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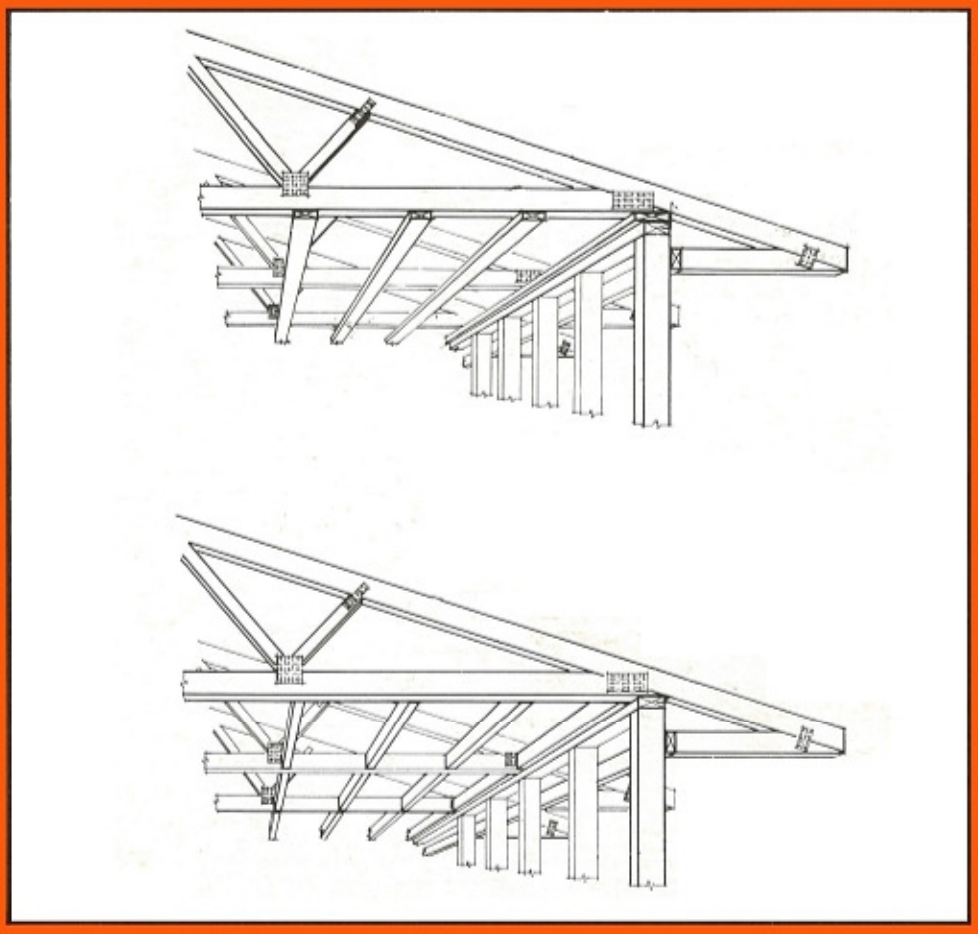

NEW ZEALAND STANDARD

Code of practice for

LIGHT TIMBER FRAME BUILDINGS

not requiring specific design

Third edition incorporating Amendments to 1981 edition

UDC 69 001-3(931):694.5

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Standards Association of New Zealand

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COMMITTEE REPRESENTATION

This Standard was prepared under the supervision of the Timber Industry Sectional Committee (36/-) and was approved as a means of compliance with relevant requirements of NZS 1900* by the Building and Civil Engineering Sectional Committee (38/-) each established by the Standards Council under the Standards Act 1965. Each of the following organizations was represented on one or both of those sectional committees:

Building Research Association of New Zealand
Department of Scientific and Industrial Research
Department of Trade and Industry
Housing Corporation of New Zealand
Ministry of Energy
Ministry of Works and Development
Municipal Association of New Zealand
New Zealand Contractors Federation
New Zealand Counties Association
New Zealand Forest Service
New Zealand Government Railways Department
New Zealand Institute of Architects
New Zealand Institution of Engineers
New Zealand Manufacturers Federation
New Zealand Master Builders Federation
New Zealand Sawmillers Federation
New Zealand Timber Importers Association
New Zealand Timber Merchants Federation
New Zealand Timber Research and Development Association
Post Office

The Light Timber Frame Committee (36/6) was responsible for the preparation of this Standard.

Standards Association of New Zealand
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Wellington 1 (Postal address: Private Bag, Wellington)
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AMENDMENTS

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FIGURE

APPENDIX

RELATED DOCUMENTS

Reference is made in this Standard to the following documents:

NEW ZEALAND STANDARDS

NZS 1900 : —— *Model building bylaw*
- Chapter 1 : 1964 *Preliminary*
- Chapter 2 : 1964 *Building permits*
- Chapter 3 : 1964 *General requirements*
- Chapter 4 : 1964 *Residential buildings*
- Chapter 5 : 1963 *Fire-resisting construction and means of egress*
- Chapter 6 : —— *Construction requirements for buildings not requiring specific design —*
  - Division 6.1 : 1978 *Timber*
  - Division 6.2 : 1964 *Masonry*
- Chapter 9 : —— *Design and construction —*
  - Division 9.1 : 1981 *Timber*
  - Division 9.2 : 1964 *Masonry*
  - Division 9.3 : 1981 *Concrete*
- Chapter 10 : 1964 *Non-structural external wallings*

NZS 2295 : 1969 *Building papers (breather type)*
NZS 3109 : 1980 *Specification for concrete construction*
NZS 3403 : 1978 *Hot-dip galvanized corrugated steel sheet for building purposes*
NZS 3441 : 1978 *Hot-dipped zinc-coated steel coil and cut lengths*
NZS 3601 : 1973 *Metric dimensions for timber*
NZS 3602 : 1975 *Code of practice for specifying timber and wood-based products for use in building*
NZS 3603 : 1981 *Code of practice for timber design*
NZS 3605 : 1977 *Load bearing round timber piles and poles*
NZS 3614 : 1971 *The manufacture of construction plywood*
NZS 3617 : 1979 *Specification for profiles of weatherboards, fascia boards, and flooring*
NZS 3631 : 1978 *Classification and grading of New Zealand timbers (National Timber Grading Rules)*
NZS 4203 : 1984 *Code of practice for general structural design and design loadings for buildings*
NZS 4206 : 1973 *Concrete interlocking roofing tiles*
NZS 4210P: 1981 *Code of practice for masonry buildings : materials and workmanship*
NZS 4211 : 1976 *Performance of windows*
NZS 4217 : 1980 *Pressed metal tile roofs*
NZS 4251 : 1974 *Code of practice for solid plastering*
NZS 4431 : 1978 *Code of practice for earth fill for residential development*
NZS 5902 : 1976 *Building drawing practice*
NZSR 22 : 1966 *The classification of roofing felts and the laying of built-up roofing (asphaltic bitumen)*
MP 3801 : 1972 *A guide to the adoption of the model building bylaw (NZS 1900) by local authorities using the standard adoption and annual updating procedure*

OTHER DOCUMENTS

BUILDING RESEARCH ASSOCIATION OF NEW ZEALAND
- BRANZ Technical Paper P21, *A wall bracing test and evaluation procedure*
- BRANZ Bulletin 212 *Soil testing*

UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION VOLUNTARY PRODUCT STANDARD:
- PS 60 — 73 *Hardboard siding*

COMMODITY SPECIFICATIONS OF THE TIMBER PRESERVATION AUTHORITY
- TPA C2B *Building poles*
- TPA C3 *Posts and sawn timbers for use in ground contact*
- TPA C7 *Building timbers — moderate decay hazard*
- TPA C11 *Plywood — moderate decay hazard*

AUSTRALIAN STANDARD
- AS 1649 — 1974 *Determination of basic working loads for metal fasteners for timber*

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM E96 — 66	*Standard method of test for water vapour transmission of materials on sheet form*

BRITISH STANDARDS

BS 729 : 1971	*Hot dip galvanized coatings on iron and steel articles*
BS 1204 : ----	*Synthetic resin adhesives (phenolic and aminoplastic) for plywood* — Part 1 : 1979 *Gap-filling adhesives*
BS 1521 : 1972	*Waterproof building papers*
BS 4071 : 1966	*Polyvinyl acetate (PVA) emulsion adhesives for wood*
BS 4940 : 1973	*Recommendation for the presentation of technical information about products and services in the construction industry*

FOREWORD

This Standard is a revision in means-of-compliance format of the technical requirements of NZS I900 : Chapter 6.1 : 1964 (other than requirements for timber and wood-based products as materials, which are contained in NZS 3602*).

There is a change of emphasis in that this Standard adds to and modifies the 'traditional' practices that were codified in the previous Chapter 6.1 by taking account on a rational engineering basis of the actual loads which the building is expected to withstand. This has led to differing requirements for different seismic zones and for different wind exposure areas as well as for different floor loadings.

Although a rational engineering approach has been adopted, advantage has been taken of the redundancies, additional strength, and other favourable factors known to be present in light timber frame buildings complying with this Standard even though such factors cannot normally be taken into account in specific structural design. Accordingly, it must be recognized that this Standard is different in kind from the standard code of practice for timber design (NZS 3603*).

Further editorial and technical amendments have been incorporated in this 1984 edition of the Standard following practical use of the 1981 edition.

The extent of the revision (over 80 pages of amendments) has caused the Standards Association to depart from the usual policy of issuing separate amendments.

SANZ will continue this policy whenever amendments are of a substantial nature.

Text, tables and diagrams that have been amended from the 1981 edition are identified by a vertical line in the margin.

ACKNOWLEDGMENT

The Standards Association of New Zealand gratefully acknowledges the financial assistance for consulting and drafting services in the preparation of this standard that was given by:

Building Research Association of New Zealand
New Zealand Timber Research and Development Association
New Zealand Steel Ltd

* see list of related documents

NEW ZEALAND STANDARD

Code of practice for

LIGHT TIMBER FRAME BUILDINGS

not requiring specific design

1 SCOPE AND INTERPRETATION

1.1 SCOPE

1.1.1
This Standard sets down construction requirements for light timber frame buildings not requiring specific design within the limitations specified by clause 1.1.2, and is approved as a means of compliance with the relevant requirements of NZS 1900*.

1.1.2
This standard applies only to buildings within the following limitations:

(a) The floor load shall not exceed 3 kPa;

(b) The eaves height measured vertically from the lowest adjoining finished ground level to the eaves level, shall not exceed 10 m, as shown in fig. 1;

(c) The slope of any roof plane shall not be steeper than 60° to the horizontal;

(d) The design wind speed V_S for the building, as calculated from NZS 4203 (clause 4.3.2), shall not exceed the following values if the building is designed for:

High wind exposure:	37 m/s
Medium wind exposure:	30 m/s
Low wind exposure:	26 m/s

(e) The snow load as specified by NZS 4203* shall not exceed 0.5 kPa; provided that where the snow loads exceeds 0.5 kPa but does not exceed 1.0 kPa, Appendix K shall apply;

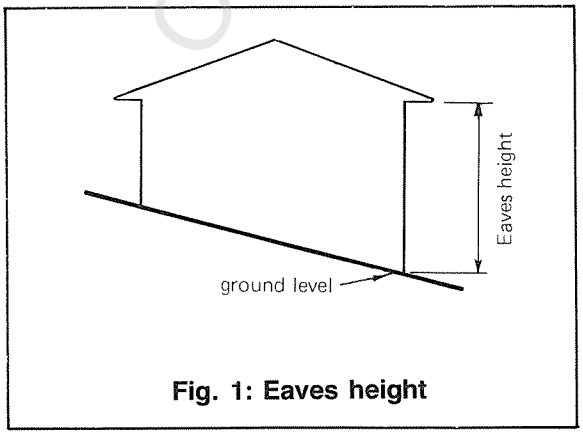


Fig. 1: Eaves height

(f) Each part of the building shall be within the limitations stated or implied by the relevant clauses or tables of this Standard;

(g) Categories 1, 2a, 2b, 3a, 3b and 4 buildings as specified by NZS 4203*.

C1.1.2
Any building or part of a building that does not comply with clause 1.1.2 is outside the scope of this Standard and will require specific design unless covered by another Standard for buildings not requiring specific design, for example, NZS 1900 : Chapter 6.2*. Points to note are:*

(a) The main body of the Standard is essentially written for a floor load of 1.5 kPa, corresponding to the load specified for domestic buildings by NZS 4203. Additional tables are given in Appendix H for floor loads of 2 kPa and 3 kPa where these are not covered by the tables in the main body of the Standard (see clause 1.2.3).*

(c) The limitation on roof slope means that 'A-frame' buildings will generally require specific design. Provision for mansard roofs is made in clause 6.4.2.

(d) The design wind speed need not be calculated if the provisions of clause 2.6.2 are satisfied.

For buildings higher than the limits given in clause 2.6.2 for ground roughness categories 1 and 2 and for buildings exposed to local acceleration of the wind, then the design wind speed V_S must be calculated and compared with the limits given in this clause for the appropriate wind exposure.

Whether or not a building site is exposed to local wind accelerations will generally be a matter of local judgment. Conditions likely to cause such accelerations include valleys and gorges shaped to produce funnelling the wind, bluffs, very exposed hillsides, peaks and ridges.

(e) In general, clause 1.1.2 (e) will be satisfied if the building is on a site where, as a matter of local knowledge, it will not be subjected to snow more than 250 mm deep.

(f) Many of the clauses and tables in this Standard contain specific or implied limitations. The use of values other than those given by the clauses and tables does not comply with this Standard. The

* see list of related documents

limitations of individual clauses and tables include:

Maximum height of foundation walls: 2 m
Maximum height of loadbearing studs: 4.8 m in top or single storeys and 3.0 m elsewhere
Maximum roof dimension S of truss roofs as determined from fig. 36B: 12 m
Maximum lintel span: 3.6 m
Maximum length of driven timber piles: 3.6 m

(This is not a complete list)

It should also be noted that certain parts of buildings (for example, foundation walls that are also retaining walls) are not included in this Standard and will therefore require specific design.

(g) *Provisions for Class III buildings are contained in the main body of the Standard while Appendix J contains additional provisions for Class I and II buildings.*

Most 'pole-frame' buildings will also require specific design, although Appendix D allows for 'pole platforms'.

Furthermore, this Standard does not cover all of the requirements of NZS 1900, and particular attention is drawn to the requirements of NZS 1900 : Chapter 4* for residential buildings and of NZS 1900 : Chapter 5* for fire resisting construction, fire stopping in timber-framed buildings, and means of egress.*

1.1.3
In the case of single-storey outbuildings not exceeding 40 m² in plan area and not used for human habitation the Engineer may, at his discretion and subject to such conditions as he considers necessary, waive any requirement of this Standard.

1.2 INTERPRETATION

1.2.1
In this Standard the word 'shall' indicates a requirement that is to be adopted in order to comply with the Standard, while the word 'should' indicates a recommended practice.

1.2.2
Subject to clause 1.2.1, clauses prefixed by 'C' and printed in italic type are intended as comments on the corresponding mandatory clauses.

C1.2.2
Clauses in Appendix C are also prefixed by 'C' but are not printed in italic type. When clause numbers are cited care should be taken to avoid any possibility of confusion, but this will rarely be necessary because the context of the citation will usually leave no doubt as to which clause is intended (see, for example, clause D2 which contains several references to clauses in Appendix C).

1.2.3
Where the floor load exceeds 1.5 kPa but does not exceed 3 kPa all other requirements of this Standard shall be subject to any specific requirement laid down in Appendix H for the loading concerned.

1.2.4
Material contained in an appendix to this Standard shall be of the same force and effect as if it were contained in the main body of the Standard.

1.2.5
Where any thickness or width is specified for a timber member in this Standard then unless specifically stated otherwise that member may have a greater thickness, or a greater width, or both.

1.2.6
Unless specifically stated otherwise, cross-sectional dimensions of timber given in this Standard shall be call dimensions as specified in NZS 3601*.

C1.2.6
The actual dimensions of timber will differ from the call dimensions because of the tolerances specified in NZS 3601 and according to its condition, for example green or dry, sawn, gauged, or dressed.*

1.2.7
Where any clause in this Standard contains a list of requirements, provisos, conditions, or the like, then each and every item in that list is to be adopted in order to comply with this Standard unless the clause specifically states otherwise.

1.2.8
Where any other Standard named in this Standard has been declared or endorsed in terms of the Standards Act 1965, then:

(a) Reference to the named Standard shall be taken to include any current amendments declared or endorsed in terms of the Standards Act 1965; or

(b) Reference to the named Standard shall be read as reference to any Standard currently declared or endorsed in terms of the Standards Act 1965 as superseding the named Standard, including any current amendments to the superseding Standard declared or endorsed in terms of the Standards Act 1965.

C1.2.8
The date at which an amendment or superseding Standard is regarded as 'current' is a matter of law depending upon the particular method by which this Standard becomes legally enforceable in the case concerned. In general, if this is by contract the relevant date is the date on which the contract is created, but if it is by Act, regulation, or bylaw then the relevant date is that on which the Act, regulation, or bylaw is promulgated; for bylaws, promulgation includes updating by the procedure set out in MP 3801.*

1.2.9
In this Standard, unless inconsistent with the context:

BALLOON FRAMING means a system of wall framing used in buildings of more than one storey in which the studs are continuous from the bottom plate to the top plate, extending past floor joists, which are supported on ribbon boards instead of top plates.

* see list of related documents

BATTEN:

CEILING BATTEN means a horizontal timber member laid underneath rafters, ceiling joists, or truss bottom chords and to which the ceiling lining is attached.

TILE BATTEN see PURLIN.

BEARER means a beam supported on jack studs, foundation walls, piles, or piers and carrying joists, jack studs, or subfloor framing. See also EAVES BEARER.

BRACE:

DIAGONAL BRACE means a member of a framed building fixed diagonally and used to resist tension or compression or both.

SUBFLOOR BRACE means a bracing element below the ground floor leve1.

WALL BRACING ELEMENT means a section of wall above the ground floor level that performs a bracing function.

BRACING means any method employed to provide lateral support to a building.

BRACING LINE means a line along or across a building for controlling the distribution of wall bracing elements.

BRACING UNIT means a measure of the performance of a wall bracing element, see clause 6.9.

BRIDGING see STRUTTING.

CALL DIMENSIONS means the dimensions as given by NZS 3601* and by which timber is referred to in commercial transactions.

CAPACITY of a timber connector means the 5 percent lower probability limit of the maximum loads for all test specimens when joints made with that connector are tested in accordance with NZS 3603 Appendix A.

The capacity of a timber connector should not be confused with its basic working load as used in structural design (see NZS 3603). The capacity is significantly higher than the basic working load. Capacities called for by this Standard relate to ultimate load conditions and not to working loads as generally used in structural design.*

CLADDING means the outside or exterior weathering surface of a building.

COLLAR TIE means a member connecting paired rafters together below the level of the ridge board in a roof.

D means a deformed reinforcing bar of the stated diameter in millimetres.

DAMP-PROOF COURSE means a durable waterproof material placed between brick, stone, or concrete and timber or metal as a protection against moisture.

DEPTH means the vertical dimension of the wide face of a member that is set on edge.

DIAPHRAGM means a member such as a floor or ceiling capable of transferring loads in its own plane to boundary members.

DWANG or NOGGING means a short member fixed between framing timbers.

EAVES BEARER or SOFFIT BEARER or SPROCKET means a horizontal member attached to the end of a truss or a rafter and to a stud or a ribbon board or a soffit plate and to which the eaves lining is attached.

FLOOR LOAD means the basic minimum uniformly distributed live load for floors as specified by NZS 4203*.

NZS 4203 specifies the basic minimum live loads to be used in the design of floors for particular types of buildings. This Standard treats those minimum design loads as if they were the maximum actual loads to be expected in buildings of those types and not requiring specific design. The loads do not (except where specifically noted in NZS 4203*) allow for possible changes of use, nor for high density mobile storage.*

FOOTING means that portion of a foundation bearing on the ground and any adjoining portion that is reinforced so as to resist the bearing forces. It may be spread out to provide an increase in bearing area or an increase in stability.

FOUNDATION means those parts of a building transmitting and distributing loads to the ground through a footing.

FOUNDATION BLOCKS see PILES.

FOUNDATION WALL see WALL.

FRAMING, BALLOON see BALLOON FRAMING.

FRAMING TIMBER means timber members to which lining, cladding, or decking is attached or which are depended upon for supporting the structure or for resisting forces applied to it.

GABLE means the triangular part of an outside wall between the planes of the roof and the line of the eaves.

GROUND LEVEL:

CLEARED GROUND LEVEL means the ground level after the site has been cleared and any site excavation has been completed but before building foundations have been excavated.

FINISHED GROUND LEVEL means the level after all backfilling, landscaping, and surface paving has been completed.

NATURAL GROUND LEVEL means the ground level before the site has been cleared.

* see list of related documents

HERRINGBONE STRUTTING see STRUTTING.

JOIST means 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.

BOUNDARY JOIST or HEADER JOIST means a joist running along the outer ends of the floor joists.

CURTAILED JOIST means a joist not of the full length as other joists but cut short and fixed to a trimmer at one end.

DEEP JOIST means a floor joist whose depth is four or more times its width.

TRIMMER JOIST see TRIMMER.

TRIMMING JOIST means a joist which is of the full span as other joists but which on one side supports one or more trimmers.

LINING means the covering for the inside of a room, cupboard, wall, ceiling, or other interior surface.

LINTEL means a horizontal framing timber spanning an opening in a wall.

LOAD see FLOOR LOAD.

M means a bolt of the stated diameter in millimetres.

NOGGING see DWANG.

PARTITION see WALL.

PILE means a block or a column-like member used to transmit loads from the building and its contents to the ground.

ANCHOR PILE means a pile directly supporting a bearer or jack stud and embedded into the ground so as to resist horizontal loads.

BRACED PILE means a pile directly supporting a bearer and having one or two diagonal braces attached to it.

CANTILEVERED PILE means a pile directly supporting a bearer and embedded into the ground so as to resist horizontal loads.

DRIVEN TIMBER PILE means a natural round timber driven into the ground (see Appendix D) to serve as a braced pile, cantilevered pile, or ordinary pile.

ORDINARY PILE means a pile that does not have a diagonal brace attached to it and that is required to resist vertical loads only.

PLATE means a timber supported by a wall or bearers or joists to support and distribute the load from floors, walls, roofs or ceiling.

BOTTOM PLATE means a plate other than a wall plate placed under the bottom ends of studs.

TOP PLATE means a plate placed over the top ends of studs.

WALL PLATE means a plate laid upon a concrete or masonry foundation wall.

POST means an isolated vertical member acting as a support.

PURLIN includes TILE BATTEN and means a horizontal member laid to span across rafters or trusses and to which the roof cladding is attached. See also UNDERPURLIN.

R means a plain round reinforcing bar of the stated diameter in millimetres.

RAFTER means a framing timber normally parallel to the slope of the roof and providing support for sarking, purlins or roof covering.

HIP RAFTER means a framing timber which conforms to the slope of the intersection of two roof surfaces meeting in a hip and into which jack rafters are trimmed.

JACK RAFTER means a short rafter extending from the valley rafter to the ridge board or hip rafter or trimmer, or from the top plate to the hip rafter or trimmer.

VALLEY RAFTER means a rafter which conforms to the slope of the intersection of two roof surfaces meeting in a valley and into which jack rafters are trimmed.

REINFORCEMENT means any form of reinforcing rod, bar, or mesh that complies with the relevant requirements of NZS I900 : Chapter 9.3A*.

RIBBON BOARD includes SOFFIT PLATE and means a horizontal framing timber secured to or checked into the edges of studs and supporting floor or ceiling joists or eaves bearers.

RIDGE BOARD means the horizontal timber to which rafters of couple-close roofs are fixed at their upper ends.

ROOF means that part of the building having its upper surface exposed to the outside and at an angle of 60° or less to the horizontal.

COUPLE-CLOSE ROOF means a roof construction in which roof timbers consist of pairs of rafters tied together at their feet by ceiling joists to prevent spreading.

FLAT ROOF means a roof having its exterior surface at an angle of less than 10° to the horizontal (that is, at a slope of less than I in 6).

HEAVY ROOF means a roof with roofing material (cladding and any sarking) having a mass exceeding 20 kg but not exceeding 60 kg per square metre of roof area (typical examples are concrete tiles, slates and the like).

* see list of related documents

LIGHT ROOF means a roof with roofing material (cladding and any sarking) having a mass not exceeding 20 kg per square metre of roof area (typical examples are steel, copper, and aluminium roof claddings of normal thickness, 6 mm thick asbestos cement tiles, 6 mm thick corrugated asbestos, and the like, without sarking).

PITCHED ROOF means a roof having its exterior surface at an angle of 10° or more to the horizontal (that is, at a slope of l in 6 or steeper).

ROOF STRUT see UNDERPURLIN STRUT.

RUNNER:

BRACE RUNNER means a horizontal member attached to the upper edges of ceiling joists or truss bottom chords and to which a diagonal brace is attached. A brace runner may also be a ceiling runner.

CEILING RUNNER means a beam supporting ceiling joists. A ceiling runner may also be a brace runner.

S means the roof dimension determined in accordance with fig. 36B (see clause 6.4.3) but subject to clause 1.2.11.

SARKING means boarding or sheet material secured to rafters, trusses, or purlins and which may also serve as the ceiling lining.

SHEATHING means material used as a backing to cladding and includes sarking.

SLEEPER see BEARER.

SOFFIT BEARER see EAVES BEARER.

SOFFIT PLATE see RIBBON BOARD.

SPACING or SPACED means the distance at which members are spaced measured centre to centre.

SPAN means the clear distance between supports measured along the member but subject to clause 1.2.11.

SPROCKET see EAVES BEARER.

STRINGER means a horizontal framing timber on edge fixed to the side of a concrete or masonry wall to support the ends of joists or rafters.

STRUT see UNDERPURLIN STRUT.

STRUTTING means short members fixed between joists to stiffen and prevent them from canting or buckling. The strutting may be solid or herringbone.

HERRINGBONE STRUTTING means members set diagonally to form a "x" pattern between the joists to act as strutting.

SOLID STRUTTING means solid timber having the same depth as the joists set between the joists to act as strutting.

STRUTTING BEAM means a beam supporting an underpurlin strut.

STUD means a vertical framing timber.

JACK STUD means a stud of less length than the full height from plate to plate of the wall of which it forms part, or a stud at pile spacing forming part of the supporting framing under the ground floor of a building.

LOADBEARING STUD means a stud in a loadbearing wall.

NON-LOADBEARING STUD means a stud in a non-loadbearing wall.
TRIMMING STUD means a stud located on the side of an opening.

THICKNESS unless otherwise specifically stated means the call dimension representing the narrow surface of a piece of timber (see also WIDTH).

TILE BATTEN see PURLIN.

TRIMMER means a framing timber supported by two trimming joists, studs or rafters, to which is fixed one or more curtailed joists, jack studs, or jack rafters.

TRIMMING JOIST see joist.

UNDERPURLIN means a horizontal timber member laid underneath rafters, supporting the rafters at intermediate points along their length.

UNDERPURLIN STRUT means a member used to transfer load from an underpurlin to a loadbearing partition or a strutting beam.

VALLEY BOARD means a board laid to support a valley gutter.

WALING means a horizontal framing member secured to or checked into the edges of studs.

METAL ANGLE WALING means a horizontal member manufactured of metal angle, usually steel, checked into a saw cut in the face of studs.

WALL:

EXTERNAL WALL means an outer wall of a building.

FOUNDATION WALL means that part of the foundation comprising a masonry or concrete wall supporting a building or part of a building, and not extending more than 2.0 m above the underside of the footing.

INTERNAL WALL means a wall other than an external wall.

LOADBEARING WALL means a wall supporting vertical loading from floors, ceiling joists, roof, or any combination thereof.

Vertical loadings on non-loadbearing walls

which result from the long term creep settlement of loadbearing members, such as trusses, rafters or joists, do not affect the 'non' loadbearing classification of such walls (see also clause C10.2.4.4.*).*

NON-LOADBEARING WALL means a wall other than a loadbearing wall.

WALL BRACING ELEMENT see BRACE.

WEATHERBOARDING means all exterior overlapping strip cladding which is fixed either horizontally or vertically, whether rough sawn or machined or formed to any special section.

WIDTH unless otherwise specifically stated means the call dimension representing the wide surface of a piece of timber (see also DEPTH).

WYTHE means a continuous vertical tier of masonry one unit in thickness.

1.2.10
Unless inconsistent with the context, and subject to clause 1.2.9, terms defined in NZS 1900* shall have the same meaning in this standard.

C1.2.10
See in particular the definitions of 'approved', 'building', and 'Engineer' in NZS 1900 : Chapter 1.*

1.2.11
The following interpretations shall apply for the purposes of the listed tables only:

(a) For the purposes of tables 3, 5, 7, 31, 34, 36, 38, 40, 41 and 42 the span of the floor joists shall be taken as the average of the spans of the floor joists on each side of the bearer concerned (see also clause 5.1.5.4 and fig. 1A).

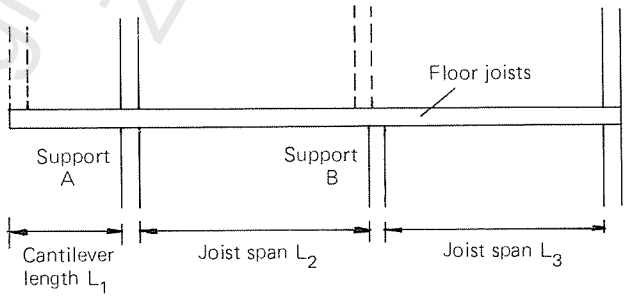
(b) For the purposes of tables 12, 13, 16, 18 and 19 the span of a supported member shall be taken as the sum of the spans of such members on each side of the wall concerned, and the roof dimension *S* shall be taken as the sum of such roof dimensions on each side of the wall concerned (see also clause 5.1.5.4 and fig. 1A).

C1.2.11

(a) Tables 3, 5, 7, 31, 34, 36, 38, 40, 41 and 42 were prepared for the most common situation where floor joists of equal span land on the bearer from both sides, and clause 1.2.11(a) provides for situations where the spans on each side are not equal and situations where floor joists land on the bearer from one side only (in which case the clause permits half of the actual span to be used for the purposes of the tables);

(b) Tables 12, 13, 16, 18 and 19 were prepared for the most common situation where loadbearing walls are external walls, so that members land on them from one side only, and clause 1.2.11(b) provides for situations where members land on a loadbearing wall from both sides.

1.2.12
Where deformed bars are specified, plain reinforcing bars may be used provided that lap and anchorage lengths are increased accordingly. (See also clause 4.6.6.2.)



Support	Support type	Joist span for support design
A	bearer	$0.5 \times (2.5 \times L_1 + L_2)$
A	wall	$(2.5 \times L_1 + L_2)$
B	bearer	$0.5 \times (L_2 + L_3)$
B	wall	$(L_2 + L_3)$
C	bearer	$0.5 \times L_3$
C	wall	L_3

Fig 1A: Definition of joist span (refer clause 1.2.11)

* see list of related documents

2 GENERAL

2.1 TIMBER AND WOOD-BASED PRODUCTS

C2.1

This clause corresponds to clauses 6.1.4 and 6.1.5 of NZS 1900 : Chapter 6.1 : 1978.*

2.1.1

The species, grade, sizes and finish, preservative treatment, moisture content, types, methods of manufacture and other relevant characteristics as appropriate of timber and wood-based products shall be approved as suitable for their end use.

2.1.2

Subject to any specific provision in this Standard, timber and wood-based products specified in accordance with NZS 3602* shall be approved as suitable.

2.1.3

All timber and wood-based products shall be adequately protected against damage, and against unacceptable variations of moisture content, both before and after installation or enclosure as appropriate.

2.1.4

As shown in fig. 2 framing timbers shall be separated from concrete or masonry by either:

(a) A free-draining air space of not less than 12 mm; or

(b) A bituminous damp-proof course or other suitable impervious material overlapping the timber by at least 6 mm;

Provided that this clause need not apply to timber treated to TPA C3* or for internal situations where the concrete or masonry is not subjected to moisture.

2.1.5

Subject to any specific provision in this Standard, timber and wood-based products protected in accordance with NZS 3602* shall be approved as adequately protected.

2.2 DURABILITY

C2.2

Timber piles may become damp in service up to approximately 300 mm above finished ground level. Galvanized steel fixings (nails, plates, dogs, bolts and so on) in these areas will require additional protection or stainless steel could be used instead.

2.2.1

Any material other than timber or wood-based products shall have or shall be protected so as to have an acceptable resistance to corrosion, degradation, or other effects adverse to the durability of the material for its end use. Material complying with clauses 2.2.2 or 2.2.3 shall be accepted as complying with this clause.

* see list of related documents

2.2.2

Mild steel structural components including bolts, nuts and washers exposed to the weather or in any position where condensation or dampness will normally occur shall be hot-dip galvanized as specified in BS 729* after forming to the final shape and dimensions, provided that in severely corrosive environments additional protection shall be provided for galvanized mild steel.

2.2.3

Structural components fabricated from hot-dip galvanized plain steel sheet or strip of the Z300 coating class of NZS 3441* may be outside the wall or ceiling lining or in the subfloor space but shall not be exposed to the weather or in any position where condensation or dampness will normally occur.

2.3 OTHER MATERIALS, COMPONENTS, PROPRIETARY PRODUCTS, AND METHODS OF CONSTRUCTION

C2.3

Clauses 2.3.1 and 2.3.2 correspond to clauses 6.1.7.1 and 6.1.7.2 of NZS 1900 : Chapter 6.1 : 1978.*

No building code can specifically cover all materials, components, and proprietary products and methods of construction. The use of those not so covered, therefore, must be subject to the discretion and informed judgement of the authority having jurisdiction, usually a territorial local authority issuing a building permit. The purpose of clause 2.3 is to assist such authorities by stating in general terms the appropriate conditions under which approvals should be given. Clause 2.3.1 (b) is principally intended to cover the introduction of new products or the use of established ones for new purposes. Clause 2.3.1 (a) is intended to preserve the status quo for established products for which there is no need of additional test information and the like.

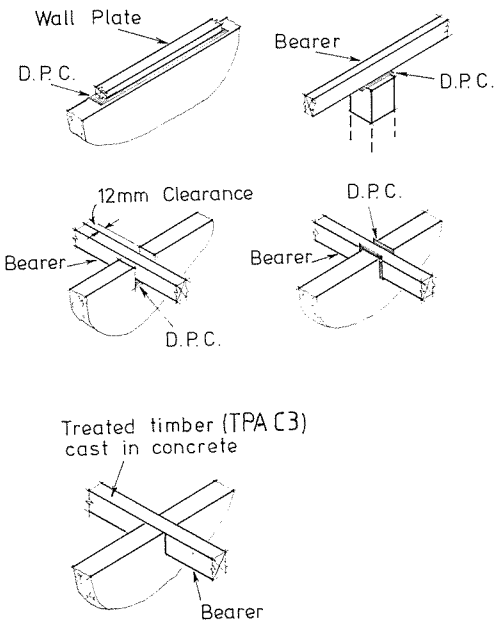


Fig. 2 : Protection of framing timbers

2.3.1
Materials, components, proprietary products, and methods of construction not specifically covered by this Standard may be used subject to the following conditions:

either

(a) They shall be shown, to the satisfaction of the Engineer, to have an established record of satisfactory performance in their intended use over a considerable time;

or

(b) They shall satisfy the following conditions:

(i) The manufacturer has specifically designated them for the intended use;

(ii) The manufacturer has supplied to their users clearly presented and adequate technical information on their relevant properties, methods of installation, and the like for the intended use;

(iii) The manufacturer has provided, to the satisfaction of the Engineer, relevant test information and assessments of their performance in the intended use issued by an approved authority.

C2.3.1
Some general performance requirements for particular uses are given in the appropriate clauses of this Standard.

2.3.2
Where any material or product is used in terms of clause 2.3.1 (b) its use shall comply with the technical information mentioned in clause 2.3.1 (b) (ii).

2.3.3
Technical information complying with Appendix B shall be approved as being clearly presented.

C2.3.3
Appendix B relates solely to the clear presentation of technical information. The question of whether the technical information so presented is adequate or not must be decided under clause 2.3.1.

2.4 WORKMANSHIP

2.4.1
Workmanship and details of construction, unless specifically covered by this Standard, or unless in accordance with the relevant requirements of NZS 1900*, shall be approved as conforming to good trade practice.

2.5 FASTENING AND FABRICATION

C2.5
See also Appendix A.

* see list of related documents

2.5.1
General

C2.5.1
*Clauses 2.5.1.1 and 2.5.1.2 correspond to clauses 6.1.3.1 and 6.1.3.2 of NZS 1900 : Chapter 6.1 : 1978**.

2.5.1.1
All parts of the building shall be securely fastened so as to resist all forces likely to be encountered during construction or during the expected life of the building and so that the building as a whole acts as a structural entity.

2.5.1.2
All timbers shall be set true to the required lines and levels with all mitres, butts, laps, housings, and the like cut accurately to provide full and even contact over all bearing surfaces.

2.5.1.3
Fastenings and connections shall be as specified in the relevant clause of this standard or in Appendix A, or shall be an alternative fixing of not less than the capacity specified in the relevant clause of this standard and used in accordance with clause 2.3.

2.5.2
Adhesives

2.5.2.1
Adhesives for timber or wood-based products used in situations exposed to the weather, in damp situations, or in high-humidity situations shall be type WBP of BS 1204:Part 1*.

2.5.2.2
Adhesives for timber or wood-based products used for loadbearing or bracing applications in dry interior situations shall comply with BS 1204:Part 1*.

C2.5.2.2
There are several adhesives that are suitable for non-loadbearing and non-bracing applications in dry interior situations, including the synthetic resins specified by BS 1204:Part 1 and the polyvinyl acetate adhesives specified by BS 4071*.*

2.5.3
Nails

2.5.3.1
Nails in structural joints shall be fully driven.

2.5.3.2
Deleted by Amendment No. 1 to NZS 3604:1981.

2.5.3.3
Where the nail size specified would cause significant splitting the nail holes shall be pre-drilled to a diameter of 80 percent of the nail diameter.

2.5.3.4
In exposed work and in flooring, nails shall be punched to a sufficient depth to allow a reasonable thickness of stopping material unless the drawings and specifications specifically state that stopping is not required.

2.5.4
Bolts and screws

2.5.4.1
In bolted joints washers shall be provided at each timber surface under the bolt head or the nut. For a MI2 bolt the washers shall be not less than 50 mm x 50 mm x 3 mm if square or not less than 55 mm diameter x 3 mm if round.

2.5.4.2
Lead holes for screws shall be drilled so that the diameter of the lead hole for the shank does not exceed the diameter of the shank and the diameter of the lead hole for the thread does not exceed the core diameter of the screw.

2.6
EARTHQUAKE ZONE AND WIND AREA

2.6.1
The earthquake zone shall be as given by table 1, or as given by fig. 3 for locations not listed in table 1.

C2.6.1
The earthquake zones shown in fig. 3 correspond to the seismic zones shown in fig. 4 of NZS 4203.*

2.6.2
The wind exposures given in 1.1.2(d) can be taken as being equivalent to the wind areas given by table 1 or as given in fig. 4 for locations not listed in the table, provided that the building is not exposed to local acceleration of the wind and the building height does not exceed; 10m in ground roughness 3 (urban areas), 5m in ground roughness 2 (open land), 3m in ground roughness 1 (facing open water).

C2.6.2
The wind areas given by table 1 and fig. 4 correspond to the basic wind speeds given by NZS 4203 as follows:*

High: Exceeding 40 m/s but not exceeding 50 m/s

Medium: Exceeding 35 m/s but not exceeding 40 m/s

Low: Not exceeding 35 m/s

Where fig. 4 does not attribute a wind area for a locality, such as mountainous areas and those marked 'special conditions', then appropriate basic wind speed data do not currently exist. For such localities, basic wind speeds, and hence design wind areas, should be determined by local authorities with the assistance of the New Zealand Meteorological Service.

Occasionally in New Zealand winds greatly in excess of the given values occur in tornadoes, of which there are probably at least 30 a year. However, these are small-scale phenomena having on the average damage paths 10 to 13 m wide and 1 to 3 km long. Because of their infrequency and small scale they are not taken into account.

* see list of related documents

Table 1

EARTHQUAKE ZONE AND WIND AREA FOR VARIOUS LOCALITIES

Locality	*Earthquake zone*	*Wind area**
North Island		
Kaitaia	C	H
Whangarei	C	H
Dargaville	C	M
Kaiwaka	C	M
Auckland	C	L
Albany	C	L
East Coast Bays	C	M
North Shore	C	L
Howick	C	M
Clevedon	C	M
Thames	B	M
Paeroa	B	L
Coromandel	B	M
Whitianga	B	H
Tairua	B	H
Hamilton	B	L
Waihi	B	M
Tauranga	B	L
Rotorua	B	L
Taupo	A	L
Gisborne	A	L
Napier	A	M
Hastings	A	M
New Plymouth	B	H
Wanganui	A	H
Marton	A	H
Palmerston North	A	M
Dannevirke	A	M
Wellington	A	H
South Island		
Nelson	A	M
Blenheim	A	L
Amberley	A	M
Christchurch	B	M
Port Hills	B	H
Banks Peninsula	B	H
Lyttelton	B	H
Timaru	B	M
Oamaru	B	M
Westport	A	M
Hokitika	A	M
Dunedin	C	M
Milton	C	M
Gore	B	M
Winton	B	M
Invercargill	B	H
Alexandra	A	L

* H = High wind area
M = Medium wind area
L = Low wind area

2.7
BUILDING PERMIT APPLICATIONS

2.7.1
Together with every application for a building permit in accordance with NZS 1900* for a building purporting to comply with this standard shall be included:

(a) A floor plan of each floor level;

(b) An elevation of each external wall;

(c) The type and location of each foundation element (for example: reinforced masonry foundation wall, anchor pile, cantilevered pile, and so on);

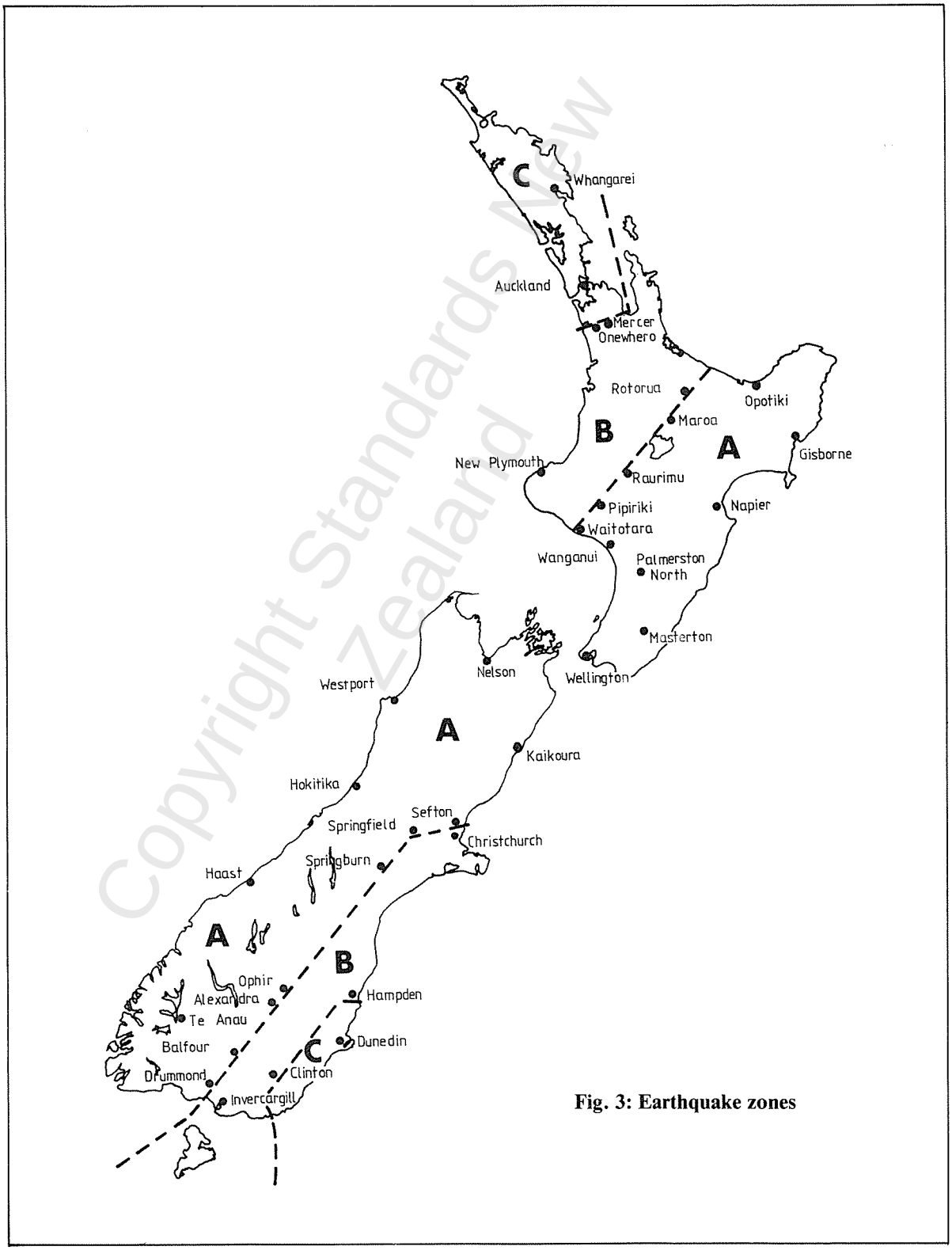


Fig. 3: Earthquake zones

(d) Adequate information on all subfloor, floor, wall, and roof framing, including the type and location of each subfloor brace, diagonal brace, and wall bracing element and the number of bracing units assigned to each wall bracing element;

(e) The type and location of cladding, sheathing, and lining.

C2.7.1

The items listed in clause 2.7.1 are to be included with building permit applications, together with any other necessary information, in order 'to show ... the exact nature and character of the proposed undertaking' as required by NZS 1900 : Chapter 2.*

* see list of related documents

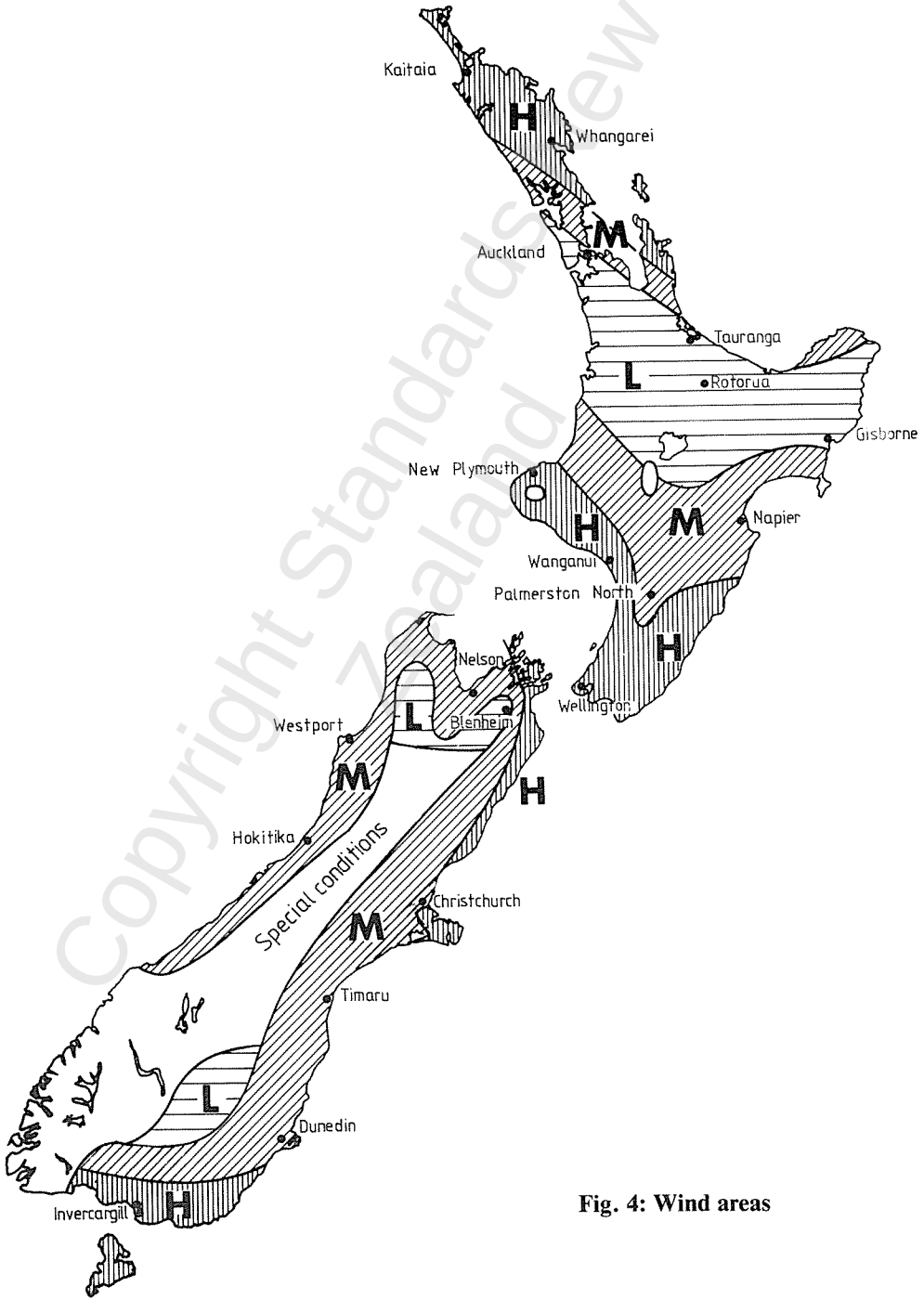


Fig. 4: Wind areas

3
SITE REQUIREMENTS

C3

The site requirements of this Standard are concerned solely with soil conditions under or adjacent to the building. Compliance with these requirements does not necessarily mean that the site is suitable for the building in terms of subdivisional and planning legislation.

3.1
SOIL BEARING CAPACITY AND SITE PROFILE REQUIREMENTS

C3.1

If a site does not comply with clause 3.1, then it will be necessary for the foundations to be the subject of specific design. However, this Standard will still apply to the rest of the building provided it complies with clause 1.1 and the foundations are designed to suit.

3.1.1

The foundation provisions of this Standard shall apply only for building sites such that:

(a) The safe bearing pressure of the soil supporting the foundations shall be not less than 100 kPa (see clause 3.1.2);

(b) The general topography of the site when compared with the surrounding area shall show no indications of slope instability;

(c) Within 1.5 m horizontal distance from any foundation the vertical distance from the underside of that foundation to any lower point on the finished ground surface, whether retained or not, shall not exceed the horizontal distance from the foundation to that point (see fig. 5);

(d) Within 1.5 m horizontal distance from any foundation the vertical distance above natural ground level of any fill, whether retained or not, shall not exceed 300 mm.

C3.1.1

Clause 3.1.1 is concerned with earth slopes only to the extent that they affect the suitability of the foundation provisions of this Standard. It does not cover the other considerations necessary to ensure slope stability in accordance with the established principles of soil mechanics and land stability. Particular points to note about clause 3.1.1 include:

(c) Clause 3.1.1 (c) is intended to ensure that footing loadings do not cause adjacent slopes to become unstable. Other causes of potential slope instability must also be taken into account.

(d) Moderate depths of earth fill over a large area adjacent to building foundations can cause the soil to consolidate at greater depths than are influenced by the foundations specified in this Standard. Such consolidation can cause differential settlement of the building foundations and thus damage the building. Typically, earth fills are placed adjacent to foundations for the construction of stairs, terraces, landscaping, and the like.

3.1.2

The safe bearing pressure of the soil supporting the foundations shall be established by an approved subsoil investigation or alternatively it may be assumed to be not less than 100 kPa if at the time when excavation for the foundations has been completed:

(a) Adjacent established buildings of a similar type supported on foundations similar to those required by this Standard show no signs of unsatisfactory behaviour attributable to soil conditions;

(b) Reasonable enquiry shows no evidence of buried services and none are revealed by excavation for foundations;

(c) Reasonable enquiry shows no indications or records of land slips having occurred in the immediate locality;

(d) Reasonable enquiry shows no evidence of earth fill on the building site and no fill material is revealed by excavation for foundations; Provided that this shall not apply where a certificate of suitability of earth fill for residential development has been issued in terms of NZS 4431* in respect of the building site and any special limitations noted on that certificate are complied with;

(e) Excavation for foundations does not reveal buried organic topsoil, soft peat, or soft clay (see clause 3.2.1);

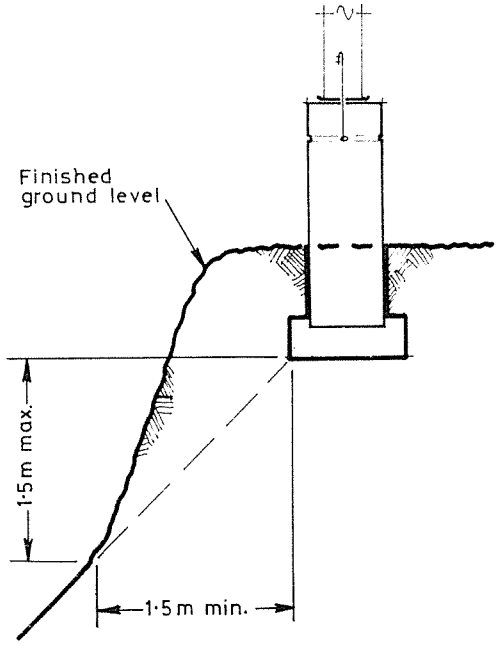


Fig. 5 : Relationship of foundation to sloping ground surface

* see list of related documents

Provided that if any of the above requirements (a) to (e) inclusive are not complied with then tests in accordance with Appendix C may be made in order to establish that the soil supporting the foundations may be assumed to have a safe bearing pressure of not less than 100 kPa.

C3.1.2
Tests in accordance with Appendix C offer a comparatively simple method for establishing whether or not a safe bearing pressure of 100 kPa may be assumed even though the site does not comply with one or more of the requirements of clause 3.1.2.

3.2 SOIL TYPES

3.2.1 Soft peat and soft clay

3.2.1.1
For the purposes of clause 3.1.2 (e) peat or clay soil shall be regarded as soft if a natural chunk of the soil (not remoulded material or loose shavings) can be easily moulded in the fingers. (Soil that exudes between the fingers when squeezed in a fist shall be regarded as very soft.) See also Appendix C.

