or
- (b) 75 mm when placed on a vapour barrier laid on a specially prepared granular base or concrete blinding. Refer to Figure D5.4.

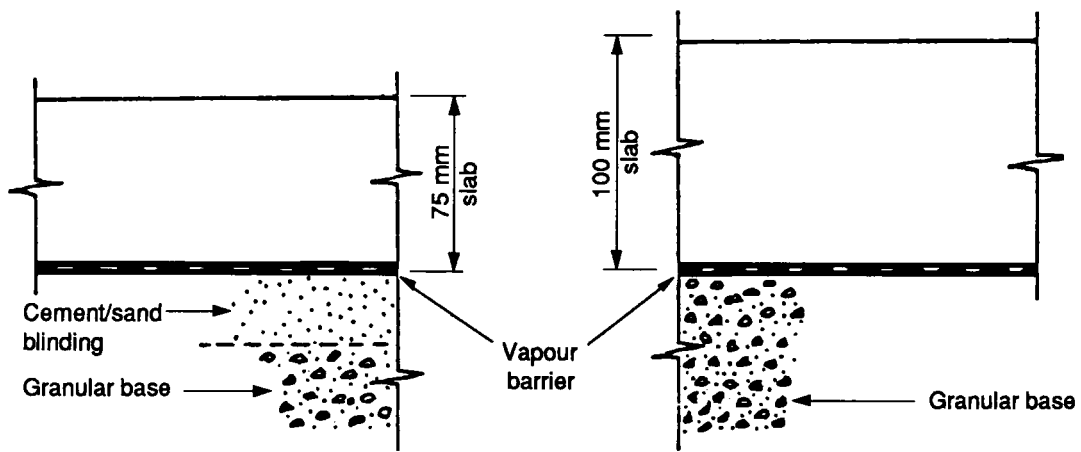


FIGURE D5.4 ALTERNATIVE CONSTRUCTION OF GROUND SLABS

**D5.4.2** Ground slab reinforcement must extend to within 75 mm of the outside edge of the thickened slab when it is cast integrally with the ground slab. Also:

- (a) where the maximum plan dimension of concrete cast in one operation does not exceed 15 m: provide 668 (F52) welded reinforcing mesh lapped 225 mm at joints;
- (b) where the maximum plan dimension of concrete cast in one operation exceeds 15 m but does not exceed 25 m provide either:
  - (i) 665 (F62) welded reinforcing mesh lapped 225 mm at joints, or
  - (ii) D10 bars at 350 mm centres both ways tied at each fourth crossing; and
- (c) where the thickened edge is cast separately from the ground slab and it supports more than one storey, the ground slab must be tied to it with R6 bars at not less than 600 mm centres, anchored into the thickened edge and lapped not more than 300 mm with the slab reinforcement.

**D5.4.3** Reinforcing steel must have a cover of 30 mm from the top surface of the ground slab and must be placed in such a manner as to avoid damage to the vapour barrier.

**D5.5 Support of loadbearing internal walls**

The slab beneath a loadbearing internal wall must be 175 mm thick over a minimum width of 300 mm and reinforced with 2/D12 bars as shown in Figure D5.5.

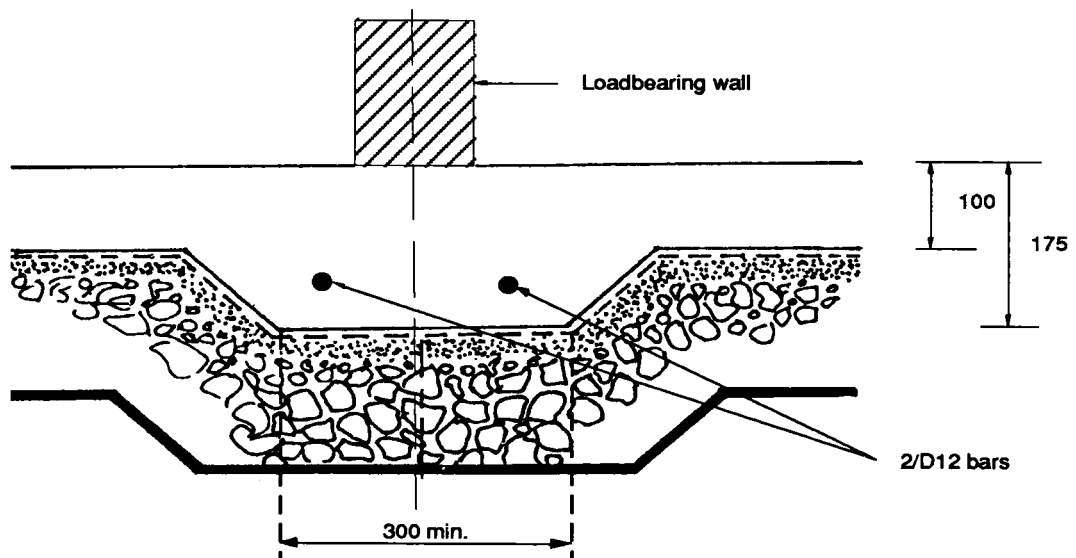


FIGURE D5.5 GROUND SLABS BENEATH INTERNAL LOADBEARING WALLS

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**SECTION E**

**CONSTRUCTION  
DETAILS**

## SECTION E CONSTRUCTION DETAILS

### E1 GENERAL

This section provides some construction details for houses. It is divided into three parts. E2 shows roof details, E3 wall details and E4 floor details. The details do not cover all contingencies and are necessarily general in nature. These would however satisfy a wide range of construction requirements.

### E2 ROOF CONSTRUCTION DETAILS

Arrange braces so that ends terminate above perimeter walls or bracing walls or as near as possible

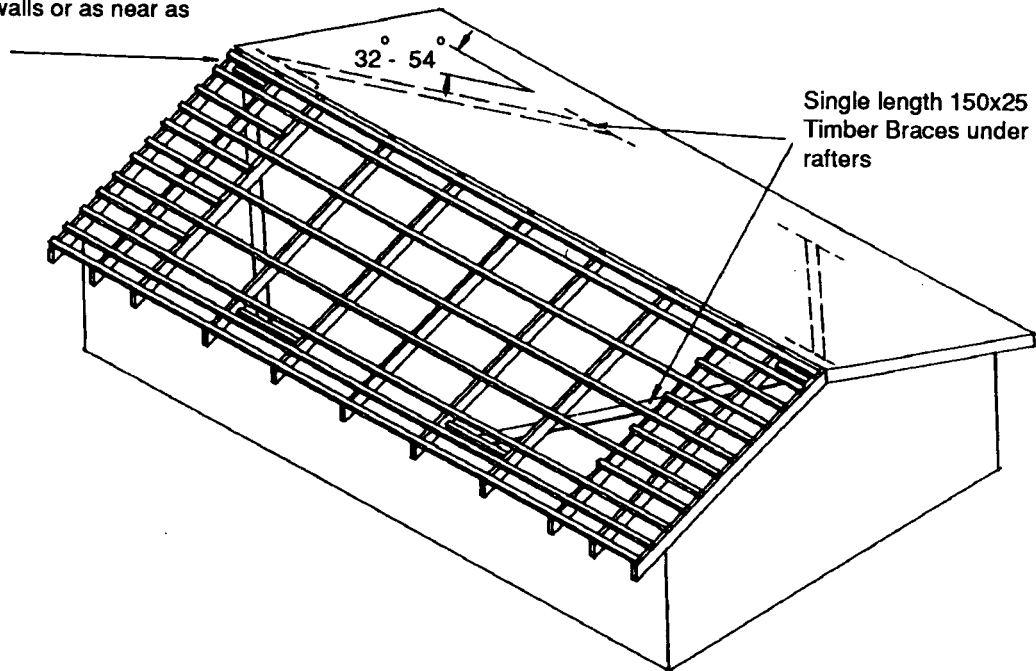


FIGURE E2.1 TIMBER BRACING FOR ROOFS CONSTRUCTED OF RAFTERS

Higher than average uplift pressures occur at the shaded area (Figure E2.2) along the edges and ridge of the roof during high winds. The associated rafters, purlins and fasteners are therefore spaced closer as shown in Figures E2.1, E2.3, E2.4, E2.5.

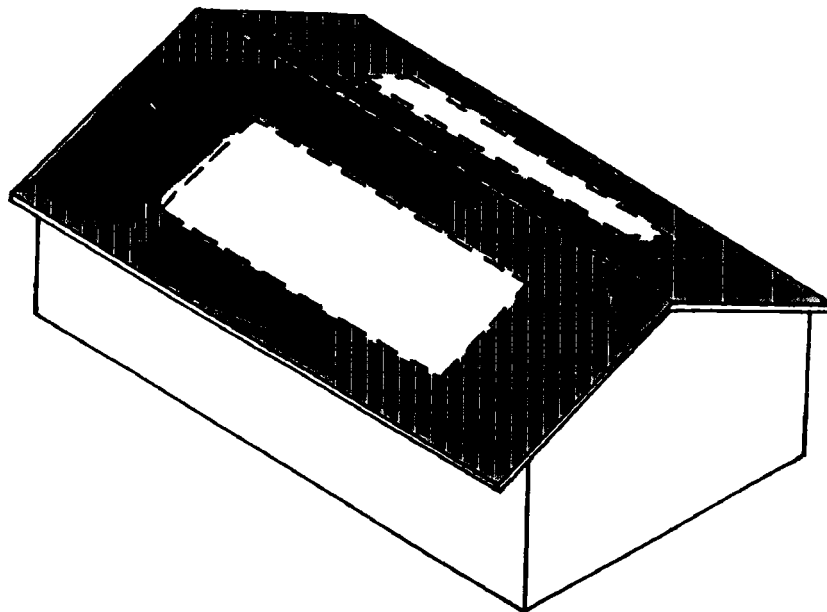
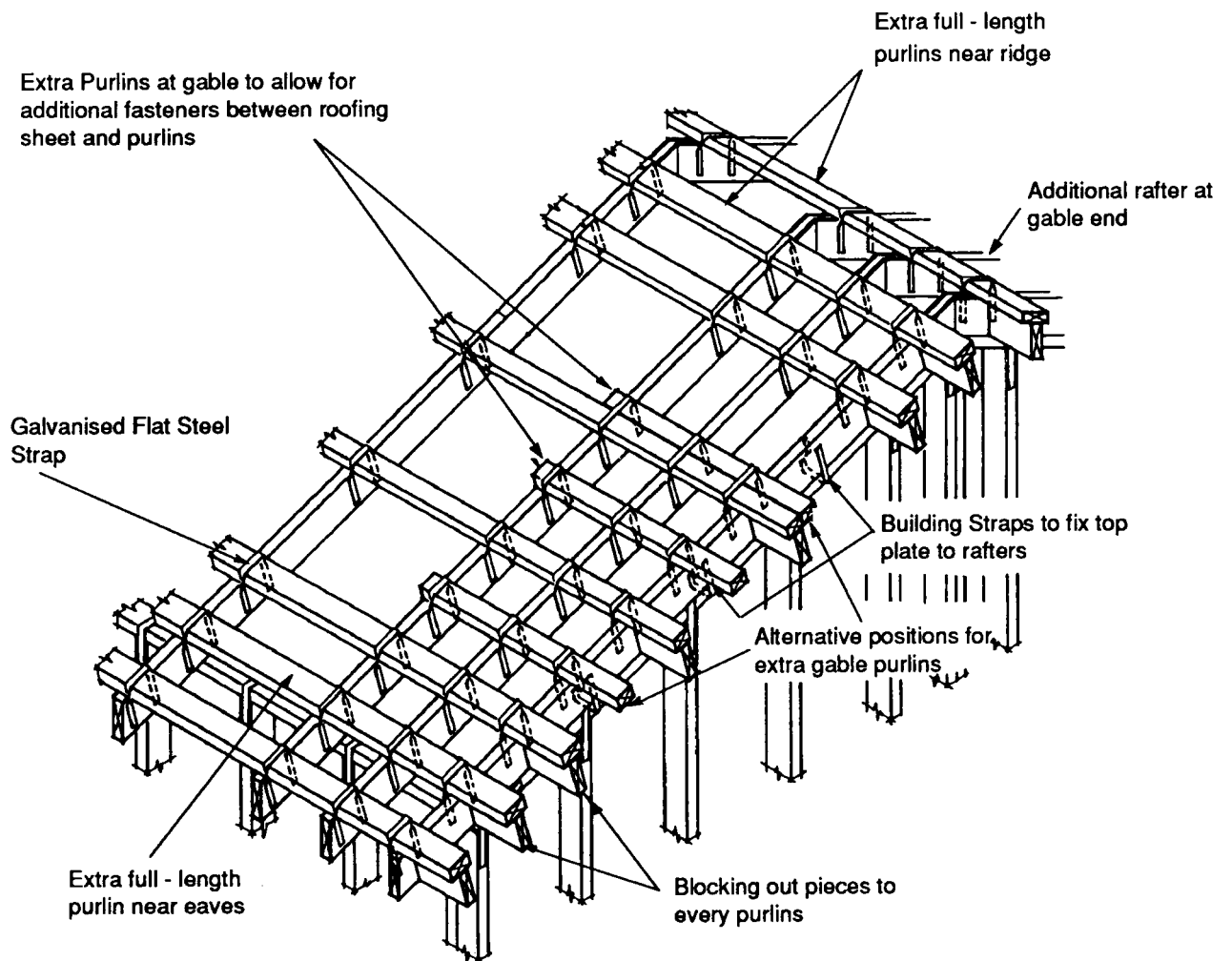


FIGURE E2.2 AREAS OF ROOF WHERE LOCAL PRESSURE FACTORS APPLY



- Notes :
- (i) It is preferable to locate the extra purlins at gables midway between the normal purlins. This will reduce the forces on the roofing sheets.
  - (ii) Care to be taken to not split purlins when nailing, especially if purlins are smaller than 100 x 50.
  - (iii) Select all fasteners on the basis of forces and capacities given in the relevant tables in Section B.

FIGURE E2.3 ROOF FRAMING AT GABLE ENDS



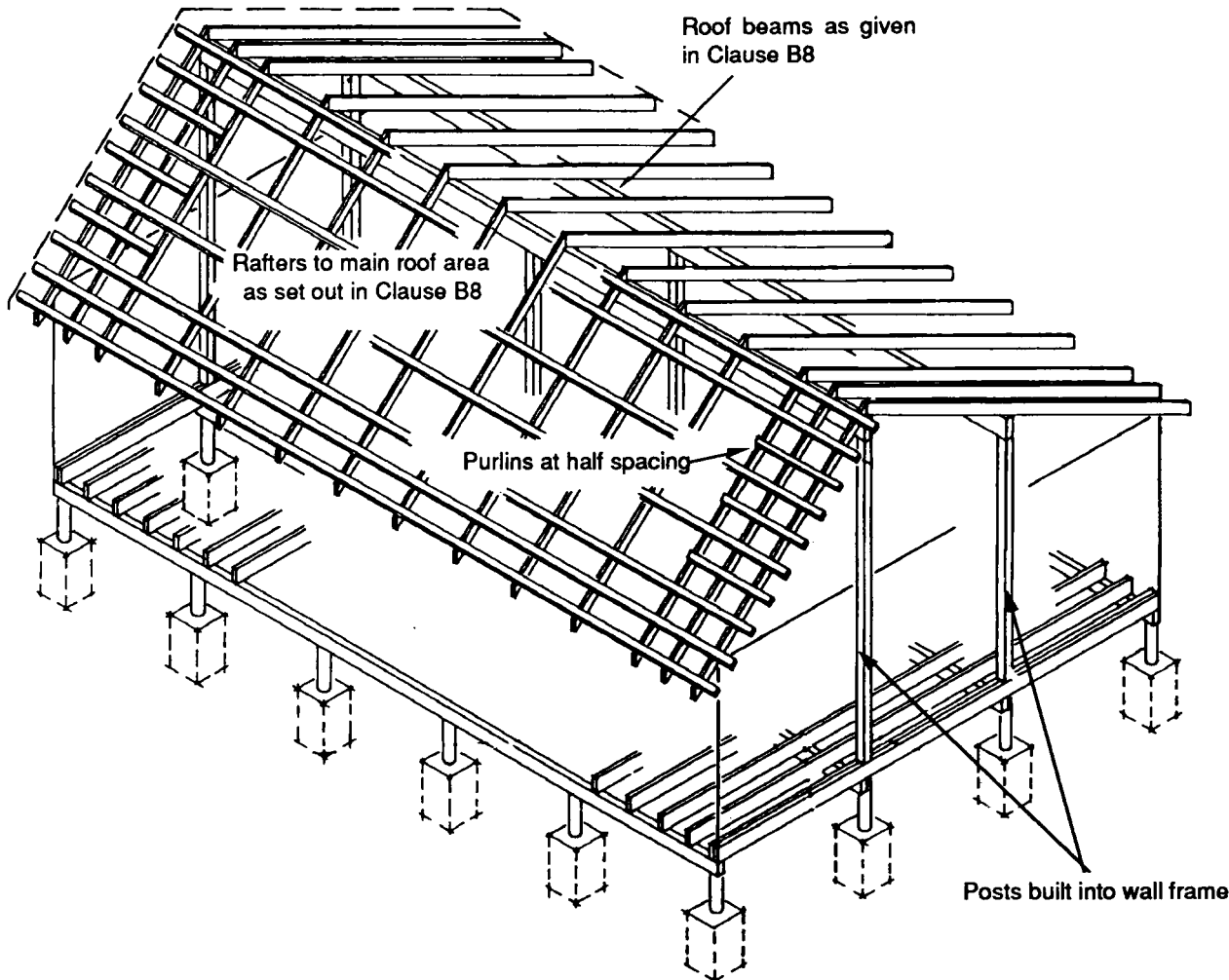
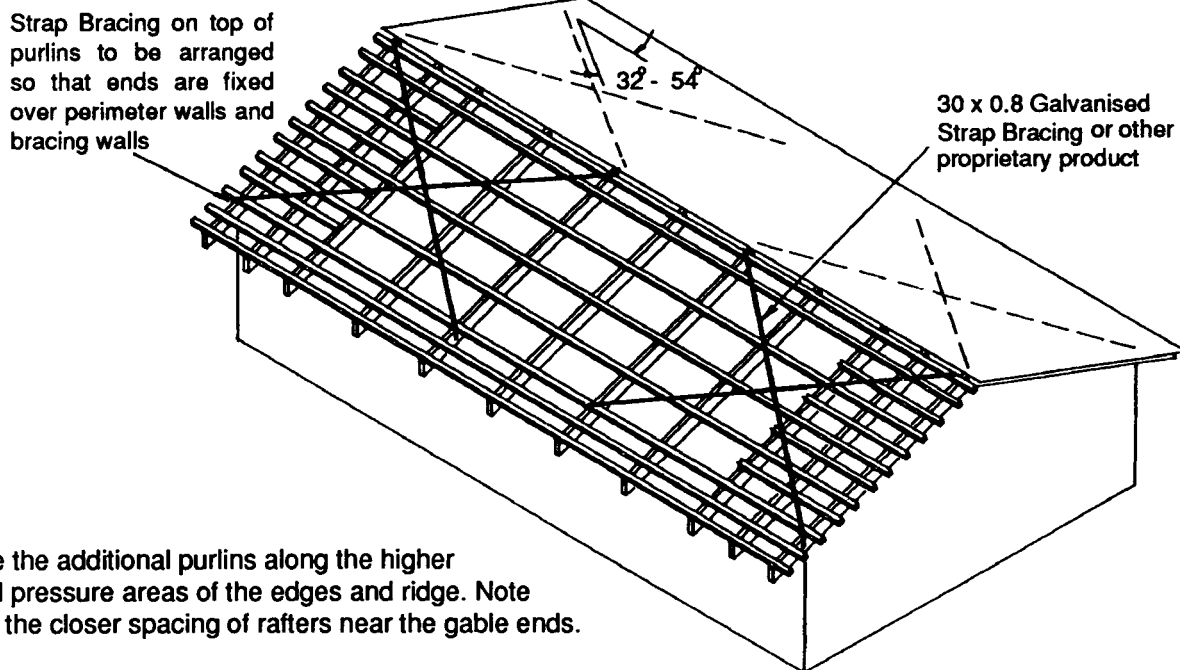
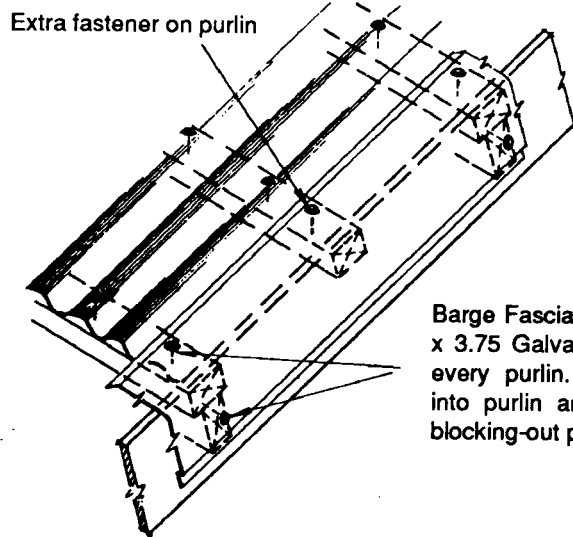


FIGURE E2.4 RAFTER ROOF FRAMING DETAILS



Note the additional purlins along the higher local pressure areas of the edges and ridge. Note also the closer spacing of rafters near the gable ends.

FIGURE E2.5 FLAT STRAP BRACING FOR ROOFS



Barge Fascia Flashing nailed with two 65 x 3.75 Galvanised Spring Head Nails at every purlin. (one through roofing iron into purlin and one through barge into blocking-out piece).

FIGURE E2.6 FIXING OF BARGE FLASHING AT GABLE END

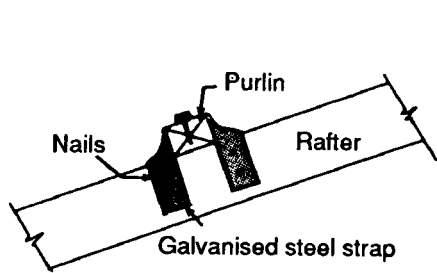


FIGURE E2.7 CONNECTION OF PURLIN

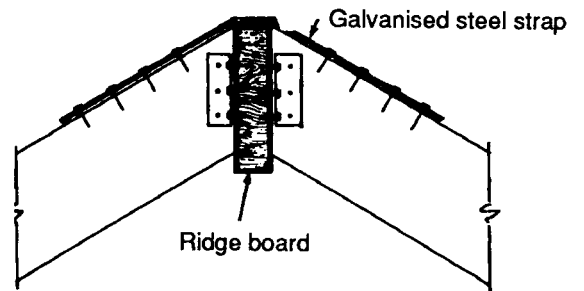


FIGURE E2.8 CONNECTION AT THE RIDGE JOINT

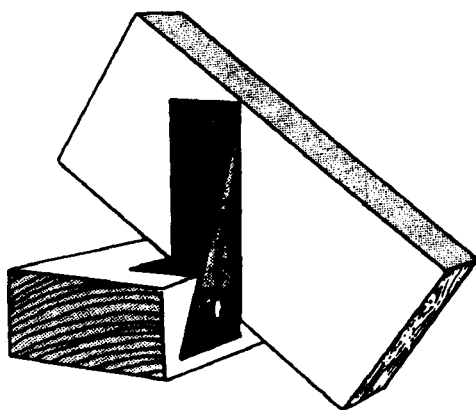


FIGURE E2.9 TRIP-L-GRIP CONNECTOR USED TO SECURE RAFTERS TO TOP PLATES

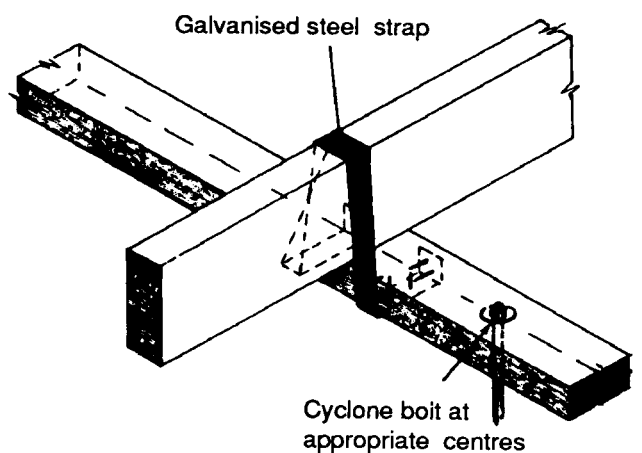


FIGURE E2.10 FIXING OF RAFTER TO THE TOP PLATE WITH GALVANISED STEEL STRAP

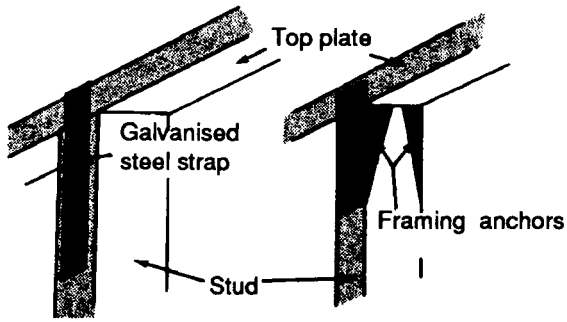


FIGURE E2.11 ANCHORING THE TOP PLATE TO THE STUDS

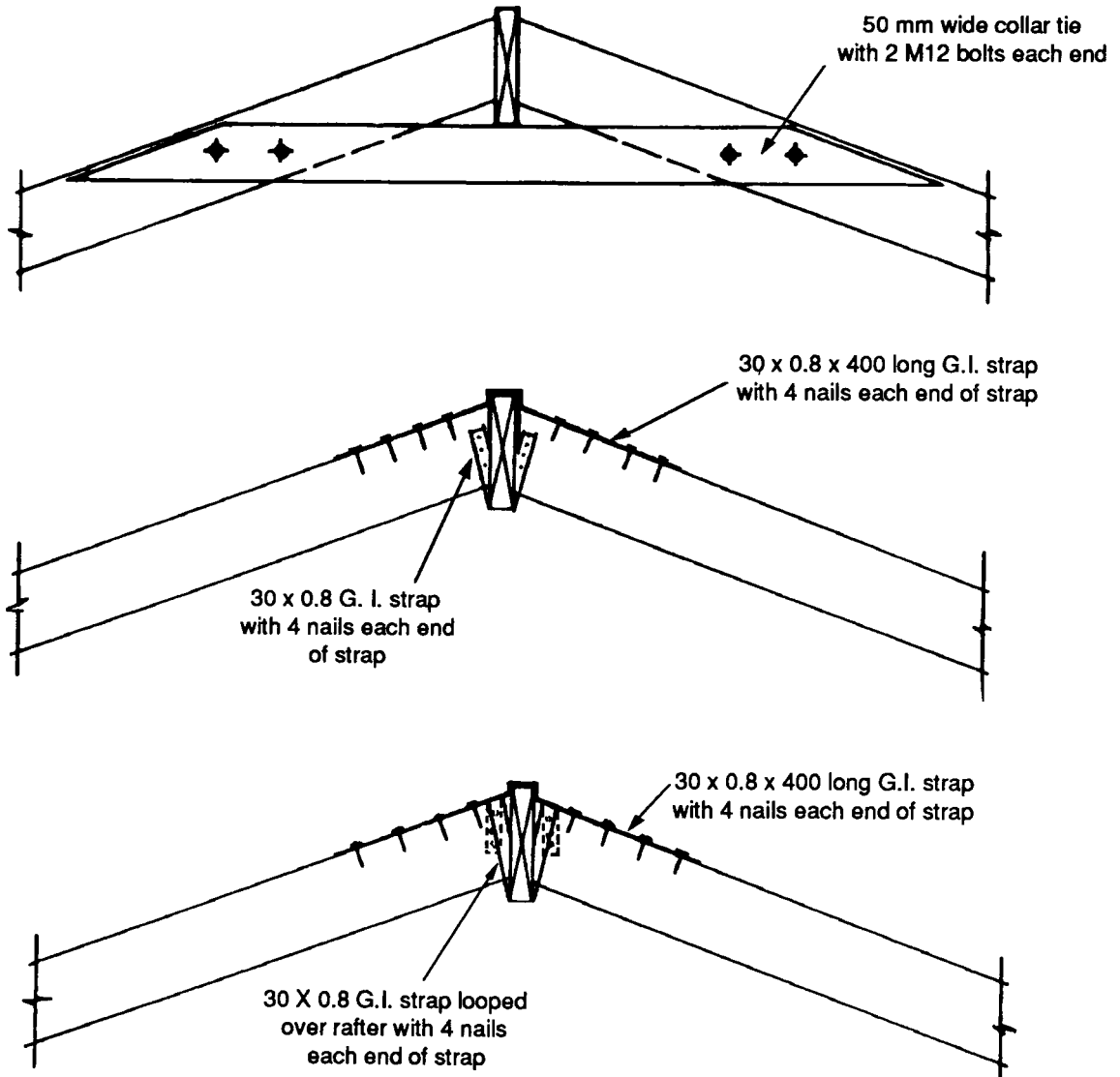


FIGURE 2.12 RIDGE BOARD TIE DOWN DETAIL

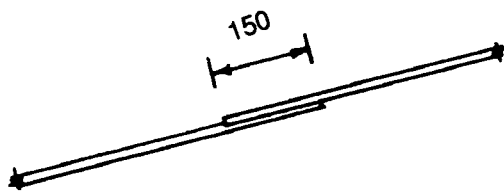


FIGURE E2.13 SHEET LAP DETAIL



FIGURE E2.14 RIDGE CAP DETAIL

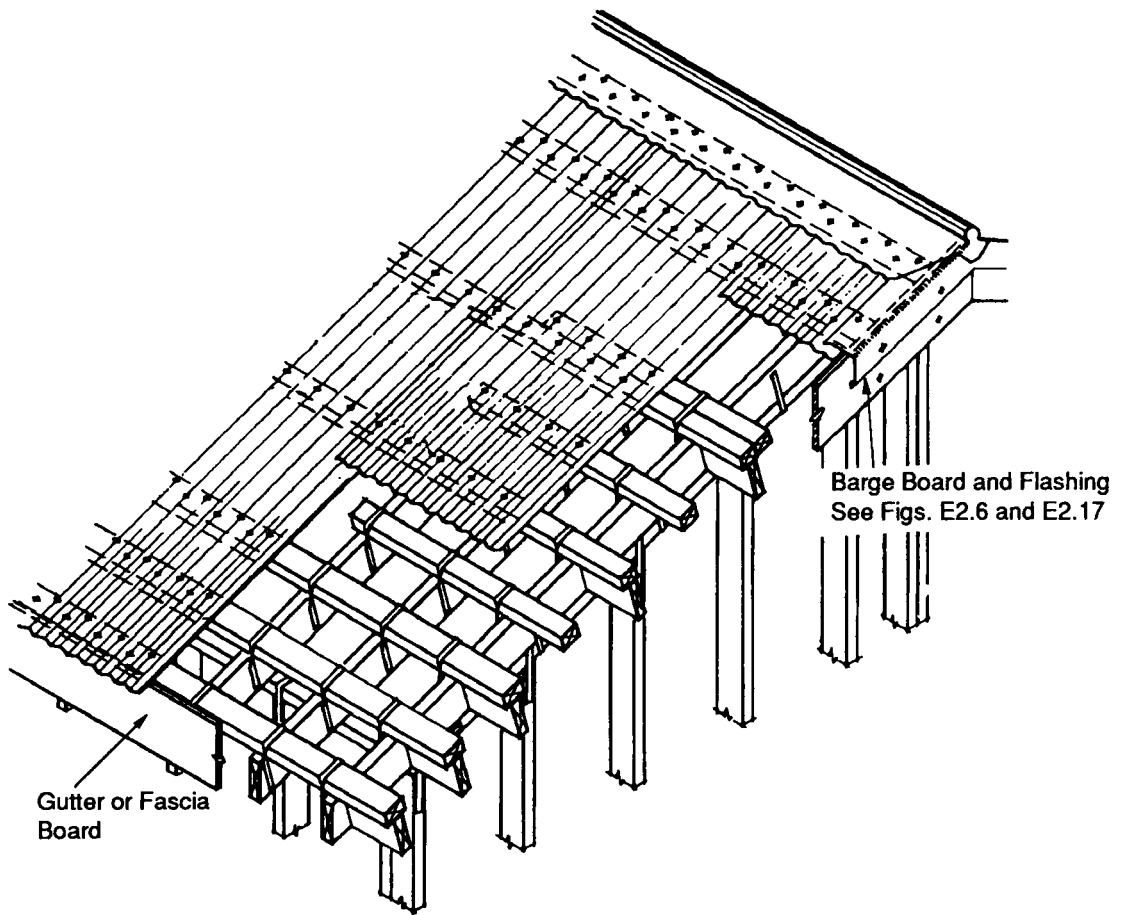


FIGURE E2.15 FIXING OF ROOF CLADDING



FIGURE E2.16 OVER LAP DETAIL

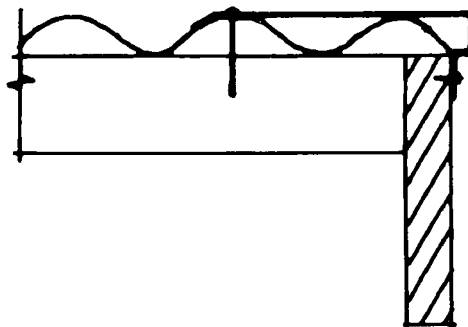
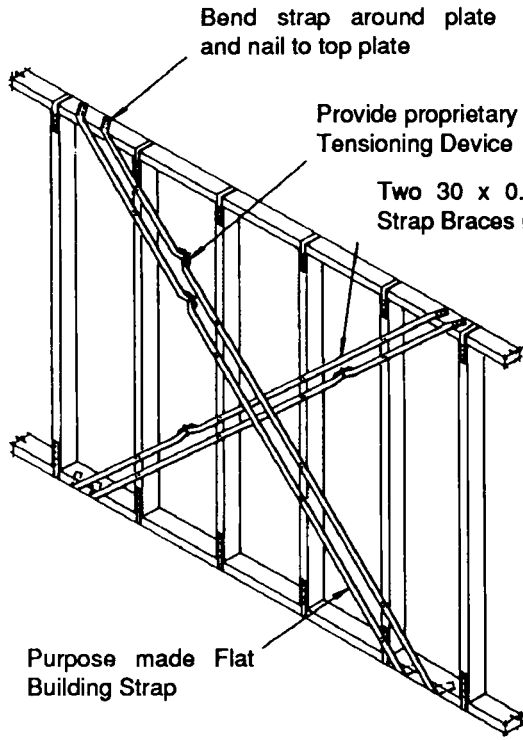
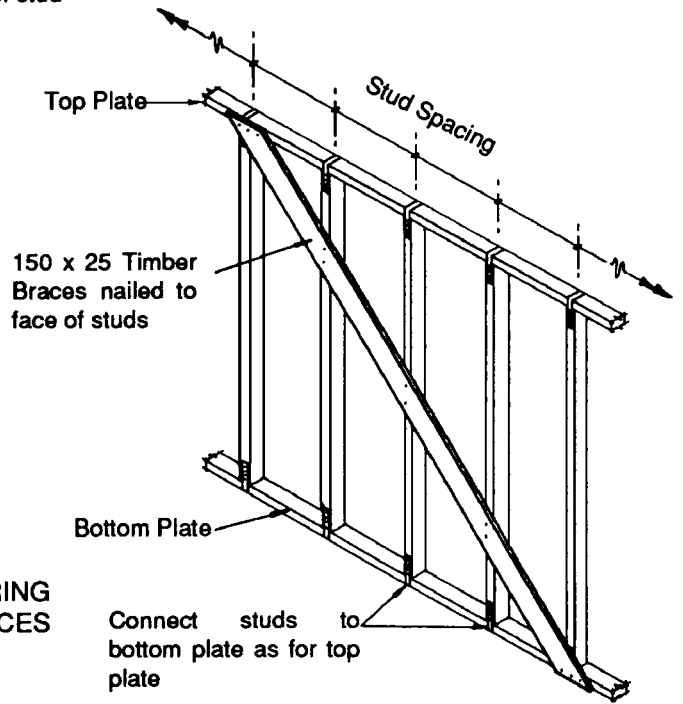


