NZS 3604:1978

NEW ZEALAND STANDARD

Code of practice for LIGHT TIMBER FRAME BUILDINGS not requiring specific design

Gr.R

UDC.69 001-3(931):694.5

SANZ STANDARDS ASSOCIATION OF NEW ZEALAND

NZS 3604:1978 LIGHT TIMBER FRAME BUILDINGS

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NEW ZEALAND STANDARD

Code of practice for

LIGHT TIMBER FRAME BUILDINGS

not requiring specific design

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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 Institute of Architects
New Zealand Institution of Engineers
New Zealand Manufacturers Federation
New Zealand Master Builders Federation
New Zealand Government Railways Department
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.

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

RELATED DOCUMENTS

Reference is made in this standard to the following documents:

NEW ZEALAND STANDARDS

NZS 282 : —— *Asbestos cement sheets* — comprising

NZS 282 : 1962 *Asbestos cement unreinforced flat sheets and corrugated sheets*

NZSR 26 : 1966 *The fixing of corrugated asbestos cement sheets*

NZS 873 : 1969 *Waterproof building papers*

NZS 1155 : —— *Synthetic resin adhesives (phenolic aminoplastic) for plywood*

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 9.2 : 1964 Masonry

Division 9.3A : 1970 Concrete — general requirements, materials and workmanship

Chapter 10 : 1964 *Non-structural external wallings*

NZS 2295 : 1969 *Building papers (breather type)*

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 : 000 *Timber design code*

NZS 3605 : 1977 *Load bearing round timber piles and poles*

NZS 3614 : 1971 *The manufacture of construction plywood*

NZS 3631 : 1978 *Classification and grading of New Zealand timbers (National Timber Grading Rules).*

NZS 4203 : 1976 *Code of practice for general structural design and design loadings for buildings*

NZS 4206 : 1973 *Concrete interlocking roofing tiles*

NZS 4211 : 1976 *Performance of windows*

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 procedures*

OTHER DOCUMENTS

BUILDING RESEARCH ASSOCIATION OF NEW ZEALAND

BRANZ Technical Paper P21, *A wall bracing test and evaluation procedure*

* In course of preparation

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 C2 *Round 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 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 1900 : 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.

This change of emphasis, together with the desire to allow a wide range of choices between alternative building practices, has led to this standard being much longer than the previous Chapter 6.1, with many more tables and diagrams.

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*).

* 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 1.2, 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 building height measured vertically from the lowest adjoining finished ground level to the intersection of the exterior surface planes of wall and roof coverings, or in the case of gable ends to half the height of the gable, shall not exceed 10 m, as shown in fig. 1;

(c) The slope of the roof shall be not steeper than 45° to the horizontal;

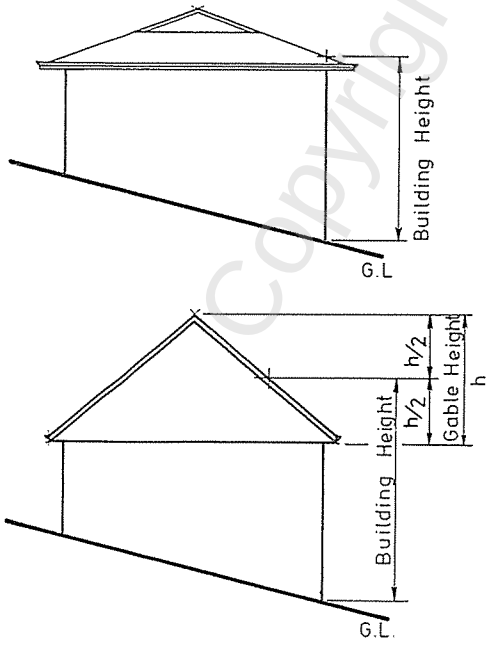


Fig. 1 : Building height

(d) The building site shall not be exposed to possible severe local wind effects;

(e) The snow load as specified by NZS 4203* shall not exceed 0.5 kPa;

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

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. 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 6.4.1.

(d) Whether or not a building site is exposed to severe local wind effects will generally be a matter of local judgment. Conditions likely to cause such effects include valleys and gorges shaped to produce funnelling of the wind, and 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 limitations of individual clauses and tables include:

Maximum height of foundation walls: 2 m

* see list of related documents

Maximum height of loadbearing studs: 3 m
Maximum roof dimension S of truss roofs as determined from fig. 35: 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.

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.

* see list of related documents

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 amendments or superseding standards are 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.

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 level.

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 AS 1649* with due regard for the moisture content of dry timber in New Zealand.

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.

* see list of related documents

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 in direct contact with, and transmitting and distributing loads to, the ground.

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.

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 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 embedded into the ground so as to resist horizontal loads from the lower end of either one or two diagonal braces attached to it and directly supporting a jack stud.

BRACED PILE means a pile directly supporting a bearer and having a diagonal brace 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, cantilever 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 1900 : 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.

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 (see also clause 1.1.2 (c)).

The maximum slope of 60° in the definition of 'roof' corresponds to the slope used in other New Zealand Standards to differentiate between a 'roof' and a 'wall'. However, this standard does not apply to roofs steeper than 45° (see clause 1.1.2).

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 1 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).

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 1 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. 35 (see clause 6.4.3).

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.

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.

* see list of related documents

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 internal walls caused by long-term creep effects with truss roofs do not affect the 'non-loadbearing' classification of such walls, see 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).

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.*

* 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*.

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

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.

2.2.2 Mild steel structural components 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 AND PROPRIETARY PRODUCTS

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. 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.

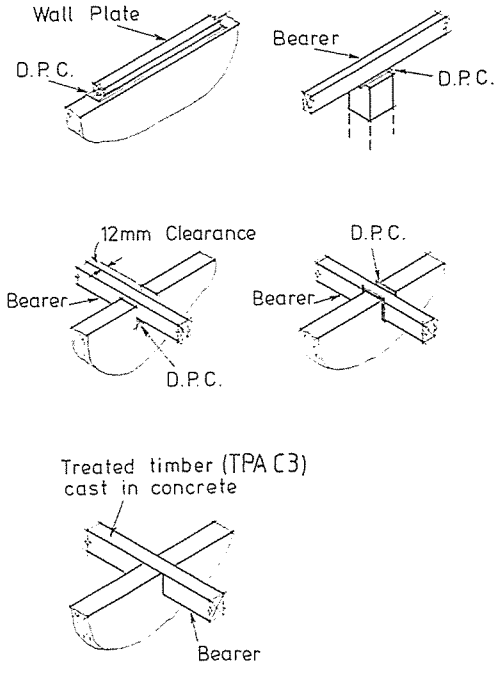


Fig. 2 : Protection of framing timbers

* see list of related documents

2.3.1 Materials, components, and proprietary products 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.

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 NZS 1155*.

2.5.2.2 Adhesives for timber or wood-based products used for loadbearing or bracing applications in dry interior situations shall comply with NZS 1155*.

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 NZS 1155 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 Skew nails shall enter not less than 30 mm nor more than 40 mm from the joint contact surface and at an angle not less than 35° nor more than 45° to the surface into which they enter.

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.

* see list of related documents

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 M12 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 zone shall be as given by table 1, or as given by fig. 4 for locations not listed in table 1.

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

High: Exceeding 40 m/s

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

Low: Not exceeding 35 m/s

The wind speeds quoted above take no account of ground roughness, nor the variation of strong winds with height above ground, nor the effects of large variations in the ground surface (topography). Because of this, clause 1.1.2 (d) lays down that this standard does not apply when the building site is exposed to possible severe local wind effects (this includes locations for which fig. 3 does not ascribe a particular wind exposure). In the preparation of this standard a topography factor (S_1) of 1.0 and a ground roughness of category 3 (see NZS 4203) were assumed.*

Occasionally in New Zealand winds greatly in excess of the given values occur in tornadoes, of which

* 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

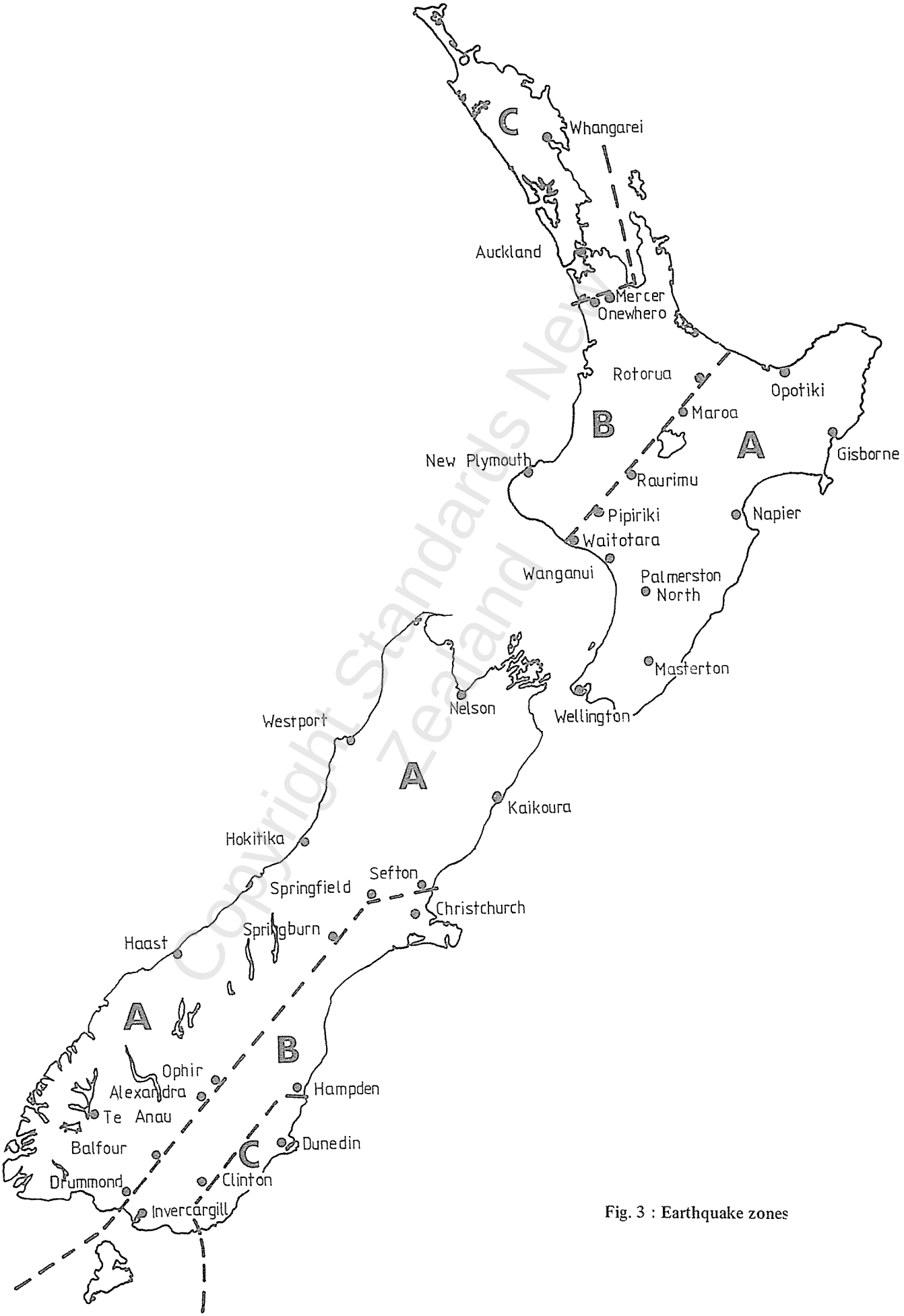


Fig. 3 : Earthquake zones

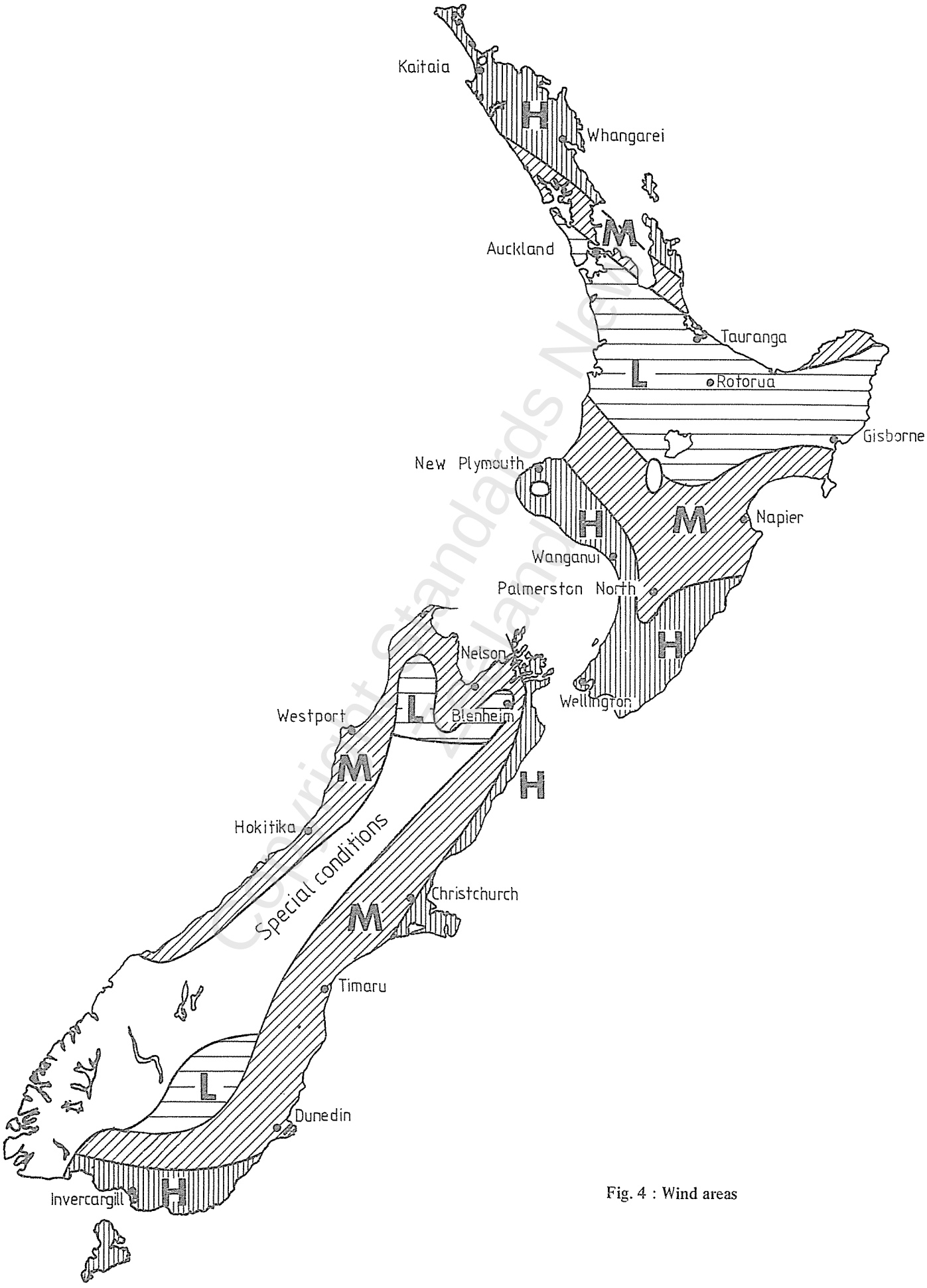


Fig. 4 : Wind areas

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.

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, etc);

(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

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;

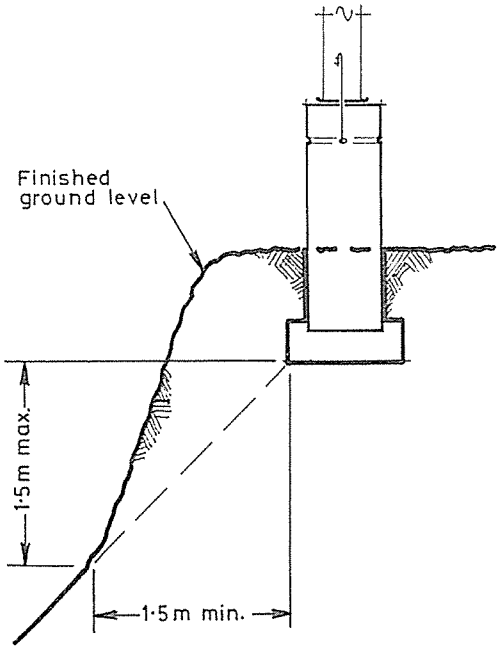


Fig. 5 : Relationship of foundation to sloping ground surface

(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);

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.