3.2.2 Expansive clay

3.2.2.1
For the purposes of clause 3.3.2 (b) expansive clay shall be assumed to be present in the soil supporting the foundations unless:

(a) Reasonable enquiry does not reveal any incidence of major cracks in dry weather on the building site itself or in the surrounding locality;

(b) The locality has not been identified as an area where expansive clay is likely to be found;

(c) Excavation for foundations does not reveal plastic clay (see clause 3.2.3).

3.2.3 Plastic clay

3.2.3.1
For the purposes of clause 3.2.2.1 (c) clay shall be regarded as plastic if a dampened sample (which need not be a natural chunk) is squeezed in a fist and upon release adheres to the hand.

3.3 BEARING

3.3.1
All foundations shall bear upon solid bottom in undisturbed material or upon firm fill where a certificate of suitability has been issued in terms of NZS 4431* (see clause 3.1.2 (d)).

3.3.2
The minimum depths of foundations below the cleared ground level shall be:

(a) 150 mm in firm rock;

(b) 450 mm in expansive clay (see clause 3.2.2);

(c) 300 mm in other materials, subject to any special limitations noted on a certificate of suitability issued in terms of NZS 4431* in respect of the building site (see clause 3.1.2 (d)).

3.4 SITE PREPARATION

3.4.1
Before a building is erected on any site all rubbish, noxious matter, and organic matter shall be removed from the area to be covered by the building.

In suspended floor construction, firm turf and close-cut grass may remain provided that for the purposes of complying with clause 3.3.2, cleared ground level shall be taken as the underside of organic matter.

3.4.2
Any subsoil drains severed during the excavation process shall be reinstated or diverted and the building area shall be permanently drained to ensure freedom from surface water in the subfloor space.

C3.4.2
Foundations should be backfilled with non-plastic material free from organic material and compacted up to cleared ground level.

* see list of related documents

4
FOUNDATIONS AND SUBFLOOR FRAMING

4.1
GENERAL

4.1.1
The foundation and subfloor framing system (except as provided for slab-on-ground floors by Appendix E) shall consist of:

(a) A system to resist vertical loads and complying with clause 4.2; combined with

(b) A system to resist horizontal loads and complying with clause 4.3.

C4.1.1
Some of the systems to resist vertical loads that are specified in clause 4.2 are also capable of resisting horizontal loads, and this is allowed for in clause 4.3.

4.1.2
To prevent dampness, not less than 3500 mm² of ventilation openings per 1 m² of floor area shall be uniformly distributed around the entire perimeter of the external walls. Such openings shall be as near as possible to, but except as provided by (c) below shall be below the level of, the plates or bearers directly supporting the ground floor joists. Acceptable methods include:

(a) Ventilators having sufficient area of openings and spaced at regular intervals not exceeding 1.8 m provided that there shall be a ventilator not more than 750 mm from any corner;

(b) Continuous slots not less than 20 mm wide between baseboards;

(c) A sufficient gap between the wall plate and the boundary joist at the ends of floor joists that are cantilevered beyond the face of the wall plate;

(d) Openings disposed in other configurations so as to provide sufficient ventilation.

4.1.3
Where the subfloor air flow is obstructed by party walls, internal foundation walls, attached terraces, or the like, and anywhere more than 7.5 m away from a ventilation opening, the soil beneath the total area of the ground floor shall be covered by a vapour barrier held down against movement.

C4.1.3
Clause 4.1.3 is satisfied by a suitable polyethylene (polythene) membrane held in place by bricks or large stones.

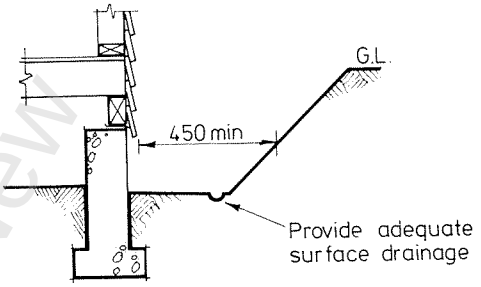


Fig. 6 : Clearance between cladding and adjacent ground

4.1.4
Access shall be provided to permit visual inspection of all subfloor framing members. A crawl space for this purpose shall be not less than 450 mm high.

C4.1.4
Clause 4.1.4 requires access height not less than 450 mm but does not require all timbers to be 450 mm or more above ground.

4.1.5
A clear horizontal separation of not less than 450 mm shall be maintained between the outside of any wall cladding and the adjacent ground (see fig. 6).

4.2
SYSTEMS TO RESIST VERTICAL LOADS

4.2.1
Single-storey buildings

4.2.1.1
The foundation and subfloor framing system to resist vertical loads in a single-storey building shall be such that the ground floor joists are directly supported by any of the following or any combination of them (see fig. 7):

(a) A wall plate continuously supported by a foundation wall;

(b) A bearer directly supported by a foundation wall (see clause 4.7) or by ordinary piles, cantilevered piles, anchor piles or braced piles;

(c) The top plate of a timber stud subfloor wall having its bottom plate directly supported by a foundation wall, excluding a single-wythe clay masonry foundation wall;

(d) The top plate of a timber stud subfloor wall having instead of a bottom plate a bearer directly supported by ordinary piles, cantilevered piles, or anchor piles;

(e) A bearer directly supported by the top plate of a timber stud subfloor wall having its bottom plate directly supported by a foundation wall, excluding a single-wythe clay masonry foundation wall, provided that the bearer shall land directly over a double stud as specified in clause 4.8.4.1 (c);

(f) A bearer directly supported by the top plate of a timber stud subfloor wall having instead of a bottom plate a bearer directly supported by ordinary piles, cantilevered piles, or anchor piles, provided that the bearer supporting the ground floor joists shall land directly over a double stud as specified in clause 4.8.4.1 (c) and directly over a pile;

(g) A bearer directly supported by jack studs at spacings equivalent to pile spacings directly supported by a wall plate on a foundation wall, excluding a single-wythe clay masonry foundation wall;

(h) A bearer directly supported by jack studs over pile centres directly supported by a bearer directly supported by ordinary piles, anchor piles, or cantilevered piles;

(j) A bearer directly supported by jack studs directly supported by ordinary piles or anchor piles;

(k) A stringer fixed to a foundation wall.

4.2.2 Two-storey buildings

4.2.2.1

The foundation and subfloor framing system to resist vertical loads in a two-storey building shall be such that the ground floor joists are directly supported by:

(a) Bearers and wall plates on continuous foundation walls, excluding single-wythe clay masonry

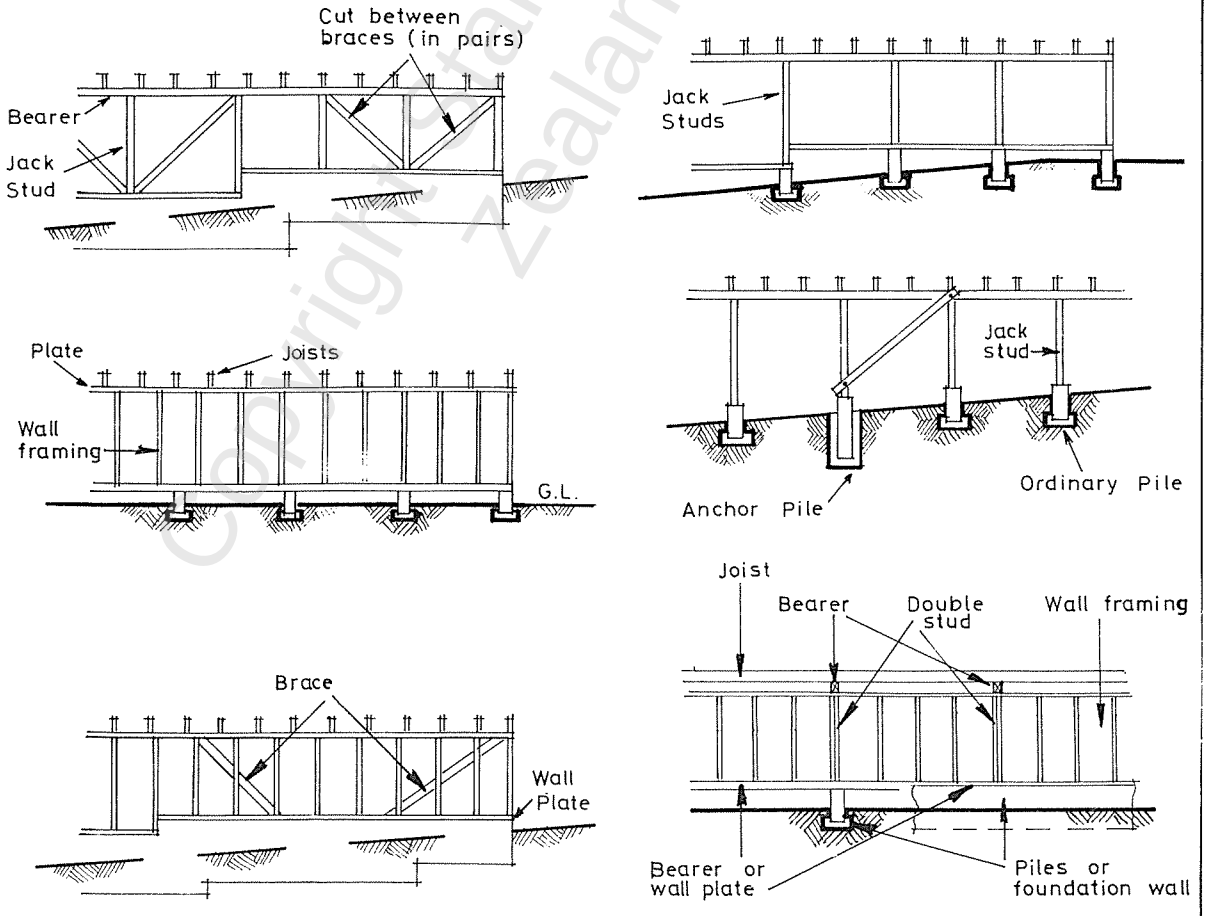


Fig. 7 : Some typical foundation and subfloor framing systems

foundation walls, around not less than 40 percent of the perimeter of the external walls;

With the remaining support coming from any of the following or any combination of them:

(b) The top plate of a timber stud subfloor wall having its bottom plate directly supported by a foundation wall, excluding a single-wythe clay masonry foundation wall;

(c) A bearer directly supported by the top plate of a timber stud subfloor wall having its bottom plate directly supported by a foundation wall, excluding a single-wythe clay masonry foundation wall, provided that the bearer shall land directly over a double stud as specified in clause 4.8.4.1 (c);

(d) A bearer directly supported by jack studs at pile spacings directly supported by a wall plate on a foundation wall, excluding a single-wythe clay masonry foundation wall;

(e) Any other systems specified for one-storey buildings in clause 4.2.1 provided that these shall not be used beneath external walls.

C4.2.2.1

The supports specified in clauses 4.2.2.1 (b), (c), and (d) are the same as those specified in clauses 4.2.1.1 (c), (e), and (g) respectively.

4.2.3
Three-storey buildings

4.2.3.1

The foundation and subfloor framing system to resist vertical loads in a three-storey building shall be such that the ground floor joists are directly supported by bearers or wall plates on continuous foundation walls, excluding single-wythe clay masonry foundation walls, extending around the entire perimeter of the external walls, which may be combined with any other systems specified for one-storey buildings in clause 4.2.1, provided that these shall not be used beneath external walls.

4.3
SYSTEMS TO RESIST HORIZONTAL LOADS

4.3.1

The foundation and subfloor framing system to resist horizontal loads shall consist of either:

(a) A continuous foundation wall, excluding a single-wythe clay masonry foundation wall, carried up to the wall plates or bearers directly supporting the ground floor joists and extending around the entire perimeter of the external walls, provided that the entire ground floor shall consist of one or more structural floor diaphragms complying with clause 5.3; or

(b) Lines of horizontal support complying with clauses 4.3.2 and 4.3.3, provided that this system shall not be used for three-storey buildings.

C4.3.1

When the system specified by clause 4.3.1 (a) is used, then it may be necessary to provide additional foundation walls across the building in order to comply with the length to width ratio requirements of clause 5.3.1(a).

4.3.2

Where required by clause 4.3.1 (b) there shall be lines of horizontal support under each external wall and at not more than 5 m spacing between external walls (see fig. 8).

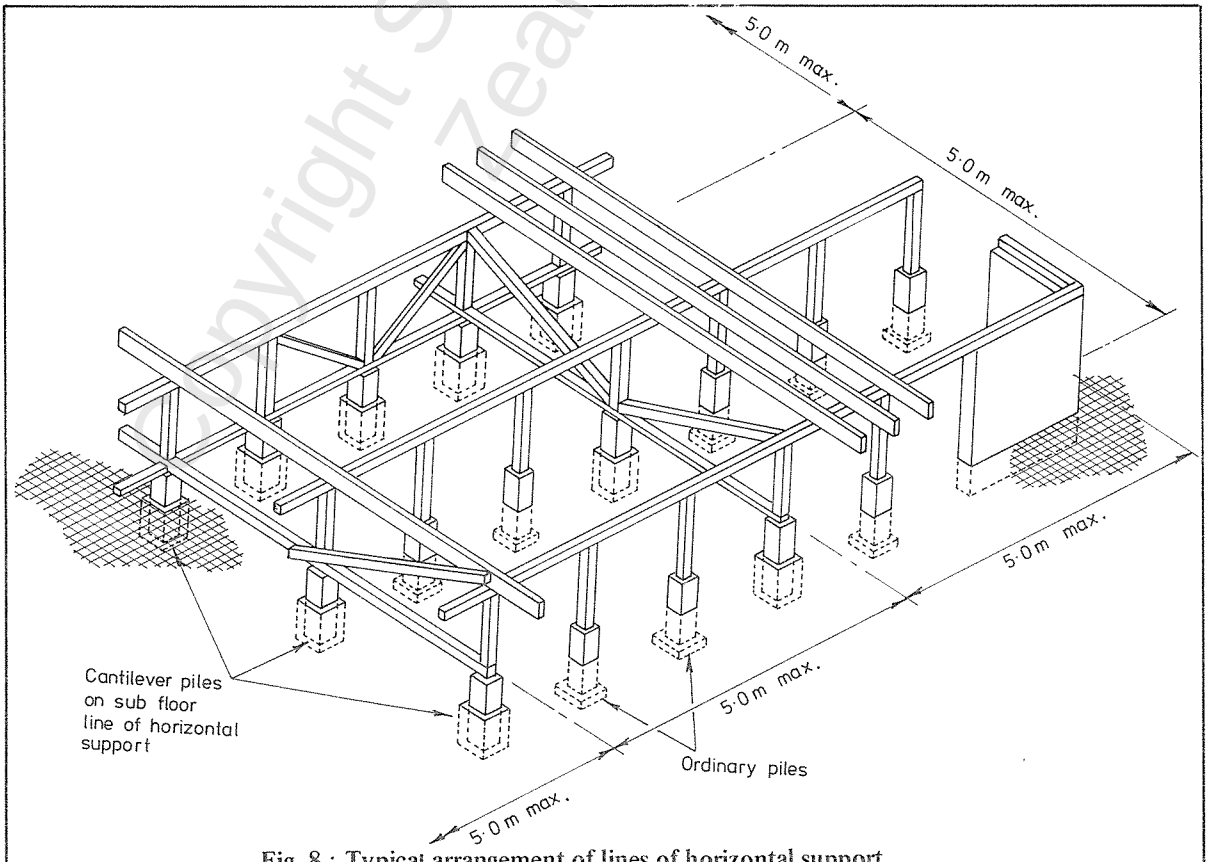


Fig. 8 : Typical arrangement of lines of horizontal support

4.3.3
Each line of horizontal support shall either:

(a) Consist of a complete row of cantilevered piles (see fig. 13) directly supporting a bearer that directly supports the floor joists and in the line of the bearer, or a complete line of such piles at right angles to the bearers, provided that this method shall not be used for a line of horizontal support under an external wall; or

(b) Subject to clauses 4.3.4 and 4.3.5, contain the number of subfloor braces required by table 2A for earthquakes, or table 2B for wind, whichever is the greater, provided however that for Class I and II buildings, Appendix J, tables 45 or 48 as appropriate shall be used instead of table 2A.

4.3.4
There shall be a subfloor brace in each direction at every external corner where both intersecting external walls exceed 4 m long. Such subfloor braces may be included in the number required by clause 4.3.3.

4.3.5
In no case shall any building have a total of less than four subfloor braces in each direction placed symmetrically at the extremities of the building.

4.3.6
Subject to clauses 4.3.4 and 4.3.5 the required number of subfloor braces shall be distributed evenly along each line of horizontal support.

4.3.7
A subfloor brace shall consist of one of the following:

(a) A diagonal timber subfloor brace complying with clause 4.9, provided that two such braces shall be required where they are cut between jack studs in compliance with clause 4.9.2.3;

(b) A subfloor sheet brace complying with clause 4.3.8;

(c) A pair of masonry piles at not more than 1.5 m and not less than 1 m centres connected by a reinforced masonry top beam not more than 1 m above a reinforced concrete footing supporting a masonry infill panel as shown in fig. 9;

(d) A 1.5 m length of continuous foundation wall that is carried up to the wall plate supporting the floor joists and that contains no openings exceeding 600 mm wide, provided that the aggregate of all lengths of foundation wall individually exceeding 1.5 m may be taken in order to determine the total number of subfloor braces in a line of horizontal support.

(e) An anchor pile to which is fixed directly, a bearer or floor joist or both.

C4.3.7
Clause 4.3.7 (a) requires two cut-between braces because the connections of such braces as specified in clause 4.9.2.3 have only half the capacity of the connections specified in clauses 4.9.2.1 and 4.9.2.2 for all other diagonal timber subfloor braces.

Table 2 SUBFLOOR BRACES
1.5 kPa and 2.0 kPa floor loads

A For earthquake:

Number of storeys	*Length of line of horizontal support or part thereof (m)*	*Slope of roof**	*Minimum number of subfloor braces per line or part thereof in earthquake zone*		
			A	*B*	*C*
Light roof					
1	10.0	0°-60°	2	2	2
	15.0	0°-60°	3	3	2
2	7.5	0°-60°	3	2	2
	10.0	0°-60°	4	3	3
	15.0	0°-60°	5	4	4
Heavy roof					
1	7.5	0°-25°	2	2	2
		26°-45°	3	2	2
		46°-60°	3	2	2
	10.0	0°-25°	3	3	2
		26°-45°	3	3	2
		46°-60°	4	3	3
	15.0	0°-25°	4	4	3
		26°-45°	5	4	3
		46°-60°	5	5	4
2	7.5	0°-25°	3	3	2
		26°-45°	4	3	3
		46°-60°	4	3	3
	10.0	0°-25°	4	4	3
		26°-45°	5	4	3
		46°-60°	5	4	4
	15.0	0°-25°	6	5	4
		26°-45°	7	6	5
		46°-60°	8	6	5

* Where a roof has planes of different slopes, the average shall be taken.

B For wind

Eaves height (m)$\phi\phi$	*Slope of roof* ϕ*	*Height of roof* (m)**	*Minimum number of subfloor braces per line in wind exposure:*		
			Low	Medium	High
5	0°-25°	3	2	2	3
5	26°-60°	2	2	2	4
		4	2	3	5
		6	3	4	6
		8	4	5	7
10	0°-10°	1	2	3	4
	11°-25°	3	3	3	5
	26°-60°	2	3	4	6
		4	4	5	7
		6	4	6	9
		8	5	6	10

$\phi\phi$ The eaves height is the average height of the eaves, or verge in the case of gable ends, above finished ground level for the 5m wide section of building being braced on the highest side of the building which is at right angles to the direction being braced.

** The height of roof is the average vertical height of the top edge of the roof (ridge, hip or verge) above the level of the eaves for the particular 5 m wide section of roof elevation at right angles to the direction being braced.

ϕ* The slope of roof is to be taken as the greatest of the slopes parallel to the direction being braced. For roofs with gable ends the roof slope shall be taken as being 26°-60° for bracing at right angles to the gable.

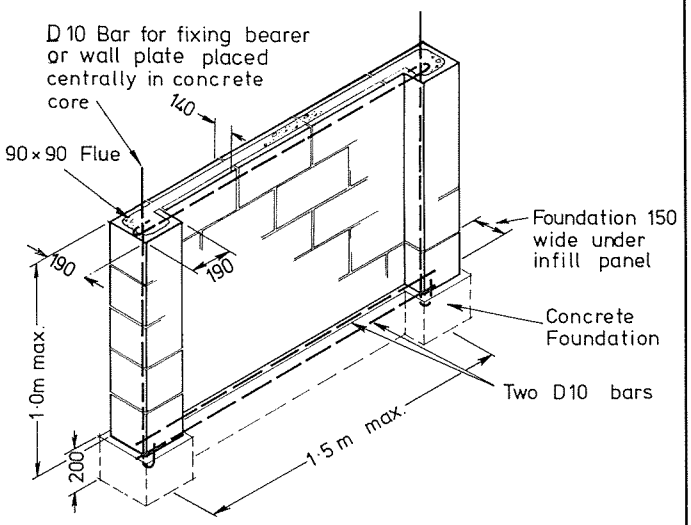


Fig. 9 : Masonry infill panel between a pair of masonry piles

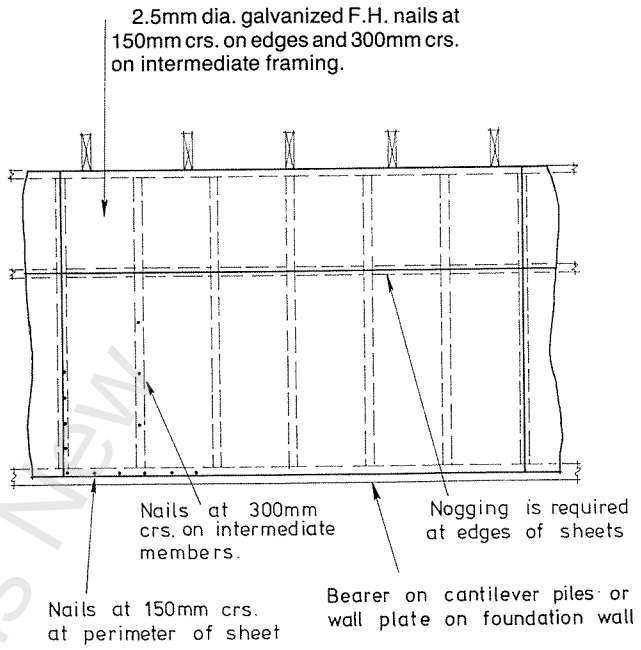


Fig. 10 : Subfloor sheet brace

4.3.8
A subfloor sheet brace shall consist of a 2.4 m length of subfloor framing covered with a sheet material which extends the full height from a bearer or plate directly supporting the floor joists down to a wall plate directly supported by a foundation wall or a bearer directly supported by either ordinary piles and anchor piles or a complete row of cantilevered piles, as shown in fig. 10 provided that:

(a) The sheet material shall be an exterior grade of either:

(i) Plywood not less than 6 mm thick three-ply; or

(ii) Any other wood-based product not less than 6 mm thick with a density not less than 880 kg/m³; or

(iii) Any other wood-based product not less than 7.5 mm thick with a density not less than 600 kg/m³;

(b) All edges of the sheet material shall be fixed to framing members;

(c) Fastenings shall be not less than 10 mm from sheet edges;

(d) The aggregate of all lengths individually exceeding 2.4 m may be taken in order to determine the total number of subfloor sheet braces in a line of horizontal support;

(e) Any individual length of subfloor framing covered with sheet material that is less than 2.4 m long shall not be considered for the purposes of this clause;

(f) Any individual piece of sheet material shall be not less than 900 mm wide.

4.4 HORIZONTAL SUPPORT FOR FOUNDATION WALLS

4.4.1
Foundation walls shall be supported against horizontal loads by one of the following:

(a) A floor diaphragm complying with clause 5.3 (see also clause 4.4.2);

(b) Lateral support walls complying with clause 4.4.3 at each end of the wall being supported and at not more than 5 m centres between, provided that a step not less than 600 mm high in the footing of a wall may be considered to be the equivalent of a lateral support wall where the length of wall on the lower side of the step is not less than I.2 m;

(c) A wide footing as shown in fig. 16 (cantilevered foundation walls);

(d) Floor joists directly supported by a wall plate or bearer on top of a foundation wall not exceeding 750 mm in height from the underside of its footing.

Except that such support need not be provided to lateral support walls that do not exceed 2 m long.

4.4.2
A foundation wall that is supported against horizontal loads by a floor diaphragm in compliance with clause 4.4.1 (a) shall:

(a) Be carried up to the underside of the plate or bearer supporting the floor joists;

(b) Be continuous around the perimeters of the external walls and the diaphragm.

4.4.3
Lateral support walls (see clause 4.4.1 (b)) shall comply with the requirements of clause 4.6 for foundation walls provided that they shall be not less than 1.2 m long and shall have a footing of the same size as that of the wall being supported, and provided also that a single-wythe clay masonry wall shall not be used as a lateral support wall for any foundation wall other than another single-wythe clay masonry foundation wall.

4.5
PILES

C4.5
Figure 11 shows typical ordinary piles. Cantilevered piles, braced piles, and anchor piles are subject to special requirements as to size of footings, height of pile, and so on as specified in clause 4.5.

4.5.1
General

C4.5.1
See Appendix D for short driven timber piles.

4.5.1.1
Piles shall be laid out in straight rows in line with and directly beneath bearers.

4.5.1.2
Pile tops shall be at levels to suit the subfloor framing, provided that the height above cleared ground level shall comply with the requirements of clause 4.5.2.

4.5.2
Height of piles

4.5.2.1
The height of a concrete or masonry pile shall be:

(a) Above finished ground level: not less than 150 mm;

(b) Above cleared ground level: not more than:

(i) 600 mm for cantilevered piles;

(ii) 520 mm for anchor piles including fixings for braces;

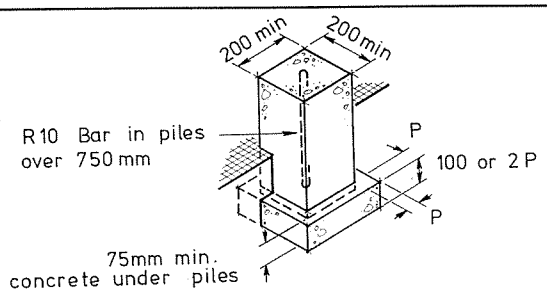
(iii) 600 mm for ordinary piles directly supporting jack studs;

(iv) 1.5 m for all other concrete or masonry piles.

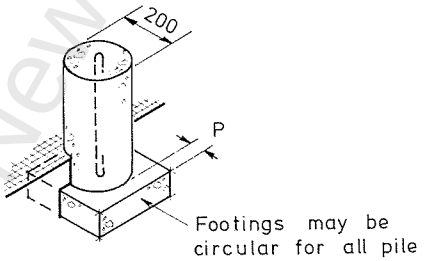
4.5.2.2
The height of a timber pile above cleared ground level shall be as required by clause 4.5.2.1 for a concrete or masonry pile except that:

(a) No timber pile shall be cut off closer than 300 mm to finished ground level, provided that this distance may be reduced to 150 mm where a bituminous damp proof course or other suitable impervious material is placed between the pile and framing timbers and overlaps these timbers by at least 6 mm.

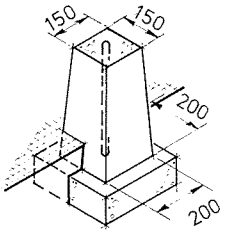
(b) Timber ordinary piles and timber braced piles may be up to 3 m in height above cleared ground level when they directly support bearers.



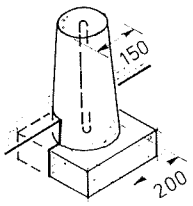
SQUARE PILES



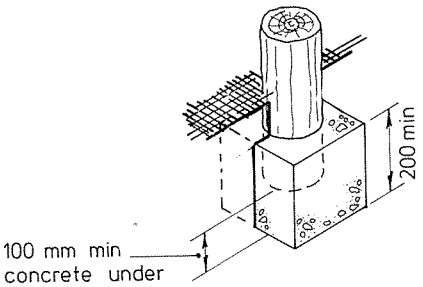
CIRCULAR PILES



SQUARE TAPERED PILES



ROUND TAPERED PILES



TIMBER PILES

Fig. 11 : Some typical ordinary piles

Table 3 PILE FOOTINGS
1.5 kPa and 2.0 kPa floor loads

A Square footings

Maximum spans of:		*Minimum plan dimensions of square footing for pile supporting:*			
Bearers	*Joists*	*Floor and non load-bearing walls only*	*Floor(s), load-bearing walls and roof of:*		
			One storey	*Two storeys*	*Three storeys*
(m)	(m)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)
1.3	2.0	200 x 200*	275 x 275*	325 x 325*	350 x 350
	3.5	225 x 225*	350 x 350	425 x 425	475 x 475
	5.0	275 x 275*	400 x 400	500 x 500	550 x 550
	6.0	300 x 300*	450 x 450	550 x 550	600 x 600
1.65	2.0	200 x 200*	300 x 300*	375 x 375	400 x 400
	3.5	250 x 250*	400 x 400	475 x 475	525 x 525
	5.0	300 x 300*	450 x 450	575 x 575	600 x 600
2.0	2.0	200 x 200*	325 x 325*	400 x 400	450 x 450
	3.5	275 x 275*	425 x 425	525 x 525	575 x 575

* 350 mm x 350 mm for anchor piles.

B Circular footings

Side of square footing	*Minimum diameter of circular footing*
(mm)	(mm)
200	230
225	260
250	290
275	310
300	340
325	370
350	400
375	430
400	460
425	480
450	510
475	540
500	570
525	600
550	620
575	650
600	680

4.5.3
Cross-section of piles

4.5.3.1
The cross-section of a concrete pile shall have a least dimension of not less than:

(a) 200 mm for parallel-sided piles;

(b) 150 mm top and 200 mm bottom for tapered piles.

4.5.3.2
The cross-section of a masonry pile shall have a least dimension of not less than 190 mm.

4.5.3.3
The diameter of a timber pile shall be not less than 140 mm.

4.5.4

Pile footings

4.5.4.1
Each pile shall be provided with a concrete footing cast in situ against undisturbed ground at a depth below cleared ground level not less than that required by clause 3.3.2.

4.5.4.2
Each pile shall either be cast integrally with its footing or shall be embedded into its footing to the depth required by clause 4.5.4.5 at the time the footing is cast.

4.5.4.3
Square footings shall have the minimum plan dimensions given by table 3A, and circular footings shall have the corresponding minimum diameter given by table 3B, provided that no footing to an anchor pile shall be less than 350 mm x 350 mm if square or of 350 mm diameter if circular.

4.5.4.4
The thickness of a pile footing shall be the greater of:

(a) All piles: Twice the distance that the footing projects beyond the face of the pile;

(b) Ordinary piles:

(i) Precast concrete: 100 mm;

(ii) Timber: 200 mm;

(c) Cantilevered piles: 450 mm measured below cleared ground level;

(d) Braced piles:

(i) Where the lower end of a diagonal brace is attached to the pile 300 mm or less above cleared ground level: 450 mm measured below cleared ground level;

(ii) Other braced piles: as for ordinary piles;

(e) Anchor piles: 900 mm measured below cleared ground level.

4.5.4.5
Each pile not cast integrally with its footing shall be embedded in its footing to a depth of not less than:

(a) Concrete and masonry piles:

(i) Ordinary piles: Sufficient to provide stability during construction;

(ii) Braced piles where the upper end of the diagonal brace is attached to the pile 150 mm or less below the top of the pile: Sufficient to provide stability during construction;

(iii) All other concrete and masonry piles: 300 mm;

Provided that the thickness of footing beneath the bottom of the embedded pile shall be not less than 75 mm;

(b) Timber piles:

(i) Ordinary piles: 100 mm;

(ii) Braced piles where the upper end of the diagonal brace is attached to the pile 150 mm or less below the top of the pile: 100 mm;

(iii) All other timber piles: 300 mm;

Provided that the thickness of footing beneath the bottom of the embedded pile shall be not less than 100 mm.

4.5.4.6
The total thickness of the footing of a pile cast integrally with its footing shall be the same as if the pile had been embedded into the footing.

4.5.5
Pile materials

4.5.5.1
Piles shall be of concrete (see clause 4.5.5.2) or of masonry (see clause 4.5.5.3), or of treated round timber (see clause 4.5.5.4).

4.5.5.2
Concrete for piles and footings shall be ordinary grade concrete of 17.5 MPa minimum strength complying with NZS 3109* provided that:

(a) Fine and coarse aggregates need not be supplied and batched separately;

(b) Precast concrete, masonry and timber piles embedded into cast in situ footings may be loaded before the footing concrete has attained its initial set in the following case only: When a building complying with this standard that has been transported to the site after being clad and lined elsewhere is lowered evenly on to all piles simultaneously;

(c) For lightweight concrete piles the minimum specified compressive strength may be reduced to not less than 10 MPa when such lightweight piles are used only as ordinary piles that either:

(i) Support jack studs only; or

(ii) Support bearers where there are continuous foundation walls, excluding single-wythe clay masonry foundation walls, extending around the entire perimeter of the external walls and carried up to the underside of the plate supporting the floor joists and the floor is a structural floor diaphragm complying with clause 5.3.

4.5.5.3
The materials and workmanship of masonry piles shall comply with NZS 4210P*.

4.5.5.4
Timber piles shall be of natural round timber complying with NZS 3605* and treated to TPA C2B*; provided that where a timber pile has been cut after treatment the cut surface shall be brush-treated in accordance with TPA requirements (see also clause 4.5.2.2 (a)). The surface shall not be cut for fixings and other purposes closer than 150 mm to finished ground level.

4.5.6
Reinforcement of concrete and masonry piles

4.5.6.1
Concrete piles and masonry piles shall be reinforced as follows:

(a) Ordinary piles: One R10 bar with hooked ends placed centrally throughout the length of all concrete piles exceeding 750 mm long and of all masonry piles exceeding 500 mm long;

(b) Cantilevered piles and braced piles: One R10 bar with hooked ends placed centrally throughout the length provided that the top end of the bar need not be hooked when it protrudes from the top of the pile to secure the bearer in compliance with clause 4.5.7.1 (b) and (c);

(c) Anchor piles: By the embedded steel angle or reinforcing steel as shown in fig. 14.

4.5.7
Fixing of timber framing other than diagonal braces to piles

4.5.7.1
Provision shall be made where necessary for the fixing of timber framing other than diagonal braces (see clause 4.9.2) to piles as follows:

(a) Ordinary piles: The fixing of a bearer or a jack stud to an ordinary pile shall be made using either 4

* see list of related documents

mm galvanized steel wire or two 4.9 mm galvanized wire dogs or equivalent (see fig. 12).

(b) Cantilevered piles: The fixing of a bearer to a cantilevered pile shall be as shown in fig. 13 or an alternative fixing of 6 kN shear capacity;

(c) Braced piles: The fixing of a bearer to a braced pile shall be:

(i) For concrete or masonry braced piles: A 10 mm dowel as permitted by clause 4.5.6.1.(b) and as shown in fig 26; or

(ii) For timber braced piles: An M10 bolt or an alternative fixing of 12kN shear capacity.

(d) Anchor piles: The fixing of a jack stud to an anchor pile shall be as given by clause 4.5.7.1(a) for ordinary piles, or as shown in fig. 14, provided that any alternative connector complying with clause 4.9.2.2 shall provide end bearing for the jack stud. The fixing of a bearer or floor joist shall

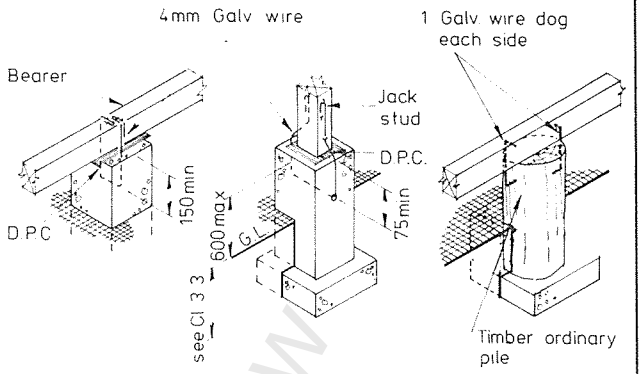
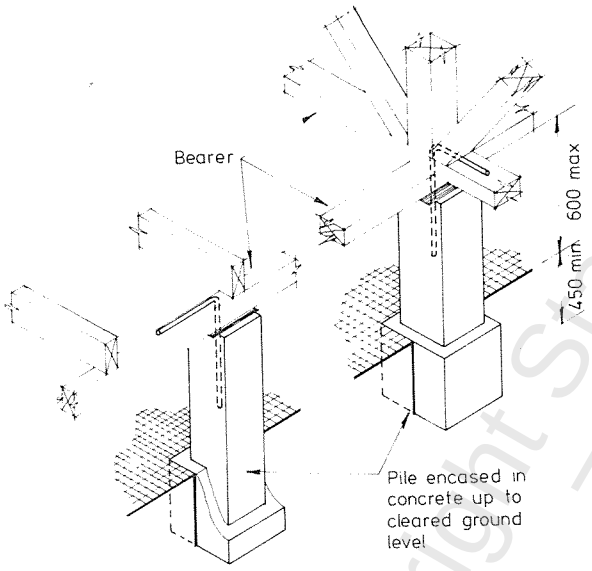
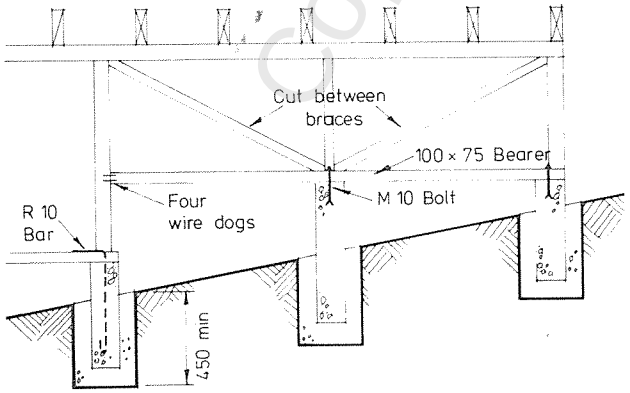


Fig. 12 : Fixing of bearers and jack studs to ordinary piles



A : General arrangement.



B : Cantilevered piles at different heights.

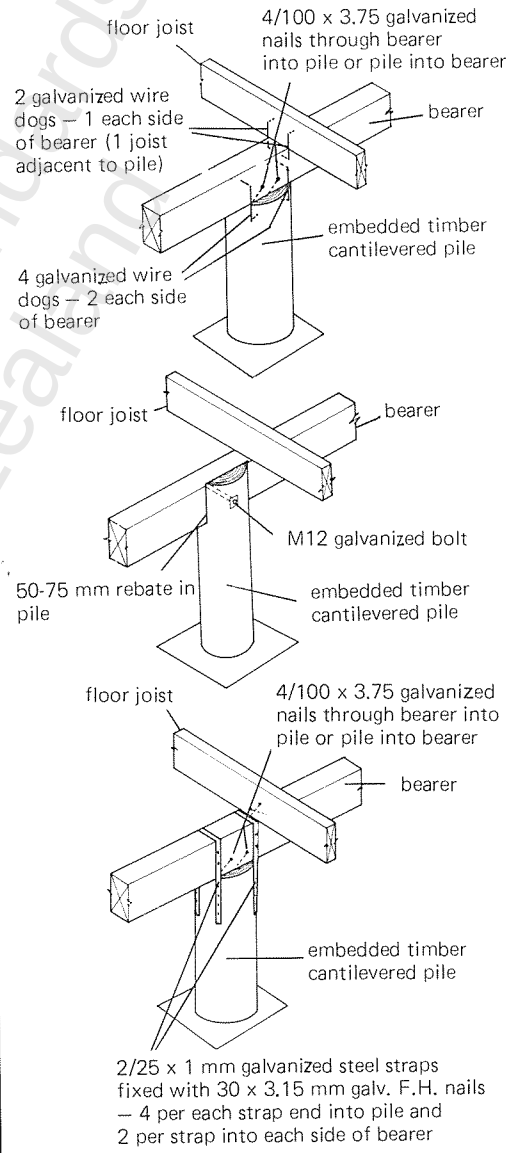


Fig. 13: Fixing of bearers to cantilevered piles

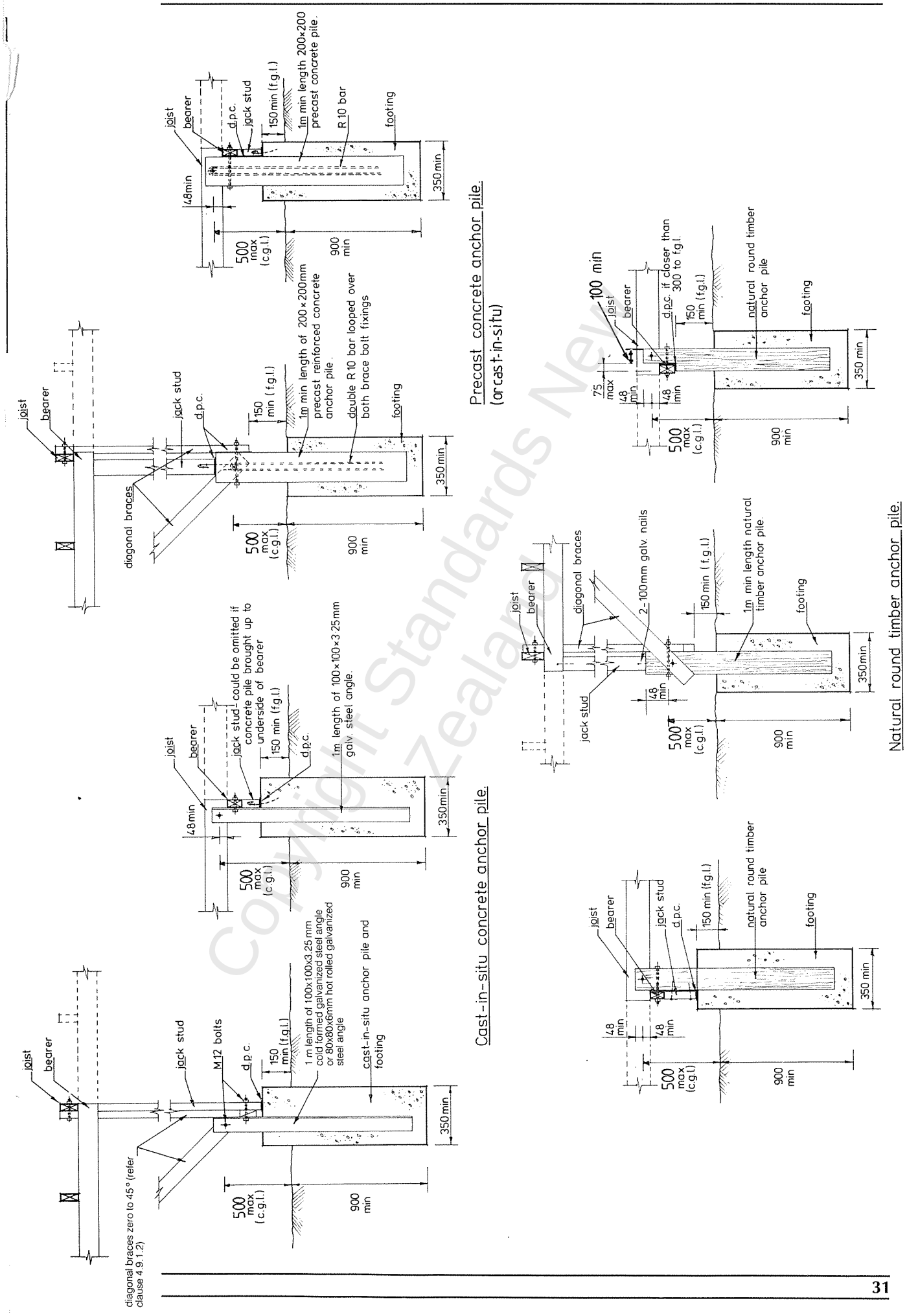


Fig. 14 : Typical anchor pile details

be an M12 bolt or an alternative fixing providing 12 kN capacity in tension or compression along the line of the bearer or joist.

4.6 FOUNDATION WALLS

4.6.1 General

4.6.1.1
The foundation wall provisions of this Standard shall apply only to foundation walls that are not retaining walls.

C4.6.1.1
It will be necessary for any foundation wall that is a retaining wall to be the subject of specific design. However, this standard will still apply to the rest of the building provided it complies with clause 1.1.

4.6.1.2
Foundation walls shall be of reinforced concrete or of reinforced masonry, except as provided by clause 4.6.1.5.

4.6.1.3
Subject to clause 4.6.1.5, openings not exceeding 2.4 m wide may occur in foundation walls, provided that:

(a) No opening shall occur beneath the end support of a bearer;

(b) The footing shall be continuous beneath all openings;

(c) Any opening exceeding 600 mm wide shall be not less than 600 mm clear of any wall end or corner;

(d) Lintels to support joists above openings shall be of timber as given by table 16, provided that no such lintel shall be required for openings not exceeding 900 mm wide and not less than 150 mm clear of the top of the foundation wall;

(e) Reinforcing around openings shall comply with clause 4.6.6.3.

4.6.1.4
The surface finish of a foundation wall that provides bearing for timber shall be true and even.

4.6.1.5
Continuous single-wythe clay masonry foundation walls as shown in fig. 15 may be used where permitted by clauses 4.2 and 4.3 provided that:

(a) For system A of fig. 15:

(i) The height above the bottom of its footing shall not exceed 1.3 m;

(ii) Only a single opening 600 mm x 600 mm to provide access, and openings 400 mm x 200 mm maximum to provide ventilation are permitted;

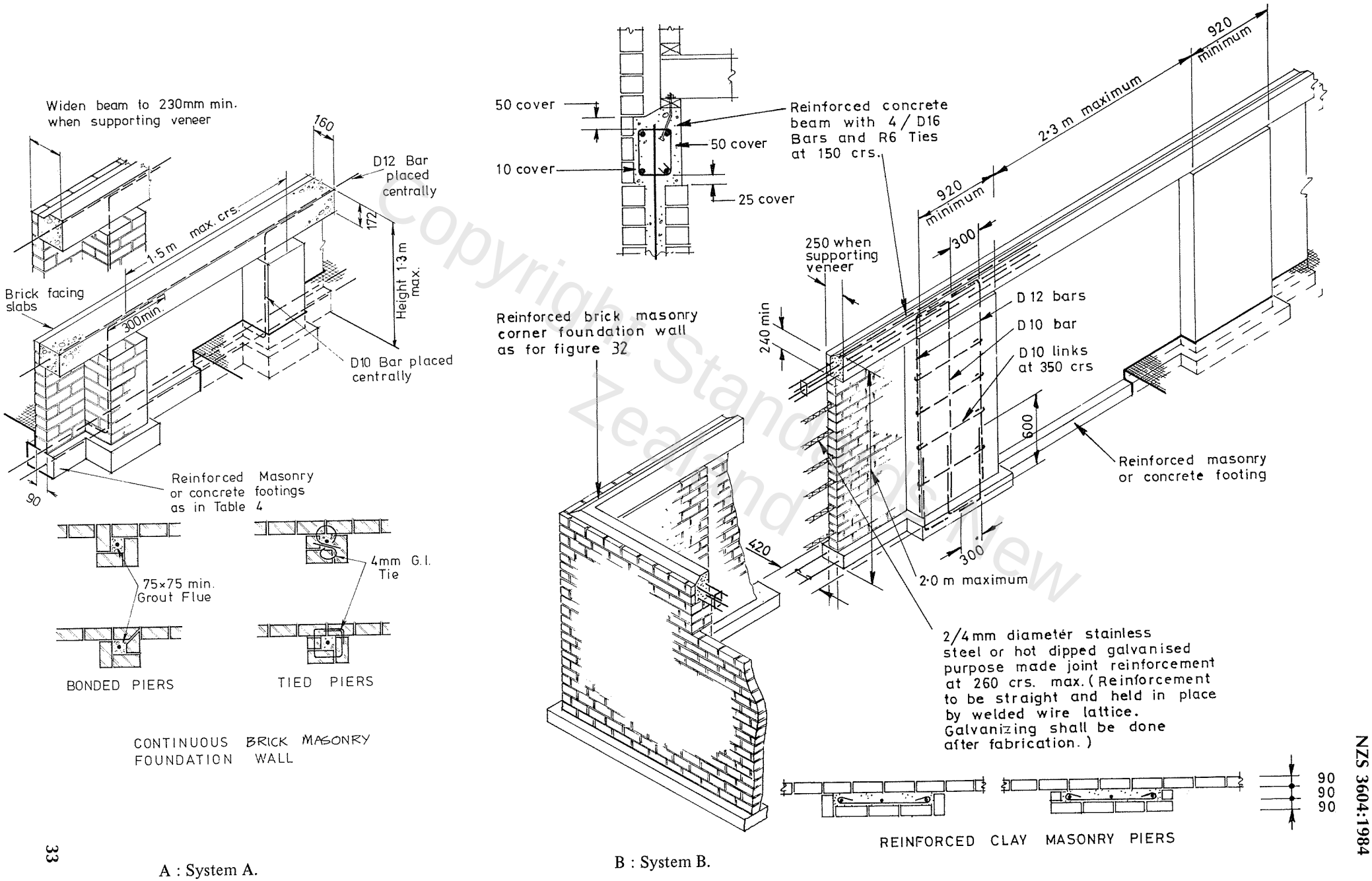
(iii) When the footing is stepped in accordance with clause 4.6.4.1 then a length of reinforced clay masonry foundation wall as shown in fig. 32 and extending not less than 1.5 m in each direction shall be provided at each corner;

(b) For system B of fig. 15:

(i) The height above the bottom of its footing shall not exceed 2 m;

(ii) Any opening exceeding 600 mm x 600 mm shall be framed by reinforced clay masonry piers;

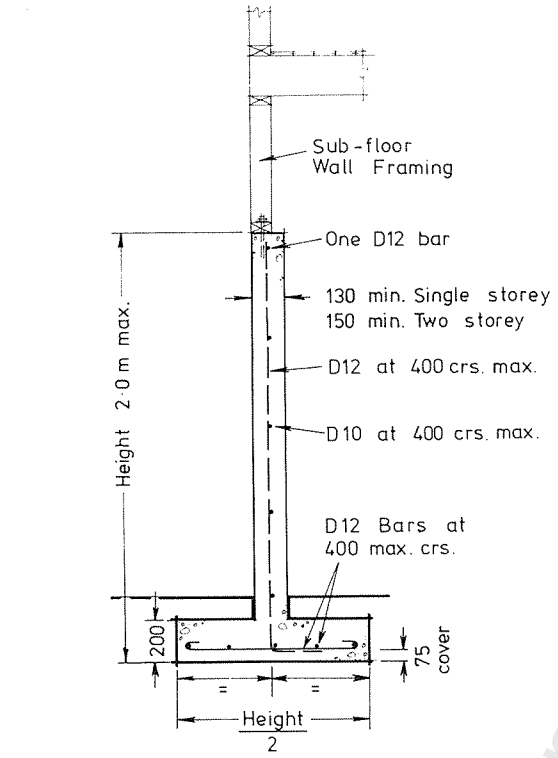
(iii) A length of reinforced clay masonry foundation wall as shown in fig. 32 and extending not less than 1.5 m in each direction shall be provided at each corner.



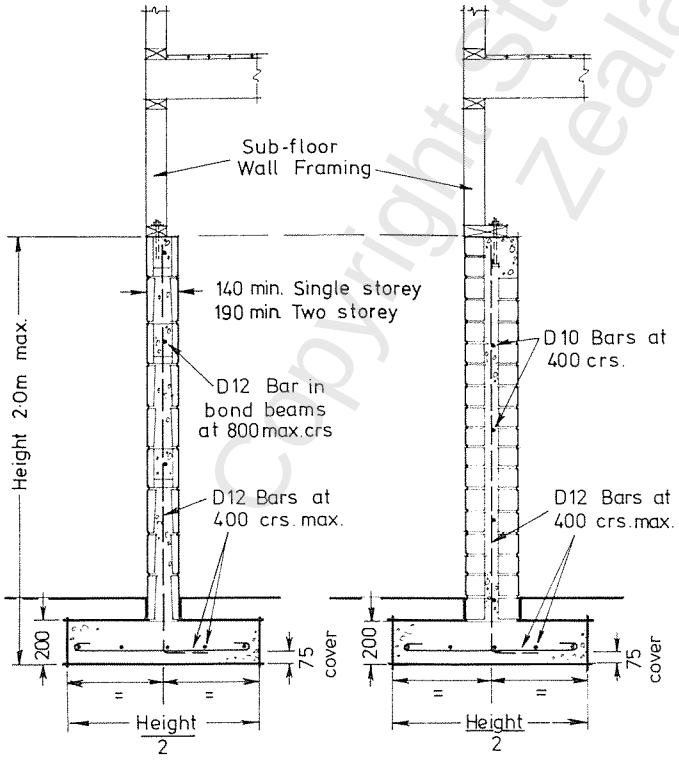
A : System A.

B : System B.

Fig. 15 : Continuous single-wythe clay masonry foundation walls



A : Reinforced concrete.



B : Reinforced concrete masonry.

C : Reinforced clay masonry.

Fig. 16 : Cantilevered foundation walls

4.6.2
Height of foundation walls

4.6.2.1
The height of a foundation wall shall be not less than 225 mm above finished ground level nor more than 2 m above the bottom of its footing except as provided by clause 4.6.1.5.

4.6.2.2
Foundation walls may be stepped to accommodate variations in cleared ground level or to suit the subfloor framing, provided that when both the top and bottom surfaces are stepped then the steppings shall be overlapped both vertically and horizontally not less than 450 mm as shown in fig. 20. (See also clauses 4.4.1 (b), 4.6.4.1, and 4.6.6.5.)

4.6.3
Width of foundation walls

4.6.3.1
The width of a foundation wall other than a single-wythe clay masonry foundation wall shall be not less than:

(a) Reinforced concrete:

(i) Supporting one storey only: 130 mm;

(ii) Supporting more than one storey: 150 mm;

(b) Reinforced masonry:

(i) Supporting one storey only: 140 mm, provided that where a reinforced masonry foundation wall supports a masonry veneer and a wall plate, the wall shall be not less than 190 mm wide.

(ii) Supporting more than one storey: 190 mm.

Table 4 FOUNDATION WALL FOOTINGS
1.5 kPa, 2.0 kPa, and 3.0 kPa floor loads

Number of storeys supported	*Minimum width of footing* (mm)	*Minimum thickness of footing* (mm)	*Minimum number of longitudinal D12 reinforcing bars*
A Reinforced concrete			
1	130*	150	1
2	200*	150	2
3	300	200	3
B Reinforced masonry			
1	190*	140	2
2	240	140	2
3	290	190	3

* 230 mm with a minimum of two bars when supporting masonry veneer.