FIGURE E2.17 FLASHING DETAIL

**E3 WALL CONSTRUCTION DETAILS**

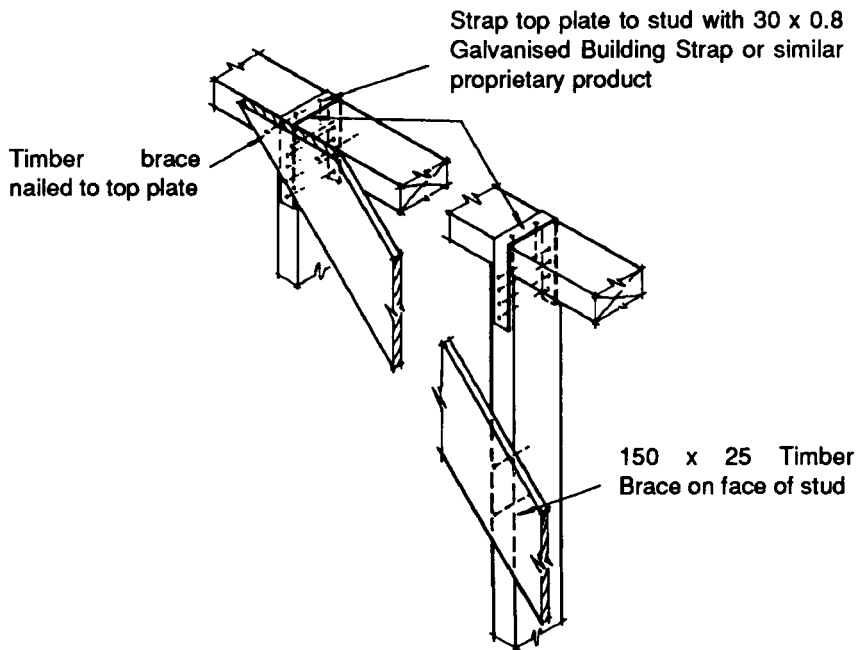


**FIGURE E3.1 LOADBEARING AND NON-LOADBEARING WALLS WITH FLAT STRAP METAL BRACES (NOT LET IN).**



Note: Do not notch plates

**FIGURE E3.2 INTERNAL BRACED WALLS NOT SUPPORTING VERTICAL LOADS FROM ROOF OR FLOOR**



**FIGURE E3.3 INTERNAL BRACED WALLS NOT SUPPORTING VERTICAL LOADS FROM ROOF OR FLOOR**

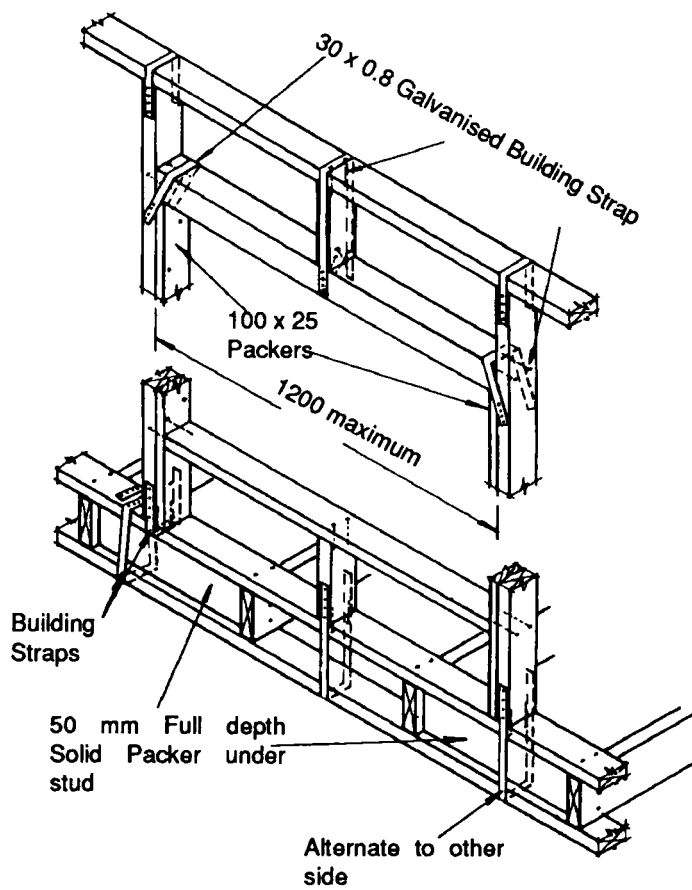


FIGURE E3.4 TIMBER LINTELS (SAWN) UP TO 1200 LINTEL SPAN

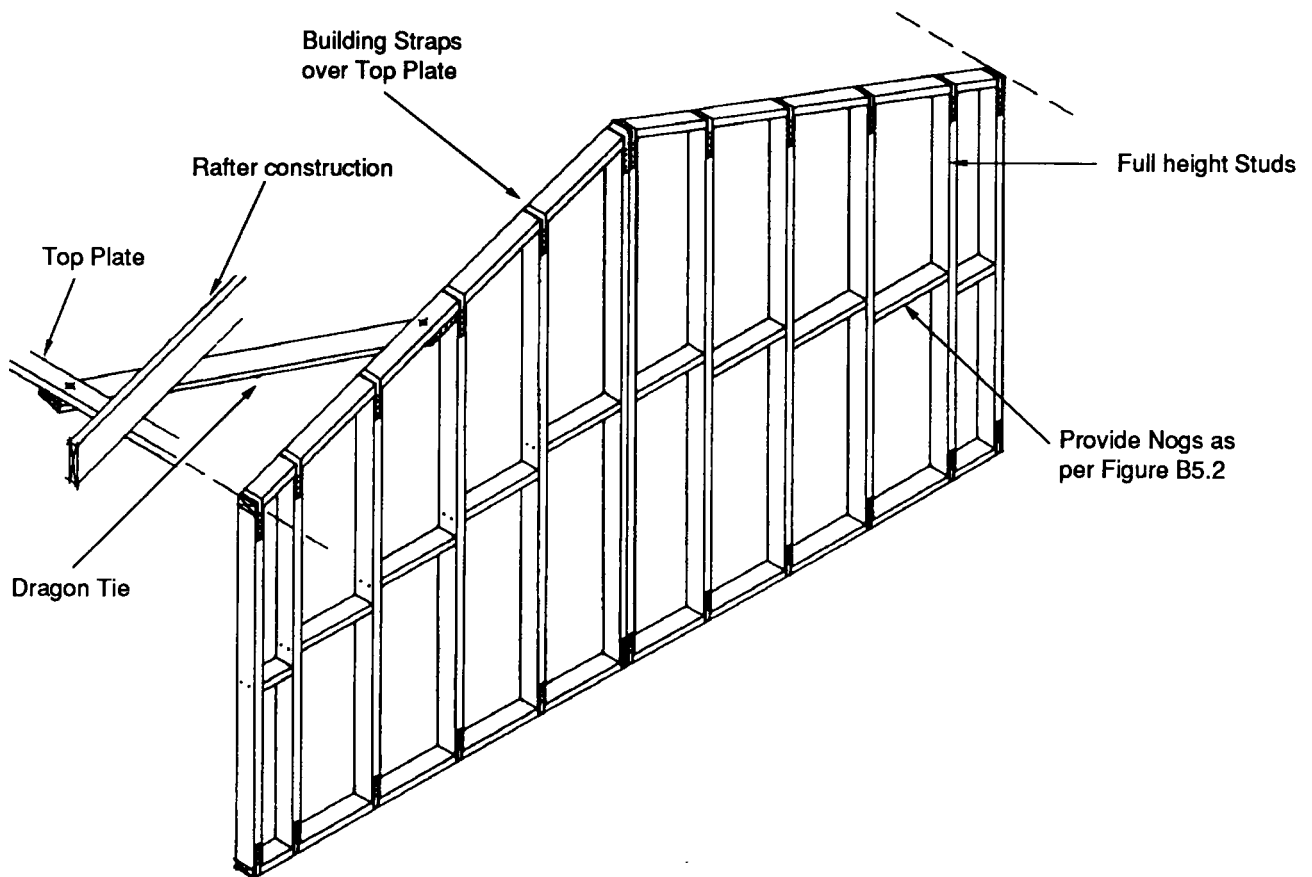


FIGURE E3.5 GABLE END WALLS

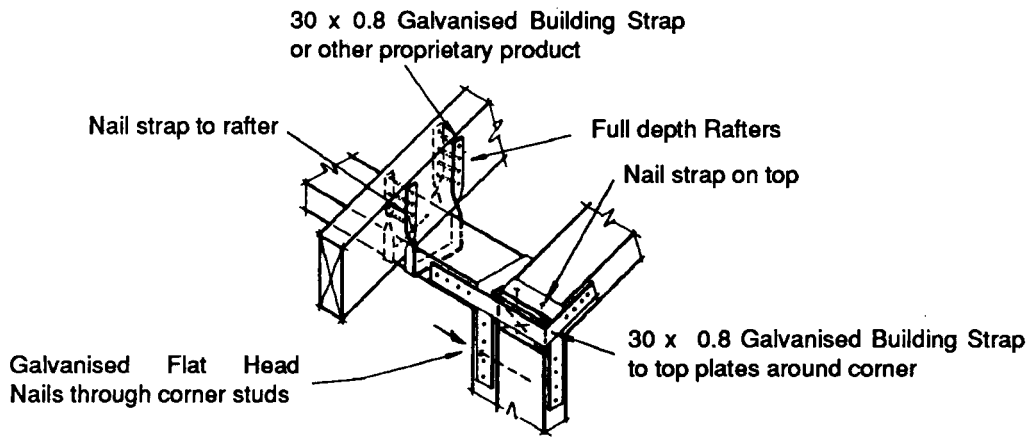
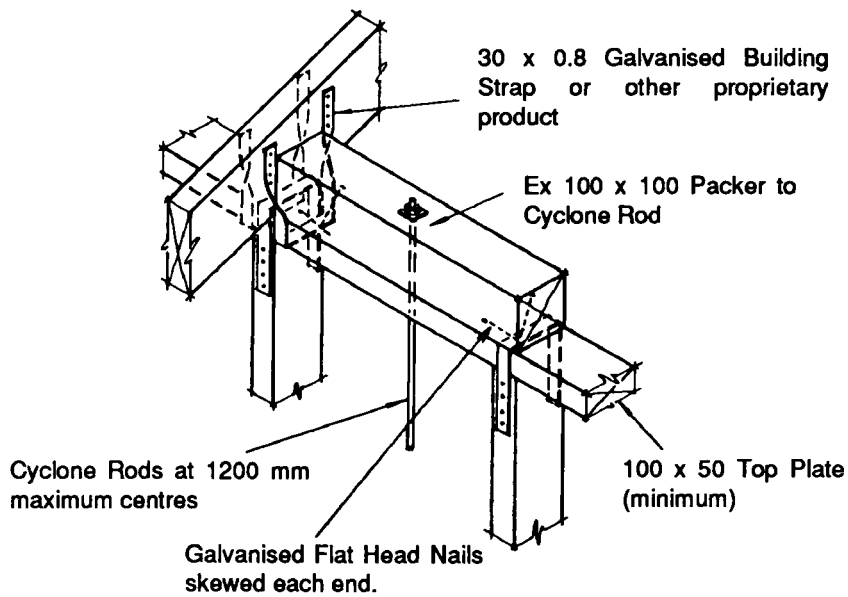
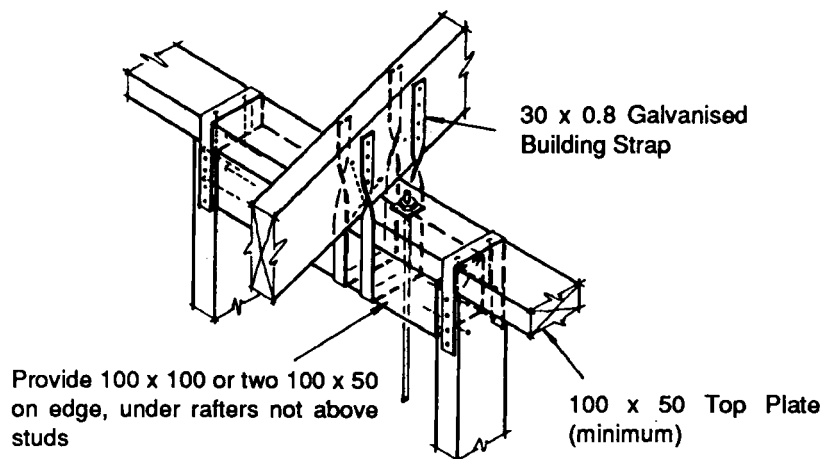


FIGURE E3.6 FIXING OF GABLE END WALLS TO SIDE WALLS AT TOP PLATE LEVEL



ALTERNATIVE A



ALTERNATIVE B

FIGURE E3.7 TOP PLATES SUPPORTING ROOFS OF BUILDINGS

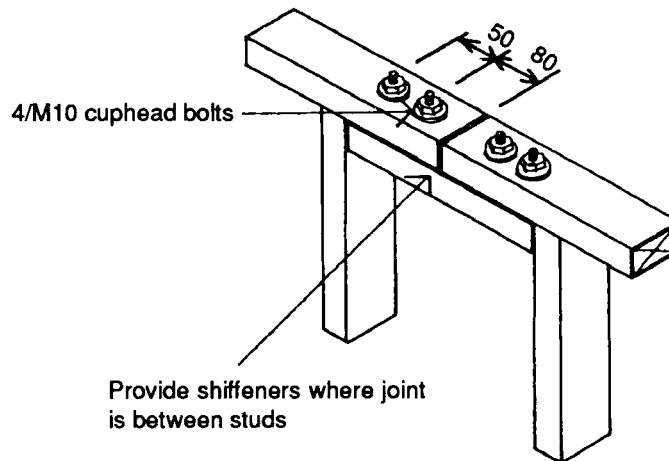
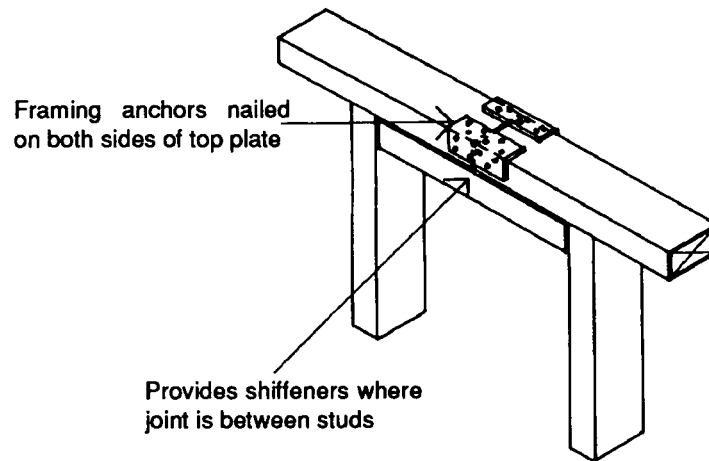
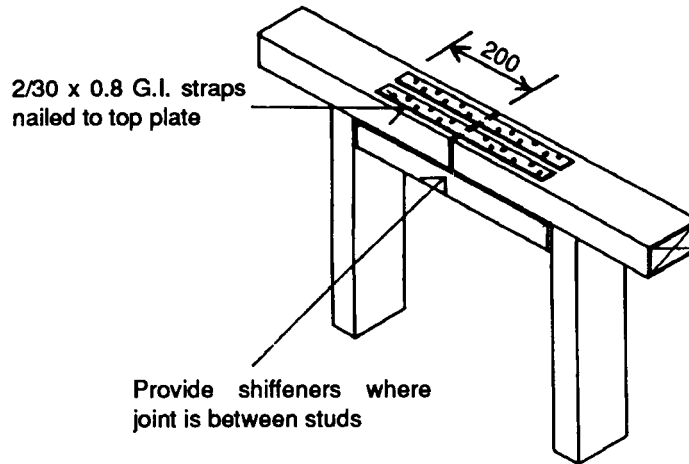
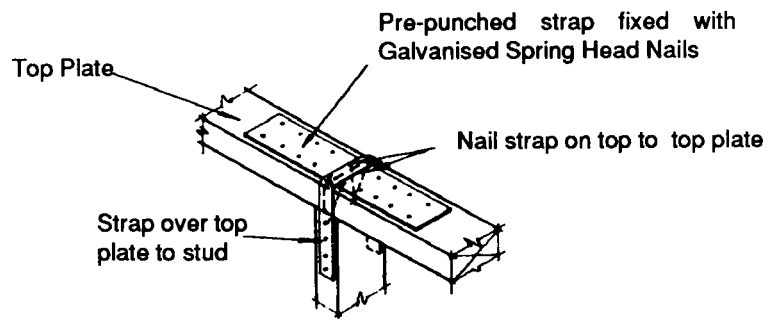


FIGURE E3.8 JOINTS IN TOP PLATES



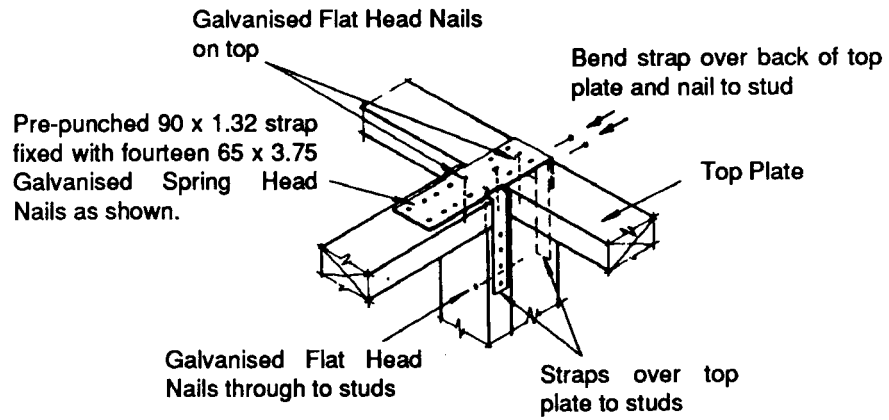


FIGURE E3.9 WALL INTERSECTION IN TOP PLATES

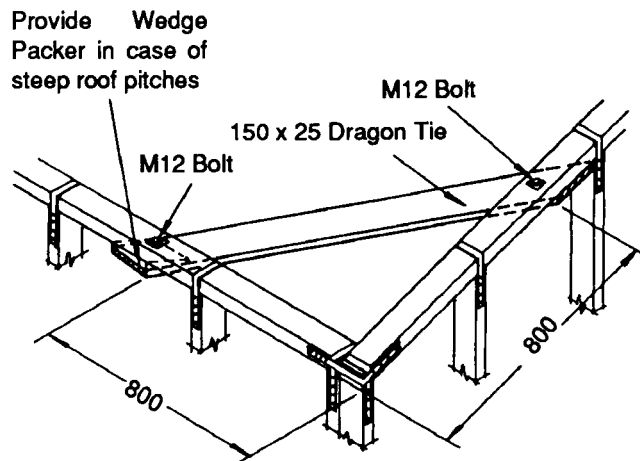


FIGURE E3.10 DETAIL OF DRAGON TIE CONNECTION

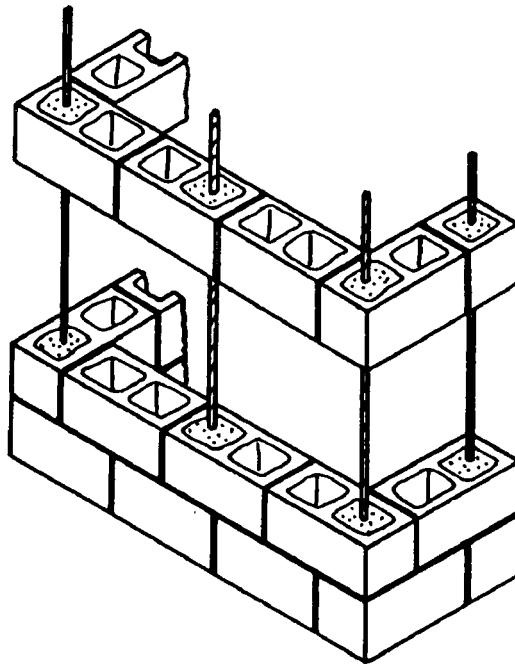


FIGURE E3.11 CORNER DETAIL FOR PARTIALLY GROUTED MASONRY WALL

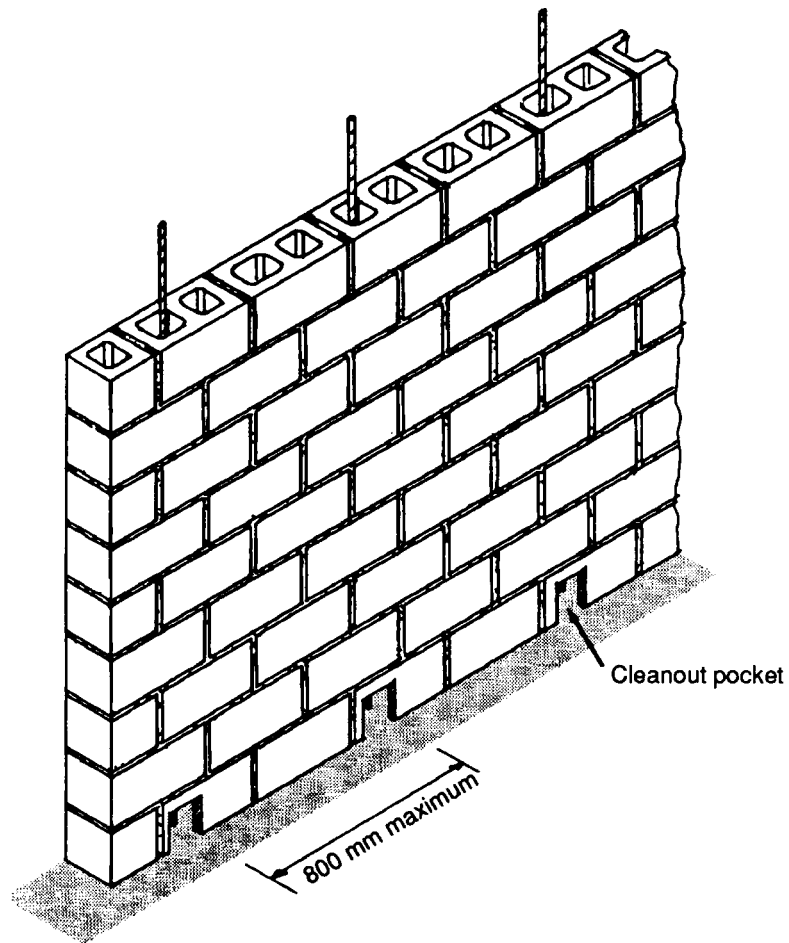


FIGURE E3.12 CLEANOUT POCKETS IN WALL FOR GROUT POURS

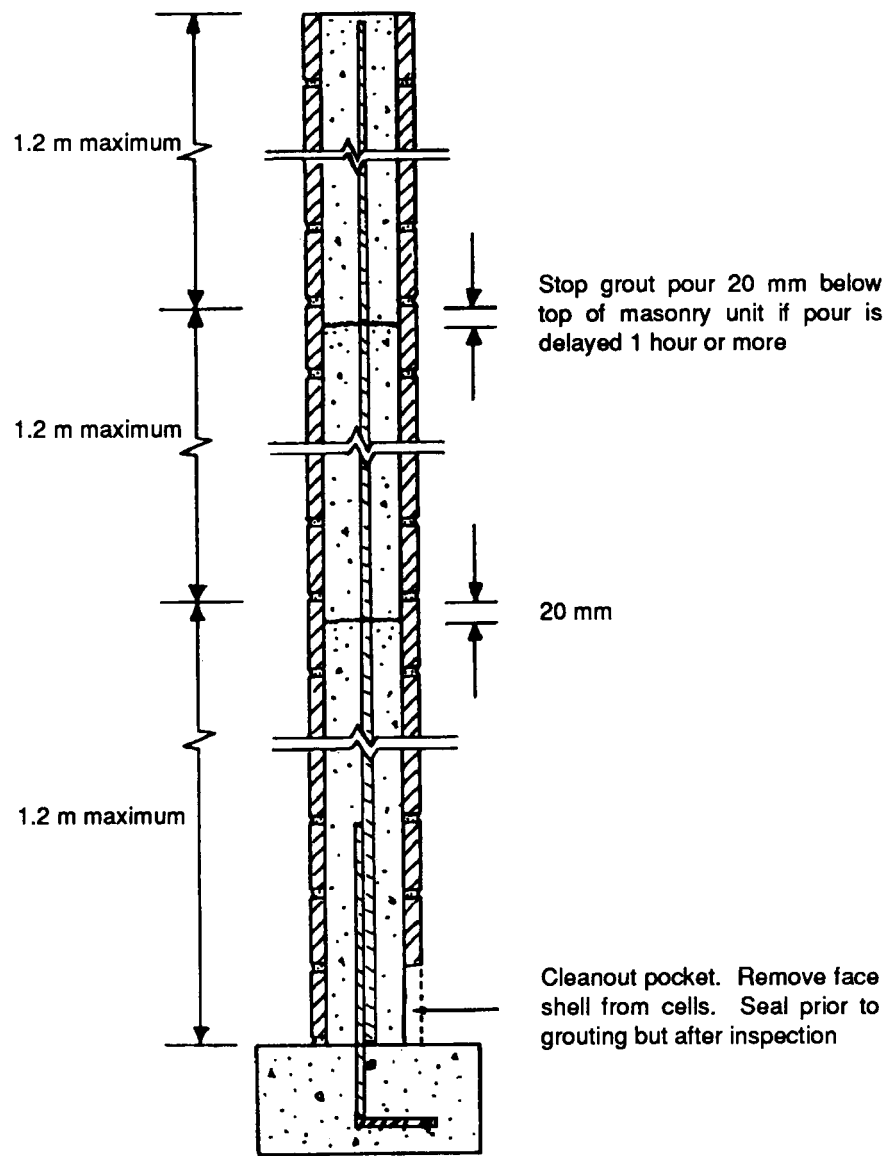


FIGURE E3.13 METHOD OF GROUTING BLOCK

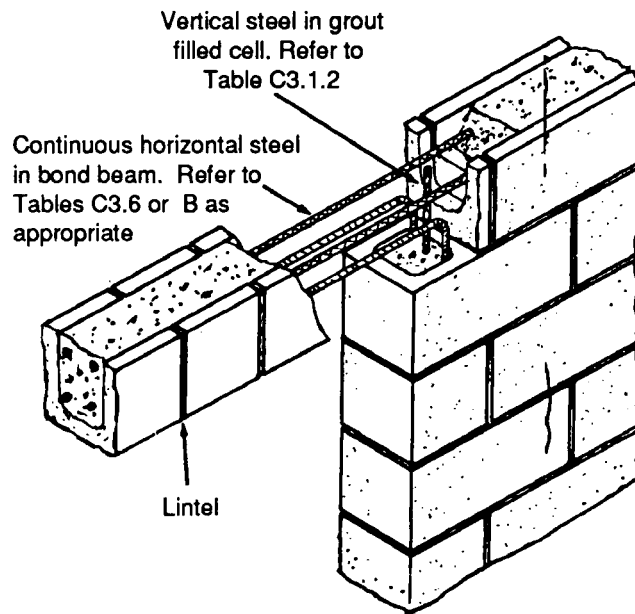


FIGURE E3.14 LINTELS AND BOND BEAM DETAILS

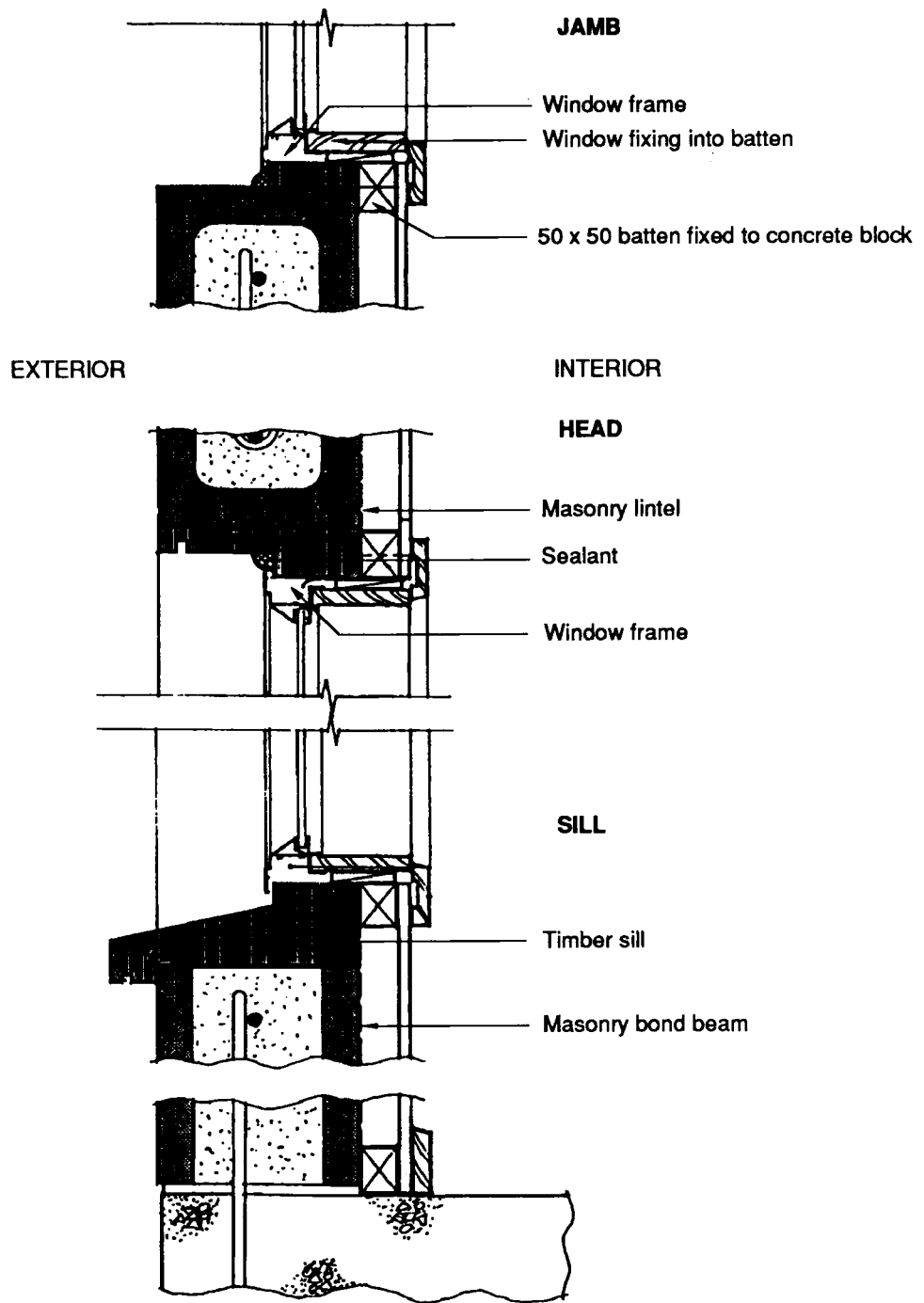


FIGURE E3.15 WINDOW DETAIL

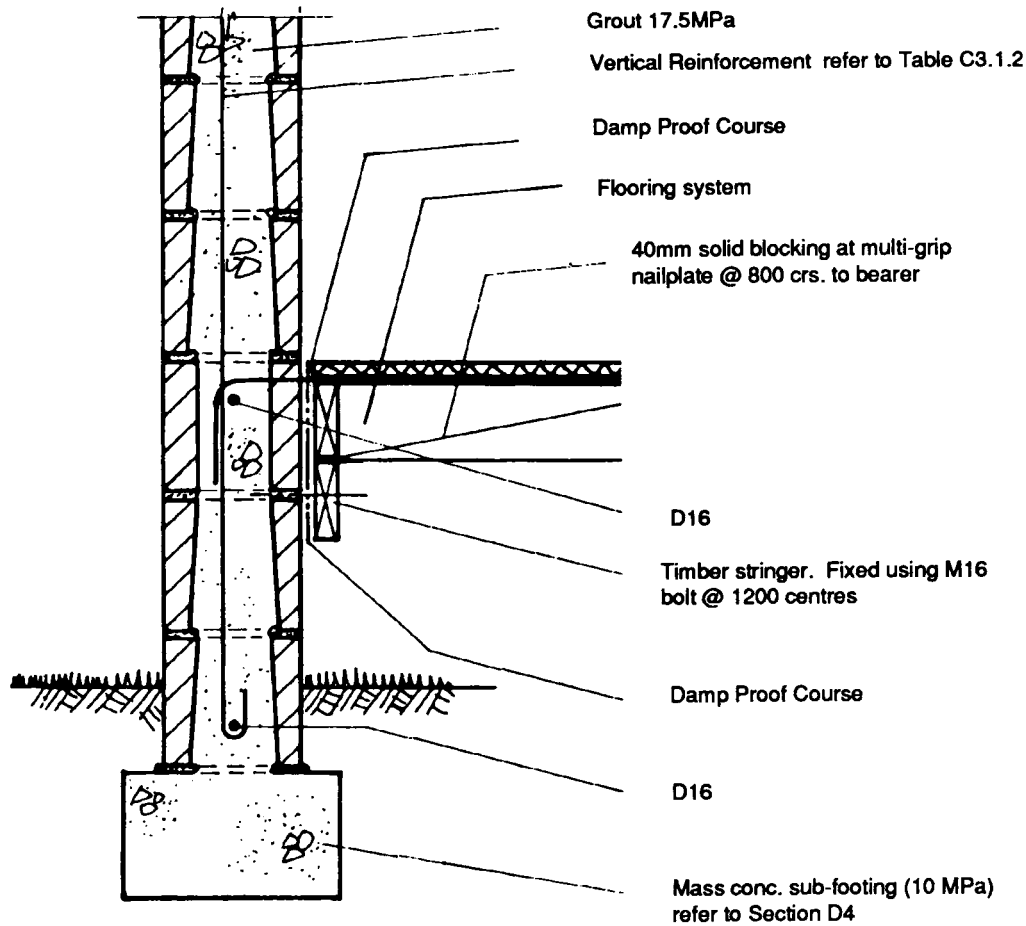


FIGURE E4.1 DETAIL OF CONCRETE MASONRY WALL - STRINGER SUPPORT

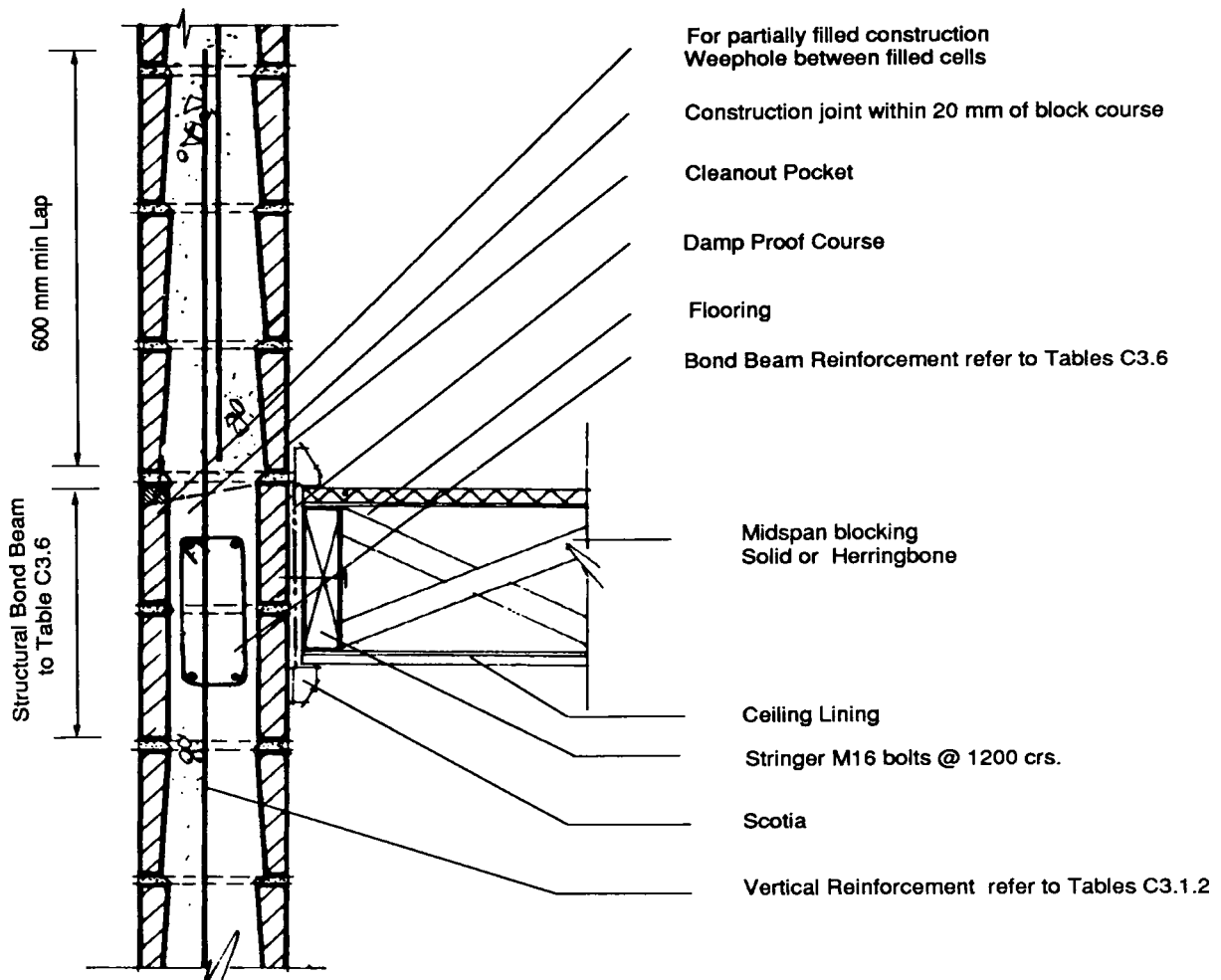


FIGURE E4.2 DETAIL OF FLOOR CONNECTIONS (PARALLEL TO JOISTS)