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 ground floor

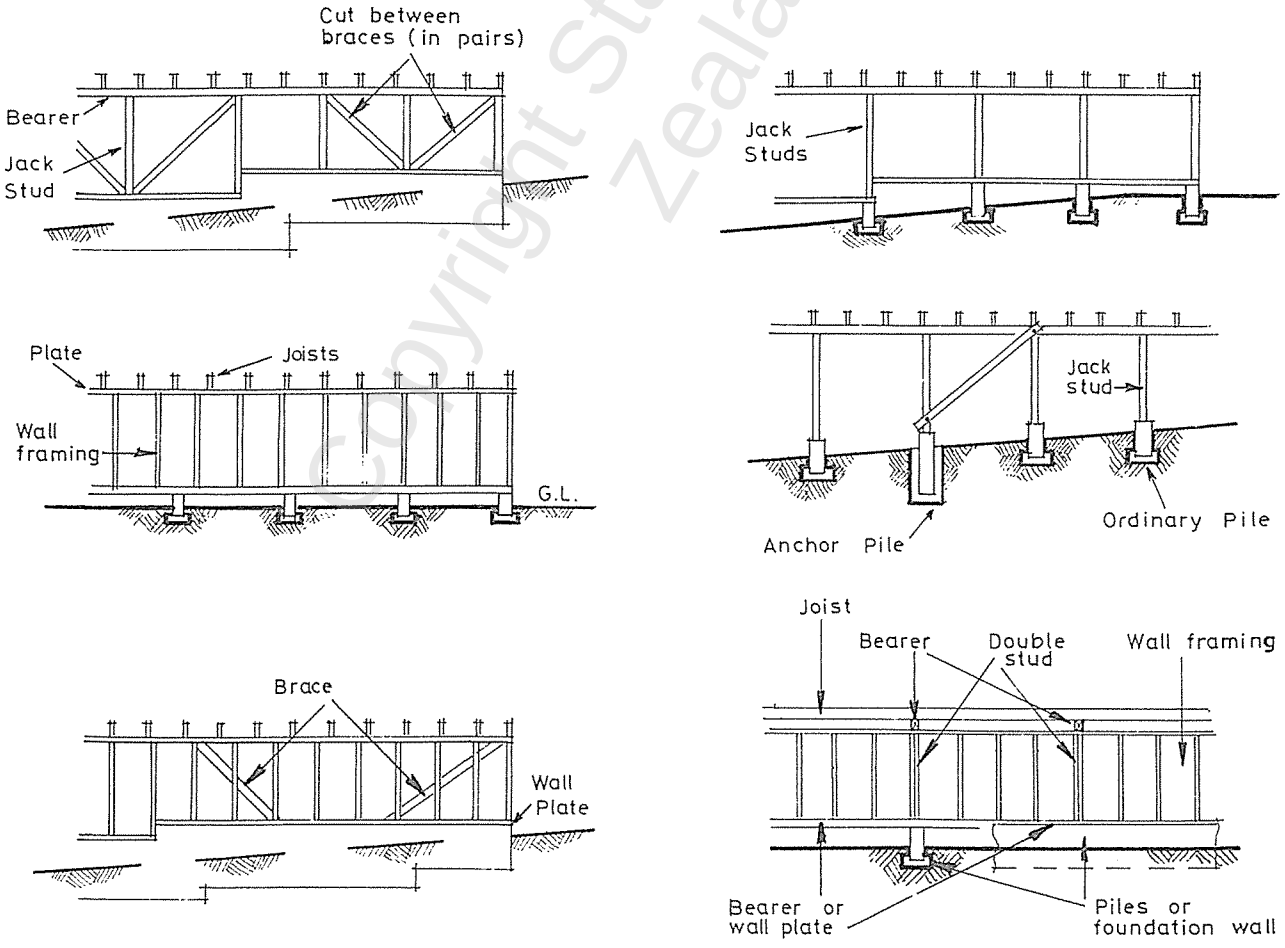


Fig. 6 : Some typical foundation and subfloor framing systems

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.

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. 7.).

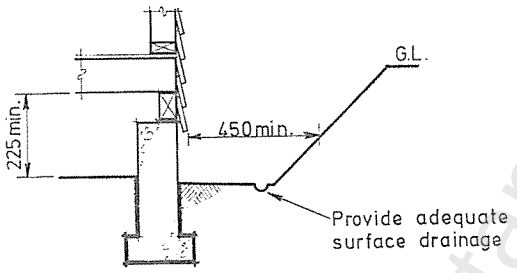


Fig. 7 : Clearance between cladding and adjacent ground

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. 6):

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

Which may be combined with 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 for a building having a length more than twice its width then it will be necessary to provide additional foundation walls across the building in order to comply with the requirement of clause 5.3.1 (a) that the length of a structural floor diaphragm shall not exceed twice its width (see also clause C5.3.1).

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.

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

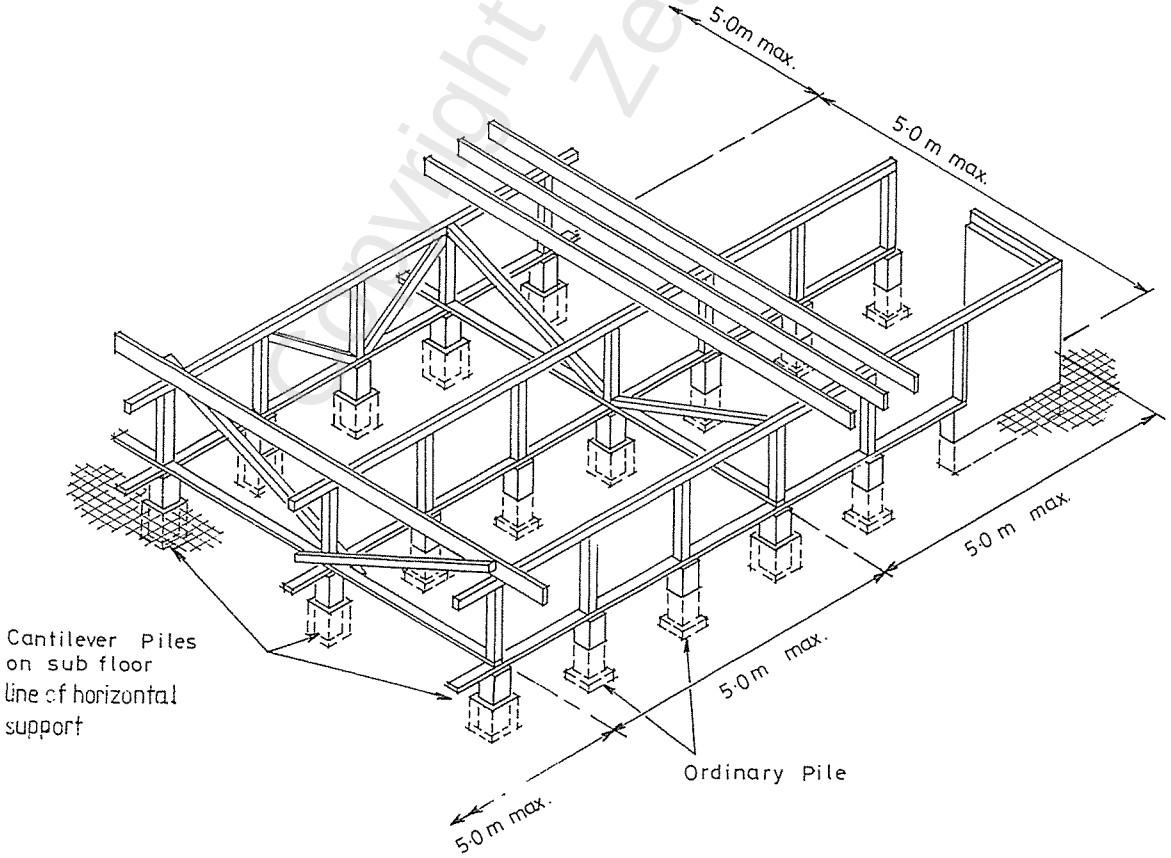


Fig. 8 : Typical arrangement of lines of horizontal support

angles to the bearers, provided that this method shall not be used for a line of horizontal support under an external wall; or

(b) Contain the number of subfloor braces required by table 2A for earthquake, or table 2B for wind, whichever is the greater.

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 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;

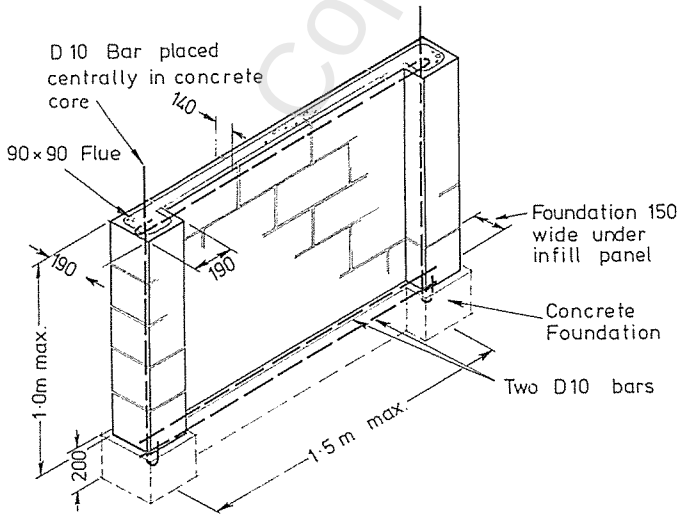


Fig. 9 : Masonry infill panel between a pair of masonry piles

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)	*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	2	2	2
	15.0	3	3	2
2	7.5	3	2	2
	10.0	3	3	2
	15.0	4	4	3
Heavy roof				
1	7.5	2	2	2
	10.0	3	3	2
	15.0	4	3	3
2	7.5	4	3	3
	10.0	5	4	4
	15.0	7	6	5

B For wind:

Maximum height of eaves above cleared ground level (m)	*Maximum slope of roof*	*Minimum number of subfloor braces per line in wind area:* Low	Medium	High
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

(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.

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.

4.3.8 A subfloor sheet brace shall consist of a 2.4 m length of sheet material extending 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 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;

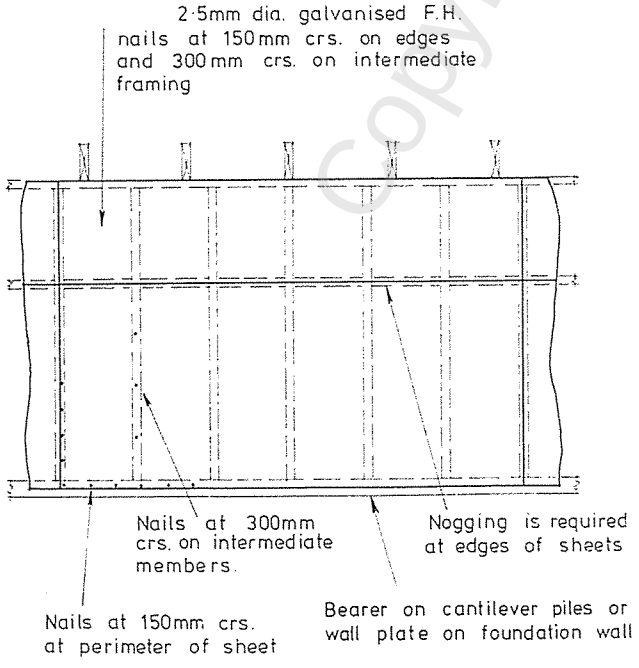


Fig. 10 : Subfloor sheet brace

(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 sheet material that is less than 2.4 m long shall not be considered for the purposes of this clause.

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 1.2 m;

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

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 above cleared ground level shall be:

(a) Not less than 150 mm;

(b) Not more than:

(i) 600 mm for cantilevered piles;

(ii) 150 mm for anchor piles;

(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;

(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.

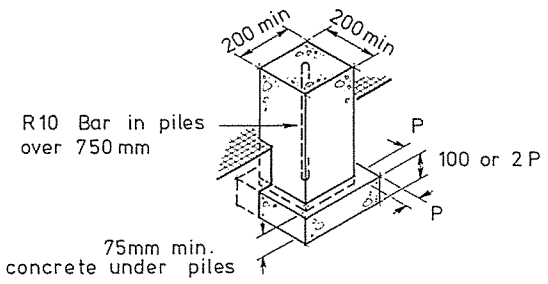
4.5.3 Cross-section of piles

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

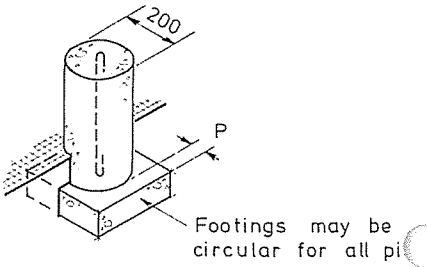
(a) 200 mm for parallel-sided piles.

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

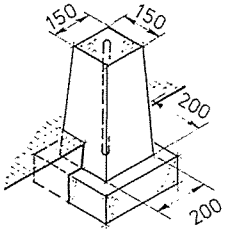
4.5.3.2 The cross-section of a masonry pile shall have a least dimension of not less than 190 mm.



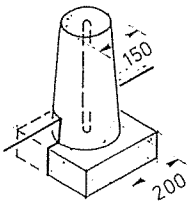
SQUARE PILES



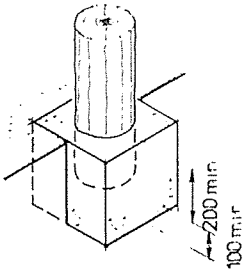
CIRCULAR PILES



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 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)
1.3	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

4.5.3.3 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 Anchor piles shall be of concrete (see clause 4.5.5.2); other piles shall be either of concrete, 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 as specified in NZS 1900 : Chapter 9.3A* provided that:

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

(b) Precast concrete 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.

C4.5.5.2 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.*

4.5.5.3 The materials and workmanship of masonry piles shall comply with NZS 1900 : Chapter 6.2*.

4.5.5.4 Timber piles shall be of natural round timber complying with NZS 3605* and treated to TPA C2*; 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)), and such a surface shall be not less than 150 mm above 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);

(c) Anchor piles: As shown by fig. 14 or by a reinforcing connector having a capacity of 17 kN horizontal force.

* see list of related documents

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 as shown in fig. 12: The fixing of a plate, a bearer, or a jack stud to an ordinary pile shall be by a length of 4 mm galvanized steel wire formed into a loop and either:

(i) Cast not less than 150 mm depth into a concrete or masonry pile, or

(ii) Passed through a suitable hole not less than 150 mm below the top of the pile,

and which is secured to the timber member so as to prevent displacement during construction;

(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 capacity tension or compression along the bearer;

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

(i) Where piles are braced by an infill panel (see clause 4.3.7 (c)) or where the upper end of the diagonal brace is within 150 mm of the bearer, as shown in fig. 26 or with an alternative fixing of 17 kN capacity tension or compression along the bearer;

(ii) In all other cases, as for ordinary piles;

(d) Anchor piles: The fixing of a jack stud to an anchor pile shall be 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.

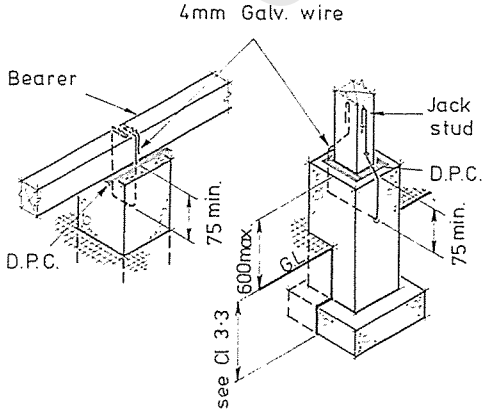
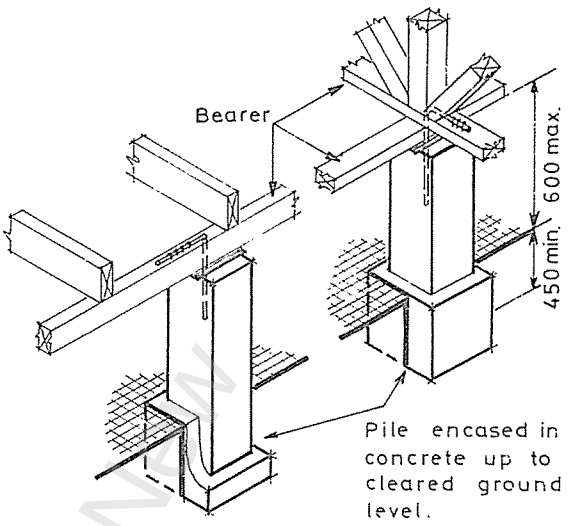
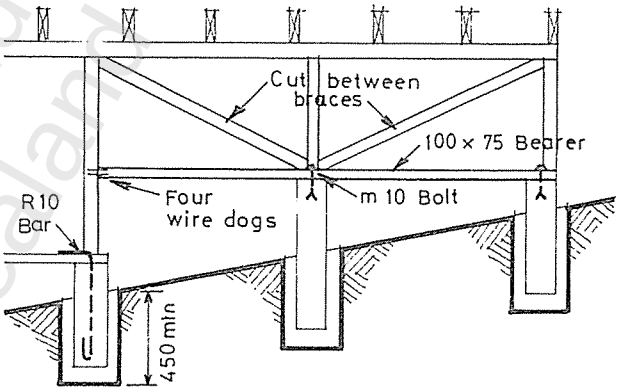


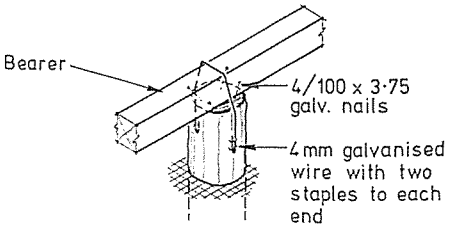
Fig. 12 : Fixing of bearers and jack studs to ordinary piles



A : General arrangement.