4.6.4
Foundation wall footings

4.6.4.1
Foundation wall footings shall have all soil bearing surfaces horizontal but may be stepped to accommodate variations in cleared ground level provided that single-wythe clay masonry foundation walls shall be stepped only at piers.

4.6.4.2
Foundation wall footings shall be:

(a) Cantilevered foundation walls: As shown in fig. 16;

(b) Single-wythe clay masonry foundation walls: As specified in clause 4.6.1.5;

(c) All other foundation walls: Of concrete or masonry of not less than the width and thickness given by table 4 reinforced continuously with not less than the number of DI2 longitudinal reinforcing bars given by table 4 and with lateral reinforcing of R4 ties at not more than 600 mm centres where more than one longitudinal bar is required;

Provided that a foundation wall footing supporting masonry veneer shall be not less than 230 mm wide.

4.6.4.3
Reinforced masonry foundation wall footings shall be laid on level concrete not less than 60 mm thick.

4.6.5
Foundation wall materials

4.6.5.1
Concrete shall be ordinary grade concrete as specified in NZS I900 : Chapter 9.3*, provided that the fine and coarse aggregates need not be supplied and batched separately.

C4.6.5.1
NZS 1900 : Chapter 9.3 requires ordinary grade concrete to have a minimum specified compressive strength of 17.5 MPa at 28 days standard cured.*

4.6.5.2
Masonry materials and workmanship shall comply with NZS I900 : Chapter 6.2*.

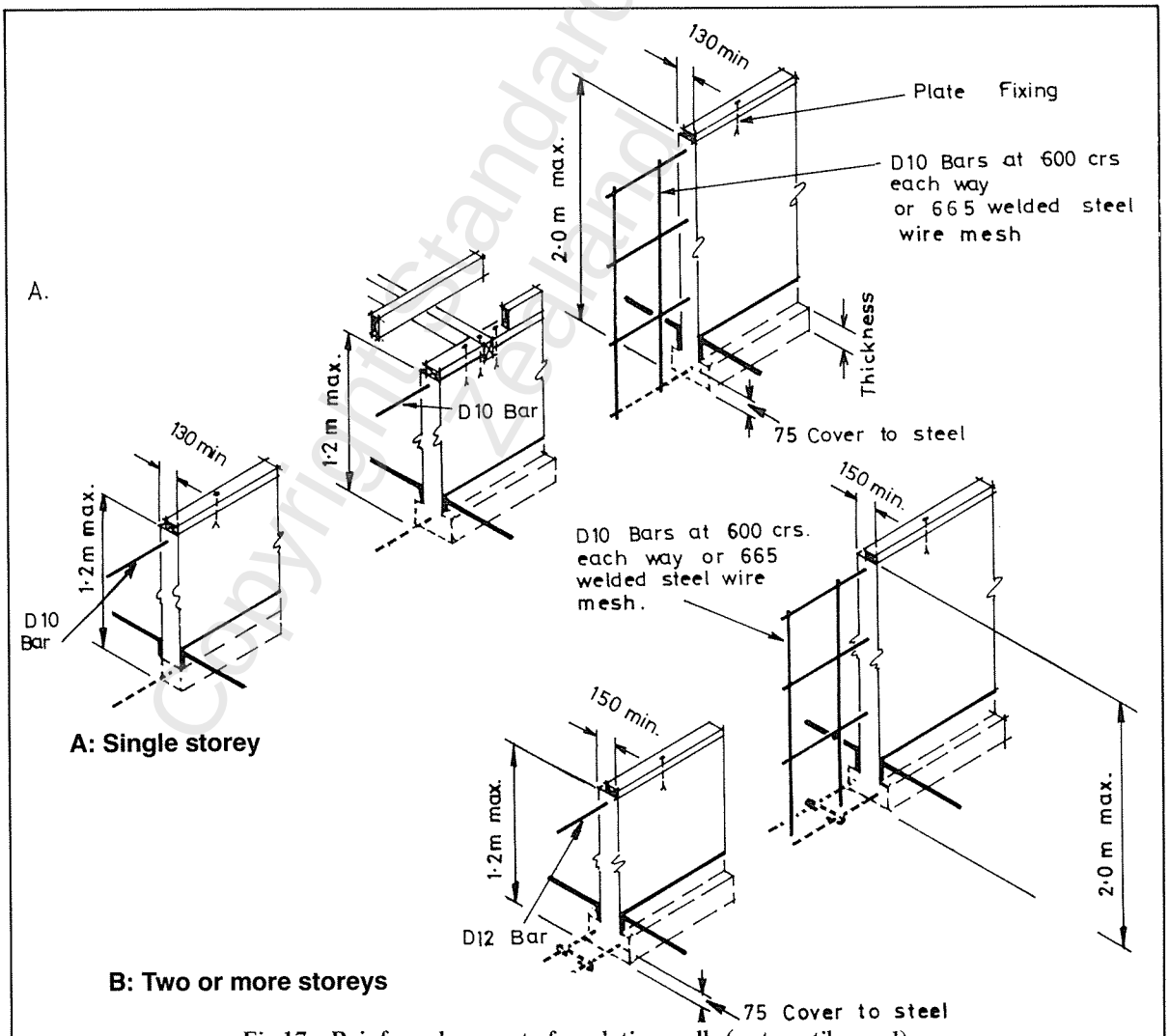


Fig.17 : Reinforced concrete foundation walls (not cantilevered)
For corner details see fig. 32 and for footing details see table 4.

* see list of related documents

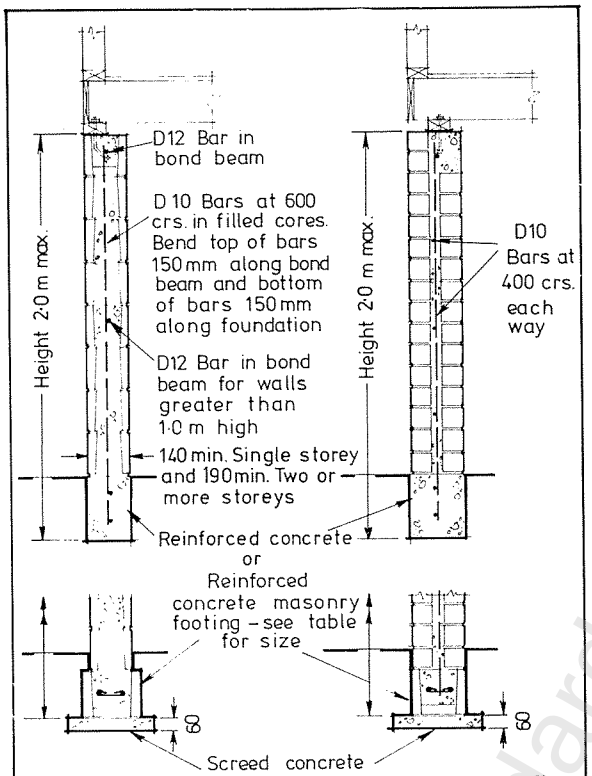


Fig. 18 : Reinforced masonry foundation walls (not cantilevered). For corner details see fig. 32

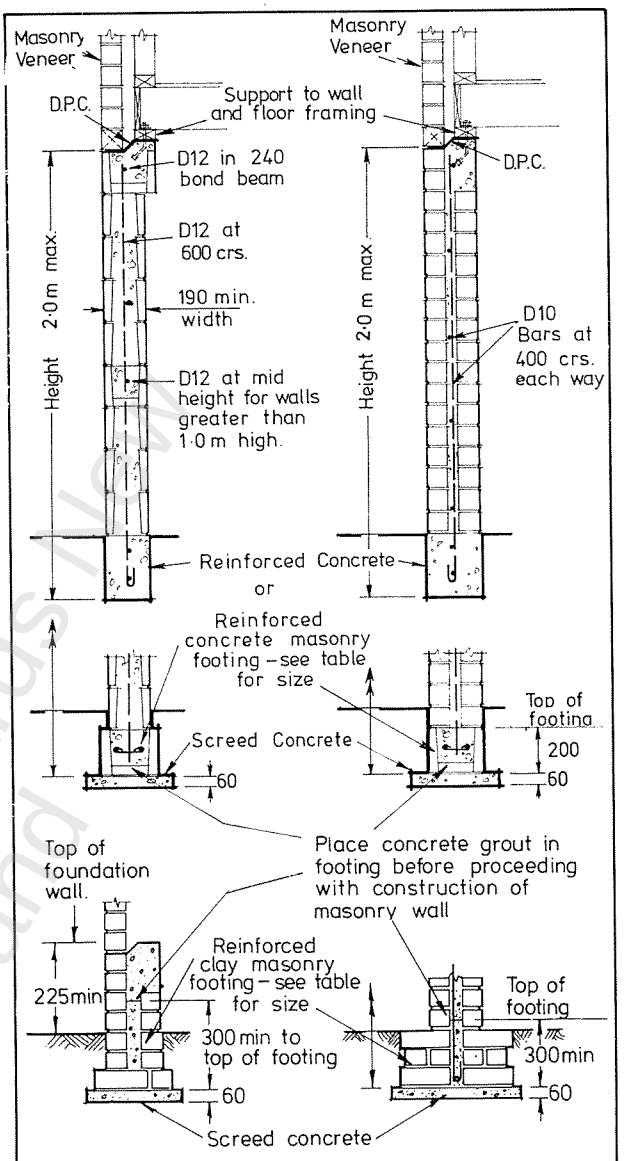


Fig. 19 : Reinforced masonry foundation walls (not cantilevered) supporting masonry veneer. For corner details see fig. 32

4.6.6
Foundation wall reinforcement

4.6.6.1
Foundation walls shall be continuously reinforced as shown by figures 15, 16, 17, 18, 19 or 32 as appropriate.

4.6.6.2
Bars shall be lapped where necessary with a lap length not less than:

(a) 40 diameters of the bar for plain bars in reinforced concrete;

(b) 32 diameters of the bar for deformed bars in reinforced concrete;

(c) 40 diameters of the bar for both plain and deformed bars in reinforced masonry.

4.6.6.3
As shown in fig. 20, any opening in a foundation wall exceeding 300 mm in any direction shall be provided with one D12 trimming bar on every side and extending not less than 600 mm past each corner of the opening.

4.6.6.4
Where the footing of a foundation wall is stepped one of the bars from the lower footing shall be carried up the vertical face of the step and one of the bars from the higher footing shall be carried on into the wall so that each bar extends not less than 600 mm beyond the intersection of the two bars, as shown in fig. 20. The two bars concerned shall each be the central bar when the footing contains three bars but may be either bar when the footing contains only two bars.

4.6.6.5
Where the top of a foundation wall is stepped the top bar shall be carried down the vertical face of the step

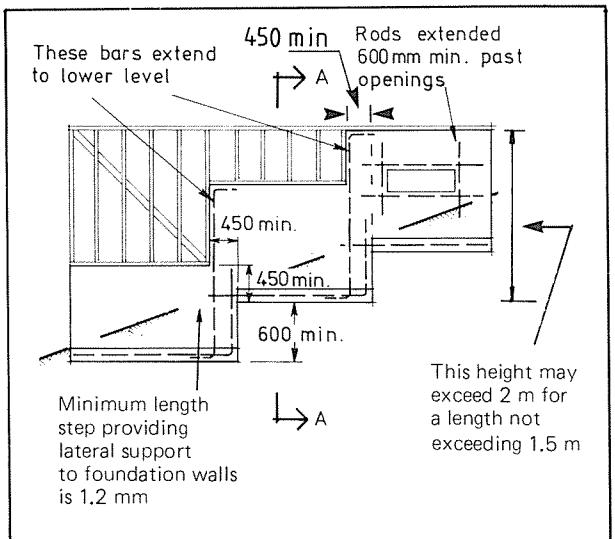


Fig. 20 : Steps and openings in foundation walls

to be lapped with the longitudinal reinforcing of the footing as shown in fig. 20.

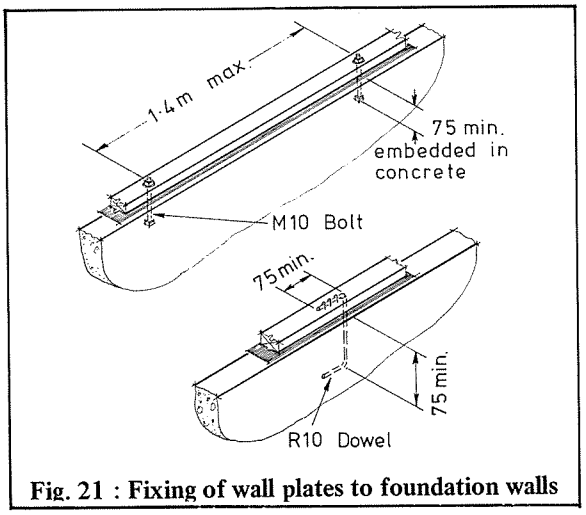


Fig. 21 : Fixing of wall plates to foundation walls

4.7 FIXING OF TIMBER OTHER THAN DIAGONAL BRACES TO FOUNDATION WALLS

4.7.1

Wall plates shall be fixed to foundation walls by either:

(a) M10 bolts set not less than 75 mm into the concrete and projecting sufficiently to allow for a washer and a fully-threaded nut above the timber as shown in fig. 21; or

(b) R10 steel dowels bent at least 90°, set not less than 75 mm into the concrete and projecting sufficiently to allow for not less than a 75 mm length of the dowel to be clinched over the timber as shown in fig. 21;

Located not more than 300 mm from the end of the timber at corners of foundation walls and not more than 1.4 m centres along the wall; Provided that where any length of foundation wall is regarded as one or more subfloor braces in accordance with clause 4.3.7 (d), each length of plate shall be fixed to it with not less than two such fixings.

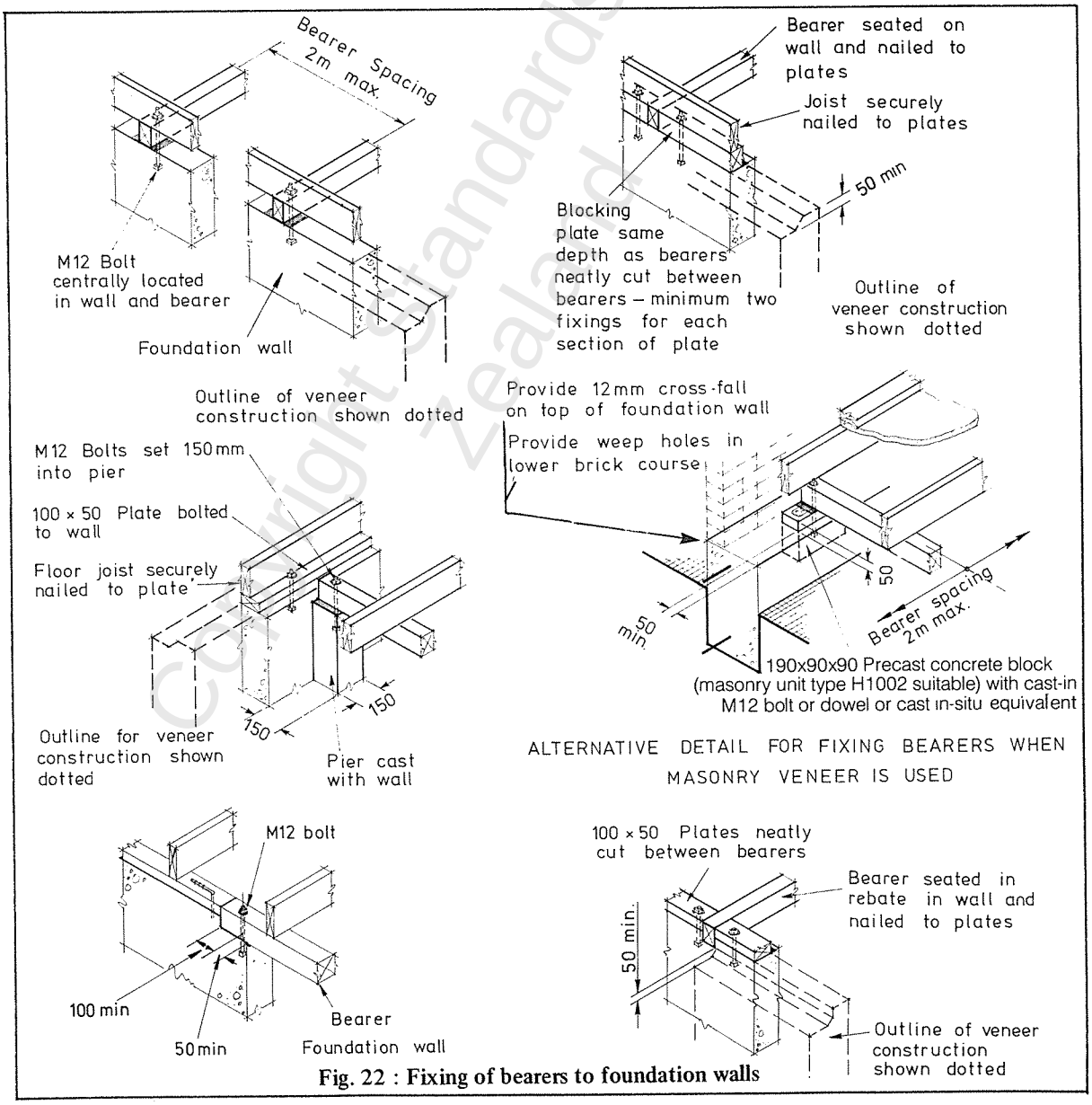


Fig. 22 : Fixing of bearers to foundation walls

4.7.2
Bearers directly supported by a foundation wall running at right angles to them shall be secured against lateral movement by one of the following methods:

(a) Only for bearer spacings not exceeding 2 m: As shown in fig. 22 each bearer shall be bolted to the foundation wall with a M12 bolt set not less than 150 mm into the wall and located centrally on the bearer and the wall;

(b) As shown in fig. 22 full depth blocking neatly cut between adjacent bearers shall be fixed to the top of the foundation wall in accordance with clause 4.7.1 provided that there shall be not less than two fixings for each length of blocking;

(c) As shown in fig. 22 each bearer shall be set in a rebate in the top of the foundation wall to a depth 50 mm less than the depth of the bearer and a 100 mm x 50 mm wall plate neatly cut between adjacent bearers shall be fixed to the top of the foundation wall in accordance with clause 4.7.1, provided that there shall be not less than two fixings for each length of wall plate;

(d) As shown in fig. 22 each bearer shall be supported by a pier not less than 150 mm x 150 mm cast integrally with the foundation wall and extending from the foundation wall footing to a height such that the top of the bearer is level with the top of the wall plate; the bearer shall be bolted to the pier with a M12 bolt set not less than 150 mm into the pier, and the wall plate shall be fixed to the top of the foundation wall in accordance with clause 4.7.1.

4.7.3
The end of a bearer which lands on a foundation wall running in the line of the bearer shall be fixed to the foundation wall by a M12 bolt set not less than 50 mm from the edge of the wall and not less than 100 mm from the end of the bearer as shown in fig. 22.

4.7.4
Stringers shall be fixed to foundation walls as required by clause 4.8.5.2.

4.8 SUBFLOOR FRAMING OTHER THAN DIAGONAL BRACES

4.8.1 Support to loadbearing walls

4.8.1.1
Except as provided for by clauses 4.8.3.11 and 5.1.5, where a loadbearing wall runs at right angles to the line of the joists beneath, such joists shall be supported within 200 mm measured between centrelines by a loadbearing wall or by a bearer (see fig. 31). Any such bearer shall itself be supported within 200 mm measured between centrelines from any trimmer stud to a lintel exceeding 2.2 m span in the loadbearing wall.

4.8.1.2
Except as provided for by clauses 4.8.3.11 and 5.1.5, where a loadbearing wall runs parallel to the line of the joists beneath, such joists shall comply with clause 5.1.3 and a bearer supporting such joists shall in turn be supported within 200 mm measured between centrelines (see fig. 31).

4.8.2 Wall plates

4.8.2.1
Wall plates shall be 100 mm x 50 mm, provided that 75 mm x 50 mm may be used when the wall plate is the bottom plate of a timber stud wall having 75 mm wide studs.

4.8.3 Bearers

4.8.3.1
Bearers shall be of the dimensions given by table 5 except as provided by clauses 4.8.3.2 and 4.8.3.3.

4.8.3.2
Where a bearer supports jack studs at pile spacings in accordance with clause 4.2.1.1 (h) and is itself supported by cantilevered piles the bearer may be 100 mm x 50 mm on its flat provided that:

(a) Where the tops of adjacent cantilevered piles are at different levels the bearer on the higher pile shall extend to the jack stud above the lower pile and be fixed to it as shown in fig. 13(b).

(b) Where a diagonal timber sub-floor brace is connected to the bearer as required by either clause 4.9.2.1 (d) or clause 4.9.2.3 then the bearer shall be 100 mm x 75 mm on edge (See figures 27 and 28).

4.8.3.3
Where a bearer in a single-storey building runs parallel to and not more than 200 mm measured centre-to-centre away from a loadbearing wall that supports a heavy roof having a roof dimension *S* exceeding 8 m (see clause 6.4.3), then the bearer shall be as given by table 5 but not less than:

(a) Bearer span not exceeding 1.3 m: 125 mm x 75 mm;

(b) Bearer span not exceeding 1.65 m: 150 mm x 75 mm;

(c) Bearer span not exceeding 2 m: 200 mm x 75 mm.

4.8.3.4
Bearers shall be continuous over two or more spans and be laid in straight lines on edge, except as provided by clause 4.8.3.2.

4.8.3.5
Bearers shall be laid so that any crook in them will straighten under load; or may be cut through to the centreline and over supports only to correct crook, provided that in such cases they shall be considered as being jointed over those supports for the purpose of determining the span.

C4.8.3.5
The method of straightening specified in clause 4.8.3.5 applies only when the crook does not exceed

Table 5 BEARERS
1.5 kPa floor load

Maximum span of bearer continuous over two or more spans	*Maximum span of joists*	*Bearer size*
(m)	(m)	(mm x mm)
1.3	1.85	100 x 75
	2.50	100 x 100
	3.00	125 x 75
	4.05	125 x 100
	4.35	150 x 75
	5.95	150 x 100 or 200 x 75
1.65	1.85	125 x 75
	2.50	125 x 100
	2.70	150 x 75
	3.70	150 x 100
	4.90	200 x 75
2.0	1.85	150 x 75
	2.50	150 x 100
	3.35	200 x 75

the maximum crook permitted by NZS 3631 for the grade concerned. If the crook does exceed the maximum permitted then the bearer is not of the required grade and must be removed.*

4.8.3.6
Bearers shall have a minimum landing on their supports of:

(a) Where bearers are butted over the support: 45 mm;
(b) In all other cases: 90 mm.

4.8.3.7
Any packing necessary beneath bearers shall be of a material as durable and as incompressible as the bearer itself, and shall provide the landing required by clause 4.8.3.6.

C4.8.3.7
Packing beneath bearers should be avoided if possible.

4.8.3.8
Joints in bearers shall be made only over supports but shall not occur where the bearer is fixed to a braced pile as required by clause 4.5.7.1 (c) (i).

4.8.3.9
A joint in a bearer shall be made over a support with a connection having a capacity of not less than 7.0 kN in tension or compression along the line of the bearer. This may be achieved by butting and flitching (see fig. 23), or flitching on each side. No joint shall occur where the bearer is fixed to a braced pile, as required by clause 4.5.7.1 (c) (i).

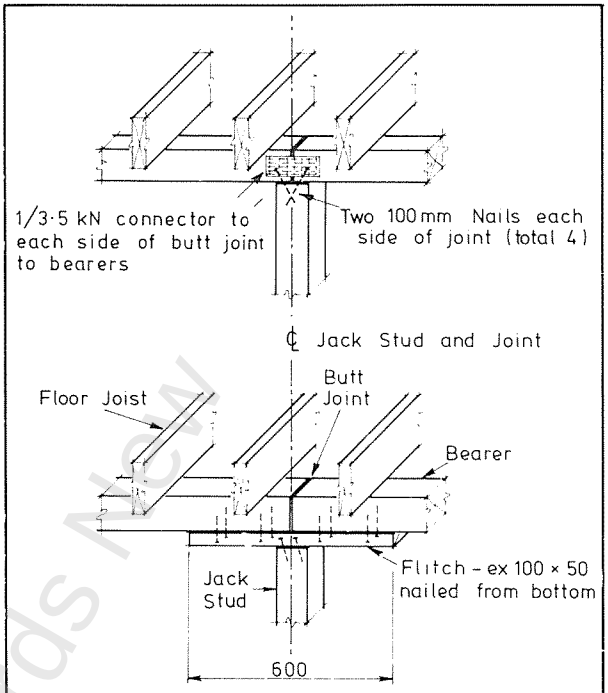


Fig. 23: Typical joints in bearers

4.8.3.10
Bearers may project as cantilevers to the distance beyond the face of the support given by clause 4.8.3.11 provided that cantilevered bearers shall support not more than one floor and an external wall.

4.8.3.11
Where permitted by clause 4.8.3.10 bearers may project as cantilevers beyond the face of the support to a distance not exceeding:

(a) Bearers at spacings not exceeding 3 m: 300 mm;

(b) Bearers at spacings exceeding 3 m: 200 mm.

4.8.3.12
Bearers may be laminated from minimum 50 mm thick timbers on edge which are nailed together, provided that where a dowel or bolt fixing passes through the depth of such a bearer then a M10 bolt shall be located within 50 mm of that fixing to tie the laminations together.

4.8.4
Timber stud subfloor walls

4.8.4.1
Timber stud subfloor walls shall comply with the requirements of clause 6 for timber stud walls within a storey except that:

(a) Wall plates shall be not less than 50 mm thick;

(b) The system to resist horizontal loads shall comply with clause 4.3 and not clause 6.3;

* see list of related documents

(c) A double stud shall be provided directly beneath any bearer at right angles to the wall and supported by the top plate.

C4.8.4.1 Clause 6.5.1.4 does not permit the use of No. 2 Framing grade or Building B grade timber for the studs of subfloor walls.

4.8.5
Stringers

4.8.5.1
No stringer shall support more than one floor and its associated non-loadbearing walls.

4.8.5.2
As shown in fig. 24 stringers shall be fixed to their supporting foundation walls with MI2 bolts set not less than 100 mm into the wall at spacings as given by table 6.

4.8.5.3
The dimensions of stringers shall be:

(a) For bolt spacings not exceeding 1 m: 125 mm x 50 mm;

(b) For bolt spacings not exceeding 1.65 m: 150 mm x 50 mm;

(c) For bolt spacings exceeding 1.65 m: 200 mm x 50 mm.

4.8.5.4
Bolts shall be not less than 50 mm from the top edge of the stringer.

4.8.6
Jack studs

4.8.6.1
Jack studs shall be of the dimensions given by table 7.

4.8.6.2
Jack studs shall be at pile spacings and shall have their greater dimension in the line of the bearer that they support.

Table 6 SPACING OF M12 BOLTS SUPPORTING STRINGERS
1.5 kPa floor load

Maximum span of floor joists	*Maximum spacing of bolts*
(m)	(m)
2	2.50
3	1.65
4	1.25
5	1.00
6	0.85

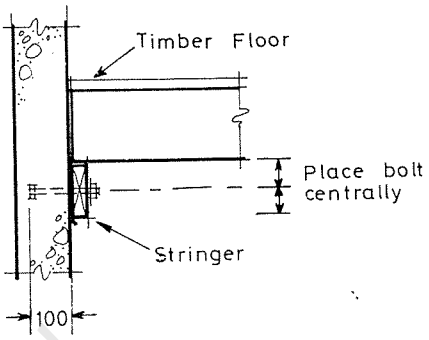


Fig. 24 : Fixing of stringers to foundation walls

4.9
DIAGONAL TIMBER SUBFLOOR BRACES

4.9.1
General

4.9.1.1
Diagonal timber subfloor braces shall be provided as necessary to comply with clause 4.3.

C4.9.1.1
Figure 25 shows lines of horizontal support at the spacings required by clause 4.3.2 and containing diagonal timber subfloor braces between piles.

Table 7 SUBFLOOR JACK STUDS
1.5 kPa floor load

Maximum span of bearers	*Jack stud size*	*Maximum length (height) of jack stud for maximum joist spans (m) of.*		
		2.0	*3.5*	*5.0*
(m)	(mm x mm)	(m)	(m)	(m)
Supporting one storey				
1.30	100 x 75	2.4	1.8	1.8
	100 x 100	3.0	3.0	3.0
2.0	100 x 75	2.4	1.8	1.2
	100 x 100	3.0	3.0	2.4
Supporting two storeys				
1.65	100 x 75	1.8	1.2	–
	100 x 100	3.0	2.4	1.8
2.0	100 x 75	1.2	–	–
	100 x 100	2.4	1.8	–
Supporting three storeys				
1.3	100 x 75	1.8	–	–
	100 x 100	2.4	1.8	–

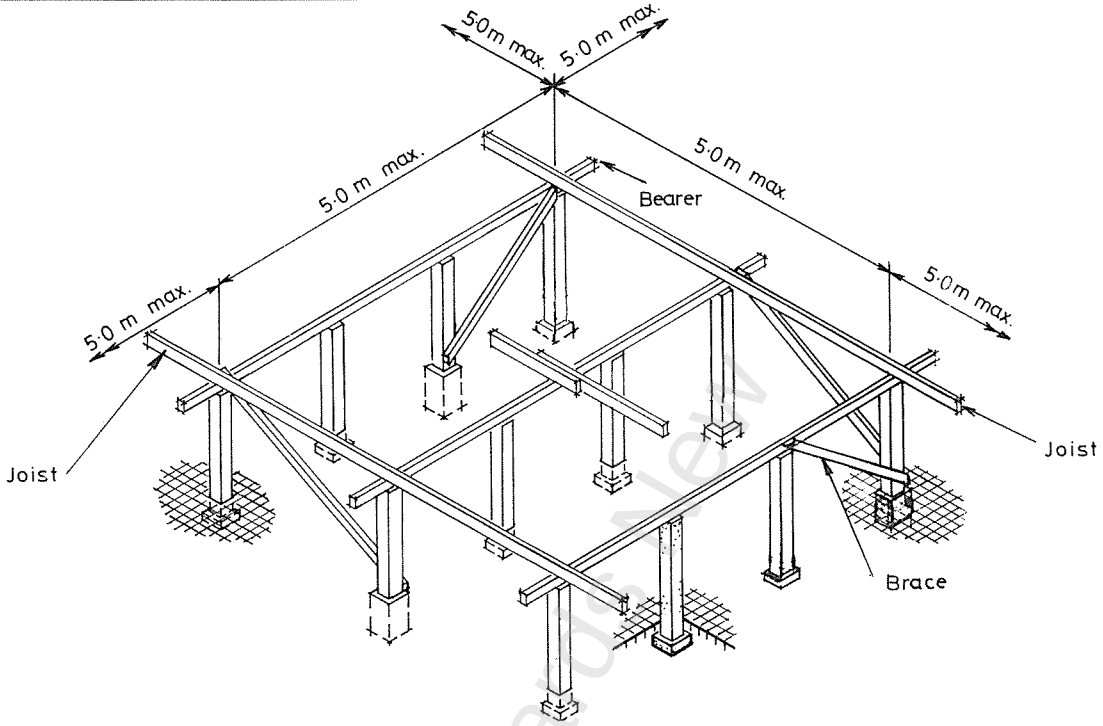


Fig. 25 : Lines of horizontal support containing diagonal timber braces

4.9.1.2
Diagonal timber subfloor braces shall slope between 0° and 45° to the horizontal.

C4.9.1.2
As far as possible, the diagonal braces along a line of horizontal support should slope alternately in opposite directions.

4.9.1.3
The upper end of a diagonal timber subfloor brace shall be attached to one of the following:

(a) A braced pile in accordance with clause 4.9.2.1 (a);

(b) A bearer in accordance with clause 4.9.2.1 (d);

(c) A joist in accordance with clause 4.9.2.1 (e);

(d) A blocking piece between joists directly supported by a bearer or by the top plate of a timber stud subfloor wall in accordance with clause 4.9.2.1 (f).

4.9.1.4
The lower end of a diagonal timber subfloor brace shall be attached to one of the following:

(a) A braced pile in accordance with clause 4.9.2.1 (b);

(b) An anchor pile in accordance with clause 4.9.2.1 (c);

(c) A bearer directly supported by a complete row of cantilevered piles in the line of the bearer, and itself supporting jack studs at pile spacings or acting as the bottom plate of a timber stud subfloor wall, in accordance with clause 4.9.2.1 (d); provided that this method shall not be used for a line of horizontal support under an external wall. (See fig. 8).

(d) A foundation wall in accordance with clause 4.9.2.1 (g) or clause 4.9.2.1 (h).

4.9.1.5
Not more than one diagonal timber subfloor brace in any line of horizontal support shall be attached to any one braced pile or any one anchor pile.

4.9.1.6
The lower end of a diagonal timber subfloor brace shall not be closer than 150 mm to the finished ground level.

4.9.1.7
A diagonal timber subfloor brace shall consist of one continuous length of timber, provided that it may consist of two continuous lengths of timber well nailed together where this is permitted by clause 4.9.1.8 (b).

4.9.1.8
The dimensions of a diagonal timber subfloor brace shall be:

(a) Length not exceeding 3 m: 100 mm x 75 mm;

(b) Length not exceeding 4.5 m: two 100 mm x 50 mm well nailed together;

(c) Length not exceeding 5 m: 100 mm x 100 mm.

4.9.1.9
For the purpose of clause 4.9.1.8 the length shall be measured along the brace between the fixings at the upper and lower ends; provided that if a brace passes an intermediate pile or jack stud and is bolted to it by a M12 bolt through both centrelines then the length of the brace may be taken as the greater of the distances between that bolt and the fixings at the upper or the lower end.

4.9.2
Fixing of diagonal timber subfloor braces

4.9.2.1
Except as provided by clauses 4.9.2.2 and 4.9.2.3, a diagonal timber brace shall be fixed as follows by a M12 bolt passing through the centreline of the brace not less than 84 mm from its end:

(a) To the top of a braced pile: The bolt shall pass through the pile within 50 mm of the centreline and not less than 50 mm nor more than 150 mm from the top of the pile (see fig. 26);

C4.9.2.1

(a) A braced pile must support a bearer directly, see clause 4.2.1.

(b) To the bottom of a braced pile: The bolt shall pass through the centreline of the pile not more than 300 mm above cleared ground level and the distance from this bolt to the top of the pile shall not be less than twice the distance from the bolt to the cleared ground level (see also clause 4.9.1.6 and fig. 26).

(c) To an anchor pile: As shown in fig. 14; see also clause 4.5.7.1 (d);

(d) To a bearer: The bolt shall pass through the centreline of the bearer not more than 200 mm measured along the bearer from the centreline of the nearest support (see fig. 27);

(e) To a joist: The bolt shall pass through the joist not less than 50 mm from the edge and not more than 200 mm measured along the joist from the centreline of the nearest joist support (see fig. 26);

(f) To a blocking piece between joists: The bolt shall pass through the blocking piece not less than 50 mm from the edge; the blocking piece shall be 50 mm thick, the same depth as the joists, and neatly cut between adjacent joists (see fig. 27);

(g) To a foundation wall in the line of the brace: The bolt shall be not less than 100 mm from any edge of the foundation wall and shall either pass through the foundation wall or be hooked around a reinforcing bar within the wall and not less than 1 m long (see fig. 27);

(h) To a foundation wall at right angles to the line of the brace: As shown in fig. 27 and not more than 250 mm nor less than 150 mm above cleared ground level.

4.9.2.2
Any fixing used as an alternative to a fixing specified in clause 4.9.2.1 shall be of 17 kN capacity tension or compression along the brace.

4.9.2.3
A diagonal timber brace may be neatly cut between jack studs and bearers or wall plates and attached to the bearers or wall plates at their intersection with the jack studs as shown in figures 27 and 28 or by connectors of 8.5 kN capacity tension or compression along the brace.

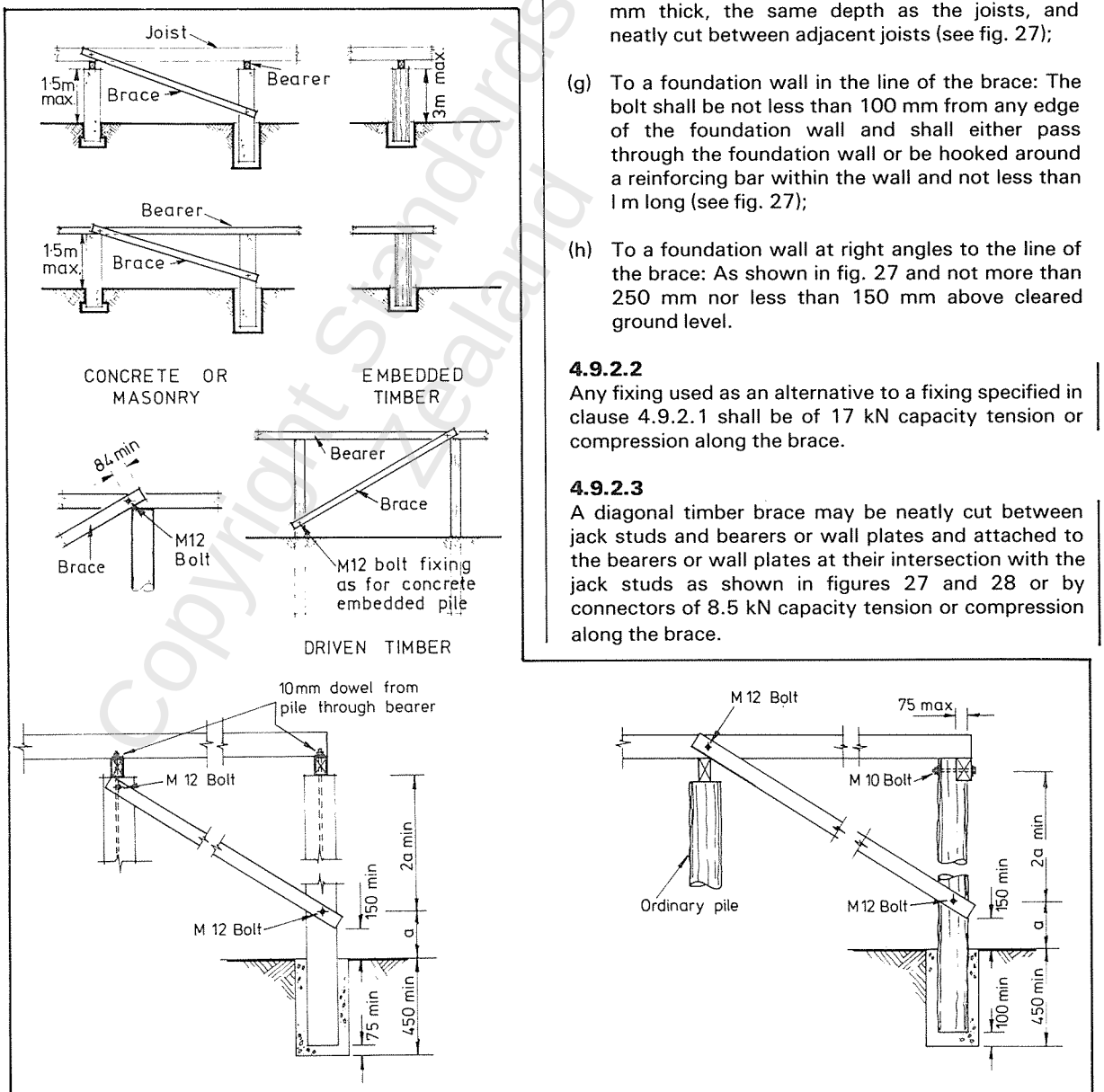


Fig. 26 : Braced piles

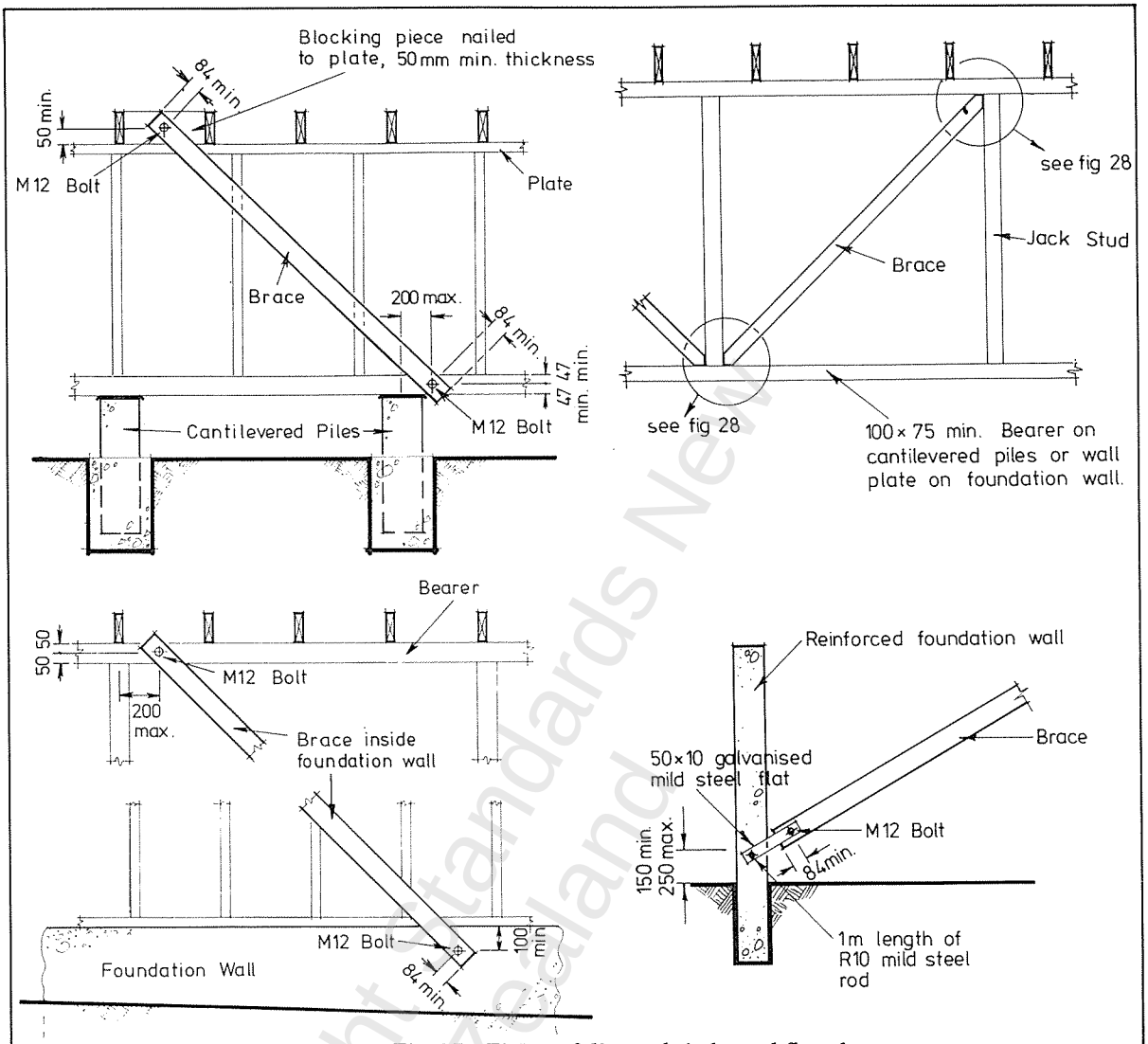


Fig. 27 : Fixing of diagonal timber subfloor braces

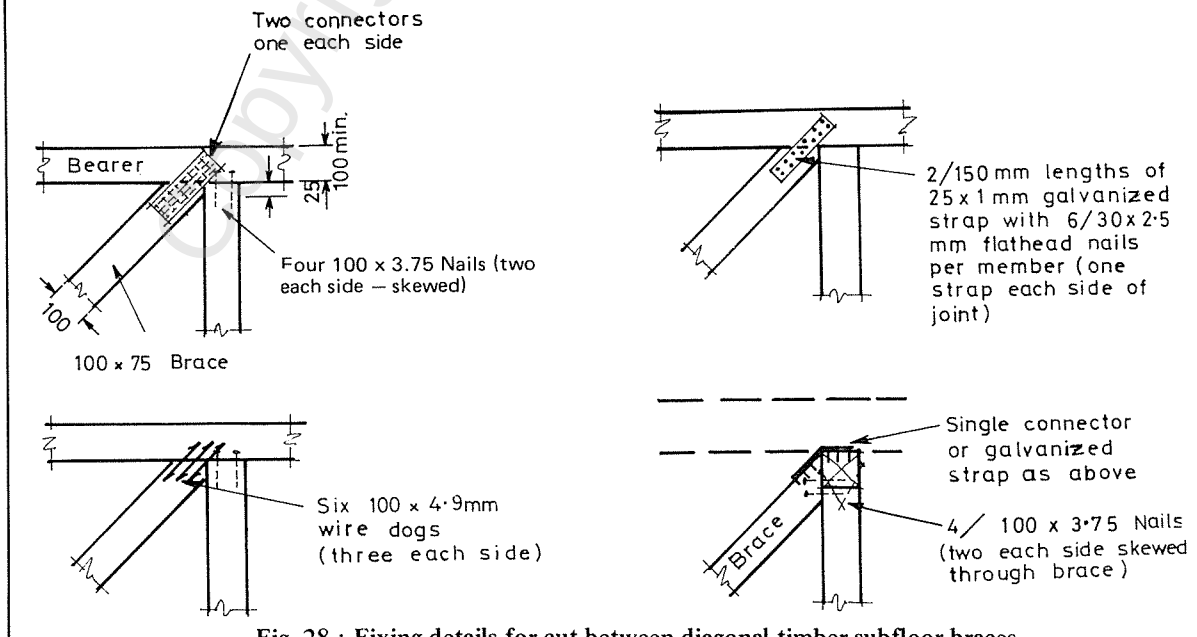


Fig. 28 : Fixing details for cut-between diagonal timber subfloor braces

5
FLOORS

C5
For concrete slab-on-ground floors see Appendix E.

5.1
FLOOR JOISTS

5.1.1
General

5.1.1.1
Floor joists shall be of the dimensions given by table 8, provided that for joists continuous over two or more spans the maximum joist span given by table 8 may be increased by 10 percent.

Table 8 FLOOR JOISTS
1.5 kPa floor load

Floor joist size	*Maximum span* of joists at a maximum spacing (mm) of:*		
	400	*450*	*600*
(mm x mm)	(m)	(m)	(m)
100 x 40	1.65	1.6	1.5
100 x 50	1.8	1.75	1.6
125 x 40	2.1	2.08	1.85
125 x 50	2.3	2.2	2.0
150 x 40	2.6	2.5	2.2
150 x 50	2.8	2.7	2.4
200 x 50	3.8	3.6	3.25
225 x 50	4.3	4.1	3.7
250 x 50	4.8	4.6	4.15
300 x 50	5.75	5.5	5.0

* May be increased by 10 percent for joists continuous over two or more spans.

5.1.1.2
Floor joists shall have their top surfaces set to a common level to support floor decking and shall be laid in straight lines on edge.

5.1.1.3
Floor joists shall be laid so that any crook in them will straighten under load, or may be cut through to the centreline and over supports only to correct crook, provided that in such cases they shall be considered as being jointed over those supports for the purpose of determining the span.

C5.1.1.3
The method of straightening specified in clause 5.1.1.3 applies only when the crook does not exceed the maximum crook permitted by NZS 3631 for the grade concerned. If the crook does exceed the maximum permitted then the joist is not of the required grade and must be removed.*

5.1.1.4
Floor joists shall have minimum landing on their supports of 32 mm.

5.1.1.5
Joints in floor joists shall be made only over supports, but not where the joist is cantilevered beyond the support.

5.1.1.6
Joints in floor joists may be butted over supports provided that in the following cases joints shall be lapped or flitched as specified in clause 5.1.1.7:

(a) In any joist to which a diagonal brace is attached;

(b) In every third joist at a line of support, provided that this shall not apply where a sheet floor decking extends not less than 600 mm on each side of the joint.

5.1.1.7
Where required by clause 5.1.1.6, joints in floor joists (see fig. 29) shall either:

(a) Be lapped not less than 150 mm on each side of the centreline of the support and nailed together from both sides; or

(b) Be butted and flitched with a piece of timber of the same dimensions as the joists and extending not less than 150 mm on each side of the joist ends, nailed to both lengths of joists from both sides, or an alternative fixing having a capacity of 5 kN in tension.

5.1.2
Lateral support of floor joists

5.1.2.1
Lines of lateral support to floor joists as specified in clause 5.1.2.2 shall be provided within 300 mm of the following locations:

(a) Ground floor joists: Along all subfloor lines of horizontal support (see clause 4.3);

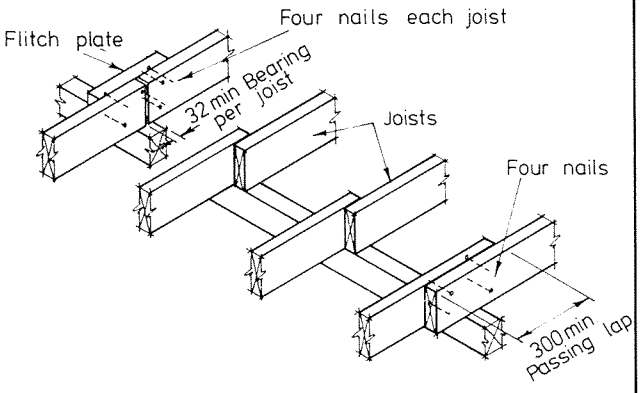


Fig. 29 : Joints in floor joists

* see list of related documents

(b) Other floor joists: Along the line of each wall that contains a wall bracing element in the storey below.

5.1.2.2
A line of lateral support to floor joists (see fig. 30) shall consist of:

(a) At the ends of joists: A continuous boundary joist 25 mm thick and the same depth as the floor joists; or

(b) In any location including at joist ends: Solid strutting complying with clause 5.1.2.4 between adjacent floor joists at not more than l.8 m centres between lengths of strutting provided that:

(i) There shall be solid strutting between the two edge pairs of joists; and

(ii) Additional solid strutting shall be provided where required by clause 5.1.4.

5.1.2.3
In addition to any lateral support required by clause 5.1.2.1, floor joists having a depth of four or more times their thickness shall be laterally supported at the mid-point of any span exceeding 2.5 m by strutting complying with clause 5.1.2.4 between all joists.

5.1.2.4
Strutting required by clauses 5.1.2.2 (b) or 5.1.2.3 shall be either:

(a) Solid strutting 40 mm thick, the same depth as the joists, neatly cut between adjacent joists; or

(b) Herringbone strutting consisting of two pieces of 40 mm x 40 mm timber set diagonally in opposite directions between the top and bottom edges of the joists.

C5.1.2.4
Squeaks in floor can result from solid strutting that does not fit tightly between the joists. This can be caused by drying shrinkage of both joists and strutting.

5.1.3
Floor joists under walls

5.1.3.1
As shown in fig. 31, where a loadbearing wall runs parallel to the line of floor joists beneath, it shall be supported by a pair of joists. Such a pair of joists may be separated by solid packing not exceeding 50 mm thick or half the thickness of the wall above, whichever is the lesser, at not more than 600 mm centres. If fitted floor decking is used there shall be not less than 20 mm landing on the joists for the decking.

5.1.3.2
As shown in fig. 31, where a non-loadbearing wall runs parallel to the line of floor joists beneath, it shall either:

(a) Be over a joist; or

(b) Be supported by solid blocking between the joists on either side of the wall in accordance with clause 5.1.3.3; or

(c) Where the wall does not contain a wall bracing element: Be within l50 mm of a joist measured between centrelines.

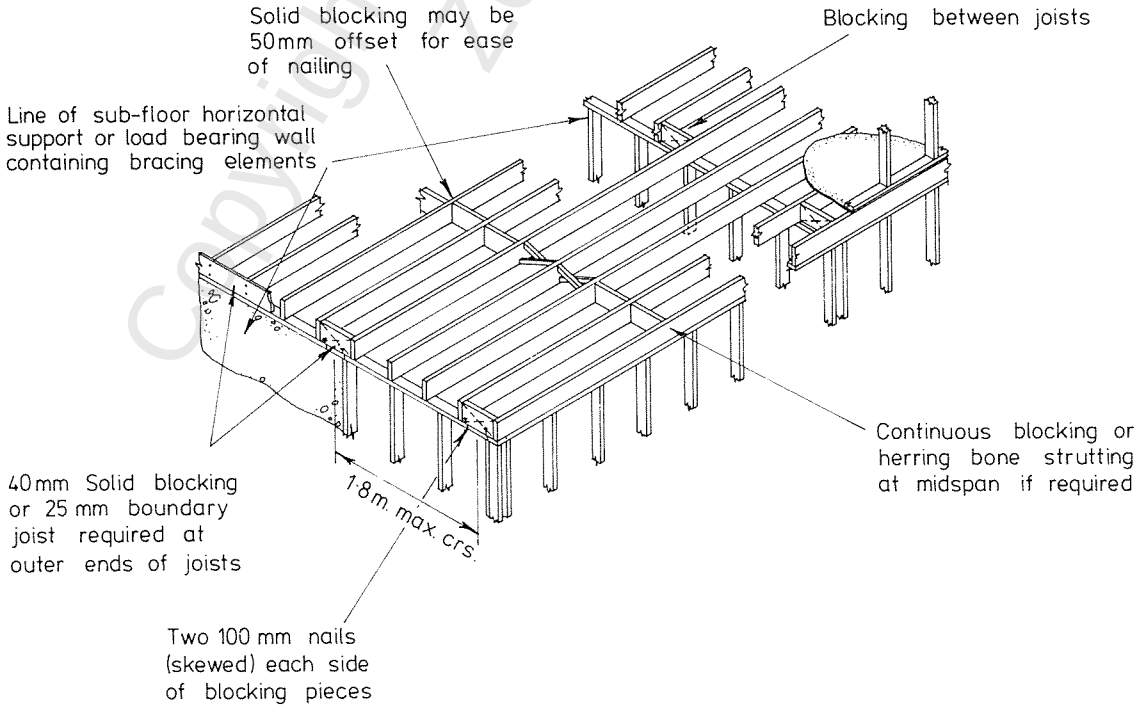


Fig. 30 : Lateral support of floor joists

5.1.3.3
Solid blocking shall be 100 mm x 50 mm cut neatly between joists, with its top flush with the top of the joists, set at each end of the wall above, at each side of any door openings, and at not more than 1.2 m centres elsewhere.