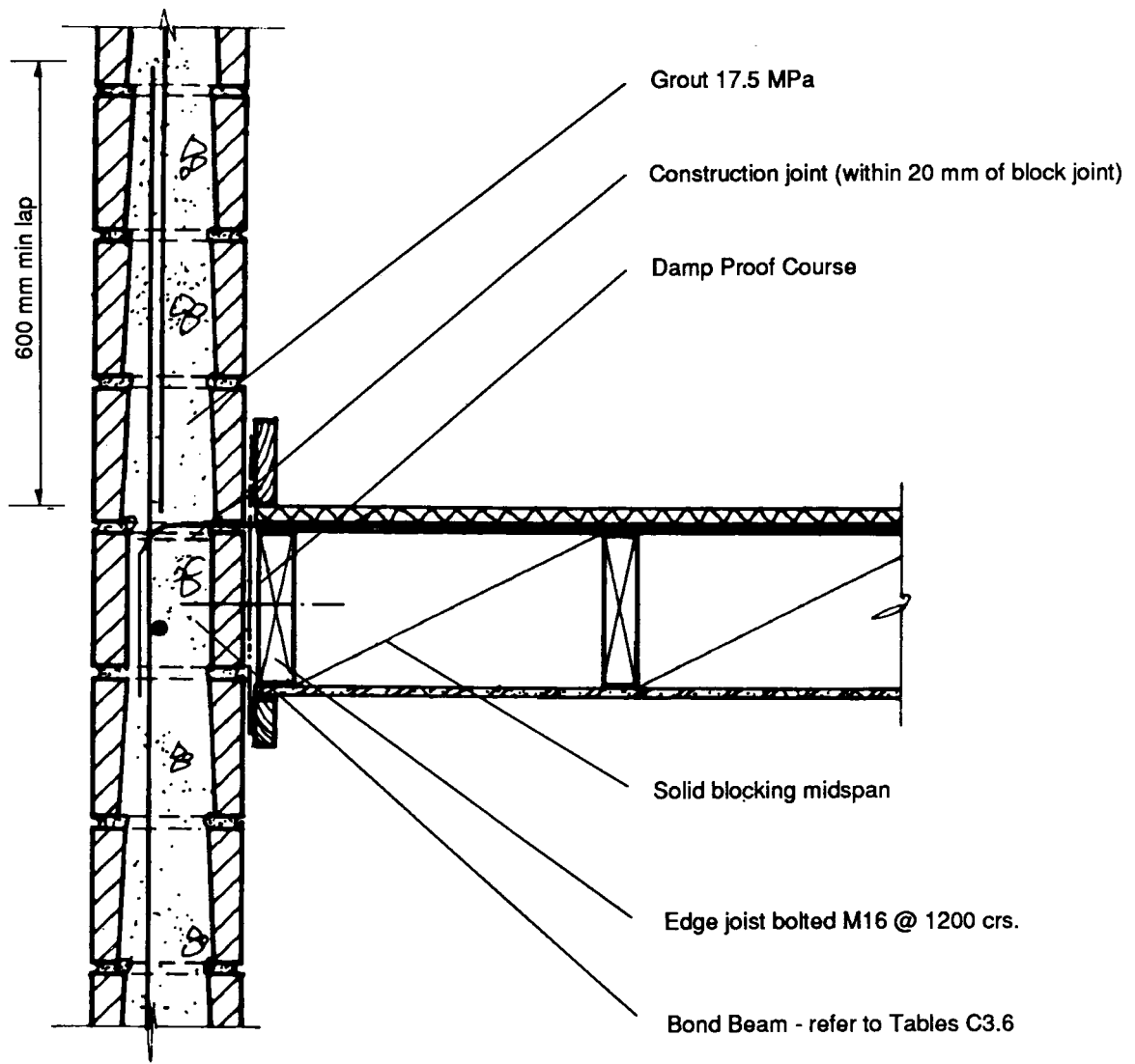


FIGURE E4.3 DETAIL OF BOUNDARY JOIST SUPPORT

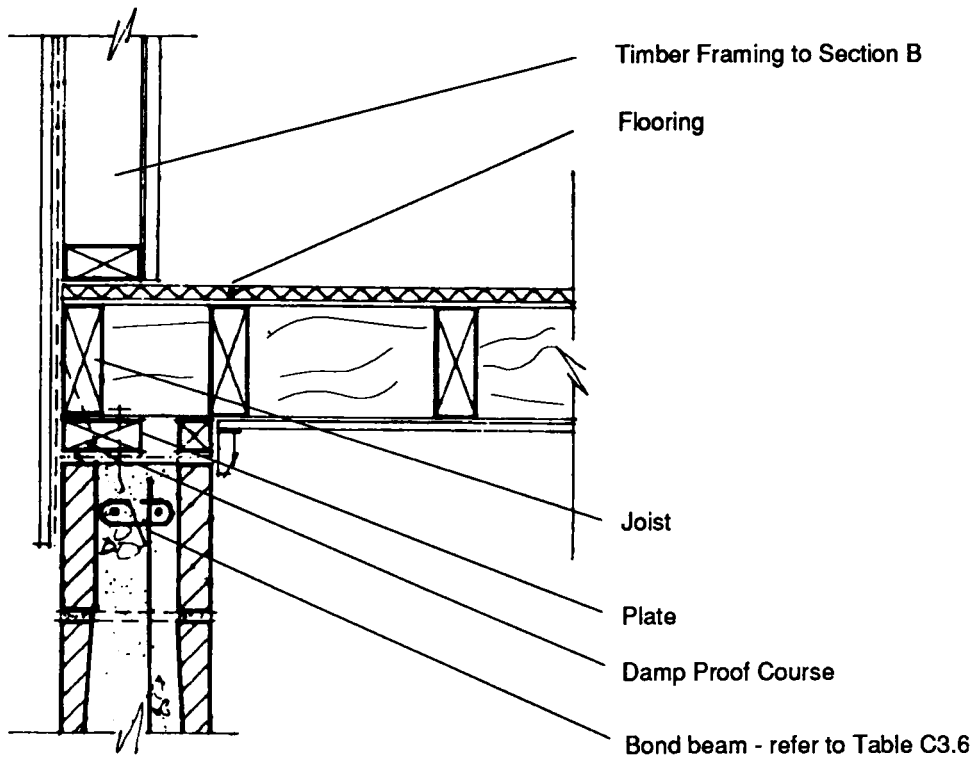


FIGURE E4.4 TIMBER FRAMED WALL ABOVE A CONCRETE MASONRY WALL

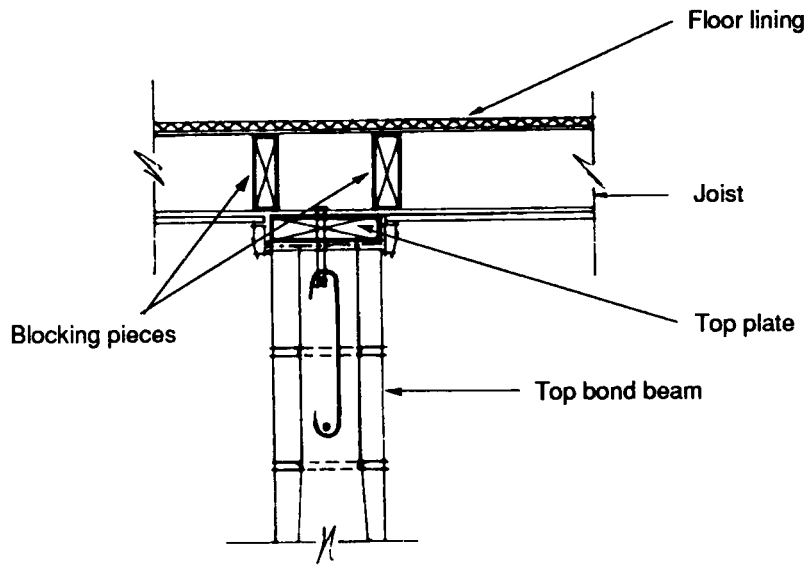


FIGURE E4.5 DETAIL OF MASONRY WALL WITH TIMBER FLOOR - PERPENDICULAR TO JOISTS

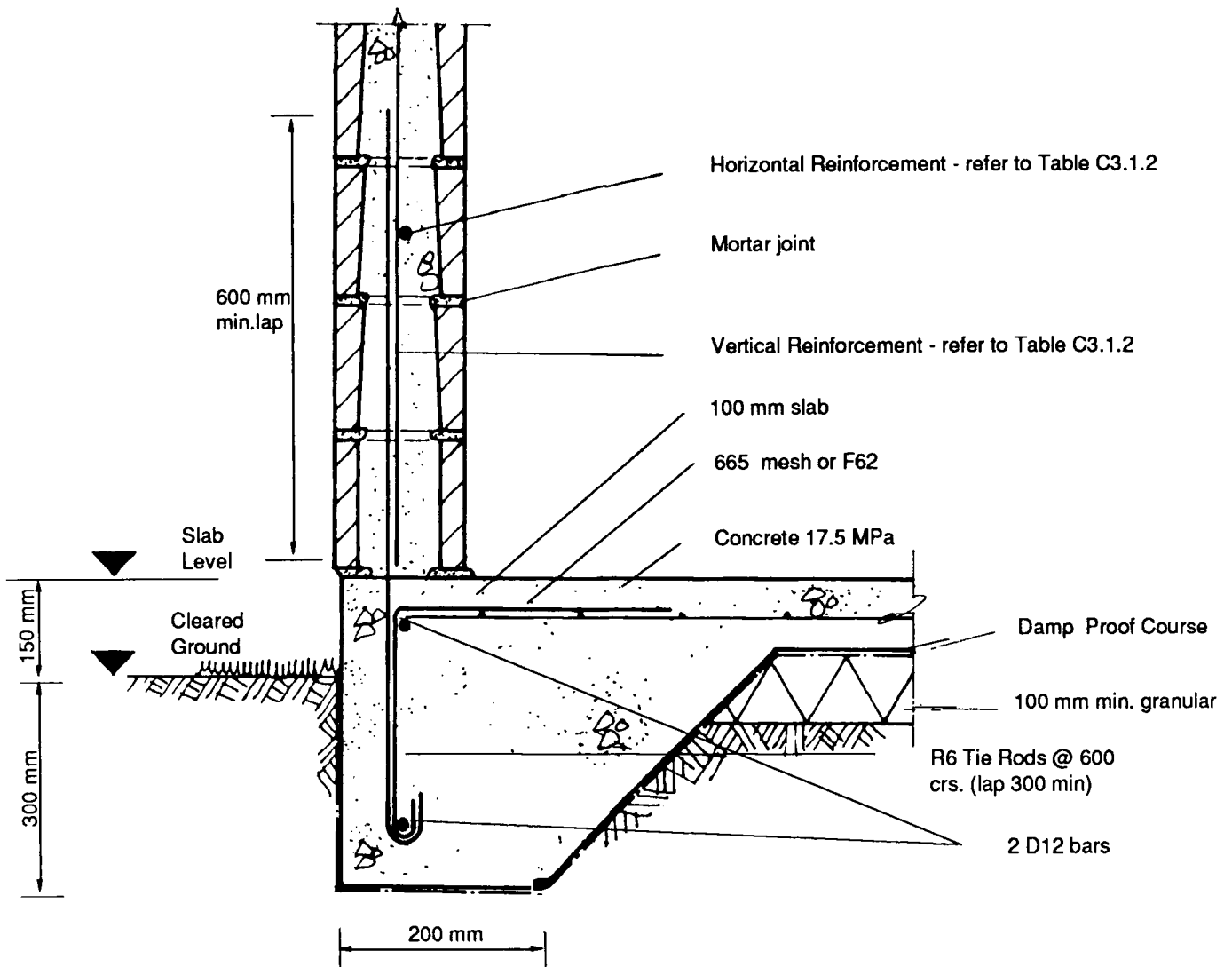


FIGURE E4.6 DETAIL OF FOOTING - IN LEVEL WITH SLAB

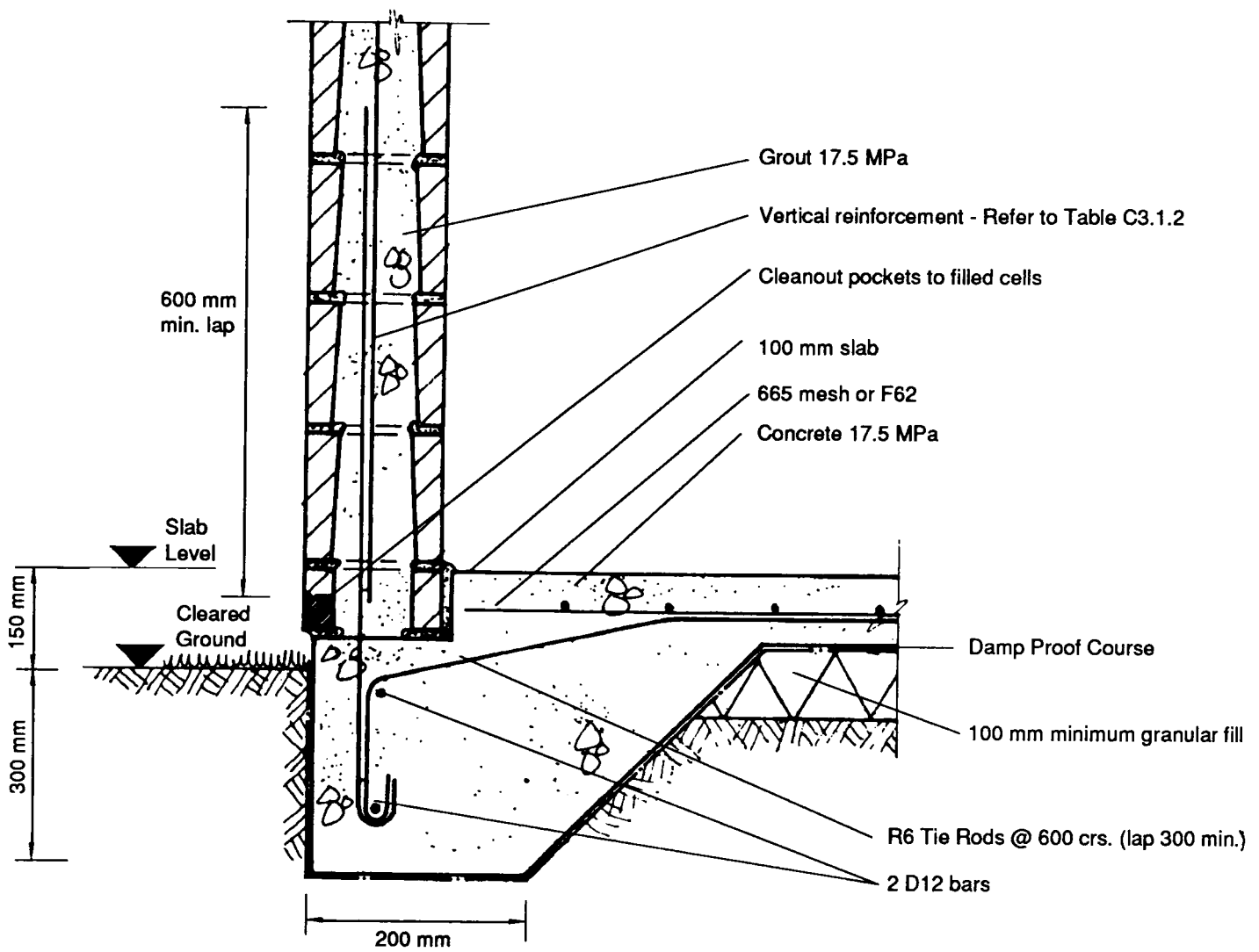


FIGURE E4.7 DETAIL OF STEP- DOWN FOOTING



# SECTION F

## HOUSE FAILURES AND PRECAUTIONS

# SECTION F HOUSE FAILURES AND PRECAUTIONS

## F1 HOW WIND ACTS ON A HOUSE

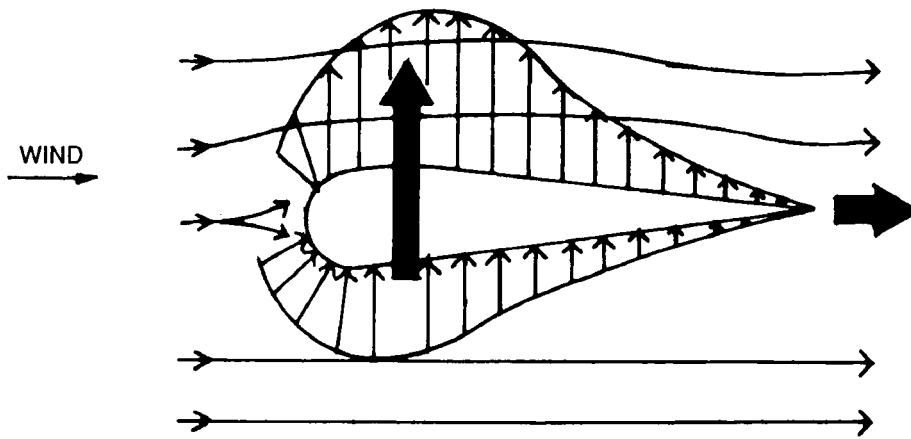


FIGURE F1.1 AIRCRAFT WING: EXPERIENCES HIGH VERTICAL (LIFT) FORCE AND SMALL HORIZONTAL (DRAG) FORCE

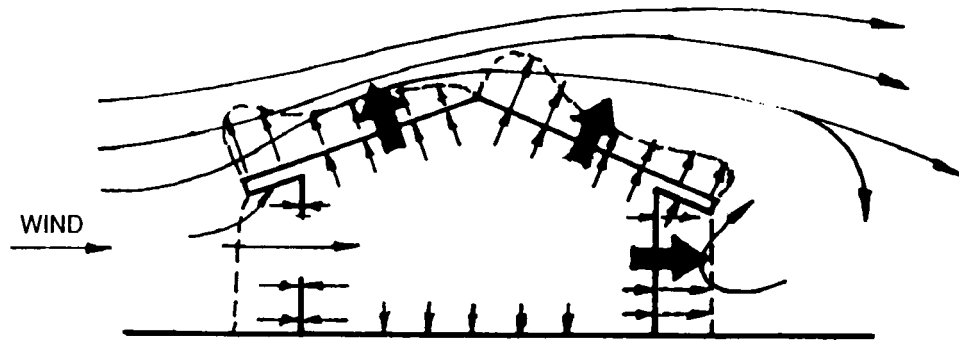


FIGURE F1.2 HOUSE: EXPERIENCES VERTICAL (UPLIFT) FORCES ON ROOF AND HORIZONTAL (SIDE-WAYS) FORCES MAINLY ON WALLS

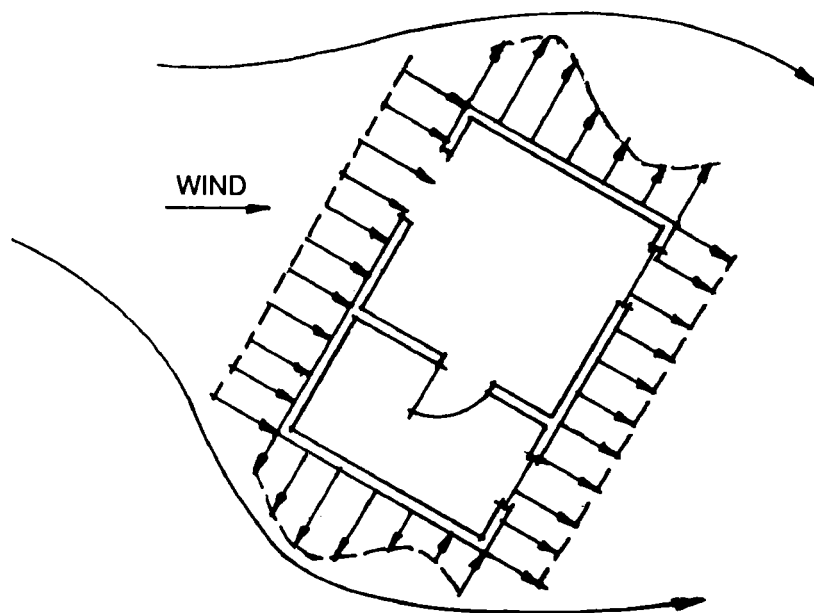
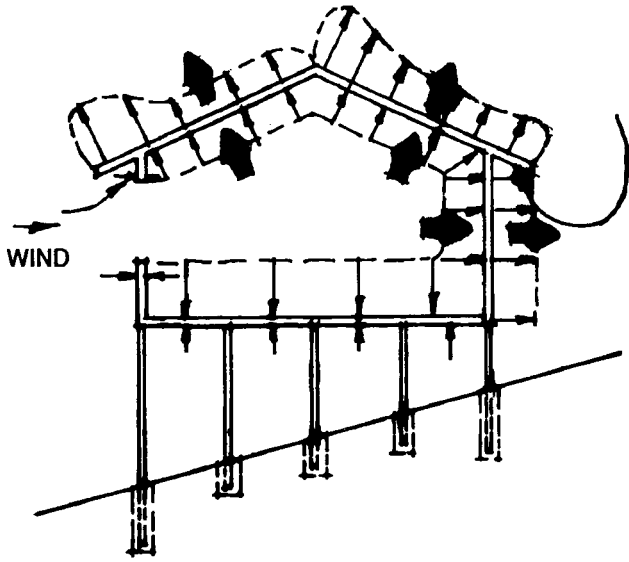
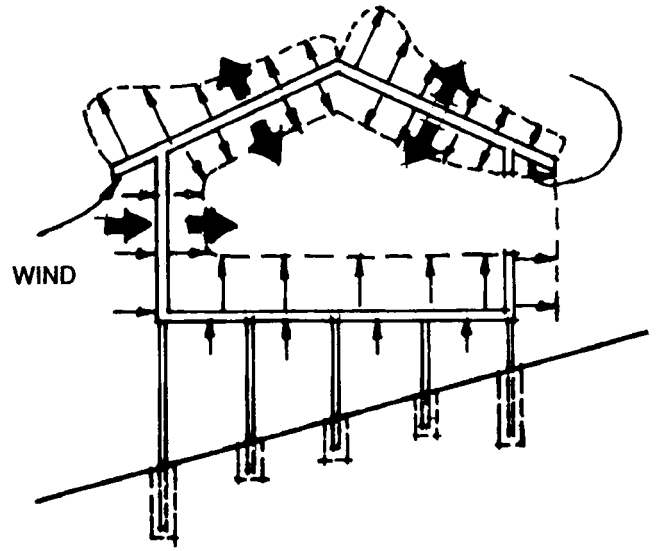


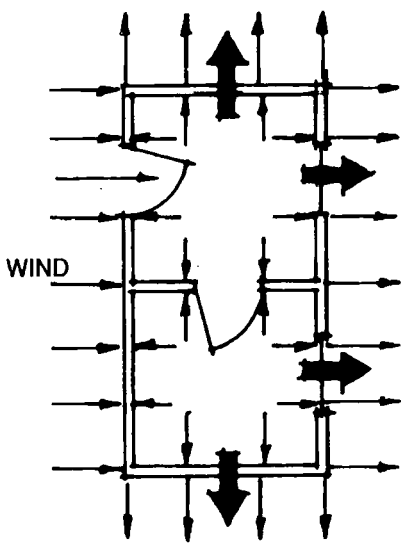
FIGURE F1.3 EXTERNAL PRESSURES ON WALLS OF A HOUSE



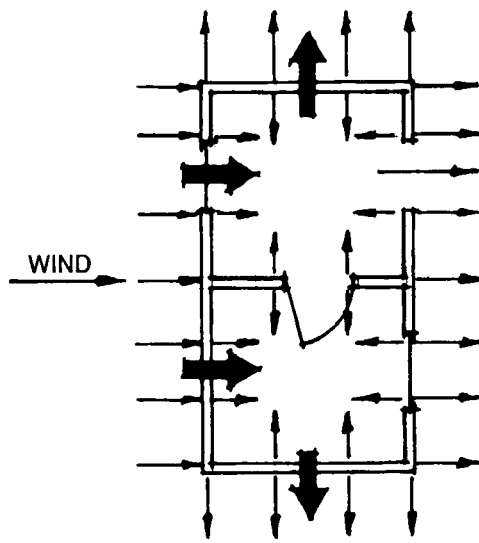
(a) WINDWARD OPENING - Internal Pressure



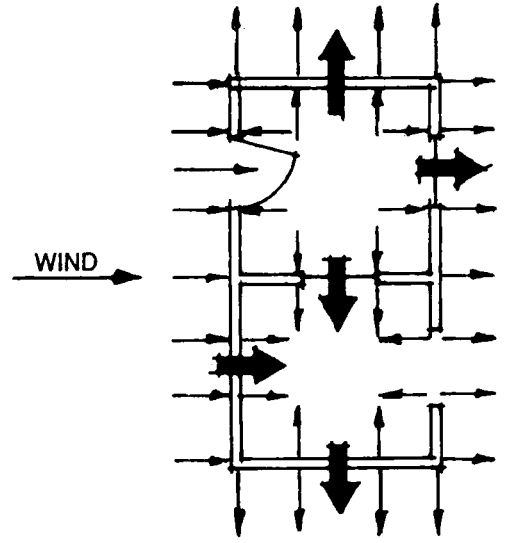
(b) LEEWARD OPENING - Internal Suction



(c) WINDWARD OPENING - Internal Pressure



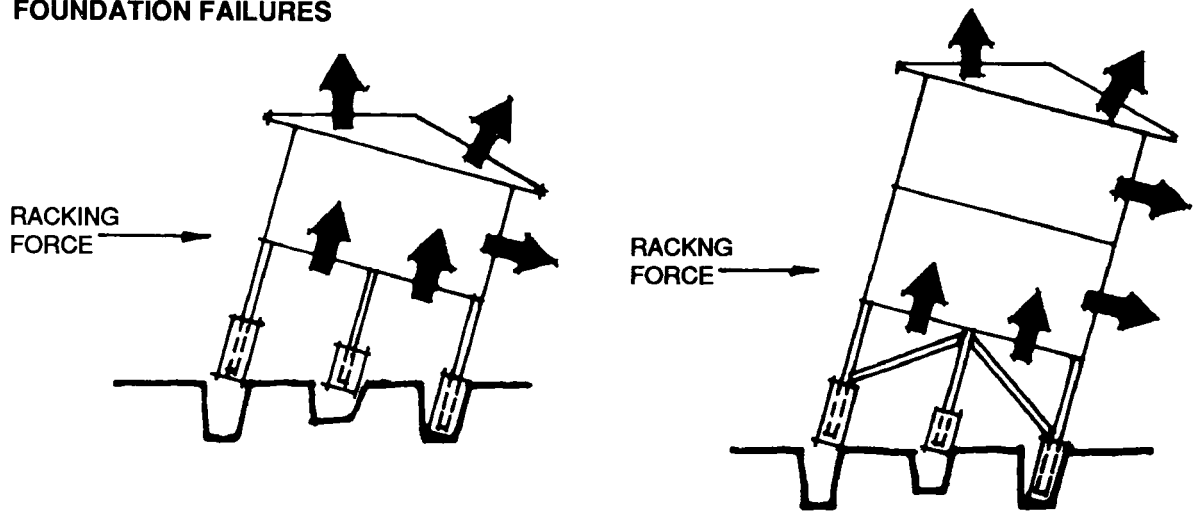
(d) LEEWARD OPENING - Internal Suction



(e) DIFFERENTIAL PRESSURE ON INTERNAL WALL

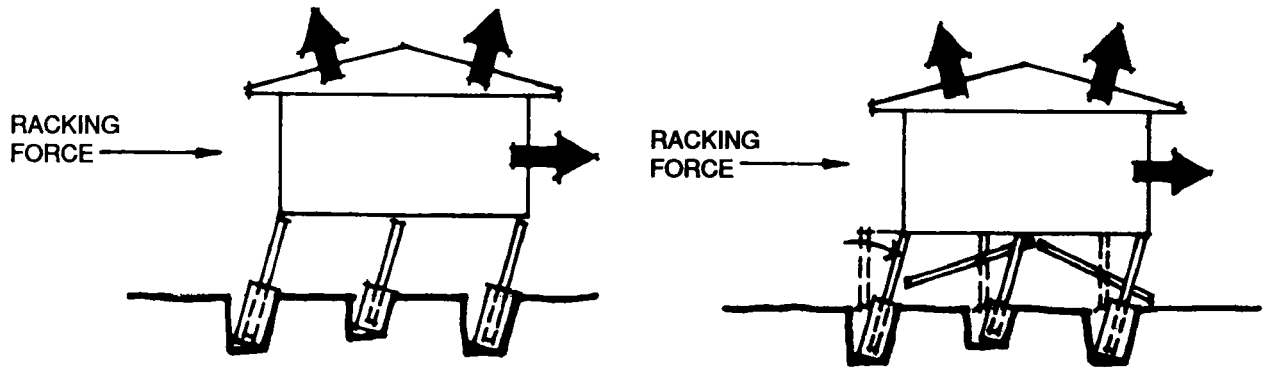
FIGURE F1.4 EFFECTS OF INTERNAL PRESSURES RESULTING FROM OPENINGS IN HOUSES

## F2 FOUNDATION FAILURES



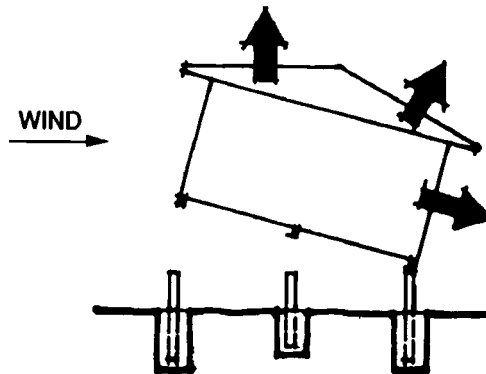
- FAILURE:**
1. Pile foundations have inadequate depth and weight to resist uplift
  2. Pile foundations constructed in soft ground with inadequate shear friction resistance to prevent the pile from being pulled out of the ground.

**REMEDY:** Provide deep and heavy footings.



- FAILURE:**
1. Pile foundations at inadequate depth and width to resist overturning.
  2. Pile foundations constructed in soft ground unable to resist overturning.
  3. Pile height exceeds maximum allowed by this manual for cantilevered piles and are overloaded.
  4. Piles, exceeding 1.2m, which are not laterally supported with diagonal braces.

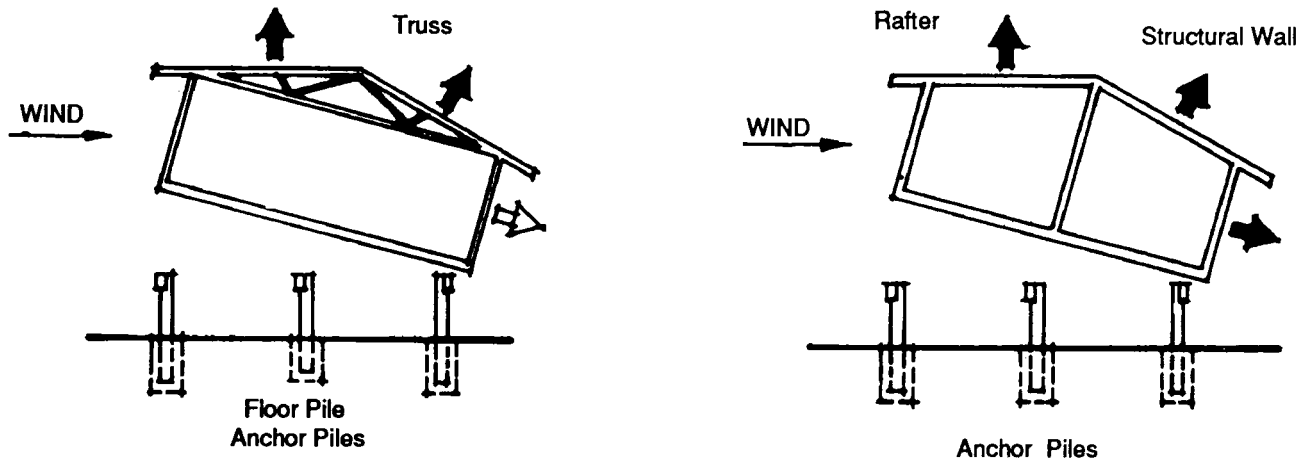
**REMEDY:** Provide deep and wide foundations with bracing as required by this manual.



- FAILURE:**
1. Connections between bearers and piles fail.
  2. Connections of braces to piles or sub-floor framing fail.