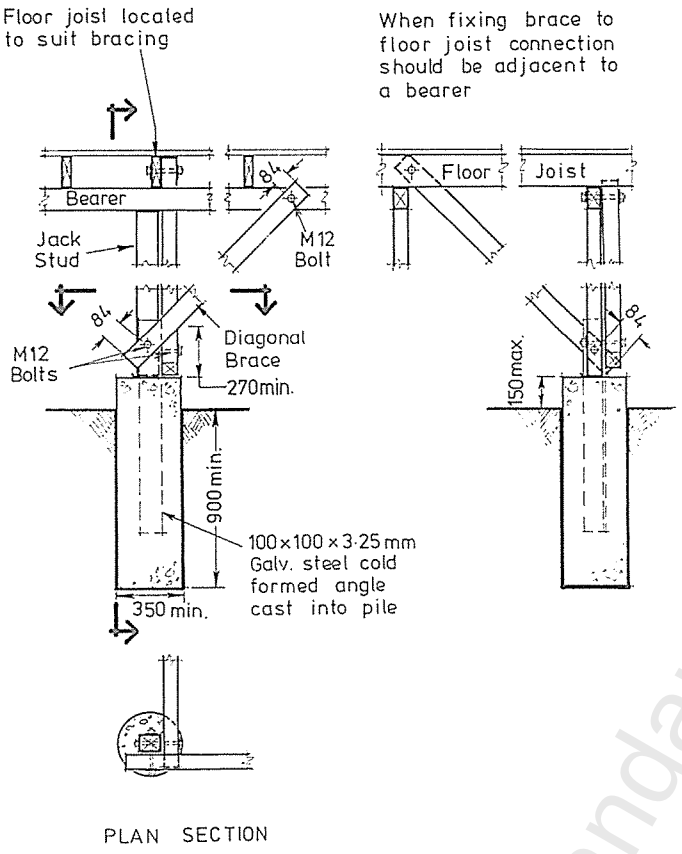


B : Cantilevered piles at different heights.

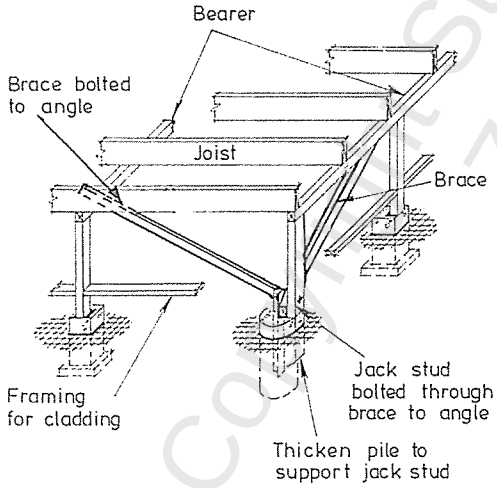


C : Driven timber cantilevered piles.

Fig. 13 : Fixing of bearers to cantilevered piles



A : Typical anchor pile details.



B : Corner anchor pile details.

Fig. 14 : Anchor piles

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) No openings shall be 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 finished ground level 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.

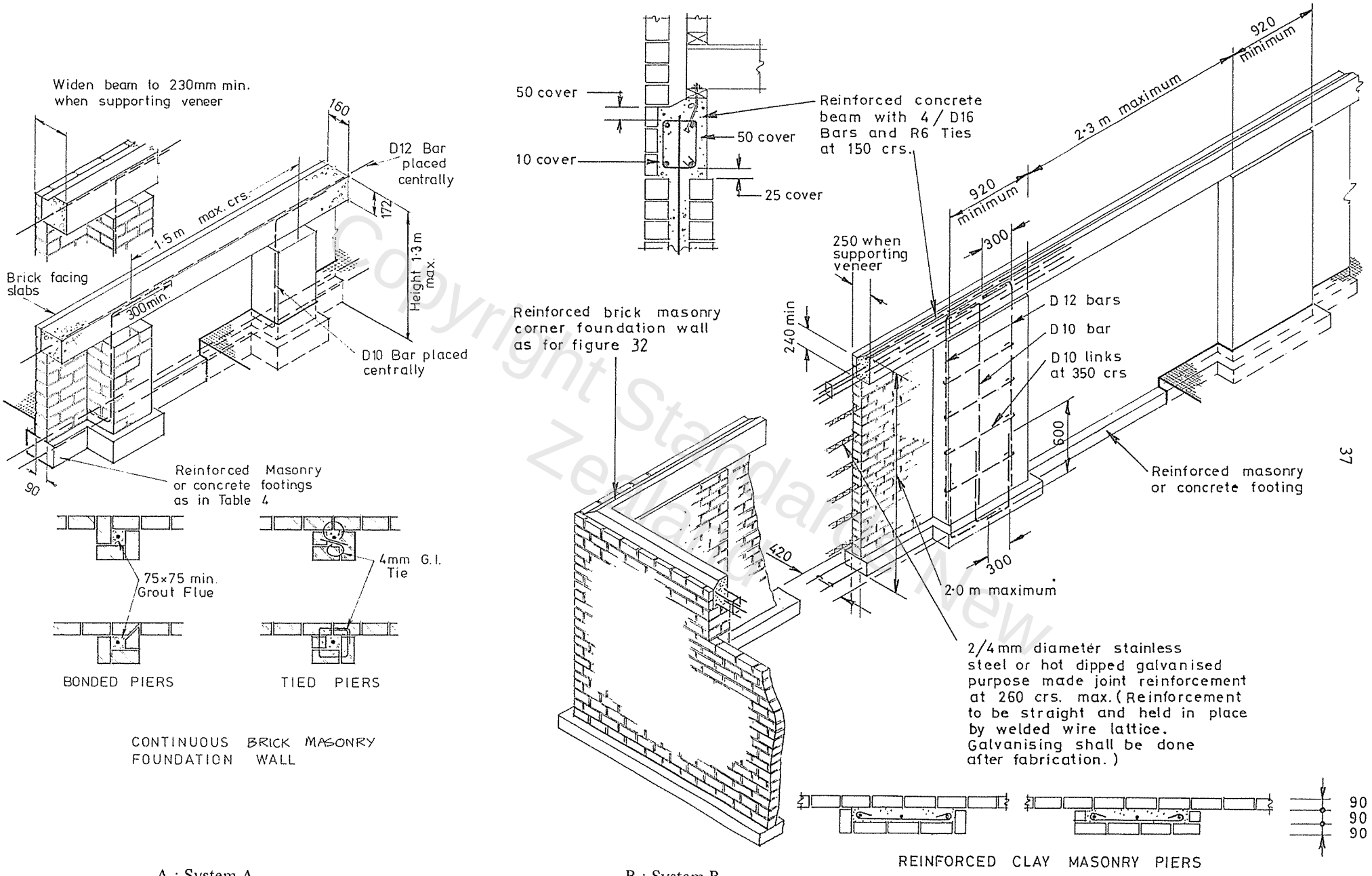
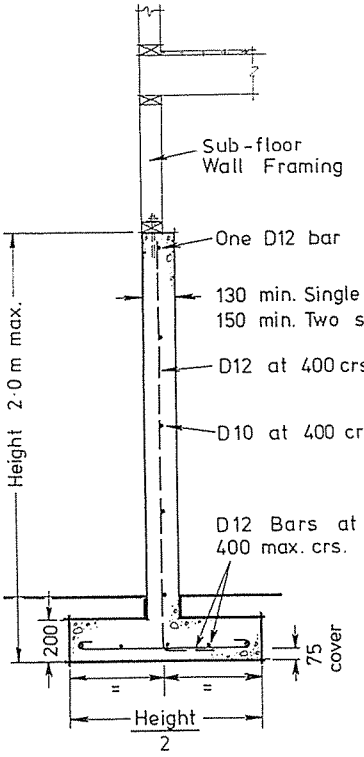


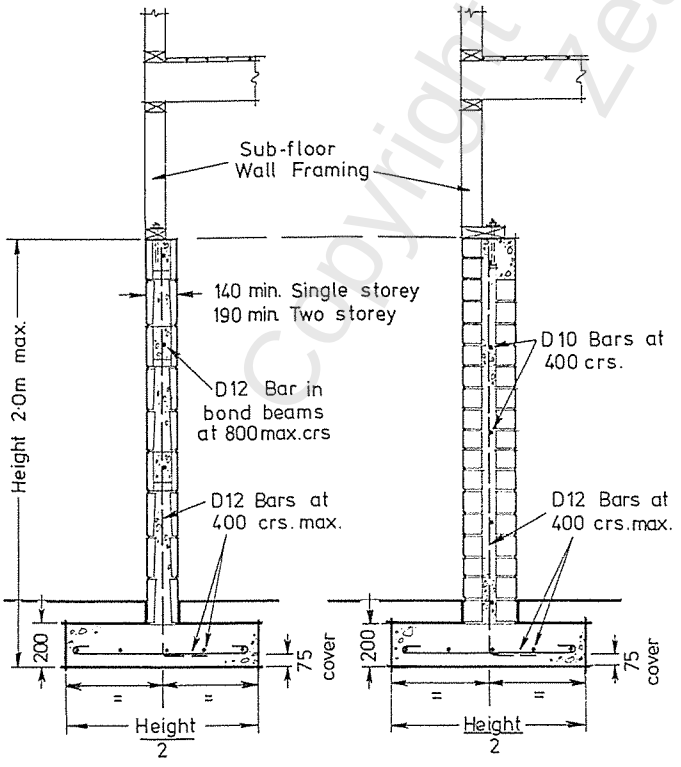
Fig. 15 : Continuous single-wythe clay masonry foundation walls

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.



A : Reinforced concrete.



B : Reinforced concrete masonry.

C : Reinforced clay masonry.

Fig. 16 : Cantilevered foundation walls

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;

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

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;

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*	3
3	300*	200*	3
B Reinforced masonry			
1	190*	140*	2
2	240	140*	3
3	290	190*	3

* 230 mm when supporting masonry veneer.

(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 D12 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 1900 : Chapter 9.3A*, provided that the fine and coarse aggregates need not be supplied and batched separately.

C4.6.5.1 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.*

4.6.5.2 Masonry materials and workmanship shall comply with NZS 1900 : Chapter 6.2*.

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 in reinforced concrete;

(b) 60 diameters of the bar 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.

* see list of related documents

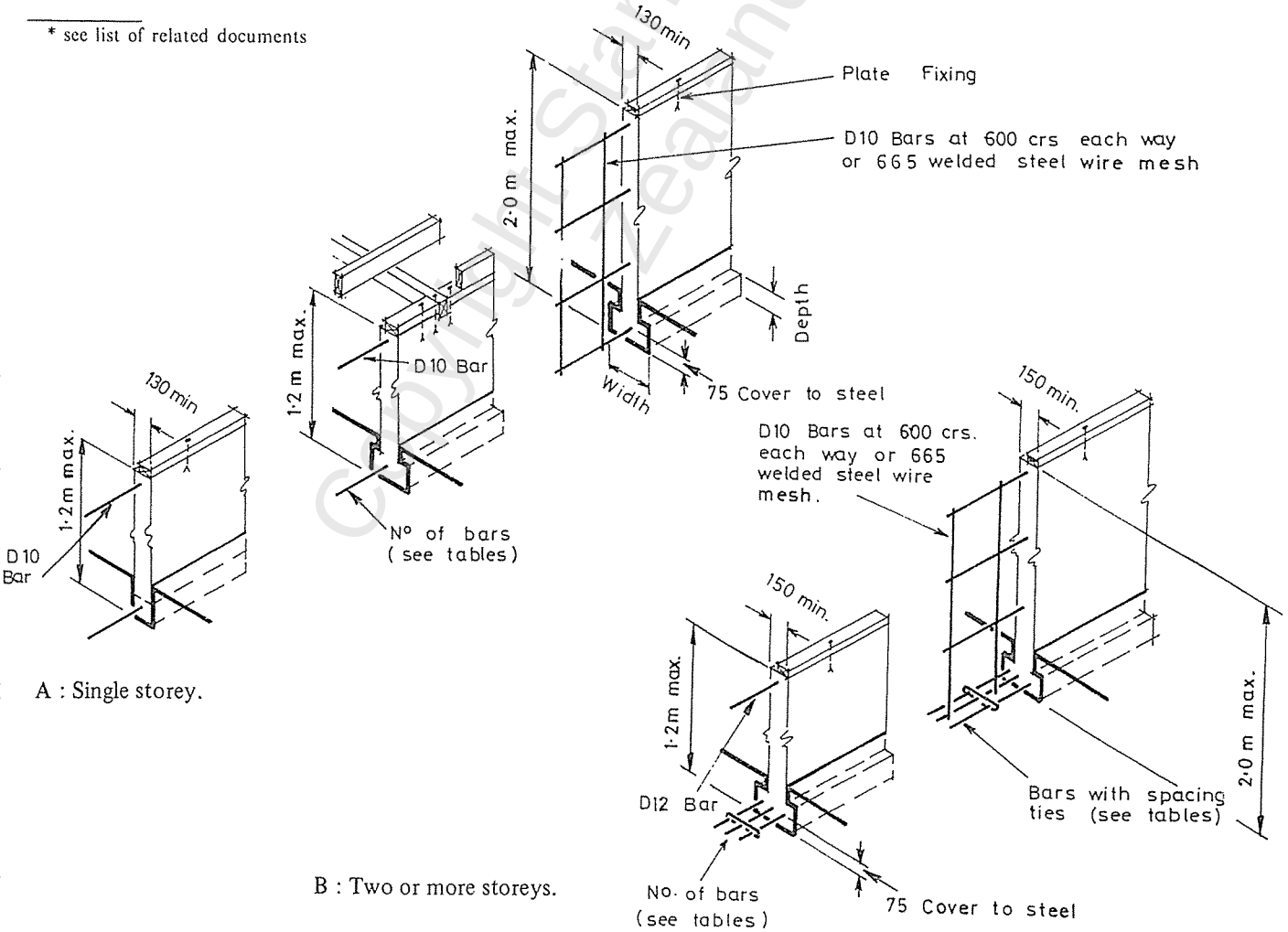


Fig 17 : Reinforced concrete foundation walls (not cantilevered)
For corner details see fig. 32

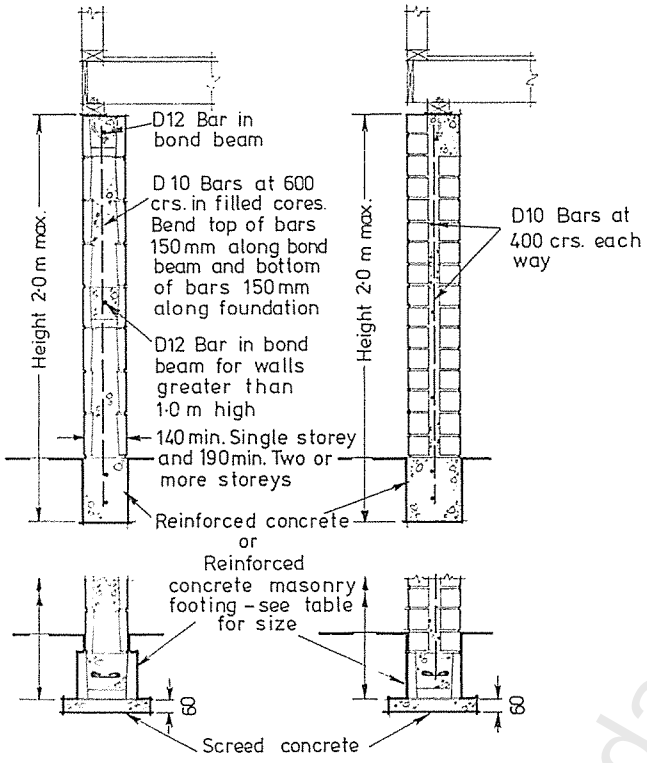


Fig. 18 : Reinforced masonry foundation walls (not cantilevered). For corner details see fig. 32