5.1.3.4
Where a loadbearing wall runs at right angles to the line of joists such joists shall comply with clause 4.8.1.1. (See fig. 31.)

5.1.4
Floor joists connected to subfloor brace foundation walls

5.1.4.1
Where floor joists run parallel to a length of foundation wall that is regarded as a subfloor brace in accordance with clause 4.3.7 (d), one joist shall be directly above the length of foundation wall and shall be directly supported for a length not less than 1.4 m by a wall plate or bearer fixed to the foundation wall in accordance with clause 4.7.1 (see fig. 32).

5.1.4.2
Where floor joists run at right angles to a length of foundation wall that is regarded as a subfloor brace in accordance with clause 4.3.7 (d), then either:

(a) The ends of the joists shall be laterally supported by a continuous boundary joist in accordance with clause 5.1.2.2 (a); or

(b) The solid strutting required by clause 5.1.2.2 (b) shall be provided between each pair of joists for a length of 1.8 m along the line of the foundation wall and either:

(i) Where the foundation wall is at a corner the 1.8 m length shall be measured from the corner (see fig. 32); or

(ii) Where the foundation wall is not at a corner the 1.8 m length shall be symmetrically disposed on the foundation wall.

5.1.5
Cantilevered floor joists

5.1.5.1
Floor joists may project as cantilevers to the distance beyond the face of the support given by table 9 provided that cantilevered floor joists shall not support a balcony decking having a mass exceeding 25 kg/m² nor a balcony balustrade having a mass exceeding 5.5 kg/m.

5.1.5.2
The depth of the joist to be used in table 9 shall be the net depth at any notch, step, or hole occurring within two-thirds of the cantilever length from the face of the support.

C5.1.5.2
When a cantilevered floor joist supports a balcony or the like it is frequently necessary to provide a notch or step in the joist at the external wall for weatherproofing.

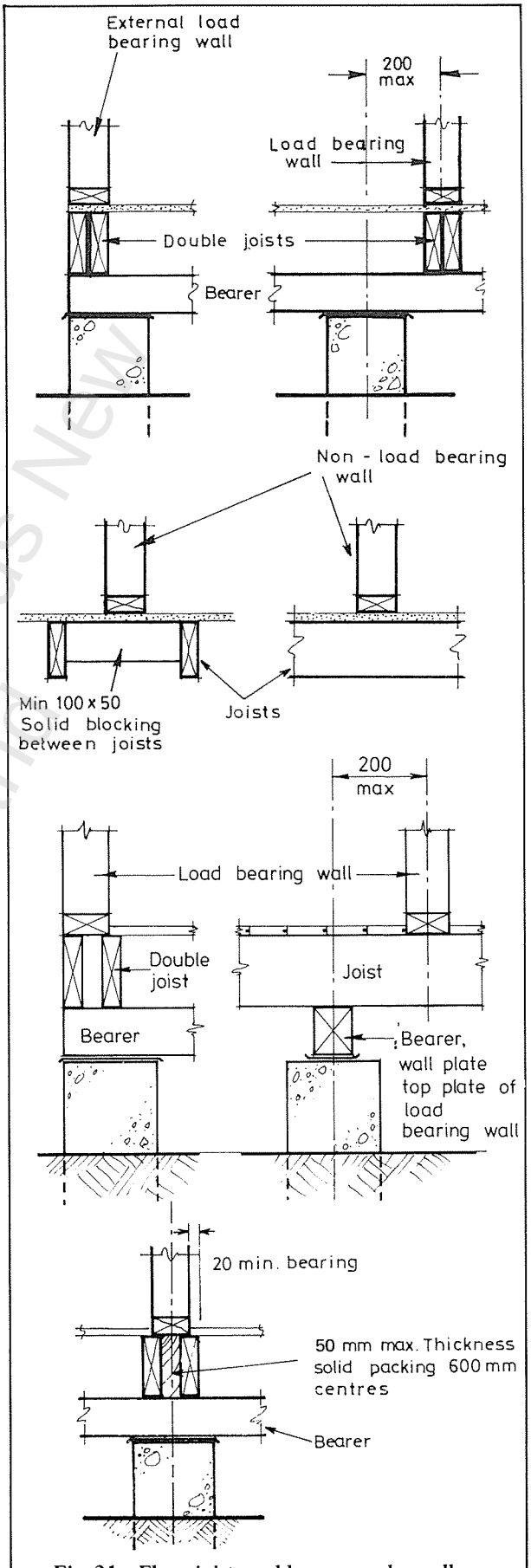
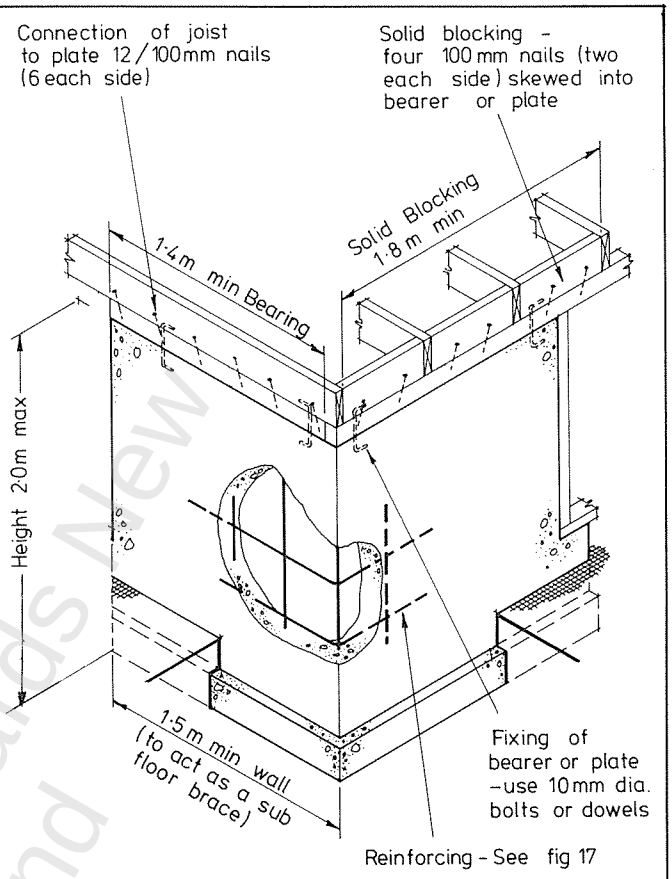


Fig. 31 : Floor joists and bearers under walls

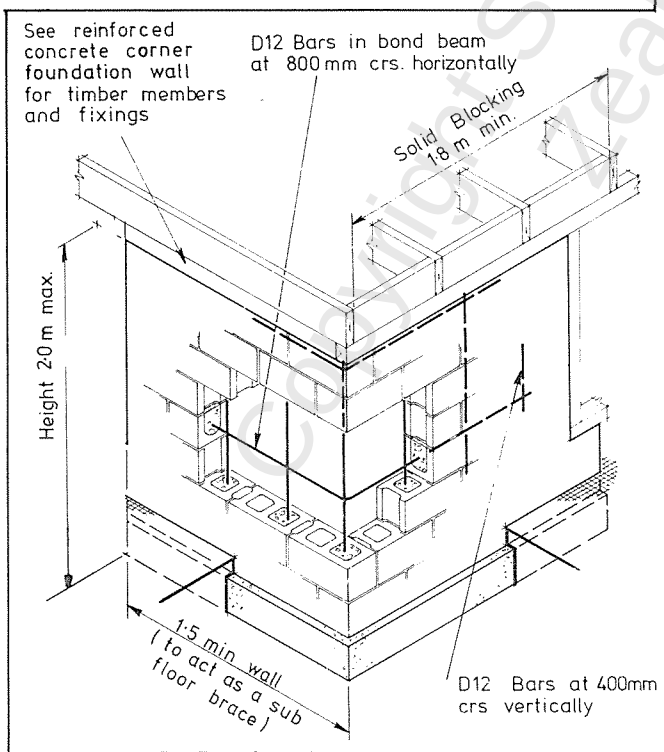
Table 9 CANTILEVERED FLOOR JOISTS

Joist size	Joist spacing	Maximum cantilever length‡ of joist supporting: Floor*, 2.4m wall and light roof of span (m)			Floor*, 2.4m wall and heavy roof of span (m)			Balcony floor† and balustrade only
		12.0	8.0	4.0	12.0	8.0	4.0	
(mm × mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
100 × 50	600	50	100	150	50	50	100	700
	450	100	100	200	50	50	100	750
	400	100	150	200	50	50	100	800
125 × 50	600	150	150	250	50	100	150	900
	450	150	200	300	100	100	200	1000
	400	150	200	300	100	150	200	1050
150 × 50	600	200	250	350	100	150	250	1100
	450	250	300	400	150	200	250	1200
	400	250	350	450	150	200	300	1250
200 × 50	600	350	450	600	200	250	400	1450
	450	400	550	700	250	350	500	1600
	400	450	550	750	250	350	500	1700
225 × 50	600	450	550	750	250	350	500	1650
	450	550	650	850	300	400	600	1850
	400	550	700	900	350	450	650	1900
250 × 50	600	550	650	900	300	450	600	1850
	450	650	800	1050	400	500	750	2050
	400	700	850	1100	400	550	800	2100
300 × 50	600	750	900	1200	450	600	850	2250
	450	900	1100	1350	550	700	1000	2450
	400	950	1150	1450	600	750	1050	2550

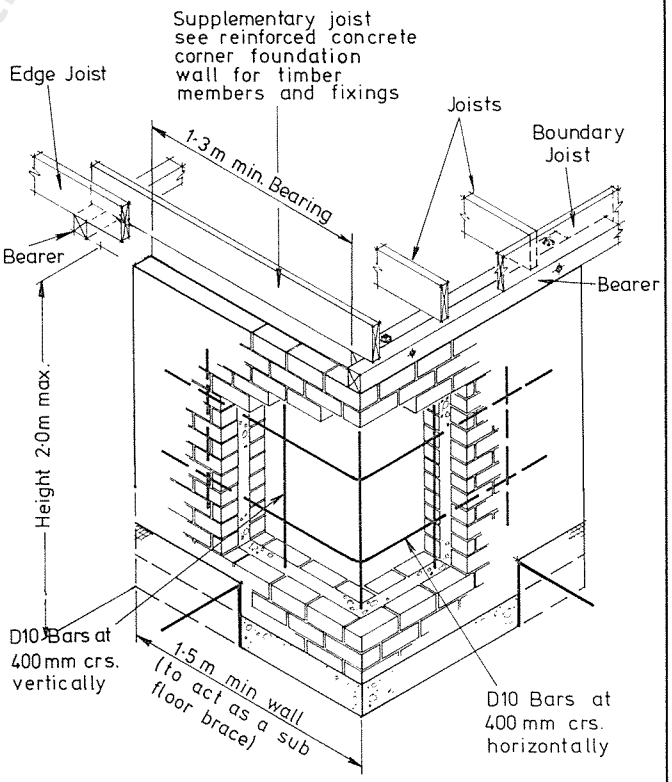
* 1.5 kPa floor load
† 2.0 kPa floor load
‡ Must be reduced by 10% for 40 mm thick joists.



A : Reinforced concrete



B : Reinforced concrete masonry



C : Reinforced clay masonry

Fig. 32 : Corner foundation walls

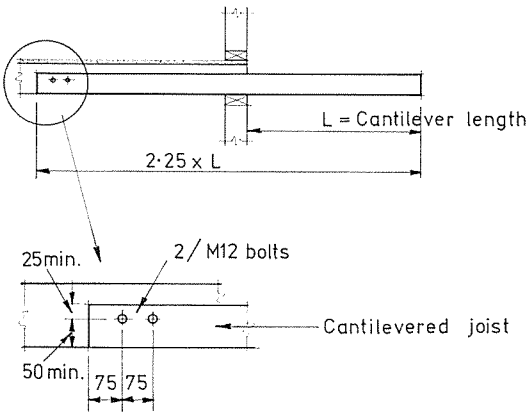


Fig. 33 : Cantilevered floor joists

5.1.5.3
Cantilevered floor joists shall either:

(a) Be continuous over the outermost support; or

(b) Be lapped over the outermost support and fixed to the adjacent joist as shown in fig. 33 with the total length of the cantilevered joist being not less than 2.25 times the cantilever length.

C5.1.5.3
The free ends of cantilevered floor joists of green timber should be propped level until the moisture content is 24 percent or less, because green timber cantilevered joists can deflect excessively under their own weight and assume permanent deformations unless propped, see NZS 3602.*

5.1.5.4
For the purposes of determining the sizes of members supporting cantilevered floor joists, the span of such joists shall be taken as being 2.5 times the actual cantilever length (see also clause 1.2.11).

5.1.6
Trimmers and trimming joists

5.1.6.1
Openings in joisted floors shall be bounded by trimmers and trimming joists (see fig. 34).

5.1.6.2
Trimmers shall be the same depth as the curtailed joists and for:

(a) Trimmer spans not exceeding l.8 m: 25 mm thicker than the curtailed joists;

(b) Trimmer spans not exceeding 2.4 m: 50 mm thicker than the curtailed joists.

5.1.6.3
Trimming joists shall be the same depth as the curtailed joists and for:

(a) Trimmer spans not exceeding l.8 m:

(i) Trimming joist spans not exceeding 3 m: 25 mm thicker than the curtailed joists;

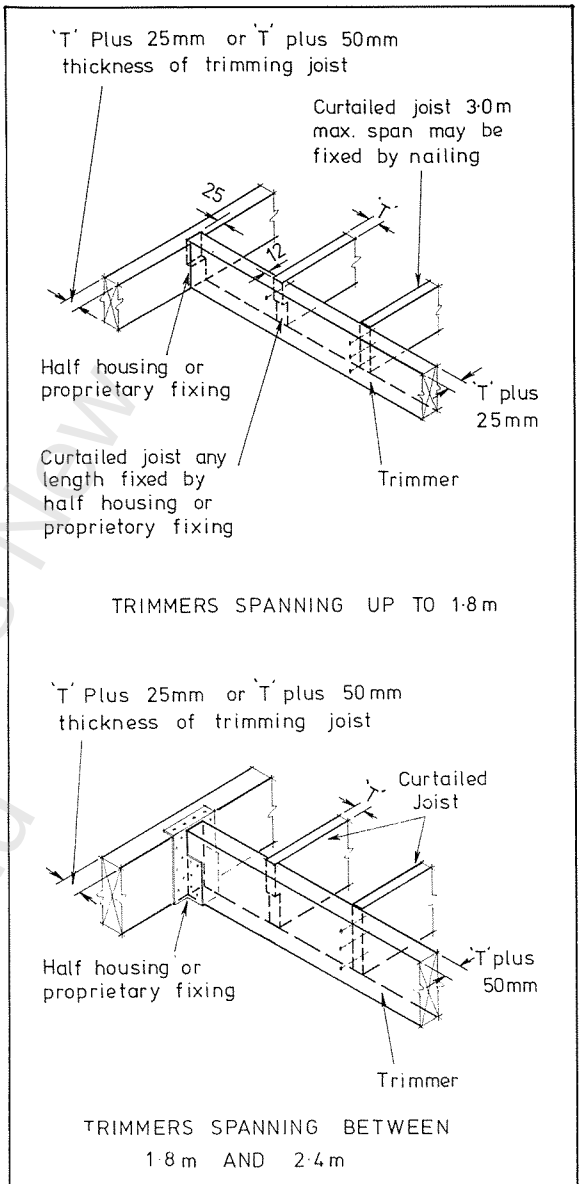


Fig. 34 : Framing around openings in joisted floors

(ii) Trimming joist spans exceeding 3 m: 50 mm thicker than the curtailed joists;

(b) Trimmer spans not exceeding 2.4 m: 50 mm thicker than the curtailed joists.

5.1.6.4
Curtailed joists shall be attached to trimmers as follows:

(a) Only curtailed joist spans not exceeding 3 m: By not fewer than three nails through the trimmer and extending not less than 50 mm into the ends of the curtailed joists; or

(b) By a half housing not less than 12 mm deep; or

(c) By a connector having a capacity of:

(i) Curtailed joist spans not exceeding 3 m: 2.7 kN;

(ii) Curtailed joist spans exceeding 3 m: 4.5 kN.

* see list of related documents

5.1.6.5
Trimmers shall be fixed to trimming joists as follows:

(a) By a half housing not less than 25 mm deep; or

(b) By a connector having a capacity of:

(i) Trimmer spans not exceeding l.8 m: 5.3 kN;

(ii) Trimmer spans not exceeding 2.4 m: 7.6 kN.

5.1.7
Holes and notches in floor joists

5.1.7.1
Holes drilled in floor joists other than cantilevered joists shall:

(a) Be within the middle third of the depth of the joist; and

(b) Be not more than three times the depth of the joist from the face of a support (see fig. 35).

5.1.7.2
Notches in floor joists other than cantilevered joists shall be not more than 450 mm from the face of a support; provided that notches that do not reduce the effective depth of a joist to less than the minimum depth required by table 8 for the joist span concerned shall be permitted in any position (see fig. 35).

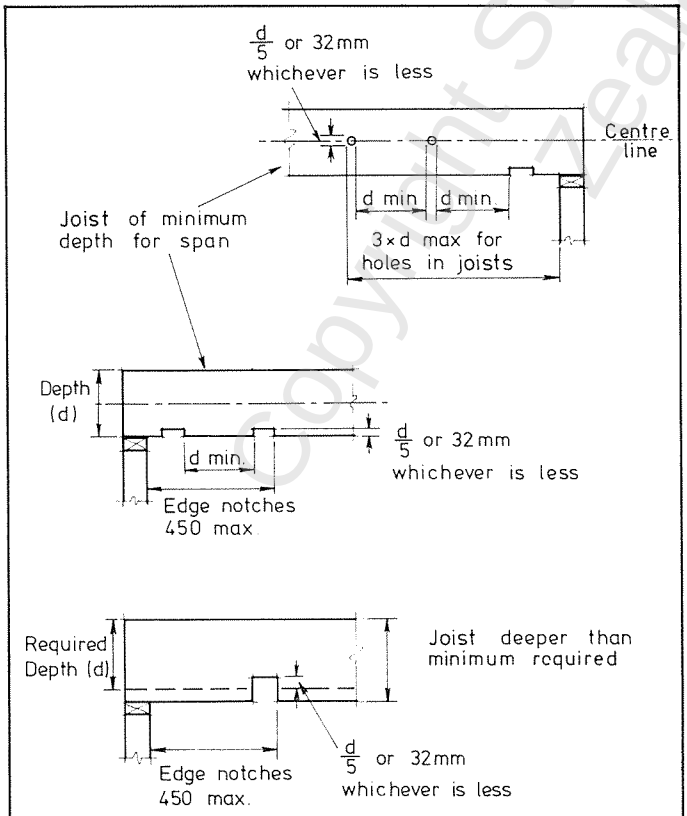


Fig. 35 : Holes and notches in floor joists other than cantilevered joists

5.1.7.3
Holes and notches shall be:

(a) Not more in diameter or depth than one-fifth the depth of the joist or 32 mm, whichever is the lesser;

(b) Be at minimum spacing measured along the joist between the edges of the holes or notches of not less than the depth of the joist.

5.2
FLOOR DECKING

5.2.1
General

5.2.1.1
Floor decking shall:

(a) Provide safe support within acceptable deflections for the appropriate floor loads;

(b) Provide a suitable surface for the support, application, and attachment of subsequent decorative and wear-resistant finishes if it does not itself possess such qualities; and

(c) Be of satisfactory durability.

5.2.2
Timber strip flooring

5.2.2.1
The minimum dry dressed thickness of tongued and grooved boards for timber strip flooring shall be as given by table 10.

5.2.2.2
Floor boards shall be laid in straight parallel lines at right angles to the joists, with tongues fitted into grooves and cramped tightly together.

5.2.2.3
Floor boards that do not have matching tongued and grooved ends shall be cut square on ends and butted tightly together at end joints. End joints shall be made over joists, and end joints in adjacent boards shall be staggered.

Table 10 STRIP FLOORING

1.5 kPa and 2.0 kPa floor loads

Maximum spacing of joists	*Minimum dry dressed thickness of tongued and grooved strip flooring of species listed below as:*	
	Type A	*Type B*
(mm)	(mm)	(mm)
400	16	16
450	19	16
600	22	19

Type A timbers: Radiata Pine, Matai, Rimu, Red Beech, Silver Beech, Douglas Fir, Larch.

Type B timbers: Tawa, Hard Beech, Jarrah, Karri, Blackbutt, Tallowwood.

(a) Diaphragms may be of any shape provided that any diaphragm or part of a diaphragm which is rectangular in plan shall have a length not exceeding 2.0 times its width, both length and width measured between supporting walls or projected lines of supporting walls or projected lines of supporting walls, except that for single storey buildings, the lenght may be 2.5 times the width.

(b) The floor decking shall consist of a sheet flooring material complying with clause 5.2.3 over the entire area of the diaphragm;

(c) The minimum sheet size shall be 2400 mm x l200 mm except where the building dimensions prevent the use of a complete sheet;

(d) The entire perimeter of a ground floor diaphragm shall be supported by foundation walls complying with clause 4.6, excluding single-wythe clay masonry foundation walls;

(e) The entire perimeter of a floor diaphragm other than a ground floor diaphragm shall be located over and connected to walls containing the number of bracing units required by clause 6.3.5.2.

C5.3.1
Where it is necessary to subdivide a floor into more than one diaphragm so as to comply with clause 5.3.1 (a), one wall will support the edges of two diaphragms (see clause C4.3.1).

5.2.2.4
Floor boards that have matching tongued and grooved ends shall have tongues fitted into grooves and butted tightly together at end joints. End joints need not be made over joists provided that:

(a) Each unjointed length of board shall be supported by two or more joists;

(b) In any span between joists there shall be two or more unjointed boards between end jointed boards.

5.2.2.5
Floor boards shall be fixed to each joist. Nails shall be well punched to allow for subsequent sanding and stopping; nails skew driven through tongues profiled for secret nailing shall be punched to allow full entry of the tongue into the groove.

5.2.3
Sheet flooring

C5.2.3
Sheet flooring materials are acceptable in accordance with clause 2.3. See also NZS 3602.*

5.2.3.1
Sheet flooring material shall to the greatest possible extent be laid in complete sheets.

5.2.3.2
Joints in sheet flooring material shall be made over supports; 50 mm x 50 mm timbers fixed between joists with their top surfaces set to a common level shall be provided as necessary for this purpose.

5.2.3.3
Each sheet shall be fastened along each edge to framing or blocking members and shall also be fastened to every intermediate framing member. Fastenings shall be not less than 10 mm from sheet edges.

5.3
STRUCTURAL FLOOR DIAPHRAGMS

5.3.1
Floor diaphragms required to comply with clauses 4.3.1 (a), 4.4.1 (a), 4.5.5.2 (c) (ii), or 6.3.5.1 shall be constructed as follows:

(a) Diaphragms may be on any shape provided that any diaphragm or part of a diaphragm which is rectangular in plan shall have a length not exceeding 2.0 times its width, both length and width measured between supporting walls or projected lines of supporting walls, except that for single storey buildings, the length may be 2.5 times the width.

(b) The floor decking shall consist of a sheet flooring material complying with clause 5.2.3 over the entire area of the diaphragm;

(c) The minimum sheet size shall be 2400 mm x l200 mm except where the building dimensions prevent the use of a complete sheet;

(d) The entire perimeter of a ground floor diaphragm shall be supported by foundation walls complying with clause 4.6, excluding single-wythe clay masonry foundation walls;

(e) The entire perimeter of a floor diaphragm other than a ground floor diaphragm shall be located over and connected to walls containing the number of bracing units required by clause 6.3.5.2.

C5.3.1
Where it is necessary to subdivide a floor into more than one diaphragm so as to comply with clause 5.3.1 (a), one wall will support the edges of two diaphragms (see clause C4.3.1).

* see list of related documents

6
WALLS

6.1
GENERAL

6.1.1
The wall system of each storey shall consist of:

(a) A system to resist vertical loads and complying with clause 6.2;

combined with

(b) A system to resist horizontal loads and complying with clause 6.3;

and

(c) Any other walls (such walls will be loadbearing).

6.2
SYSTEMS TO RESIST VERTICAL LOADS

6.2.1
The wall system to resist vertical loads shall be such that all roof framing members and all floor framing members not supported by a subfloor framing system complying with section 4 shall be directly supported by any of the following or any combination of them:

(a) Another roof or floor framing member;

(b) A loadbearing wall framing member;

(c) A post.

6.3
SYSTEMS TO RESIST HORIZONTAL LOADS

6.3.1
General

6.3.1.1
The wall system to resist horizontal loads in any storey shall consist of wall bracing elements complying with clause 6.9 in the following walls:

(a) External walls as required by clause 6.3.3;

(b) Internal walls on bracing lines as required by clause 6.3.4;

(c) Walls connected to the four edges of a diaphragm complying with clause 6.3.5.1 as required by clause 6.3.5.2.

6.3.1.2
Subject to clause 6.3.1.1, wall bracing elements shall as far as is practicable be located at the corners of external walls and evenly throughout the building.

6.3.1.3
Each wall bracing element shall be rated at the number of bracing units given by clause 6.9.1.

6.3.1.4
The total number of bracing units of all wall bracing elements in each of two directions at right angles to each other in any storey shall be as required by clause 6.3.2; provided that in any building consisting of wings or blocks that are not at right angles to each other this requirement shall be satisfied individually for each such wing or block.

6.3.2
Total number of bracing units

6.3.2.1
The total number of bracing units of all wall bracing elements in each of two directions at right angles to each other in any storey shall be not less than the greater of:

(a) The number of bracing units per square metre given by table 11A for earthquake multiplied by the gross roof plan area in square metres of the roof above the storey being considered, provided that for the lower storeys of two-storey and three-storey buildings with light roofs the gross floor area of the floor above the storey being considered may be used instead of the gross roof plan area; provided that for Class I or Class II buildings, Appendix J tables 47 or 50 shall be used instead of table 11A as appropriate.

(b) The number of bracing units per metre given by table IIB for wind multiplied by the maximum horizontal dimension of the roof above the storey being considered measured at right angles to the wall bracing elements being considered, provided that for roofs not steeper than 25° the maximum horizontal dimension of the external wall of the storey being considered may be used instead of the maximum horizontal dimension of the roof.

C6.3.2.1
The total number given by table 11A for earthquake loading will be the same for each of the two directions that are to be considered in each storey. The total number given by table 11B for wind loading will be different for the two directions (except for square buildings).

6.3.3
Wall bracing elements in external walls

6.3.3.1
Subject to clause 6.3.5.2, each external wall exceeding 3 m long in any storey shall contain a total of not less than 10 bracing units per metre of its length.

6.3.3.2
For the purpose of clause 6.3.3.1 only, the wall length shall be taken as the total length of all external walls in the same direction that are offset not more than 2 m from the adjacent parallel wall.

C6.3.3.2
The length of an external wall is normally measured between any two adjacent corners, but for the purpose of clause 6.3.3.2 it is measured between adjacent corners of return walls exceeding 2 m long.

6.3.3.3
Where diagonal dragon ties complying with clause 6.3.3.4 are used, then for the purposes of determining the distance from an external wall to an adjacent

parallel bracing line as given by clause 6.3.4.2, the external wall line may be considered to be moved up to 2.5 m so as to lie through the intersection of the dragon ties with the adjoining walls at right angles (see fig. 36A), provided that :

(a) The external wall contains not less than 100 bracing units;

(b) The adjoining external walls each contain, or are each connected to, a wall which contains not fewer than 100 bracing units.

6.3.3.4
Where dragon ties are used in accordance with clause 6.3.3.3 they shall be located one at each end of the external wall being considered and shall each:

(a) Consist of a continuous length of 100 mm x 40 mm timber, or a continuous length of 50 mm x 1 mm steel strip;

(b) Be connected to the top plates of the external wall and the adjoining external wall at right angles as given by clause 6.3.3.3, and to intermediate joists, rafters or trusses;

(c) Be fixed to the adjoining external wall not more than 2.5 m from the junction of that wall with the external wall;

(d) Be at an angle of not more than 45° to the external wall being considered.

6.3.3.5
Dragon ties shall either be fixed directly to the top plates or, in the case of timber dragon ties, may be fixed to blocking pieces which are not deeper than 100 mm and are at least 75 mm wide. At the external wall being considered the dragon tie shall also be fixed to a joist, truss or rafter located within 100 mm of the top plate. At the adjoining walls at right angles the blocking piece shall span between and be fixed to adjacent joists, trusses or rafters. Steel strip dragon ties shall have their ends bent over the outside of the top plate, and half of the nails shall be driven into the side and half into the top of the top plate (see fig. 36A).

6.3.4
Wall bracing elements in internal walls on bracing lines

6.3.4.1
Bracing lines shall be parallel to external walls except as provided by clause 6.3.1.4.

6.3.4.2
Bracing lines in any storey shall be at not more than 5 m centres in each direction between external walls, provided that there need be no bracing lines within the area covered by a diaphragm complying with clause 6.3.5.1 supported by walls complying with clause 6.3.5.2.

C6.3.4.2
Bracing lines in each storey are considered separately and need not coincide with those of the storey below nor with the subfloor lines of horizontal support required by section 4.

Table 11 BRACING UNITS
1.5 kPa and 2.0 kPa floor loads

A For earthquake

Location of storey	*Average slope of roof*	*Minimum number of bracing units per square metre in earthquake zone:*		
		A	*B*	*C*
Light Roof				
Single storey or top storey	0°-25°	2	2	2
	26°-45°	3	2	2
	46°-60°	3	2	2
Lower of two storeys or middle of three storeys	0°-25°	5	4	3
	26°-45°	5	4	4
	46°-60°	6	5	4
Lowest of three storeys	0°-25°	7	6	5
	26°-45°	8	6	5
	46°-60°	8	7	6
Heavy Roof				
Single storey or top storey	0°-25°	3	3	2
	26°-45°	4	4	3
	46°-60°	5	4	3
Lower of two storey or middle of three storeys	0°-25°	6	5	4
	26°-45°	7	6	5
	46°-60°	7	6	5
Lowest of three storeys	0°-25°	8	7	6
	26°-45°	9	8	6
	46°-60°	10	8	7

B For wind

Location of storey †	*Height of each storey* (m)	*Minimum number of bracing units per metre for wind acting on the walls in wind exposure and for roof slope: ϕ*					
		LOW		MEDIUM		HIGH	
		≤25°	≥25°	≤25°	≥25°	≤25°	≥25°
Single or top	2.4	9	11	12	14	18	22
Lower of two or middle of three	2.4	27	33	35	43	55	67
Lower of three	2.4	45	54	58	71	91	111
Single or top	3.6	13	16	18	21	27	33
Lower of two	3.6	40	49	52	64	82	100
Single or top	4.8	18	22	23	29	36	44
Lower of two	4.8	53	65	70	85	109	133

Slope of roof ϕ*	*Height of roof* (m)**	*Minimum number of bracing units per metre for wind acting on the roof in wind exposure: ϕ*		
		LOW	MEDIUM	HIGH
0°-10°	1	0	0	0
11°-25°	1	7	9	14
	3	21	27	42
26°-35°	1	8	10	16
	5	40	50	80
36°-60°	1	10	13	20
	8	80	104	160

ϕ The minimum number of bracing units is to be the sum of those for wind acting on the walls and wind acting on the roof.

ϕ* The slope of roof is to be taken as the greatest of the slopes parallel to the direction being braced. For roofs with gable ends the roof slope shall be taken as being 36°-60° for bracing at right angles to the gable.

** The height of roof is the average vertical height of the top edge of the roof (ridge, hip or verge) above the level of the eaves, for the entire roof elevation at right angles to the direction being braced.

† This is the location of the storey being braced.

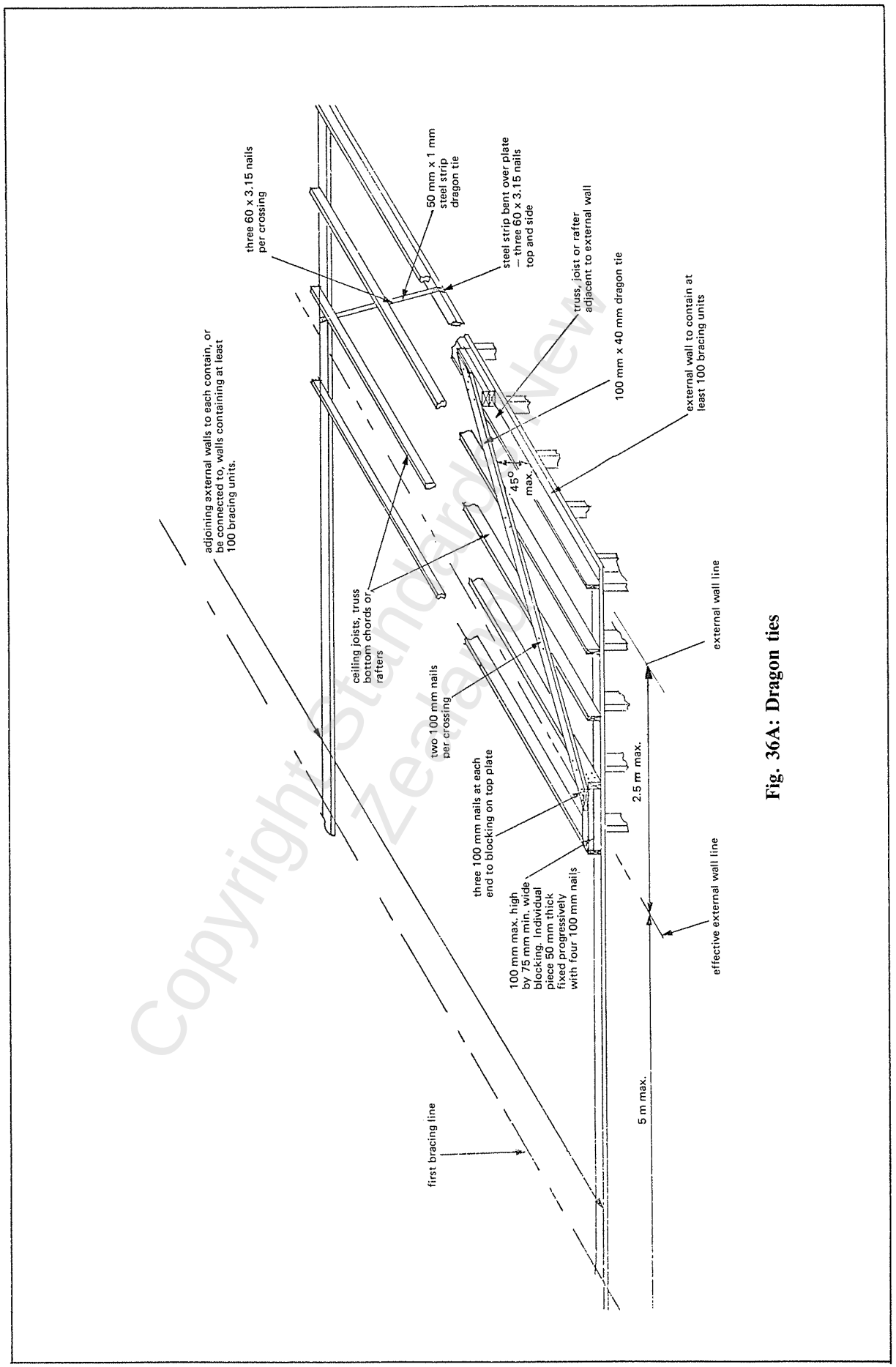


Fig. 36A: Dragon ties

6.3.4.3
Each bracing line shall contain a total of not less than 70 bracing units contributed by either of the following or any combination of them:

(a) Wall bracing' elements in internal walls on the bracing line;

(b) Pairs of wall bracing elements in internal walls parallel to the bracing line such that one wall bracing element is on each side of the bracing line and each wall bracing element is not more than 2 m from the bracing line.

6.3.5
Diaphragms

6.3.5.1
A diaphragm used with a wall system to resist horizontal loads shall be directly supported by walls in the storey being considered and shall be one of the following:

(a) A floor diaphragm complying with clause 5.3 and having a length not exceeding 15 m;

(b) A ceiling diaphragm complying with clause 12.5.

6.3.5.2
Each edge of the diaphragm shall be connected to a wall containing a total of not less than 10 bracing units per metre of diaphragm dimension measured at right angles to the wall being considered, provided that no such wall shall contain less than 100 bracing units. Where two diaphragms are connected to a wall, then the requirements for that wall shall be the sum of those required for each diaphragm.

6.4
WALL FRAMING: GENERAL REQUIREMENTS

6.4.1
Except as permitted by clause 6.4.2, wall framing timbers shall be set plumb and square.

6.4.2
For the purpose of forming mansard roofs only, wall frames may be inclined not more than 20° from the vertical.

6.4.3
For the purpose of determining the dimensions of wall framing members, the roof dimension *S* shall be determined in accordance with fig. 36B, except as provided by clause 1.2.11(b), and provided that when the eaves overhang exceeds 750 mm then the roof dimension *S* shall be increased by twice the additional eaves overhang.

C6.4.3
The roof dimension S *determined in accordance with fig. 36B relates to the roof mass carried by the walls. It does not correspond to the span of a roof member and must not be used for determining the sizes of roof members.*

Wall framing member sizes were determined on the basis that the roof loading corresponded to S *plus an eaves overhang not exceeding 750 mm; however, it is not permitted to reduce* S *when the eaves overhang is less than 750 mm.*

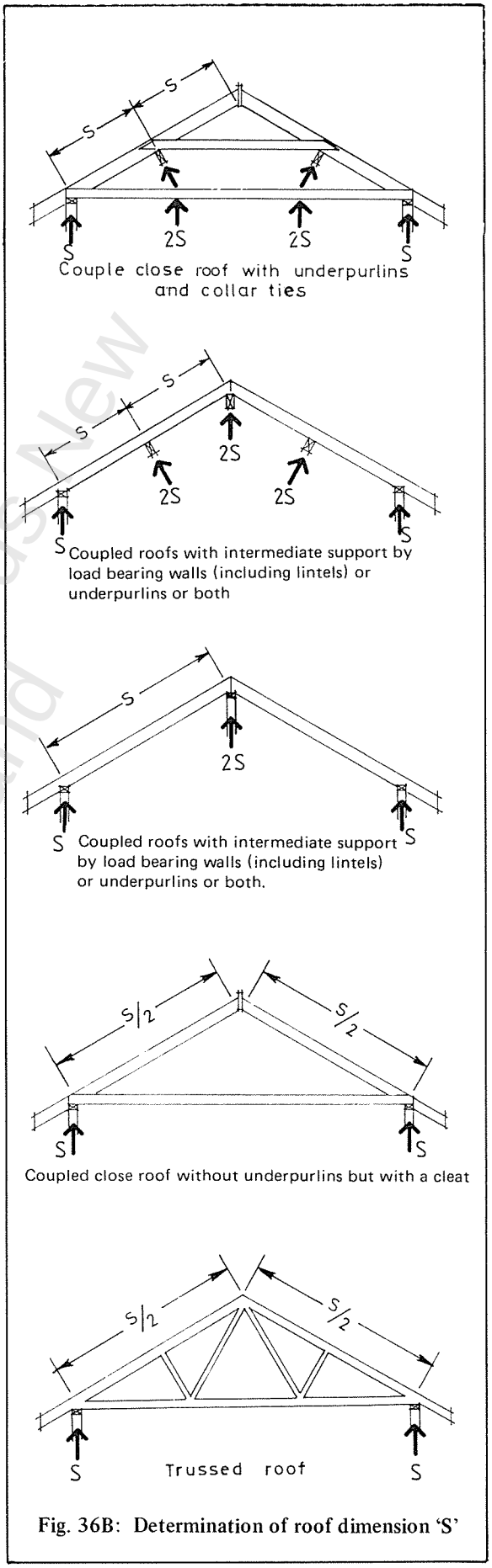


Fig. 36B: Determination of roof dimension 'S'

6.5 STUDS

6.5.1 General

6.5.1.1
Studs shall be of the following dimensions:

(a) Loadbearing walls: As given by table 12 except that two 40 mm thick studs may be used instead of one 75 mm thick stud of the same width, and two 50 mm thick studs may be used instead of one 100 mm thick stud of the same width; provided that table 13 shall apply when No. 2 Framing grade or Building B grade timber is used in accordance with clause 6.5.1.4; and for the purposes of balloon framing the length (height) of studs is measured between a plate and the ribbon board. Gable end walls supporting the weight of gable verges only shall be regarded as load bearing walls but the stud sizes only may be as given by table 14.

(b) Non-loadbearing walls: As given by table I4 except that two 40 mm thick studs may be used instead of one 75 mm thick stud of the same width, and two 50 mm thick studs may be used instead of one 100 mm thick stud of the same width.

C6.5.1.1
Figure 37 shows the location of walls as referred to in tables 11, 12, 15, 18, 19, and 20.

6.5.1.2
The wind exposure shall be:

(a) External walls: As given by table I, or as given by fig. 4 for locations not listed in table I;

(b) Internal walls (including party walls): Low wind exposure.

C6.5.1.2
Treating internal walls as if they were subjected to low wind exposure allows, among other things, for the effects of varying air pressures within a building (which can impose significant loadings during high winds if doors, windows, and the like open or break). It also ensures a minimum level of strength and stiffness for general serviceability.

6.5.1.3

When both floor joists and roof members contribute load to a loadbearing wall, the stud size shall be that given for the joist span or that given for the roof dimension *S* (see clause 6.4.3), whichever is the greater.

6.5.1.4
No. 2 Framing grade may be used for internal non-loadbearing walls as given by table 14 and may be used for studs in loadbearing walls subject to the following conditions:

(a) The wall shall not be of high wind exposure;

(b) The wall shall support roof loads only;

(c) The wall shall have a row of dwangs or waling within I60 mm of its mid-height;

(d) The studs shall not be trimming studs;

(e) Stud length shall not exceed 3.0 m;

(f) Studs shall be of the dimensions given by table I3.

C6.5.1.4
Clause 6.5.1.4 conflicts with NZS 3602, which specifies No. 2 Framing grade for studs in non-loadbearing internal walls only, and does not specify Building B grade for framing members. However, the grading rules in the 1978 revision of NZS 3631* now specify No. 2 Framing grade and Building B grade so that they are acceptable for the limited usage as studs permitted by this Standard, and NZS 3602* will be amended or revised accordingly. In the interim until that has been completed, clause 2.1 of this Standard lays down that if this Standard conflicts with NZS 3602* then the requirements of this Standard shall prevail.*

6.5.1.5
Wall junctions shall be framed up with not less than two studs blocked and nailed.

6.5.1.6
Holes in the face and notches in the edge of a stud shall be not more in diameter or depth respectively than:

(a) 75 mm wide studs: 19 mm, provided that this may be increased to 22 mm for the purpose of fitting diagonal braces complying with clause 6.9.2.3;

(b) 100 mm wide studs: 25 mm, provided that this may be increased to 35 mm where not more than three consecutive studs are drilled or notched.

* see list of related documents

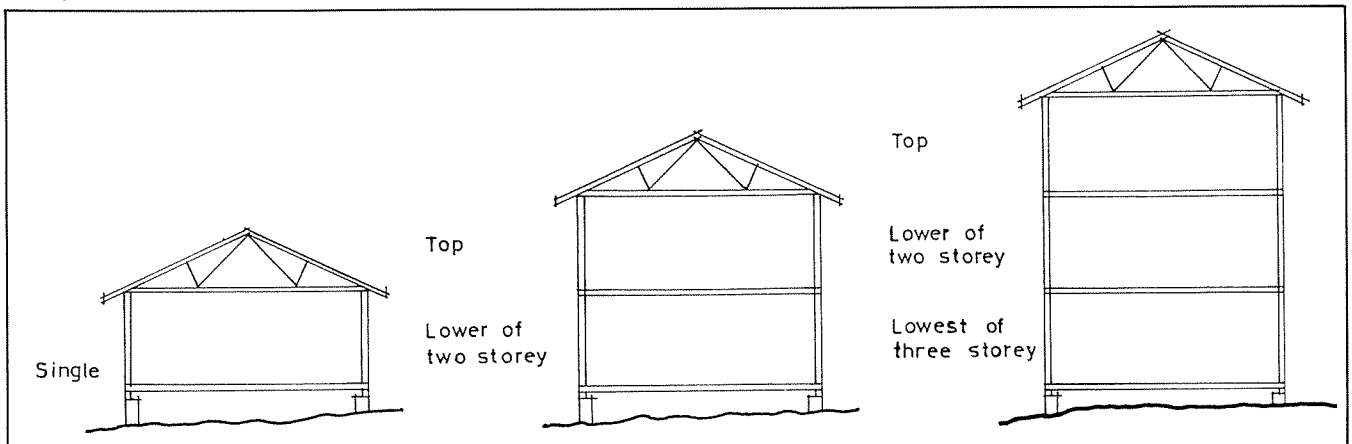


Fig. 37 : Location of wall framing for the purposes of tables 11, 12, 15, 18, 19 and 20.

Table 12 STUDS IN LOADBEARING WALLS
1.5 kPa and 2.0 kPa floor loads

A Single or top storey – Light roof

Wind exposure	*Maximum span of member supported * (m)*	*Stud sizes for studs of maximum length (height) of:*								
		2.4 m			*2.7 m*			*3.0 m*		
		At a maximum stud spacing (mm) of:			*At a maximum stud spacing (mm) of:*			*At a maximum stud spacing (mm) of:*		
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
		(mm x mm)	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*
High	6.0	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 50	100 x 50	100 x 50	100 x 75
	9.0	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75	100 x 50	100 x 75	100 x 75
	12.0	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75	100 x 50	100 x 75	100 x 75
Medium	6.0	75 x 50	75 x 50	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
	9.0	75 x 50	75 x 50	100 x 40	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
	12.0	75 x 50	75 x 50	100 x 40	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
Low and internal walls	6.0	75 x 50	75 x 50	75 x 50	75 x 50	75 x 50	75 x 50	75 x 50	100 x 40	100 x 40
	9.0	75 x 50	75 x 50	75 x 50	75 x 50	75 x 50	100 x 40	75 x 50	100 x 40	100 x 40
	12.0	75 x 50	75 x 50	75 x 50	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40
		3.6 m			*4.2 m*			*4.8 m*		
		At a maximum stud spacing (mm) of:			*At a maximum stud spacing (mm) of:*			*At a maximum stud spacing (mm) of:*		
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
		(mm x mm)	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*
High	6.0	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75	150 x 75	–
	9.0	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75	150 x 75	–
	12.0	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75	150 x 75	–
Medium	6.0	100 x 75	100 x 75	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75
	9.0	100 x 75	100 x 75	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75
	12.0	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75
Low and internal walls	6.0	100 x 40	100 x 50	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75
	9.0	100 x 40	100 x 50	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75
	12.0	100 x 40	100 x 50	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75

* The greater of roof dimension *S* (see clause 6.4.3) or span of joists.

B Top or single storey – Heavy roof

Wind exposure	*Maximum span of member supported* (m)*	*Stud sizes for studs of maximum length (height) of:*								
		2.4 m			*2.7 m*			*3.0 m*		
		At a maximum stud spacing (mm) of:			*At a maximum stud spacing (mm) of:*			*At a maximum stud spacing (mm) of:*		
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
		(mm x mm)	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*
High	6.0	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75	100 x 50	100 x 75	100 x 75
	9.0	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75	100 x 50	100 x 75	100 x 75
	12.0	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75	100 x 75	100 x 75	100 x 75
Medium	6.0	75 x 50	75 x 50	100 x 40	100 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
	9.0	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
	12.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 50
Low and internal walls	6.0	75 x 50	75 x 50	75 x 50	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40
	9.0	75 x 50	75 x 50	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	12.0	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
		3.6 m			*4.2 m*			*4.8 m*		
		At a maximum stud spacing (mm) of:			*At a maximum stud spacing (mm) of:*			*At a maximum stud spacing (mm) of:*		
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
		(mm x mm)	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*
High	6.0	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75	150 x 75	–
	9.0	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75	150 x 75	–
	12.0	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75	150 x 75	–
Medium	6.0	100 x 75	100 x 75	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75
	9.0	100 x 75	100 x 75	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75
	12.0	100 x 75	100 x 75	100 x 100	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75	150 x 75
Low and internal walls	6.0	100 x 40	100 x 50	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75
	9.0	100 x 50	100 x 50	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75
	12.0	100 x 50	100 x 50	100 x 75	100 x 75	100 x 100	150 x 50	150 x 50	150 x 50	150 x 75

*The greater of roof dimension *S* (see clause 6.4.3) or span of joists.

C Lower of two storey or subfloor beneath one storey

Wind exposure	*Maximum span of member supported * (m)*	*Stud sizes for studs of maximum length (height) of:*								
		2.4 m			*2.7 m*			*3.0 m*		
		At a maximum stud spacing (mm) of:			*At a maximum stud spacing (mm) of:*			*At a maximum stud spacing (mm) of:*		
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
		(mm x mm)	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*
High	6.0	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75	100 x 50	100 x 75	100 x 75
	9.0	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75	100 x 75	100 x 75	100 x 75
	12.0	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75	100 x 75	100 x 75	100 x 75
Medium	6.0	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
	9.0	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 40	100 x 50
	12.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75
Low and internal walls	6.0	75 x 50	75 x 50	100 x 40	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40
	9.0	75 x 50	75 x 50	100 x 40	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50
	12.0	75 x 50	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50

* The greater of roof dimension *S* (see clause 6.4.3) or span of joists.

D Lower of three storey or subfloor beneath two storey

Wind exposure	*Maximum span of member supported * (m)*	*Stud sizes for studs of maximum length (height) of:*								
		2.4 m			*2.7 m*			*3.0 m*		
		At a maximum stud spacing (mm) of:			*At a maximum stud spacing (mm) of:*			*At a maximum stud spacing (mm) of:*		
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
		(mm x mm)	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*	*(mm x mm)*
High	6.0	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75	100 x 75	100 x 75	100 x 75
	9.0	100 x 40	100 x 50	100 x 75	100 x 50	100 x 50	100 x 75	100 x 75	100 x 75	100 x 75
	12.0	100 x 40	100 x 50	100 x 75	100 x 50	100 x 75	100 x 75	100 x 75	100 x 75	100 x 100
Medium	6.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75
	9.0	100 x 40	100 x 40	100 x 50	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75
	12.0	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75	100 x 50	100 x 50	100 x 75
Low and internal walls	6.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 40	100 x 50
	9.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75
	12.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 40	100 x 50	100 x 75

NOTE – In table 12:

100 x 40 may be substituted for 75 x 50
125 x 40 may be substituted for 100 x 75
125 x 50 may be substituted for 100 x 100

* The greater of roof dimension *S* (see clause 6.4.3) or span of joists.

Table 13 STUDS OF NO. 2 FRAMING GRADE OR BUILDING B GRADE IN LOADBEARING WALLS

Wind exposure	*Maximum roof dimension S**	*Stud size for maximum spacing of studs (mm) of:*		
		400	*480*	*600*
	(m)	(mm x mm)	(mm x mm)	(mm x mm)
Medium	6.0	100 x 40	100 x 50	100 x 75†
	12.0	100 x 50	100 x 50	100 x 75
Low and internal walls	6.0	100 x 40	100 x 40	100 x 50
	12.0	100 x 40	100 x 40	100 x 50

* See clause 6.4.3.

† 100 mm x 50 mm may be used for light roofs only.

Table 14 STUDS IN NON-LOADBEARING WALLS

Wind exposure	*Maximum length (height) of stud*	*Stud size for stud spacings (mm) of:*		
		400	*480*	*600*
	(m)	(mm x mm)	(mm x mm)	(mm x mm)
High	2.4	75 x 50	100 x 40	100 x 40
	2.7	100 x 40	100 x 50	100 x 50
	3.0	100 x 50	100 x 50	100 x 75
	3.3	100 x 75	100 x 75	100 x 100
	3.6	100 x 100	100 x 100	150 x 50
	3.9	150 x 50	150 x 50	150 x 50
	4.2	150 x 50	150 x 50	150 x 75
	4.8	150 x 75	150 x 75	150 x 100
Medium	2.4	75 x 50	75 x 50	75 x 50
	2.7	75 x 50	75 x 50	100 x 40
	3.0	100 x 40	100 x 40	100 x 50
	3.3	100 x 40	100 x 50	100 x 75
	3.6	100 x 75	100 x 75	100 x 100
	3.9	100 x 75	100 x 100	150 x 50
	4.2	100 x 100	150 x 50	150 x 50
	4.8	150 x 50	150 x 75	150 x 75
Low and internal walls	2.4	75 x 40	75 x 40	75 x 50
	2.7	75 x 40	75 x 40	75 x 50
	3.0	75 x 50	100 x 40	100 x 40
	3.3	100 x 40	100 x 50	100 x 50
	3.6	100 x 40	100 x 50	100 x 75
	3.9	100 x 75	100 x 75	100 x 100
	4.2	100 x 75	100 x 100	150 x 50
	4.8	150 x 50	150 x 50	150 x 75

NOTE – In table 14:

100 x 40 may be substituted for 75 x 50
125 x 40 may be substituted for 100 x 75
125 x 50 may be substituted for 100 x 100

Table 15 TRIMMING STUDS
1.5 kPa and 2.0 kPa floor loads

Maximum clear width of opening (span of lintel)	*Thickness of other studs required if at 600 mm spacing*	*Thickness of trimming studs*
(mm)	(mm)	(mm)
A Single storey, top storey or non-loadbearing walls		
1.8	40	50
	50	50
	75	100
	100	125
3.0	40	50
	50	75
	75	100
	100	150
3.6	40	75
	50	100
	75	150
	100	200
B Any other location		
0.9	40	50
	50	75
	75	100
	100	150
1.8	40	75
	50	75
	75	125
	100	150
3.0	40	75
	50	100
	75	150
	100	200
3.6	40	100
	50	125
	75	175
	100	250

6.5.2
Trimming studs

6.5.2.1
A trimming stud shall be provided to each side of any opening as follows (see fig. 38);

(a) Trimming studs shall have the same width as the studs in the wall and subject to clause 6.6.1.4 shall have the thickness given by table 15 provided that:

(i) Double studs nailed together to give a total thickness not less than that required by table 15 may be used;

(ii) A doubling stud providing seating for a lintel shall not be more than 350 mm shorter than the doubled stud;

C6.5.2.1
Where a stud adjacent to an opening has the minimum thickness required for a trimming stud, then any additional stud which is provided to support a lintel is not a doubling stud but is rather a jack stud and the provisions of this clause do not apply to this jack stud.