**REMEDY:** Provide adequate connections between bearers and piles and braces and piles.

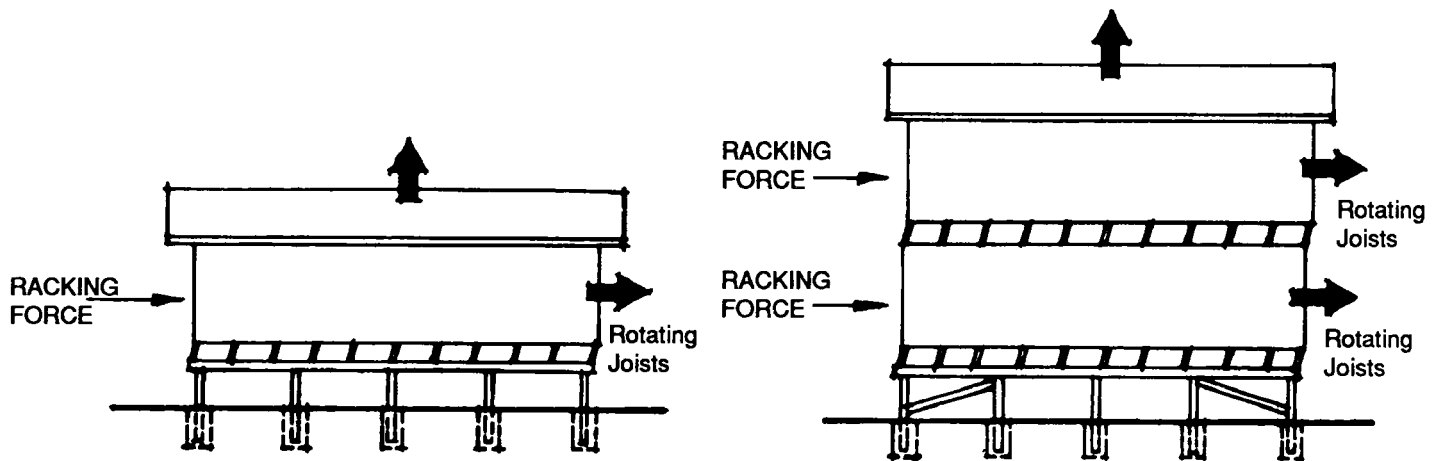
### F3 BEARER AND JOIST FAILURES



**FAILURE:** Connections between bearers and floor joists fail.

**REMEDY:** Provide adequate connections between bearers and floor joists.

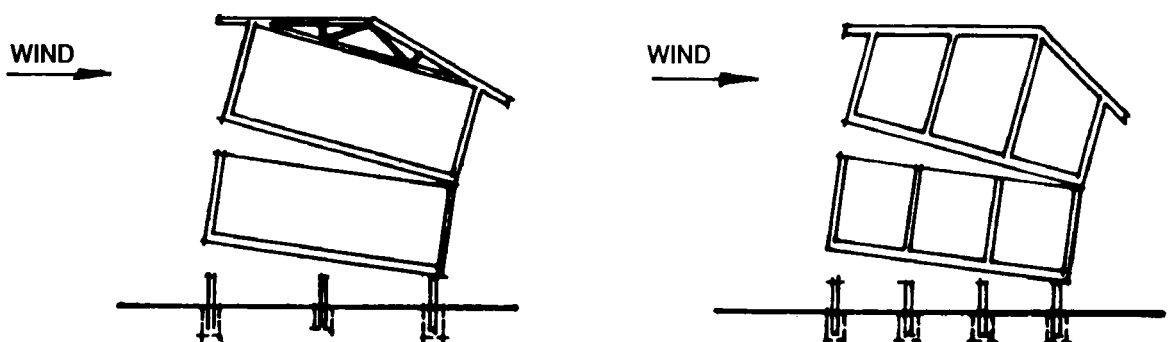
**FIGURE F3.1 FAILURE OF FLOOR BEARER/JOIST CONNECTIONS**



**FAILURE:** Joists rotate under lateral wind load.

**REMEDY:** Provide solid blocking and/or boundary joists.

**FIGURE F3.2 FAILURE OF FLOOR BY JOIST ROTATION**



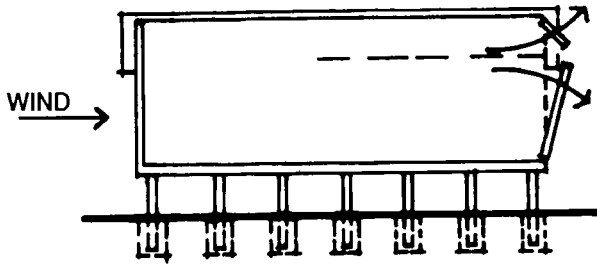
**FAILURE:** Floor to wall or floor to bearer connections fail

**REMEDY:** Provide adequate connections between floor and wall and between floor and bearer.

**FIGURE F3.3 FAILURE OF FLOOR JOIST TO WALL AND BEARER CONNECTIONS**

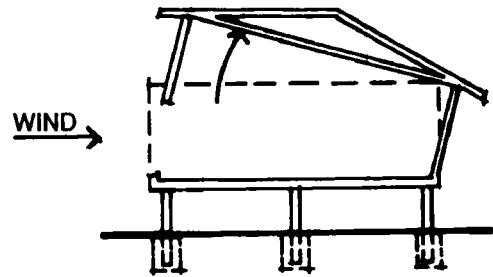
**F4 FAILURE OF WALLS**

Preferred Gable full height studs to roof

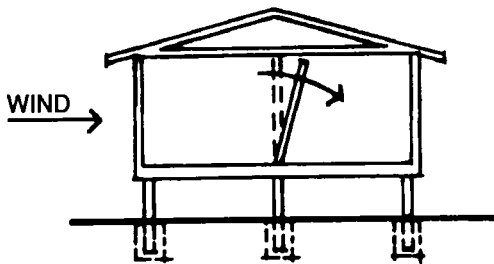


**FAILURE:** Gable end wall blows out.  
**REMEDY:** Provide lateral support to gable end wall in line of ceiling joists.

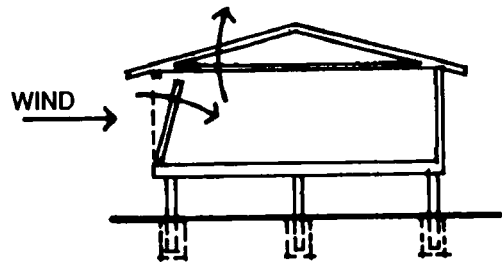
Non-preferred Gable construction, not laterally supported by ceiling joists



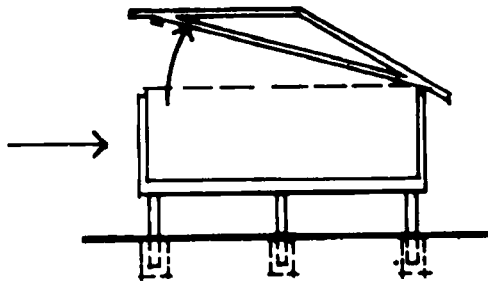
**FAILURE:** Roof and walls blow away.  
**REMEDY:** Provide adequate fixing of bottom plates to studs



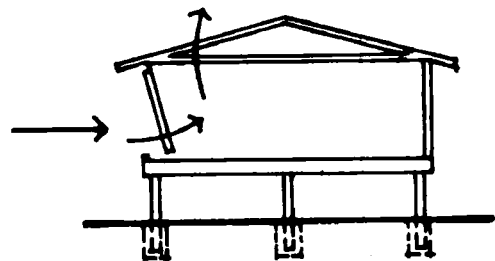
**FAILURE:** Internal wall blows over  
**REMEDY:** Provide adequate fixing of internal walls at plate level.



**FAILURE:** Wall blows over and roof lifts  
**REMEDY:** Provide adequate fixing of top plates to studs



**FAILURE:** Roof blows away leaving walls standing.  
**REMEDY:** Provide adequate fixing of top plates to studs.



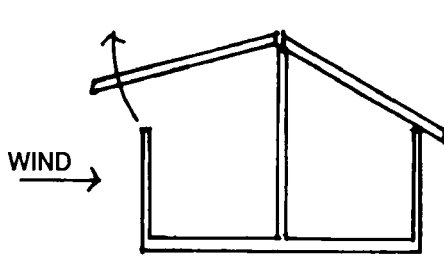
**FAILURE:** Wall blows inwards and roof lifts.  
**REMEDY:** Provide adequate fixing of bottom plates to studs.

RACKING FORCE →

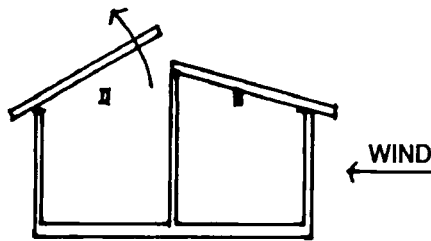
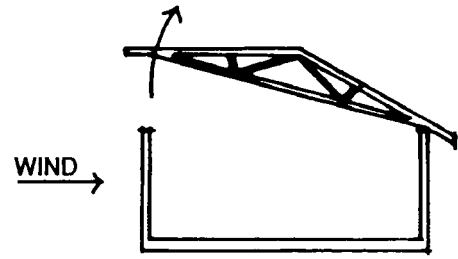


**FAILURE:** Wall collapses under racking load.  
**REMEDY:** Provide the required number and type of braces with adequate nailing.

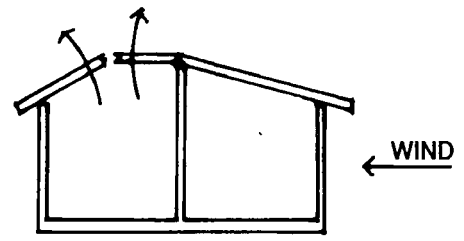
**F5 FAILURE OF ROOF**



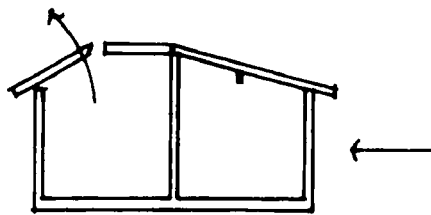
**FAILURE:** Tie down of rafter or truss to top plate inadequate for wind force  
**REMEDY:** Fix securely at top plate



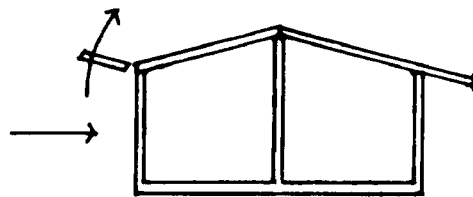
**FAILURE:** Tie down of rafter to ridge or under purlin inadequate  
**REMEDY:** Fix securely at ridge and under purlin



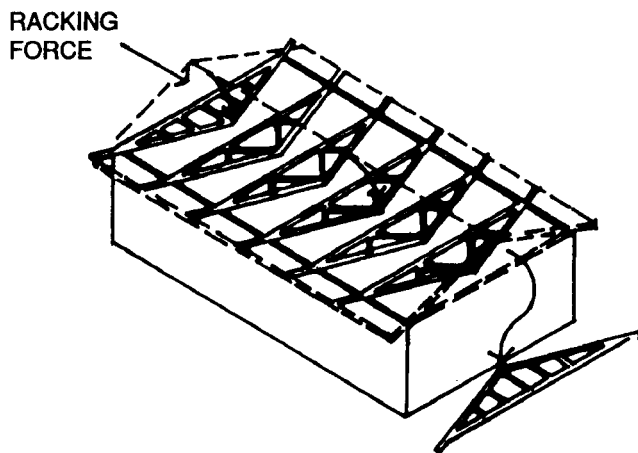
**FAILURE:** Breakage of rafter or other member  
**REMEDY:** Provide members of correct size and number



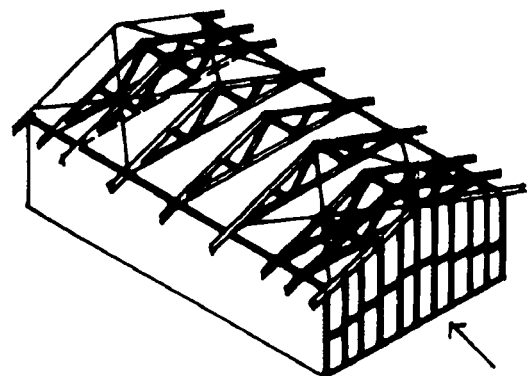
**FAILURE:** Under purlin inadequately tied down  
**REMEDY:** Fix under purlins securely to structure



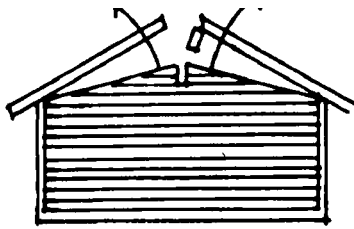
**FAILURE:** Cantilever rafter breaks at eave overhang  
**REMEDY:** Provide rafters of correct size and spacing for cantilever



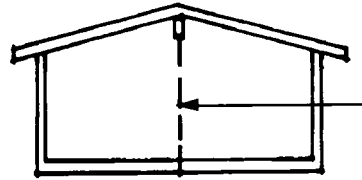
**FAILURE:** Trusses collapse longitudinally due to inadequate bracing.



**REMEDY:** Provide adequate diagonal bracing and ensure cladding is correctly fixed as this provides a considerable amount of bracing.

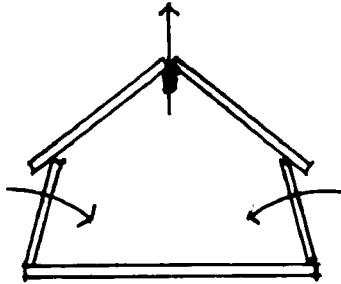


**FAILURE:** Ridge Beam not tied down but walls are adequately supported

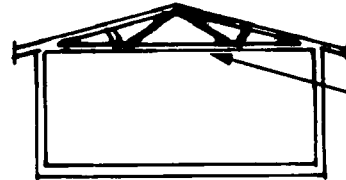


Holding down bolt

**REMEDY:** Tie Ridge Beam down to foundation structure

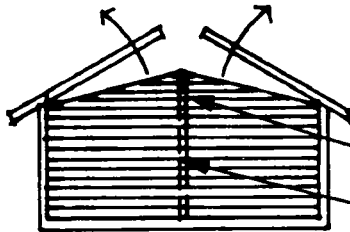


**FAILURE:** Ridge not tied down and walls inadequately supported



Roof trussed

**REMEDY:** Form Truss in roof by nail plate fixings or provide bracing walls and adequate tie-down.

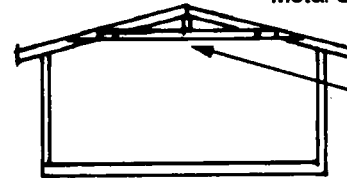


Roof Beam or Loadbearing Wall

**FAILURE:** Roof not tied at ridge but walls are adequately supported



Metal Strap

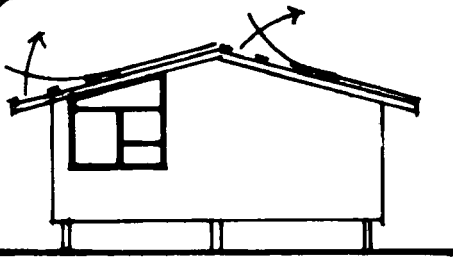


Timber Tie

**REMEDY:** Tie Rafters together with straps or bolted timber tie

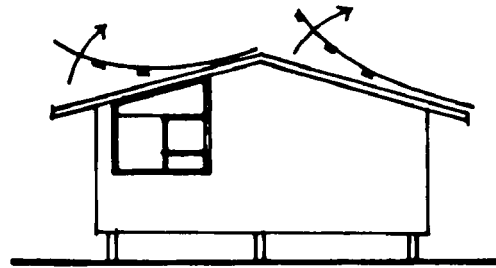
## F6 FAILURE OF ROOF CLADDINGS

WIND →



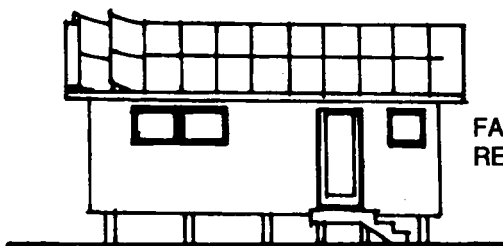
**FAILURE:** Wind lifts roofing off purlins  
**REMEDY:** Provide more fasteners through roofing material

WIND →



**FAILURE:** Wind lifts roofing and purlins together  
**REMEDY:** Provide adequate fixing of purlins to rafters

WIND →



**FAILURE:** Wind lifts roofing off purlins  
**REMEDY:** Provide more fasteners through roofing material and a suitable fascia barge flashing adequately fixed. Do not use a rolled edge flashing



## **F7 CARE AND PRECAUTIONS**

### **F7.1 Checklist for masonry construction**

#### **A Before grouting**

- 1 Has all debris been removed from the base of the wall?
- 2 Check the wall for plumb. Tolerance 10 mm in 3 m (3/8 inch in 9 feet) within a storey.
- 3 Is the wall straight? Tolerance 5 mm in 10 m (1/4 inch in 33 feet); 10 mm any length over 10 m. (Overall position of wall in house presumed checked at first course setting out).
- 4 Has reinforcement been tied to starter bars.
- 5 Reinforcement correctly located in wall or pier? Is there a minimum 6 mm clearance from reinforcement to the face of all shells of masonry?
- 6 Is vertical steel to within 50 mm or 1/4 the length on an individual grouted cell?
- 7 Is vertical steel adequately supported laterally to prevent movement during grouting? Support interval (height /bar diameter) not more than 1.2 m/10 mm; 2.4 m/12 mm; 3.6 m/16 mm.
- 8 Are minimum lap lengths of 300 grade reinforcement 400 mm for 10 mm, 480 mm for 12 mm and 640 mm for 16 mm?
- 9 After cleaning out cells, have cleanout pockets been properly closed?
- 10 Is the grout as specified? Not too much water, but workable. Aggregate not too fine.

#### **B After grouting**

- 1 After filling and waiting:
  - Revibrate and top up.
  - Trowel down expanded grout top.
- 2 At construction joints, if required, lightly brush/wash the grout surface after initial set.
- 3 In hot weather, protect wall top from premature drying out.
- 4 Remove any grout spills on wall surface.

### **F7.2 Some precautions for builders, homeowners and occupants**

#### **F7.2.1 Construction phase**

- 1 Use the correct member sizes, connector types and sizes etc. as required by this Manual.
- 2 Use reputable manufacturers specifications and details where they vary from those shown or prescribed anywhere in this manual.
- 3 Make sure that all joints are firmly held together.
- 4 Where there are trusses, use nail plates on both sides of the joints.
- 5 Tighten all bolts correctly - not loose nor overtight.
- 6 Use the correct sizes of washers with the bolts (Refer to table B10.4.1)
- 7 Keep available or have in place strong shutters for all glazed openings to prevent glass breakage by flying debris.

- 8 Use prefabricated metal connectors and wherever possible predrilled metal straps.
- 9 Use appropriately treated timber for external and internal use. Where in doubt ask Dept. of Forestry or other reputable source.
- 10 Tie all reinforcing rods properly.
- 11 Provide cleanout pockets in blocks for grouting.
- 12 Compact grout properly in cores by either using a mechanical vibrator or rodding.
- 13 When site mixing of concrete or grout use the correct mixture of cement, clean water, and aggregate.

#### **F7.2.2 During the cyclone season**

- 1 Put window shutters in place as soon as a cyclone warning is issued.
- 2 Keep yard clear of any potential flying debris.
- 3 Trim down branches of trees which may break during a cyclone and become flying debris.
- 4 Keep clear of all glazed openings during a cyclone.
- 5 Stock up food supplies for use during/after a cyclone.
- 6 Keep a battery operated radio to listen to broadcasts regarding the cyclone.
- 7 If the house is in a flood prone area, move to higher ground before flooding occurs
- 8 If the house is in an area known to cause mudslides, vacate house and move to firm ground.

#### **F7.2.3 In the event of an earthquake**

- 1 Take cover under a desk or brace yourself in a doorway, unless you are able to get out of the building and be in an open area away from buildings and trees.
- 2 Keep clear of glazed areas and cabinets.
- 3 If the house is in a coastal region and a tsunami warning is issued, move to higher ground. Do not wait.
- 4 If you are in a car, STOP the car and stay there.
- 5 Move away from buildings.
- 6 Do not use any lift if in a building with one.

#### **F7.2.4 Precautions against fire**

- 1 Where a fire service is available keep their telephone number handy.
- 2 Discuss with family members the appropriate sequences of action in case a fire should occur. Discuss scenarios such as what to do if there is a fire in the kitchen or a bedroom and how to prevent the occurrence of such fires. Also determine common assembly spot after escaping.
- 3 Keep the house and yard tidy. Do not allow tall grass and shrubs to grow close to any combustible facing of walls etc.
- 4 Store liquid fuels in small quantities in air-tight containers and clearly label them. Many serious fires have occurred by the mistaken use of lawn mower fuel in kerosene stoves.

- 5 Keep matches out of reach of children.
- 6 Do not ever smoke in bed.
- 7 Check electrical appliances periodically. If there are any kinks, frayed ends, cracked/cut insulation, etc. replace immediately. Discoloured switches and sockets may indicate faults. If hot to touch they are faulty. Get them checked/replaced.

#### **F7.2.5 In the event of a fire**

- 1 Where there is a fire service call them promptly.
- 2 Alert others around you.
- 3 Evacuate the house and assist others. Assemble at a pre-arranged open area. This will help to check that all those present have escaped.
- 4 With any fat-fire or fire in a sauce pan, cover with a lid. Do not try to carry it outside. With oil and fat fires do not use water to put them out.
- 5 With electrical fires, switch off and disconnect any plug. Do not use water to put them out.
- 6 If smouldering fire is discovered in any mattress or cushion etc: try to remove it outdoors and douse with plenty of water.
- 7 If caught in smoke, get close to the floor and crawl to escape. Inhaling any smoke will quickly disorient/incapacitate a person and lead to fatality.
- 8 If unable to escape from fire outside a room, plug all cracks/crevice/openings with wet blanket or clothing and stay close to the floor. If water is available, keep the floor wet.

#### **F7.3 Warning against unsafe practices**

Some methods of construction and some actions of residents could endanger lives or result in damage. These are listed in the form of prohibitions.

##### **F7.3.1 Construction phase**

- 1 Do not flatten roofing sheets when hammering nails or driving screws.
- 2 Do not leave gaps or allow slackness between joints and connections. Make all connections tight.
- 3 Do not use clouts on metal connectors.
- 4 Do not use undersized members or connectors.
- 5 Do not use nail plates on only one side of a truss.
- 6 Do not punch holes in metal straps with a nail or other sharp object. These tear far more quickly than straps with holes pre-punched by the manufacturer.
- 7 Do not use any other brand of preformed metal connectors if a particular brand is specified.
- 8 Do not build a lowset house in an area known to be flood-prone.
- 9 Do not rely only on skew nailed joints.
- 10 Do not nail metal straps in one line; stagger the nails
- 11 Do not leave loose debris near buildings.

- 12 Do not leave wide gaps in window shutters.
- 13 Do not use untreated timber for external use.

**In the event of a cyclone**

- 14 Do not stand near glazed openings during a cyclone.
- 15 Do not wander out after the cyclone. The lull may be temporary. Wait for radio announcement.
- 16 Do not go near broken down power lines.

**In the event of an earthquake**

- 17 Do not move your belongings.
- 18 Do not go near broken down power lines.

**In the event of a fire**

- 19 Do not use the lift, if in a highrise building at the time.
- 20 Do not return to the building until the all clear signal is given.
- 21 Do not use a hose reel on an electrical or oil/fat fire.
- 22 Do not run from the building, walk quickly instead to a safer place.
- 23 **DO NOT GO SIGHTSEEING IN THE EVENT OF ANY OF THE ABOVE.**

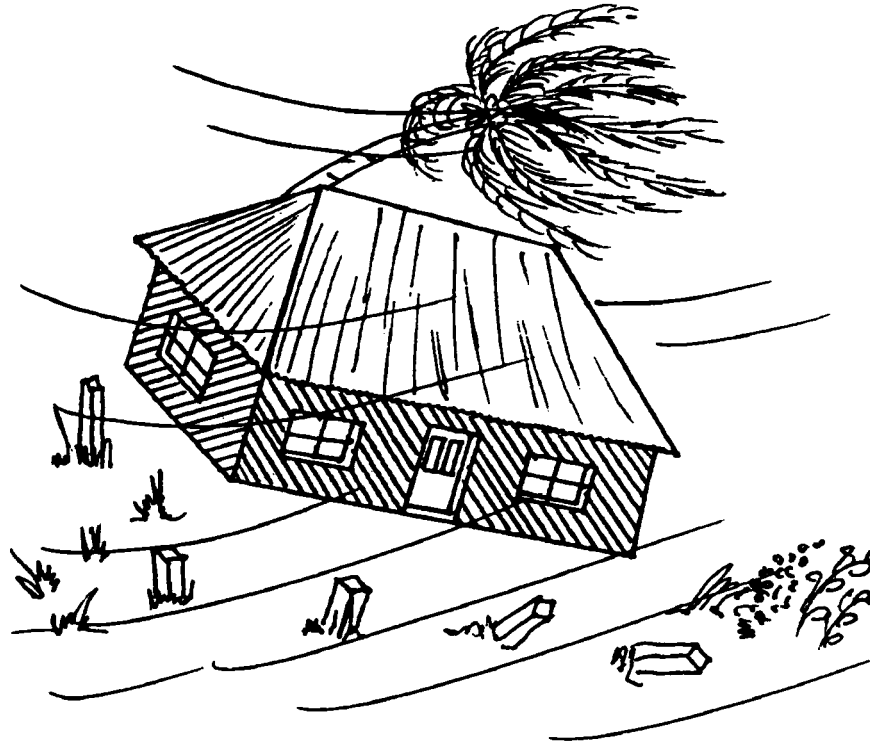
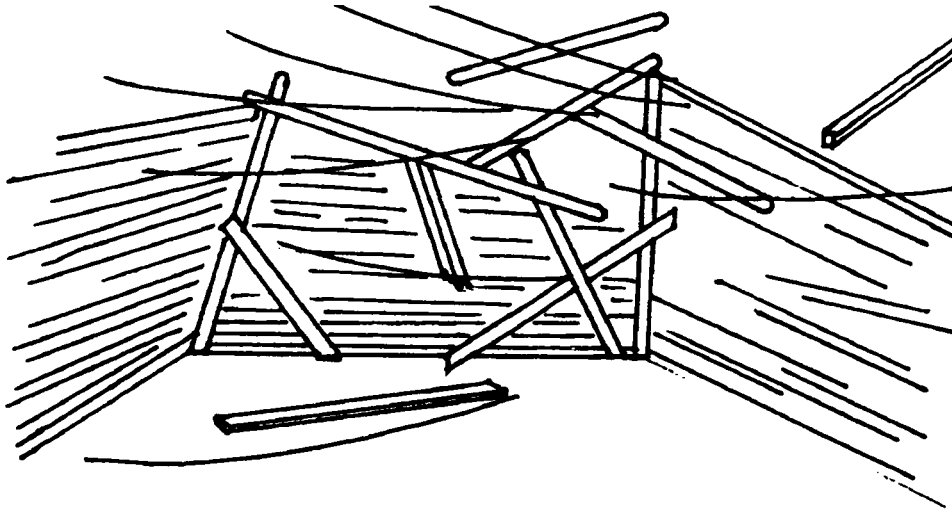


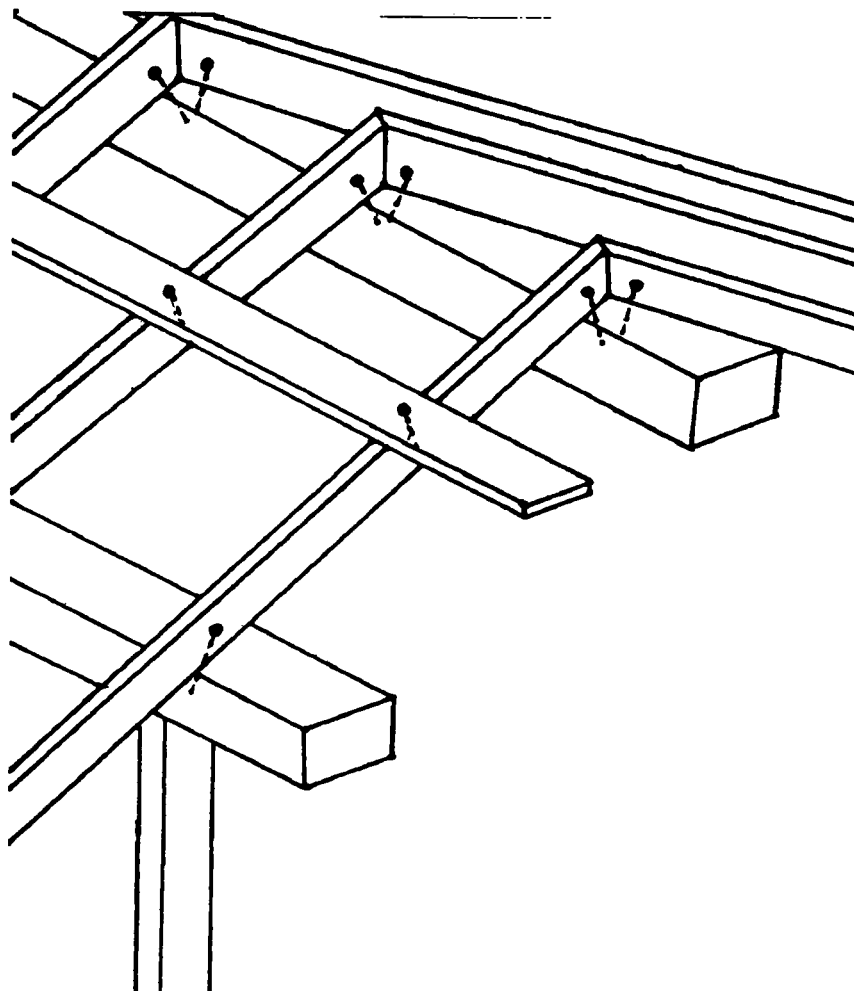
FIGURE F8.1 STRONG WINDS WILL BLOW HOUSES OFF THEIR FOUNDATIONS



FIGURE F8.2 WINDS WILL BLOW AWAY THE ROOF SHEETING



**FIGURE F8.3 POORLY BRACED AND JOINTED HOUSES WILL BREAK UP**



**FIGURE F8.4 DO NOT DEPEND ON THE NAILS ALONE TO KEEP YOUR ROOF UNLESS YOU HAVE USED SPECIAL PURPOSE ANCHOR NAILS OR SCREWS BOTH WITH CYCLONE WASHERS**