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

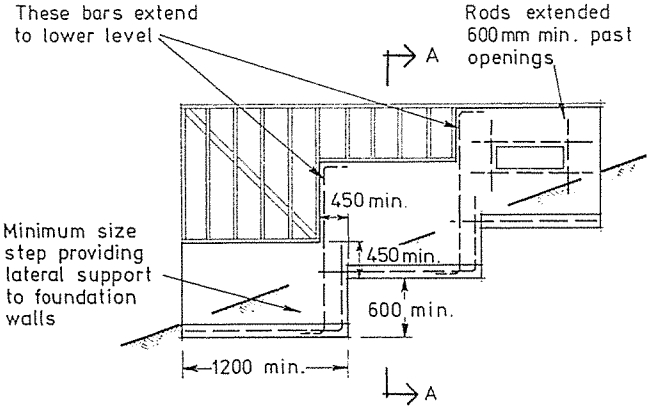


Fig. 20 : Steps and openings in foundation walls

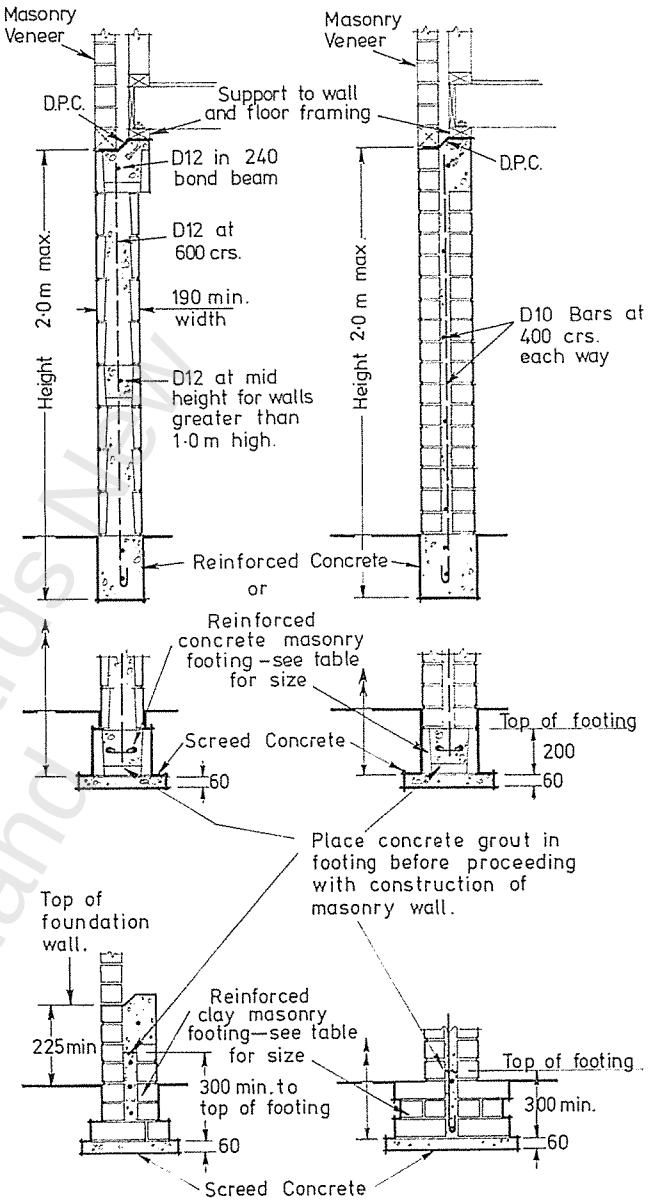


Fig. 19 : Reinforced masonry foundation walls (not cantilevered) supporting masonry veneer. For corner details see fig. 32

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 on the centreline of the timber and at not less

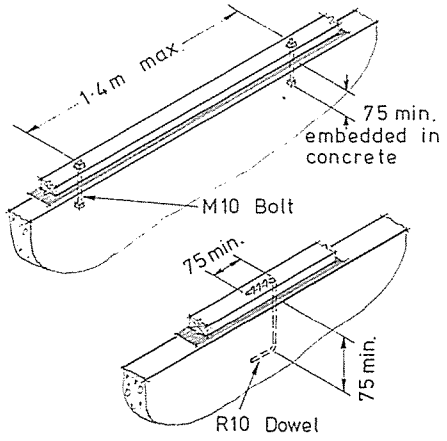


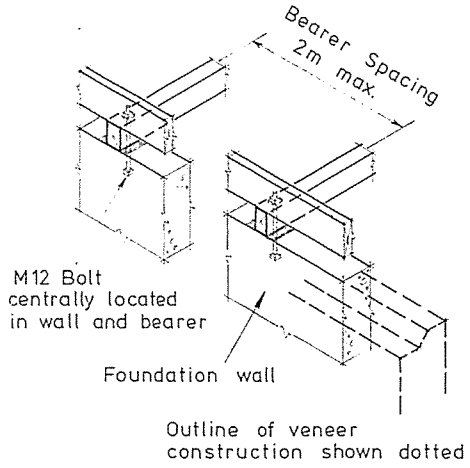
Fig. 21 : Fixing of wall plates to foundation walls

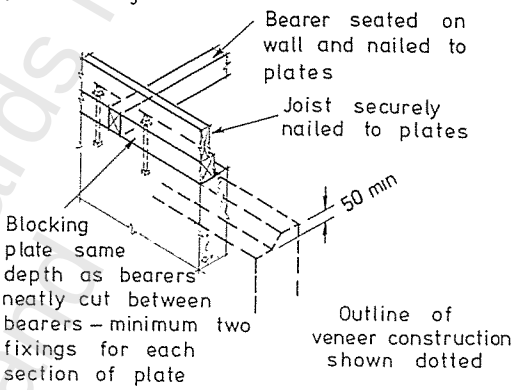
than 1.4 m centres along it; Provided that where any length of foundation wall is regarded as a subfloor brace in accordance with clause 4.3.7 (d), each length of plate shall be fixed to it with not less than three such fixings.

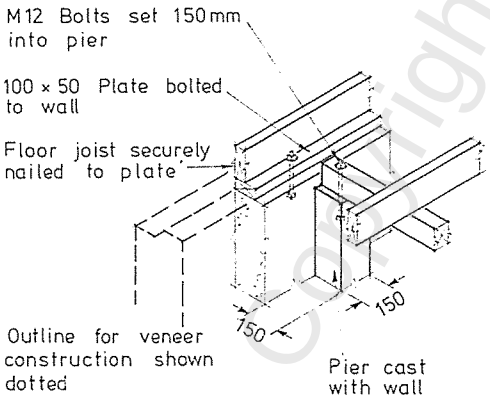
4.7.2 Bearers directly supported by a foundation wall running at right angles to them shall be secured against lateral movement by one of the following methods:

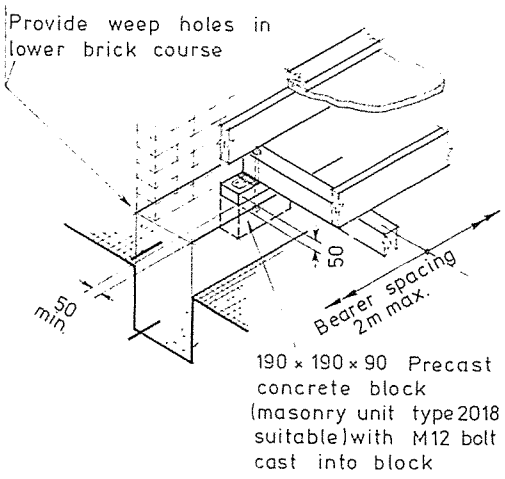
(a) Only for bearer spacings not exceeding 2 m: As shown in fig. 22 each bearer shall be bolted to the foundation wall with a M12 bolt set not less than 150 mm into the wall and located centrally on the bearer and the wall;

(b) As shown in fig. 22 full depth blocking neatly cut between adjacent bearers shall be fixed to the top

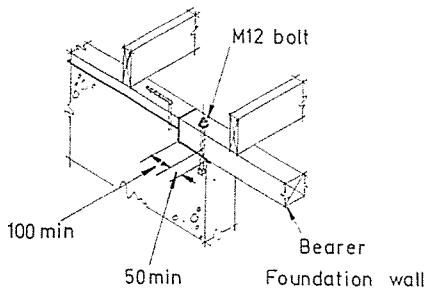








ALTERNATIVE DETAIL FOR FIXING BEARERS WHEN MASONRY VENEER IS USED



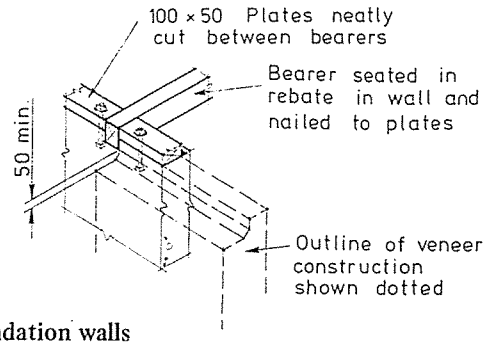


Fig. 22 : Fixing of bearers to foundation walls

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 4.8.4.2.

4.8 SUBFLOOR FRAMING OTHER THAN DIAGONAL BRACES

4.8.1 Support to loadbearing walls

4.8.1.1 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 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 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. 13B.

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;

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

(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 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 the bearer is continuous over the support: 90 mm;

(b) Where bearers are butted over the support: 45 mm;

(c) Where the end of a bearer is supported by a foundation wall in accordance with clause 4.7.2 or clause 4.7.3: 125 mm;

(d) 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 Joints in bearers shall be either:

(a) Butted and flitched over the support as shown in fig. 23; or

(b) Halved or scarfed centrally over piles only.

* see list of related documents

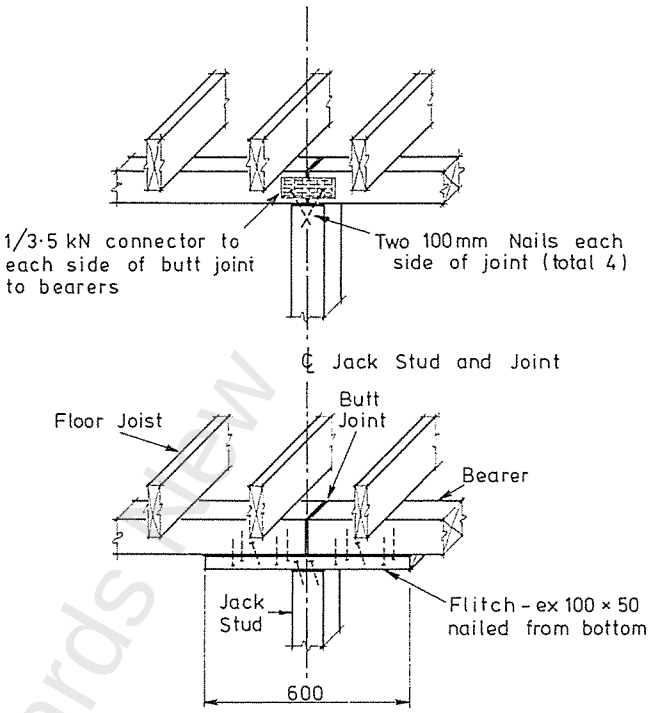


Fig. 23 : Joints in bearers

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.

4.8.4 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;

(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 6.5.1.5 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 M12 bolts set not less than 100 mm into the wall at spacings as given by table 6.

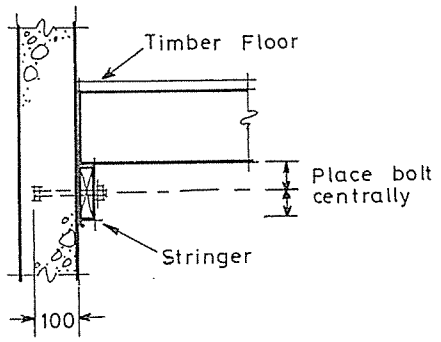


Fig. 24 : Fixing of stringers to foundation walls

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

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 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	–

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.

4.9.1.2 Diagonal timber subfloor braces shall slope

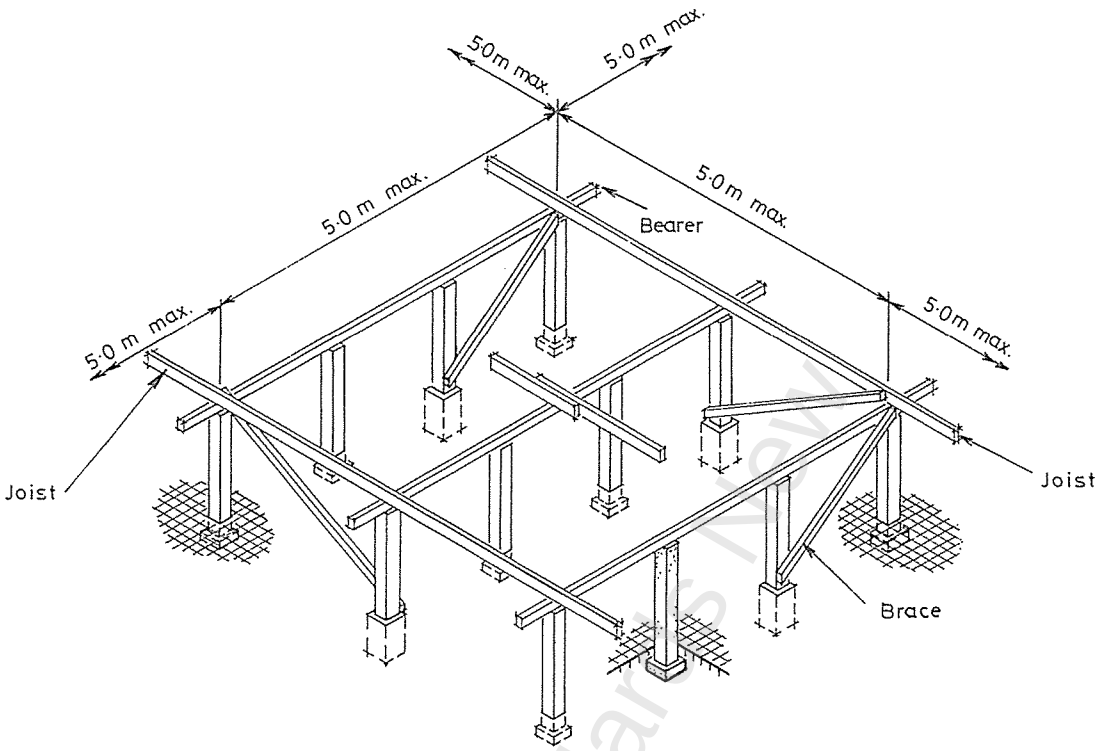


Fig. 25 : Lines of horizontal support containing diagonal timber braces between piles

not more than 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);

(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.

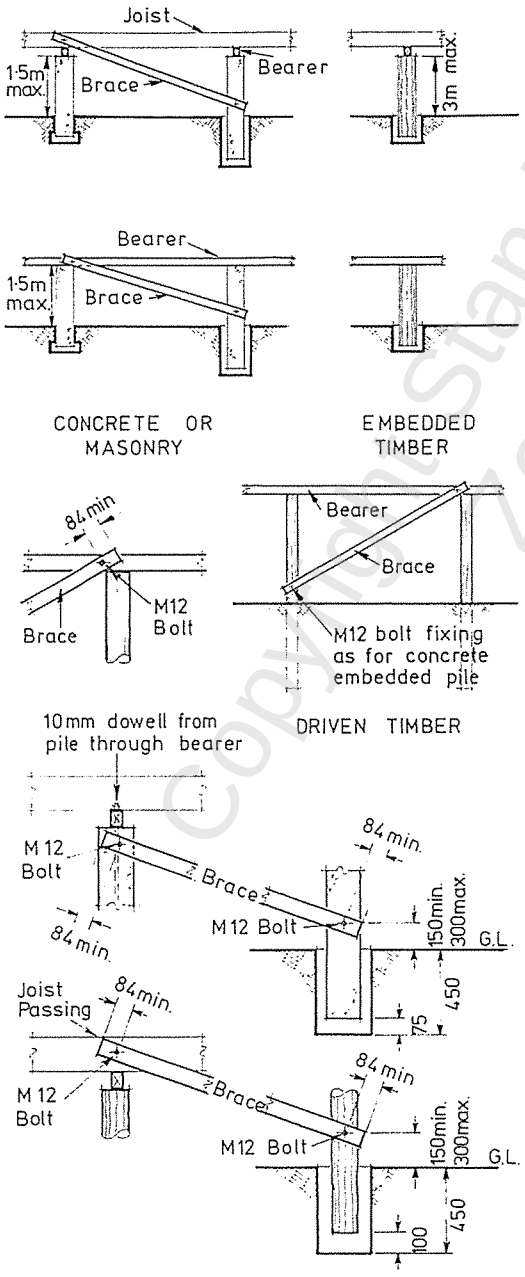


Fig. 26 : Braced piles

(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 (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 500 mm above the underside of the foundation wall footing.

4.9.2.2 Any fixing used as an alternative to a fixing specified in clause 4.9.2.1 shall be of 24 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 12 kN capacity tension or compression along the brace.