(b) Trimming studs, whether single or double, shall not contain holes, notches, checks, or cuts in the middle third of their length.

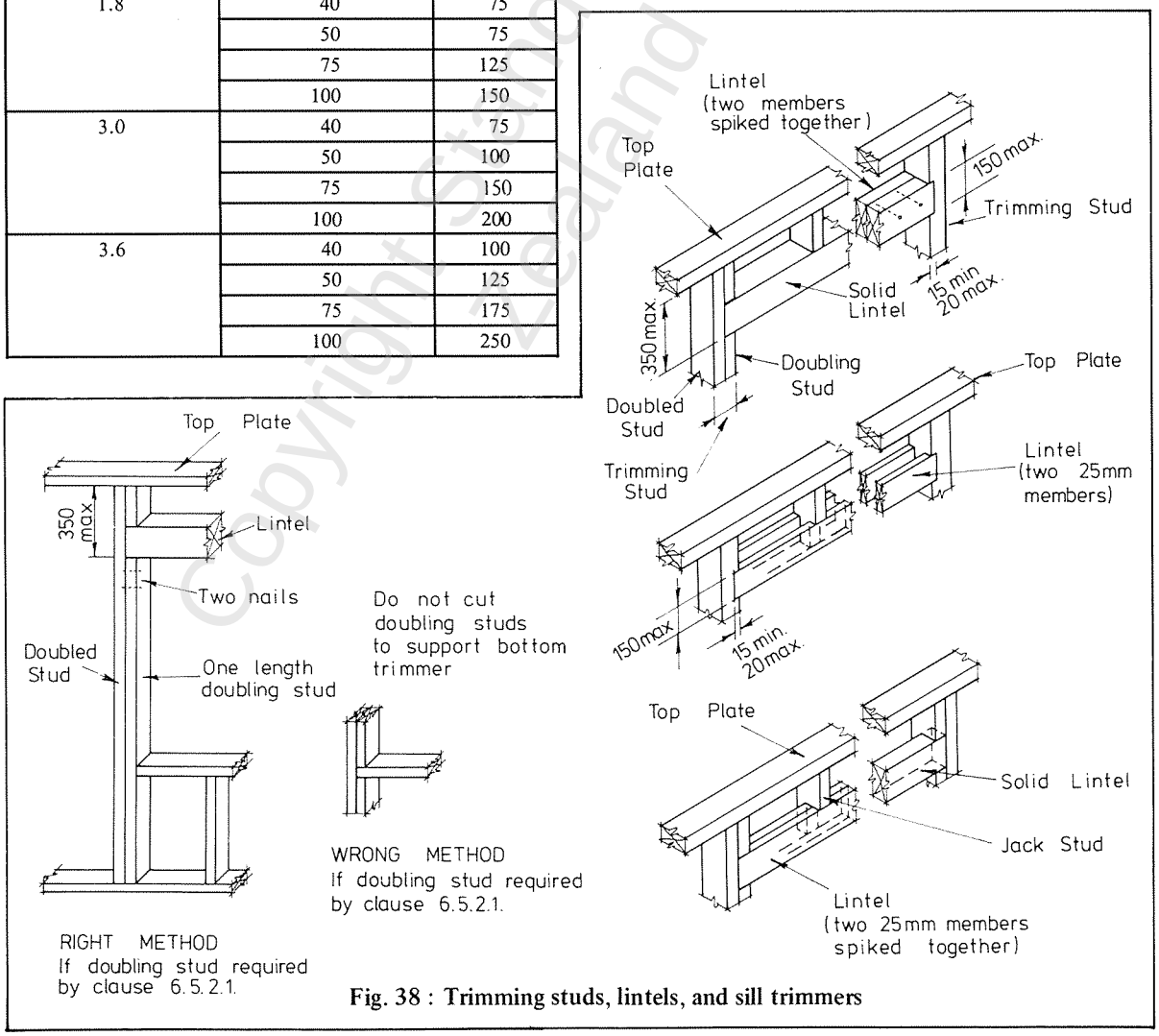


Fig. 38 : Trimming studs, lintels, and sill trimmers

6.5.3
Straightening studs

6.5.3.1
Studs may be cut through to the centreline to correct crook (see fig. 39) provided that:

(a) There shall not be more than two such cuts in any stud;

(b) Fishplates the same width as the stud, 25 mm thick, and extending not less than 225 mm past each side of the cut shall be nailed to both faces of the stud;

(c) Not more than one quarter of the studs in any run of wall shall be partially cut, and no two such cut studs shall be adjacent to one another;

(d) No trimming stud, whether single or double, shall be partially cut.

C6.5.3.1
The method of straightening specified in clause 6.5.3.1 applies only when the crook does not exceed the maximum crook permitted by NZS 3631 for the grade concerned. If the crook does exceed the maximum permitted then the stud is not of the required grade and must be removed.*

6.5.4
Lateral support of studs

6.5.4.1
All studs shall be laterally supported by either:

(a) Exterior wall coverings complying with section 8 or wall linings complying with section 9 provided that such material shall be fixed to the studs by connections of adequate rigidity (see clause 6.5.4.2); or

(b) Dwangs, walings, or metal walings in accordance with clause 6.8.

6.5.4.2
For the purpose of clause 6.5.4.1 the nailing of cladding or lining material directly to the stud shall be considered a connection of adequate rigidity, provided that building paper or similar material not exceeding 3 mm thick may separate the lining or cladding material from the stud. Masonry veneer ties, clip fixings, and adhesive fixings shall not be considered connections of adequate rigidity.

6.6
LINTELS AND SILL AND HEAD TRIMMERS

6.6.1
Lintels

6.6.1.1
Lintels shall be provided over all openings in loadbearing walls (see figures 38 and 40).

6.6.1.2
Lintels shall be of the dimensions given by table 16 which only provides for evenly distributed uniform loads at maximum 1200 mm centres, from wall framing, joists, rafters and trusses.

* see list of related documents

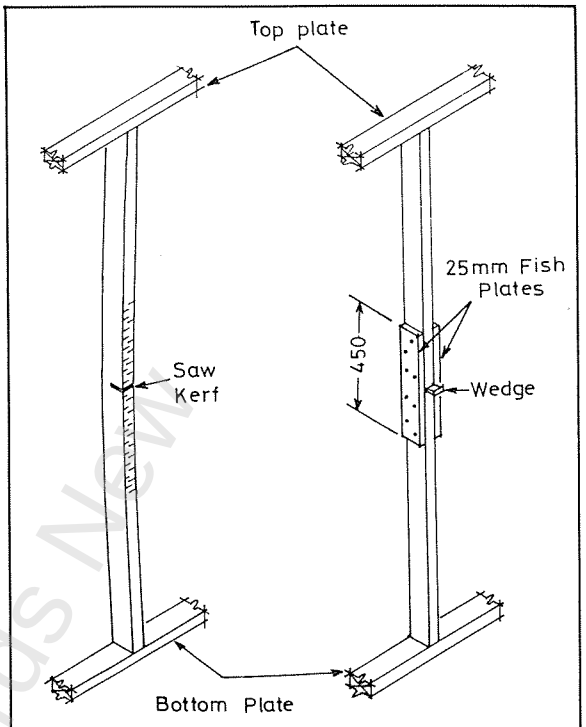


Fig. 39 : Straightening studs

C6.6.1.2
Where non-uniform concentrated loads occur on a lintel, such as from an upper storey trimming stud supporting a lintel of greater than 1.2 m span, or from a girder truss, then the lintel size must be separately calculated.

6.6.1.3
A lintel shall consist of one continuous length of timber or of two or more continuous lengths of timber, each the full depth of the lintel and 25 mm thick, nailed together.

6.6.1.4
As shown in fig. 38 lintels shall be supported at each end for the full thickness of the lintel by:

(a) For lintels not exceeding 150 mm deep: The trimming stud checked not less than 15 mm nor more than 20 mm;

(b) For lintels not exceeding 250 mm deep: A 40 mm thick doubling stud or jack stud;

(c) For lintels not exceeding 300 mm deep: A 50 mm thick doubling stud or jack stud.

6.6.1.5
Lintels supporting rafters or trusses of light roofs shall be secured against uplift in accordance with clause 6.6.1.6 where:

(a) High wind exposure:

  (i) The roof dimension *S* exceeds 6 m; or
  (ii) The lintel span exceeds 2.4 m and the roof dimension *S* exceeds 4 m;

(b) Medium wind exposure: The lintel span exceeds 2.7 m and the roof dimension *S* exceeds 8 m.

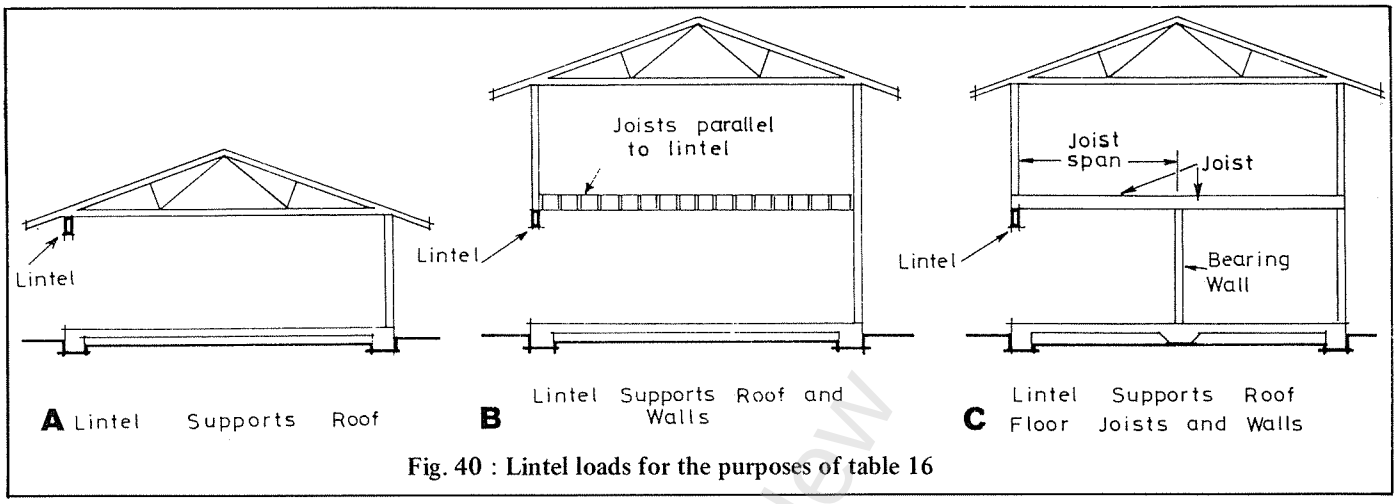


Fig. 40 : Lintel loads for the purposes of table 16

Table 16 LINTELS
1.5kPa and 2.0kPa floor loads

Maximum clear width of opening (span of lintel)	*Maximum span of member supported**	*Depth of lintel supporting:*								
		Roof only or roof and walls only where lintel thickness (mm) is: (Figs. 40A & 40B)			*Floor and walls only where lintel thickness (mm) is:*			*All other cases where lintel thickness (mm) is: (Fig. 40C)*		
		50	75	100	50	75	100	50	75	100
(m)	(m)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
A Light roof										
0.95	8.0	200	125	100	125	100	100	200	150	125
	12.0	200	150	125	125	125	100	200	200	150
1.25	8.0	200	150	125	150	125	125	200	200	150
	12.0	200	200	150	200	150	125	250	200	200
1.55	8.0	200	150	125	200	150	150	250	225	200
	12.0	200	200	150	200	200	200	300	250	200
1.85	8.0	200	200	150	225	200	200	300	250	200
	12.0	250	200	200	250	225	200	—	300	250
2.15	8.0	225	200	150	250	225	200	—	300	250
	12.0	250	225	200	300	250	225	—	—	300
2.45	8.0	250	200	150	300	250	225	—	—	300
	12.0	300	250	200	—	300	250	—	—	—
2.75	8.0	300	225	200	—	300	250	—	—	300
	12.0	—	300	225	—	—	300	—	—	—
3.05	8.0	—	250	200	—	—	300	—	—	—
	12.0	—	300	250	—	—	—	—	—	—
3.65	8.0	—	—	250	—	—	—	—	—	—
	12.0	—	—	300	—	—	—	—	—	—

* The greater of roof dimension S (see clause 6.4.3), span of joists, span of underpurlins, or span of strutting beams, as appropriate.

Table 16 (cont'd) LINTELS
1.5kPa and 2.0kPa floor loads

Maximum clear width of opening (span of lintel)	*Maximum span of member supported**	*Depth of lintel supporting:*								
		Roof only or roof and walls only where lintel thickness (mm) is: (Figs. 40A & 40B)			*Floor and walls only where lintel thickness (mm) is:*			*All other cases where lintel thickness (mm) is: (Fig. 40C)*		
		50	75	100	50	75	100	50	75	100
(m)	(m)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
B Heavy roof										
0.95	8.0	200	150	125	125	100	100	200	200	125
	12.0	200	200	125	125	125	100	225	200	150
1.25	8.0	200	200	125	150	125	125	225	200	150
	12.0	225	200	150	200	150	125	300	225	200
1.55	8.0	200	200	150	200	150	150	300	225	200
	12.0	250	200	200	200	200	200	—	300	225
1.85	8.0	250	200	200	225	200	200	—	300	225
	12.0	300	225	200	250	225	200	—	—	300
2.15	8.0	300	225	200	250	225	200	—	—	250
	12.0	—	300	225	300	250	225	—	—	300
2.45	8.0	300	250	225	300	250	225	—	—	300
	12.0	—	300	250	—	300	250	—	—	—
2.75	8.0	—	300	225	—	300	250	—	—	—
	12.0	—	—	300	—	—	—	—	—	—
3.05	8.0	—	—	250	—	—	300	—	—	—
	12.0	—	—	300	—	—	—	—	—	—
3.35	8.0	—	—	300	—	—	—	—	—	—
	12.0	—	—	—	—	—	—	—	—	—

* The greater of roof dimension S (see clause 6.4.3), span of joists, span of underpurlins, or span of strutting beams, as appropriate.

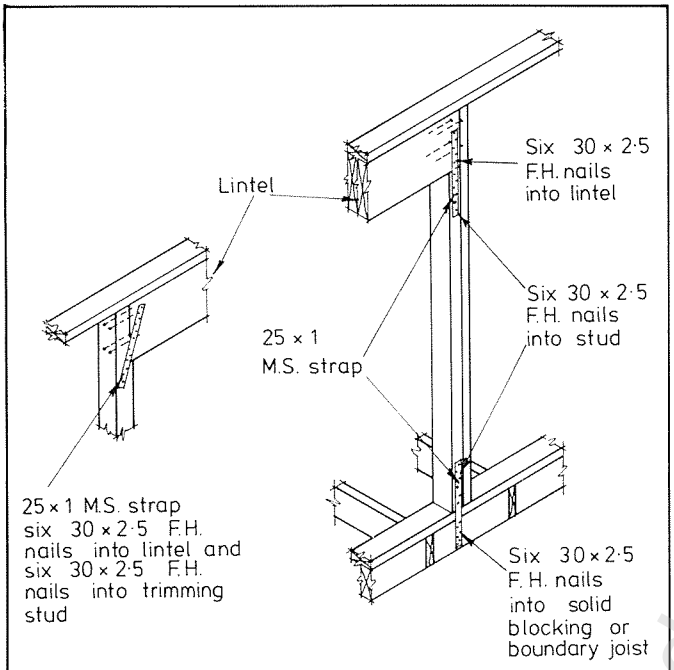


Fig. 41 : Fixing of lintels against uplift

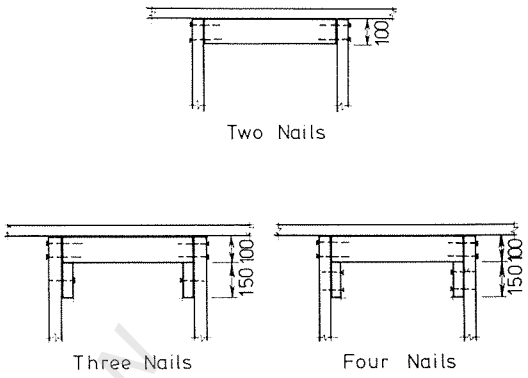


Fig. 42 : Top plates of loadbearing walls with supporting dwang on edge (see table 18 and fig. 45C)

6.6.1.6
Each lintel required by clause 6.6.1.5 to be secured against uplift shall in addition to the fixing required by Appendix A be fixed at each end to a trimming stud which is fixed to floor framing, each fixing to be as shown in fig. 41 or an alternative fixing of 5 kN capacity in tension along the line of the trimming stud.

6.6.2
Sill and head trimmers

6.6.2.1
Sill trimmers to openings shall be of the same width as the studs and of the thickness given by table 17.

6.6.2.2
Where a head trimmer to an opening is provided it shall be of the same width as the studs and of the thickness given by table 17.

Table 17 SILL AND HEAD TRIMMERS
See clause 6.6.2.1

Maximum clear width of opening	*Thickness of sill and header trimmers*
(m)	(mm)
2.0	40
2.4	50
3.0	75
3.6	100 (or two 50 mm)

6.7 PLATES

6.7.1
Top plates

6.7.1.1
Top plates of loadbearing walls shall be of the dimensions given by table 18 (see also figures 42 and 45) except as provided by clause 6.7.1.2 and may be substituted by a lintel.

6.7.1.2
Where a roof or floor framing member supported by a loadbearing wall lands on the top plate directly over a stud then table 18 shall not apply and the top plate shall be the same width as the studs and 40 mm thick provided that the roof dimension *S* shall not exceed 12 m.

6.7.1.3
Top plates of non-loadbearing walls shall be the same width as the studs and not less than 40 mm thick.

6.7.2
Bottom plates

6.7.2.1
Bottom plates shall be of the following dimensions:

(a) Loadbearing walls: As given by table 19 except as provided by clause 4.8.2 (wall plates) and clauses 6.7.2.2 and 6.7.2.4;

(b) Non-loadbearing walls: The same width as the studs and 40 mm thick except as provided by clauses 6.7.2.3 and 6.7.2.4.

6.7.2.2
Subject to clause 6.7.2.4, the bottom plate of a loadbearing wall that is continuously supported by either:

(a) A joist (including a boundary joist); or

(b) Solid blocking 40 mm thick;
Shall be the same width as the studs and 40 mm thick.

6.7.2.3
Subject to clause 6.7.2.4, the bottom plate of a non-loadbearing wall that is continuously supported by either:

(a) A joist (including a boundary joist); or

(b) Solid blocking 40 mm thick; or

(c) Floor decking;

Shall be the same width as the studs and 25 mm thick.

6.7.2.4
Any bottom plate to which a diagonal brace is attached in accordance with clause 6.9.2 shall be 50 mm thick.

6.7.3
Joints in plates

6.7.3.1
Joints in top plates shall be made only over supports.

6.7.3.2
The top plate of a wall that does not contain any wall bracing elements shall be halved and nailed at joints or be provided with an alternative fixing having a capacity in tension or compression of 3 kN.

6.7.3.3
The top plate of a wall that contains one or more wall bracing elements shall be jointed according to the rating of the highest-rated individual wall bracing element as follows:

(a) Rating not exceeding 100 bracing units: A 3 kN connection as shown in fig. 43 or by an alternative fixing of 3 kN capacity tension or compression along the plate;

(b) Rating exceeding 100 bracing units: A 6 kN connection as shown in fig. 43 or by an alternative fixing of 6 kN capacity tension or compression along the plate.

6.7.4
Lateral support of top plates

6.7.4.1
Top plates shall be laterally supported at not more than 2.5 m centres by framing members or by a diaphragm complying with clause 6.3.5; where there is no such diaphragm and the required support is not provided directly by top plates, joists, rafters, trusses, ceiling battens, or purlins then it shall be provided by 75 mm x 50 mm connecting members running between the top plate and a floor or roof framing member that is parallel to the wall and to which ceiling framing is attached. Such connecting members to external walls shall be fixed at each end as shown by fig. 44, or an alternative fixing of 2.5 kN capacity in tension or compression along the line of the member.

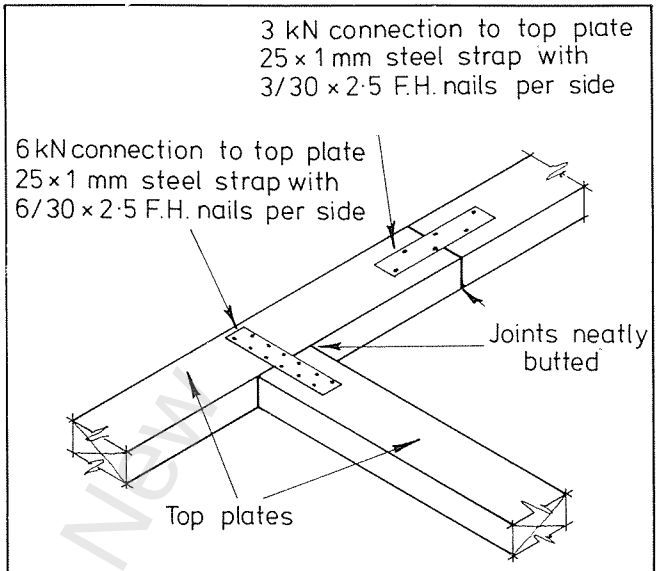


Fig. 43 : Interconnection and jointing of top plates in walls containing wall bracing elements

6.7.5
Checks, holes, and notches in plates

6.7.5.1
No plate shall be checked to less than the thickness required by clause 6.7.1 or clause 6.7.2 as appropriate (see also clause 6.9.4.6).

6.7.5.2
Holes in the face and notches in the edge of a plate shall be not more in diameter or depth respectively than:

(a) 75 mm wide plates: 16 mm;

(b) 100 mm wide plates: 25 mm.

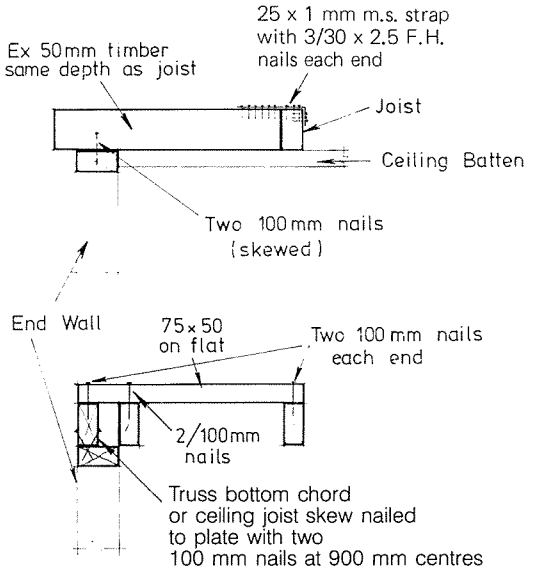


Fig. 44 : Connecting members providing lateral support to the top plates of external walls

Table 18 TOP PLATES OF LOADBEARING WALLS
1.5 kPa and 2.0 kPa floor loads
Applies for any spacing of trusses or rafters

A Single or top storey

Plate size	*Position of truss or rafter centreline relative to centreline of nearest stud*	*Maximum spacing of trusses or rafters*	*Maximum roof dimension* S* of:					
			Light roof for stud spacing (mm) of:			*Heavy roof for stud spacing (mm) of:*		
			400	*480*	*600*	*400*	*480*	*600*
(mm x mm)		(mm)	(m)	(m)	(m)	(m)	(m)	(m)
75 x 50 (see fig. 45A)	Anywhere	600	12.0	12.0	9.5	10.2	7.0	4.2
		900	12.0	9.7	6.0	6.4	4.3	2.4
		1200	10.2	7.0	4.2	–	–	–
100 x 50 (see fig. 45A)	Anywhere	600		12.0	12.0	12.0	10.0	6.2
		900		12.0	8.6	9.2	6.2	3.7
		1200		10.0	6.2			
	Within 150 mm	600		12.0	12.0	12.0	12.0	11.3
		900		12.0	12.0	10.4	8.6	7.1
		1200		12.0	11.3			
100 x 50 plus 150 x 40 (see fig. 45B) 2-100 x 50	Anywhere	600		12.0	12.0	12.0	12.0	11.6
		900		12.0	12.0	12.0	11.8	7.4
		1200		12.0	11.6			
	Within 150 mm	600		12.0	12.0	12.0	12.0	12.0
		900		12.0	12.0	12.0	12.0	12.0
		1200		12.0	12.0			
100 x 50 with 100 x 50 dwang (see fig. 45C)	Anywhere	600		12.0 (2)†	12.0 (2)†	12.0 (2)†	12.0 (2)†	12.0 (2)†
		900		12.0 (2)†	12.0 (2)†	12.0 (3)†	11.3 (4)†	8.8 (3)†
		1200		12.0 (2)†	12.0 (2)†			

* See clause 6.4.3.

† Number of 100 mm nails through studs at each end of dwang. Use block below dwang if three or more nails are required (see fig. 42).

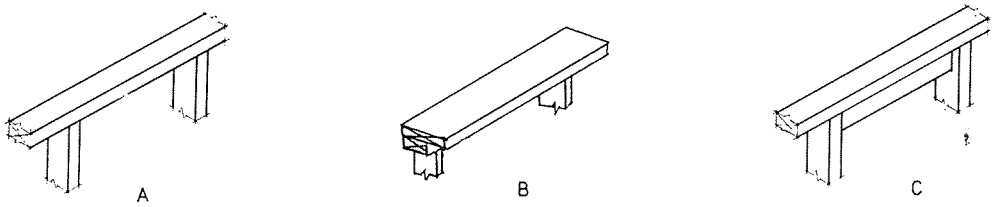


Fig. 45 : Top plate arrangements (see also fig. 42).

Table 18 (continued)

B Lower of two storeys and subfloor stud walls supporting one storey:

(Trusses, rafters, or joists in any position)

Plate size	*Maximum span of floor joists*	*Maximum spacing of floor joists*	*Maximum roof dimension S* of:*				
			Light roof for stud spacing (mm) of:		*Heavy roof for stud spacing (mm) of:*		
			480	*600*	*400*	*480*	*600*
(mm x mm)	(m)	(mm)	(m)	(m)	(m)	(m)	(m)
100 x 50 (see fig. 45A)	3.0	400	12.0	12.0	12.0	12.0	6.4
		450	12.0	11.5	12.0	10.3	5.1
		600	12.0	6.6	10.6	6.5	2.7
	6.0	400	12.0	10.6	12.0	10.4	4.7
		450	12.0	8.1	11.9	8.6	3.5
		600	9.3	3.2	6.1	4.8	–
100 x 50 plus 150 x 40 (see fig. 45B) 2-100x50 or 100 x 75 (see fig. 45A)	3.0	400	12.0	12.0	12.0	12.0	12.0
		450	12.0	12.0	12.0	12.0	12.0
		600	12.0	12.0	12.0	12.0	8.2
	6.0	400	12.0	12.0	12.0	12.0	12.0
		450	12.0	12.0	12.0	12.0	12.0
		600	12.0	12.0	12.0	12.0	6.5

C Lowest of three storeys and subfloor stud walls supporting two storeys:

100 x 50 plus 150 x 40 (see fig. 45B) 2-100x50	3.0	400	12.0	12.0	12.0	12.0	11.2
		450	12.0	12.0	12.0	12.0	9.0
		600	12.0	10.7	12.0	11.4	4.8
	6.0	400	12.0	12.0	12.0	12.0	7.8
		450	12.0	12.0	12.0	12.0	5.7
		600	12.0	4.0	12.0	8.1	–
100 x 75 (see fig. 45A)	3.0	400	12.0	12.0	12.0	12.0	12.0
		450	12.0	12.0	12.0	12.0	12.0
		600	12.0	12.0	12.0	12.0	6.9
	6.0	400	12.0	12.0	12.0	12.0	11.0
		450	12.0	12.0	12.0	12.0	8.5
		600	12.0	8.2	8.8	8.8	3.5

* See clause 6.4.3.

Table 19 BOTTOM PLATES OF LOADBEARING WALLS

1.5 kPa and 2.0 kPa floor loads

Plate size	*Maximum span of floor joists*	*Maximum spacing of floor joists*	*Maximum roof dimension S* of:*					
			Light roof for stud spacing (mm) of:			*Heavy roof for stud spacing (mm) of:*		
			400	*480*	*600*	*400*	*480*	*600*
(mm x mm)	(m)	(mm)	(m)	(m)	(m)	(m)	(m)	(m)
A Single or top storey:								
75 x 40	N/A	400	12.0	7.3	3.2	5.4	3.1	–
		450	10.1	6.0	2.3	4.5	2.4	–
		600	6.4	3.3	–	2.6	–	–
75 x 50	N/A	400	12.0	12.0	12.0	12.0	11.3	8.5
		450	12.0	12.0	11.7	9.3	7.3	5.2
		600	11.5	8.8	6.1	5.1	3.8	2.4
75 x 75	N/A	400	12.0	12.0	12.0	12.0	12.0	12.0
		450	12.0	12.0	12.0	12.0	12.0	11.7
		600	12.0	12.0	12.0	12.0	12.0	8.0
100 x 40	N/A	400	12.0	12.0	10.5	8.4	7.2	4.6
		450	11.7	9.9	6.2	5.2	4.3	2.5
		600	6.4	4.3	2.5	2.4	–	–
100 x 50	N/A	400	12.0	12.0	12.0	12.0	12.0	12.0
		450	12.0	12.0	12.0	12.0	11.0	8.2
		600	12.0	12.0	10.0	8.0	6.2	4.4
100 x 75	N/A	Up to 600	12.0	12.0	12.0	12.0	12.0	12.0
B Any other storey or subfloor stud wall:								
100 x 50 or two 100 x 40	3.0	400	12.0	12.0	12.0	12.0	12.0	9.2
		450	12.0	12.0	10.8	10.4	7.6	4.8
		600	6.8	6.8	3.1	4.1	2.8	–
	6.0	400	12.0	12.0	7.8	12.0	9.3	5.0
		450	12.0	12.0	7.4	8.7	5.9	3.1
		600	3.4	3.4	–	2.9	–	–
100 x 75	3.0	450	12.0	12.0	12.0	12.0	12.0	12.0
		600	12.0	12.0	12.0	12.0	12.0	8.6
	6.0	450	12.0	12.0	12.0	12.0	12.0	12.0
		600	12.0	12.0	12.0	12.0	10.8	6.9

* See clause 6.4.3.

6.8
DWANGS, WALINGS, METAL WALINGS, AND RIBBON BOARDS

6.8.1
Dwangs, walings, or metal walings shall be provided:

(a) Where required by clause 6.5.4 for the lateral support of studs;

(b) Where required by section 8 for the support of exterior wall coverings;

(c) Where required by section 9 for the support of lining.

C6.8.1
It might also be necessary to provide dwangs or similar members for purposes not covered by this standard, such as to prevent the twisting of studs in areas where local knowledge of climatic conditions makes this advisable, for fire stopping, or to support fittings.

6.8.2
Dwangs, walings, and metal walings, where required by clause 6.5.4, shall be spaced at not more than 1350 mm centre-to-centre and shall be of not less than the following dimensions:

(a) Dwangs: 50 mm x 50 mm or 75 mm x 40 mm;

(b) Walings: 75 mm x 25 mm;

(c) Metal walings: 22 mm x 22 mm x 1.2 mm angle.

6.8.3
Dwangs for the support of cladding or lining shall be flush with the face of studs.

6.8.4
Dwangs may be staggered either side of a horizontal straight line by a centre-to-centre distance not exceeding 300 mm.

6.8.5
Walings and metal walings may be butt jointed on a stud anywhere along their length.

6.8.6
Walings and metal walings shall not be checked into opposite sides of the same stud within a distance of 150 mm measured along the stud.

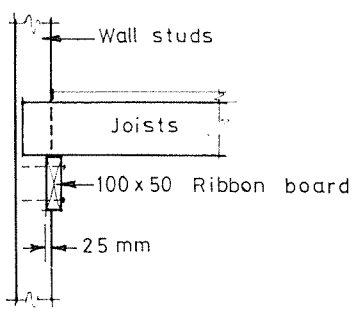


Fig. 46 : Ribbon boards.

6.8.7
Ribbon boards supporting joists in balloon framing shall be 100 mm x 50 mm on edge checked 25 mm into studs (see fig. 46).

6.9
WALL BRACING ELEMENTS

6.9.1
General

6.9.1.1
For the purposes of clause 6.3 a wall bracing element shall be either:

(a) Any of the wall bracing elements specified in clauses 6.9.2 to 6.9.6 inclusive and rated at the number of bracing units given by table 20; or

(b) Any wall bracing element that has been shown in accordance with clause 2.3 to comply with the specification for a wall bracing element that has been tested in accordance with the test specified in BRANZ Technical Paper P21* and rated at the number of bracing units established by that test, provided that no such element shall be rated at more than 83 bracing units per metre of element length.

6.9.1.2
Wall bracing elements shall be connected to the top plates of external walls as required by clause 6.9.7.

6.9.2
Diagonal braces with sheet material

6.9.2.1
A wall bracing element complying with this clause (types 1 to 6 inclusive of table 20) shall be a length of timber stud wall that:

(a) Has sheet material fixed to one or both faces in accordance with clause 6.9.2.2 over the entire part of the wall containing the brace; and

(b) Contains a diagonal brace or braces complying with clauses 6.9.2.3 and 6.9.2.4.

6.9.2.2
The sheet material shall:

(a) Be of not less than 450 kg/m³ density;

(b) Be wood-based material not less than 4.5 mm thick or gypsum-based material not less than 8 mm thick;

(c) Be fixed to framing members;

(d) Have fixings not less than 10 mm from sheet edges.

6.9.2.3
The diagonal brace shall be any of the following:

(a) Continuous let-in 100 mm x 25 mm timber;

* see list of related documents

(b) Continuous galvanized steel angle not less than 22 mm x 22 mm x l.2 mm;

(c) Continuous galvanized steel strip of 8 kN capacity and tensioned before being closed in; provided that diagonal braces of this type shall be used only in diagonally opposed pairs within the same length of wall;

(d) 75 mm x 40 mm timber cut between studs; provided that diagonal braces of this type shall be used only in diagonally opposed pairs within the same length of wall.

C6.9.2.3
The diagonal braces specified in clause 6.9.2.3 resist horizontal loads by acting in conjunction with the sheet material required by clause 6.9.2.1 (a). Such braces are not necessarily adequate to resist erection loads before the sheet material is fixed.

The diagonally opposed pairs of braces required by clauses 6.9.2.3 (c) and 6.9.2.3 (d) can be in separate wall bracing elements, or can run wholly across the same studs (in which case they are in the same wall bracing element) or can run partly across the same studs (in which case only one of the pair is entirely within a wall bracing element).

6.9.2.4
Each diagonal brace shall extend between top plate and bottom plate in one continuous straight line not steeper than 55° to the horizontal there being no requirement on the miminum angle of a brace.

6.9.2.5
The length of a wall bracing element complying with this clause shall be taken as the lesser of:

(a) The plan length of the diagonal brace; or

(b) l.5 times the length of that part of the wall bracing element that is entirely covered by the sheet material.

6.9.3
Diagonal boarding

6.9.3.1
A wall bracing element complying with this clause (type 7 of table 20) shall be a length of timber stud wall that has diagonal boards fixed to one face in accordance with clauses 6.9.3.2 and 6.9.3.3.

6.9.3.2
The diagonal boards shall:

(a) Be 100 mm x 25 mm;

(b) Be in straight lines no steeper than 55° to the horizontal;

(c) Be spaced at not more than one board width apart;

(d) Be fixed to each stud or plate that they cross.

6.9.3.3
End joints in boards shall be made over studs provided that:

(a) End joints on any stud shall be separated by not less than two boards continuous over that stud; and

(b) Adjacent boards shall not be end jointed on adjacent studs.

6.9.3.4
The length of a wall bracing element complying with this clause shall be taken as the distance measured centre-to-centre between studs of that part of the wall in which diagonal boards run from the top plate to the bottom plate provided that not more than one third of this length may be occupied by a wall opening above such boards.

6.9.4
Sheet bracing

6.9.4.1
A wall bracing element complying with this clause (types 8, 9, and 10 of table 20) shall consist of a length of timber stud wall not less than 900 mm long that has sheet bracing material fixed to one face in accordance with clauses 6.9.4.2 and 6.9.4.3 and that has its end studs connected to joists in accordance with clause 6.9.4.5 (see fig. 47).

6.9.4.2
Sheet bracing material shall:

(a) Be either:

(i) Plywood not less than 6 mm thick three-ply; or

(ii) Any other wood-based product not less than 4.5 mm thick with a density not less than 880 kg/m³; or

(iii) Any other wood-based product not less than 6 mm thick with a density not less than 600 kg/m³;

(b) Be fixed to framing members;

(c) Have fixings not less than 10 mm from sheet edges.

6.9.4.3
Each sheet of sheet bracing material shall:

(a) Be not less than 300 mm wide;

(b) Run in a continuous length from top plate to bottom plate except that:

(i) There may be one horizontal joint not less than 900 mm above the bottom plate made by fixing sheet edges to a horizontal framing member in the same manner as to plates;

(ii) The top edge of a sheet need not extend to the top plate provided it is fixed to a 50 mm x 40 mm horizontal framing member not more than 300 mm below the top plate in the same manner as to plates.

6.9.4.4
The length of a wall bracing element complying with this clause shall be taken as the distance measured centre-to-centre between studs of that part of the wall

that is entirely covered by the sheet bracing material and which are connected to joists as specified in clause 6.9.4.5.

6.9.4.5
The studs at the outer edges of a sheet bracing element shall be connected to a joist (including a boundary joist) as shown in fig. 47 or by an alternative fixing of 6.0 kN capacity in tension or compression along the line of the stud.

6.9.4.6
Studs, plates, and dwangs may be reduced in width not more than 10 mm to accommodate sheet bracing material.

6.9.5
Reinforced concrete or reinforced masonry

6.9.5.1
A wall bracing element complying with this clause (type II of table 20) shall consist of a length of

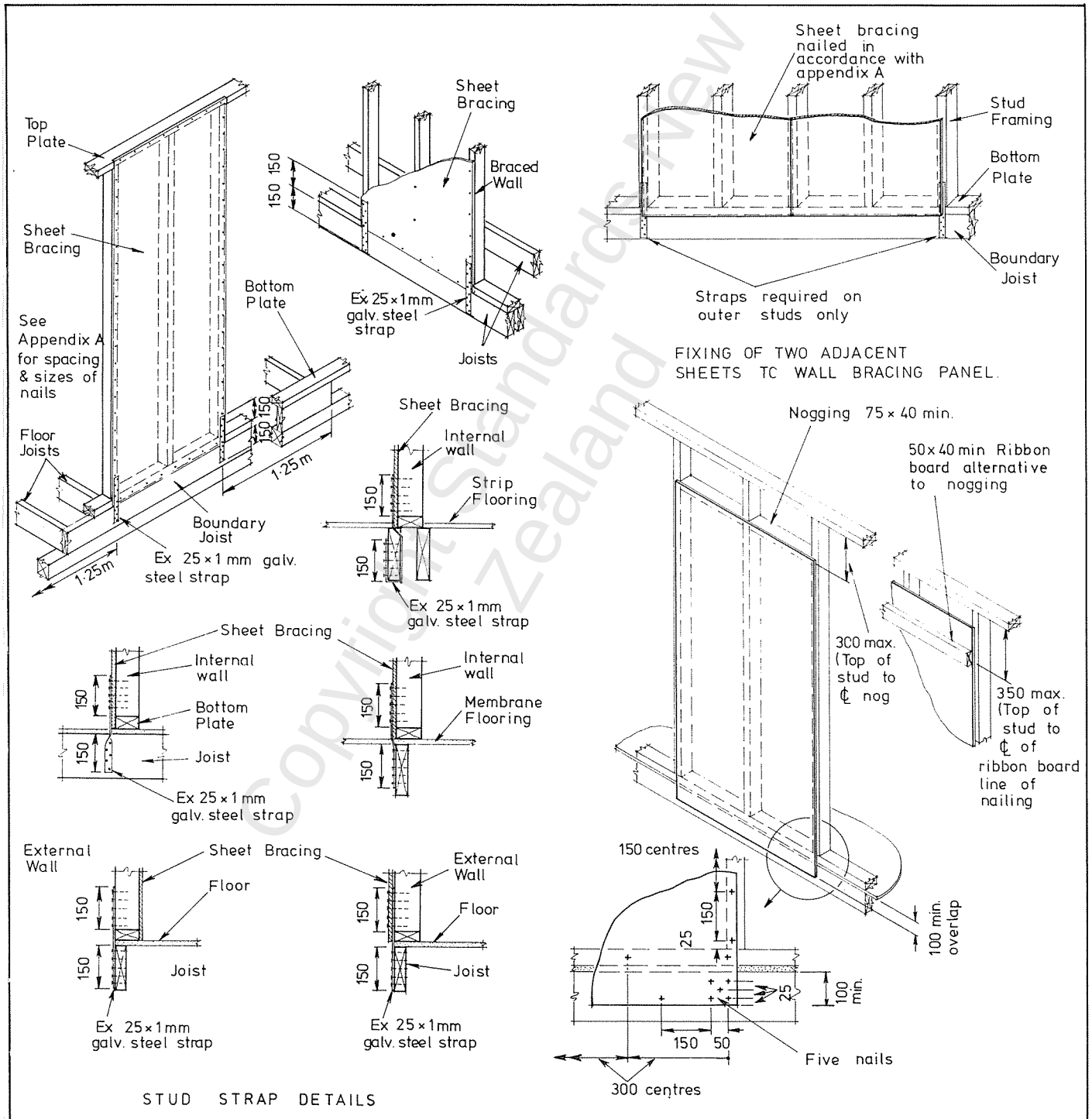


Fig. 47 : Sheet bracing wall bracing elements

reinforced concrete or reinforced masonry wall (not including masonry veneer) that complies with the relevant requirements of NZS I900* and that has a length not less than half its height.

C6.9.5.1

A masonry wall that contains the minimum reinforcing permitted by NZS 1900 : Chapter 6.2 complies with clause 6.9.5.1 even though it is classified as an 'unreinforced' wall for the purposes of NZS 1900 : Chapter 6.2* or Chapter 9.2*.*

6.9.6

Sheet material both sides

6.9.6.1

A wall bracing element complying with this clause (type I2 of table 20) shall be a length of timber stud wall not less than I.2 m long that is entirely covered by sheet material fixed to both faces in accordance with clause 6.9.6.2.

6.9.6.2

The sheet material shall:

(a) Be of not less than 450 kg/m³ density;

(b) Be a wood-based material not less than 4.5 mm thick or a gypsum-based material not less than 8 mm thick;

(c) Be fixed to framing members;

(d) Have fixings not less than 10 mm from sheet edges.

* see list of related documents

Table 20 RATINGS OF 2.4m HIGH† WALL BRACING ELEMENTS

Type	*Description of wall bracing element*	*Rating (bracing units per metre of element length)*
	Diagonal braces with sheet material (clause 6.9.2):	
1	Let-in timber or steel angle brace, sheet on one face	42 in single or top storey 50 in any other location
2	Let-in timber or steel angle brace, sheet on both faces	62 in single or top storey 74 in any other location
3	Steel strip or cut-in timber pair of braces, both entirely within element, sheet on one face	42 in single or top storey 50 in any other location
4	Steel strip or cut-in timber pair of braces, both entirely within element, sheet on both faces	62 in single or top storey 74 in any other location
5	Steel strip or cut-in timber pair of braces, one not entirely within element, sheet on one face	30 in single or top storey 36 in any other location
6	Steel strip or cut-in timber pair of braces, one not entirely within element, sheet on both faces	47 in single or top storey 56 in any other location
7	Diagonal boarding (clause 6.9.3)	42 in single or top storey 50 in any other location
	Sheet bracing (clause 6.9.4):	
	Sheet bracing on one face:	
8	Element length not exceeding 1.8 m	67 in any location
9	Element length exceeding 1.8 m	83 in any location
10	Sheet bracing on one face, sheet material to clause 6.9.2.2 on the other:	83 in any location
11	Reinforced concrete or reinforced masonry (clause 6.9.5), rating for each side of the element to which framing is attached	42 in any location
12	Sheet material both sides (clause 6.9.6)	42 per 1.2 m minimum length

†For wall bracing elements of other heights (other than type 11), these ratings must be multiplied by $\frac{2.4}{\text{element height in metres}}$ except that elements less than 1.8m high shall be rated as if they were 1.8m high.

6.9.6.3
Such wall bracing elements shall not be considered to contribute more than 50 percent of the total number of bracing units required in all bracing lines in any direction.

6.9.7
Connection of wall bracing elements to external walls at right angles

6.9.7.1
Subject to clause 10.4.2.2, each wall that contains one or more wall bracing elements shall be connected at top plate level, either directly or through a framing member in the line of the wall, to external walls at right angles to it with connections as follows:

(a) Each wall containing wall bracing elements rated at a total of not more than 100 bracing units: To at least one such external wall by a 3 kN connection as shown in fig. 43 or by an alternative fixing of 3 kN capacity in tension or compression along the line of the wall bracing elements;

(b) Each wall containing wall bracing elements rated at a total of not more than 200 bracing units: To at least two external walls by 3 kN connections as shown in fig. 43 or by an alternative fixing of 3 kN capacity in tension or compression along the line of the wall bracing elements;

(c) Each wall containing wall bracing elements rated at a total of more than 200 bracing units: To at least two external walls by 6 kN connections as shown in fig. 43 or by two alternative fixings each of 3 kN capacity in tension or compression along the line of the wall bracing elements.

7 POSTS

7.1
Isolated 100 mm x 100 mm posts not exceeding 3 m long may be used to support beams directly supporting rafters or trusses of spans not exceeding 6 m. Such beams shall be of the dimensions given by table 16 for lintels.

7.2
Posts shall be secured at each end against uplift and displacement as shown in fig. 48.

7.3
Where posts are not required by fig. 48 to be secured against uplift, they may be supported on an ordinary pile. Posts shall not be supported by cantilevered floor joists that form a balcony.

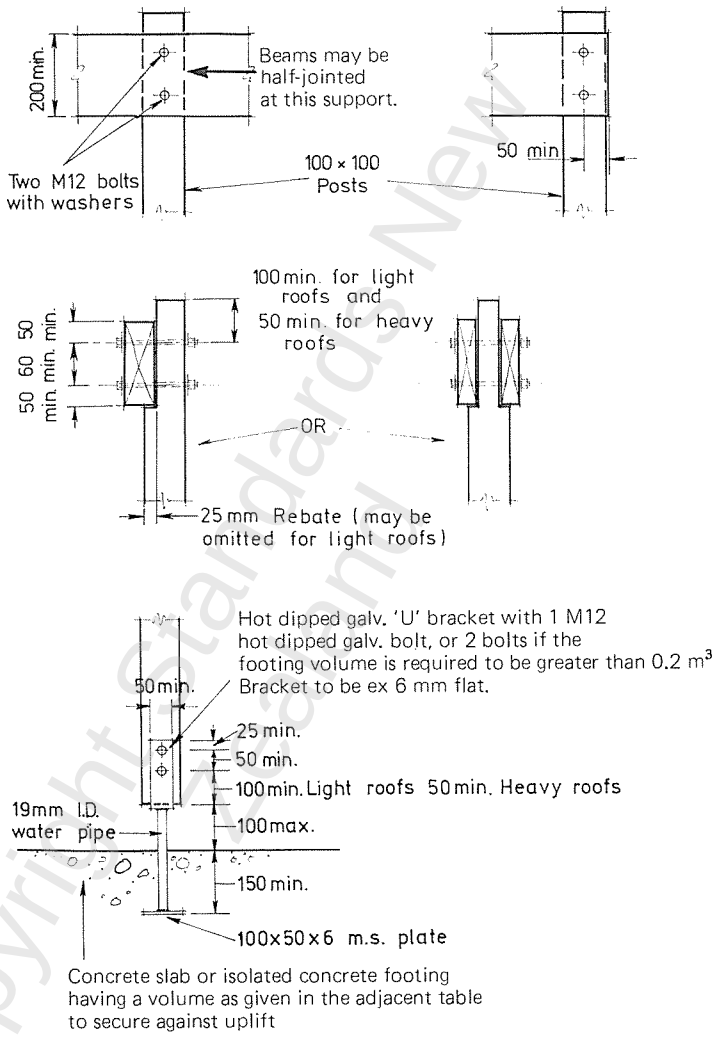


Fig. 48 : Fixing of posts and beams

Roof type	Wind Exposure	Volume of footing concrete (m^3) for a supported area (m^2) of:						
		1	2	4	6	8	10	12
Light	High	0.05	0.1	0.2	0.3	0.4	0.5	0.6
	Medium	0.03	0.05	0.1	0.15	0.2	0.25	0.3
	Low	0.02	0.03	0.07	0.1	0.15	0.15	0.2
Heavy	High	0.03	0.05	0.1	0.15	0.2	0.25	0.3
	Medium and Low — No securement for uplift required							

Table 20A POST AND BEAM FOUNDATIONS

8
EXTERIOR WALL COVERINGS

8.1
GENERAL

8.1.1
Exterior wall covering systems (including sheathing, cladding, building paper, and any other component parts of the covering system) shall:

(a) Comply with the relevant requirements of NZS 1900 : Chapter 10*; and

(b) Provide a suitable surface for the support, application, and attachment of subsequent decorative and wear-resistant finishes if they do not themselves possess such qualities; and

(c) Be of acceptable strength and durability.

8.1.2
Exterior finishing timber other than weatherboards shall be fixed to framing members by nails of length two and a half times the finished thickness of the attached material where the framing is of native species and three times the finished thickness where the framing is of exotic softwoods, whether New Zealand grown or imported. The minimum nail length shall be 57 mm and there shall be two nails per fixing point. Nails that are not punched and stopped shall be galvanized or non-ferrous.

8.1.3
Any exterior wall covering system that consists of a cladding material as specified in clauses 8.2 to 8.6 inclusive over building paper complying with clause 8.7 shall be accepted as complying with clause 8.1.1. Any other exterior wall covering system used in accordance with clause 2.3 shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

8.2
TIMBER WEATHERBOARDS

8.2.1
General

8.2.1.1
Timber weatherboards shall comply with the relevant requirements of NZS 3617*.

8.2.1.2
Weatherboards shall be fixed to framing members by 60 mm x 2.8 mm nails with one nail per fixing point, just clear of laps. Nails that are not punched and stopped shall be galvanized or non-ferrous.

8.2.2
Lap-jointed horizontal weatherboards

8.2.2.1
Joints in lap-jointed horizontal weatherboards shall:

(a) Be made over a stud;

(b) Be bored for nailing;

(c) Be mitred or fitted with corrosion-resistant soakers.

8.2.2.2
Internal angles shall be scribed.

8.2.2.3
External angles shall be mitred, or fitted with corrosion-resistant soakers, or fitted with coverboards and scribers.

8.2.2.4
End grain shall be sealed against moisture penetration.

8.2.2.5
Horizontal laps shall be:

(a) 23 mm for weatherboards with a rebate of not less than 25 mm;

(b) 32 mm for non-rebated weatherboards.

8.2.3
Batten-jointed vertical weatherboards

8.2.3.1
Batten-jointed vertical weatherboards shall have weather grooves not more than 12 mm from both edges.

8.2.3.2
Batten-jointed vertical weatherboards shall be installed in continuous lengths with not more than 6 mm gaps between boards and with gaps covered by 75 mm x 25 mm double-grooved continuous battens.

8.2.3.3
Batten-jointed vertical weatherboards shall be fixed to 50 mm x 40 mm dwangs or 75 mm x 40 mm timber walings at not more than 480 mm centres in either case.

8.2.4
Shiplap vertical weatherboards

8.2.4.1
Shiplap vertical weatherboards shall be fixed to 50 mm x 40 mm dwangs or 75 mm x 40 mm timber walings at not more than 480 mm centres in either case.

8.3
WOOD-BASED PRODUCTS

8.3.1
Wood-based products shall comply with the relevant requirements of NZS 3602*, and fibreboard shall in addition comply with PS 60-73*.

8.3.2
Wood-based products shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

8.4
Deleted by Amendment No. 1 to NZS 3604:1981.

* see list of related documents

8.5
MASONRY VENEER

8.5.1
Masonry veneer shall comply with Appendix F.

8.6
SOLID PLASTER FINISH

8.6.1
Solid plaster finish shall comply with Appendix G.

8.7
BUILDING PAPER

8.7.1
Breather-type building paper complying with NZS 2295* shall be fixed to the exterior face of stud framing or sheet bracing material and shall:

(a) Be run horizontally;

(b) Be lapped not less than 75 mm at joins with the upper sheet lapped over the lower sheet;

(c) Be adequately secured to plates, bearers, and studs;

(d) Extend from the upper side of the top plate to the underside of the bearers or wall plates supporting the ground floor joists;

(e) Be repaired or replaced if punctured or torn, immediately before exterior coverings are fixed.

8.8
WINDOWS

8.8.1
Windows shall comply with the relevant requirements of NZS I900 : Chapter 10*.

8.8.2

High wind exposure: DWP I100 Pa;
Medium wind exposure: DWP 750 Pa;
Low wind exposure: DWP 550 Pa.

* see list of related documents

9
WALL LININGS

9.1
GENERAL

9.1.1
All rooms intended for human habitation shall have interior wall linings which shall:

(a) Be supported by framing members;

(b) Withstand the impacts of normal use;

(c) Prevent the ingress of dust;

(d) Provide a suitable surface for the support, application, and attachment of subsequent decorative and wear-resistant finishes if they do not themselves possess such qualities;

(e) Be of acceptable strength and durability.

9.1.2
The exposed surfaces of linings in any position where surface water splashing or condensation will normally occur shall be impermeable, or shall be capable of being finished in situ so as to be impermeable, to water.

C9.1.2
Positions where surface water splashing or condensation will normally occur include bathrooms, showers, laundries, and the like.

9.1.3
Interior finishing timbers shall be fixed to framing members by nails or brads of length three times the thickness of the attached material. The minimum nail or brad length shall be 25 mm. Galvanized or non-ferrous nails shall be used in positions where surface water splashing or condensation will normally occur.

9.1.4
Subject to clause 9.1.2 and to any applicable requirements of clause 6.9 for wall bracing elements, any lining material specified in clause 9.2 shall be accepted as complying with clause 9.1.1. Any other wall lining material used in accordance with clause 2.3 shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

9.2
TIMBER AND WOOD-BASED PRODUCTS

9.2.1
Timber and wood-based products shall comply with the relevant requirements of NZS 3602* and shall be not less than 3 mm thick.

9.2.2
Wood-based products used as lining material in any position where surface water splashing or condensation will normally occur shall be provided with adequate additional support.