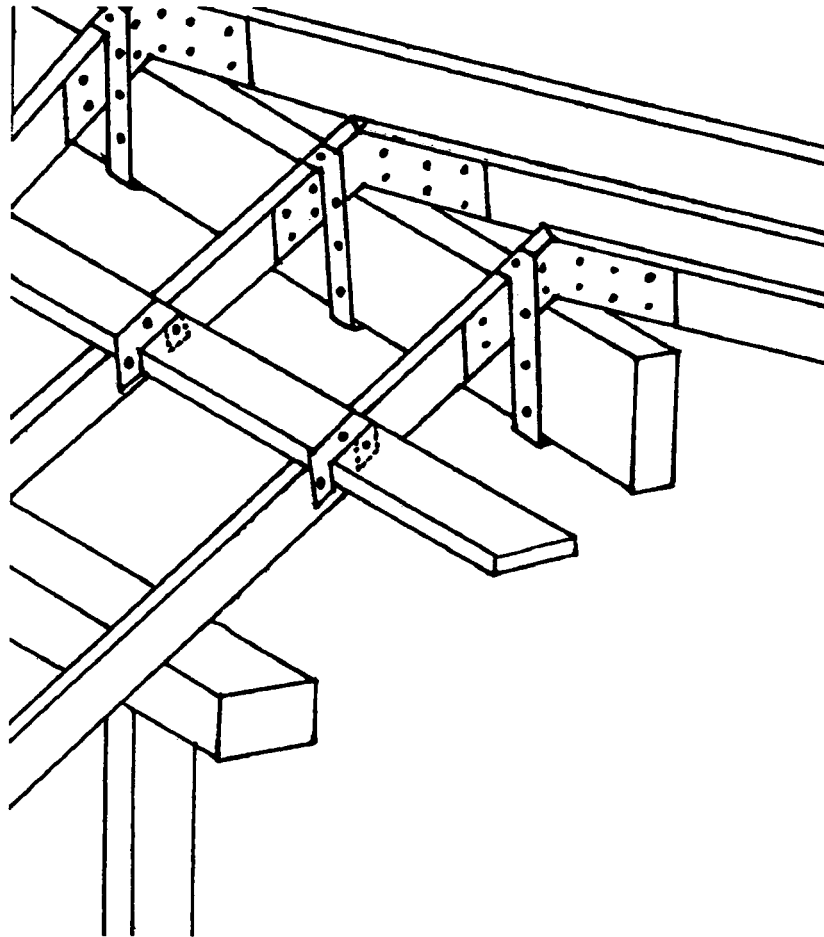


FIGURE F8.5 USE GALVANISED PRE-DRILLED METAL STRAPS LIKE THESE OR USE NO. 8 WIRE TO FIRMLY TIE UP JOINTS

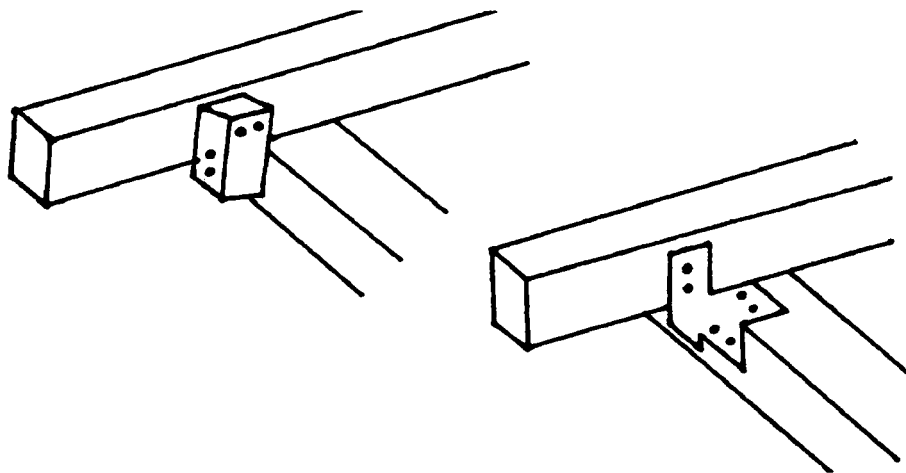


FIGURE F8.6 USE TIMBER OR METAL CLEATS TO HOLD DOWN RAFTERS

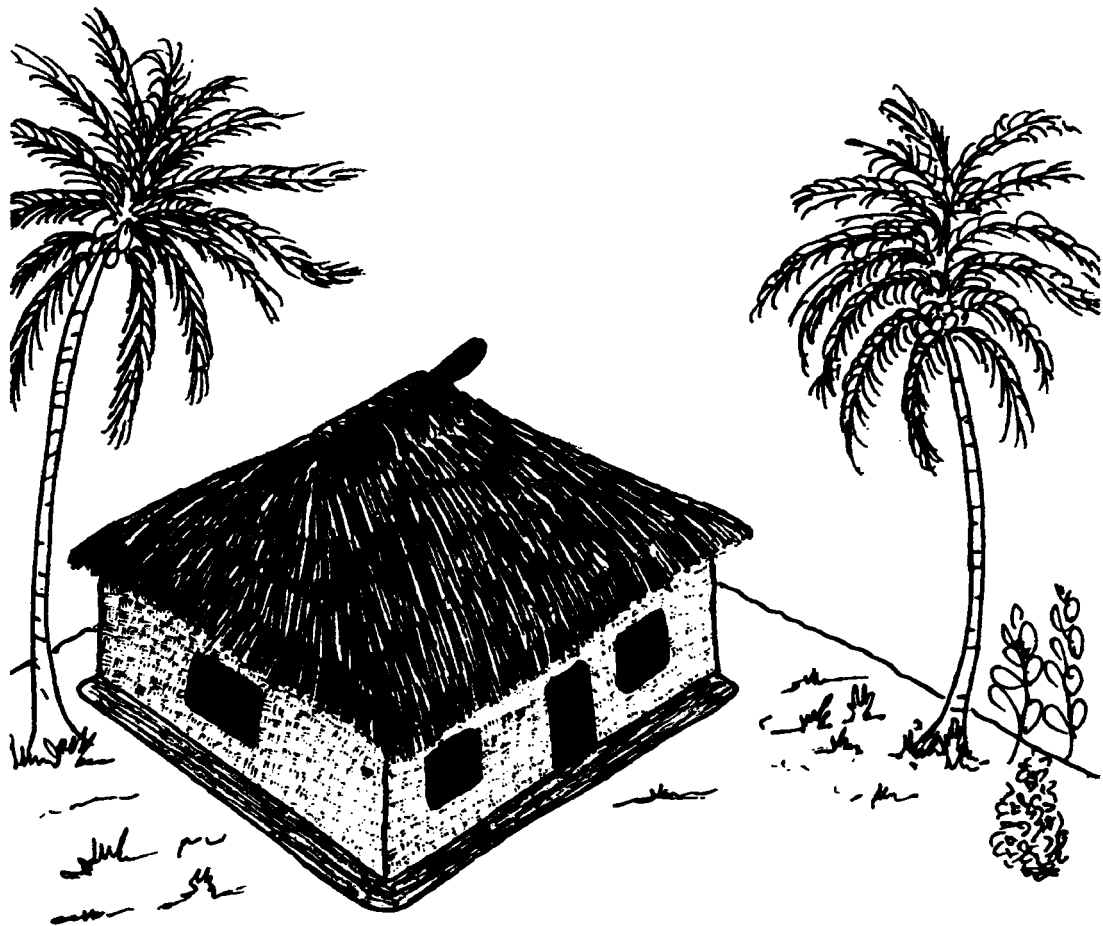


FIGURE F8.7 BUILD YOUR HOUSE ON A FIRM SITE



FIGURE F8.8 CUT INTO EARTH IF YOU BUILD A HOUSE ON A STEEP SLOPE



**FIGURE F8.9 IT IS UNWISE TO BUILD A HOUSE ON A STEEP SLOPE**



**FIGURE F8.10 IF THE SUPPORTS ARE NOT BRACED, THE HOUSE CAN BE BLOWN OFF IT'S SUPPORTS**



**FIGURE F8.11 BRACE THE SUPPORTS AS SHOWN AND TIE DOWN**





FIGURE F8.12 TIE YOUR HOUSE PROPERLY TO THE POSTS

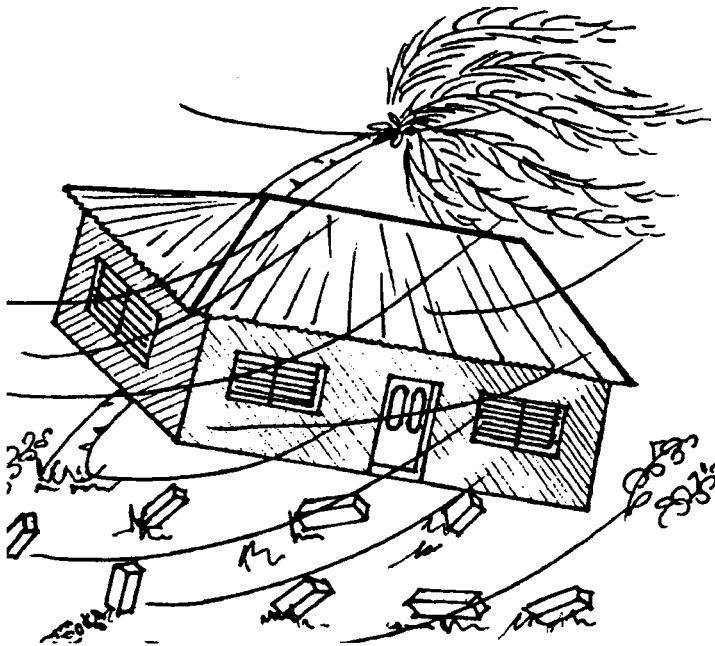


FIGURE F8.13 A HOUSE THAT IS NOT PROPERLY TIED DOWN WILL BLOW OFF THE POSTS

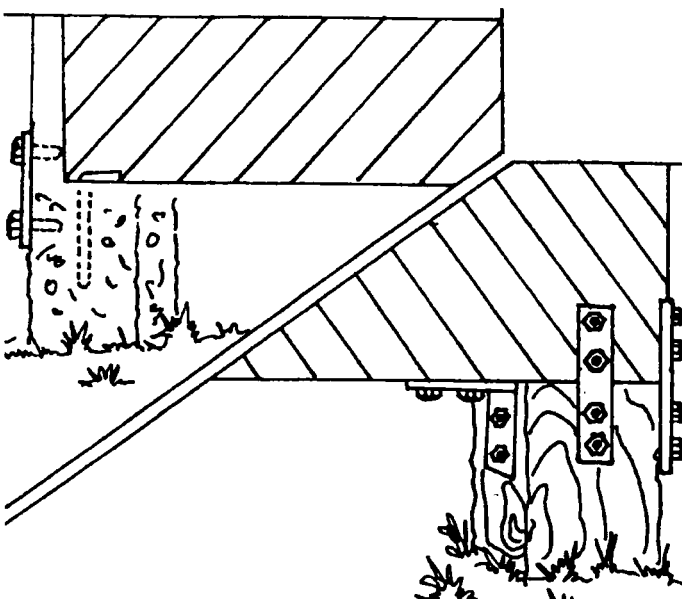


FIGURE F8.14 USE METAL STRAPS AND BOLTS TO TIE THE HOUSE TO THE POSTS

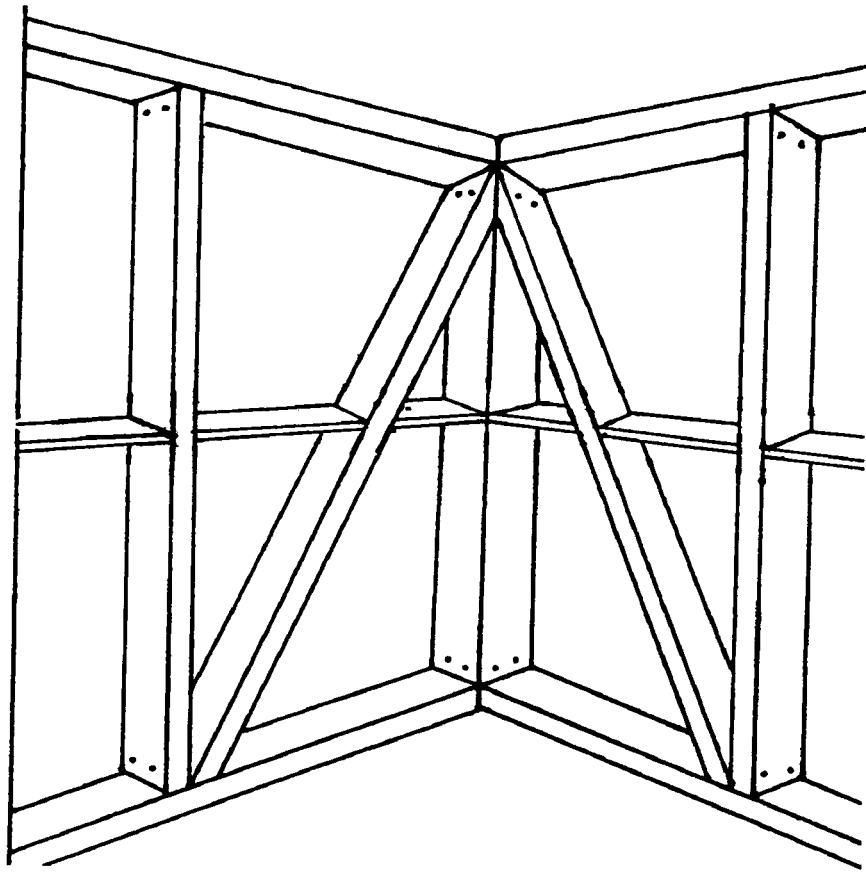


FIGURE F8.15 WALLS MUST BE BRACED IN THE CORNERS

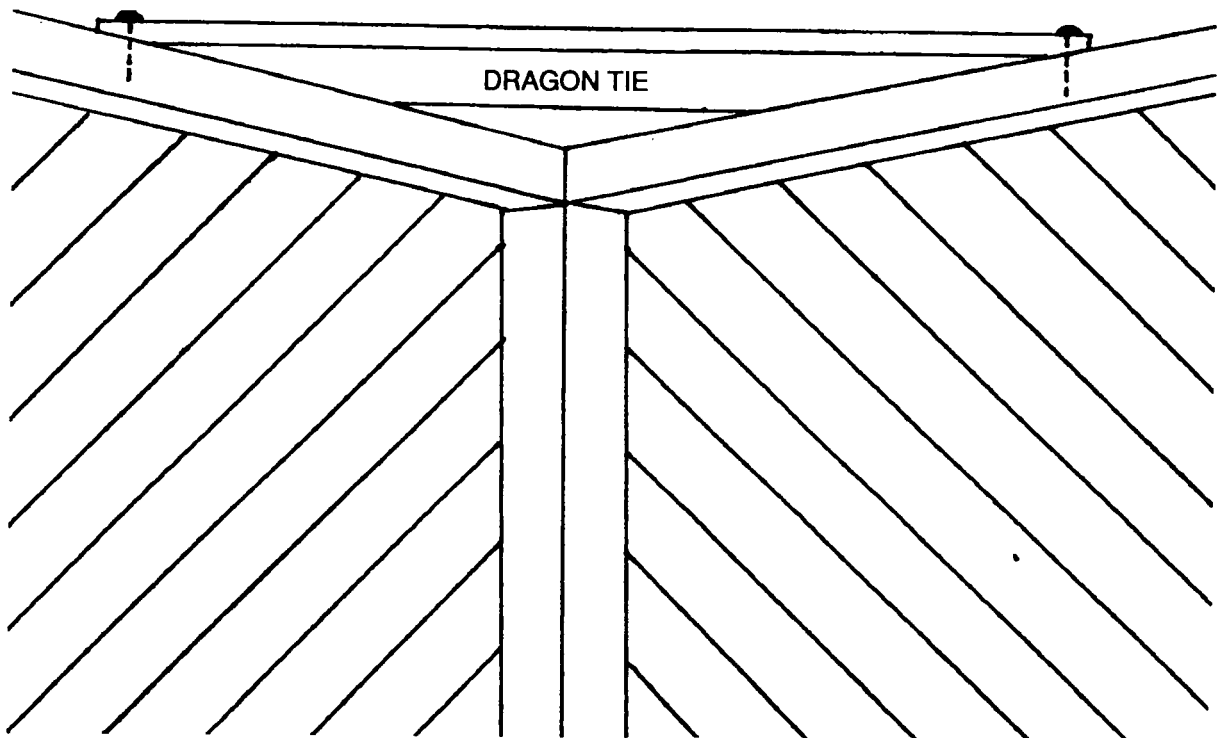


FIGURE F8.16 USE A DRAGON TIE TO BRACE EXTERNAL WALLS



FIGURE F8.17 GLASS WINDOWS AND DOORS WILL BREAK DURING A CYCLONE

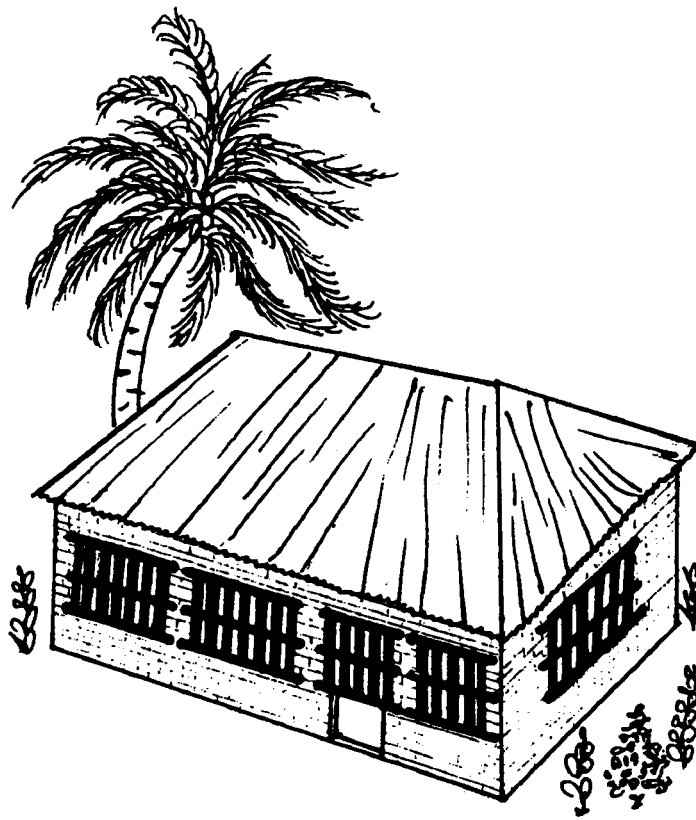


FIGURE F8.18 PROTECT ALL GLASS WINDOWS AND DOORS WITH PROPER CYCLONE SHUTTERS



FIGURE F8.19 OVERHANGS MUST BE AS SHORT AS IS NECESSARY

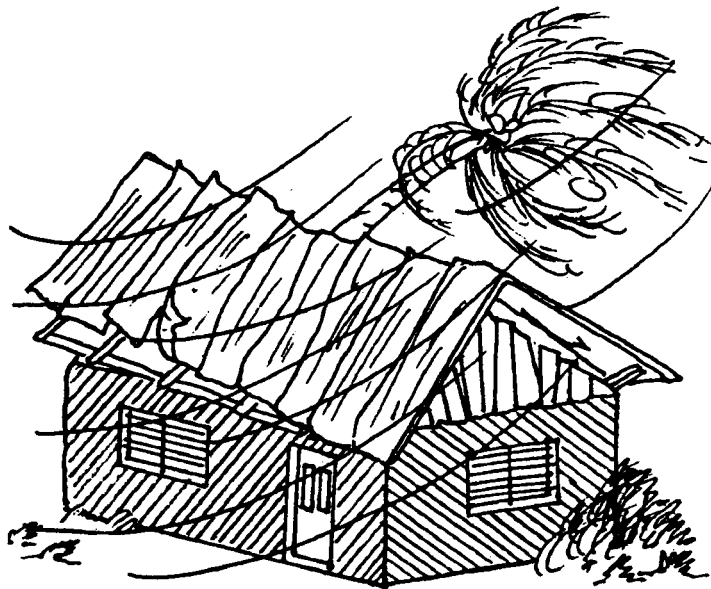


FIGURE F8.20 LONG OVERHANGS WILL CAUSE A ROOF TO BLOW OFF IN A CYCLONE

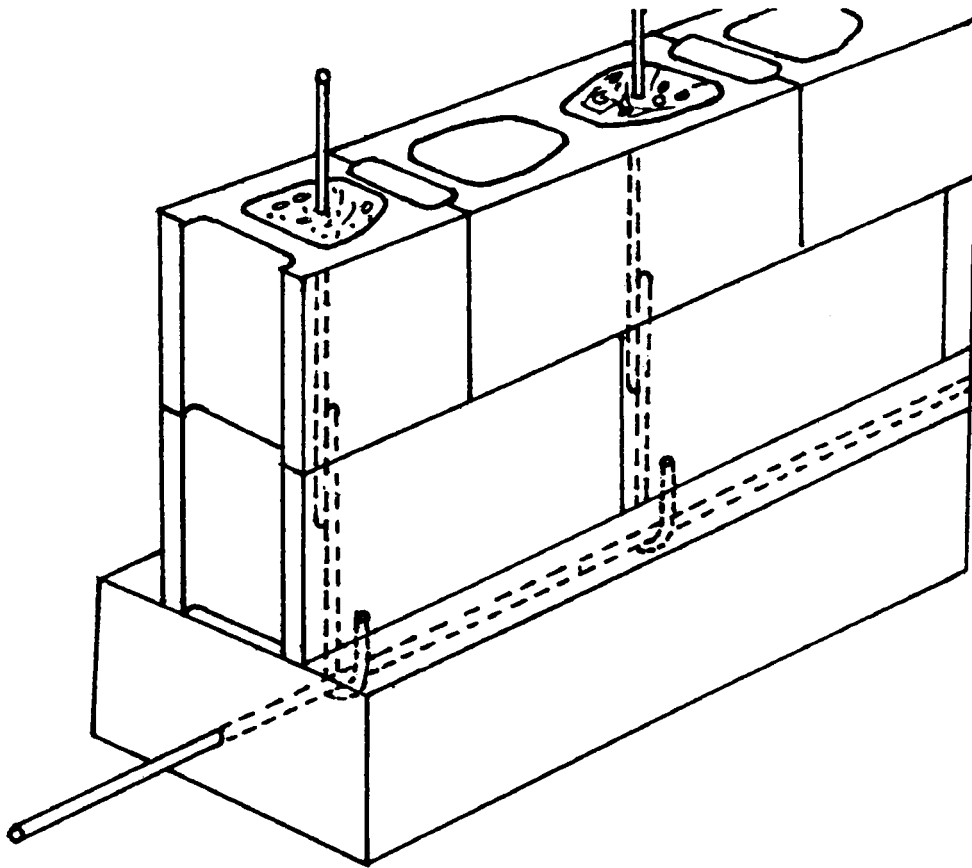


FIGURE F8.21 ANCHOR STARTER BARS INTO FOOTING. PROVIDE ADEQUATE LAP LENGTH FOR REINFORCEMENT. GROUT AROUND BARS FULLY

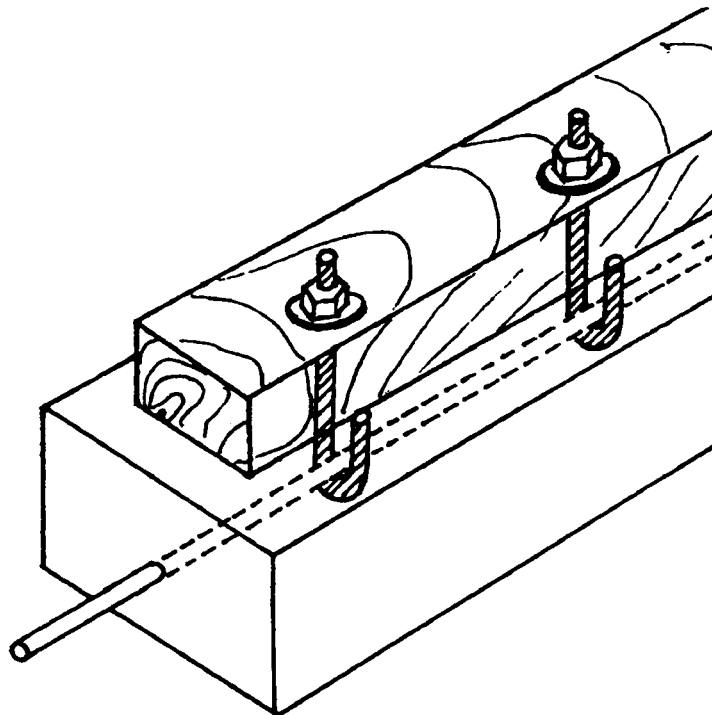


FIGURE F8.22 BOTTOM PLATE MUST BE PROPERLY ANCHORED TO THE FOOTING

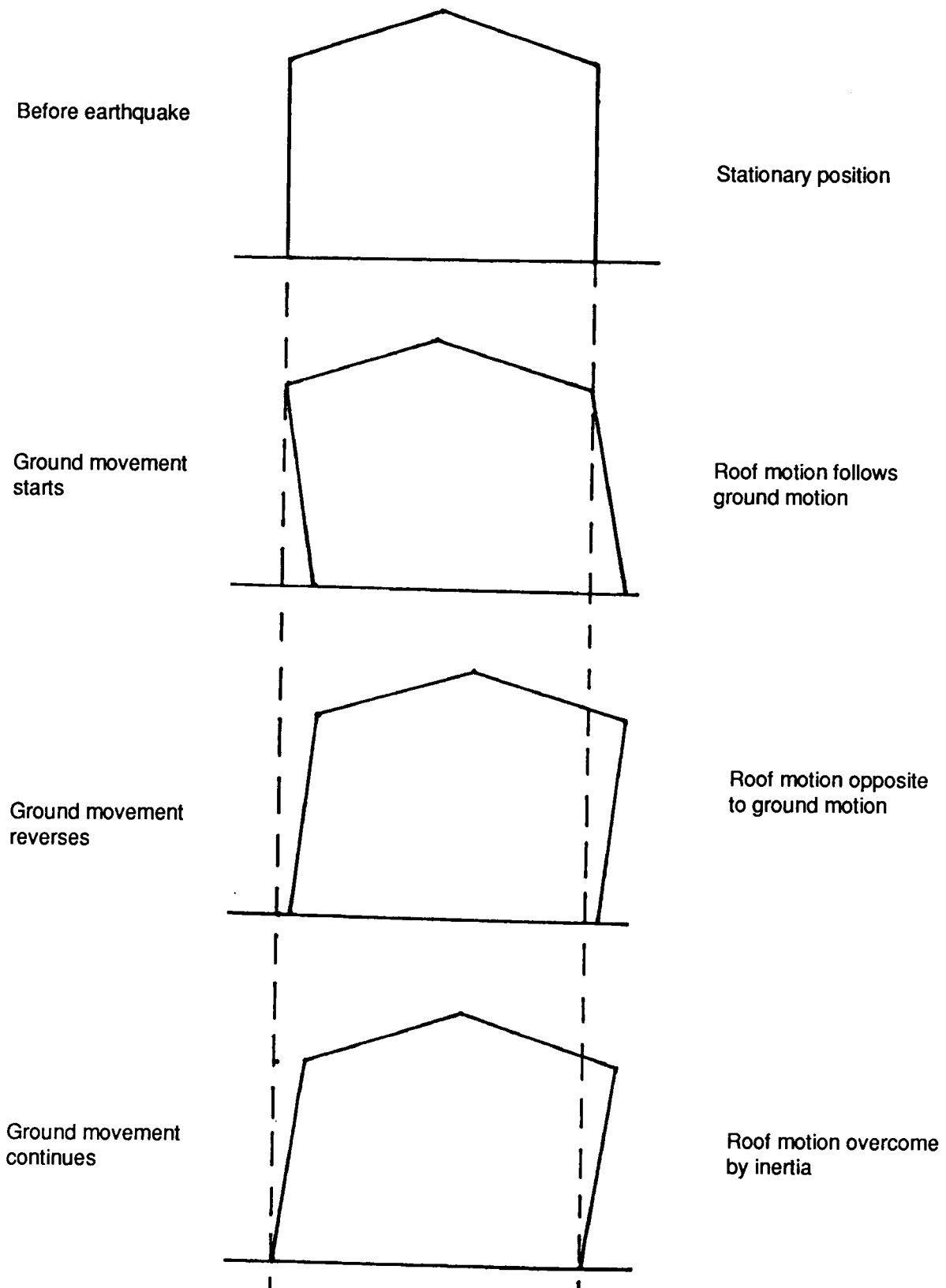
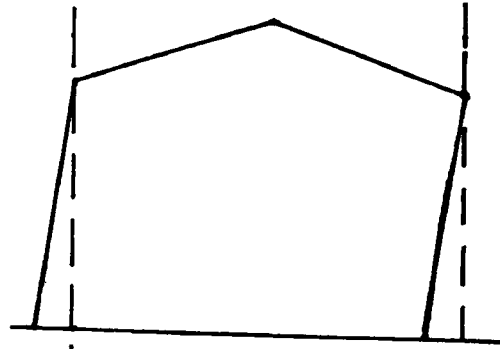


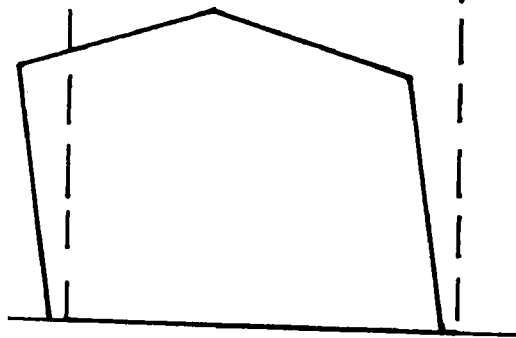
FIGURE F9.1 BEHAVIOUR OF HOUSE DURING EARTHQUAKES

Ground movement continues further



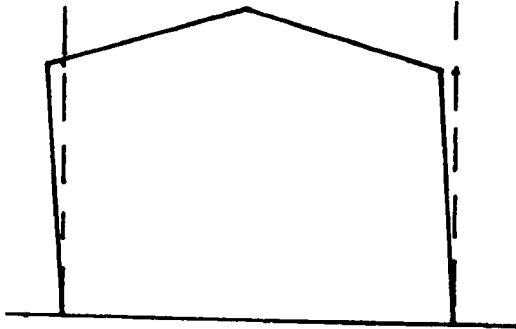
Roof motion follows ground motion

Ground movement reverses



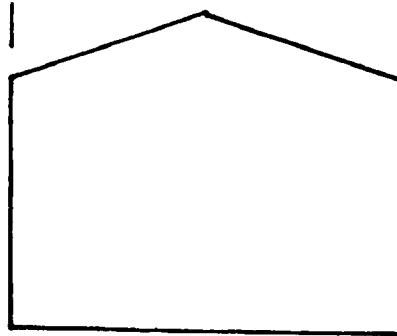
Roof motion overcome by inertia

Ground movement stops



Roof motion continues in direction of ground motion

After earthquake



Roof motion stopped by inertia

FIGURE F9.1 continued

BEHAVIOUR OF HOUSE DURING EARTHQUAKES



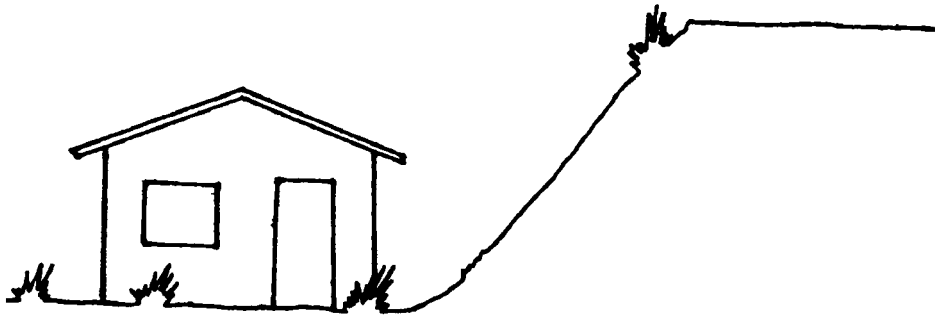


FIGURE F9.2 DO NOT BUILD A HOUSE TOO CLOSE TO A STEEP SLOPE. LANDSLIDES MAY OCCUR DURING PERIODS OF HEAVY RAIN OR DURING AN EARTHQUAKE

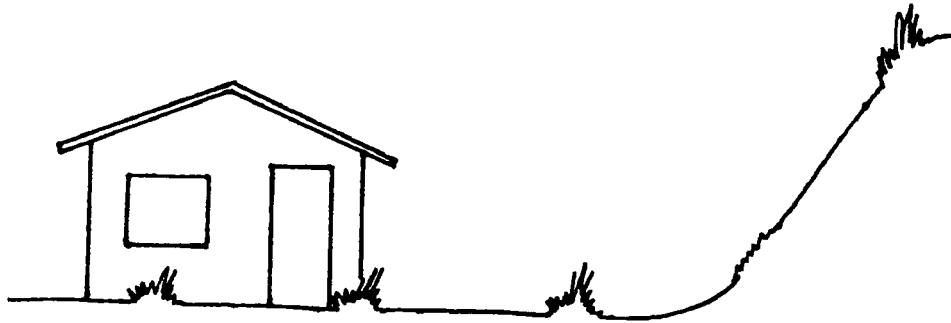


FIGURE F9.3 BUILD A HOUSE AT A SAFE DISTANCE FROM A STEEP SLOPE

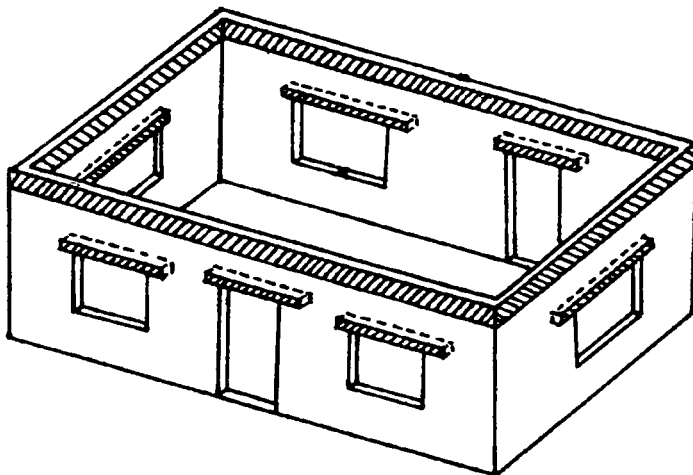


FIGURE F9.4 PROVIDE LINTELS OVER ALL DOORS AND WINDOWS

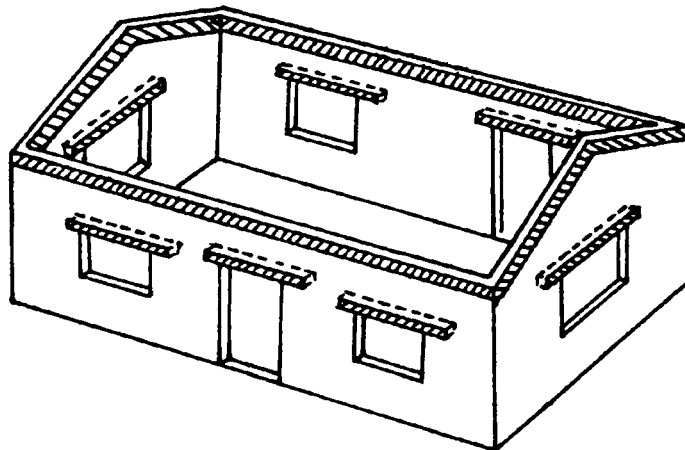


FIGURE F9.5 PROVIDE A BOND BEAM ON TOP OF ALL EXTERNAL WALLS

**SECTION G**

**MISCELLANEOUS**

## SECTION G MISCELLANEOUS

### G1. WINDOW SHUTTERS

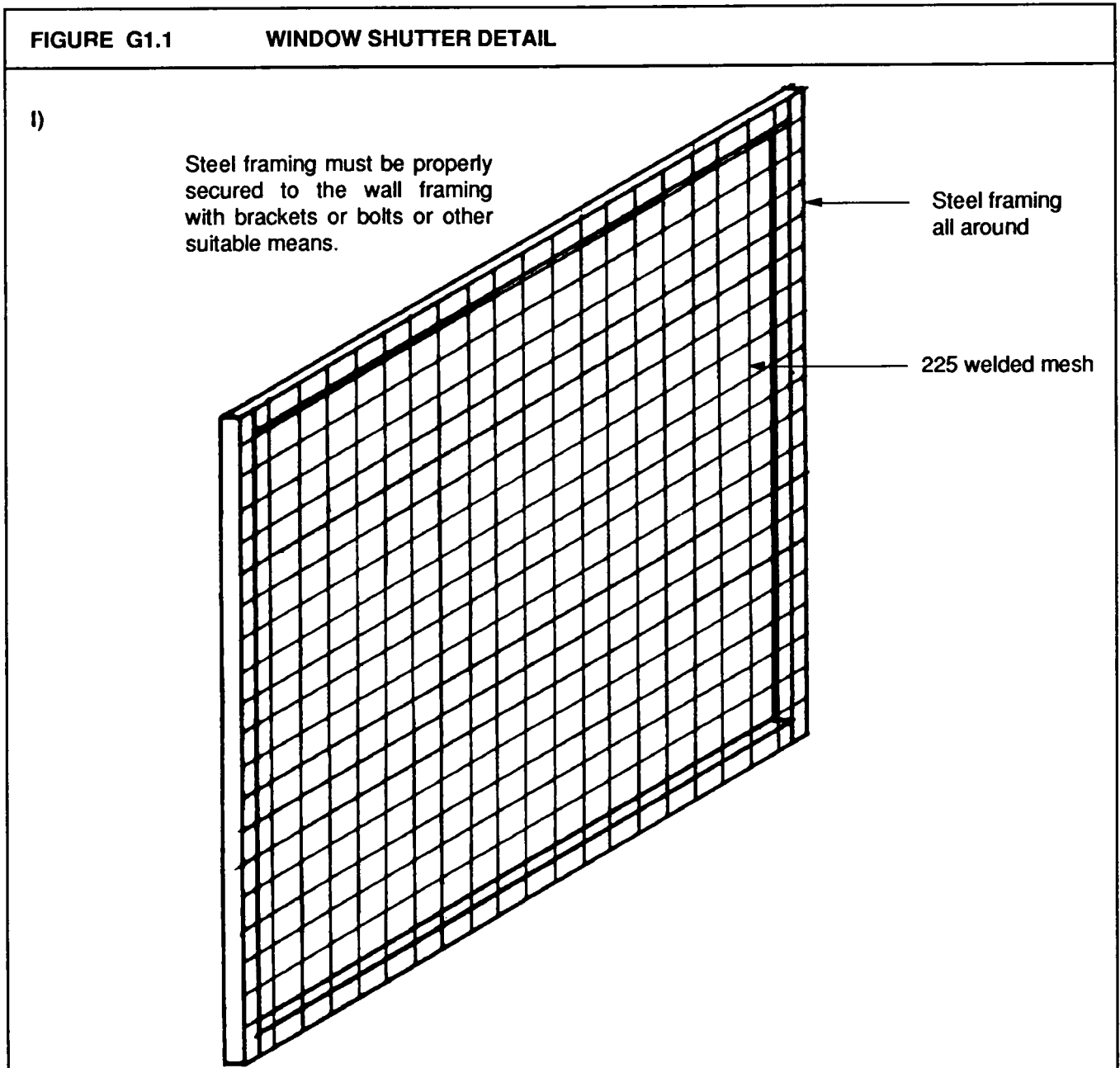
#### G1.1 General

All windows **MUST** be protected from flying debris during cyclones by means of shutters. Figure G1.1 shows two different types of shutters that can be used to protect windows from flying debris. Timber used to construct the shutters must be of a fairly good quality and must not contain too many knots and other defects.