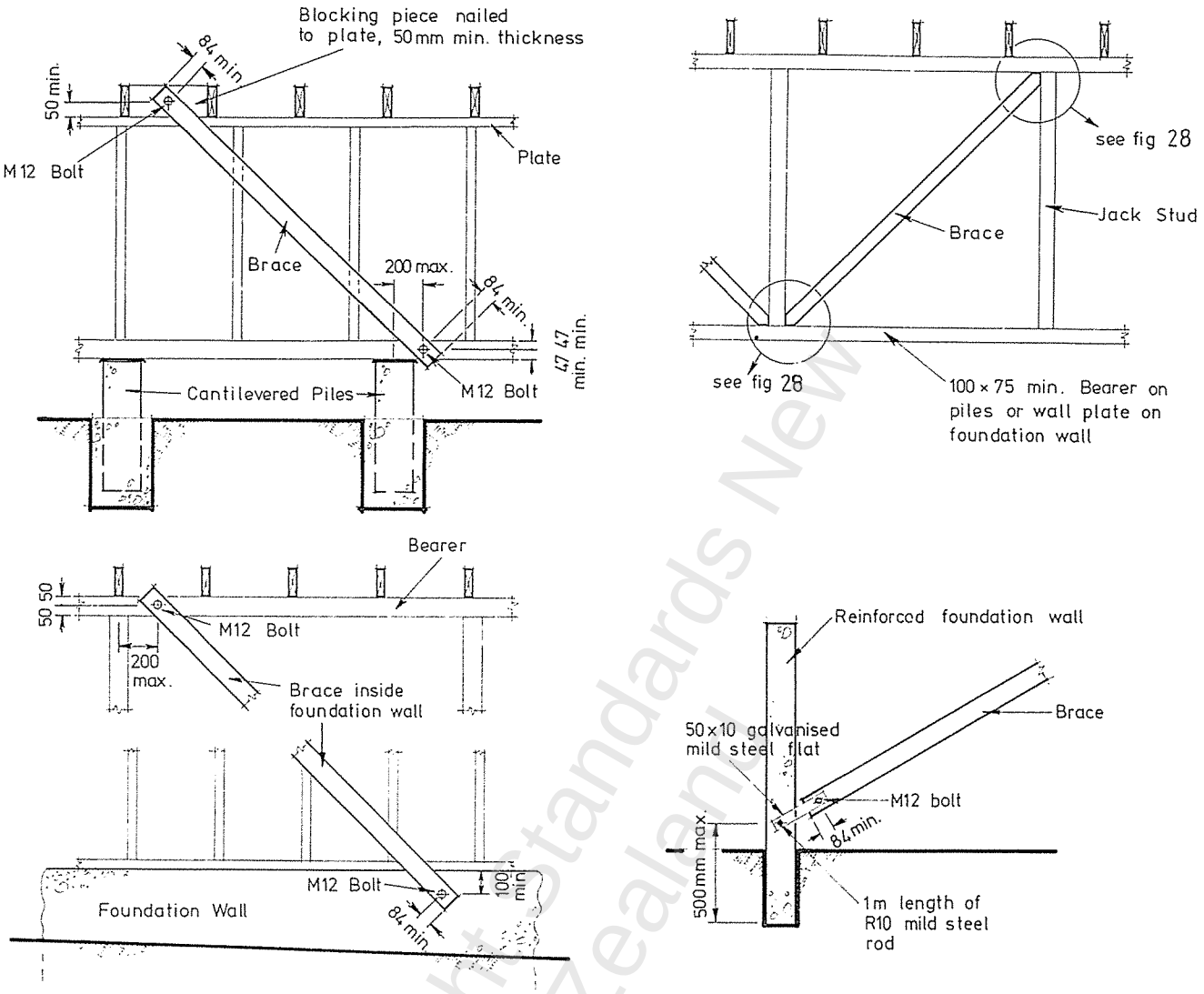


Fig. 27 : Fixing of diagonal timber subfloor braces

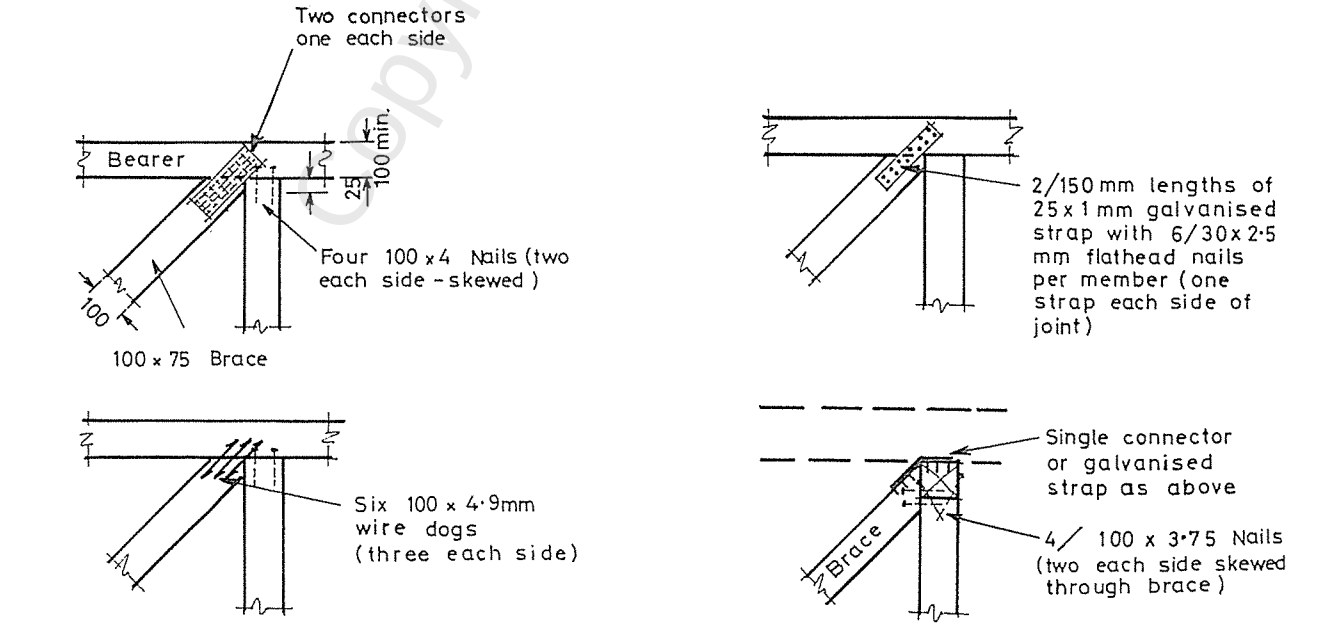


Fig. 28 : Fixing details for cut-between diagonal timber subfloor braces

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 joist.

5.1.1.7 Where required by clause 5.1.1.6, joints in floor joists shall as shown in fig. 29 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.

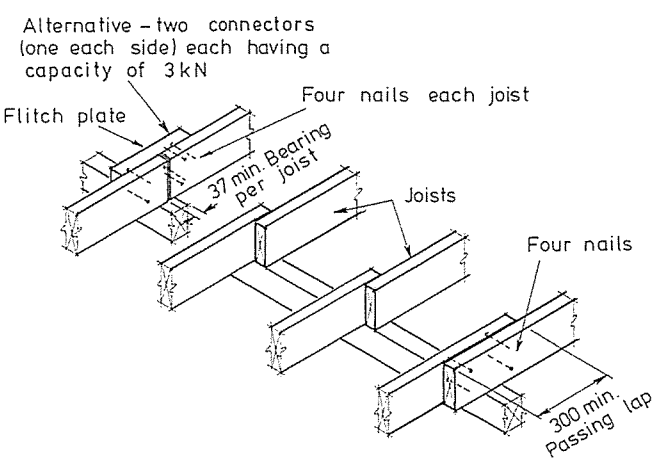


Fig. 29 : Joints in floor joists.

* see list of related documents

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);

(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;

(b) In any location: Solid strutting complying with clause 5.1.2.4 between adjacent floor joists at not more than 1.8 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

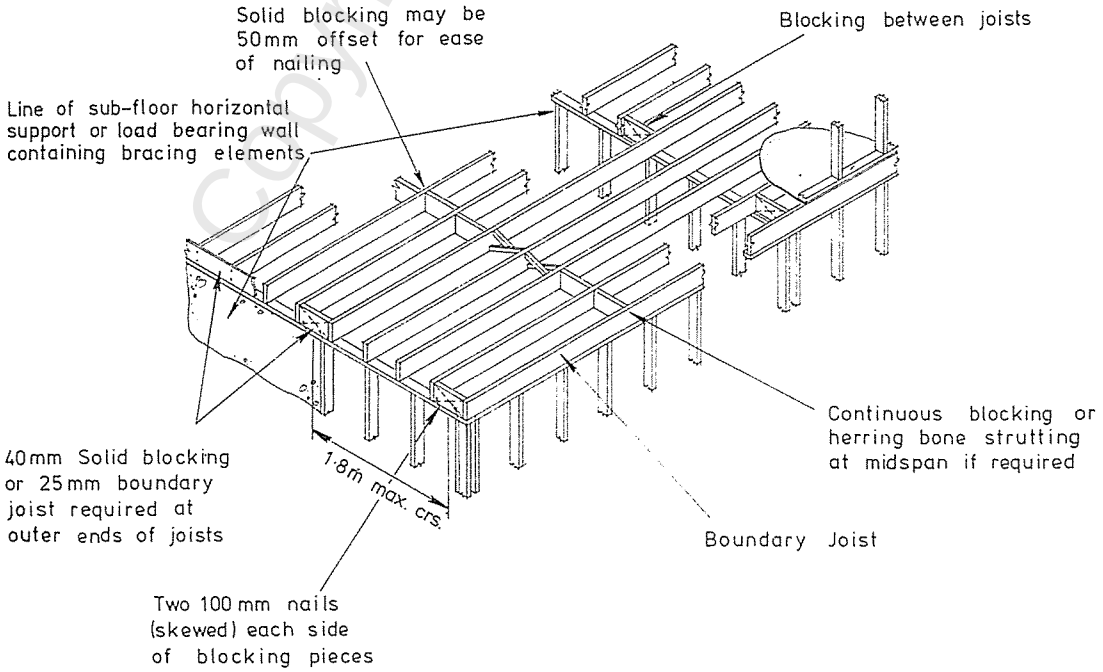


Fig. 30 : Lateral support of floor joists.

(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 150 mm of a joist measured between centrelines.

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.

5.1.4 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(b) (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

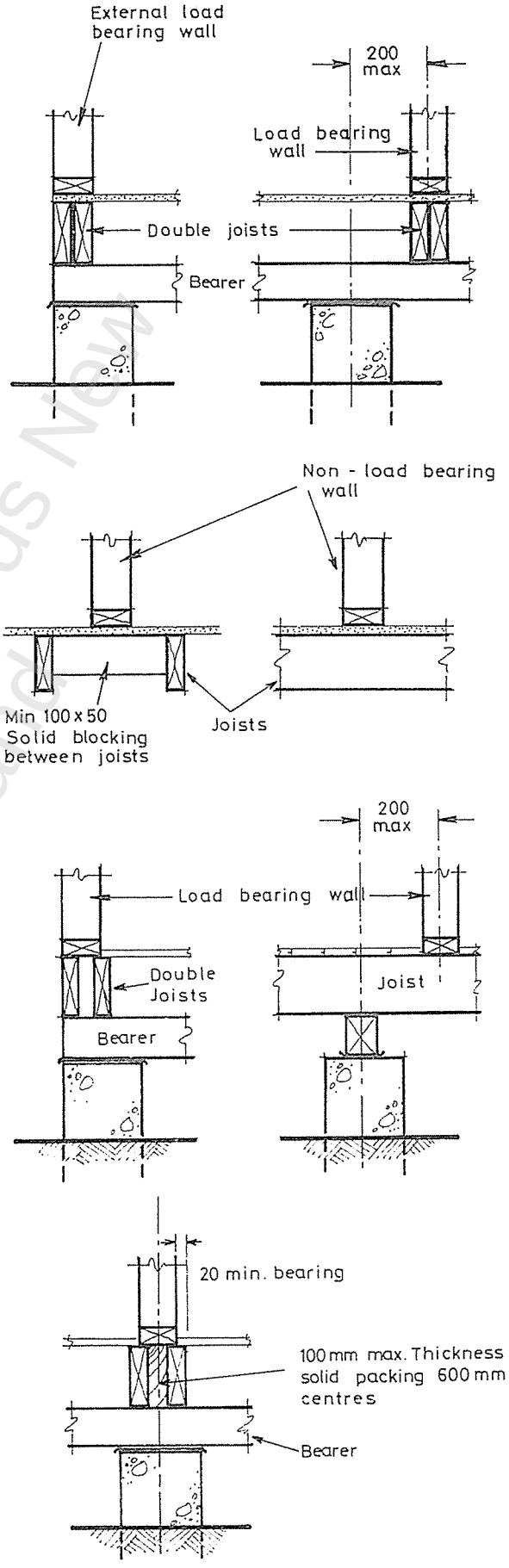


Fig. 31 : Floor joists and bearers under walls

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.

Table 9

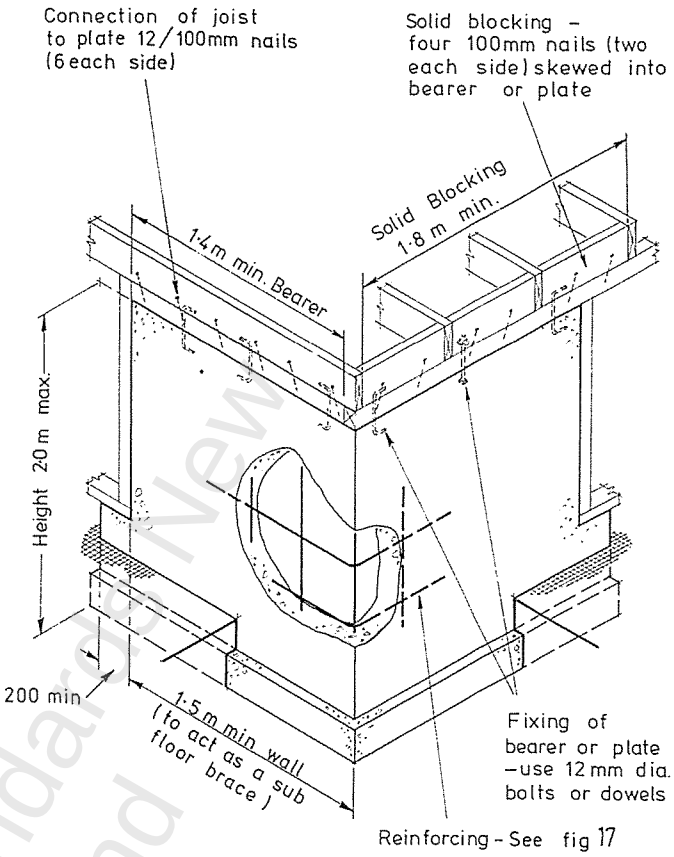
CANTILEVERED FLOOR JOISTS

1.5 kPa and 2.0 kPa floor loads

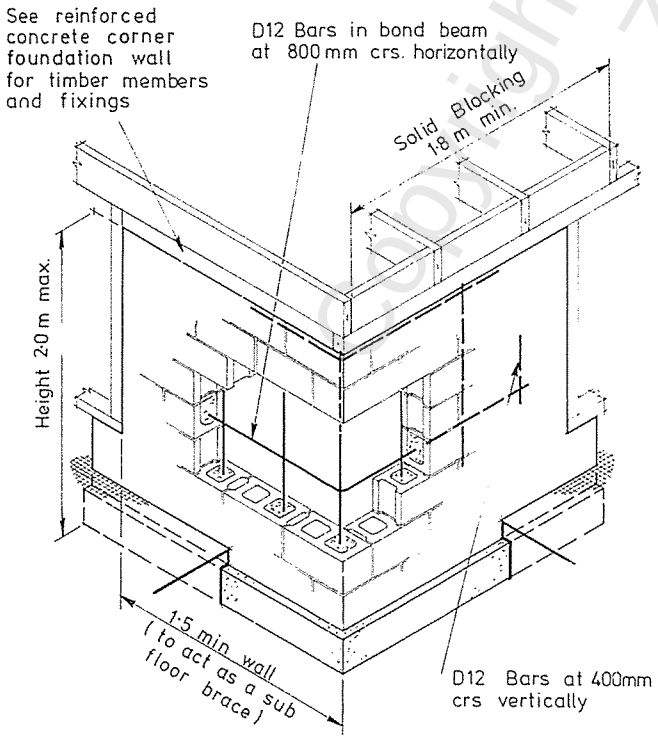
Depth of cantilevered joist	*Maximum length of cantilevered joist supporting:*		
	Floor, wall, and light roof*	*Floor*, wall, and heavy roof*	*Balcony floor† and balustrade only*
(mm)	(mm)	(mm)	(mm)
100	125	75	550
125	175	100	850
150	225	150	1100
200	375	275	1500
225	425	350	1700
250	775	425	1900
300	925	625	2200

* 1.5 kPa or 2.0 kPa floor loads.