C9.2.2
The additional support required by clause 9.2.2 is to allow for the effects that large changes of moisture content have on wood-based sheet products.

9.2.3
Wood-based products shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

* see list of related documents

10 ROOFS

10.1 GENERAL

10.1.1
The roof system shall consist of:

(a) A system to resist vertical loads and complying with clause 10.1.2;

combined with

(b) A system to resist horizontal loads and complying with clause 10.1.3.

10.1.2
The system to resist vertical loads shall consist of any combination of the following:

(a) Roof trusses complying with clause 10.2.

(b) Roof framing members complying with clause 10.3.

10.1.3
The system to resist horizontal loads shall consist of roof bracing complying with clauses 10.4 and 10.5 (see table 27) for the type of roof concerned.

10.1.4
Any flat roof with access for fire escape, roof garden, light storage, or general pedestrian traffic, and any flat roof where people can be expected to congregate on occasions irrespective of access, shall be regarded as a floor having a 2.0 kPa floor load for the purposes of this standard.

10.1.5
Where a concrete or masonry wall extends above or to the underside of roof cladding, roof framing shall be supported on 100 mm x 50 mm rafters fixed to the side of the wall with M12 bolts at not more than 1.4 m centres; where the wall is required to have a fire resistance rating the bolts shall be anchored into the wall without passing through it in such a way as to maintain the required fire resistance rating of the wall.

10.2 ROOF TRUSSES

10.2.1 Maximum dimensions and spacings

10.2.1.1
The roof dimension *S* of a roof truss as given by clause 6.4.3 shall not exceed 12 m, the eaves overhang shall not exceed 750 mm measured horizontally from the face of the support, and the truss spacing shall not exceed 1200 mm for light roofs, and 900 mm for heavy roofs.

C10.2.1.1
Some trusses by their special nature, such as girder trusses, carry non-uniform larger loads and will require that an effective roof span S based on the area of roof supported, be calculated in order to size the supporting wall framing members, other than lintels (see clause C6.6.1.2).

* see list of related documents

10.2.2 Design and fabrication

10.2.2.1
Roof trusses shall be specifically designed in accordance with NZS 3603* and shall be fabricated in controlled factory conditions provided that with the approval of the Engineer they may be assembled on site to the same standards of workmanship and quality control.

10.2.3 Drawings and specifications

10.2.3.1
Drawings and specifications shall be provided for all roof trusses. These shall contain all information necessary to fabricate and erect the truss in accordance with its specific design and shall specifically include:

(a) The name of the person or organization responsible for the specific design of the truss;

(b) The truss design reference number or similar identification;

(c) The span of the truss expressed both as the horizontal distance between supports and as the roof dimension *S* as given by clause 6.4.3;

(d) The eaves overhang;

(e) The roof slope;

(f) The truss spacing;

(g) The dead load specifying the type of roof cladding and the type of ceiling for which the truss is designed;

(h) The live load specifying the wind exposure and the snow load (if any) for which the truss is designed;

(j) The dimension of all truss members and components;

(k) The species and grade of the timber to be used for truss members;

(m) The location and type of all fastenings (including adhesives) to be used for fabricating the truss;

(n) The recommended camber;

(o) The fixing requirements at supports, which shall not be less than the minimum fixing required by clause 10.2.5.1;

(p) The fixing requirements for wall framing members if different from those specified in this standard (see clause 10.2.5.2);

(q) The lateral support requirements (if any) for truss members;

(r) Bracing requirements if different from those specified in this standard.

10.2.4
Handling, transport, and erection

10.2.4.1
Handling, transport, and erection procedures for roof trusses shall be such as to protect the trusses from damage.

10.2.4.2
Any roof truss that has been damaged shall be removed from the site or repaired to the satisfaction of the Engineer.

C10.2.4.2
Clause 10.2.4.2 applies both to accidental damage, including over-stressing of connections, and to deliberate actions such as cutting a truss member to facilitate erection. Advice on repairs should be sought from the person or firm responsible for the specific design of the truss, or when that is not practicable from a structural designer of comparable experience.

10.2.4.3
Roof trusses shall be erected in accordance with the drawings and specifications so as to be plumb and properly aligned at the required spacings.

10.2.4.4
Where trusses are connected to the top plates of internal walls as required by clauses 6.7.4.1 and 10.5.1.2, then the trusses shall not come into contact with or be connected to such top plates until after all ceiling framing, roof framing, and roof cladding have been installed.

C10.2.4.4
Although roof trusses are generally designed on the assumption that they receive no support from internal walls, long-term creep effects might impose loads on such walls through the connections between trusses and top plates. This loading on internal walls, and on truss and floor framing members, is considered to be acceptable and does not affect the 'non-loadbearing' classification of the internal walls concerned.

10.2.5
Anchorage

10.2.5.1
The fixing for a roof truss at its support shall be as given by the drawings and specifications but not less than two 100 mm skewed nails plus either two 4.9 mm wire dogs or an alternative fixing of 5 kN capacity in tension against uplift.

10.2.5.2
In high wind exposure additional fixing complying with clause 10.2.5.3 shall be provided to the top plate and its supporting members of a wall supporting a truss that supports a light roof and exceeds 7.2 m clear span.

10.2.5.3
Where required by clause 10.2.5.2 the top plate shall have additional fixing to studs and lintels by pairs of 4.9 mm wire dogs at not more than 900 mm centres, or an alternative fixing of 5 kN capacity in tension against uplift at not more than 900 mm centres.

C10.2.5.3
Each additional fixing required by clause 10.2.5.3 should be as close as possible to a truss.

10.3
FRAMED ROOFS

C10.3
Clause 10.3 is written specifically for couple-close roofs (see fig. 49), but the requirements for individual

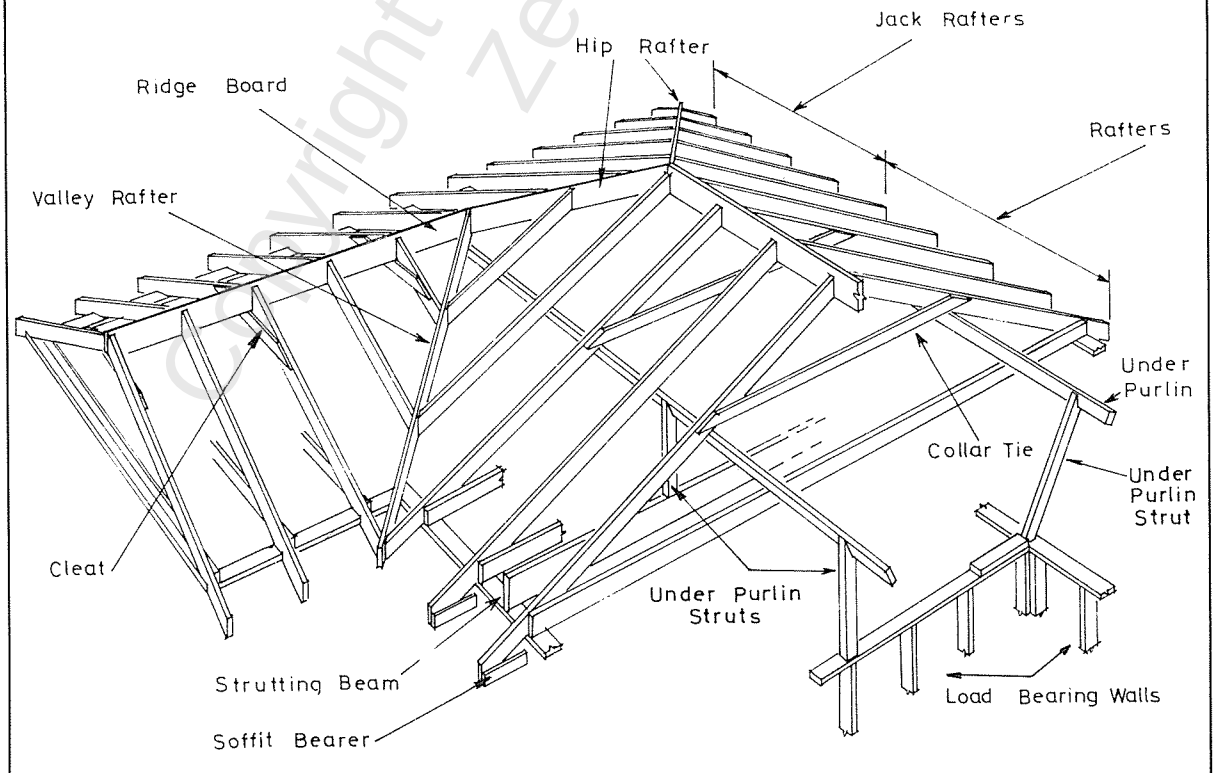


Fig. 49 : Roof framing members

roof framing members apply equally to framed roofs of other types, for example, mono-pitch skillion and exposed rafter roofs.

10.3.1
Joints in roof framing members

10.3.1.1
Roof framing members shall have a minimum landing on their supports of 32 mm except as specifically provided for the member concerned.

10.3.1.2
Joints in all roof framing members permitted to be jointed, other than ridge boards, shall be made only over supports, but not where the member is cantilevered beyond the support.

C10.3.1.2
All roof framing members should as far as possible be in continuous lengths.

10.3.1.3
Joints in rafters and ridgeboards shall be made by a connector of 3 kN capacity in tension or compression along the line of the rafter. This may be achieved by butting and flitching with timber 25 mm thick extending not less than 225 mm on each side on the joint.

10.3.2
Rafters
10.3.2.1
Rafters (including hip and valley rafters) shall span between any two of the following:

(a) Ridge board;
(b) Underpurlin;
(c) Top plate;
(d) Lintel, beam, or stringer;
(e) Another rafter.

Table 21 RAFTERS OTHER THAN HIP AND VALLEY RAFTERS – 0.5 kPa SNOW LOAD

Rafter size	*Maximum span* of rafters at a maximum spacing (mm) of:*			
	400	*600*	*900*	*1200*
A Light roof:				
(mm x mm)	*(m)*	*(m)*	*(m)*	*(m)*
75 x 40	1.8	1.6	1.4	1.3
100 x 40	2.5	2.2	1.9	1.7
125 x 40	3.1	2.7	2.4	2.2
150 x 40	3.7	3.3	2.9	2.6
75 x 50	2.0	1.7	1.5	1.4
100 x 50	2.7	2.4	2.1	1.9
125 x 50	3.4	3.0	2.6	2.4
150 x 50	4.0	3.5	3.1	2.8
200 x 50	5.3	4.7	4.1	3.8
225 x 50	5.9	5.2	4.6	4.2
250 x 50†	6.5	5.8	5.1	4.7
300 x 50†	7.7	6.8	6.1	5.6
100 x 75	3.0	2.7	2.3	2.1
125 x 75	3.8	3.3	2.9	2.7
150 x 75	4.5	4.0	3.5	3.2
200 x 75	6.0	5.3	4.7	4.3
225 x 75	6.7	5.9	5.2	4.8
250 x 75	7.3	6.5	5.8	5.3
300 x 75	8.6	7.7	6.8	6.2

Rafter size	*Maximum span* of rafters at a maximum spacing (mm) of:*			
	400	*480*	*600*	*900*
B Heavy roof:				
(mm x mm)	*(m)*	*(m)*	*(m)*	*(m)*
75 x 40	1.5	1.5	1.3	1.2
100 x 40	2.1	2.0	1.8	1.6
125 x 40	2.6	2.4	2.3	2.0
150 x 40	3.1	2.9	2.7	2.4
75 x 50	1.7	1.6	1.5	1.3
100 x 50	2.2	2.1	2.0	1.7
125 x 50	2.8	2.6	2.5	2.2
150 x 50	3.3	3.1	2.9	2.6
200 x 50	4.3	4.1	3.8	3.4
225 x 50	4.8	4.6	4.3	3.8
250 x 50†	5.3	5.0	4.7	4.2
300 x 50†	6.2	5.9	5.5	4.9
100 x 75	2.5	2.4	2.2	1.9
125 x 75	3.1	3.0	2.8	2.4
150 x 75	3.7	3.5	3.3	2.9
200 x 75	4.8	4.6	4.3	3.8
225 x 75	5.4	5.1	4.8	4.3
250 x 75	5.9	5.6	5.3	4.7
300 x 75	6.8	6.5	6.1	5.5

*May be increased by 10 % for rafters continuous over two or more spans that are not birdsmouthed at intermediate supports.
† Require lower edge to be supported by ceiling framing, lining or equivalent at mid span.

Table 22 VALLEY RAFTERS

Valley rafter size	*Maximum span of valley rafter supporting:*	
	Light roof	*Heavy roof*
(mm x mm)	(m)	(m)
100 x 50	1.65	1.55
125 x 50	2.25	2.05
150 x 50	2.70	2.35
200 x 50	3.55	3.00
200 x 75	3.95	3.35
225 x 75	4.40	3.70
250 x 75	4.75	4.00
300 x 75	5.50	4.65

10.3.2.2
Rafters other than hip and valley rafters shall be of the dimensions given by table 21. Heavy coupled close roofs without underpurlins and with rafters greater than 150 mm x 50 mm shall have ceiling joists fixed to each rafter.

10.3.2.3
Valley rafters shall be of the dimension given by table 22.

10.3.2.4
Subject to clause 10.3.2.5, hip rafters shall be 25 mm thick and 50 mm deeper than the rafters that they support.

10.3.2.5
Hip rafters that project 600 mm or more measured along the rafter beyond their supports so as to form overhanging eaves shall either:

(a) Be of the same thickness as the rafters they support; or

(b) Be flitched on both sides with timber 25 mm thick extending not less than 450 mm along the rafter in both directions from the birdsmouth and nailed to the rafter from both sides with nails passing through the flitch and the rafter.

10.3.2.6
Each rafter other than a hip or valley rafter shall run at right angles to its associated ridge or eaves line.

10.3.2.7
Rafters shall be fitted to top plates, lintels, and beams as shown in fig. 50.

10.3.2.8
Any rafter that directly supports ceiling lining material shall be fixed as follows:

(a) To top plates: As required by clause 10.2.5 as if the rafter were a truss;

(b) To corresponding rafters: As shown in fig. 50 or by an alternative connection of 6 kN capacity in tension and compression along the line of the rafter.

Table 23 CEILING JOISTS

Ceiling joist size	*Maximum span* of ceiling joists at a maximum spacing (mm) of:*		
	480	*600*	*900*
(mm x mm)	(m)	(m)	(m)
100 x 40	2.35	2.15	1.85
100 x 50	2.55	2.35	2.00
125 x 40	2.95	2.75	2.40
125 x 50	3.20	3.00	2.60
150 x 40	3.60	3.30	2.80
150 x 50	3.90	3.60	3.10
200 x 50	5.20	4.80	4.20

* May be increased by 10 % for joists continuous over two or more spans.

10.3.3
Ridge boards

10.3.3.1
Ridge boards in couple-close roofs shall be 25 mm thick and provide full bearing for the whole depth of the rafters.

10.3.3.2
Any length of ridge board that supports one or more jack rafters shall itself be supported by struts at not more than 1.8 m centres. Such struts shall comply with the requirements for underpurlin struts given by clause 10.3.8.

10.3.4
Ceiling joists for framed roofs

10.3.4.1
Ceiling joists shall be of the dimensions given by table 23.

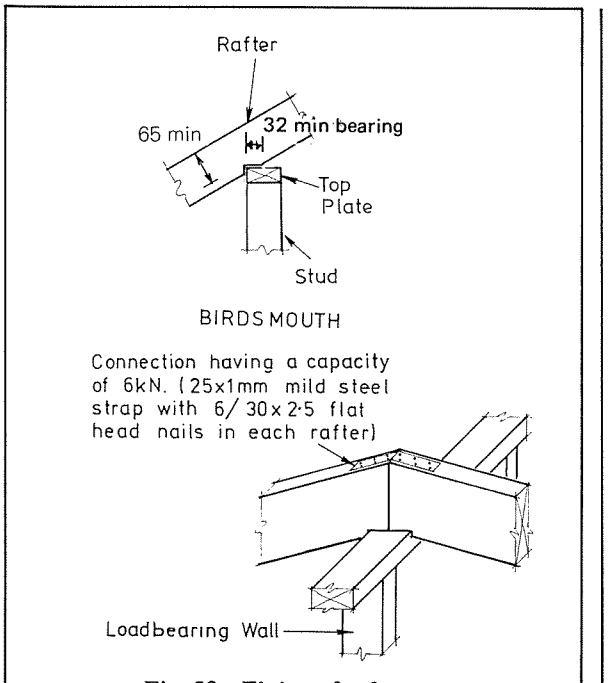


Fig. 50 : Fixing of rafters

Table 24 CEILING RUNNERS

Ceiling runner size	*Maximum span of ceiling runners at a maximum spacing (m) of:*		
	1.8	*2.4*	*3.0*
(mm x mm)	(m)	(m)	(m)
150 x 25	2.9	2.7	2.4
200 x 25	3.7	3.4	3.1
100 x 50	2.6	2.4	2.0
125 x 50	3.2	3.0	2.6
150 x 50	3.9	3.6	3.1
200 x 50	5.2	4.8	4.2
200 x 75	5.9	5.4	4.9

10.3.4.2
Ceiling joists shall have their bottom surfaces set to a common level to support ceiling lining and shall be laid in straight lines on edge.

10.3.4.3
Ceiling joists shall have minimum landing on their supports, other than ceiling runners, of 32 mm.

10.3.4.4
Ceiling joists shall not be supported by roof or ceiling framing members other than ceiling runners complying with clause 10.3.5.

10.3.4.5
As shown in fig. 51, joints in ceiling joists shall either:

(a) Be lapped not less than 300 mm; or

(b) Be butted and flitched with timber of the same dimensions as the joists and extending not less than 225 mm on each side of the joint.

10.3.5
Ceiling runners for framed roofs

10.3.5.1
Ceiling runners shall be of the dimensions given by table 24.

10.3.5.2
Ceiling runners shall be laid in straight lines on edge.

10.3.5.3
Ceiling runners shall have minimum landing of 65 mm on a packer directly supported by the top plate of a loadbearing wall, provided that either:

(a) The ceiling runner shall land directly over a stud; or

(b) The packer shall span between the studs on each side of the ceiling runner.

10.3.5.4
The ends of ceiling runners may be chamfered provided that the depth of the ceiling runner at its support shall not be reduced by more than 50 percent.

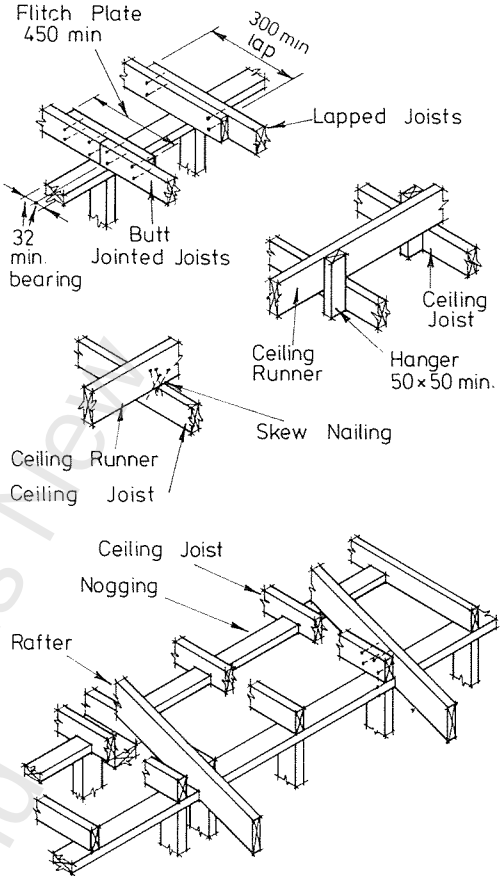


Fig. 51 : Fixing of ceiling framing members

C10.3.5.4
Where the roof necessitates a chamfer greater than 50 percent of the ceiling runner depth, then the runner may either have a member spliced to its underside so as to effectively extend the runner to the top plate, or alternatively the runner support may be a framing member which is blocked out from, but supported by, the top plate.

10.3.5.5
Ceiling runners shall be held in the vertical position at each end by fixing to suitable framing or packing timbers.

10.3.5.6
Ceiling joists may be fixed to ceiling runners by 50 mm x 50 mm hangers arranged to alternate on opposite sides of the ceiling runner as shown in fig. 51.

10.3.6
Valley boards

10.3.6.1
Each valley board shall be:

(a) 25 mm thick and wide enough to support the valley gutter;

(b) Laid over the jack rafters abutting the valley rafter;

(c) Fixed to each jack rafter.

10.3.7 Underpurlins

10.3.7.1
Underpurlins shall be of the dimensions given by table 25.

10.3.7.2
An underpurlin may project as a cantilever to a distance beyond the face of its support not exceeding one quarter of its span.

C10.3.7.2
Cantilevered ends of underpurlins will generally occur at hips and valleys, where the underpurlin should be mitred and fixed to the hip or valley rafter.

10.3.7.3
The underpurlin spacing shall be the distance between the underpurlin and the adjacent rafter support measured along the rafter.

10.3.8 Underpurlin struts

10.3.8.1
Underpurlin struts provided to support underpurlins shall be at right angles to the underpurlins and shall either be:

(a) Isolated struts; in which case they shall be at right angles to the plane of the roof, or be vertical, or lie at any inclination between these two (see figure 52A); or

(b) In pairs; and be fixed to a common member at their support at a horizontal distance away from an underpurlin of not less than one quarter of the distance between the underpurlins (see fig. 52B).

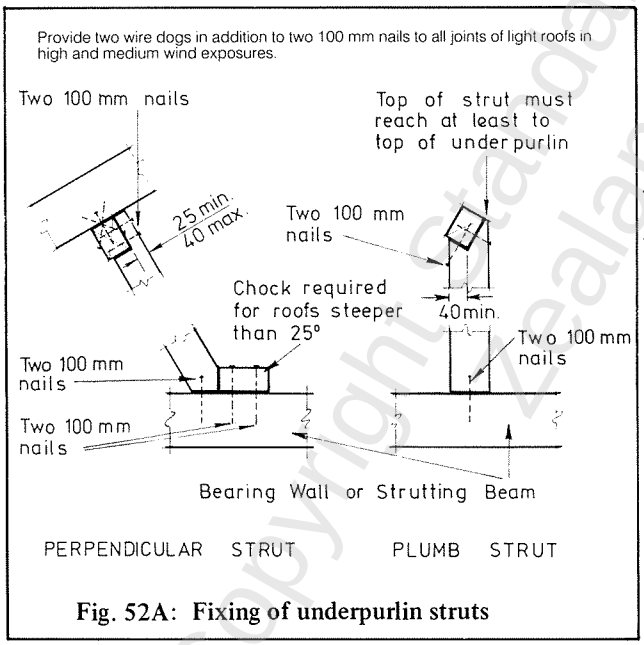


Fig. 52A: Fixing of underpurlin struts

Table 25 UNDERPURLINS

Underpurlin size	*Maximum span of underpurlins at a maximum spacing (m) of:*		
	1.8	*2.4*	*3.0*
(mm x mm)	(m)	(m)	(m)
A Light roof *			
100 x 50	1.80	1.60	–
100 x 75 or 125 x 50	2.30	2.00	1.75
125 x 75 or 150 x 50	2.90	2.50	2.20
150 x 75	3.50	3.05	2.75
200 x 50	3.95	3.35	3.05
200 x 75	4.70	4.10	3.65
B Heavy roof			
100 x 50	1.35	–	–
100 x 75 or 125 x 50	1.65	–	–
125 x 75 or 150 x 50	2.00	1.75	1.50
150 x 75	2.40	2.10	1.90
200 x 50	2.75	2.35	2.15
200 x 75	3.35	2.90	2.60

See also clause 10.3.8.5

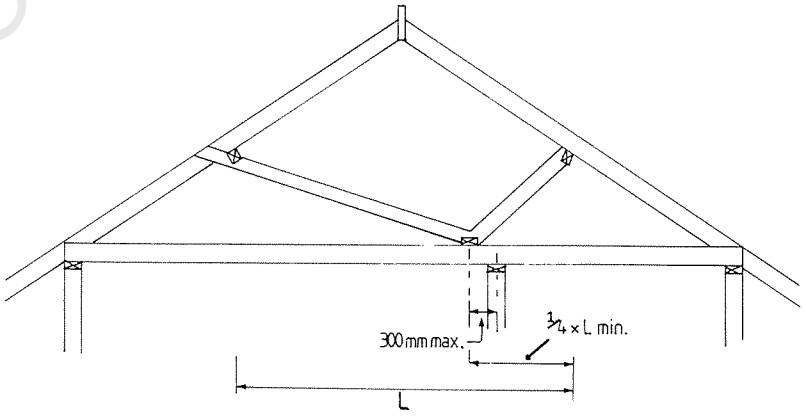


Fig. 52B: Paired underpurlins

10.3.8.2
Each underpurlin strut shall consist of:

(a) Not exceeding 1.75 m long: A continuous length of 100 mm x 50 mm timber;

(b) Not exceeding 3.75 m long: A continuous length of 100 mm x 75 mm timber.

10.3.8.3
Underpurlin struts shall be directly supported by one of the following:

(a) The top plate of a loadbearing wall, provided that either

(i) The underpurlin strut shall land directly over a stud; or

(ii) The top plate shall be doubled between the studs on each side of the underpurlin strut;

(b) A lintel complying with clause 6.6;

(c) A strutting beam complying with clause 10.3.9;

(d) A 100 mm x 50 mm timber laid on its flat on top of ceiling joists and within 300 mm of a loadbearing wall. The timber shall be fixed to at least two joists each side of the underpurlin strut.

10.3.8.4
Underpurlin struts shall be fixed to underpurlins, strutting beams, top plates, and lintels as shown in fig. 52.

10.3.8.5
For a light roof, the area supported by an underpurlin strut shall not exceed:

(a) 4.5 m² in high wind exposure;

(b) 8.5 m² in medium wind exposure;

10.3.9
Strutting beams

10.3.9.1
Strutting beams shall be of the dimensions given by table 26.

10.3.9.2
Strutting beams shall have a clearance of not less than 25 mm above the ceiling lining or framing.

10.3.9.3
Strutting beams shall not be used as ceiling runners.

10.3.9.4
The ends of strutting beams may be chamfered provided that the depth of the strutting beam at its support shall not be reduced by more than 50 percent.

10.3.9.5
Strutting beams shall have a minimum landing of 65 mm on a packer directly supported by one of the following:

(a) The top plate of a loadbearing wall, provided that either:

Table 26 STRUTTING BEAMS

Strutting beam size	*Maximum span of under-purlin*	*Maximum span of strutting beams at a maximum spacing (m) of:*		
		1.8	*2.4*	*3.0*
(mm x mm)	(m)	(m)	(m)	(m)
A Light roof:				
150 x 75	1.80	3.55	3.05	2.55
	2.40	3.05	2.40	1.95
	3.00	2.35	2.00	1.50
200 x 75	1.80	5.55	4.75	4.30
	2.40	4.75	4.15	3.50
	3.00	4.30	3.55	2.80
B Heavy roof:				
150 x 75	1.80	2.15	1.60	1.30
	2.40	1.60	1.20	0.90
	3.00	1.20	0.90	0.75
200 x 75	1.80	3.85	3.40	2.30
	2.40	3.40	2.20	1.75
	3.00	2.30	1.75	1.35

(i) The strutting beam shall land directly over a stud; or

(ii) The top plate shall be doubled between the studs on each side of the strutting beam;

(b) A lintel complying with clause 6.6.

10.3.10
Collar ties and cleats

10.3.10.1
As shown in fig. 53, in couple-close roofs steeper than 10° to the horizontal (1 in 6) pairs of rafters shall be connected by the following:

(a) Where underpurlins are used: Collar ties complying with clause 10.3.10.2;

(b) Where underpurlins are not used: Cleats complying with clause 10.3.10.3.

10.3.10.2
Collar ties shall:

(a) Be at 1.8 m centres or every third pair of rafters, whichever is the closer;

(b) Be fixed to the sides of the rafters immediately above each underpurlin;

(c) Consist of 150 mm x 25 mm or 100 mm x 50 mm timber.

10.3.10.3
Cleats shall:
(a) Be at 1.8 m centres or every third pair of rafters, whichever is the closer;
(b) Be fixed to the sides of the rafters immediately beneath the ridge board;
(c) Consist of 100 mm x 25 mm timber.

10.3.11
Eaves
10.3.11.1
A rafter may extend as a cantilever beyond its supporting top plate for a distance not exceeding one quarter of its maximum permitted span or 750 mm measured horizontally from the face of the support, whichever is the lesser, provided that where 100 mm x 50 mm rafters are boxed they may extend 750 mm.

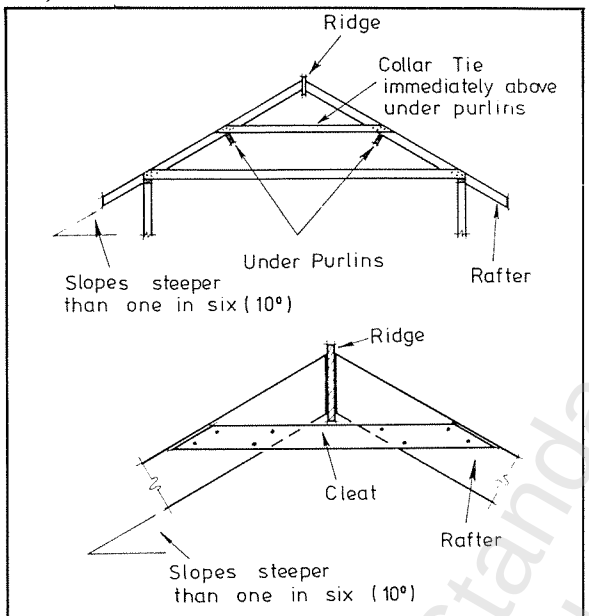


Fig. 53 : Collar ties and cleats

C10.3.11.1
The eaves of truss roofs are covered by the design requirements of clause 10.2.

10.3.11.2
Eaves soffits shall be lined in compliance with clause 8.1.

10.3.11.3
In boxed eaves, eaves bearers shall be attached to the ends of rafters or trusses and to studs or ribbon boards, and shall be at not more than 900 mm centres.

10.3.11.4
Eaves bearers shall consist of:

(a) Not exceeding 600 mm long: 50 mm x 40 mm timber;
(b) Not exceeding 750 mm long: 75 mm x 40 mm timber.

10.3.12
Gable verges

10.3.12.1
Gable verges shall be framed by either:

(a) Purlins extending as cantilevers beyond their end supports as shown in fig. 54 for a distance not exceeding that given by clause 10.3.12.2; or
(b) Outriggers complying with clause 10.3.12.3 and as shown in fig. 54.

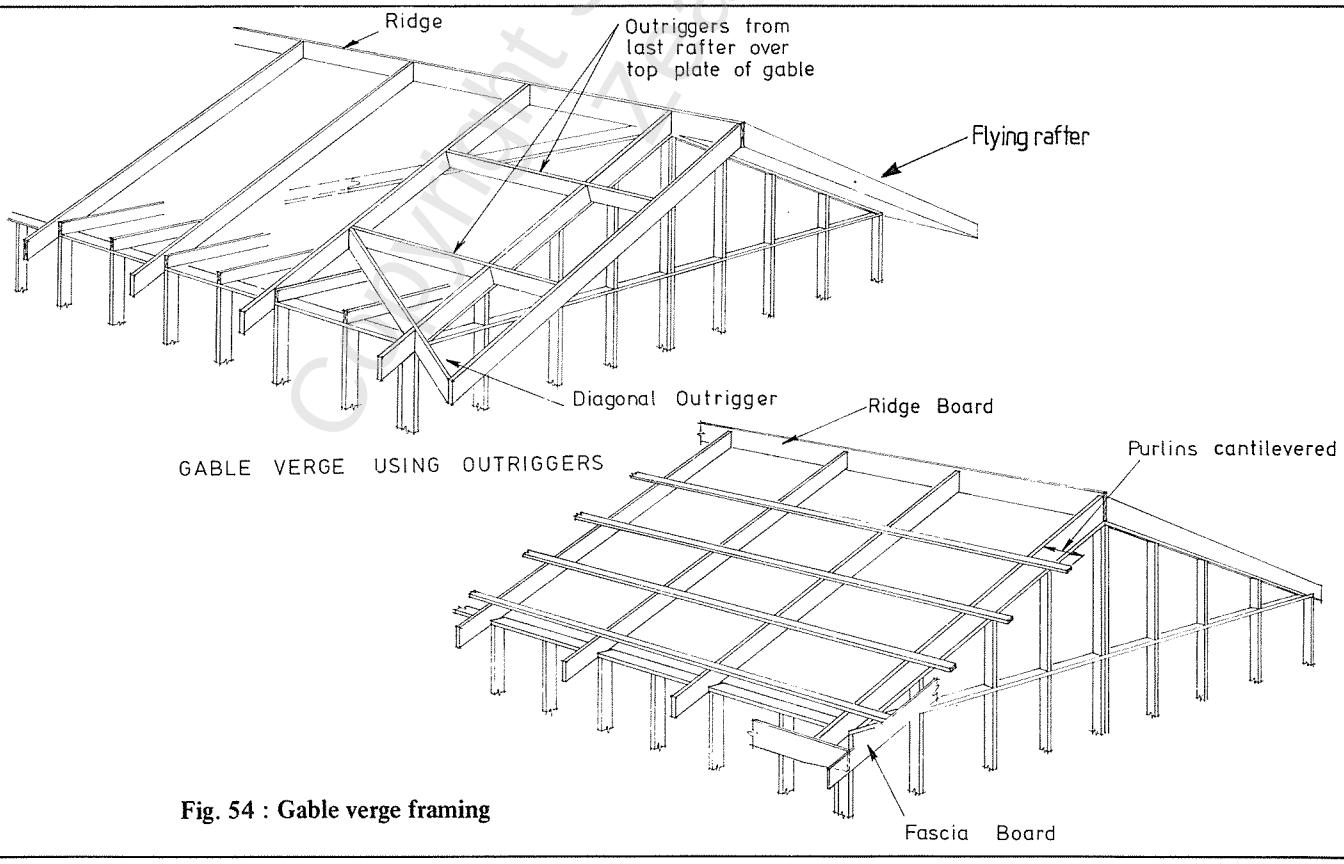


Fig. 54 : Gable verge framing

10.3.12.2
Purlins may extend as cantilevers beyond their end supports for a distance not exceeding:

(a) Laid on their flat:

(i) Light roofs: 600 mm;

(ii) Heavy roofs: 300 mm;

(b) Laid on their edge:

(i) Light roofs: 600 mm;

(ii) Heavy roofs:

75 mm x 50 mm purlins: 450 mm;

100 mm x 50 mm purlins: 600 mm.

10.3.12.3
Outriggers shall (see fig. 54):

(a) Be laid on edge and be of minimum sizes 75 mm x 40 mm for light roofs and 100 mm x 40 mm for heavy roofs;

(b) Be located at not more than 900 mm centres;

(c) Extend beyond their end supports for a distance not exceeding 600 mm;

(d) Have a flying rafter of minimum size 100 mm x 40 mm fixed to their ends;

(e) Have blocking pieces of the same size as the outriggers fitted and fixed between the outriggers along the line of the end support. Purlins shall be fixed to the blocking pieces and to the flying rafter.

10.3.12.4
Gable verge soffits shall be lined in compliance with clause 8.1.

10.3.12.5
Dwangs for gable verge underlinings shall be 75 mm x 40 mm timber.

10.4 SYSTEMS TO RESIST HORIZONTAL LOADS

C10.4
Table 27 summarizes the requirements of this clause. Mono-pitch roof planes which form a part or whole of a roof shall be considered to be a gable roofs and shall have their highest support considered to be the ridge line. For small roofs the definition of "small" has, to date, not proved possible since, in selecting any area or dimension limitation below which bracing is not required, there are a number of exceptions. The recommendation at present is that small roof planes commonly used on dormers and porches, do not require bracing. If "small" is to be defined then in time the definition may evolve as a result of applying commonsense to normal situations.

10.4.1 Light hip roofs

10.4.1.1
Each ridge line and its associated trusses or rafters in a light hip roof shall be braced by not less than three hip or valley rafters running clear from the ridge line to the top plate of a loadbearing wall, or shall be braced as required by clause 10.4.3 for a light gable roof.

10.4.2 Heavy hip roofs

10.4.2.1
Each ridge line and its associated trusses or rafters in a heavy hip roof shall be braced as shown in fig. 55 by:

Table 27 SUMMARY OF ROOF BRACING SYSTEMS

Roof type	*Roof plane diagonal braces unless sarked (see clause 10.5.1)*	*And/ or*	*Roof space diagonal braces*	*And/ or*	*Hip or valley rafters*	*And/ or*	*Hip end top plate*
Light hip	–	–	–	–	Minimum 3 per ridge	–	–
Heavy hip	One per 35 m^2 roof plane plan area	and	None	and	Minimum 3 per ridge	and	Top plate connected at 2.5 m maximum centres to wall bracing elements
Light gable	One per 50 m^2 roof plane plan area	or	At each end of ridge and maximum 7.5 m centres between	–	–	–	–
Heavy gable	One per 25 m^2 roof plane plan area, minimum 2 per plane	and	One per 12 m^2 roof plane plan area, parallel to ridge but not less than 2 m from a parallel external wall	–	–	–	–

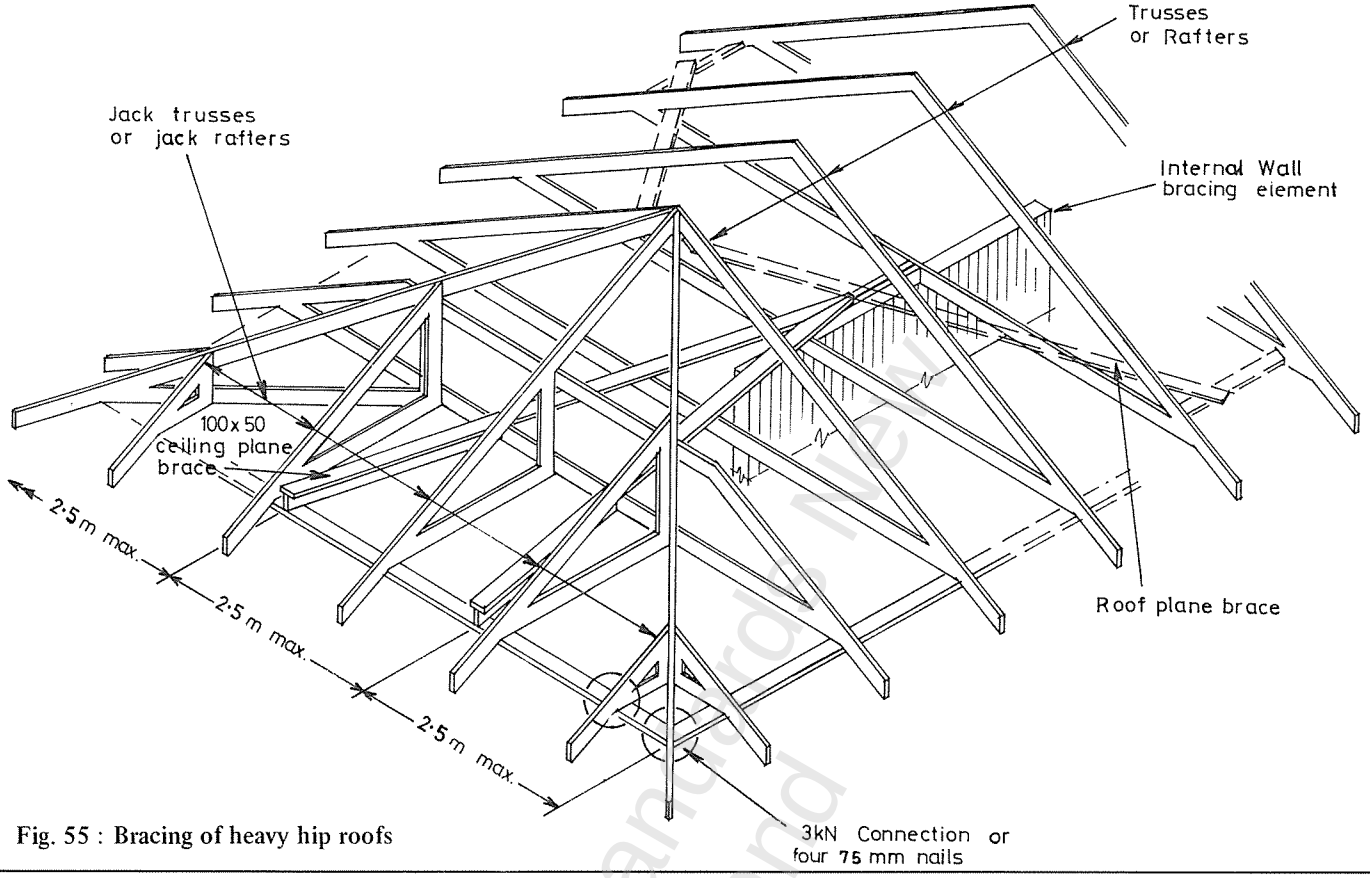


Fig. 55 : Bracing of heavy hip roofs

(a) Not less than three hip or valley trusses or rafters running clear through from the ridge line to the top plate of a loadbearing wall; and

(b) One roof plane diagonal brace complying with clause 10.5.2 in each side plane of the roof for each 35 m² or part thereof of plan area of that plane;

Or shall be braced as required by clause 10.4.4 for a heavy gable roof.

10.4.2.2
A top plate supporting hip-end jack trusses or jack rafters shall be connected at not more than 2.5 m centres to wall bracing elements parallel to the ridge line. Such connections shall be either:

(a) As required by clause 6.9.7; or

(b) By braces in the plane of the ceiling. As shown in fig. 56 each such ceiling brace shall be a continuous length of 100 mm x 50 mm timber fixed to the upper side of each truss bottom chord or ceiling joist that it intersects, to the top plate of the supporting wall, and to the bracing element;

Provided that no such connections shall be required when the top plate is a boundary member of a ceiling diaphragm complying with clause 12.5.

C10.4.2.2
(b) Blocking may be necessary at the intersection with the top plate.

10.4.2.3
Any fixing used as an alternative to a fixing shown in fig. 55 or fig. 56 shall have a capacity as follows:

(a) Jack truss or jack rafter to top plate: 2 kN in tension or compression along the line of the top chord or the rafter;

(b) Hip or valley truss or rafter to top plate: 3 kN in tension or compression along the line of the top chord or the rafter;

(c) Ceiling brace to top plate: 3.5 kN in tension or compression along the line of the ceiling brace.

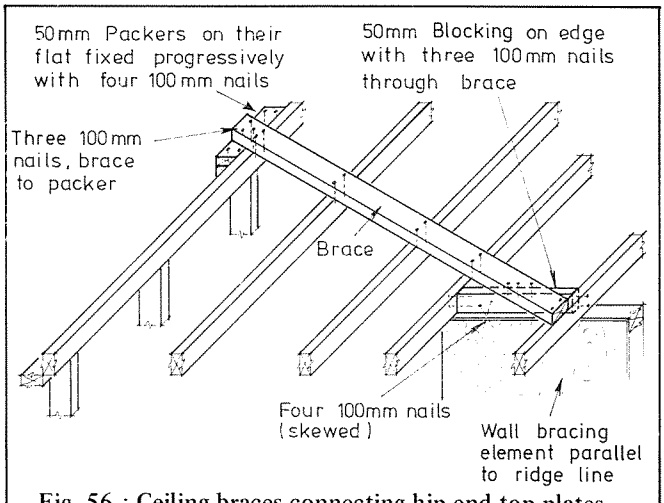


Fig. 56 : Ceiling braces connecting hip-end top plates to wall bracing elements

10.4.3
Light gable roofs

10.4.3.1
Each ridge line and its associated trusses or rafters in a light gable roof shall be braced by either:

(a) One roof plane diagonal brace complying with clause 10.5.2 in each plane of the roof for each 50 m² or part thereof of plan area of that plane; or

(b) Roof space diagonal braces complying with clause 10.5.3 at not more than 7.5 m centres along the ridge line provided that there shall be one such brace at each end of the ridge line.

10.4.4
Heavy gable roofs

10.4.4.1
Each ridge line and its associated trusses or rafters in a heavy gable roof shall be braced as shown in fig. 57 by:

(a) One roof plane diagonal brace complying with clause 10.5.2 in each plane of the roof for each 25 m² or part thereof of plan area of that plane; or

(b) One roof space diagonal brace complying with clause 10.5.3 for each 12 m² or part thereof of the plan area of each roof plane; such braces shall:

(i) Be not less than 2 m from a parallel external wall, provided that at least half of all such braces shall be not more than 2 m from the ridge line;

(ii) Be evenly distributed along the length of the roof.

C10.4.3.1 and C10.4.4.1.
For the purpose of clauses 10.4.3.1 and 10.4.4.1 the area of a verge overhang but not an eaves overhang, is required to be included in the roof plane plan area.

10.5
ROOF BRACING

10.5.1
General

10.5.1.1
Roof bracing shall be provided as required by clause 10.4, provided that roof plane diagonal braces may be omitted where hit-and-miss diagonal sarking complying with clause 10.5.4 or sheet sarking complying with clause 10.5.5 or a structural ceiling diaphragm complying with clause 12.5 and attached to the rafters is provided.

C10.5.1.1
In roofs where there is no roof space (for example, coupled roofs) and hence roof space diagonal braces

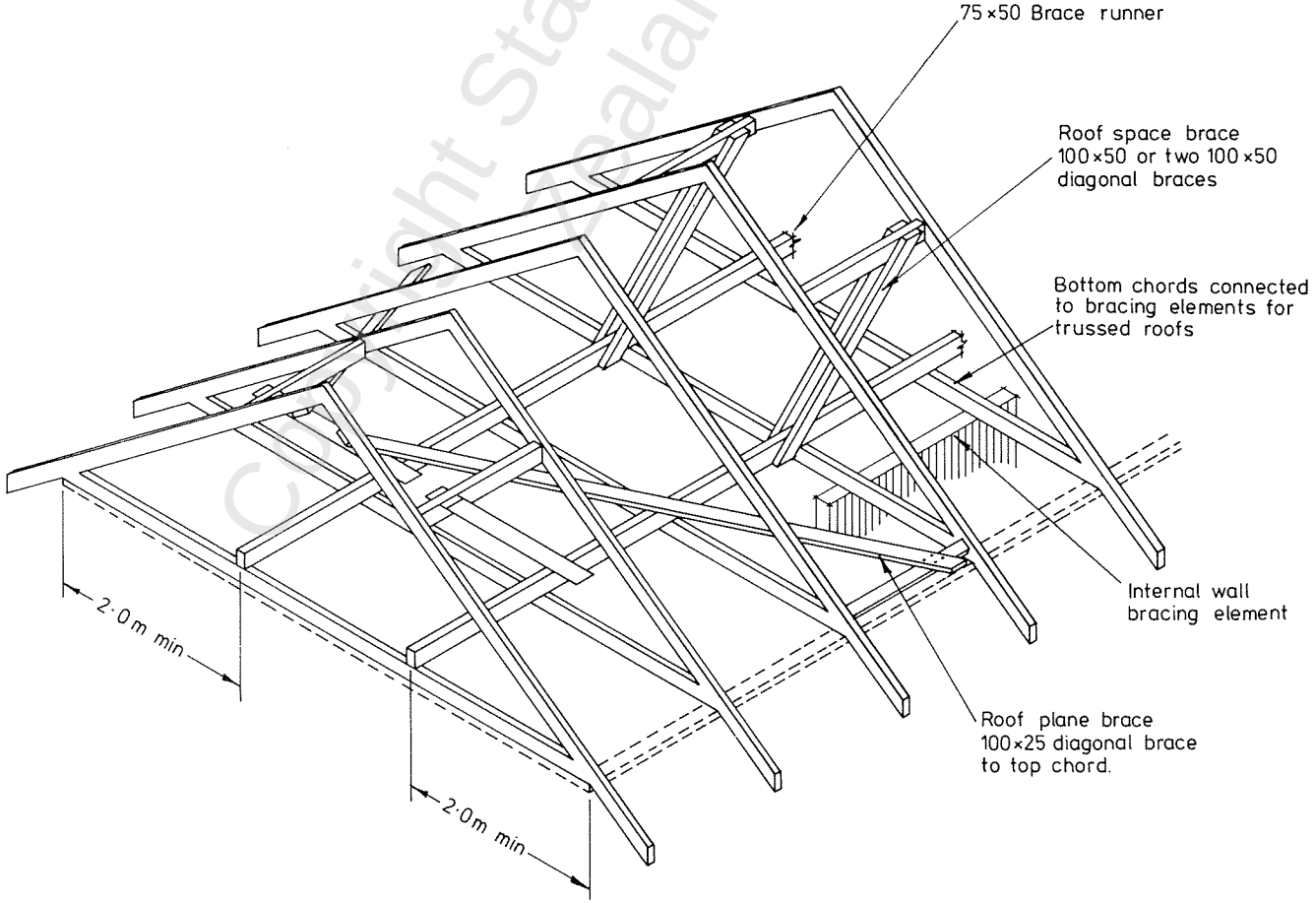


Fig. 57 : Bracing of heavy gable roofs

cannot be fitted, the function of such braces is assumed to be taken by load bearing walls which support the rafters and which contain wall bracing elements.

10.5.1.2
The bottom chord of a truss that crosses an internal wall containing one or more wall bracing elements shall be connected to the top plate of the wall either directly or by a ceiling batten running parallel to the plate and fixed to both the plate and the bottom chord.

10.5.2
Roof plane diagonal braces

10.5.2.1
Where only one roof plane diagonal brace is required then it shall intersect one end of the ridge line.

10.5.2.2
Where more than one roof plane diagonal brace is required then one shall intersect each end of the ridge line and any others shall as far as possible be evenly distributed along the ridge and run alternately in opposing directions.

10.5.2.3
As shown in fig. 58 each roof plane diagonal brace shall:

(a) Run at 45° to the ridge line and from the ridge line to the top plate of the supporting wall;

(b) Consist of either:

(i) A continuous length of 100 mm x 25 mm timber or

(ii) A diagonally opposing pair of continuous steel strips each having a capacity of 8kN in tension, fixed to each top chord or rafter that is intersected, and to the top plate.

C10.5.2.3
(b) Blocking between trusses or joists may be necessary at the intersection with the top plate.

10.5.3
Roof space diagonal braces

10.5.3.1
Roof space diagonal braces shall as far as possible be evenly distributed over the length of the roof and run alternately in opposite directions.

10.5.3.2
As shown in fig. 59 each roof space diagonal brace shall:

(a) Run not steeper than 45° to the horizontal from top chord level to bottom chord level or from ridge board or rafter level to ceiling joist level as appropriate;

(b) In plan view be parallel to or at not more than 25° to the ridge line;

(c) Consist of:

(i) For an effective length not exceeding 2m: A continuous length of 100 mm x 50 mm timber;

(ii) For an effective length not exceeding 5.2 m: Two continuous lengths of 100 mm x 50 mm timber spaced 50 mm apart and nailed together through the spacing pieces at centres not exceeding 1 m;

(iii) A diagonally opposing pair of steel strips, each having a capacity of 8 kN in tension.

C10.5.3.2 (c)
Where a roof space brace can be fixed to a roof framing member within its length then the effective length may be measured between such a fixing and end of the brace.

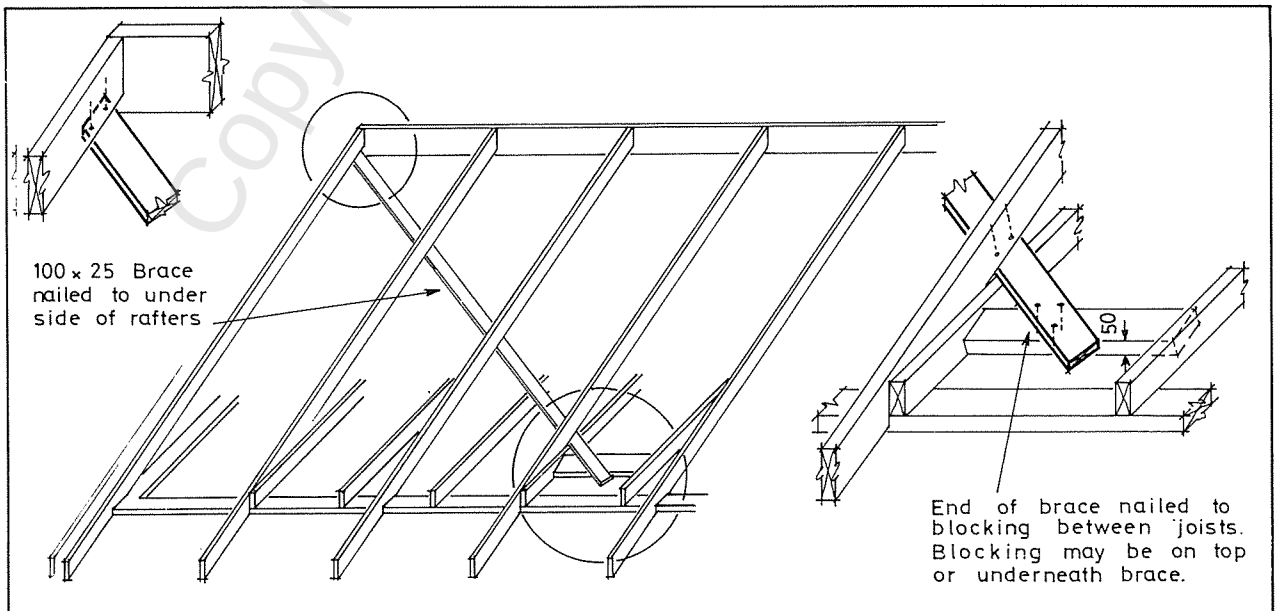


Fig. 58 : Roof plane diagonal braces

10.5.3.3
The top end of each roof space diagonal brace shall be fixed to the ridge board or to a 100 mm x 50 mm blocking piece fixed between adjacent top chords or rafters.

10.5.3.4
The bottom end of each roof space diagonal brace shall be fixed to a 75 mm x 50 mm brace runner which shall:

(a) Either be laid over a ceiling diaphragm complying with clause 12.5 or run parallel to and within 300 mm measured centre-to-centre of a wall containing a wall bracing element;

(b) Be fixed to not less than two bottom chords or ceiling joists on each side of the diagonal brace.