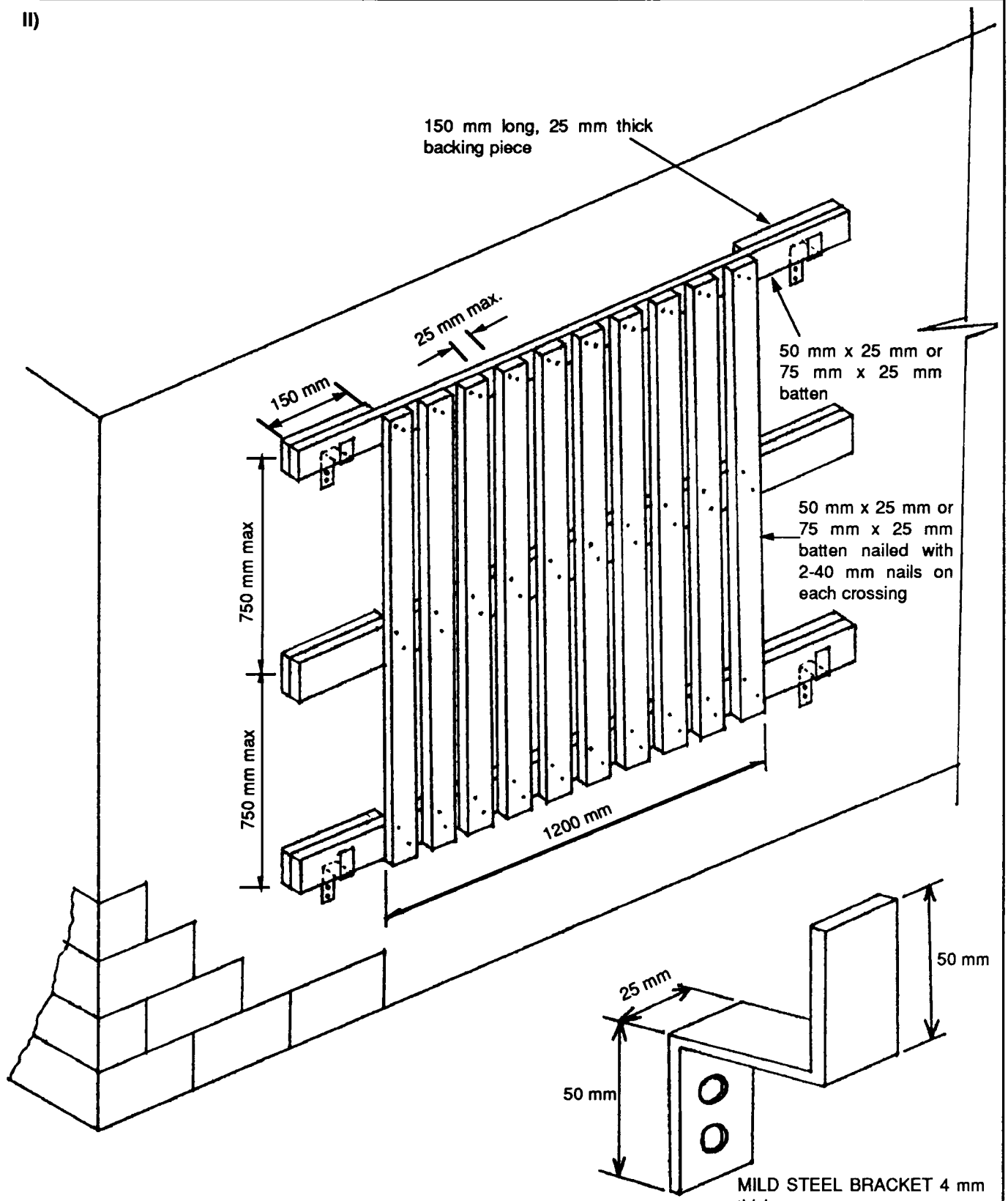
Shutters in front of glass windows or doors not only protect the glass from flying debris, but shield the glass to some extent from the pressure of the wind. Preventing the glass from breaking will stop the sudden rush of wind inside which could result in the explosive break-up of the house. Shutters must be firmly fixed in place when a cyclone warning is issued. They must be stored in a proper manner if they are not permanently fixed in place. If shutters are stored during non cyclonic periods, it would help to number them with the windows also match-marked. This would allow prompt and correct installation of the shutters once a cyclone warning is received.

#### G1.2 Impact test for Shutters

Shutters must be so constructed as to resist impact by a 4 kg piece of timber of 100 mm x 50 mm cross-section, striking it at any angle at a speed of 15 m/s.



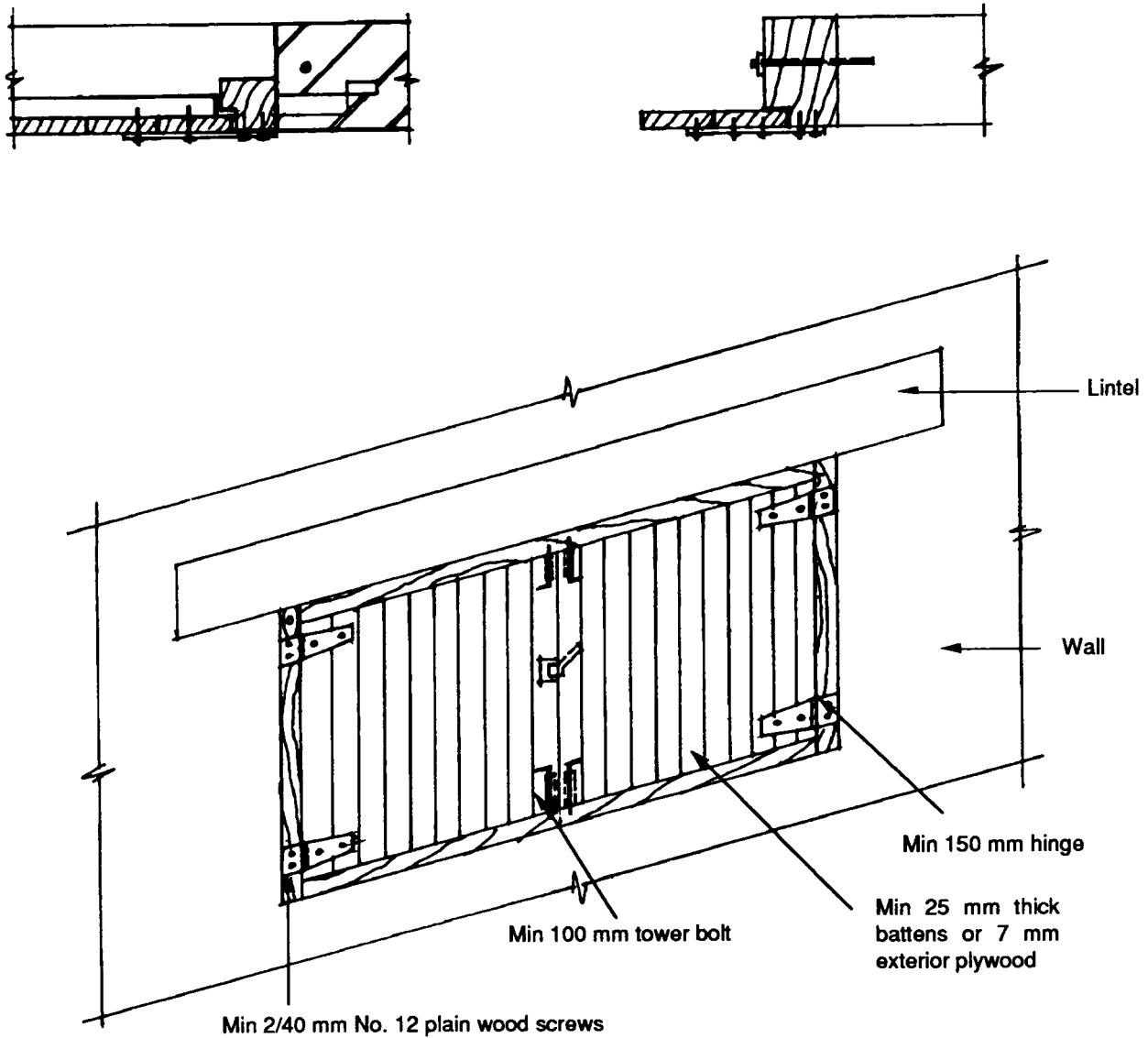
II)



NOTES:

1. Cross bracing is required when the vertical and horizontal dimensions exceed those given above.
2. 100 mm tower bolts may be used where brackets cannot be fixed to the wall
3. Mild steel brackets must be fixed to the concrete wall using 2-8 mm dyna bolts or equal.
4. A minimum of 4 brackets must be used with every shutter.
5. Shutter bracket MUST be of 4 mm thick mild steel and MUST be a minimum width of 25 mm.
6. For shutters of  $\geq 1500$  mm height, additional brackets MUST be used.
7. Battens MUST be spaced no more than 25 mm apart.

III )



**Notes:**

1. Holes for tower bolts to be 1-2 mm greater than the bolt diameter.
2. Hole for tower bolt must be deep enough to accommodate the tower bolt fully.
3. Tower bolts on the upper edge of the window must be locked in place to ensure that they do not fall open under repeated wind loading conditions.
4. For windows which hinge open vertically , 2 tower bolts must be used on the bottom of the window to secure it in place.
5. Butt hinges may also be used.

### G1.3 TIMBER FRAMED DOORS

In cyclonic areas all glazed doors must be protected by means of shutters that pass the test given in Clause G1.2. A better and more simpler way is to have timber framed doors which do not have any glass area. Figure G1.3 shows typical details of timber framed doors and various types of hinges.

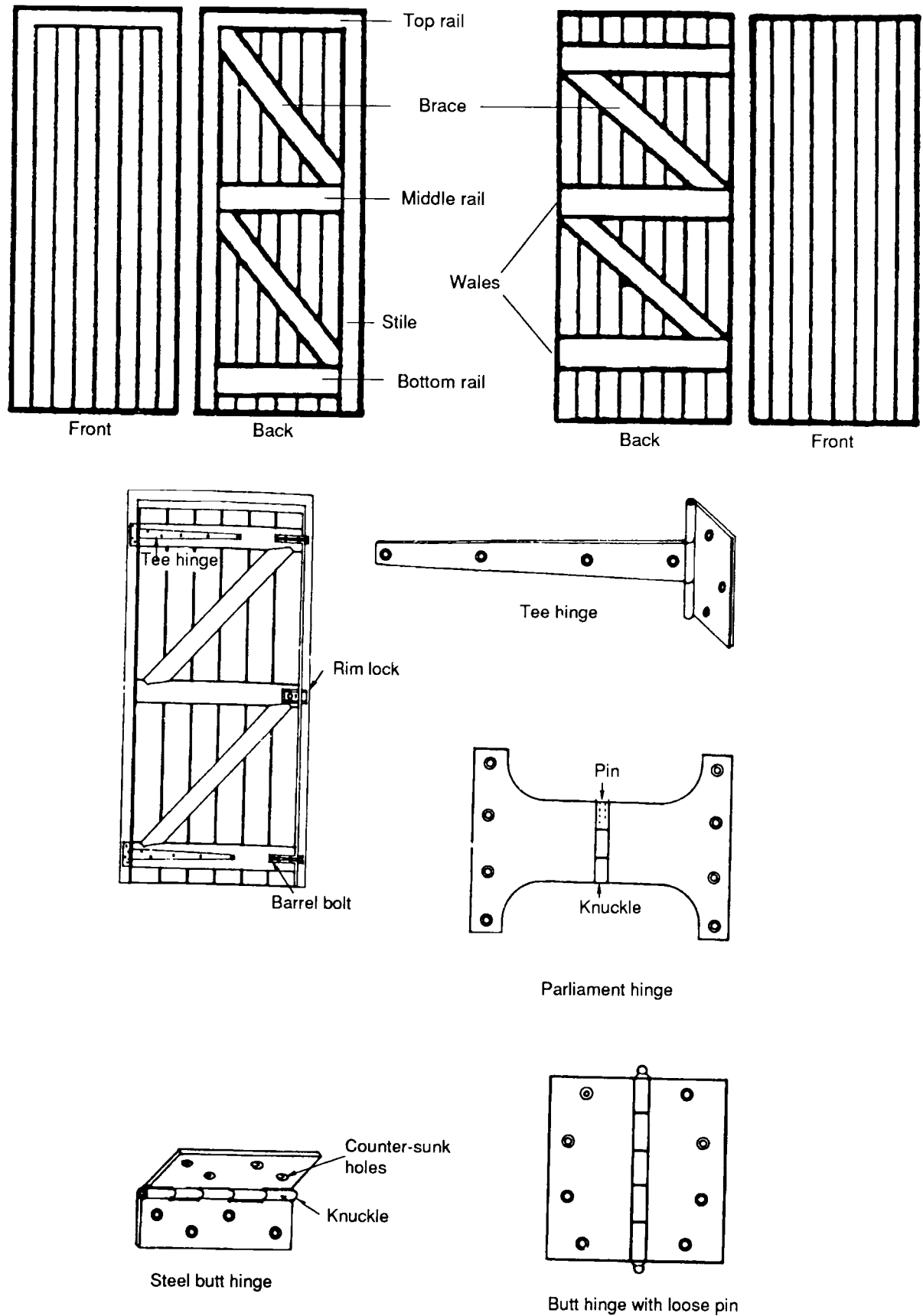


FIGURE G1.3 TYPICAL EXTERNAL DOORS AND HINGES

## G2 LEAN-TO HOUSES

### G2.1 General

Lean-to houses are fully enclosed houses with monoslope (single slope) roofs.

### G2.2 Design

The design of lean - to houses is the same as the design of gable ended roof houses.

### G2.3 Application

1. Determine the design windspeed from Table A4.5.1 or A4.5.2
2. Select the table that corresponds to the design windspeed determined from step 1.
3. From the options available, select the correct sizes of members.

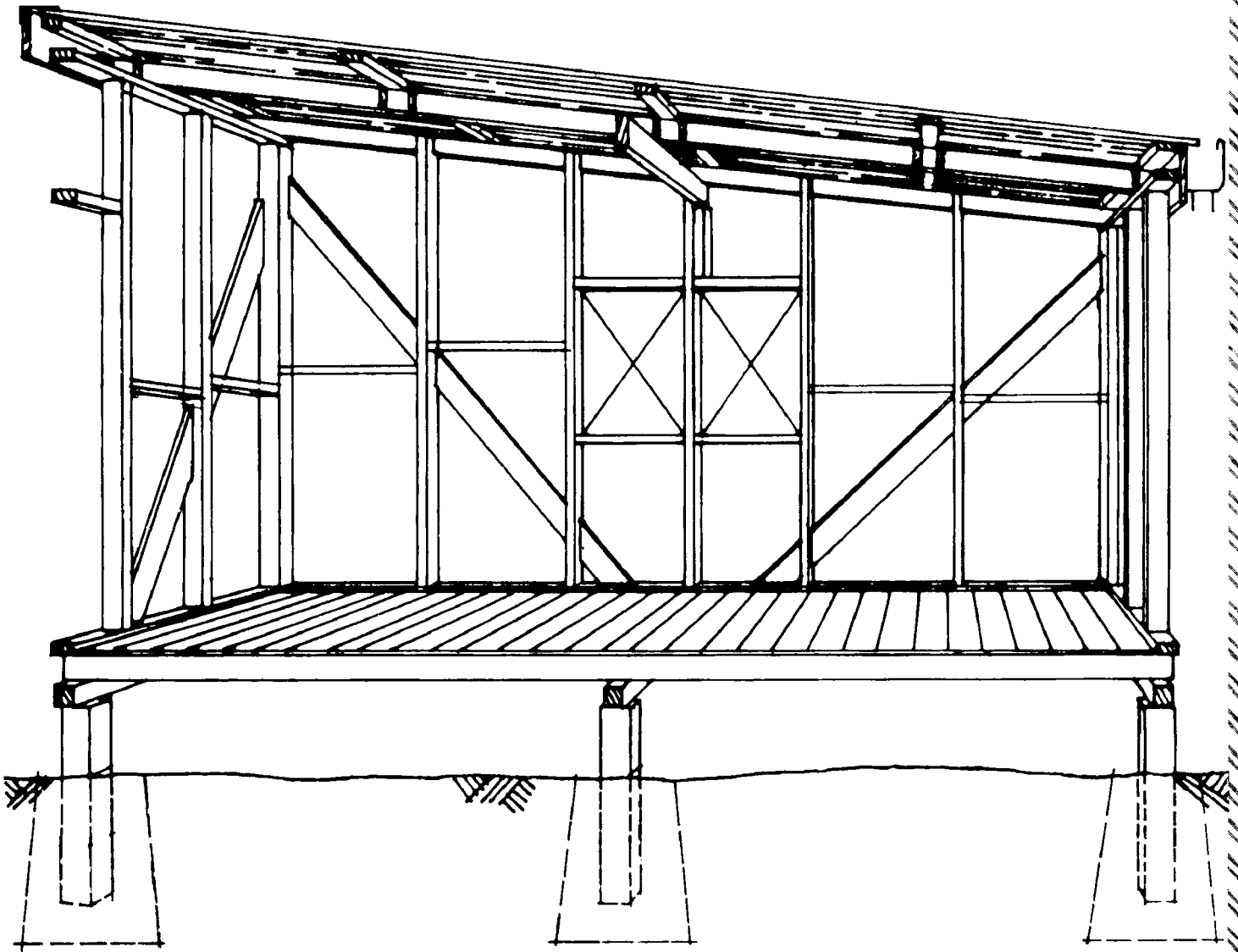


FIGURE G2.1 LEAN-TO BUILDING

### G3 LEAN - TO GARAGE DETAILS

#### G3.1 Member sizes for garages

- i Purlins: 75 x 50 purlin, F4 @ 1200 mm maximum centres
- ii Rafters: @ 1200 mm maximum centres

RAFTER SIZES							
DESIGN WINDSPEED (m/s)		≤ 53	54 - 57	58 - 60	61 - 64	65 - 69	70 - 74.5
STRESS GRADE	F4	150 x 50	150 x 50	175 x 50	175 x 50	-	-
	F5	125 x 50	150 x 50	150 x 50	175 x 50	175 x 50	175 x 50
	F7	125 x 50	125 x 50	125 x 50	150 x 50	150 x 50	175 x 50
	F8	125 x 50	125 x 50	125 x 50	125 x 50	150 x 50	150 x 50

- iii Beams:

BEAM SIZES					
DESIGN WINDSPEED (m/s)		≤ 60	61 - 64	65 - 69	70 - 74.5
STRESS GRADE	F4	125 x 75	150 x 75	150 x 75	175 x 75
	F5	125 x 75	125 x 75	150 x 75	150 x 75
	F7	125 x 75	125 x 75	125 x 75	150 x 75
	F8	125 x 75	125 x 75	125 x 75	150 x 75

- iv Posts: 100 x 100

#### G3.2 Tie-down details

- i Cladding/Purlins: Nail on every crest
- ii Purlin/Rafter

TIE-DOWN METHOD FOR PURLIN TO RAFTER		
DESIGN WINDSPEED (m/s)		
≤64	65-69	70-74.5
A	B	C

- A Strap with 3/3.15 φ nails per leg
- B Strap with 4/3.15 φ nails per leg
- C Looped strap with 4/3.15 φ nails per leg.



iii Rafter/Beams

Strap rafter to beam with 30 x 0.8 G.I. strap with 3/3.15  $\phi$  nails per leg.

iv Beam/Post

Tie-down beam to post with 2/M12 bolt and 50 x 6 mm M.S. plate on both sides

v Post/Footing

Tie beam to footing with 2/M12 bolts with 50 x 8 mm M.S. stirrups - Refer to Figure B10.9(D) (II)

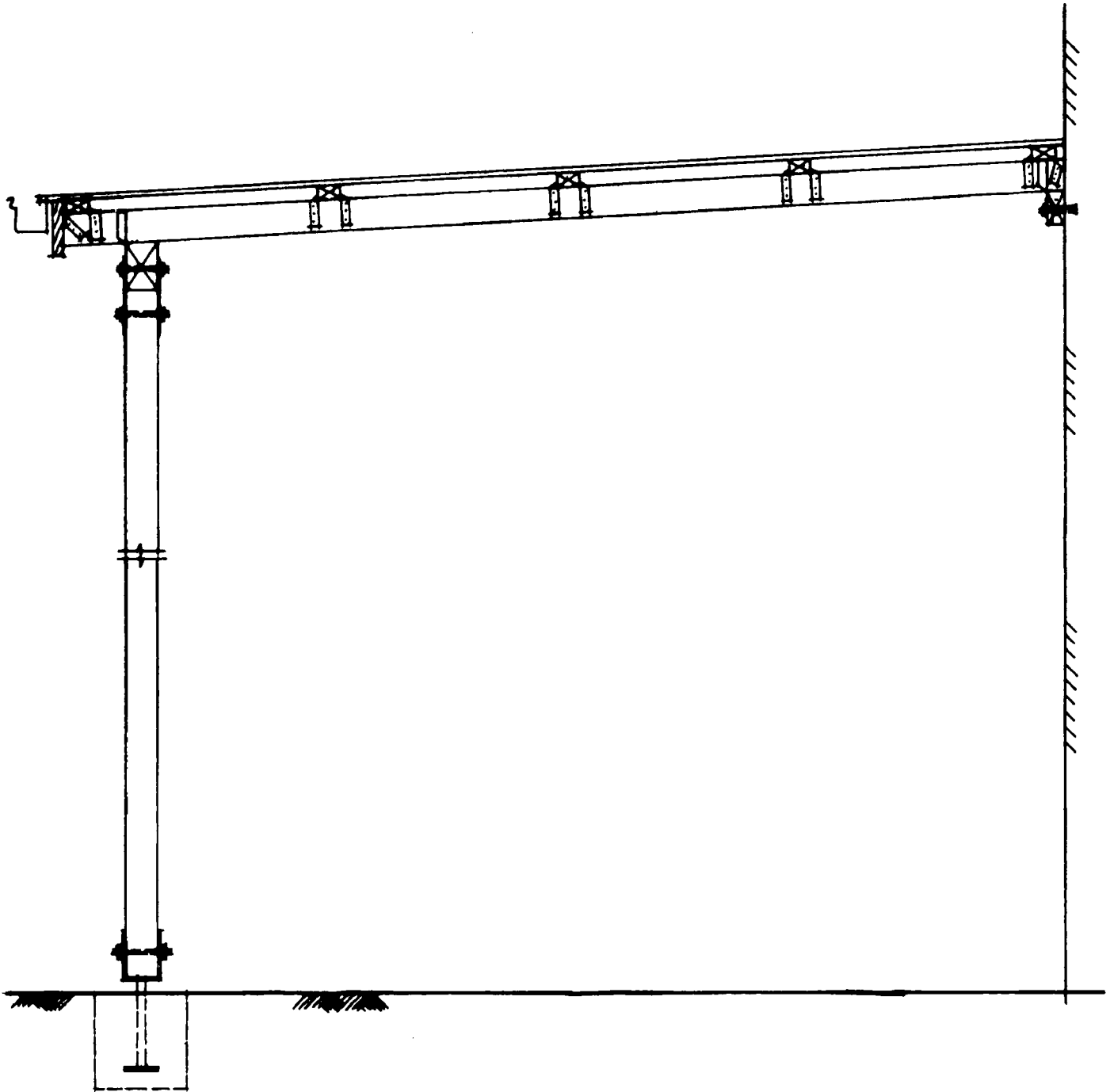
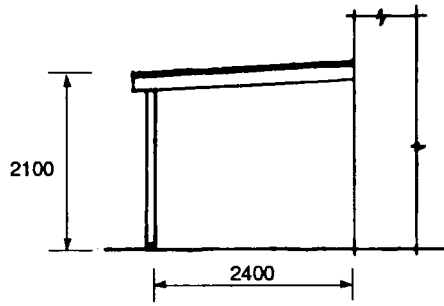
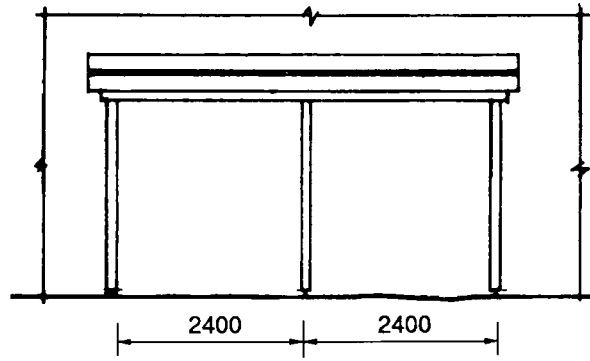


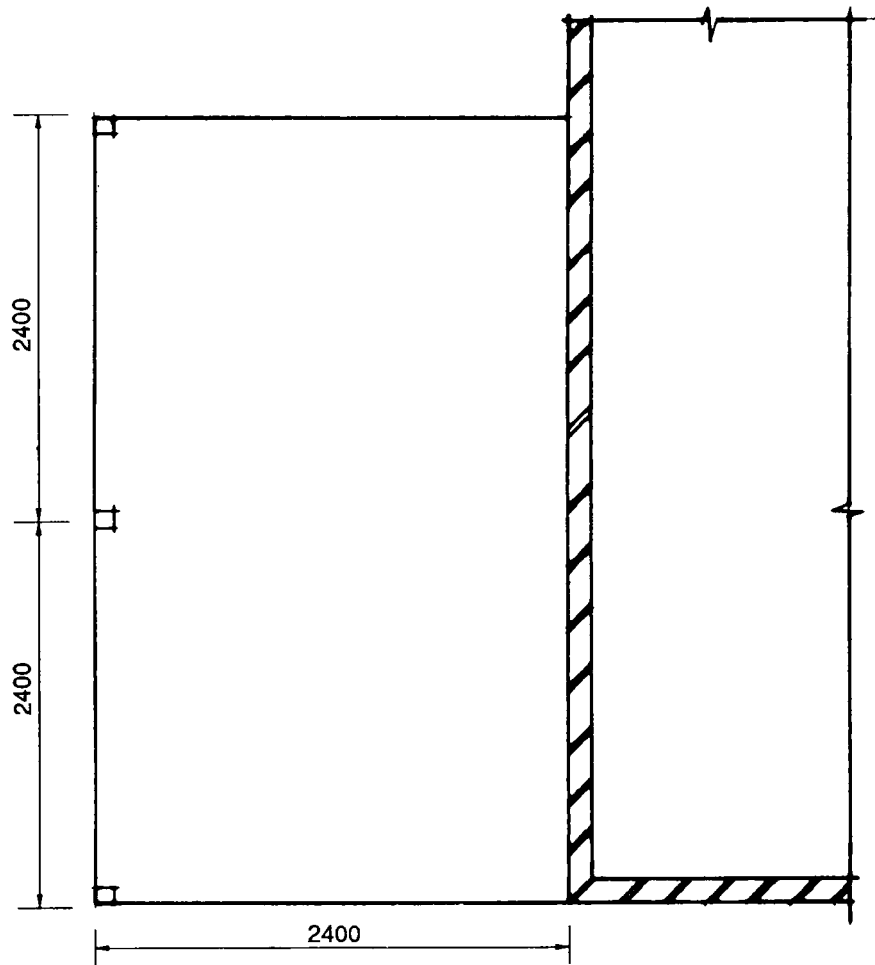
FIGURE G3.1 LEAN - TO GARAGE CROSS - SECTION



FRONT ELEVATION



SIDE ELEVATION



PLAN

FIGURE G3.2 LEAN - TO GARAGE PLAN AND ELEVATIONS

G4 DETAIL OF STEPS

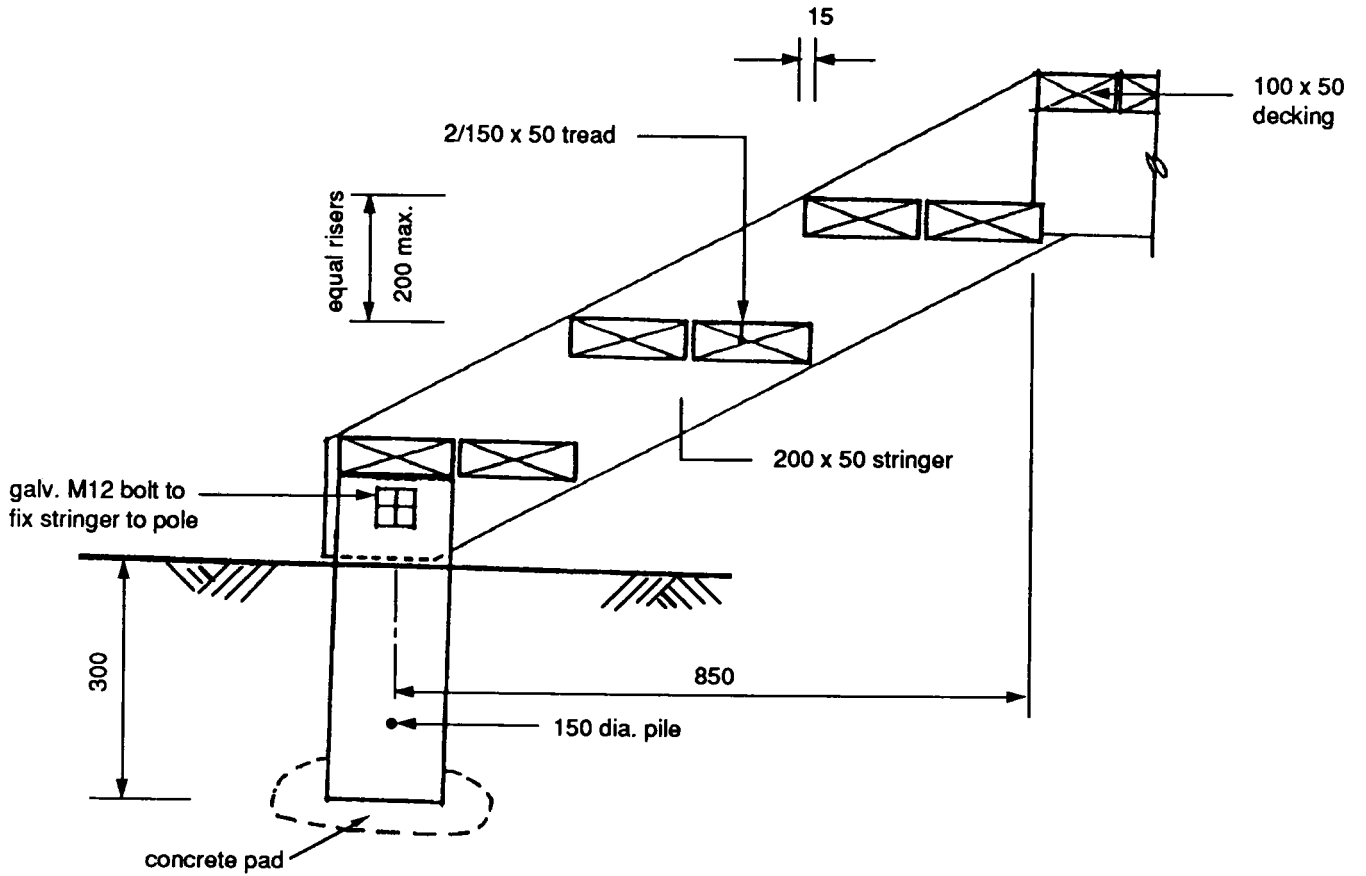


FIGURE G4.1 DETAIL OF TIMBER STEPS

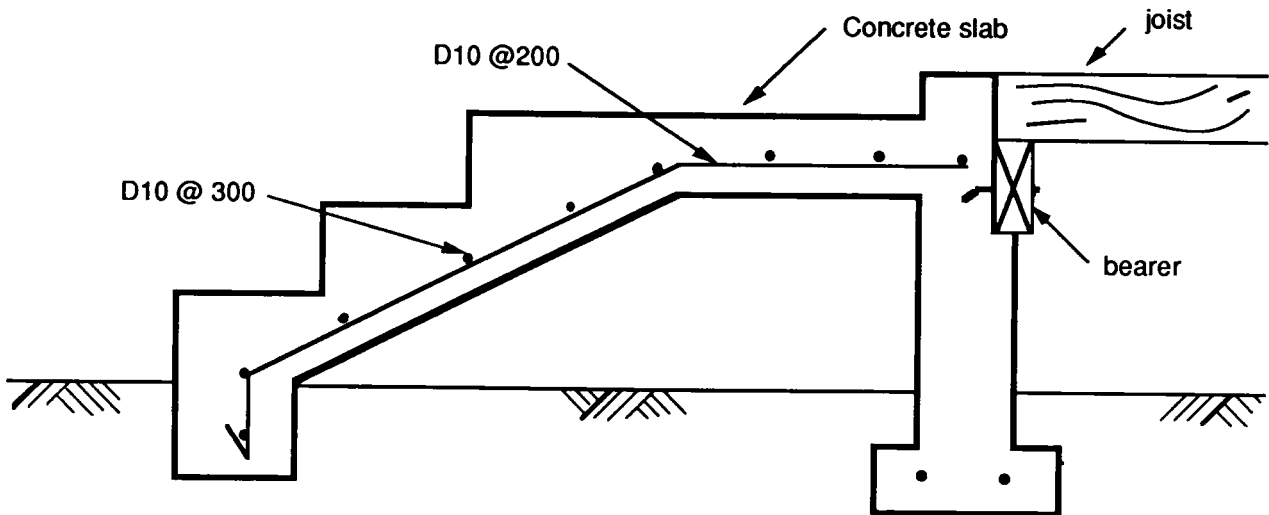


FIGURE G4.2 DETAIL OF CONCRETE STEPS

## G5 WINDOW GLASS THICKNESS FOR HOUSES

### G5.1 Scope

The minimum required thickness and maximum allowable areas for window glass for use in houses are given. The details do not provide for safety against human impact. The glass considered is ordinary window glass.

### G5.2 Determination of area of glass

TABLE G5.2

GLASS THICKNESS (mm)	ALLOWABLE AREA OF GLASS (sq. m) SUPPORTED ON ALL FOUR EDGES					
	DESIGN WINDSPEEDS (m/s)					
	≤51	52 - 55	56 - 60	61 - 64	65 - 69	70 - 74.5
3	0.75	0.65	0.55	0.45	0.40	-
4	1.30	1.10	0.94	0.77	0.70	0.60
5	2.00	1.70	1.40	1.15	1.08	0.90
5.5	2.30	1.95	1.60	1.35	1.22	1.05
6	2.80	2.40	2.00	1.60	1.50	1.30

### G5.3 Determination of length of glass

TABLE G5.3

GLASS THICKNESS (mm)	ALLOWABLE SPANS BETWEEN SUPPORTS (m) SUPPORTED BETWEEN TWO OPPOSITE EDGES					
	DESIGN WINDSPEEDS (m/s)					
	≤51	52 - 55	56 - 60	61 - 64	65 - 69	70 - 74.5
3	0.32	0.30	0.27	0.26	0.24	0.22
4	0.43	0.40	0.37	0.34	0.32	0.29
5	0.55	0.51	0.47	0.44	0.40	0.37
5.5	0.60	0.55	0.51	0.48	0.44	0.40
6	0.66	0.62	0.57	0.53	0.49	0.46

### G5.4 Maximum lengths for louvre blades of clear and patterned glass

TABLE G5.4

Nominal thickness of glass (mm)	Maximum blade length (mm)		
	Less than 100 wide	100 to 155 wide	155 to 225 wide
3	400	500	*
4	500	600	*
5	600	750	750
5.5	650	900	900
6	750	900	900

\* Not to be used in this thickness

## **G6 RETAINING WALLS**

### **G6.1 SCOPE**

Some standard design details for reinforced concrete masonry retaining walls are given. Professional engineering advice must be sought where loading conditions or soil types are likely to be outside the limits shown.

### **G6.2 RETAINING WALL TYPES**

**TYPE 1:** Is used when the allotment is below the level of a neighbouring property and is to be built as close as possible to the boundary.

**TYPE 2:** Is used when filling against a neighbouring boundary.

### **G6.3 CONSTRUCTION METHODS**

Construction without supervision.

The work is carried out by competent tradesmen and is self-supervised.

### **G6.4 MATERIAL SPECIFICATIONS**

Concrete for footings : Concrete must be to grade 17.5 MPa.

Grout : Concrete for grout must have a minimum compressive strength of 17.5 MPa.

Mortar for laying blocks : Mortar for laying blocks must have a minimum compressive strength of 12.5 MPa.

Reinforcing steel : Reinforcing steel must be deformed mild steel bars of 275 MPa grade.

### **G6.5 LIMITATIONS**

- 1 The walls are not designed against forces from heavy equipment or large vehicles on the retained soil but allows for light traffic such as passenger cars.
- 2 A drainage layer of suitable granular material must be provided at the back of the wall with a perforated pipe at the base discharging to the open.
- 3 Surface water must be prevented from accumulating at the wall and overloading the drainage system.
- 4 Soil behind retaining wall has been assumed to be firm clay.