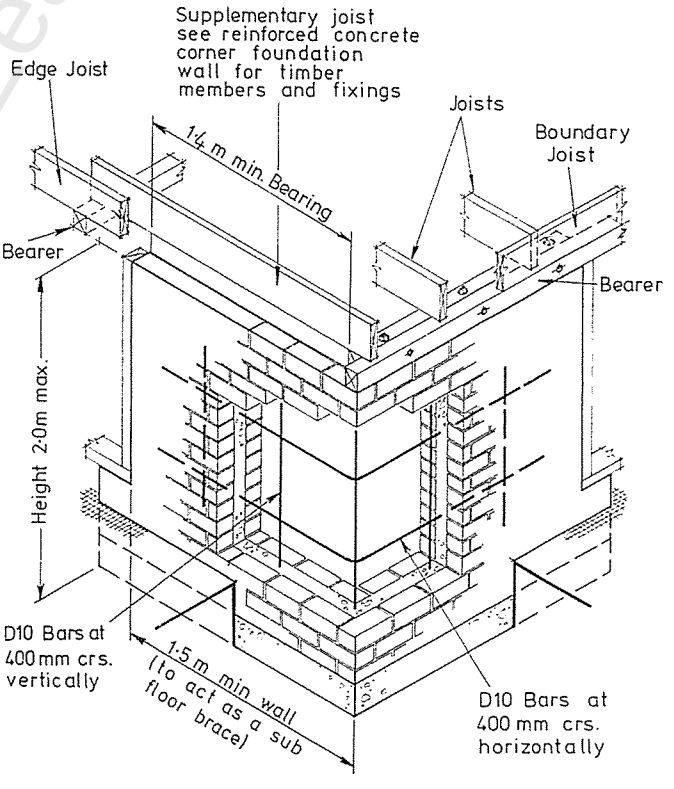
† 2.0 kPa floor load.



A : Reinforced concrete



B : Reinforced concrete masonry



C : Reinforced clay masonry

Fig. 32 : Corner foundation walls.

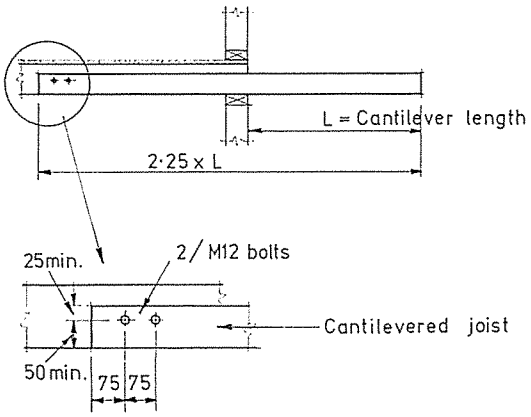


Fig. 33 : Cantilevered floor joists

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.*

5.1.6 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 1.8 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 1.8 m:

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

(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.

* see list of related documents

5.1.6.4 Curtailed joists shall be attached to trimmers as follows:

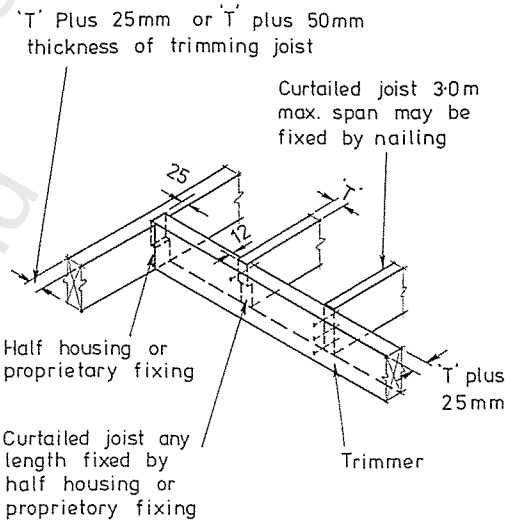
(a) Only curtailed joist spans not exceeding 3 m: By not fewer than three nails through the trimmer and extending not less than 50 mm into the ends of the curtailed joists; or

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

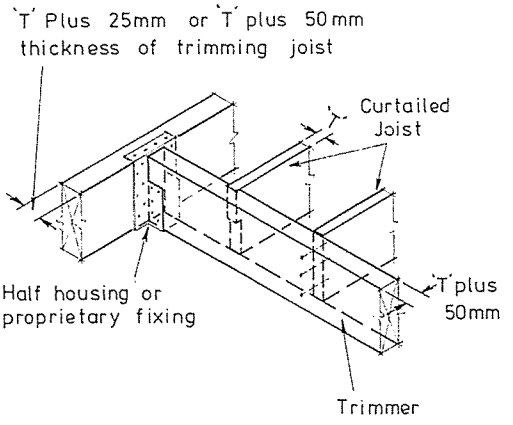
(c) By a connector having a capacity of:

(i) Curtailed joist spans not exceeding 3 m: 1.25 kN;

(ii) Curtailed joist spans exceeding 3 m: 2.5 kN.



TRIMMERS SPANNING UP TO 1·8m



TRIMMERS SPANNING BETWEEN 1·8m AND 2·4m

Fig. 34 : Framing around openings in joisted floors

5.1.6.5 Trimmers shall be fixed to trimming joists as follows:

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

(b) By a connector having a capacity of:

(i) Trimmer spans not exceeding 1.8 m: 4 kN;

(ii) Trimmer spans not exceeding 2.4 m: 5.3 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).

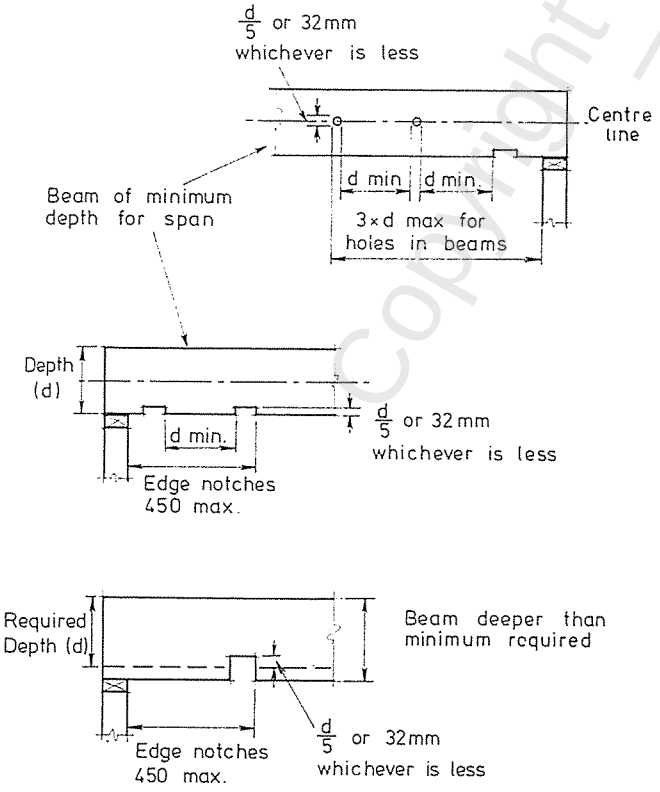


Fig. 35 : Holes and notches in floor joists other than cantilevered joists

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.

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.

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.

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 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) 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 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 1200 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 non-loadbearing and any wall bracing elements that they contain will not be taken into account for the purposes of clause 6.3).

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 supporting 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;

(b) The number of bracing units per metre given by table 11B 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 provided that no such wall shall contain less than 50 bracing units.

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

Table 11

BRACING UNITS

1.5 kPa and 2.0 kPa floor loads

A For earthquake:

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°	3	3	2
	45°	4	3	3
Lower of two storeys	25°	6	5	4
	45°	7	6	5
Lowest of three storeys	25°	9	8	6
	45°	10	8	7
Heavy roof				
Single storey or top storey	25°	5	4	3
	45°	6	5	4
Lower of two storeys	25°	8	6	5
	45°	9	7	6
Lowest of three storeys	25°	11	9	7
	45°	12	10	8

B For wind:

Location of storey	*Maximum slope of roof*	*Minimum number of bracing units per metre in wind exposure:*		
		Low	*Medium*	*High*
Single storey or top storey	25°	18	23	33
	45°	44	53	80
Lower of two storeys	25°	43	53	80
	45°	73	90	133
Lowest of three storeys	25°	68	80	120
	45°	94	115	170

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.

6.3.4 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.

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;

(b) A ceiling diaphragm complying with clause 12.5;

(c) A roof braced with hit-and-miss diagonal sarking complying with clause 10.5.4 or with sheet sarking complying with clause 10.5.5.

6.3.5.2 Each edge of the diaphragm shall be supported by 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.

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. 36, 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. 36 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.*

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;

(b) Non-loadbearing walls: As given by table 14 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. For balloon framing the length (height) of studs is measured between a plate and the ribbon board.

6.5.1.2 The wind exposure shall be:

(a) External walls: As given by table 1, or as given by fig. 4 for locations not listed in table 1;

(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, amongst 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.

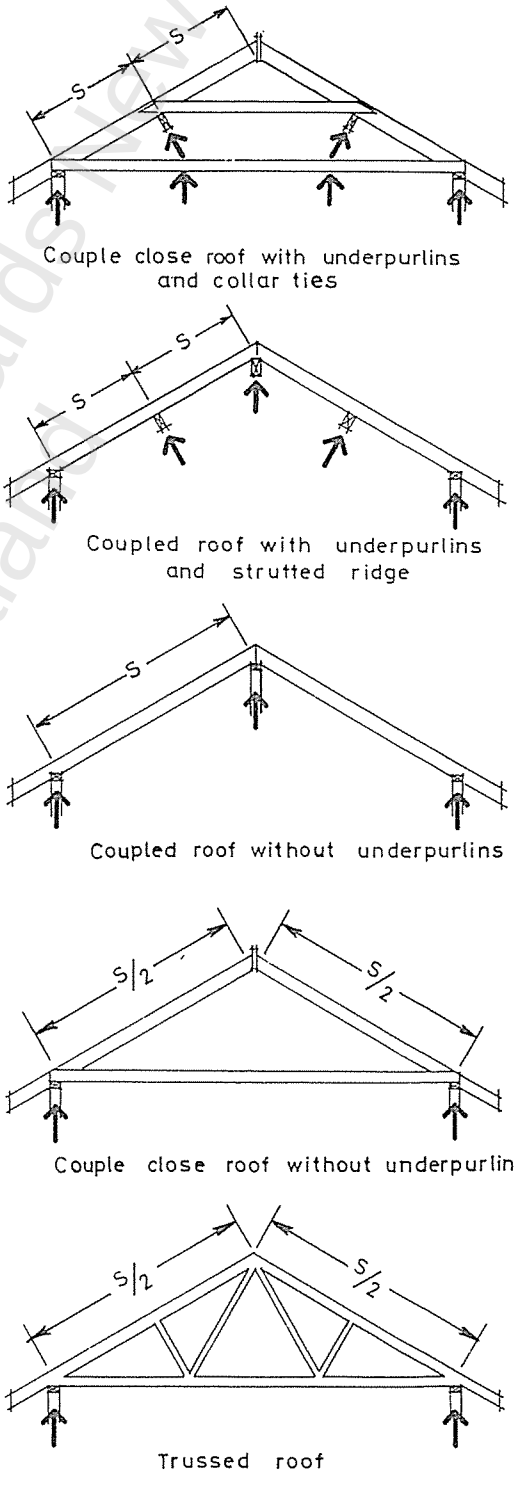


Fig. 36 : Determination of roof dimension 'S'

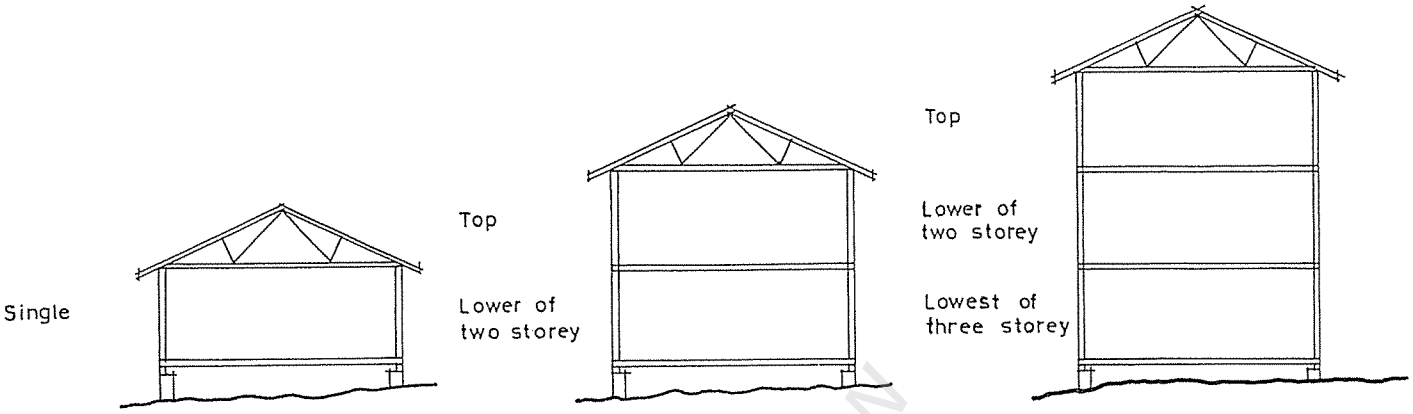


Fig. 37 : Location of wall framing for the purposes of tables 11, 12, 15, 18, 19 and 20.

Table 12

STUDS IN LOADBEARING WALLS

1.5 kPa, 2.0 kPa, and 3.0 kPa floor loads

Wind exposure	*Maximum span of member supported**	*Stud sizes for studs of maximum length (height) of:*								
		2.4 m in:						*3.0 m in any location at maximum stud spacing (mm) of:*		
		Single storey, top storey, lower of two storeys, or subfloor beneath one storey, at maximum stud spacing (mm) of:			*Lowest of three storeys or subfloor beneath two or three storeys; at maximum stud spacing (mm) of:*					
		400	*480*	*600*	*400*	*480*	*600*	*400*	*480*	*600*
	(m)	(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 50 A†	100 x 50	100 x 75 125 x 40 B†	100 x 50	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40	100 x 100 125 x 50	100 x 100 125 x 75
	9.0	100 x 50 A†	100 x 50	100 x 75 125 x 40 B†	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40	100 x 75 125 x 40	100 x 100 125 x 50	100 x 100 125 x 75
	12.0	100 x 50	100 x 50	100 x 75 125 x 40 B†	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40	100 x 75 125 x 40	100 x 100 125 x 40	100 x 100 125 x 75
Medium	6.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40
	9.0	100 x 40	100 x 40	100 x 50 A†	100 x 40	100 x 40	100 x 50	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40
	12.0	100 x 40	100 x 40	100 x 50 A†	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40
Low	9.0	75 x 50	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 50	100 x 50	100 x 75 125 x 40
	12.0	100 x 40	100 x 40	100 x 40	100 x 40	100 x 40	100 x 50	100 x 50	100 x 75 125 x 40	100 x 75 125 x 40

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

† NOTES - A : 100 mm x 40 mm may be used for light roofs only.
B : 100 mm x 50 mm may be used for single and top storey only.

6.5.1.4 No. 2 Framing grade or Building B grade timber 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 160 mm of its mid-height;

(d) The studs shall not be corner studs and shall not be trimming studs;

(e) Stud length shall not exceed 3.0 m;

(f) Studs shall be of the dimensions given by table 13.

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.*

* see list of related documents

Table 13

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

Wind exposure	*Maximum roof dimension**	*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	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.

6.5.1.5 Except as provided by clause 6.5.2, 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: 16 mm;

(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.