10.5.4
Hit-and-miss diagonal sarking

10.5.4.1
Hit-and-miss diagonal sarking shall consist of 75 mm x 25 mm boards that are:

(a) Inclined at not less than 40° nor more than 50° to the ridge line;

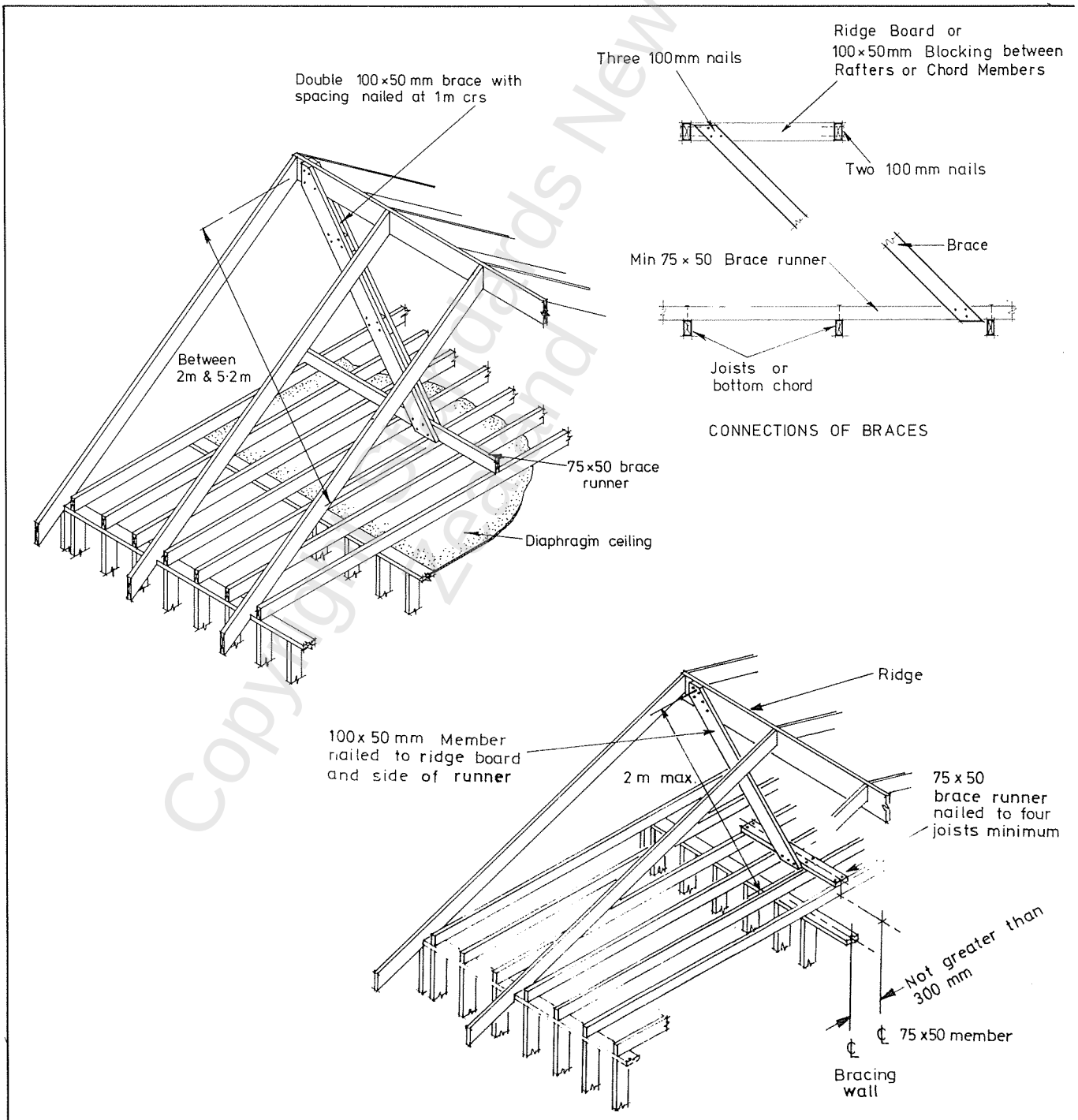


Fig. 59A: Roof space diagonal braces

(b) Spaced not more than board width apart;

(c) Fixed to each top chord or rafter that they cross;

(d) End jointed only over top chords or rafters.

10.5.5
Sheet sarking

10.5.5.1
Sheet sarking shall:

(a) Be either:

(i) Plywood not less than 6 mm thick three-ply; or

(ii) Any other wood-based product not less than 4.5 mm thick having a density not less than 880 kg/m³; or

(iii) Any other wood-based product not less than 6 mm thick having a density not less than 600 kg/m³;

(b) Cover the entire roof surface;

(c) Be fixed directly to rafters or truss top chords;

(d) Have fixings not less than 10 mm from sheet edges.

10.6
PURLINS

10.6.1
Purlins shall be spaced to suit the roof cladding material in accordance with section 11 or with clearly presented and adequate technical information supplied by the manufacturer of the roof cladding material.

C10.6.1
Section 11 specifically mentions only those roof cladding materials for which there are applicable New Zealand Standards, but only one of those standards (NZS 4206 for concrete tiles) specifies purlin (tile batten) spacings. In all other cases section 11 requires the spacing to be stated by the manufacturer.*

10.6.2
Purlins shall be of the dimensions given by table 28.

10.6.3
Purlins shall be laid parallel to the associated ridge or eaves line.

10.6.4
Purlins may be butt jointed over supports provided that no two adjacent purlins shall be jointed over the same truss or rafter.

C10.6.4
Purlins should as far as possible be in continuous lengths.

10.6.5
Purlins may extend as cantilevers as provided by clause 10.3.12.2

* see list of related documents

Table 28 PURLINS

Maximum span of purlins (mm)	*Maximum spacing of purlins* (mm)	*Purlin size* (mm x mm)
A Light roof:		
600	400	50 x 40 on flat
	900	50 x 40 on flat
	1200	75 x 50 on edge
900	400	50 x 40 on flat
	900	75 x 50 on flat
	1200	100 x 50 on flat 75 x 50 on edge
1200	400	50 x 50
	900	100 x 50 on flat 75 x 50 on edge
	1200	100 x 50 on edge
B Heavy roof:		
480	400	50 x 25 on flat
	1200	75 x 50 on edge
600	400	50 x 40 on flat
	1200	100 x 50 on edge
900	400	50 x 50
	1200	100 x 50 on edge

10.6.6
Purlins shall be fixed in accordance with the following recommendations:

(a) Where purlins are laid directly over sheet sarking or ceiling lining material of maximum 13 mm thickness, the fixing of the purlin to the rafter shall be as given in (c) where:

(i) In high wind areas the supporting area (purlin spacing times rafter spacing) of roof cladding exceeds 0.6 m².

(ii) In medium wind areas the supported area exceeds 0.9 m².

(iii) In low wind areas the supported area exceeds 1.2 m².

In all other cases the minimum fixing shall be two 100 mm x 3.75 mm skew driven nails.

(b) Where dummy rafters are laid over sheet sarking or ceiling lining material of maximum 13 mm thickness, the fixing of the purlin to the dummy

rafter shall be in accordance with table 30 (for fixing purlin to rafter). The fixing of the dummy rafter to the rafter shall be either:

(i) Where the rafter is at least 25 mm thicker than the dummy rafter: As detailed in fig. 59B3; or

(ii) Where the dummy rafter consists of one or more laminations of maximum 50 mm deep timber: As detailed in fig. 59B4; or

(iii) As given in (c).

(c) Where required by clauses 10.6.6 (a) or (b) the fixing of a purlin or dummy rafter to a rafter shall be made using a length of 25 mm x 1 mm steel strip which is fixed to the rafter and purlin or dummy rafter as detailed in figure 59B1, or 59B2, or an alternative fixing having a capacity of 2 kN. Such fixings shall be spaced no further than 1.2 m apart.

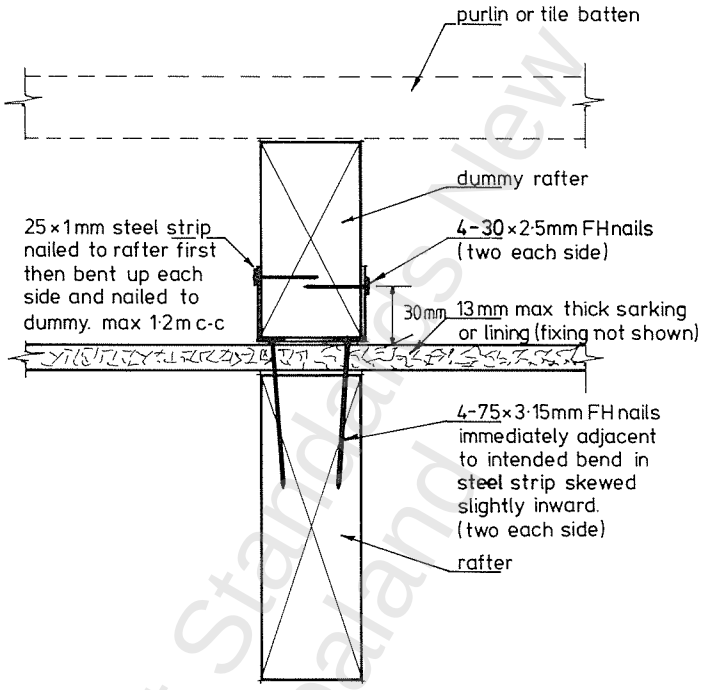


Fig. 59B1.

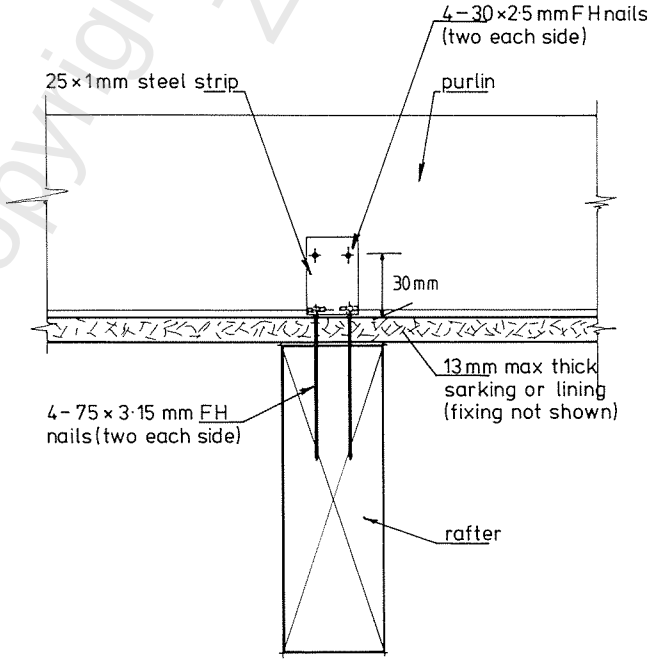
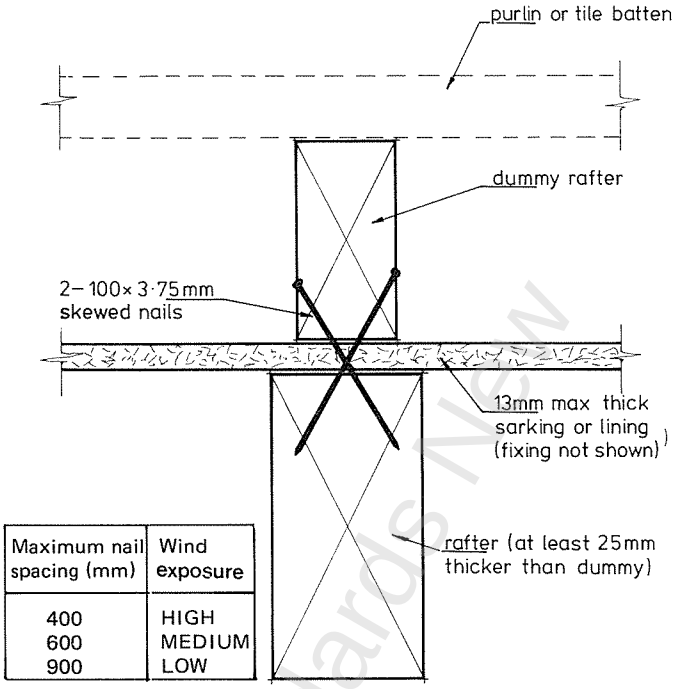


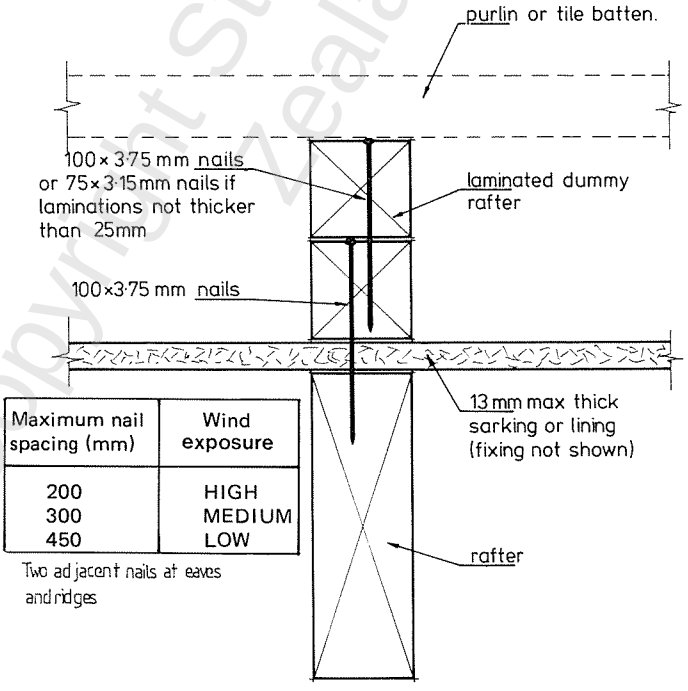
Fig. 59B2.

Fig. 59B: Purlin fixings for sarked roofs



Maximum nail spacing (mm)	Wind exposure
400	HIGH
600	MEDIUM
900	LOW

Fig. 59B3.



Maximum nail spacing (mm)	Wind exposure
200	HIGH
300	MEDIUM
450	LOW

Two adjacent nails at eaves and ridges

Fig. 59B4 .

Fig. 59B: Purlin fixings for sarked roofs

11
ROOF COVERINGS

11.1
GENERAL

11.1.1
Exterior roof covering systems (including sheathing, sarking, cladding, roof underlay, and any other component parts of the system together with all flashings, overflashings, and soakers used in conjunction with the gutters, sumps, heads, and downpipes necessary for the controlled disposal of water from the roof) shall:

(a) Comply with the relevant requirements of NZS 1900 : Chapter 10* relating to weather and corrosion resistance, condensation, and differential movement;

(b) Be of acceptable strength and durability;

(c) Be resistant to wear and abrasion in any situation where it is likely to be subject to pedestrian traffic.

C11.1.1
Although the scope of NZS 1900 : Chapter 10 is limited to 'non-structural' external walls and panels, its requirements for the matters listed in clause 11.1.1 (a) are equally appropriate for roof covering systems and are therefore called for by this standard.*

Both NZS 1900 : Chapter 3 and NZS 3204:Part 1* specify safety precautions in the construction of roofs clad with asbestos cement. Corresponding precautions should be taken with any other brittle roof cladding material.*

11.1.2
Any roof cladding material specified in clauses 11.3 to 11.6 inclusive shall be accepted as complying with the relevant requirements of clause 11.1.1. Any other roof cladding material used in accordance with clause 2.3 shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

11.2
ROOFING UNDERLAY

11.2.1
Roofing underlay shall be provided beneath all metal and all asbestos cement roof claddings. The use of underlay beneath other roof cladding materials shall be in accordance with clearly presented and adequate technical information supplied by the manufacturer of the roofing material concerned.

11.2.2
Roofing underlay shall be breather type building paper complying with NZS 2295* provided that an underlay complying with NZS 873* may be used if in addition it is shown to have a surface absorbency exceeding 100 g/m² net absorption.

C11.2.2
In the absence of a New Zealand Standard test, the recommended test for surface absorbency is as follows:

(a) Maintain samples not less than 100 mm x100 mm at 20 °C and 50 percent relative humidity for at least 48 hours;

(b) Weigh the samples to obtain the unsoaked weight in grams;

(c) Totally immerse the samples in water at 20 °C for 24 hours;

(d) Remove from water and store in a vertical position for 1 min to allow surplus water to drain off;

(e) Re-weigh the samples to obtain the soaked weight in grams;

(f) Calculate the water absorbency (grams per square metre) of each sample as the difference between the soaked weight and the unsoaked weight (in grams) divided by the area of the sample (in square metres).

It is recommended that roofing underlays complying with NZS 873 should in addition have a water vapour flow resistance not exceeding 15 MNs/g when tested in accordance with ASTM E96*.*

11.2.3
Roofing underlay shall:

(a) Be lapped not less than 75 mm at joins, and where laid horizontally the upper sheet shall be lapped over the lower sheet;

(b) Be adequately supported at not more than 300 mm centres in either direction by galvanized wire, galvanized wire netting or other suitable corrosion-resistant material;

(c) Be repaired or replaced as necessary immediately before exterior coverings are fixed.

11.3
CORRUGATED STEEL

11.3.1
Corrugated steel sheets shall comply with NZS 3403*.

11.3.2
Corrugated steel sheets shall be fixed to purlins. The spacing of the purlins and the fixing of the corrugated steel sheets to the purlins shall be in accordance with clearly presented and adequate technical information supplied by the manufacturer.

11.4
CORRUGATED ASBESTOS CEMENT

11.4.1
Corrugated asbestos cement sheets shall comply with NZS 282*.

* see list of related documents

11.4.2
Corrugated asbestos cement sheets shall be fixed in accordance with NZSR 3204* to purlins spaced in accordance with clearly presented and adequate technical information supplied by the manufacturer.

11.4.3
The recommendations of NZSR 3204* shall be followed in order to comply with this standard.

11.5
CONCRETE INTERLOCKING TILES

11.5.1
Concrete interlocking tiles shall comply with NZS 4206*.

11.5.2
Concrete interlocking tiles shall be fixed in accordance with NZS 4206* to purlins spaced in accordance with NZS 4206*.

11.6
BUILT-UP ROOFING (ASPHALTIC BITUMEN)

11.6.1
Built-up roofing (asphaltic bitumen) shall comply with class A of NZSR 22*.

11.6.2
The recommendations of NZSR 22* shall be followed in order to comply with this standard.

C11.6.2
NZSR 22 does not use the word 'shall'. Clause 11.6.2 is intended to make it clear that notwithstanding clause 1.2.1 the recommendations of NZSR 22* are to be regarded as mandatory requirements for the purposes of this standard.*

11.7
PRESSED METAL TILES

11.7.1
Pressed metal tiles shall comply with NZS 4217:Part 1*.

11.7.2
Pressed metal tiles shall be fixed in accordance with NZS 4217:Part 2*.

* see list of related documents

12
CEILINGS

12.1
CEILING LINING MATERIAL

12.1.1
All rooms intended for human habitation shall have ceiling linings which shall:

(a) Be supported by framing members;

(b) Prevent the ingress of dust;

(c) Provide a suitable surface for the support, application, and attachment of subsequent decorative finishes if necessary;

(d) Be of acceptable strength and durability.

12.1.2
The exposed surfaces of linings in any position where surface water splashing or condensation will normally occur shall be impermeable, or shall be capable of being finished in situ so as to be impermeable, to water.

C12.1.2
Positions where surface water splashing or condensation will normally occur include bathrooms, showers, laundries, and the like.

12.1.3
Interior finishing timbers shall be fixed to framing members as required by clause 9.1.3.

12.1.4
Subject to clause 12.1.2 and to any applicable requirements of clause 12.5, any wall lining material specified in section 9 shall be accepted as complying with clause 12.1.1. Any other ceiling lining material used in accordance with clause 2.3 shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

12.2
CEILING LINING SUPPORTS

12.2.1
Truss roofs

12.2.1.1
The framing timbers required by clause 12.1.1 for the support of ceiling linings under trussed roofs shall be any of the following or any combination of them:

(a) Bottom chords of trusses;

(b) Ceiling battens having the dimensions given by table 29 attached to the underside of bottom chords;

(c) 75 mm x 50 mm solid dwanging as shown in fig. 60 at not more than 900 mm centres and spanning between bottom chords spaced at not more than 1200 mm centres;

Table 29 CEILING BATTENS

Maximum spacing of ceiling battens	*Size of ceiling battens for a maximum span (mm) of:*		
	600	*900*	*1200*
(mm)	(mm x mm)	(mm x mm)	(mm x mm)
400	40 x 25	75 x 30	50 x 40
600	75 x 25	50 x 40	75 x 40

(d) Intermediate ceiling joists of the same size as and parallel to the bottom chords and fixed to 75 mm x 50 mm ceiling runners on edge as shown by fig. 60 and at the spacing given by table 23 provided that no ceiling runner shall cross a bottom chord more than 500 mm away from a panel point.

C12.2.1.1
Ceiling battens and solid dwanging can serve not only to support ceiling lining but also to provide lateral support to bottom chords against buckling in compression as a result of wind uplift forces on the roof.

12.2.2
Framed roofs and floors

12.2.2.1
The framing timbers required by clause 12.1.1 for the support of ceiling linings under framed roofs or floors shall be any of the following or any combination of them:

(a) Ceiling joists complying with clause 10.3.4 or floor joists complying with clause 5.1;

(b) Rafters complying with clause 10.3.2 (see especially clause 10.3.2.8);

(c) 75 mm x 50 mm solid dwanging as shown in fig. 60 at not more than 900 mm centres and spanning between ceiling joists, floor joists or rafters;

(d) Ceiling battens having the dimension given by table 29 attached to the underside of rafters, floor joists or ceiling joists.

12.3
OPENINGS IN CEILINGS

12.3.1
Access to ceiling space shall be provided through a clear opening not less than 600 mm x 500 mm, giving easy unobstructed access of at least 600 mm in height between the top of the ceiling joists and other roof members.

12.3.2
Openings in ceilings shall be bounded by trimmers and trimming joists.

12.3.3
Trimmers shall be the same depth as the curtailed ceiling joists and:

(a) Trimmer spans not exceeding 1.2 m: The same thickness as the curtailed joists;

(b) Trimmer spans not exceeding 2.4 m: 25 mm thicker than the curtailed joists;

(c) Trimmer spans not exceeding 3 m: 50 mm thicker than the curtailed joists.

12.3.4
Trimming joists shall be the same depth as the curtailed ceiling joists and:

(a) Trimmer spans not exceeding l.2 m:

(i) Trimming joist spans not exceeding 3 m: The same thickness as the curtailed joists;

(ii) Trimming joist spans exceeding 3 m: 25 mm thicker than the curtailed joists;

(b) Trimmer spans not exceeding 3 m: 50 mm thicker than the curtailed joists.

12.4 PLATFORMS IN THE ROOF SPACE

12.4.1
A platform in the roof space for the purpose of supporting a water supply tank not exceeding 200 litres capacity shall be either:

(a) Four 100 mm x 50 mm timbers fixed to ceiling joists and located centrally over a loadbearing wall;

(b) Four 100 mm x 50 mm timbers fixed to the top of truss bottom chords;

Provided that where ceiling joists or trusses are spaced at greater than 600 mm centres, the timber shall be placed on edge. Where these timbers are separated by more than 150 mm, a decking shall be provided.

12.5 STRUCTURAL CEILING DIAPHRAGMS

12.5.1
Ceiling diaphragms required to comply with clauses 6.3.5.1 and 10.5.1.1 shall be constructed as follows:

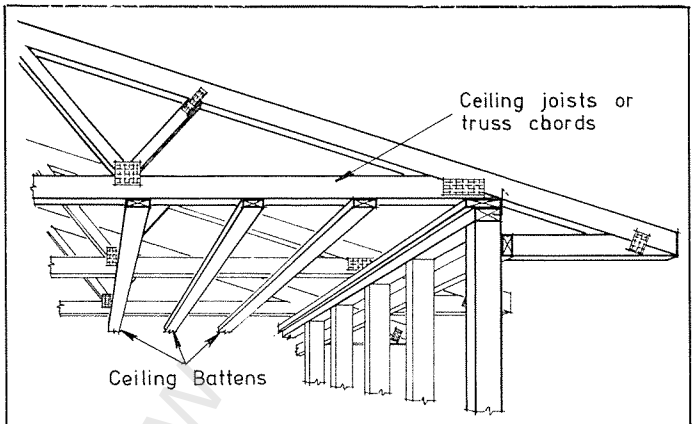
(a) The diaphragm shall be square or rectangular and its length shall not exceed twice its width, both length and width being measured between supporting walls;

(b) The ceiling lining shall consist of a sheet material complying with clause 12.5.2 over the entire area of the diaphragm;

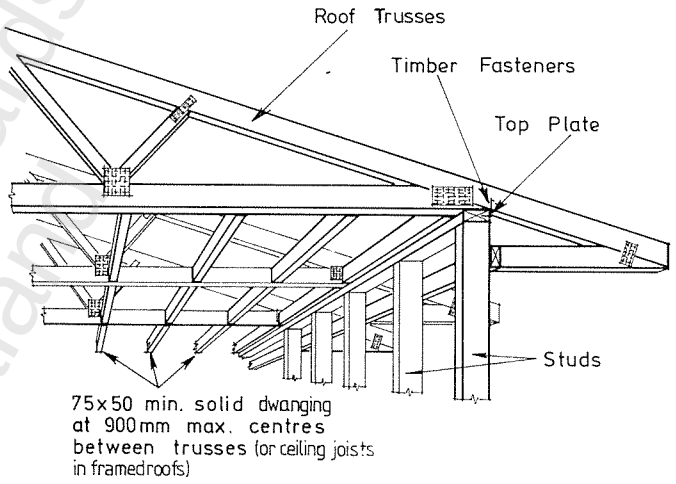
(c) The minimum sheet size shall be l800 mm x 900 mm except where the building dimensions prevent the use of a complete sheet;

(d) Each sheet shall be fastened along each edge to boundary members and shall also be fastened to every intermediate framing member;

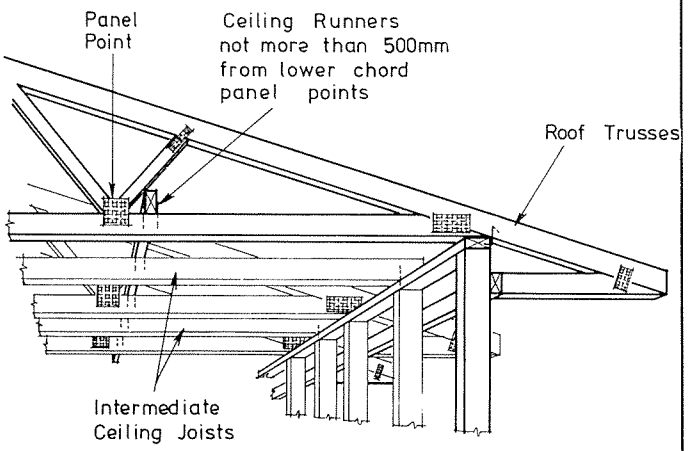
(e) Fastenings shall be not less than l0 mm from sheet edges.



CEILING BATTENS



SOLID DWANGING



INTERMEDIATE JOISTS

Fig. 60 : Ceiling lining supports

12.5.2
Ceiling lining material for ceiling diaphragms shall be:

(a) For diaphragms not steeper than 25° to the horizontal and not exceeding l5 m long under light or heavy roofs:

(i) Plywood not less than 6 mm thick three-ply; or

(ii) Any other wood-based product not less than 4.5 mm thick having a density not less than 880 kg/m³; or

(iii) Any other wood-based product not less than 6 mm thick having a density not less than 600 kg/m³;

(b) For diaphragms not steeper than 25° to the horizontal and not exceeding 7.5 m long under light or heavy roofs; A gypsum-based sheet material not less than 8 mm thick;

(c) For diaphragms not steeper than 45° to the horizontal and not exceeding 7.5 m long under light or heavy roofs:

(i) Plywood not less than 6 mm thick three-ply; or

(ii) Any other wood-based product not less than 4.5 mm thick having a density not less than 880 kg/m³; or

(iii) Any other wood-based product not less than 6 mm thick having a density not less than 600 kg/m³.

C12.5.2
Clause 12.5 refers to the slope (if any) of the ceiling, not of the roof. However, sloping ceilings are generally at the same slope as the roof above.

For the purposes of this clause, ''length'' and ''long'' apply only to the diaphragm dimension measured at right angles to the direction of loading being considered. In addition, if the ''long'' dimension is parallel to the direction of the ceiling slope (at right angles to the ridge line), then the requirements for diaphragms not steeper than 25° can be used in all cases.

APPENDICES

APPENDIX A

NAILING SCHEDULE

A1
This appendix specifies the fastenings and connections to be used in structural joints (as listed in table 30) which are not specified in the relevant clauses of this standard (see clause 2.5).

CA1
This appendix is based on the performance of smooth round shank steel wire nails (see NZS 3602).*

A2
In table 30 a connector identified by length and diameter only shall be a nail, provided that the letters 'FH' indicate that flat-head nails shall be used.

A3
Wire dogs shall be not less than 4.9 mm diameter and shall penetrate not less than 30 mm into each piece of timber. Two l00 mm x 3.75 mm skew nails may be substituted for one wire dog.

A4
Any nail specified in table 30 may be replaced by any other nail of the same type provided that neither the length nor the diameter shall be less than that specified.

A5
Staples of the specified dimensions may be substituted for nails only where so stated in table 30.

A6
The length of nails passing through sheet material thicker than 10 mm shall be the length specified in table 30 or three times the sheet thickness, whichever is the greater.

A7
The joints listed in table 30 shall be made with the specified number of connectors of the specified type, length, and diameter driven in the specified locations into both pieces of timber at right angles unless skewed nails are specified.

The depth of penetration into the point side piece of timber shall be at least 45 percent of the length of the nail.

* see list of related documents

Table 30

NAILING SCHEDULE

Joint	*Length (mm) x diameter (mm) and type*	*Number and location*
Subfloor framing		
Bearer to jackstud	100 x 3.75	2 (skewed)
Bearer to jackstud adjacent to cut-between brace	100 x 3.75	4 (skewed)
Bearer end to cut-between plates	100 x 3.75	4 (skewed)
Bearer to top plate of wall framing	100 x 3.75	4 (skewed)
Flitch to each bearer end	100 x 3.75	4
Flitch to jackstud	100 x 3.75	4 (skewed)
Stud or jackstud to plate	100 x 3.75	2 (end nailed)
	or	
	75 x 3.15	4 (skewed)
Sheet material for subfloor brace to:	30* x 2.5 FH	
(a) Framing members at sheet edges		150 mm centres
(b) Intermediate supports		300 mm centres
Floor framing		
Joist to plate or bearer	100 x 3.75	2 (skewed)
Lapped joint in joist	100 x 3.75	2 (each side)
Flitched joint in joist	100 x 3.75	4 (each end)
Herringbone strutting to joist	60 x 2.8	2 (skewed)
Solid blocking to joist	100 x 3.75	2 (end nailed)
	or	
	75 x 3.15	4 (skewed)
Joist to plate on foundation walls	100 x 3.75	12 (skewed) per 1.5 m length
Solid blocking between joists to plate or bearer	100 x 3.75	4 (skewed)
Boundary joist to end of each joist	100 x 3.75	2 (end nailed)
Curtailed joist not exceeding 3 m long to trimmer	100 x 3.75	3 (end nailed)
Curtailed joist to trimmer when half housed	100 x 3.75	2 (end nailed)
Floor decking		
Strip flooring not exceeding 75 mm wide to floor joist	2½ x finished thickness	1
Strip flooring not exceeding 100 mm wide to floor joist	2½ x finished thickness	2
Sheet decking (not exceeding 21 mm thick) to:	60* x 2.8 or 57* x 11.1 x 1.8 mm staples	
(a) Supports at sheet edges		150 mm centres
(b) Intermediate supports		300 mm centres

* See clause A6.

Table 30 (continued)

Joint	*Length (mm) x diameter (mm) and type*	*Number and location*
Wall framing		
Stud to plate	100 x 3.75 or 75 x 3.15	2 (end nailed) 4 (skewed)
Double studs at openings, blocking and studs at wall intersections	100 x 3.75	600 mm centres
Doubling stud to doubled stud immediately under lintel	100 x 3.75	2
Lintel to trimming stud	75 x 3.15 or 100 x 3.75	4 (skewed) 2 (end nailed)
Bottom plate to floor framing at:	100 x 3.75	
(a) External walls and internal wall bracing elements		2 at 600 mm centres
(b) Internal walls (may be nailed to floor decking)		1 at 600 mm centres
Half joint in top plate	75 x 3.15	3
Sill or header trimmer to trimming stud for:	100 x 3.75	
(a) Trimmer not exceeding 2.4 m long		2 (end nailed)
(b) Trimmer not exceeding 3.6 m long		3 (end nailed)
Top plate 150 mm x 40 mm to 100 mm x 50 mm and top plate to lintel.	100 x 3.75	2 at 500 mm centres
Dwang to stud	75 x 3.15 or 100 x 3.75	2 (skewed) 2 (end nailed)
Fishplate to straightened stud	60 x 2.8	4 each side of cut
Waling to stud	60 x 2.8	2
Ribbon board to stud	100 x 3.75	2
Stucco batten to stud	60 x 2.8 (galv.)	500 mm centres
Wall bracing elements		
Diagonal bracing:		
100 mm x 25 mm brace to:	75 x 3.15	
(a) Plates		3
(b) Studs		2
Steel angle brace to:	60 x 3.15	
(a) Plates		3
(b) Studs		2
Steel strip brace to plates:	60 x 3.15	3
Cut-between timber brace to stud	75 x 3.15	2 (skewed)
Sheet material to clause 6.9.2.2 and 6.9.6.2	30* x 2.5 FH	
(a) Studs and plates at sheet edges		150 mm centres
(b) Intermediate studs		400 mm centres

* See clause A6.

Table 30 (continued)

Joint	*Length (mm) x diameter (mm) and type*	*Number and location*
Wall bracing elements (continued)		
Diagonal boarding:	60 x 2.8	
100 mm x 25 mm boards to studs and plates		2
200 mm x 25 mm boards to studs and plates		3
Sheet bracing:	30* x 2.5 FH	
Sheets to:		
(a) Studs and plates at sheet edges		150 mm
(b) Intermediate studs		300 mm centres
Stud strap to stud or joist	30 x 2.5 FH	6
Roof framing		
Rafter to ridge board	75 x 3.15 or 100 x 3.75	4 (skewed) 2 (end nailed)
Rafter or jack rafter to top plate or underpurlin		
(a) Light roof in high wind exposure when:	100 x 3.75 plus wire dogs	2 (skewed) 2
(i) The rafter span exceeds 2.5m, or		
(ii) The rafter spacing exceeds 900mm		
(b) Light roof in medium wind exposure when:	100 x 3.75 plus wire dogs	2 (skewed) 2
(i) The rafter span exceeds 5m, or		
(ii) The rafter spacing exceeds 900mm and the rafter span exceeds 3m		
(c) Light roof in low wind exposure when:	100 x 3.75	2 (skewed)
(i) The rafter spacing exceeds 900mm and the rafter span exceeds 4.5m	plus wire dogs	2
(d) All other cases	100 x 3.75	2 (skewed)
Truss to top plate of internal wall	100 x 3.75	2
Ceiling batten to parallel top plate of internal wall bracing element	75 x 3.15	2 at 400 mm centres
Collar tie or cleat to rafter	75 x 3.15	4
Flitches to ridge board and roof members from each side and on both sides of joint	60 x 2.8	3
Hip rafter to top plate	75 x 3.15	
(a) Heavy roof		4 (skewed)
(b) Light roof		2 (skewed)
Underpurlin strut to underpurlin or top plate or strutting beam:		
(a) Light roof in high and medium wind exposure	100 x 3.75 plus wire dogs	2 2
(b) Other cases	100 x 3.75	2 (skewed)
Strutting beam to top plate:		
(a) Light roof in high and medium wind exposure	100 x 3.75 plus wire dogs	2 (skewed) 2
(b) All other cases	100 x 3.75	2 (skewed)

* See clause A6.

Table 30 (continued)

Joint	*Length (mm) x diameter (mm) and type*	*Number and location*
Roof framing (continued)		
Roof braces, at each connection to a framing member:		
(a) 100 mm x 25 mm brace	100 x 3.75	2
	or	
	75 x 3.15	3
(b) 75 mm x 50 mm brace runner	100 x 3.75	2
(c) 100 mm x 50 mm brace	100 x 3.75	3
(d) Steel strip brace: (i) At ends	60 x 3.15	3
(ii) Other cases	60 x 3.15	2
100 mm x 50 mm blocking between rafters, joists or truss chords	100 x 3.75	2 (end nailed)
Jack rafter to hip or valley rafter	75 x 3.15	3 (skewed)
Outrigger to gable top plate:		
(a) Light roofs in high wind exposure	100 x 3.75 plus wire dogs	2 (skewed) 1
(b) Other cases	100 x 3.75	2 (skewed)
Outrigger to rafter	100 x 3.75	2 (end nailed)
	or	
	75 x 3.15	4 (skewed)
Purlin or batten to outrigger	100 x 3.75	250 mm centres
Flying rafter to outrigger	100 x 3.75	2
Outrigger blocking to top plate	100 x 3.75	4 (skewed)
Purlin or batten directly (not through sarking) to rafter or top chord‡		

Locality in roof	*Maximum purlin spacing* (mm)	*Maximum rafter spacing* (mm)	*Wind exposure*		
Light roofs:					
Body	1200	1200	all	100 x 3.75	2 (skewed)
Edge†	1200	1200	high	100 x 3.75 plus wire dogs	2 (skewed) 1
Edge†	1200	1200	medium low	100 x 3.75	2 (skewed)
Body	900	900	high	100 x 3.75	2
Body	900	900	medium low	100 x 3.75	1
Edge†	900	900	all	100 x 3.75	2 (skewed)
Body	400	1200		100 x 3.75	1
Edge†	400	900		100 x 3.75	1
Edge†	400	1200		100 x 3.75 plus 75 x 3.15	1 1 (skewed)

† The edge of the roof shall be taken as within 1/10th of the roof plan width measured from the fascia, barge, hip, or ridge line

‡ Where purlins or battens are butt-jointed on a rafter or top chord, two 75 x 3.15 mm skew driven nails may be used at each member end.

Table 30 (continued)

Joint	*Length (mm) x diameter (mm) and type*	*Number and location*

Roof framing (continued)

Locality in roof	*Maximum purlin spacing* (mm)	*Maximum rafter spacing* (mm)	*Wind exposure*		
Heavy roofs:					
Anywhere	400	900	all	100 x 3.75	1
Anywhere	1200	900	all	100 x 3.75	2 (skewed)
25 mm thick purlins					
Anywhere	400	480	all	75 x 3.15 FH	1

Roof sarking

Board sarking to rafters or top chords:	2½ x finished thickness	
(a) Boards not exceeding 75 mm wide		1
(b) Boards exceeding 75 mm wide		2
Sheet material for sheet sarking to:	30* x 2.5 FH	
(a) Rafters or top chords at sheet edges		150 mm centres
(b) Intermediate supports		300 mm centres

Ceiling framing

Ceiling batten to top plate	75 x 3.15	1
Ceiling joist to top plate	100 x 3.75	2 (skewed)
Ceiling joist to rafter	100 x 3.75	3
Lapped joint in joist	100 x 3.75	2 (each side)
Flitched joint in joist	100 x 3.75	4 (each end)
Ceiling runner to top plate	100 x 3.75	2 (skewed)
Ceiling runner to ceiling joist	100 x 3.75	2 (skewed)
Hanger to runner or joist	100 x 3.75	2
Ceiling batten to joist, rafter or truss:		
(a) 50 mm x 25 mm	60 x 2.8 or 57 x 11.1 x 1.8 staple	1 1
(b) 75 mm x 40 mm	75 x 3.15	2
Dragon tie to top plate or blocking piece:		
(a) 100 mm x 40 mm	100 x 3.75	3
(b) Steel strip	60 x 3.15	6
Dragon tie to joist, truss, or rafter:		
(a) 100 mm x 40 mm	100 x 3.75	2
(b) Steel strip	60 x 3.15	3
Blocking piece to top plate truss, joist or rafter	100 x 3.75	4

Ceiling lining

Sheet material for ceiling diaphragm to:	30* x 2.5 FH	
(a) Framing members at sheet edges		150 mm centres
(b) Intermediate supports		300 mm centres

* See clause A6.

APPENDIX B

PRODUCT LITERATURE

B1
Scope

B1.1
This appendix gives outline requirements for the clear presentation of technical information about products and services for the construction industry. More detailed guidance is given by BS 4940*.

B1.2
This appendix covers only the manner in which information is to be presented and not the extent of the information necessary in each particular case.

CB1.2
The fact that an item of information is mentioned in this appendix does not mean that it must be published. The extent of the information to be published in any particular case must be decided under clause 2.3 and not under this appendix.

B2
General

B2.1
All documents shall be on A4 size sheets or on sheets folded to A4 size, and the cover sheet shall carry the CI/SfB classification reference.

B2.2
All documents shall be dated, and where previous documents have been superseded this shall be stated.

B2.3
All drawings shall comply with NZS 5902* where applicable.

B2.4
Information shall be presented in terms of the headings listed in clauses B3 to B10 inclusive, where applicable, and in that order. Relevant information not covered by clauses B3 to B10 inclusive shall be included in an appropriate position.

B3
Identification

B3.1
Information given in this section is to enable the reader of the document to identify the product, its purpose and use, and the listing of authoritative documents, such as test certificates and standards relating to it as follows:

(a) Introduction: Product name, type, grade, quality, producer, commodity number, short description of product, its purpose and conditions of use, together with any limitations of use;
(b) Authority: Related documentation: Statutory (legal) requirements, standards, quality and assessment certificates, guarantees, codes of practice, national specifications.

* see list of related documents

B4
Description

B4.1
This section is designed to contain information relating to the product 'as purchased':

(a) Composition: Constituents, parts, type of finish;
(b) Manufacture: Combination of constituents and parts;
(c) Description: Accessories, shape, size, weight, appearance. Information relating to its behaviour in subsequent use shall be placed in the section covered by clause B5.

B5
Performance

B5.1
This section is designed to contain characteristics relating to behaviour in use and working characteristics.

B5.2
Specific characteristics: Structural, mechanical, fire, thermal, optical, acoustic, electrical, compatibility, durability, workability, maintenance.

B6
Applications

B6.1
This section is for recording the suitability of the product for various applications and uses and the functional and economic factors which need to be taken into account when selecting a product.

B7
Construction

B7.1
This section should normally be in the form of instructions for doing the work and should also be used for instructions for work involving the alteration, removal or demolition of the product.

B8
Operation and maintenance

B8.1
Resources and operation. Labour, plant, material and space requirements, method of operation and control.

B8.2
Maintenance. Cleaning maintenance, repair maintenance, protective measures, personal safety, public safety.

B9
Technical services

B9.1
This section is for describing any product support and consultancy services provided by the producer such as service and maintenance organization and technical advisory services.

B10
References

B10.1
This section is for listing references not required by clause B3.1 (b).

APPENDIX C

TESTS FOR SOIL BEARING CAPACITY

C1
Scope

C1.1
This appendix defines a test method that may be used to establish that the soil supporting the foundations may be assumed to have a safe bearing pressure of not less than 100 kPa as required by clause 3.1.2.

C2
Penetrometer

C2.1
The penetrometer shall be a Scala penetrometer or similar instrument consisting essentially of a steel shaft with a conical tip having an included angle of 30° and a base area of 322 mm² that is driven into the ground by a steel mass of 9 kg falling freely through a distance of 508 mm on to a collar fixed to the shaft.

CC2.1
For further details of the construction and use of the Scala penetrometer see BRANZ Bulletin 212.*

C3
Method of test

C3.1
The tip of the penetrometer shall be driven to a depth below the underside of the proposed footing of not less than 1.2 m or twice the width of the widest footing, whichever is the deeper.

C3.2
The depth of penetration shall be measured from a board placed firmly across the ground surface.

C3.3
The number of blows taken shall be recorded for each 300 mm or part thereof that the tip is driven below the underside of the proposed footing.

C3.4
If necessary, the penetrometer may be used within a probe hole augered for the purpose, provided that no account shall be taken of any blow made when the probe hole is less than 300 mm above the tip of the penetrometer.

C3.5
A bore hole of not less than 50 mm diameter shall be augered at the site of each penetrometer test. The bore hole shall be taken to the same depth as the tip of the penetrometer, but at no stage shall the hole be deeper than the tip. For each bore hole the following information shall be recorded for each 300 mm or part thereof below ground surface (stating whether this is original ground level or cleared ground level as appropriate):

(a) Soil types and colours;

(b) Presence of any stones, gravel, or other hard material;

(c) Presence of any topsoil, peat, fill, or other foreign material;

(d) Ground water level;

(e) Soil strength of any peat or clay encountered, tested on natural chunks (not remoulded material or loose shavings) thus:
Stiff: Cannot be moulded in the fingers

Firm: Can be moulded in the fingers only by strong pressure

Soft: Can be moulded in the fingers easily

Very soft: Exudes between the fingers when squeezed in the fist

(f) Presence of expansive clay.

C4
Test results

C4.1
The soil supporting the foundations may be assumed to have a safe bearing pressure of not less than 100 kPa when:

(a) None of the following is encountered below the depth of the underside of the proposed footing at any test site:

(i) Organic topsoil;

(ii) Soft or very soft peat;

(iii) Soft or very soft clay that contains stones, gravel, or other hard material;

(iv) Fill material except where a certificate of suitability has been issued in terms of NZS 4431* (see clauses 3.1.2 (d) and 3.3.1):

and

(b) The number of blows per 75 mm depth of penetration below the underside of the proposed footing at each test site exceeds:

(i) Three down to a depth equal to the width of the widest footing below the underside of the proposed footing;

(ii) Two at greater depths;

and

(c) Comparison of the results at all test sites shows that soil conditions are closely similar at each test site.

* see list of related documents

C4.2
The number of blows per 75 mm may be obtained by averaging the number of blows for greater depths not exceeding 300 mm.

C5
Number of tests required
C5.1
Test sites shall be selected so as to give adequate information about the soil over the entire plan area of the proposed building; provided that there shall be not less than four test sites for a building not exceeding 200 m^2 plan area with not less than one additional test site for each 100 m^2 additional plan area of building.

C5.2
The position of each test site in relation to proposed foundations shall be recorded.

APPENDIX D

SHORT DRIVEN TIMBER PILES

D1
Scope

D1.1
This appendix sets down requirements for natural round timber piles not exceeding 3.6 m long driven into the ground.

D1.2
This appendix is applicable only in conjunction with and as a supplement to the rest of this standard.

D1.3
The rest of this standard shall apply to all matters that are not specifically varied by the provisions of this appendix.

D1.4
Where all of the piles supporting a building are cantilevered driven round timber piles complying with clauses D6 and D7 then:

(a) Clauses 4.1.1(a) and 4.1.1(b) are satisfied; and

(b) Clauses 4.2.2 and 4.3 do not apply.

D2
Soil bearing capacity

D2.1
Bore holes complying with the applicable requirements of clause C3.5 shall be augered at sites selected in accordance with clause C5 and the information obtained from those bore holes shall be regarded as having been revealed by 'excavation for foundations' for the purposes of clause 3.1.2.

D2.2
For the purposes of this appendix the requirements of Appendix C shall be modified as set out in clauses D2.3 to D2.6 inclusive.

D2.3
Clause C3.1 shall be modified to require that the tip of the penetrometer shall be driven to 1.5 m below cleared ground level.

D2.4
Clause C3.5 shall be modified to require that the bore hole shall be augered to a depth 800 mm below the base of the proposed adjacent piles or to 2 m below cleared ground level, whichever is the deeper.

D2.5
Clause C4.1 (a) shall be modified to require that the listed unsuitable materials shall not be encountered at a depth greater than 300 mm below cleared ground level.

D2.6
Clause C4.1 (b) shall be modified to require that the number of blows per 75 mm at depths more than 600 mm below cleared ground level shall exceed two.

D3
Driving of piles

CD3
In all cases at least one test pile should be driven before the delivery of the pile material so as to ensure that adequate resistance to driving can be obtained. In cases where it is necessary to make penetrometer tests and the number of blows per 75 mm of penetrometer penetration lies between two and three, at least four test piles should be driven in locations distributed uniformly over the site of the proposed building.

D3.1
Piles shall be driven without damage to the pile until:

(a) The base of the pile has reached a depth below cleared ground level of not less than:

900 mm through gravel;

1200 mm through other types of soil; and

(b) The driving resistance required by clause D6 has been achieved.

CD3.1
A suitable rig would be a tractor-mounted fence post driver that provides adequate control of the vertical and horizontal pile alignment during driving and that permits the required free fall of the hammer with free-running ropes, easy rotation of winching draw and pulleys, and clear retraction of the brake.

D3.2
The maximum length of pile to be driven shall not exceed 3.6 m.

D3.3
Piles shall be driven with the small end diameter at the base.

D4
Tolerances

D4.1
Pile tops shall be at such levels as to support bearers without packing.

D4.2
Piles shall be in straight rows with a tolerance of 10 mm between the centre of any pile top and a straight line.

CD4.2
The straight line will be the centreline of the bearer.

D4.3
Piles shall be plumb with a tolerance of 15 mm per 1 m length of pile.

D5
Driving resistance

D5.1
The driving resistance shall be measured by the set per blow when driven by a hammer having a mass *M* of not less than 200 kg falling freely through a distance *h* of not less than 480/*M* metres (where *M* is in kilograms).

CD5.1
The free fall of the hammer has been defined so as to ensure that the hammer will deliver to the top of the pile not less than 4800 J of energy per blow.

D5.2
The set per blow shall be measured from a datum beam supported at least I m clear of the pile and the driving rig.

D5.3
The set for each blow over not less than the final 200 mm of driving shall be clearly marked on the pile.

D6
Spacing of piles

D6.1
The maximum spacing between piles along the line of the bearer shall be determined from the driving resistance during the driving of piles in accordance with table 31 provided that the spacing shall not exceed the maximum span of the bearer as given by table 5.

D6.2
In any case where a pile top has been driven to the level required by clause D3.1 and the set per blow still exceeds the maximum given by table 31, that pile shall not be regarded as providing support to the bearer.

CD6.2
The situation described in clause D6.2 indicates a local 'soft spot' and it will be necessary to drive additional piles on either side of it.

D7
Cantilevered piles

D7.1
Driven round timber piles shall be regarded as cantilevered piles only when:

(a) No pile top is more than 1.2 m above cleared ground level; and

Table 31 SPACING OF DRIVEN ROUND TIMBER PILES
1.5 kPa floor load

A Piles supporting floors only:

Maximum span of joists	*Maximum spacing of piles (span of bearer) when the maximum set per blow (mm) does not exceed:*		
	25	*50*	*100*
(m)	(m)	(m)	(m)
1.6	2.00	2.00	2.00
2.0	2.00	2.00	1.60
2.4	2.00	2.00	1.35
2.8	2.00	2.00	1.15
3.2	2.00	2.00	1.00
3.6	2.00	1.80	0.90
4.0	2.00	1.60	–
4.4	2.00	1.45	–
4.8	2.00	1.35	–
5.2	1.85	1.25	–
5.6	1.75	1.15	–

B Piles supporting floors and walls:

Maximum span of joists	*Maximum roof dimension S* of:*		*Maximum spacing of piles (span of bearer) supporting:*				
			One storey when the maximum set (mm) per blow does not exceed:			*Two storeys when the maximum set (mm) per blow does not exceed:*	
	Light roof	*Heavy roof*	*25*	*50*	*100*	*25*	*50*
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
1.2	4.8	2.4	2.00	2.00	1.60	2.00	2.00
1.6	6.4	3.2	2.00	2.00	1.20	2.00	1.70
2.0	8.0	4.0	2.00	2.00	0.95	2.00	1.40
2.4	9.6	4.8	2.00	1.60	–	1.70	1.15
2.8	11.2	5.6	2.00	1.40	–	1.45	1.00
3.2	12.0	6.4	1.80	1.20	–	1.30	0.85
3.6	12.0	7.2	1.60	1.10	–	1.15	–
4.0	12.0	8.0	1.45	0.95	–	1.05	–
4.4	12.0	8.8	1.30	0.90	–	0.95	–
4.8	12.0	9.6	1.20	–	–	0.85	–
5.2	12.0	10.4	1.10	–	–	–	–
5.6	12.0	11.2	1.00	–	–	–	–

* See clause 6.4.3.

(b) No pile top within any 5 m wide strip of building plan area is more than twice the height above cleared ground level of any other pile top within that strip; and

(c) The number of piles in any 5 m wide strip of building plan area is not less than the number given by table 32A for earthquake or by table 32B for wind, whichever is the greater.

D7.2
For the purposes of clause 5.1.2 each bearer shall be considered to be a sub-floor line of horizontal support.

D8
Bearer fixings

D8.1
The fixing of bearers to driven round timber piles shall be as for ordinary timber piles. The fixing of bearers to driven round timber cantilevered piles shall be as shown in fig. 61 or an alternative fixing having a capacity in any horizontal direction of 2.5 kN.

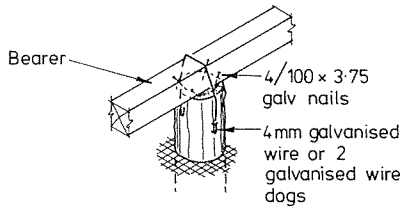


Fig. 61: Fixing of bearers to driven timber cantilevered piles

Table 32

DRIVEN ROUND TIMBER CANTILEVERED PILES

1.5 kPa and 2.0 kPa floor loads

A For earthquake:

Number of storeys	*Minimum number of cantilevered piles per 10 m length of 5 m wide strip in earthquake zone:*		
	A	*B*	*C*
Light roof:			
One	10	8	7
Two	17	13	10
Heavy roof:			
One	16	14	11
Two	22	18	15

B For wind:

Maximum height of eaves above cleared ground level	*Maximum height of pile above cleared ground level*	*Minimum number of cantilevered piles per 5 m wide strip in wind exposure:*		
		Low	*Medium*	*High*
(m)	(mm)			
Roof slope not exceeding 25°				
4.5	600	11	14	23
7.0	600	21	28	
4.5	1200	24	30	
Roof slope exceeding 25° but not exceeding 45°				
4.5	600	17	22	36
7.0	600	28	34	
4.5	1200	36	41	

APPENDIX E

CONCRETE SLAB-ON-GROUND FLOORS

E1
Scope

E1.1
This appendix sets down requirements for concrete slab-on-ground floors.

E1.2
This appendix applies only in conjunction with and as a supplement to the rest of this standard.

E1.3
The rest of this standard shall apply to all matters that are not specifically varied by the provisions of this appendix.