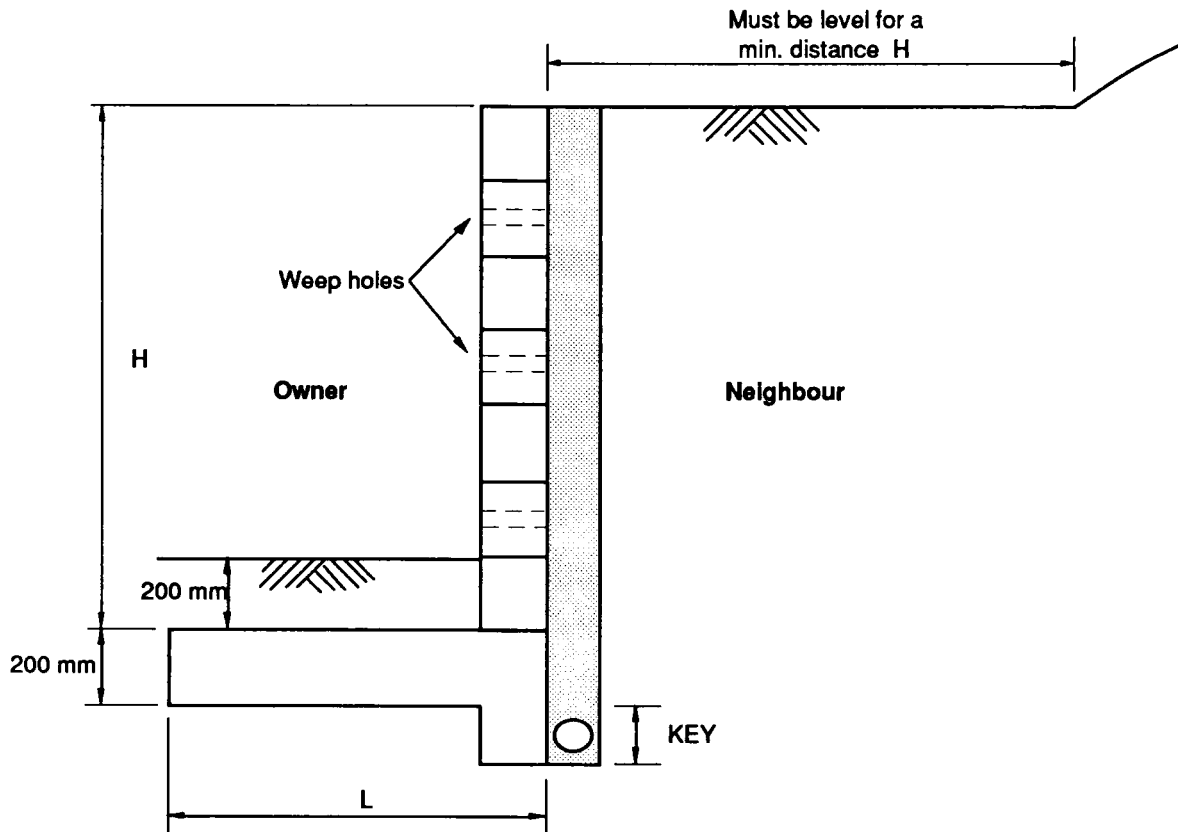


FIGURE G6.1 TYPE 1 RETAINING WALL

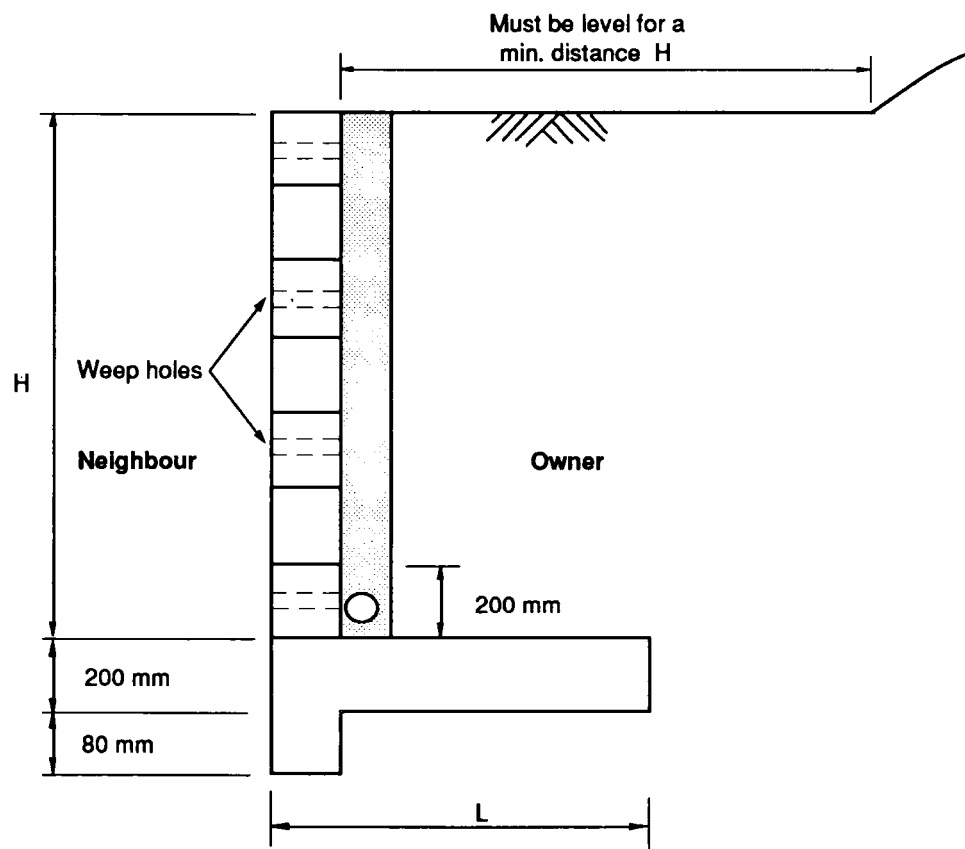


FIGURE G6.2 TYPE 2 RETAINING WALL

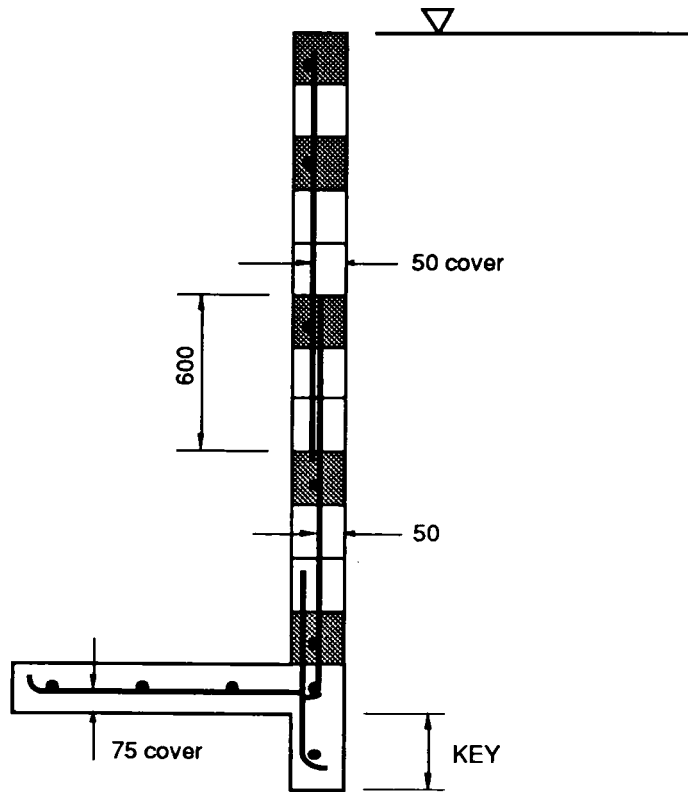


FIGURE G6.3 REINFORCEMENT DETAILS FOR TYPE 1 RETAINING WALLS

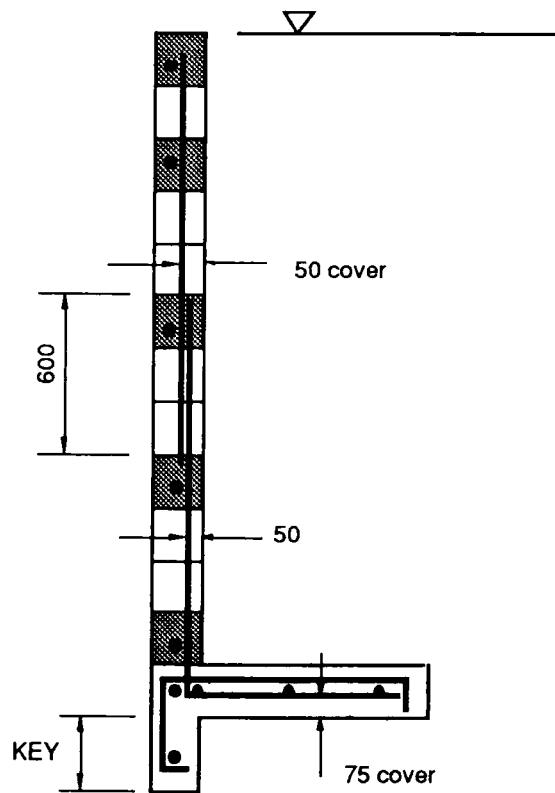


FIGURE G6.4 REINFORCEMENT DETAILS FOR TYPE 2 RETAINING WALLS

TABLE G6.1 TYPE 1 RETAINING WALL - WITH ALLOWANCE FOR LIGHT TRAFFIC

WALL THICKNESS	HEIGHT (mm)	VERTICAL REINFORCEMENT	HORIZONTAL REINFORCEMENT	WIDTH OF FOOTING (L) (mm)	DEPTH OF KEY (K) (mm)	TRANSVERSE FOOTING REINFORCEMENT	LONGITUDINAL FOOTING REINFORCEMENT	KEY REINFORCEMENT
150	1200	D16 - 600 #	D12 - 600	1200	80	**	D12 - 300	D12 - 400
	1200	D12 - 600 #	D12 - 600	1100	80	**	D16 - 300	D12 - 400
200	1500	D16 - 600 #	D12 - 600	1450	175	**	D16 - 300	D12 - 400

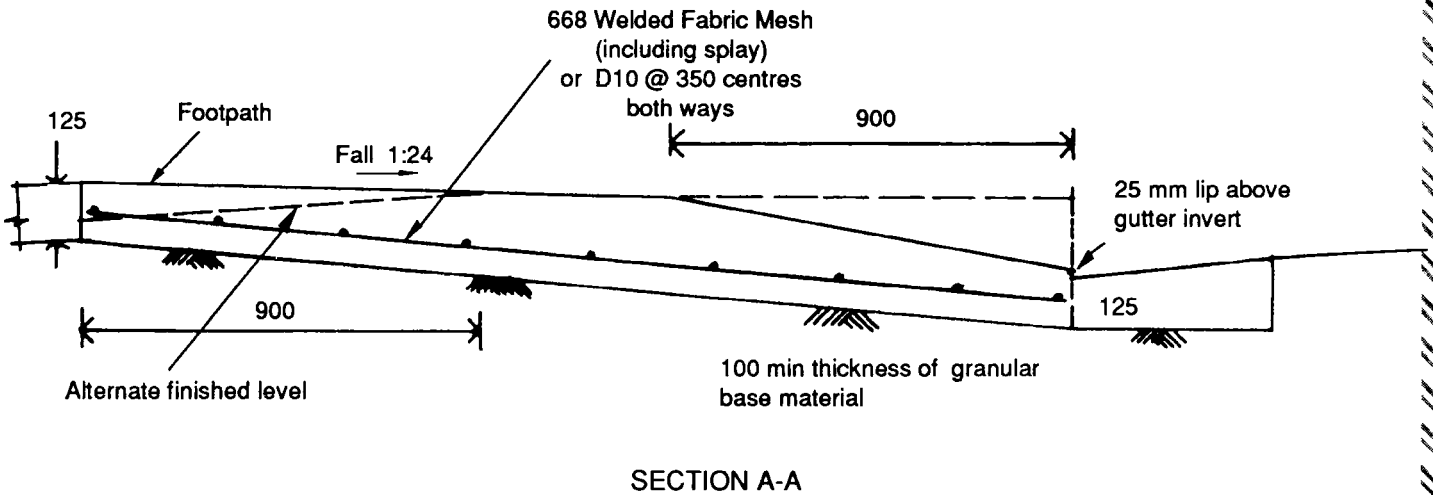
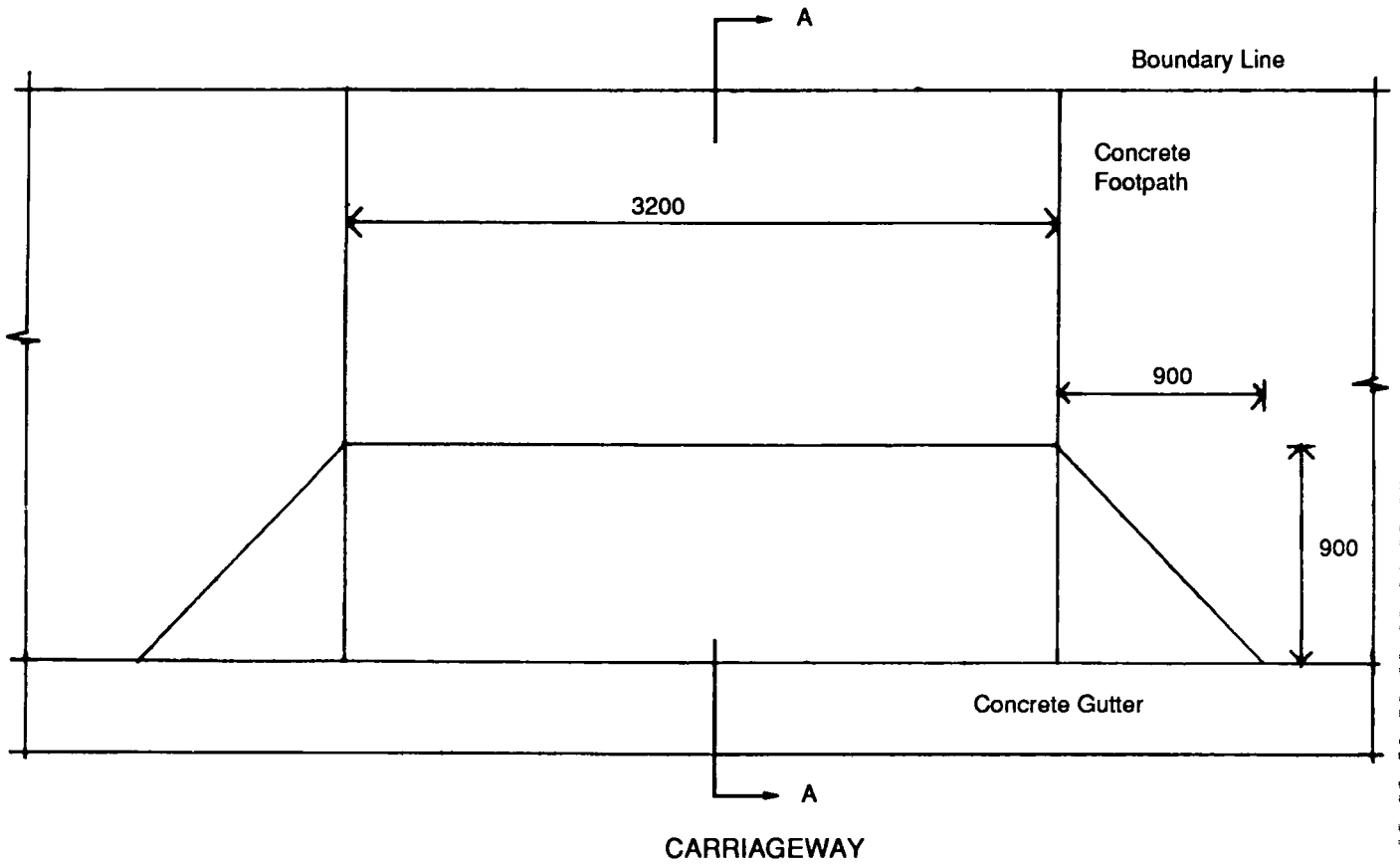
TABLE G6.2 TYPE 2 RETAINING WALL - WITH ALLOWANCE FOR LIGHT TRAFFIC

WALL THICKNESS	HEIGHT (mm)	VERTICAL REINFORCEMENT	HORIZONTAL REINFORCEMENT	WIDTH OF FOOTING (L) (mm)	DEPTH OF KEY (K) (mm)	TRANSVERSE FOOTING REINFORCEMENT	LONGITUDINAL FOOTING REINFORCEMENT	KEY REINFORCEMENT
150	1200	D16 - 600 #	D12 - 600	700	80	**	D12 - 300	D12 - 300
	1200	D12 - 600 #	D12 - 600	700	80	**	D16 - 300	D12 - 300
200	1500	D16 - 600 #	D12 - 600	875	80	**	D16 - 300	D12 - 300

# fill all cells  
 \*\* as for vertical reinforcement



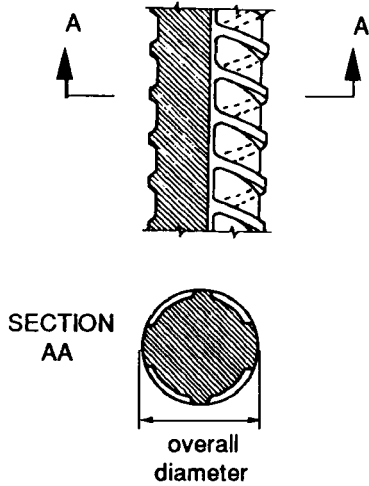
**G7 DRIVEWAY CONSTRUCTION DETAILS**



**Notes:**

1. Splay to be 1500 x 1500 for kerb height greater than 200 mm.
2. Concrete to be to grade 25 MPa.
3. All dimensions in millimetres.

TABLE G8.1 EQUIVALENT BAR DIAMETERS METRIC / IMPERIAL



Imperial	Metric
1/4"	D6
3/8"	D10
#4	D12
#5	D16
#6	D20

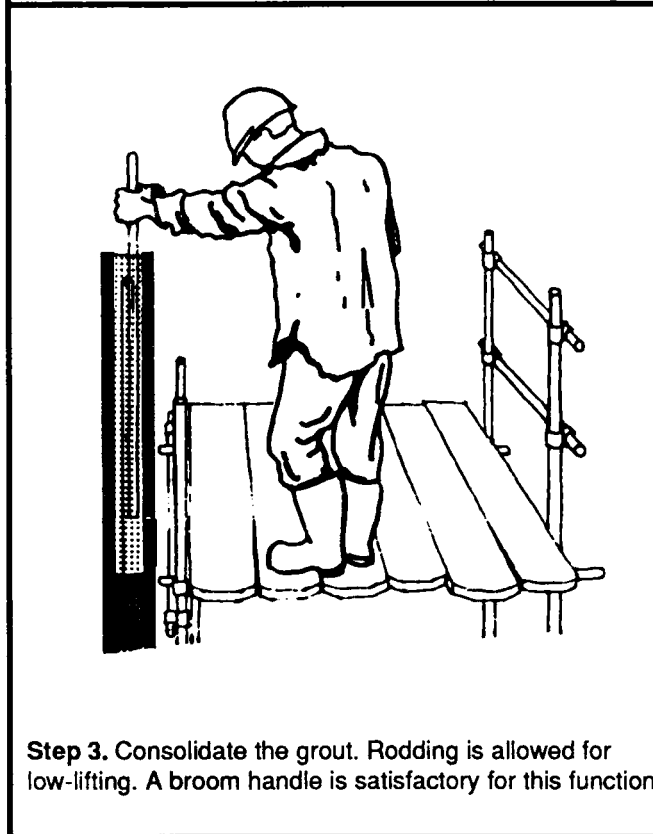
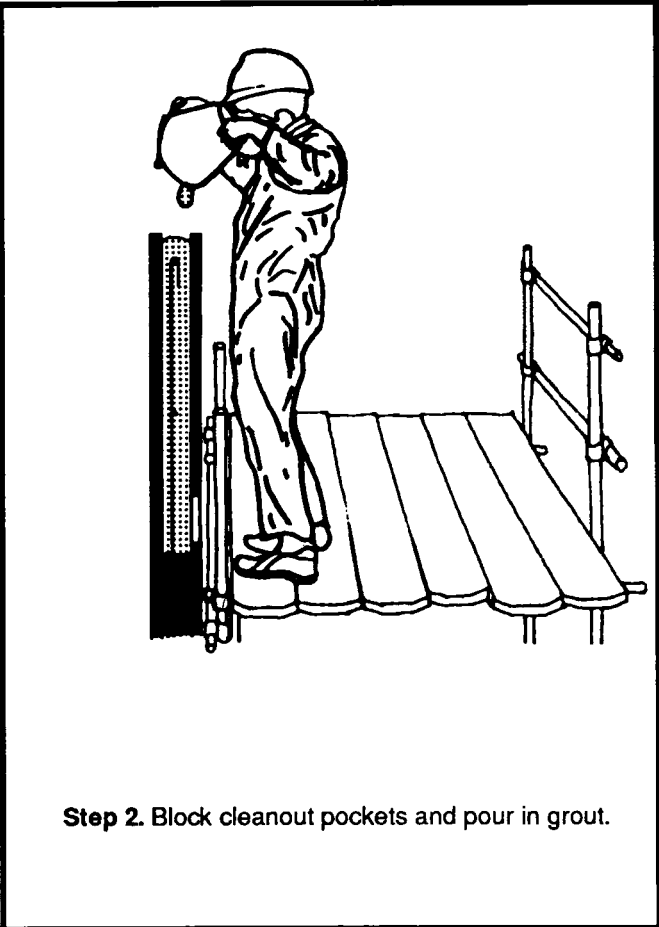
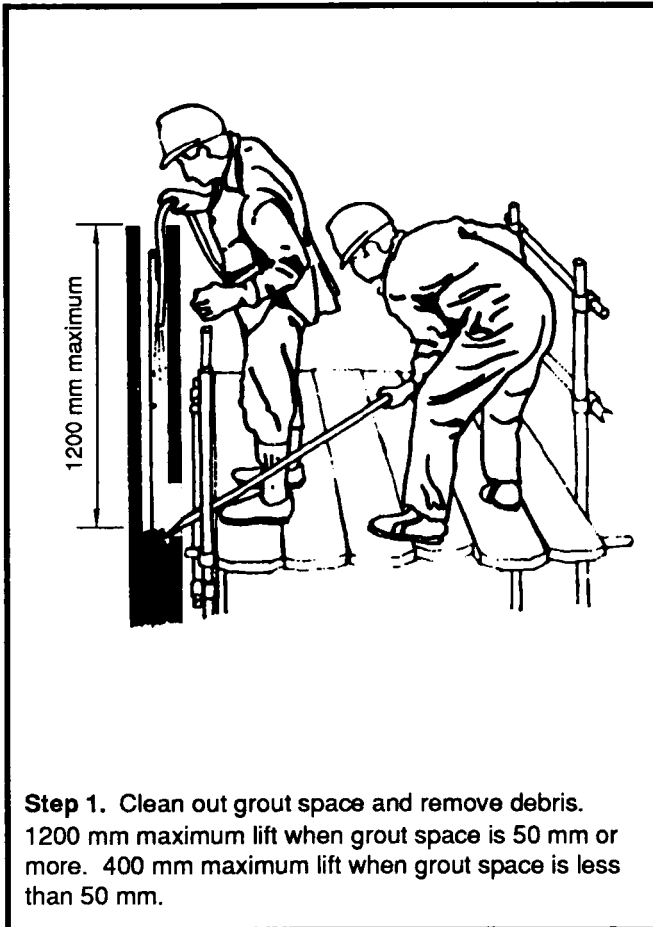
TABLE G8.2 HOOK AND COG ALLOWANCES FOR BENT BARS AND FITMENTS

BAR SIZE (mm)	DIMENSIONS (mm)		
	r	a	b
12	30	70	180
16	40	70	300
20	50	80	400
24	60	100	580



TABLE G8.3 MINIMUM LAP LENGTH (mm) FOR DEFORMED BARS IN COMPRESSION

BAR SIZE (mm)	LAP LENGTH (mm)
12	400
16	400
20	450
24	550
28	650
32	725





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# SECTION H

## LOW - COST HOUSES

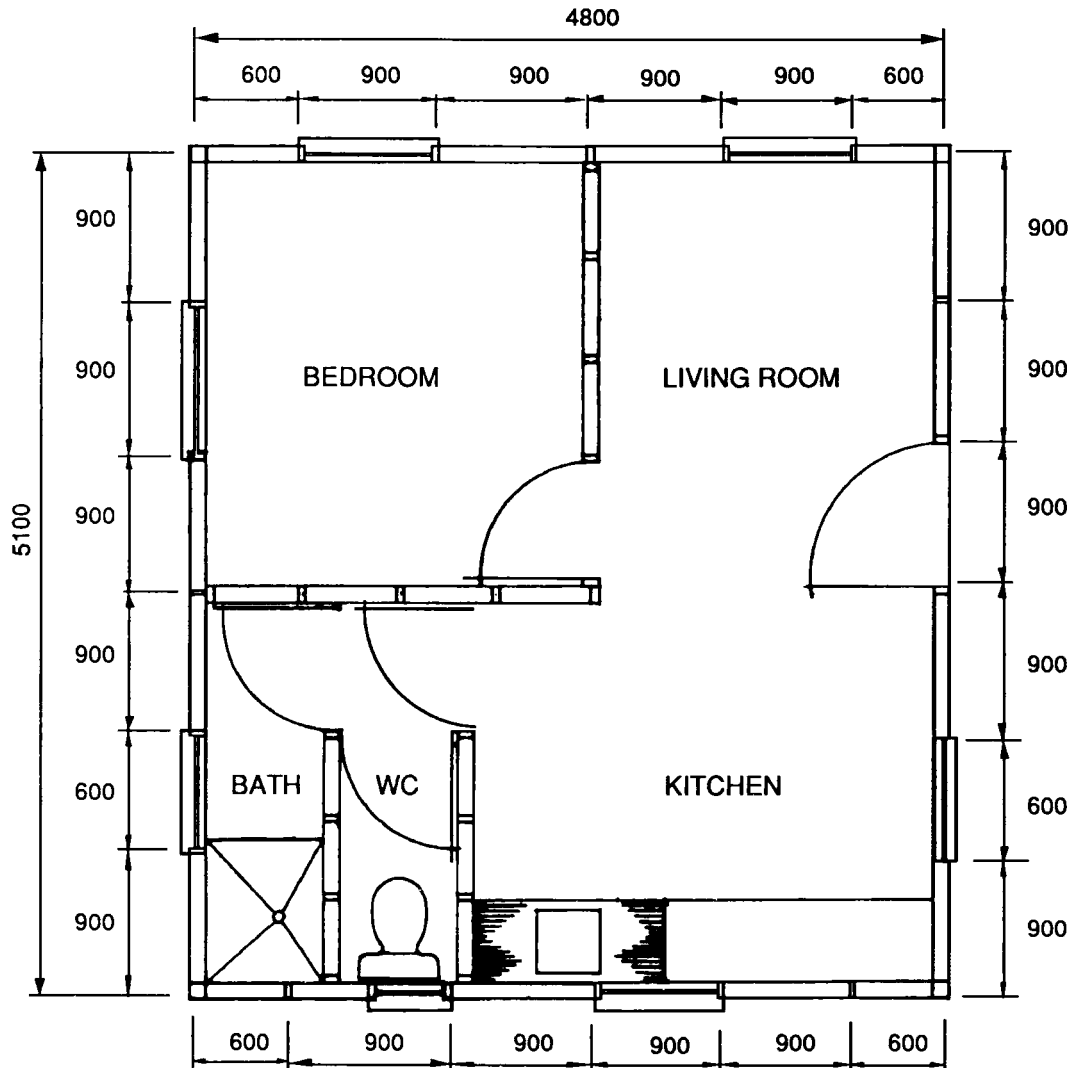
# SECTION H LOW - COST HOUSE DETAIL

## H1 LIMITATIONS

MAXIMUM DESIGN WINDSPEED : 55 m/s  
MAXIMUM BUILDING HEIGHT : 2700  
MINIMUM BUILDING HEIGHT : 2400  
BUILDING WIDTH : 5100  
BUILDING LENGTH : 4800

External and internal walls may be of either timber or masonry construction; however, all walls in a house to this design must wholly be of either and not a combination of the two.

## H2 PLAN



- Notes
- i. All door widths 750 mm
  - ii. All window widths 900 mm
  - iii. All dimensions in millimetres

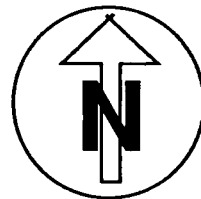
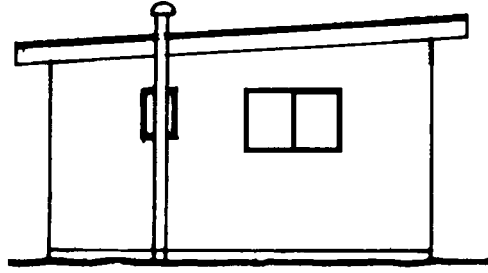
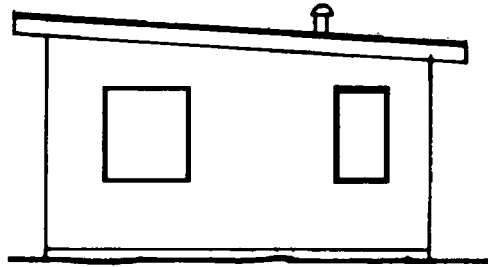