Table 14

STUDS IN NON-LOADBEARING WALLS

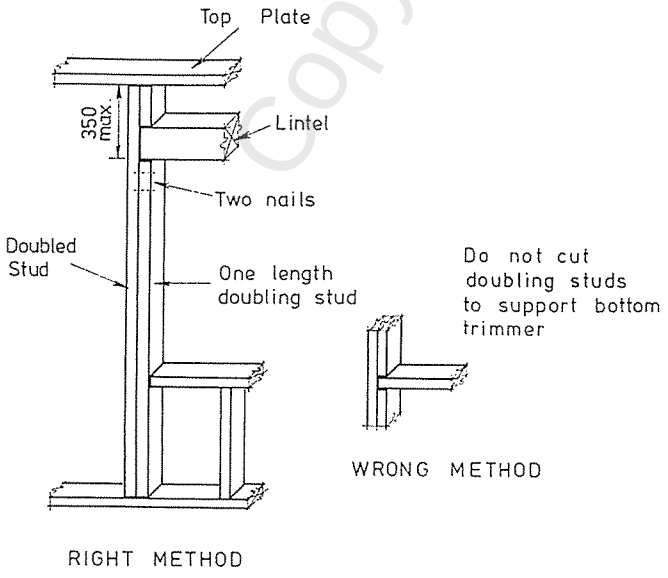
Wind exposure	*Maximum length (height) of stud*	*Stud size for stud spacings (mm) of:*		
		400	*480*	*600*
	(m)	(mm x mm)	(mm x mm)	(mm x mm)
High	2.7	100 x 50	100 x 50	100 x 75 125 x 40
	3.0	100 x 100 125 x 40	100 x 100 125 x 40	100 x 100 125 x 50
	3.6	100 x 100 125 x 50	125 x 75 150 x 40	125 x 100 150 x 50
	4.2	125 x 75 150 x 50	– –	– –
Medium	2.7	100 x 40	100 x 40	100 x 50
	3.0	100 x 40	100 x 50	100 x 100 125 x 40
	3.6	100 x 75 125 x 40	100 x 75 125 x 40	100 x 100 125 x 40
	4.2	100 x 100 125 x 50	125 x 75 150 x 40	150 x 50 –
	4.8	125 x 75 150 x 50	125 x 100 150 x 50	– –
Low	2.7	75 x 40	75 x 40	75 x 50 100 x 40
	3.0	100 x 40	100 x 40	100 x 50
	3.6	100 x 75 125 x 40	100 x 75 125 x 40	100 x 100 125 x 40
	4.2	100 x 100 125 x 50	100 x 100 125 x 50	125 x 75 150 x 40
	4.8	125 x 75 150 x 40	125 x 75 150 x 50	125 x 75 150 x 50

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*	*Thickness of trimming studs*
(m)	(mm)	(mm)
A Single storey or top storey		
1.8	40	50
	50	50
3.0	40	50
	50	75
3.6	40	75
	50	100
B Any other location		
0.9	40	50
	50	75
1.8	40	75
	50	75
3.0	40	100
	50	100
3.6	40	100
	50	125



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;

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

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;

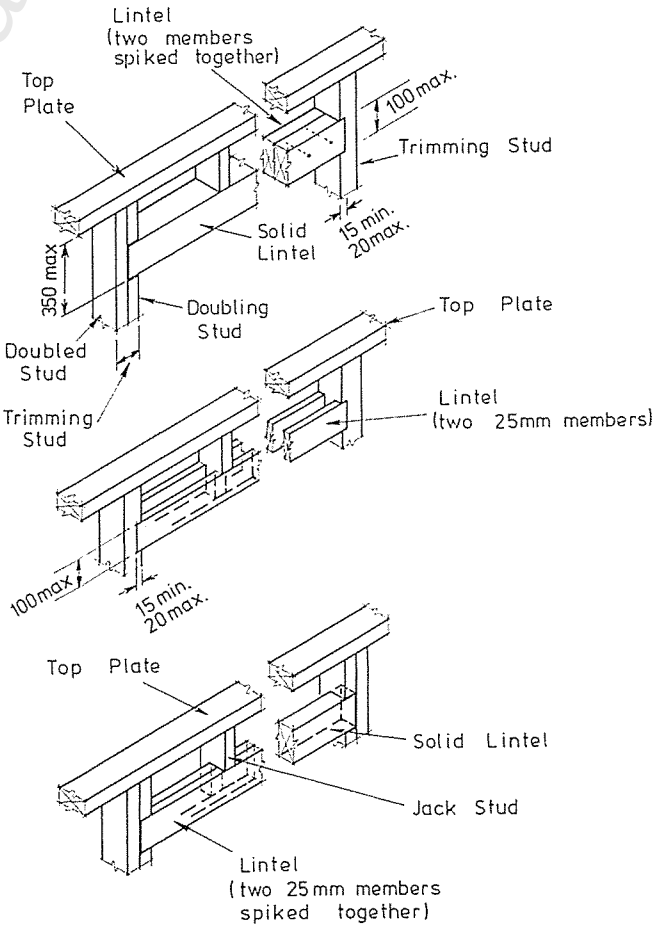


Fig. 38 : Trimming studs, lintels, and sill trimmers

(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.

* see list of related documents

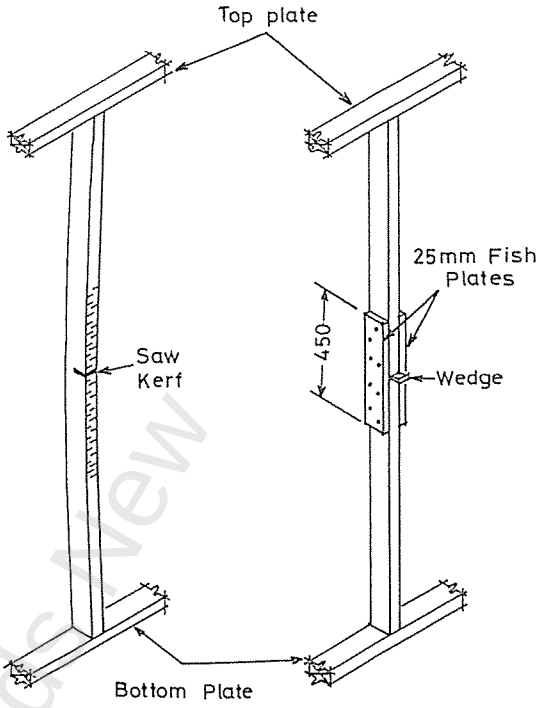


Fig. 39 : Straightening studs

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 100 mm deep: The trimming stud checked not less than 15 mm nor more than 20 mm;

(b) For lintels not exceeding 200 mm deep: A 50 mm thick doubling stud;

(c) For lintels not exceeding 300 mm deep: A 75 mm thick doubling 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 lintel span exceeds 1.5 m and the roof dimension *S* exceeds 8 m; or

(ii) The lintel span exceeds 2.7 m;

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

Table 16

LINTELS

1.5 kPa and 2.0 kPa floor loads

Maximum clear width of opening (span of lintel)	*Maximum span of member supported**	*Depth of lintel supporting:*								
		Roof only where lintel thickness (mm) is:			*Roof and walls only where lintel thickness (mm) is:*			*All other cases where lintel thickness (mm) is:*		
		50	*75*	*100*	*50*	*75*	*100*	*50*	*75*	*100*
(m)	(m)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
A Light roof										
0.9	8.0	125	100	100	125	125	100	125	100	100
	12.0	150	125	100	150	125	100	150	125	100
1.2	8.0	125	100	100	150	125	100	200	150	125
	12.0	150	125	125	200	125	125	200	200	150
1.5	8.0	150	125	100	150	125	100	250	200	150
	12.0	200	150	125	200	150	125	300	250	200
1.8	8.0	150	125	125	200	150	125	250	200	200
	12.0	200	150	150	200	200	150	–	250	250
2.1	8.0	200	150	150	200	200	150	–	250	250
	12.0	250	200	200	250	200	200	–	300	300
2.4	8.0	250	200	150	250	200	200	–	300	250
	12.0	300	250	200	300	250	200	–	–	300
2.7	8.0	–	200	200	–	250	200	–	–	300
	12.0	–	250	250	–	300	250	–	–	300
3.0	8.0	–	250	200	–	250	200	–	–	–
	12.0	–	300	250	–	300	250	–	–	–
3.6	8.0	–	300	250	–	300	250	–	–	–
	12.0	–	–	300	–	–	300	–	–	–

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

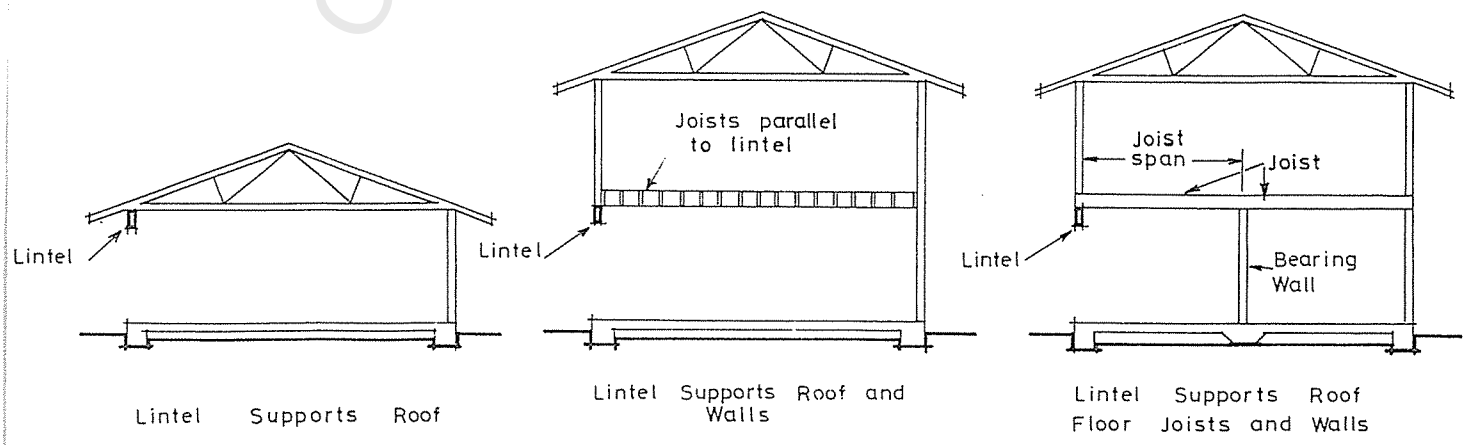


Fig. 40 : Lintel loads for the purposes of table 16

Table 16 (cont.)

LINTELS

1.5 kPa and 2.0 kPa floor loads

Maximum clear width of opening (span of lintel)	*Maximum span of member supported**	*Depth of lintel supporting:*								
		Roof only where lintel thickness (mm) is:			*Roof and walls only where lintel thickness (mm) is:*			*All other cases where lintel thickness (mm) is:*		
		50	*75*	*100*	*50*	*75*	*100*	*50*	*75*	*100*
(m)	(m)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
B Heavy roof										
0.9	8.0	125	125	100	150	125	100	150	125	100
	12.0	200	125	125	200	150	125	200	125	125
1.2	8.0	150	125	100	200	125	125	200	150	150
	12.0	200	150	125	200	200	150	250	200	200
1.5	8.0	200	150	125	200	150	125	250	200	200
	12.0	250	200	150	250	200	150	300	250	200
1.8	8.0	200	150	125	200	200	150	300	250	200
	12.0	250	200	200	250	200	200	–	300	250
2.1	8.0	250	200	200	250	200	200	–	300	250
	12.0	300	250	200	300	250	200	–	–	300
2.4	8.0	300	250	200	300	250	200	–	–	300
	12.0	–	300	250	–	300	250	–	–	–
2.7	8.0	–	250	250	–	300	250	–	–	300
	12.0	–	–	300	–	–	300	–	–	–
3.0	8.0	–	300	250	–	300	250	–	–	–
	12.0	–	–	300	–	–	300	–	–	–
3.3	8.0	–	300	250	–	–	300	–	–	–
	12.0	–	–	–	–	–	–	–	–	–
3.6	8.0	–	–	300	–	–	300	–	–	–

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

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.

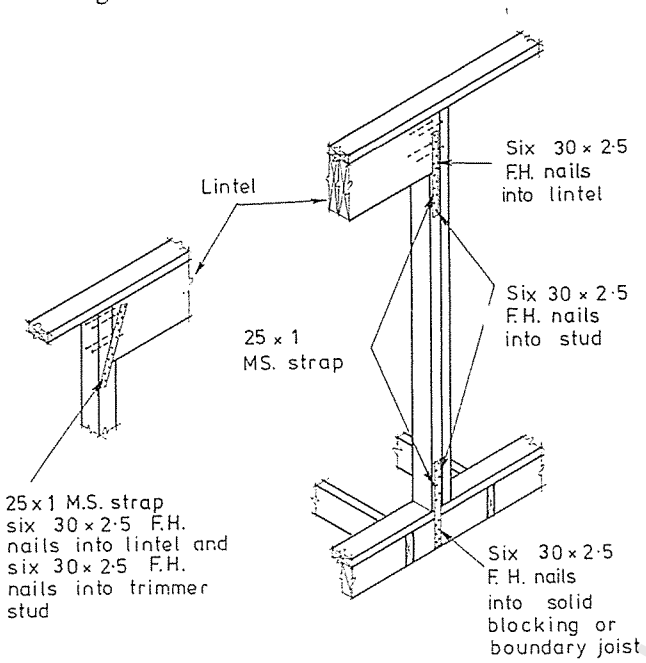


Fig. 41 : Fixing of lintels against uplift

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.

6.7.1.2 When every 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 50 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.

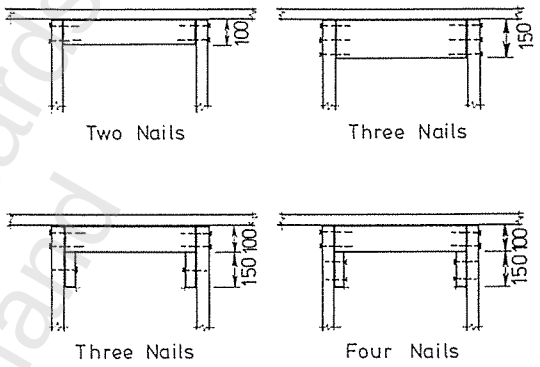


Fig. 42 : Top plates of loadbearing walls with supporting dwang on edge (see table 18 and fig. 45C)

6.7.2 Bottom plates

6.7.2.1 Bottom plates shall be of the following dimensions:

(a) Loadbearing external 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) Loadbearing internal walls: The same width as the studs and 50 mm thick except as provided by clauses 6.7.2.2 and 6.7.2.4;

(c) 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.

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 less 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, or purlins then it shall be provided by 75 mm x 50 mm connecting members running between the top plate and

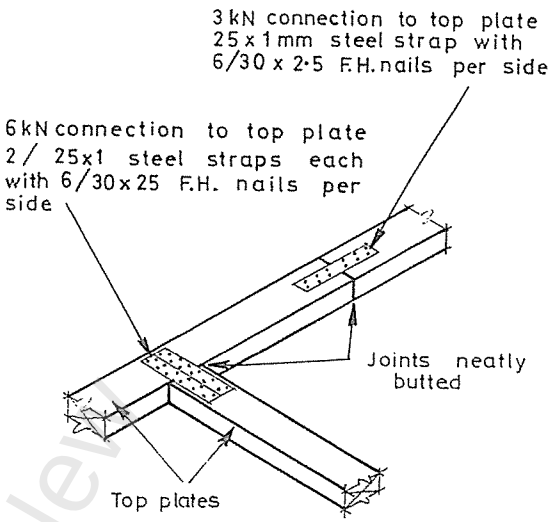


Fig. 43 : Interconnection and jointing of top plates in walls containing wall bracing elements

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.

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.

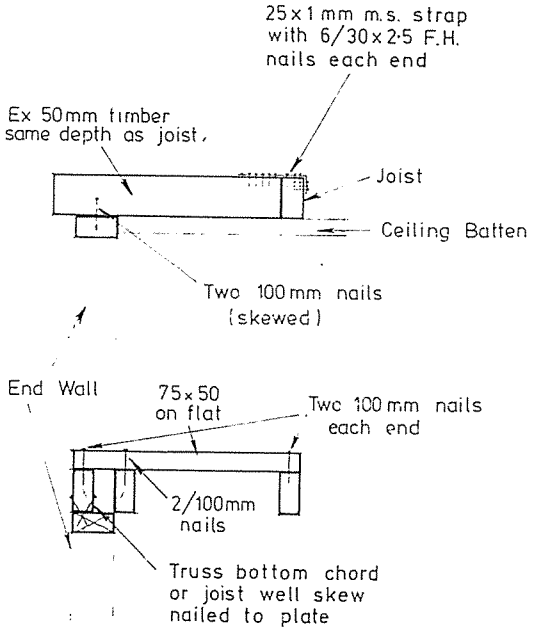


Fig. 44 : Connecting members providing lateral support to the top plates of external walls

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 (mm x mm)	*Position of truss or rafter centreline relative to centreline of nearest stud*	*Maximum spacing of trusses or rafters* (m)	*Maximum roof dimension* S* of: *Light roof for stud spacing (mm) of:* 480 (m)	600 (m)	*Heavy roof for stud spacing (mm) of:* 400 (m)	480 (m)	600 (m)
75 x 50 (see fig. 45A)	Anywhere	600	7.2	7.2	7.2	7.2	4.6
		900	7.2	6.4	6.0	4.6	2.8
		1200	7.2	4.6	4.9	3.3	1.9
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	6.6	4.4	2.5
	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	7.5	6.1	5.1
100 x 50 plus 150 x 40 (see fig. 45B)	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	12.0	8.6	5.2
	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	12.0	11.7	9.7
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)†	10.0 (5)†	8.1 (4)†	6.3 (3)†

* 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).

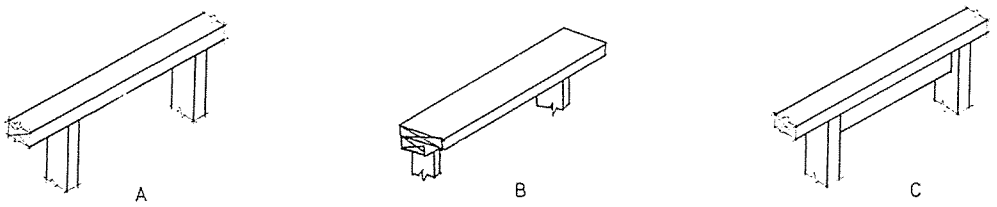


Fig. 45 : Top plate arrangements (see also fig. 42).