E2
General

E2.1
The finished concrete floor level of a slab-on-ground floor shall be a minimum height above the adjoining finished ground level (see fig. 62) of:

(a) Where the adjoining ground is protected by permanent paving:

(i) Masonry veneer exterior wall covering: 100 mm;
(ii) Any other exterior wall covering: 150 mm;

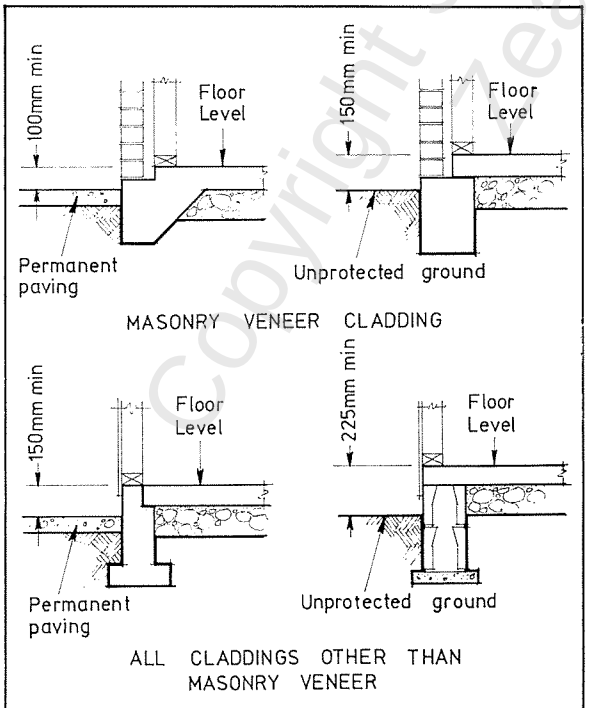


Fig. 62 : Minimum heights of finished concrete slab-on-ground floors above adjoining finished ground level

* see list of related documents

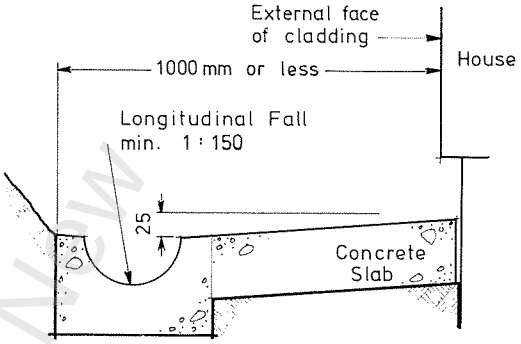


Fig. 63 : Protection of finished ground adjoining buildings with concrete slab-on-ground floors

(b) Where the adjoining ground is not protected by permanent paving:

(i) Masonry veneer external wall covering: 150 mm;

(ii) Any other exterior wall covering: 225 mm.

E2.2
The finished ground level adjoining the building around its entire perimeter shall fall away from the building at a slope of not less than 1 in 25. Where this slope extends 1 m or less from the building it shall be protected by permanent paving (see fig. 63).

E2.3
Concrete slab-on-ground floors shall have continuous foundation walls complying with clause 4.6 and extending around the entire perimeter of the external walls. The foundation walls shall either:

(a) Be constructed in reinforced concrete or reinforced masonry separately from the ground slab (see fig. 64); or

(b) Be cast integrally with the ground slab as an edge thickening in which case the slope from the underside of the integral foundation wall to the underside of the ground slab shall be no steeper than 45° (see fig. 64).

E2.4
All concrete used in slab-on-ground floors shall be ordinary grade concrete as specified in NZS 1900 : Chapter 9.3A* provided that the fine and coarse aggregates need not be supplied and batched separately.

CE2.4
NZS 1900 : Chapter 9.3A requires ordinary grade concrete to have a minimum specified compressive strength of 17.5 MPa at 28 days standard cured.*

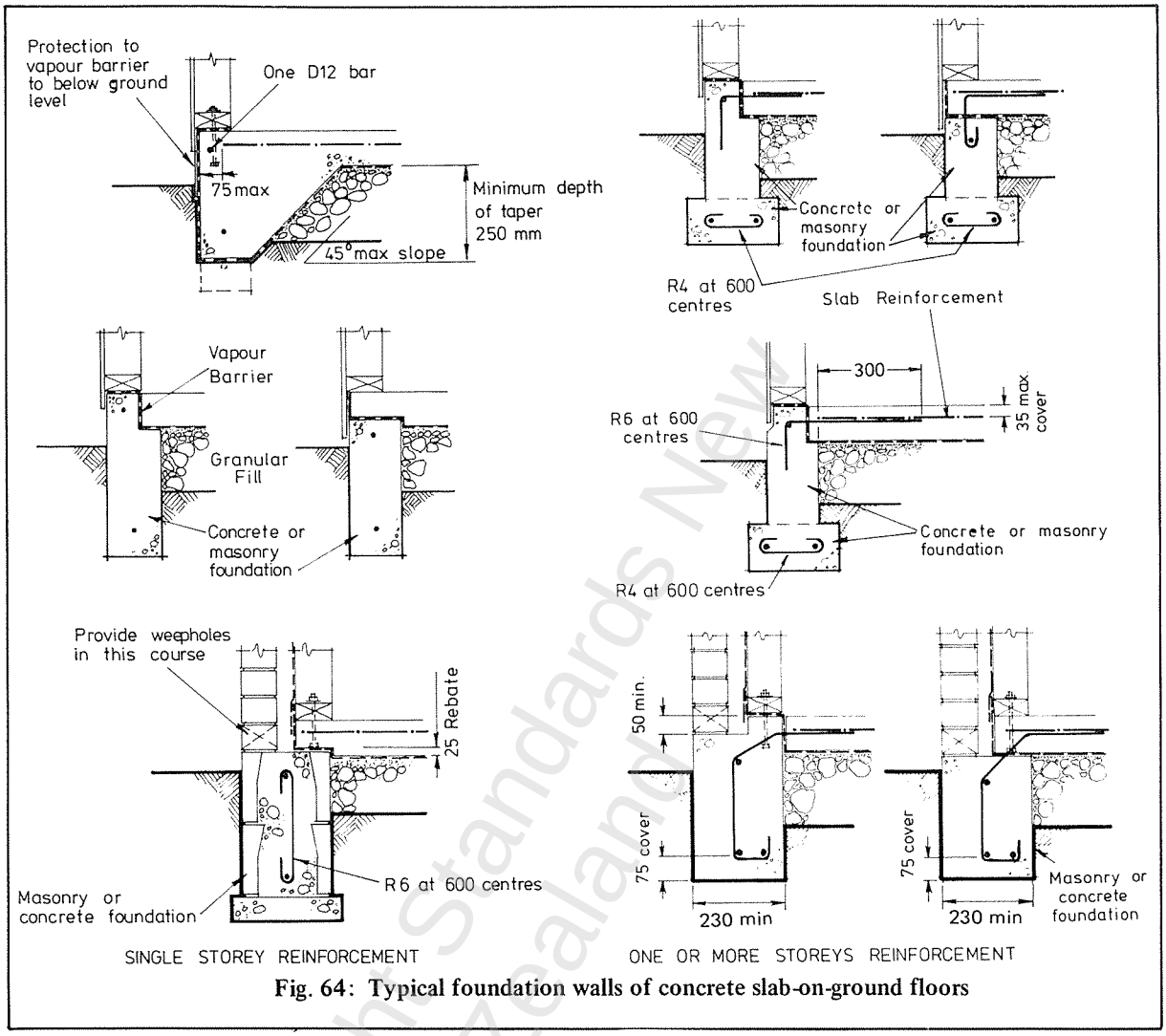


Fig. 64: Typical foundation walls of concrete slab-on-ground floors

E2.5

Every slab-on-ground floor shall incorporate a continuous vapour barrier between the ground and the floor surface (see fig. 64). The vapour barrier shall either:

(a) Be laid beneath the ground slab on a surface suitable to receive the type of vapour barrier material being used; or

(b) Be laid over the ground slab and be protected by a concrete floor topping not less than 50 mm thick (see fig. 65).

CE2.5

A minimum topping thickness of 50 mm is required to resist vapour pressure.

E2.6

Where thermal insulating material is required it may be placed in any appropriate position to achieve the desired effect provided that no reduction of any dimension given by this standard shall be permitted.

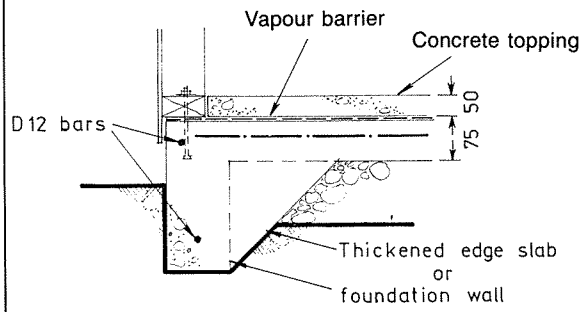


Fig. 65 : Vapour barrier laid over ground slab and protected by concrete topping

E3
Bearing

E3.1
Clause 3.3.2 (minimum depth of foundations below cleared ground level) shall apply to the foundation walls but not to the ground slab itself. The depth shall be measured from the cleared ground level outside the foundation wall and not from the cleared ground level beneath the ground slab.

CE3.1
The cleared ground level beneath the slab will need to be such that:

(a) The granular fill material can be placed on solid bottom or firm fill where a certificate of suitability has been issued in terms of NZS 4431 (see clause 3.3.1); and*

(b) The thickness of granular fill complies with clause E5.1; and

(c) The finished floor level complies with clause E2.1.

E4
Foundation walls

E4.1
For the purposes of clauses 4.6.4 and E4.3 and of table 4 (foundation wall footings), foundation walls of slab-on-ground floors shall be regarded as supporting the ground floor.

CE4.1
The width and reinforcing requirements for foundation wall footings for slab-on-ground buildings are the same as for other types of building having the same number of storeys.

E4.2
Foundation walls shall be continuously reinforced with not less than one D12 bar at the top of the wall.

E4.3
Foundation walls constructed separately from the ground slab and supporting more than one floor (see clause E4.1) shall be tied to the ground slab by R6 bars at not less than 600 mm centres lapped not less than 300 mm with the slab reinforcing and anchored into the foundation wall (see fig. 64).

E5
Granular base

E5.1
Granular fill material complying with clause E5.2 shall be placed in layers not exceeding 100 mm thick over the area beneath the proposed ground slab so that the total thickness of granular base is not less than 100 mm nor more than 300 mm.

E5.2
Granular fill material shall be rounded gravel, crushed rock, or scoria and:

(a) Not more than 5 percent shall pass a 2.2 mm sieve;

(b) 100 percent shall pass either:
A 19 mm sieve for any fill thickness; or
A 37.5 mm sieve for a fill thickness exceeding 150 mm.

E5.3
The top surface of the granular base shall be treated as necessary to receive the vapour barrier in accordance with clauses E6, E7, E8, E9, or E10 as appropriate.

E6
Vapour barriers: general

E6.1
The vapour barrier shall:

(a) Have a water vapour flow resistance not less than 90 MNs/g when tested in accordance with ASTM E96*;

(b) Be of acceptable durability and strength to withstand the conditions of installation and end use;

(c) Be laid on a surface suitable to receive the type of vapour barrier material being used.

E6.2
Any vapour barrier material and its receiving surface specified in clauses E7 to E10 inclusive shall be accepted as complying with clause E6.1.

E6.3
More than one type of vapour barrier material may be used provided that there shall be adequate lapping between different materials.

E6.4
Any penetrations through the vapour barrier shall be sealed.

CE6.4
Penetrations by services or by reinforcing steel may be sealed by taping or by the use of a wet-applied vapour barrier material or by other means appropriate to the type of material.

E6.5
The vapour barrier shall abut and may include any damp-proof course provided to protect timber in accordance with clause 2.1.

E6.6
Vapour barrier materials shall be repaired or replaced as necessary immediately before concrete is placed over them.

E7
Bituminous sheet vapour barriers

E7.1
Bituminous sheet vapour barrier material shall:

(a) Have a hessian or fibreglass core;

(b) Be not less than 3 mm thick;

(c) Have heat-bonded lap joints not less than 50 mm wide;

(d) Be protected from damage.

* see list of related documents

CE7.1
Vertical faces cannot be exposed in any situation where the sheet might suffer damage.

E7.2
Bituminous sheet vapour barrier material shall be laid over:

(a) A smooth-surfaced blinding layer not less than 5 mm thick of coarse sand or a sand cement slurry; or

(b) Heavyweight building paper.

E8
Polyethylene (polythene) sheet vapour barriers

CE8
Polyethylene is usually referred to as 'polythene' in the New Zealand building industry.

E8.1
Polyethylene sheet vapour barrier material shall:

(a) Be either:

(i) A single unprotected layer of polyethylene not less than 0.25 mm thick; or

(ii) A multi-layer laminate in which one or more layers of polyethylene having an aggregate thickness not less than 0.1 mm thick are incorporated with layers of other material that provides adequate protection to the polyethylene;

(b) Have heat-sealed joints not less than 50 mm wide or lap joints not less than 150 mm wide sealed with pressure-sensitive plastics tape not less than 50 mm wide provided that such tape need not be used with self-sealing polyethylene sheets;

(c) Be protected from damage.

CE8.1
Vertical faces cannot be exposed in any situation where the sheet might suffer damage.

E8.2
Polyethylene sheet vapour barrier material shall be laid over either:

(a) A smooth-surfaced blinding layer not less than 5 mm thick of coarse sand or a sand cement slurry; or

(b) Heavyweight building paper.

E9
Asphalt vapour barriers

E9.1
Asphalt vapour barrier material shall:

(a) Be 20-30 penetration natural asphalt;

(b) Be hot-poured in two coats to form a membrane not less than 3 mm thick.

E9.2
Asphalt vapour barrier material shall be hot-poured over a prime coat of cold-brushed bituminous emulsion on a layer of concrete not less than 50 mm thick.

E10
Rubber emulsion vapour barriers

E10.1
Rubber emulsion vapour barrier material shall:

(a) Contain not less than 10 percent rubber latex;

(b) Be applied in at least two coats at right angles to each other and in accordance with clearly presented and adequate technical information supplied by the manufacturer.

CE10.1
The information supplied by the manufacturer should take account of the shrinkage cracking that will occur in the supporting concrete layer.

E10.2
Rubber emulsion vapour barrier material shall be laid on a layer of concrete not less than 50 mm thick.

E11
Ground slabs

E11.1
Except as required by clause E12 beneath certain loadbearing walls, the minimum thickness of the ground slab shall be:

(a) Sheet vapour barrier beneath in accordance with clause E7 or E8: 100 mm;

(b) Wet-applied vapour barrier beneath in accordance with clause E9 or E10: 75 mm;

(c) Vapour barrier above in accordance with clause E2.5 (b): 75 mm.

E11.2
A ground slab whose foundation walls support more than one floor (see clause E4.1) shall be reinforced in accordance with clauses E11.3 and E11.4 and all other ground slabs shall either be reinforced in accordance with clauses E11.3 and E11.4 or shall contain shrinkage control joints in accordance with clause E11.5.

E11.3
Ground slab reinforcing shall extend to within 75 mm of the outside edge of the slab (including the foundation wall when it is cast integrally with the ground slab) and shall consist of:

(a) Where the maximum plan dimension of concrete cast in one operation does not exceed 15 m: 668 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 either:

(i) 665 welded reinforcing mesh lapped 225 mm at joints; or

(ii) D10 bars at 350 mm centres both ways tied at each fourth crossing.

EII.4
Reinforcing shall have not less than 35 mm cover to the top surface of the ground slab and shall be supported in position in a way that will not damage the vapour barrier.

EII.5
Shrinkage control joints in unreinforced ground slabs shall be formed by either:

(a) Restricting the maximum plan dimension of concrete between construction joints, or between contraction strips inserted while the concrete is being cast, to:

(i) 75 mm slab thickness: 3 m;

(ii) 100 mm slab thickness: 4 m;

or

(b) Dividing the slab into bays of the maximum plan dimension given by clause EII.5 (a) at an appropriate time not more than two days after the concrete has been cast by saw cuts 6 mm wide to a depth of one-quarter the slab thickness or the nominal maximum size of the slab aggregate, whichever is the greater.

CE11.5
The appropriate time to make the saw cuts specified by clause E11.5 (b) is after the slab has set sufficiently not to be accidentally damaged by the operation but before its drying shrinkage has caused cracking. This will depend upon the ambient temperature.

Special care is necessary when making saw cuts into concrete that contains electrical heating elements, and this should be done only in co-operation with the installer of the elements.

E12
Support of loadbearing internal walls

E12.1
The slab beneath a loadbearing internal wall that supports either:

(a) Two floors and a roof; or

(b) One floor and a heavy roof;

Shall be 200 mm thick over a minimum width of 300 mm and reinforced with two D12 bars as shown in fig. 66.

E13
Fixing of timber

EI3.1
Framing timbers shall be fixed to slab-on-ground floors as required by clause 4.7.1 (fixing of wall plates to foundation walls) provided that shot-fired fasteners may be used in accordance with clause EI3.2.

EI3.2
Shot-fired fasteners may be used to fix internal walls to slab-on-ground floors, excluding the bottom plates and end studs of sheet bracing wall bracing elements which shall be fixed as shown in fig. 67. Where permitted, shot-fired fasteners shall:

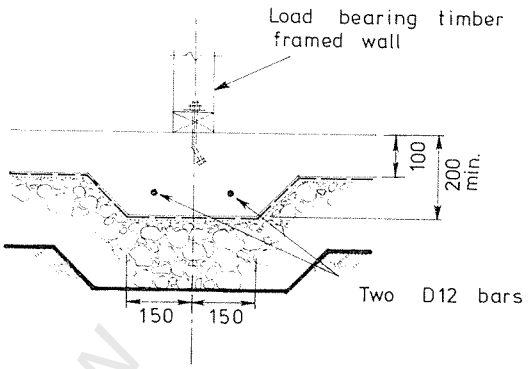


Fig. 66 : Ground slabs beneath internal loadbearing walls

(a) Be of 4 mm diameter and fitted with discs;

(b) Be provided within 150 mm of each end of the plate and at not more than 900 mm centres elsewhere.

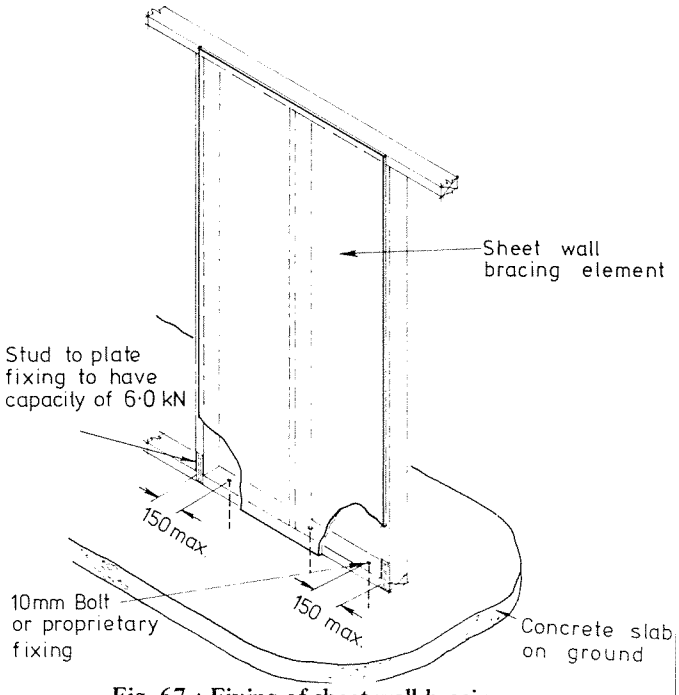


Fig. 67 : Fixing of sheet wall bracing elements to concrete slabs

APPENDIX F

MASONRY VENEER EXTERIOR WALL COVERING

F1
Scope

F1.1
This appendix sets down requirements for masonry veneer exterior wall coverings.

F1.2
This appendix applies only in conjunction with and as a supplement to the rest of this standard.

F1.3
The rest of this standard shall apply to all matters that are not specifically varied by the provisions of this appendix.

* see list of related documents

F2
General

F2.1
The materials and workmanship of masonry veneer shall be in accordance with NZS I900 : Chapter 6.2*.

F2.2
The height of any masonry veneer wall measured to the top of the veneer or, in the case of a gable end wall, to half the height of the gable shall not exceed 4 m above the top of the foundation wall nor 7 m above finished ground level.

CF2.2
The 4 m maximum height is measured from the top of the foundation wall even when the veneer is supported by the foundation wall footing as shown in fig. 68.

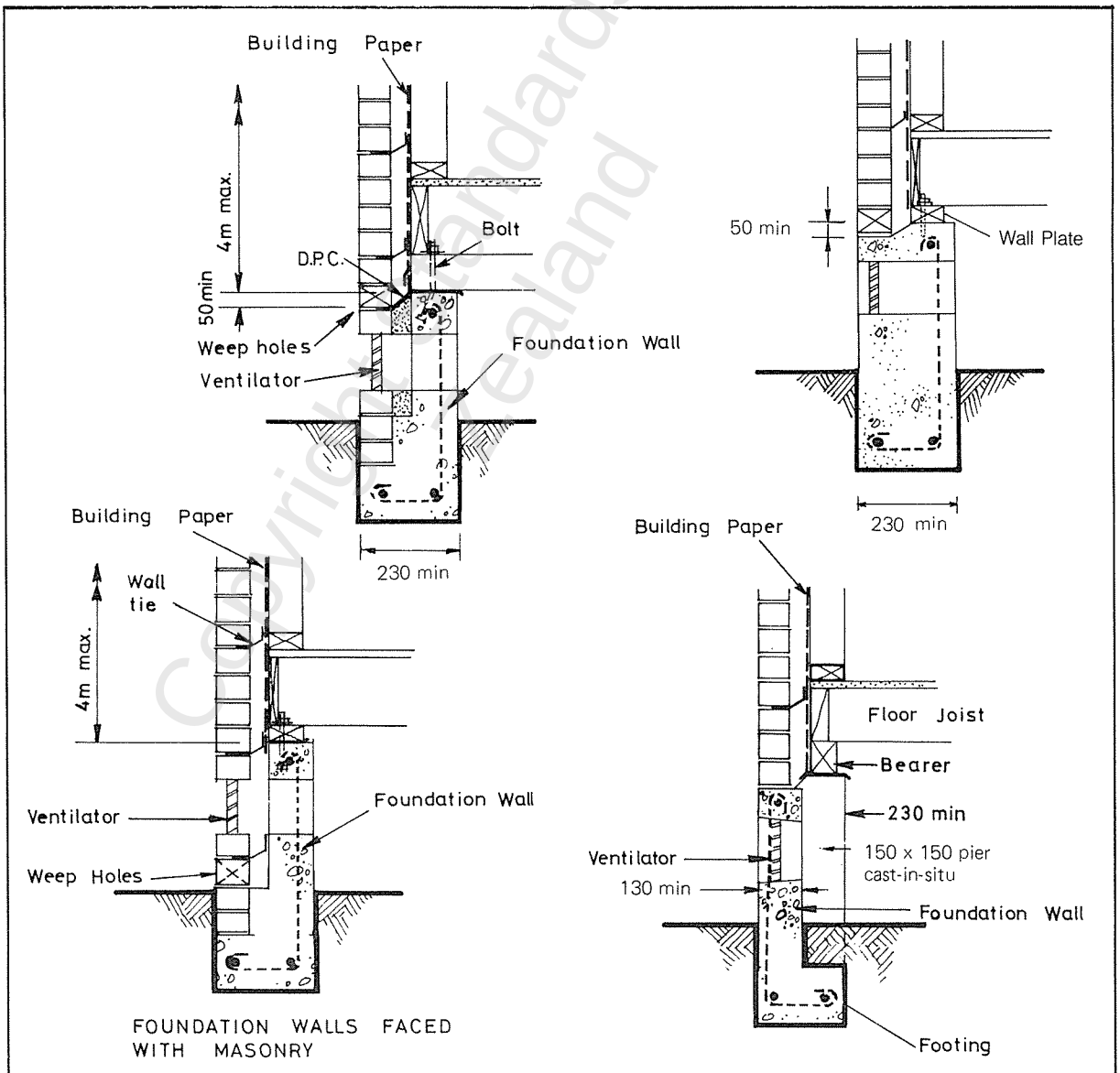


Fig. 68 : Foundation walls supporting masonry veneer

F2.3
No section of veneer wall shall be less than 390 mm long except at corners where a minimum return length of 300 mm may be used.

F2.4
The masonry units shall have an actual width of not less than 87 mm.

F3 Foundations

F3.1
Masonry veneer shall be supported by either the top of a foundation wall or the footing of a foundation wall (see fig. 68).

F3.2
Where a foundation wall supports a masonry veneer and a wall plate, then the top of the foundation wall shall be stepped so that the surface supporting the wall plate is at least 50 mm above the surface supporting the veneer (see fig. 68).

F4 Cavities

F4.1
The cavity between the masonry veneer and the exterior face of the timber stud wall shall be not less than 40 mm nor more than 75 mm wide.

F4.2
Pipes and services shall not be placed in the cavity.

F4.3
The cavity shall be ventilated to the outside air with top and bottom openings. The bottom openings shall serve also as weep holes to drain moisture to the outside (see figures 68 and 69).

F4.4
The cavity shall be sealed off from the roof space (see fig. 69).

F5 Wall ties

F5.1
Masonry veneer shall be attached to its structural backing (wall framing members or foundation walls) by wall ties.

F5.2
Wall ties and their connections shall be of hot-dip galvanized mild steel complying with clause 2.2.2 or be of other equivalent corrosion resistant material; provided that wall ties of galvanized steel shall in any case have a minimum diameter of 4.75 mm if single-leg of round bar or a minimum thickness of 1.5 mm and a minimum width of 25 mm if of strip.

F5.3
Wall ties and their fixings shall be shown by testing to be able to resist a horizontal load in tension or compression equal to the weight of twice the area of masonry veneer supported without elongation or shortening of the assembly by more than 1.5 mm.

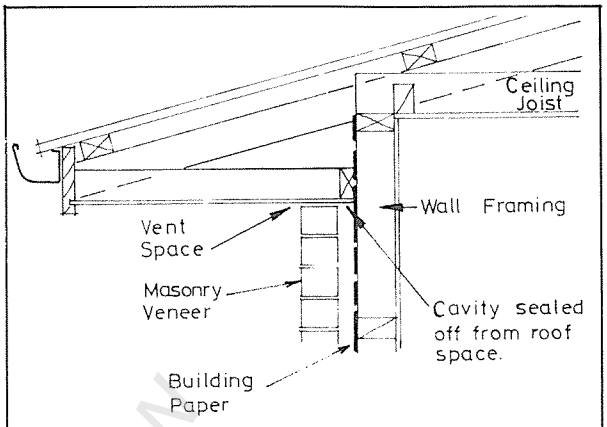


Fig. 69 : Venting and sealing of cavities between masonry veneer and timber stud walls

F5.4
Wall ties shall be spaced either:

(a) At not more than 600 mm horizontally and not more than 350 mm vertically; or

(b) At not more than 450 mm horizontally and not more than 400 mm vertically;

Provided that the vertical spacing shall not exceed four courses high.

F5.5
Wall ties shall be face-fixed to timber framing members so that the building paper is not pierced by more than the fixing nails.

F6 Openings

F6.1
Openings with masonry veneer above shall be spanned by mild steel angle lintels galvanized as required by clause 2.2.2.

F6.2
Lintels shall be of the dimensions given by table 33 or of a size recommended by the manufacturer of the veneer.

F6.3
Lintel bars shall have a minimum landing of 200 mm on their supporting masonry.

F6.4
Wall ties shall be provided within 300 mm of the edges of openings at the spacings required by clause F5.3.

Table 33 STEEL ANGLE LINTELS

Maximum width of opening (span of lintel)	*Lintel size*
(m)	(mm x mm x mm)
1.5	64 x 64 x 6.5 or 60 x 60 x 8.0
2.0	102 x 76 x 6.5 or 80 x 80 x 10.0
2.4	127 x 76 x 8.0
3.0	152 x 76 x 8.0
3.6	178 x 76 x 8.0

APPENDIX G

SOLID PLASTER EXTERIOR WALL COVERING

G1
Scope

G1.1
This appendix sets down requirements for solid plaster exterior wall covering.

G1.2
This appendix applies only in conjunction with and as a supplement to the rest of this standard.

G1.3
The rest of this standard shall apply to all matters that are not specifically varied by the provisions of this appendix.

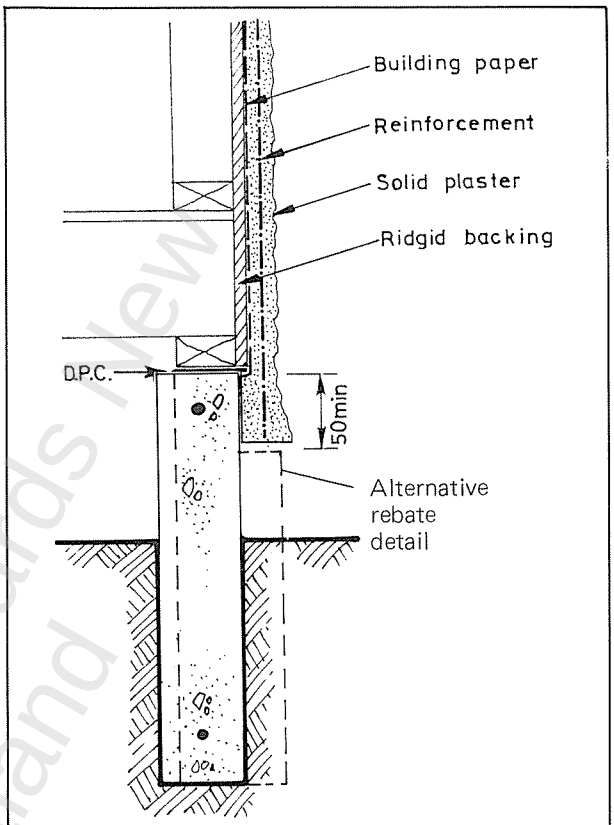
G2
General

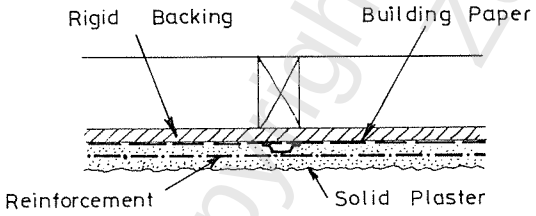
G2.1
The materials, proportions, mixes, reinforcement, and application of plaster shall comply with NZS 4251* except as specifically varied by this appendix.

G2.2
All framing and internal lining shall be completed before the finishing coat of plaster is applied.

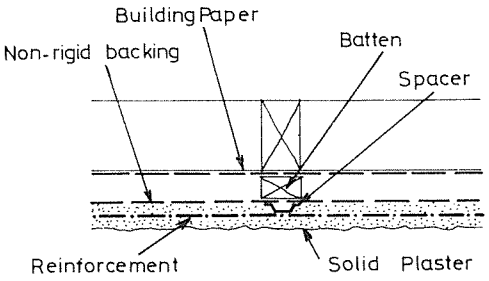
CG2.2
Vibration or jarring of external walls should be avoided from the start of plastering until curing has been completed.

* see list of related documents





RIGID BACKING DETAIL



NON-RIGID BACKING DETAIL

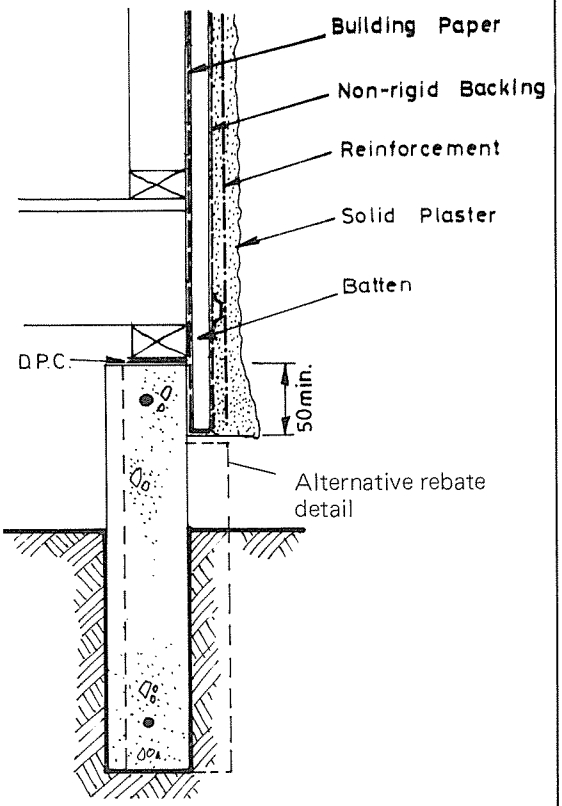


Fig. 70 : Solid plaster exterior wall coverings

G2.3
No wall of an existing building shall be covered with plaster unless the Engineer is satisfied that the wall and its foundations are in a sound and satisfactory condition.

G2.4
Solid plaster exterior covering shall only be used on buildings which have a continuous perimeter reinforced concrete or reinforced masonry foundation wall and the covering shall be attached to timber stud wall framing.

CG2.4
Solid plaster cannot be applied to jack studs at pile spacings.

G2.5
If the top of the foundation wall is rebated to let-in the solid plaster then the bottom of the rebate shall be at least 50 mm below any surface supporting a wall plate (see fig. 70). The rigid backing, or the non-rigid backing and its supporting battens, shall extend to the bottom of the plaster.

G3
Backing

CG3
What this standard calls 'backing' is referred to in NZS 4251 by the more general term 'background', and should not be confused with the structural backing provided by timber stud wall framing.*

G3.1
Solid plaster shall be applied to a rigid backing complying with clauses G3.2 and G3.3 (see fig. 70), provided that where stud spacing does not exceed 480 mm a non-rigid backing complying with clauses G3.4 and G3.5 may be used (see fig. 70).

G3.2
Rigid backing shall be any of the following fixed to the outside of stud framing:

(a) Purpose-made cement wallboard or fibrous plaster sheet not less than 10 mm thick;

(b) Asbestos cement sheet complying with NZS 3204:Part 1* and not less than 4.5 mm thick;

(c) Construction plywood complying with NZS 3614* and treated to TPA CII* and not less than 7.5 mm thick;

(d) Close boarded diagonal timber sheathing of not wider than 150 mm and not thinner than 25 mm boards treated to TPA C7*, spaced not more than a board width and not closer than 25 mm.

G3.3
The breather-type building paper required by clause 8.7 shall be fixed to the outer face of rigid backing.

G3.4
Non-rigid backing shall be breather-type building paper complying with NZS 2295* or waterproof building paper complying with NZS 873* or other suitable non-rigid material used in accordance with NZS 4251*.

G3.5
Non-rigid backing shall be attached to 25 mm battens treated to TPA C7* fixed vertically to the faces of the studs over the breather-type building paper required by clause 8.7.

G4
Control joints

G4.1
Control joints shall be provided at not more than 4 m centres horizontally and vertically by cutting or by physical separation.

G5
Ventilation

G5.1
Where non-rigid backing is used the cavity between the backing and the building paper shall be ventilated to the outside air with top and bottom openings. The bottom openings shall serve also as weep holes to drain moisture to the outside.

G5.2
The cavity shall be sealed off from the roof space and from the subfloor space.

* see list of related documents

APPENDIX H

2.0 kPa and 3.0 kPa FLOOR LOADS

H1
Scope

HI.1
This appendix sets down requirements for 2.0 kPa and 3.0 kPa floor loads.

HI.2
This appendix applies only in conjunction with and as a supplement to the rest of this standard.

HI.3
The rest of this standard shall apply to all matters not specifically varied by the provisions of this appendix.

H2
2.0 kPa floor loads

H2.1
For 2.0 kPa floor load on any floor or floors the following modifications shall apply:

(a) Bearers: Table 5 shall be replaced by table 34;

(b) Stringers: Table 6 shall be replaced by table 35;

(c) Subfloor jack studs: Table 7 shall be replaced by table 36;

(d) Floor joists: Table 8 shall be replaced by table 37. In clauses 5.1.6.4(c) and 5.1.6.5(b), the values of 2.7 kN, 4.5 kN, 5.3 kN, and 7.6 kN shall be replaced with 3.4 kN, 5.7 kN, 6.8 kN and 9.7 kN respectively;

(e) Driven piles: Table 31 shall be replaced by table 38.

H3
3.0 kPa floor loads

H3.1
3.0 kPa floor load shall be permitted on ground floors only. Where ground floors with 3.0 kPa floor load are supported by timber stud loadbearing subfloor walls such subfloor walls shall be considered as being the lowest of three storeys (see fig. 37).

H3.2
Clause 5.1.5 shall not apply for 3.0 kPa floor load.

H3.3
For 3.0 kPa floor load the following modifications shall apply:

(a) Subfloor braces: Table 2 shall be replaced by table 39;

(b) Pile footings: Table 3 shall be replaced by table 40;

(c) Bearers: Table 5 shall be replaced by table 41;

(d) Stringers: Table 6 shall be replaced by table 35;

(e) Subfloor jack studs: Table 7 shall be replaced by table 42;

(f) Floor joists: Table 8 shall be replaced by table 43. In clauses 5.1.6.4(c) and 5.1.6.5(b), the values of 2.7 kN, 4.5 kN, 5.3 kN, and 7.6 kN shall be replaced with 5.0 kN, 8.3 kN, 9.8 kN and 14 kN respectively;

g) Strip flooring: Table 10 shall be replaced by table 44.

Table 34 BEARERS

2.0 kPa floor load

Maximum span of bearer continuous over two or more spans	*Maximum span of joists*	*Bearer size*
(m)	(m)	(mm x mm)
1.30	1.45	100 x 75
	2.00	100 x 100
	2.35	125 x 75
	3.20	125 x 100
	3.45	150 x 75
	4.65	150 x 100
	6.25	200 x 75
1.65	1.45	125 x 75
	2.00	125 x 100
	2.15	150 x 75
	2.90	150 x 100
	3.85	200 x 75
2.00	1.30	125 x 100
	1.45	150 x 75
	2.00	150 x 100
	2.60	200 x 75

Table 35

SPACING OF M12 BOLTS SUPPORTING STRINGERS

2.0 kPa and 3.0 kPa floor loads

Maximum span of floor joists	*Maximum spacing of bolts*
(m)	(m)
2	1.25
3	0.90
4	0.70
5	0.50
6	0.50

Table 36

SUBFLOOR JACK STUDS

2.0 kPa floor load

Maximum span of bearers	*Jack stud*	*Maximum jack stud height for maximum joist spans (m) of:*		
		2.0	*3.5*	*5.0*
(m)	(mm x mm)	(m)	(m)	(m)
Supporting one storey:				
1.30	100 x 75	2.4	1.8	1.2
	100 x 100	3.0	3.0	2.4
1.65	100 x 75	2.4	1.8	–
	100 x 100	3.0	3.0	2.4
2.00	100 x 75	1.8	1.2	–
	100 x 100	3.0	2.4	1.8
Supporting two storeys:				
1.30	100 x 75	1.8	–	–
	100 x 100	3.0	2.4	1.8
1.65	100 x 75	1.2	–	–
	100 x 100	2.4	1.8	–
2.00	100 x 100	2.4	–	–

Table 37

FLOOR JOISTS

2.0 kPa floor load

Floor joist size	*Maximum span of joists* at a maximum spacing (mm) of:*		
	400	*450*	*600*
(mm x mm)	(m)	(m)	(m)
100 x 40	1.60	1.50	1.30
100 x 50	1.70	1.60	1.40
125 x 40	1.95	1.85	1.60
125 x 50	2.10	2.00	1.75
150 x 40	2.40	2.20	2.00
150 x 50	2.60	2.40	2.15
200 x 50	3.50	3.35	2.85
225 x 50	3.95	3.80	3.25
250 x 50	4.40	4.25	3.60
300 x 50	5.30	5.10	4.30

* May be increased by 10 percent for joists continuous over two or more spans.

Table 38

SPACING OF DRIVEN ROUND TIMBER PILES

2.0 kPa floor load

A Piles supporting floors only:

Maximum span of joists	*Maximum spacing of piles (span of bearer) when the maximum set per blow (mm) does not exceed:*		
	25	*50*	*100*
(m)	(m)	(m)	(m)
1.6	2.00	2.00	1.75
2.0	2.00	2.00	1.40
2.4	2.00	2.00	1.15
2.8	2.00	2.00	1.00
3.2	2.00	1.73	–
3.6	2.00	1.55	–
4.0	2.00	1.40	–
4.4	1.90	1.25	–
4.8	1.75	1.15	–
5.2	1.60	1.05	–

B Piles supporting floors and walls:

Maximum span	*Maximum roof dimension S* of:*		*Maximum spacing of piles (span of bearer) supporting:*				
			One storey when the maximum set (mm) per blow does not exceed:			*Two storeys when the maximum set (mm) per blow does not exceed:*	
	Light roof	*Heavy roof*	*25*	*50*	*100*	*25*	*50*
(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
1.2	6.4	3.2	2.00	2.00	1.35	2.00	2.00
1.6	8.5	4.3	2.00	2.00	1.00	2.00	1.45
2.0	12.0	5.3	2.00	1.65	0.80	1.75	1.20
2.4	12.0	6.4	2.00	1.35	–	1.50	1.00
2.8	12.0	7.5	1.75	1.15	–	1.25	–
3.2	12.0	8.5	1.55	1.05	–	–	–
3.6	12.0	9.6	1.35	0.90	–	–	–
4.0	12.0	10.7	1.25	–	–	–	–
4.4	12.0	11.7	1.10	–	–	–	–
4.8	12.0	12.0	1.00	–	–	–	–
5.2	12.0	12.0	0.95	–	–	–	–

Table 39

SUBFLOOR BRACES

3.0 kPa floor load

A For earthquake:

Number of storeys	*Length of line of horizontal support or part thereof*	*Minimum number of subfloor braces per line or part thereof in earthquake zone:*		
		A	*B*	*C*
Light roof				
1	7.5	3	2	2
	10.0	4	3	2
	15.0	5	4	3
2	7.5	4	3	3
	10.0	6	5	3
	15.0	7	6	5
Heavy roof				
1	7.5	3	2	2
	10.0	5	4	3
	15.0	6	5	4
2	7.5	4	3	3
	10.0	7	6	4
	15.0	8	7	6

B For wind:

Maximum height of eaves above cleared ground level	*Maximum slope of roof*	*Minimum number of subfloor braces per line in wind area:*		
		Low	*Medium*	*High*
(m)				
3	25°	1	1	2
	45°	2	2	3
6	25°	2	2	3
	45°	2	3	4
10	25°	3	4	6
	45°	3	5	7

Table 40

PILE FOOTINGS

3.0 kPa floor load

Maximum spans of:		*Minimum plan dimensions of square footing for pile supporting:*			
Bearers	*Joists*	*Floor only*	*Floor and walls of:*		
			One storey	*Two storeys*	*Three storeys*
(m)	(m)	(mm x mm)	(mm x mm)	(mm x mm)	(mm x mm)
1.30	2.0	225 x 225*	300 x 300*	375 x 375	425 x 425
	3.5	300 x 300*	400 x 400	500 x 500	550 x 550
	5.0	325 x 325*	450 x 450	575 x 575	625 x 625
	6.0	350 x 350	500 x 500	625 x 625	675 x 675
1.65	2.0	250 x 250*	350 x 350	425 x 425	475 x 475
	3.5	325 x 325*	425 x 425	575 x 575	625 x 625
	5.0	375 x 375	500 x 500	650 x 650	700 x 700
2.0	2.0	275 x 275*	375 x 375	475 x 475	525 x 525
	3.5	375 x 375	475 x 475	625 x 625	675 x 675

* 350 mm x 350 mm for anchor piles.

Table 41

BEARERS

3.0 kPa floor load

Maximum span of bearer continuous over two or more spans	*Maximum span of joists*	*Bearer size*
(m)	(m)	(mm x mm)
1.30	1.40	100 x 100
	1.65	125 x 75
	2.25	125 x 100
	2.40	150 x 75
	3.30	150 x 100
	4.35	200 x 75
1.65	1.40	125 x 100
	1.50	150 x 75
	2.00	150 x 100
	2.70	200 x 75
2.00	1.40	150 x 100
	1.85	200 x 75

Table 42

SUBFLOOR JACK STUDS

3.0 kPa floor load

Maximum span of bearers	*Jack stud*	*Maximum jack stud height for maximum joist spans (m) of:*		
		2.0	*3.5*	*5.0*
(m)	(mm x mm)	(m)	(m)	(m)
Supporting one storey:				
1.30	100 x 75	2.4	1.2	–
	100 x 100	3.0	2.4	2.4
1.65	100 x 75	1.8	–	–
	100 x 100	3.0	2.4	1.8
2.00	100 x 75	1.8	–	–
	100 x 100	3.0	2.4	1.8
Supporting two storeys:				
1.30	100 x 75	1.2	–	–
	100 x 100	2.4	1.8	–
1.65	100 x 100	2.4	–	–
2.00	100 x 100	1.8	–	–

Table 43

FLOOR JOISTS

3.0 kPa floor load

Floor joist size	*Maximum span* of joists at a maximum spacing (mm) of:*		
	400	*450*	*600*
(mm x mm)	(m)	(m)	(m)
100 x 40	1.30	1.25	1.10
100 x 50	1.40	1.35	1.20
125 x 40	1.65	1.55	1.40
125 x 50	1.80	1.70	1.50
150 x 40	2.05	1.95	1.65
150 x 50	2.20	2.10	1.80
200 x 50	2.90	2.80	2.40
225 x 50	3.30	3.15	2.70
250 x 50	3.65	3.50	3.00
300 x 50	4.40	4.20	3.60

* May be increased by 10 percent for joists continuous over two or more spans.

Table 44

STRIP FLOORING

3.0 kPa floor load

Maximum spacing of joists	*Minimum dry dressed thickness of tongued and grooved strip flooring of species listed below as:*	
	Type A	*Type B*
(mm)	(mm)	(mm)
400	22	19
450	22	22
600	25	25

Type A timbers: Radiata Pine, Matai, Rimu, Red Beech, Silver Beech, Douglas Fir, Larch.

Type B timbers: Tawa, Hard Beech, Jarrah, Karri, Blackbutt, Tallowwood.

APPENDIX J

BUILDINGS OTHER THAN CATERGORY 4

J1
Scope

J1.1
This appendix sets down requirements for buildings of earthquake risk category other than category 4 (see table 4 and clause C3.4.2(a) of NZS 4203*).

J1.2
This appendix applies only in conjunction with and as a supplement to the rest of this Standard.

J1.3
The rest of this Standard shall apply to all matters not specifically varied by the provisions of this appendix.

J2
Buildings other than category 4

J2.1
For buildings other than catergory 4 the number of subfloor braces given by table 24 the number of bracing units given by table 11A, the number of roof braces given by table 27 and the number of driven timber cantilevered piles given by table 32A shall, where applicable, be multiplied by the appropriate risk factor given in table 4 of NZS 4203 and rounded to the nearest whole number.

* see list of related documents

Table 45 SUBFLOOR BRACES
Class I Buildings 1.5 kPa and 2.0 kPa floor loads

Number of storeys	*Length of line of horizontal support or part thereof* (m)	*Minimum number of subfloor braces per line or part thereof in earthquake zone:*		
		A	*B*	*C*
Light roof				
1	7.5	3	2	2
	10.0	3	3	2
	15.0	5	4	3
2	7.5	4	3	3
	10.0	6	5	4
	15.0	8	7	6
Heavy roof				
1	7.5	3	3	2
	10.0	5	4	3
	15.0	7	6	5
2	7.5	5	4	4
	10.0	7	6	5
	15.0	10	8	7

Table 46 SUBFLOOR BRACES
Class I Buildings 3.0 kPa floor load

Number of storeys	*Length of line of horizontal support or part thereof* (m)	*Minimum number of subfloor braces per line or part thereof in earthquake zone:*		
		A	*B*	*C*
Light roof				
1	7.5	4	3	3
	10.0	5	5	4
	15.0	8	7	5
2	7.5	6	5	4
	10.0	8	6	5
	15.0	11	9	8
Heavy roof				
1	7.5	5	4	3
	10.0	7	5	5
	15.0	10	8	7
2	7.5	7	6	5
	10.0	9	7	6
	15.0	13	11	9

Table 47 BRACING UNITS
Class I Buildings 1.5 kPa and 2.0 kPa floor loads

Location of storey	*Maximum slope of roof*	*Minimum number of bracing units per square metre in earthquake zone:*		
		A	*B*	*C*
Light roof				
Single storey or top storey	25°	5	4	3
	45°	6	5	4
Lower of two storeys	25°	10	8	6
	45°	10	9	7
Lowest of three storeys	25°	14	12	9
	45°	15	12	10
Heavy roof				
Single storey or top storey	25°	7	6	5
	45°	9	8	6
Lower of two storeys	25°	12	10	8
	45°	14	11	9
Lowest of three storeys	25°	16	13	11
	45°	18	15	12

Table 48 SUBFLOOR BRACES
Class II Buildings 1.5 kPa and 2.0 kPa floor loads

Number of storeys	*Length of line of horizontal support or part thereof* (m)	*Minimum number of subfloor braces per line or part thereof in earthquake zone:*		
		A	*B*	*C*
Light roof				
1	7.5	2	2	2
	10.0	3	2	2
	15.0	4	3	2
2	7.5	3	3	2
	10.0	5	4	3
	15.0	7	5	5
Heavy roof				
1	7.5	3	3	2
	10.0	4	3	3
	15.0	6	5	4
2	7.5	4	4	3
	10.0	6	5	4
	15.0	8	7	5

Table 49 SUBFLOOR BRACES
Class II Buildings 3.0 kPa floor load

Number of storeys	*Length of line of horizontal support or part thereof* (m)	*Minimum number of subfloor braces per line or part thereof in earthquake zone:*		
		A	*B*	*C*
Light roof				
1	7.5	3	3	3
	10.0	4	4	3
	15.0	7	5	4
2	7.5	5	4	3
	10.0	6	5	4
	15.0	9	7	6
Heavy roof				
1	7.5	4	3	3
	10.0	5	4	4
	15.0	8	7	5
2	7.5	5	5	4
	10.0	7	6	5
	15.0	11	9	7

Table 50 BRACING UNITS
Class II Buildings 1.5 kPa and 2.0 kPa floor loads

Location of storey	*Maximum slope of roof*	*Minimum number of bracing units per square metre in earthquake zone:*		
		A	*B*	*C*
Light roof				
Single storey or top storey	25°	4	3	3
	45°	5	4	3
Lower of two storeys	25°	7	6	5
	45°	9	7	6
Lowest of three storeys	25°	11	9	8
	45°	12	10	8
Heavy roof				
Single storey or top storey	25°	6	5	4
	45°	7	6	5
Lower of two storeys	25°	10	8	6
	45°	11	9	7
Lowest of three storeys	25°	13	11	9
	45°	15	12	10

APPENDIX K

1.0 kPa SNOW LOADS

K1.1
This appendix sets down requirements for buildings were the design snow load is greater than 0.5 kPa but does not exceed 1.0 kPa.

K1.2
This appendix applies only in conjunction with, and as a supplement to, the rest of this Standard.

K1.3
The rest of this standard shall apply to all matters not specifically varied by the provision of this appendix.

K1.4
Table 51 shall replace table 21, and in tables 16 (lintels), 22 (valley rafters), 25 (underpurlins) and 26 (strutting beams), the maximum spans shall be reduced by 15 % for heavy roofs and 25 % for light roofs.

Table 51 RAFTERS OTHER THAN HIP AND VALLEY RAFTERS – 1.0 kPa SNOW LOAD

Rafter size	*Maximum span* of rafters at a maximum spacing (mm) of:*			
	400	*600*	*900*	*1200*
A Light roof:				
(mm x mm)	*(m)*	*(m)*	*(m)*	*(m)*
75 x 40	1.8	1.6	1.3	1.1
100 x 40	2.5	2.2	1.8	1.5
125 x 40	3.1	2.7	2.2	1.9
150 x 40	3.7	3.3	2.7	2.4
75 x 50	2.0	1.7	1.5	1.3
100 x 50	2.7	2.4	2.0	1.7
125 x 50	3.4	3.0	2.5	2.2
150 x 50	4.0	3.5	3.1	2.6
200 x 50	5.3	4.7	4.1	3.6
225 x 50	5.9	5.2	4.6	4.0
250 x 50†	6.5	5.8	5.1	4.5
300 x 50†	7.7	6.8	6.1	5.4
100 x 75	3.0	2.7	2.3	2.1
125 x 75	3.8	3.3	2.9	2.6
150 x 75	4.5	4.0	3.5	3.2
200 x 75	6.0	5.3	4.7	4.3
225 x 75	6.7	5.9	5.2	4.8
250 x 75	7.3	6.5	5.8	5.3
300 x 75	8.6	7.7	6.8	6.2

Rafter size	*Maximum span* of rafters at a maximum spacing (mm) of:*			
	400	*480*	*600*	*900*
B Heavy roof:				
(mm x mm)	*(m)*	*(m)*	*(m)*	*(m)*
75 x 40	1.5	1.5	1.3	1.1
100 x 40	2.1	2.0	1.8	1.5
125 x 40	2.6	2.4	2.3	1.9
150 x 40	3.1	2.9	2.7	2.4
75 x 50	1.7	1.6	1.5	1.3
100 x 50	2.2	2.1	2.0	1.7
125 x 50	2.8	2.6	2.5	2.2
150 x 50	3.3	3.1	2.9	2.6
200 x 50	4.3	4.1	3.8	3.4
225 x 50	4.8	4.6	4.3	3.8
250 x 50†	5.3	5.0	4.7	4.2
300 x 50†	6.2	5.9	5.5	4.9
100 x 75	2.5	2.4	2.2	1.9
125 x 75	3.1	3.0	2.8	2.4
150 x 75	3.7	3.5	3.3	2.9
200 x 75	4.8	4.6	4.3	3.8
225 x 75	5.4	5.1	4.8	4.3
250 x 75	5.9	5.6	5.3	4.7
300 x 75	6.8	6.5	6.1	5.5

* May be increased by 10 % for rafters continuous over two or more spans.

† Require lower edge to be supported by ceiling framing, lining or equivalent at mid span.

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Declared on 28 September 1984 by the Standards Council to be a Standard specification pursuant to the provisions of section 23 of the Standards Act 1965.

First published	November 1978
Reprinted incorporating Amendments	August 1981
This edition incorporating further Amendments	October 1984

Printing code 10,000-1984/7023/19994

This third edition cancels and replaces the second edition (i.e. NZS 3604:1981).

NZS 3604 : 1984

NZS 3604 : 1984