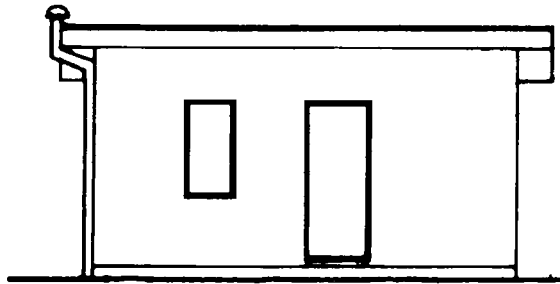
FIGURE H2 PLAN AND DIMENSIONS OF HOUSE



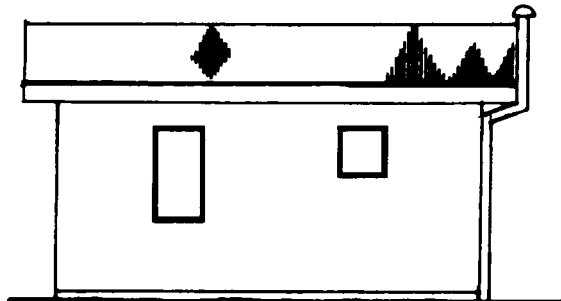
SOUTH ELEVATION



NORTH ELEVATION



EAST ELEVATION



WEST ELEVATION

FIGURE H3 ELEVATIONS

H4 FOUNDATION DETAILS

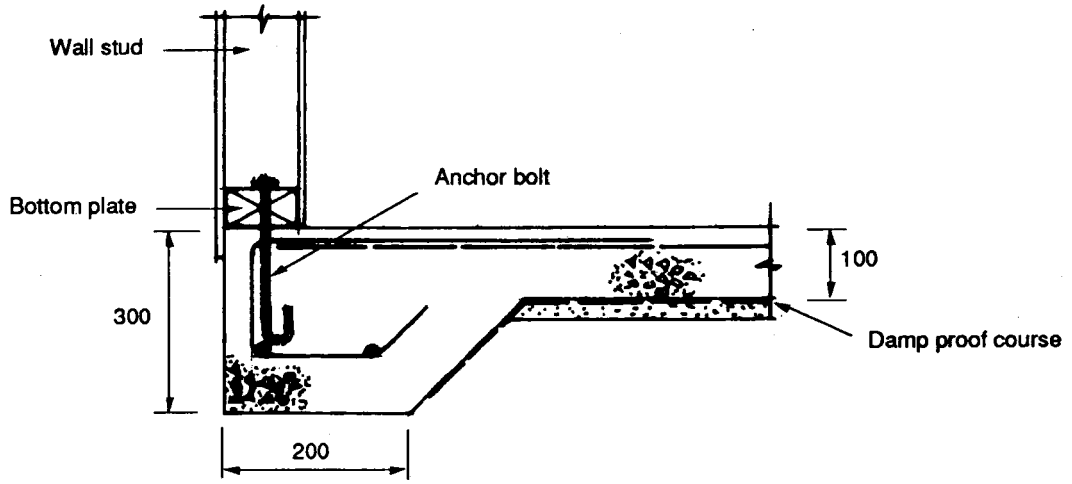


FIGURE H4.1 EXTERNAL WALL FOOTING

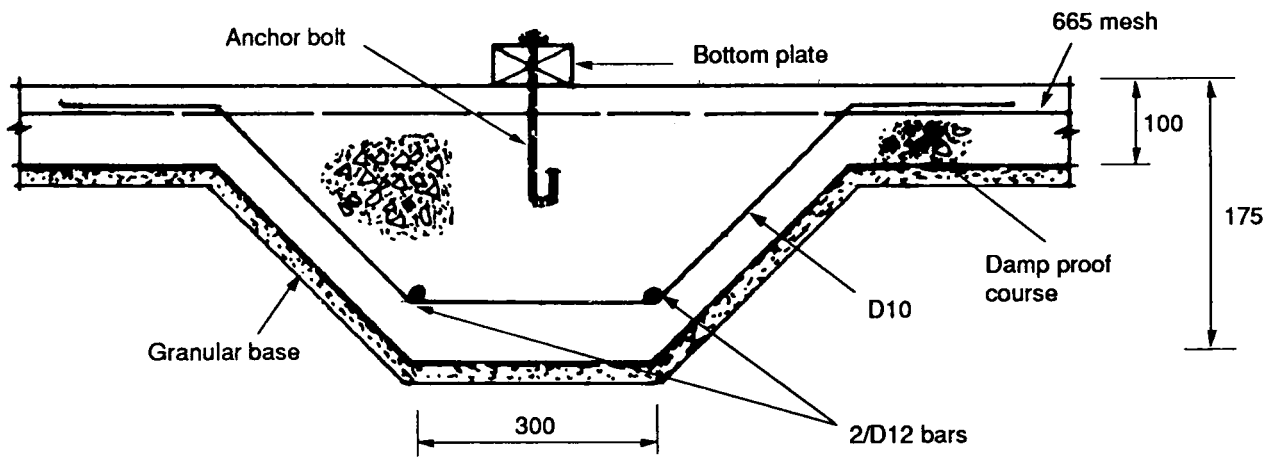


FIGURE H4.2 INTERNAL WALL FOOTING

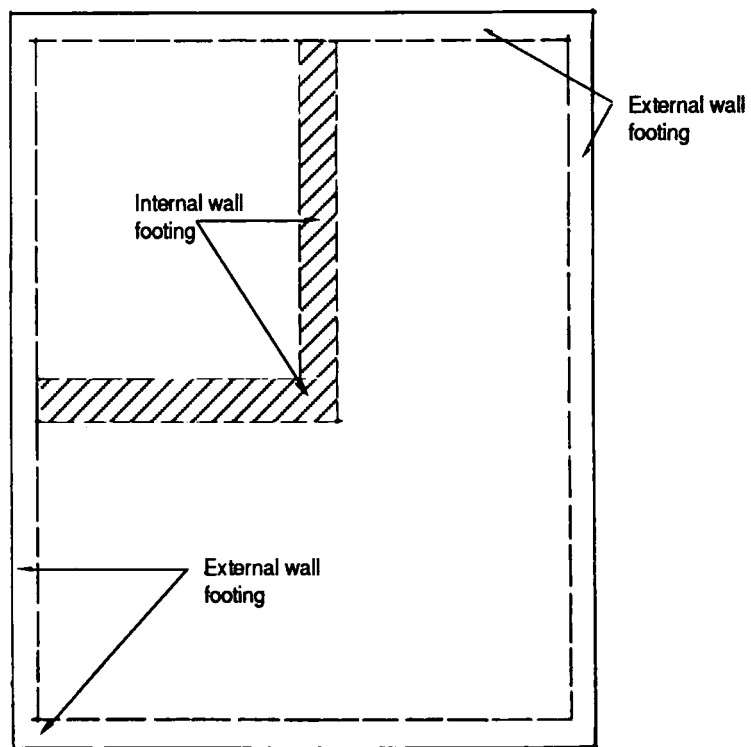


FIGURE H4.3 FOOTING PLAN



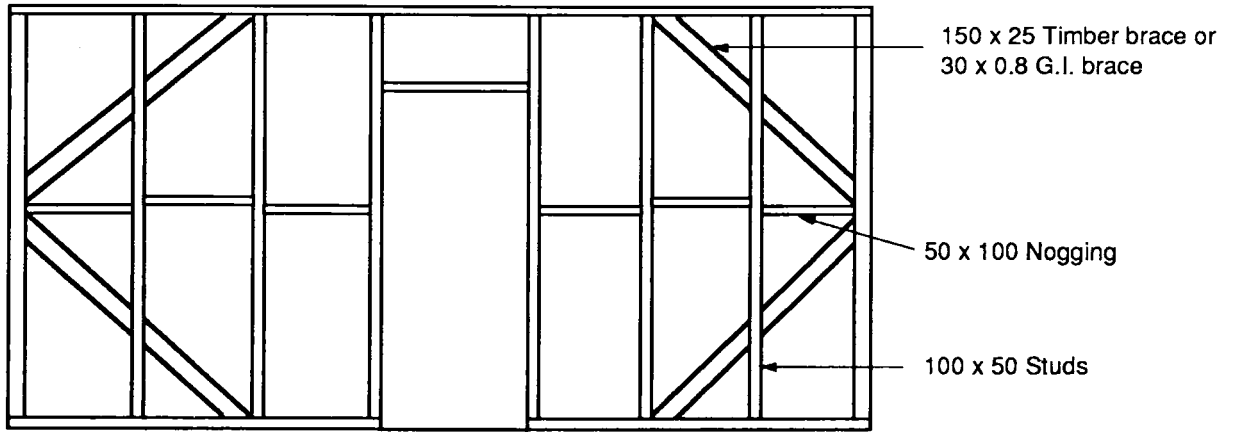


FIGURE H5.1 TYPICAL KNEE BRACING DETAIL FOR ALL CORNERS OF WALL - ELEVATION

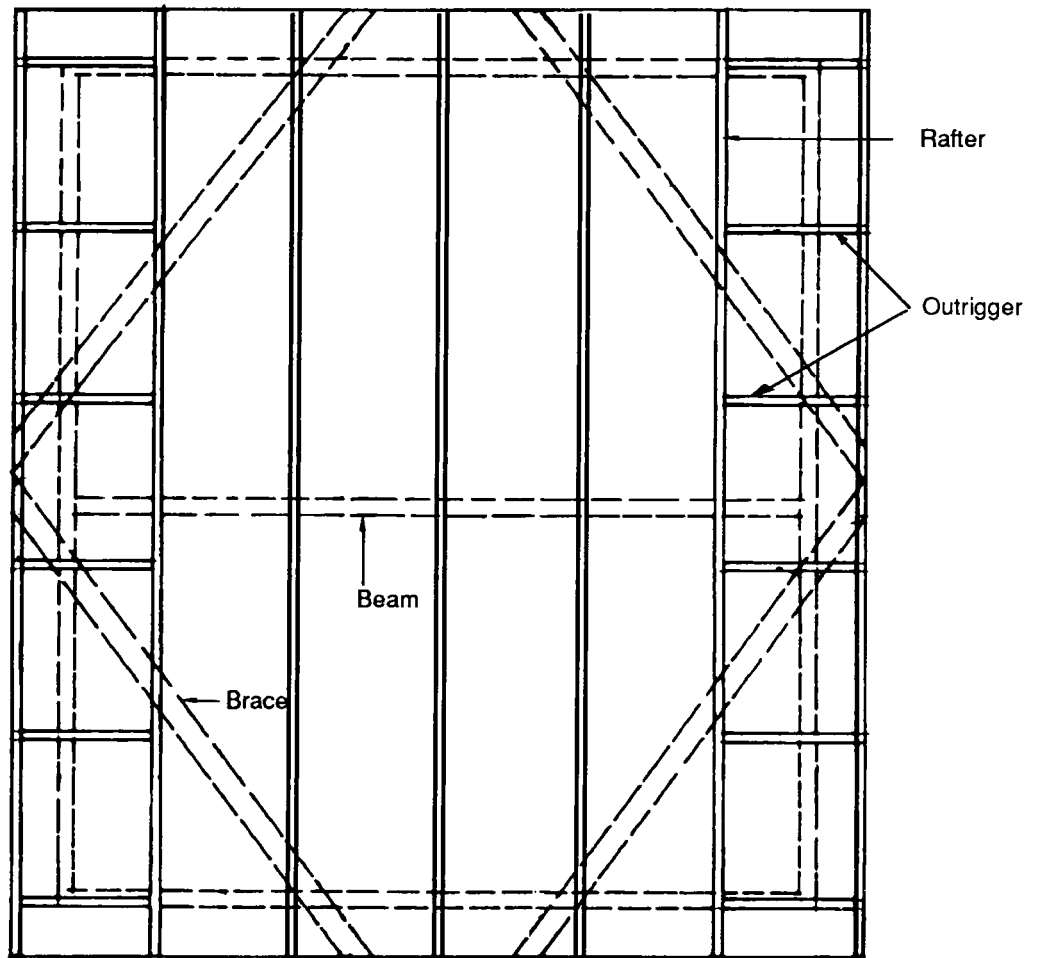


FIGURE H5.2 ROOF BRACING - PLAN

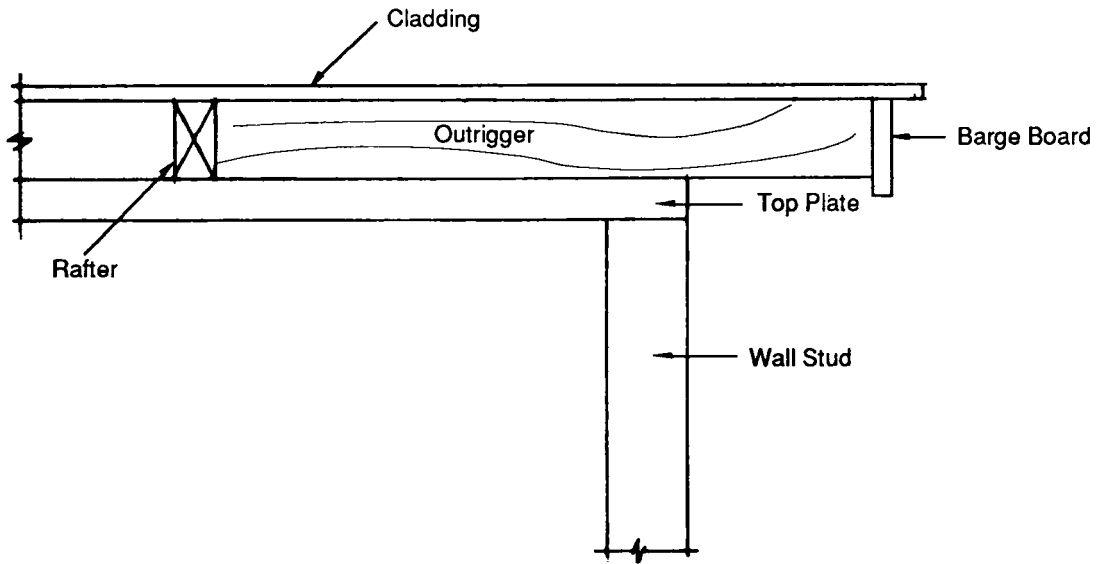


FIGURE H6.1 OUTRIGGER DETAIL

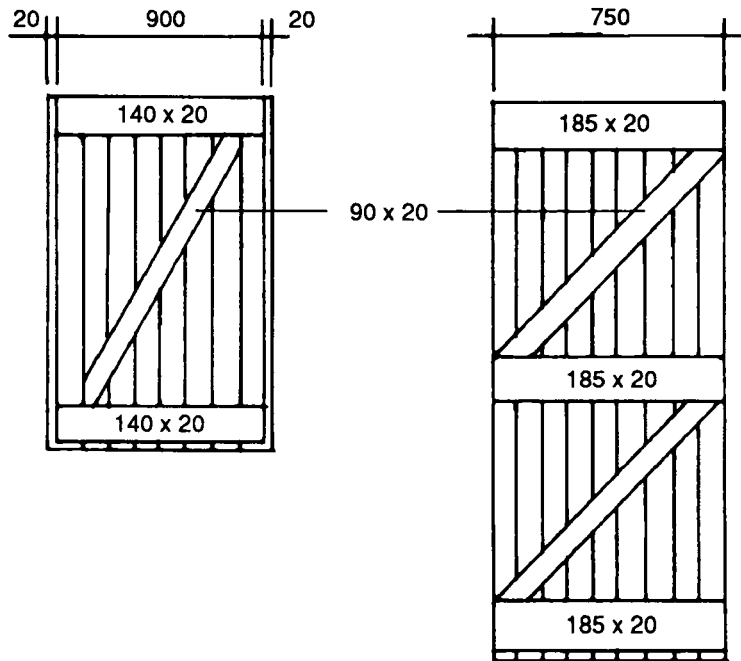


FIGURE H6.2 DOOR AND WINDOW DETAIL

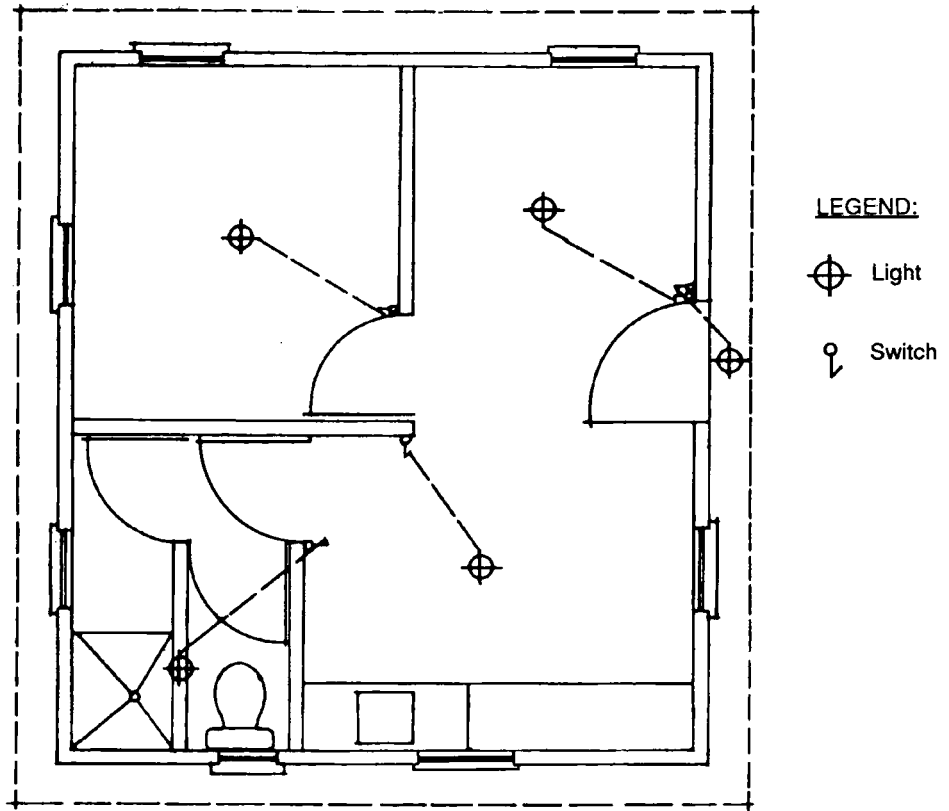


FIGURE H6.3 ELECTRICAL WIRING LAYOUT

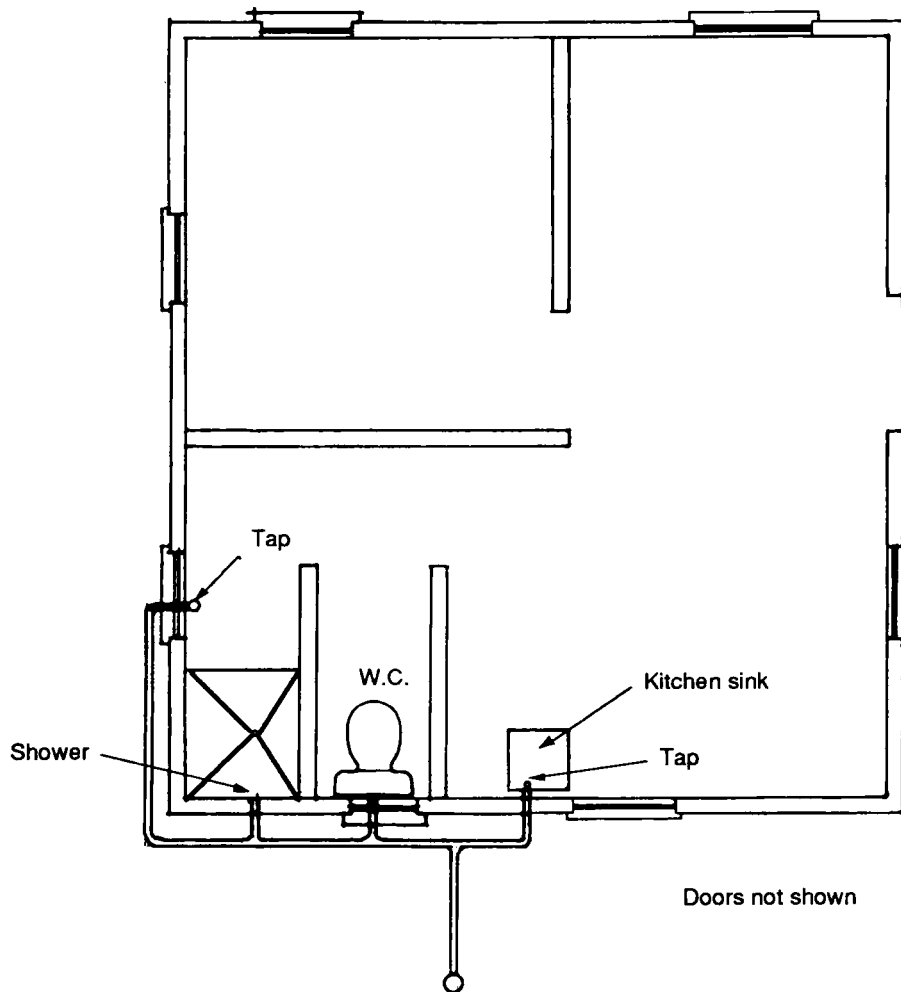


FIGURE H6.4 PLUMBING DETAIL

## H7 MEMBER SIZES (All in millimetres)

### H7.1 Roof

Cladding:	Lightweight (eg. sheet roof cladding)		
Rafters :	Minimum stress grade	:	F8
	Call dimensions	:	150 x 50
	Spacing (mm)	:	900
Beams :	Minimum stress grade	:	F8
	Call dimensions	:	200 x 75
Purlins :	<b>Not required</b>		

### H7.2 Timber framed walls

Top plate *	:	50 x 100		
Bottom plates	:	50 x 100		
Noggings	:	50 x 100		
Studs	:	Minimum stress grade	:	F8
		Call dimensions	:	100 x 50
Internal wall studs	:	Minimum stress grade	:	F8
		Call dimensions	:	100 x 40

If the external wall is of timber construction then the internal walls must also be of timber construction for the bedroom.

### H7.3 Masonry walls

150mm partially reinforced masonry blockwall \*

Vertical Reinforcement	:	D12 @ 600 mm centres
Horizontal Reinforcement	:	4 D16 bars in 150 x 400 concrete bond beam at top and bottom of wall
Lintel	:	150 x 200 concrete or masonry with 2 D16 bars R6 ties @ 600 mm centres
Intermediate bond beam	:	Not required

If the external wall is of masonry construction then the internal walls must also be of masonry construction for the bedroom.

\* Although partially grouted masonry wall is not allowed in zones 7 and 8 by Clause C3, in this instance it has been used because of the size of the house.

### H7.4 Other wall types

Corrugated iron roofing sheets may be used for external wall cladding of houses to this design. However the noggings must be spaced no further than 900 mm. Alternate **troughs** must be fastened to the noggings with 40 x 3.75  $\phi$  nails with large washers. The internal walls for the bedroom must of timber or masonry construction

Houses constructed to this detail will also satisfy the limitations given at Clause H1 at page H -1.

## **H7.5 Floor**

Slab on ground.

100 mm thick slab on compacted granular fill reinforced with F62 (665) mesh or D10 bars at 350 mm centres both ways. Refer to Figures H4.1 and H4.2 for details.

## **H7.6 Corner bracing of walls**

Knee brace every corner of wall with either 150 x 25 timber brace or 30 x 0.8 galvanised straps as shown in Figure H5.1.

## **H7.7 Roof bracing**

150 x 25 timber braces or 30 x 0.8 galvanised straps or suitable proprietary product as shown in Figure H5.2

## **H8 TIE - DOWN**

### **H8.1 Cladding to rafter**

Nail every crest of cladding within 1200 mm of roof edges. Nail every alternate crest in other areas. In cyclonic winds, damage is expected to occur to sheet metal cladding if nails are used. To avoid this load spreading washers in conjunction with nails must be used or use Type 17 No 14 hot dip galvanised screws with load spreading washers.

Note : Load spreading washers for nails are manufactured by Hylton Parker (Pty) Ltd. NZ.

### **H8.2 Rafter to wall**

Use 30 x 0.8 G.I looped strap with 6/3.15 $\phi$  nails each end of strap. Refer to Figure H8.2.

### **H8.3 Top plate to stud**

Use 30 x 0.8 G.I. strap with 6/3.15  $\phi$  nails at each end of strap. Refer to Figure H8.3.

### **H8.4 Bottom plate to foundation**

Bottom plate must be bolted to the footing at 900 centres as shown in Figure H8.4.

### **H8.5 Beams to studs**

75 x 8 mm M.S saddle bolted to double studs with 1 M12 bolt as shown in Figure H8.5.

Note : Beam must be supported on double studs. Studs must be nailed together with 100 x 4.5  $\phi$  nails at 300 mm spacings.

# APPENDICES

# APPENDIX I DESIGN CRITERIA

## 1 GENERAL

The calculations in this manual have been based on the following codes :-

- (a) The design loads contained in NZS 4203 : General Structural Design and Design Loadings for Buildings, Sections 1 and 2.
- (b) The wind loads contained in AS1170 Part 2, Wind Forces, Sections 1 and 3 ;
- (c) The earthquake loads contained in NZS 4203 : General Structural Design and Design Loadings for Buildings, Section 3 ;
- (d) AS1720, SAA Timber Structures Code, Part 1 - 1988 edition ;
- (e) NZS 4230(P) Design of Masonry Structures.
- (f) NZS 4229 Code of practice for MASONRY BUILDINGS not requiring specific design.

## 2 DERIVATION OF DESIGN WIND LOADS

The wind loads used in the preparation of this manual have been derived from the Australian Wind Loading Code, AS1170 Part 2, 1989. Sections 1 and 3 have been used to calculate the design windspeeds that act on the building.

### 2.1 Design Windspeeds

The design windspeed is derived by multiplying the basic windspeed for permissible stress methods by the various multiplying factors for terrain category, shielding, topography and structure importance.

$$V_z = V_p \times M_{(z, cat)} \times M_s \times M_t \times M_i$$

where	$V_z$	=	the design wind gust speed at height z, in metres per second
	$V_p$	=	the basic windspeed for permissible stress methods
	$M_{(z, cat)}$	=	a gust windspeed multiplier for a terrain category at height z
	$M_s$	=	a shielding multiplier
	$M_t$	=	a topographic multiplier for gust wind speeds
	$M_i$	=	a structure importance multiplier

### 2.2 Terrain Category

Terrain, over which the approach wind flows towards a structure, is assessed on the basis of the following category descriptions:

- (a) Category 2 - open terrain, grassland with few well scattered obstructions having heights generally from 1.5 m to 10 m and water surfaces at windspeeds ( $V_u$ ) and  $V_p$ .

where  $V_u$  is the ultimate limit state windspeed and  
 $V_p$  is the basic windspeed for permissible stress methods.

- (b) Category 2 1/2 - Scattered trees and tall grass, or scattered obstructions of the size of domestic houses. This category is also used to denote the fact that the wind stream has traversed not less than half of the full development length of 2.5 km over category 3 type terrain.

## 2.3 Multiplying Factors

### (a) Terrain and Structure Height Multiplier ( $M_{(z, cat)}$ )

The terrain and structure height multiplier has been derived from Table 3.2.5.2, AS 1170 Part 2 1989, based on terrain category 2 and interpolated category 2 1/2.

### (b) Shielding Multiplier ( $M_s$ )

The shielding multiplier has been assumed to be 1.0.

### (c) Topographic Multiplier ( $M_t$ )

Eight values for the topographic multiplier have been considered. Where the topographic features are in between these values, interpolation is permitted.

### (d) Structure Importance Multiplier

It has been assumed that this manual will be used for construction of normal houses. As such a structure importance multiplier of 1.0 has been used throughout.

**TABLE 1**

**TOPOGRAPHIC MULTIPLIER AT CREST ( $\theta = 0$ )  
FOR GUST WINDSPEEDS**

Upwind slope ( $\phi$ )	Topographic multiplier ( $M_t$ )	
	Escarments	Hills and ridges
1 in 20	-	1.09
1 in 10	1.08	1.18
1 in 7	-	1.27
1 in 5	1.16	1.36
1 in 3.3	1.24	-

## 2.4 Dynamic Wind Pressures

$$q_z = 0.6 \times V_z^2 \times 10^{-3}$$

where

$q_z$  = the free stream gust dynamic wind pressure at height,  $z$ , in kilopascals

$V_z$  = the design gust windspeed at height  $z$ , in metres per second.

## 2.5 External Pressure Coefficient ( $C_{pe}$ )

These are derived from Tables 3.4.3.2, 3.4.3.2(B), and 3.4.3.2(C) for roofs. For walls these are derived from Tables 3.4.3.1, 3.4.3.1(B), and 3.4.3.1(C). (All tables from AS 1170 Part 2)

## 2.6 Internal Pressure Coefficient ( $C_{pi}$ )

Internal pressure coefficient has been taken as + 0.3 .



### 3 DESIGN EARTHQUAKE LOADS

The earthquake loads used in the preparation of this manual have been derived from section 3 of the New Zealand Standard NZS 4203, General Structural Design and Design Loadings for Buildings.

#### 3.1 Horizontal seismic Force

The horizontal seismic force acting along either principal axis at the base of the structure must be calculated from;

$$V = C(T) \times W_t$$

where  $C(T)$  is the coefficient as calculated from the equation given below

$W_t$  is the sum of the lumped seismic weights in the structure for all levels above the base of the structure.

$$C(T) = C_o(T, \mu) \times R \times Z$$

where  $C(T)$  is the ordinate at a period of T seconds

$C_o(T, \mu)$  is the response function with period T and ductility factor  $\mu$

R is a risk factor

For the purposes of this manual, the following assumptions have been made;

- . T has been taken as 0.2 seconds
- . R has been taken as 1.0
- .  $\mu$  is the structural ductility factor required to define the  $C_o(T, \mu)$  value and has been taken as 1.25 for masonry and 4.0 for timber structures

Z is a zone factor as follows:

Earthquake Zone	7	8
Zone Factor	0.7	0.8

See Figure A5

## APPENDIX II EXAMPLES

### 1 Calculation of Design Windspeed

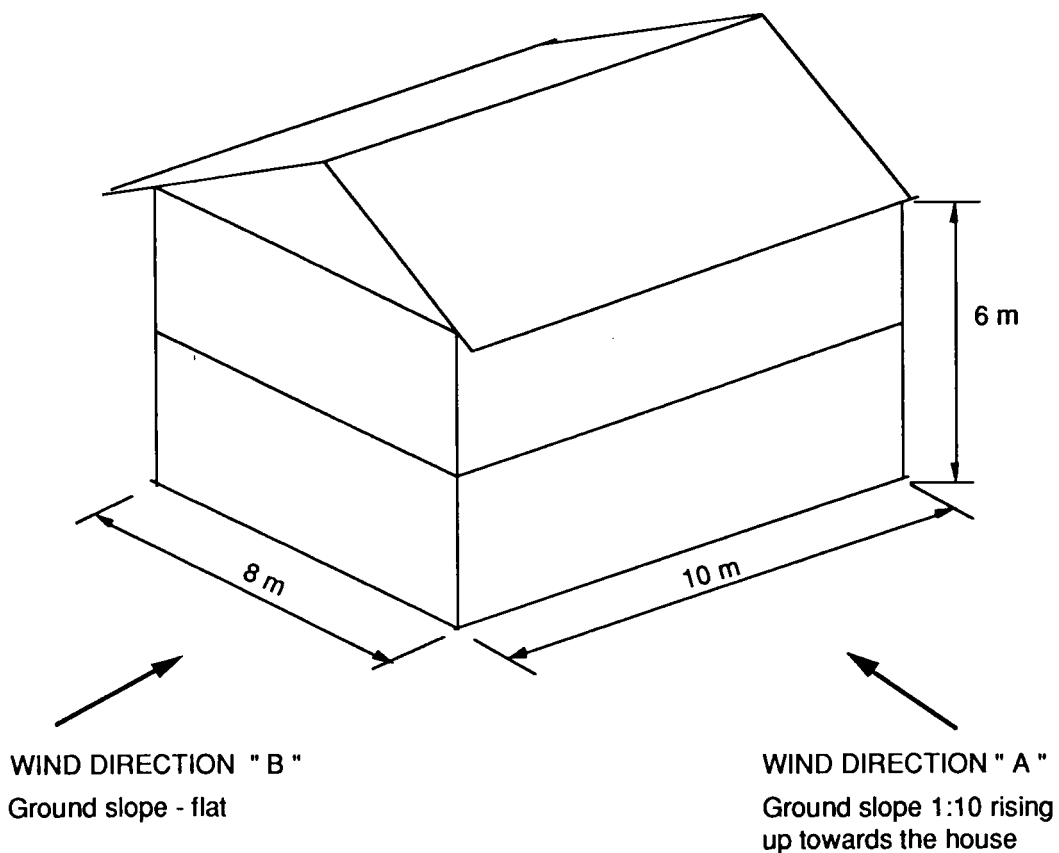
#### Building Geometry and Site Conditions

Length	:	10 m
Width	:	8 m
Height	:	6 m
Roof Pitch	:	10° for wind direction "A" and 0° for direction "B" (see Figure below)
Terrain	:	category 2
Topography	:	On the crest of an escarpment with the house facing an upwind slope of 1 :10. The ground slope along the house (wind direction "B", see Figure below) is flat.
Earthquake zone	:	7

#### FROM TABLE A4.5.2

=> DESIGN WINDSPEED = 60 m/s in direction "A", and  
= 55 m/s in direction "B".

### 2 Calculation of Bracing Wall Requirements



## 2.1 UPPER STOREY

(a) For wind direction "A"

=> **From Table B9.3 (A)**

Bracing Demand for 49 m/s = 2.1 kN/m

For 60 m/s and 10 m length =  $10 \times 2.1 \times 1.5$  => **31.5 kN**

(b) For wind direction "B"

=> **From Table B9.3 (B)**

Bracing Demand for 49 m/s for 8 m width => 22.4 kN

For 55 m/s =  $1.26 \times 22.4$  => **28.2 kN**

(c) Earthquake load

=> **From Table B9.3 (C)**

For zone 7 for 60 m<sup>2</sup> => **21.2 kN** in each direction "A" and "B"

THE VALUE OF THE MINIMUM BRACING STRENGTH TO BE PROVIDED IN DIRECTION "A" IS THE HIGHEST VALUE OF (a) and (c), ie 31.5 kN

THE VALUE OF THE MINIMUM BRACING STRENGTH TO BE PROVIDED IN DIRECTION "B" IS THE HIGHEST VALUE OF (b) and (c), ie 28.2 kN

## 2.2 LOWER STOREY

(a) For wind direction "A"

**From Table B9.3 (A)**

Bracing Demand for 49 m/s => 6.0 kN/m

For 60 m/s and 10 m length =  $10 \times 6 \times 1.5$  => **90 kN**

(b) For wind direction "B"

**From Table B9.3 (B)**

Bracing Demand for 49 m/s for 8 m width => 61.1 kN

For 55 m/s =  $1.26 \times 61.1$  => **77 kN**

(c) Earthquake load

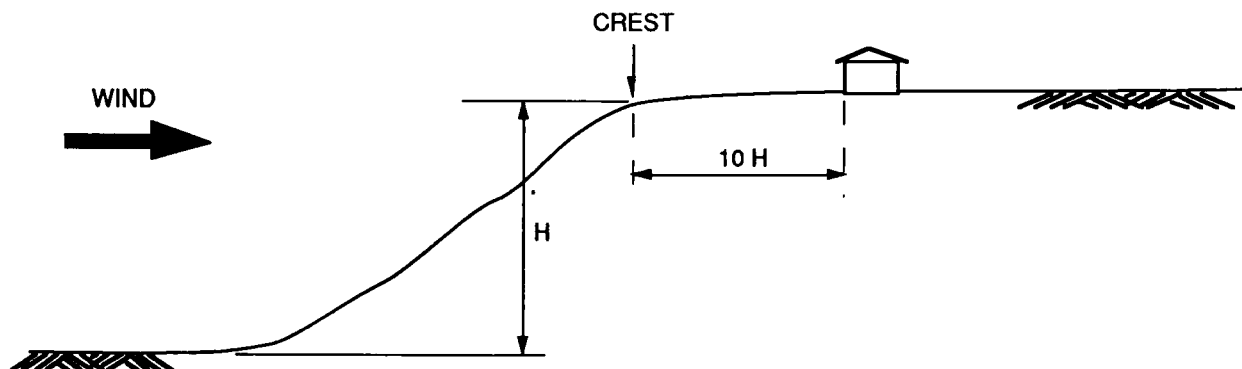
**From Table B9.3(C)**

For zone 7 for 60 m<sup>2</sup> => **31.8 kN**

THE VALUE OF THE MINIMUM BRACING STRENGTH TO BE PROVIDED IN DIRECTION "A" IS THE HIGHEST VALUE OF (a) and (c), ie 90 kN

THE VALUE OF THE MINIMUM BRACING STRENGTH TO BE PROVIDED IN DIRECTION "B" IS THE HIGHEST VALUE OF (b) and (c), ie 77 kN

### 3.3 EXAMPLE FOR CALCULATION OF DESIGN WINDSPEED IF THE HOUSE IS SITUATED DOWNWIND FROM CREST OF AN ESCARPMENT



- Basic Windspeed : 57 m/s
- Terrain : Category 2
- Upwind Slope of Escarpment : 1 : 10
- Building height : 6 m

At crest, Design Windspeed ( from Table A4.5.2 ): 60 m/s

From Table A4.4.2 Topographic Multiplying factor is applicable up to 15 H downwind from crest.

At 15 H downwind from crest, Design Windspeed ( from Table A4.5.2 )=> 55 m/s

Reduction in windspeed at 10 H from the crest

$$= \frac{10 H (60-55)}{15 H} = 3.3 \text{ m/s}$$

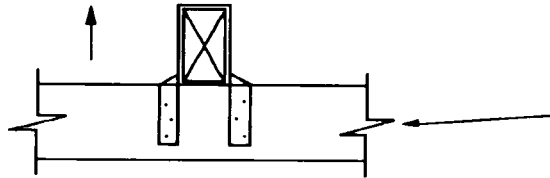
$$\text{Design windspeed at the house} = 60 - 3.3 = 56.7 \text{ m/s}$$

# APPENDIX III - TIMBER CLASSIFICATION AND PRESERVATIVE TREATMENT

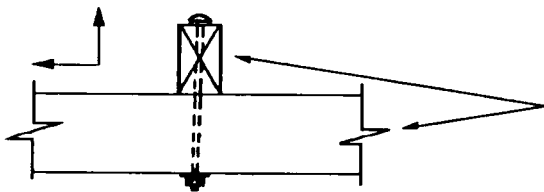
## 1 JOINT GROUPS

Pieces of timber are allocated Joint groups (see Terms and Definitions) to designate their structural properties at mechanical joints. The smaller the numerical value of a joint group rating, the greater its joint strength. For example a joint group rating of J2 indicates stronger joint properties than a rating of J3 or J4.

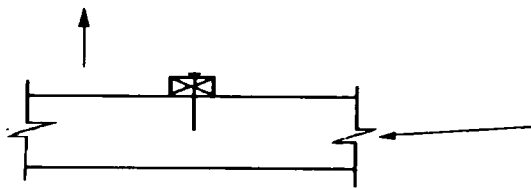
When a joint consists of pieces of timber with different joint group ratings, generally the timber with the lowest rating determines the rating of the joint as a whole. However the manner in which the forces are transmitted through the joint must also be taken into consideration. The examples in Figure 1-1 illustrate this.



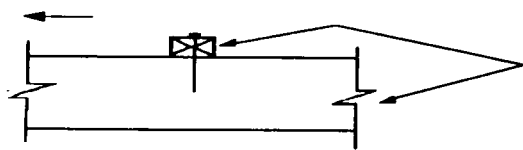
Joint Group (J, JD rating) is based on this member as Design Strength is controlled by the nails working in shear.



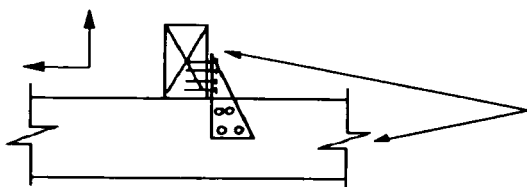
Joint Group (J, JD rating) to be based on the weaker of either member as Design Strength is controlled by shear or bearing of the bolt in both members.



Joint Group (J, JD rating) is based on this member as Design Strength is controlled by the shank of the nail or screw in withdrawal. (This assumes that no prior failure occurs in bearing of the screw or nail head against the timber piece on top).



Joint Group (J, JD rating) is based on the weaker of either member as the Design Strength is controlled by the nails or screws in shear in both members.



Joint Groups (J, JD rating) is based on the weaker of either member as the Design Strength is controlled by the nails in both members.

**Note :** Arrows to the left indicate the direction of load.

FIGURE 1-1 ILLUSTRATIONS OF JOINT GROUPS

TABLE 2 - 1

## VISUAL STRESS GRADES OF VANUATU TIMBERS

GREEN (UNSEASONED) TIMBER				
F11	F8	F7	F5	F4
Nakavika	Natora Black bean	Namalaus Nakoka	Nakatambol Stinkwood Narara Natapoa Tamanu	Whitewood Nandau Nangai Wild Natongtong Birime Kauri

DRY (SEASONED) TIMBER				
F14	F11	F8	F7	F5
Natora Nakavika	Black bean	Namalaus Nakatambol Narara Tamanu Nakoka	Stinkwood Natapoa Nandau Nangai Wild Natongtong Birime	Whitewood Nandai Mclektree Kauri

## LIST OF REFERENCES

1. AS1170.2 (1989 ) SAA Loading Code. Wind loads
2. AS1684 (1979 ) SAA Timber Framing Code
3. AS1720.1 (1988 ) SAA Timber structures code - Design methods
4. AS2858 (1986 ) Timber - Softwood - Visually graded for structural purposes
5. AS2878 (1986 ) Timber - classification into strength groups
6. AS3600 ( 1988 ) Concrete structures
7. NZS3108 (1983 ) Concrete production - ordinary grade
8. NZS3422 ( 1975 ) Welded fabric of drawn steel wire for concrete reinforcement
9. NZS4203 (1984 ) General structural design and design loadings for buildings
10. NZS4210P (1981 ) Masonry buildings - Materials and workmanship
11. NZS4223 (1989 ) Glazing in buildings
12. NZS4229 ( 1986 ) Concrete masonry buildings not requiring specific design
13. NZS4230P (1985 ) The design of masonry structures
14. Queensland timber framing manual ( 1987 ), TRADAC
15. New Zealand concrete masonry manual (1986), Cement and concrete association of NZ
16. Basic guide to concrete constuction (1985 ), Cement and concrete association of Aust.
17. Low - rise domestic and similar framed structures, part 1 - Design criteria ( 1978 ), CSIRO
18. Fiji Pine code of practice for light timber buildings not requiring specific design ( 1985 )  
Dept. of Forestry, Fiji