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 100 x 40 (see fig. 45B) 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)	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 EXTERNAL 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	6.0	400	7.2	7.2	7.2	6.3	5.4	3.4
		450	7.2	7.2	4.6	3.9	3.2	1.9
		600	4.8	3.2	1.9	1.8	–	–
75 x 50	6.0	400	7.2	7.2	7.2	7.2	7.2	7.2
		450	7.2	7.2	7.2	7.2	7.2	6.1
		600	7.2	7.2	7.2	6.0	4.6	3.3
75 x 75	6.0	600	7.2	7.2	7.2	7.2	7.2	7.2
100 x 40	6.0	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	6.0	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	6.0	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 6.5.5 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.

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).

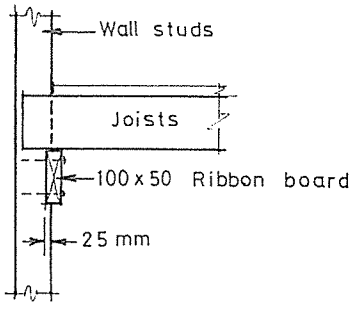


Fig. 46 : Ribbon boards.

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;

Provided that no account shall be taken of any wall bracing element that is rated at less than a total of 50 bracing units except as provided by clause 6.9.6.3.

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 lining

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; 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/m^3 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;

(b) Continuous galvanized steel angle not less than 22 mm x 22 mm x 1.2 mm;

* see list of related documents

(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.

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) 1.5 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 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/m^3; or

(iii) Any other wood-based product not less than 6 mm thick with a density not less than 600 kg/m^3;

(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 900 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 Each of the studs at the edges of a sheet of sheet bracing material shall be connected to a joist (including a boundary joist) as shown in fig. 47 or by an alternative fixing of 3.5 kN capacity in tension or compression along the line of the stud.

6.9.4.6 Studs, plate, 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 reinforced concrete or reinforced masonry wall (not including masonry veneer) that complies with the relevant requirements of NZS 1900* and that has a length not less than half its height.

C6.9.5.1 A masonry wall that contains the

* see list of related documents

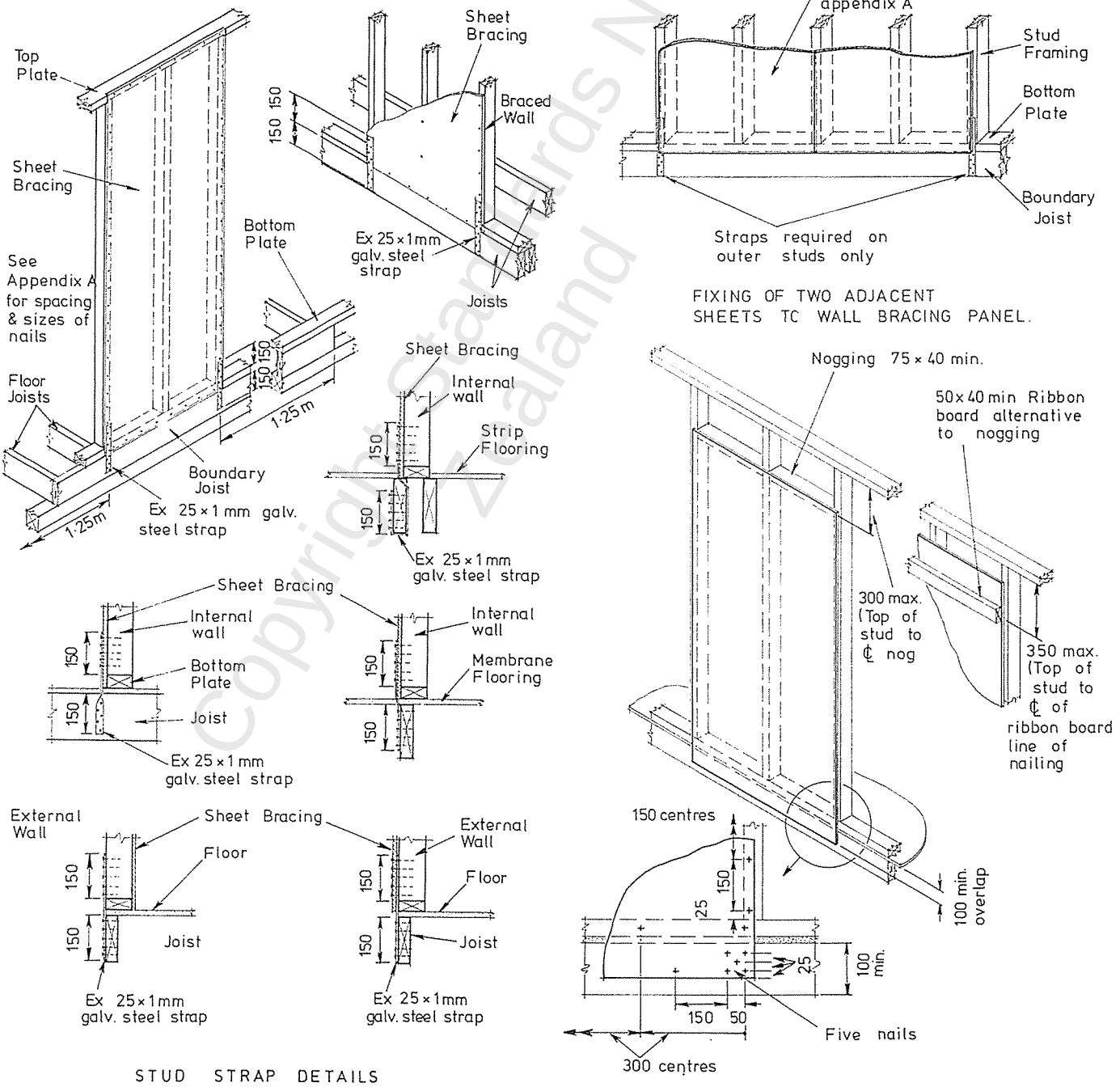


Fig. 47 : Sheet bracing wall bracing elements

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*.*

6.9.5.2 The length of a wall bracing element complying with this clause shall be taken as the length of the wall.

6.9.6 Lining both sides

6.9.6.1 A wall bracing element complying with this clause (type 12 of table 20) shall be a length of timber stud wall not less than 1.2 m nor more than 1.7 m long that is entirely covered by sheet material fixed to both faces in accordance with clause 6.9.6.2.

* see list of related documents

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.

6.9.6.3 Each wall bracing element complying with this clause shall be considered to contribute 42 bracing units to its associated bracing line, provided that such

Table 20

RATINGS OF WALL BRACING ELEMENTS

Type	*Description of wall bracing element*	*Rating (bracing units per metre of element length)*
	Diagonal braces with sheet lining (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 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 on both faces	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	Lining both sides (clause 6.9.6)	As given by clause 6.9.6.3

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;

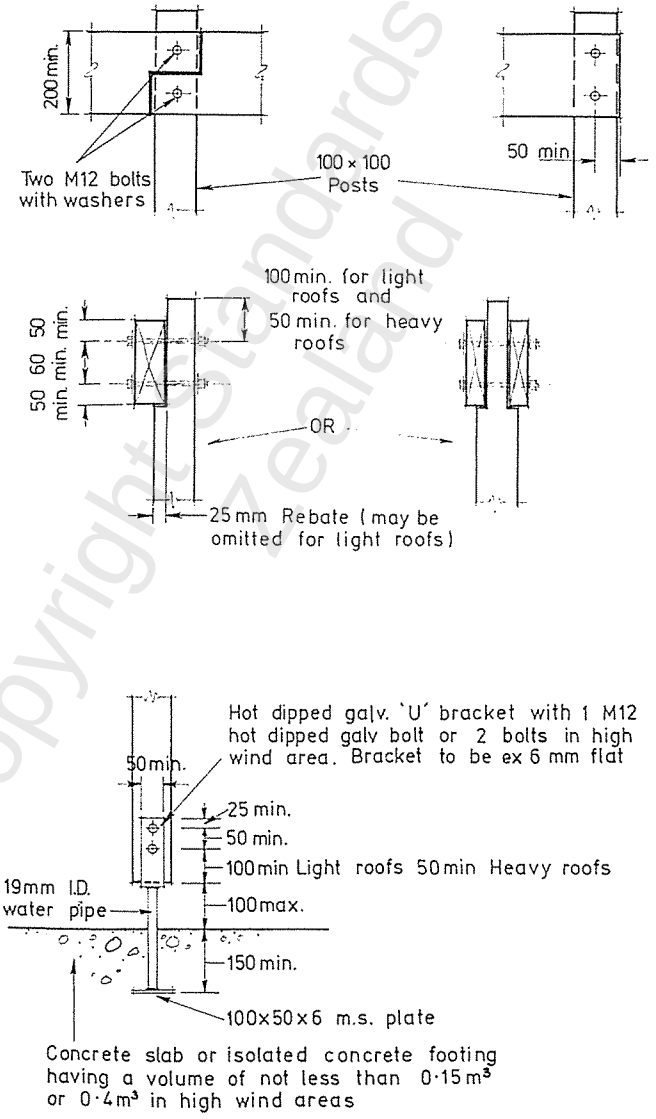
(c) Each wall containing wall bracing elements rated at a total of more than 200 bracing units: To at least two external walls by 6 kN connections as shown in fig. 43 or by two alternative fixings each of 3 kN capacity in tension or compression along the line of the wall bracing elements.

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 Posts shall not be supported by cantilevered floor joists that form a balcony.



POST CONNECTION DETAILS

Fig. 48 : Fixing of posts and beams

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 Wall and roof sarking and 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 3602*.

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 cover-boards 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 PS60-73*.

* see list of related documents

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 ASBESTOS CEMENT SHEETS

8.4.1 Asbestos cement sheets shall comply with NZS 282*.

8.4.2 Asbestos cement corrugated sheets shall be fixed in accordance with NZSR 26*.

8.4.3 The recommendations of NZSR 26* shall be followed in order to comply with this standard.

C8.4.3 NZSR 26 does not use the word "shall". Clause 8.4.3 is intended to make it clear that notwithstanding clause 1.2.1 the recommendations of NZSR 26* are to be regarded as mandatory requirements for the purposes of this standard.*

8.4.4 Asbestos cement flat sheets shall be fixed to framing members in accordance with clearly presented and adequate technical information supplied by the manufacturer.

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 as necessary immediately before exterior coverings are fixed.

8.8 WINDOWS

8.8.1 Windows shall comply with the relevant requirements of NZS 1900 : Chapter 10*.

8.8.2 Windows that comply with the requirements of NZS 4211* shall be accepted as complying with clause 8.8.1 provided that they shall be of air leakage grade C or better and shall have a design wind pressure (DWP) rating appropriate to the site of the building as follows:

High wind exposure: DWP 1100 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 21) 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.

C10.2.1.1 Roof trusses exceeding these dimensions would impose higher loadings than can be adequately resisted by buildings complying with this standard.

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.

* see list of related documents

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 areas 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 roof framing members apply equally to framed roofs of other types.

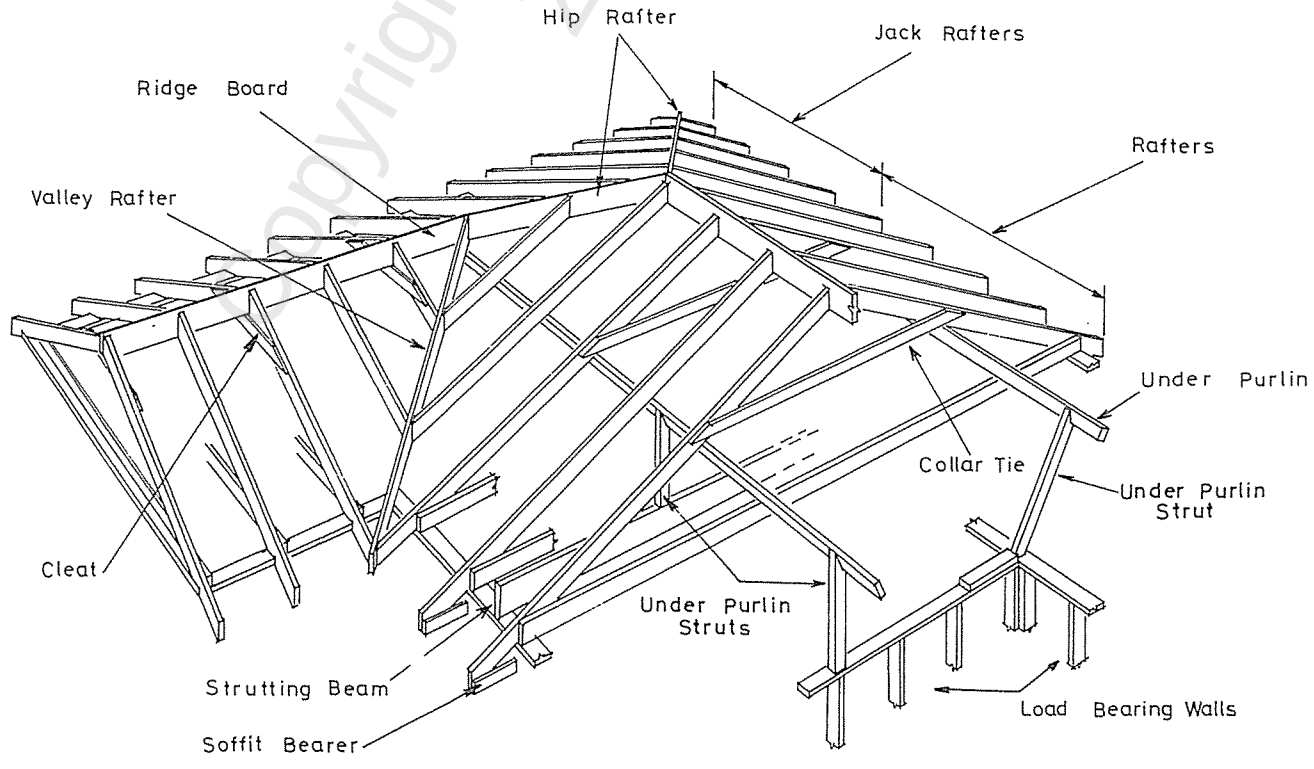


Fig. 49 : Roof framing members

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 shall be butted and flitched with timbers 25 mm thick and 50 mm less than the rafter in width, extending not less than 225 mm on each side of the rafter ends and nailed to both lengths of the member from both sides, or shall be made by an alternative connector of 3 kN capacity in tension or compression along the line of the rafter.

10.3.1.4 Joints in ridge boards shall be butted and flitched on both sides with pieces of timber extending not less than 200 mm on each side of the ridge board ends, nailed to both lengths of ridge board from both sides with nails passing through the flitch and the ridge board into the flitch on the other side.

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.

10.3.2.2 Rafters other than hip and valley rafters shall be of the dimensions given by table 21.

10.3.2.3 Valley rafters shall be of the dimension given by table 22.

Table 21

RAFTERS OTHER THAN HIP AND VALLEY RAFTERS

Rafter size	*Maximum span of rafters at a maximum spacing (mm) of:*		
	600	*900*	*1200*
(mm x mm)	(m)	(m)	(m)
A Light roof:			
75 x 40	1.35	1.20	1.10
100 x 40	1.95	1.75	1.65
125 x 40	2.55	2.35	2.15
150 x 40	3.15	2.85	2.65
75 x 50	1.45	1.30	1.20
100 x 50	2.05	1.85	1.75
125 x 50	2.70	2.50	2.30
150 x 50	3.35	3.05	2.85
200 x 50	4.65	4.25	3.85
100 x 75	2.35	2.15	2.05
125 x 75	3.10	2.85	2.65
150 x 75	3.85	3.50	3.25
200 x 75	5.35	4.80	4.40
225 x 75	6.15	5.50	5.00
250 x 75	6.85	6.05	5.55

Rafter size	*Maximum span of rafters at a maximum spacing (mm) of:*		
	480	*600*	*900*
(mm x mm)	(m)	(m)	(m)
B Heavy roof:			
75 x 40	1.10	–	–
100 x 40	1.70	1.60	1.40
125 x 40	2.20	2.00	1.85
150 x 40	2.70	2.55	2.30
75 x 50	1.20	–	–
100 x 50	1.80	1.70	1.50
125 x 50	2.35	2.15	1.95
150 x 50	2.90	2.70	2.45
200 x 50	4.00	3.70	3.30
100 x 75	2.10	2.00	1.75
125 x 75	2.70	2.50	2.25
150 x 75	3.35	3.10	2.80
200 x 75	4.60	4.15	3.80
225 x 75	5.30	4.90	4.35
250 x 75	5.85	5.35	4.80

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

10.3.2.4 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 fixed to top plates, wall plates, lintels, and beams as shown in fig. 50 provided that the plumb cut of the birdsmouth shall not exceed one quarter of the depth of the rafter at that point.

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.

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. There shall be a ceiling joist connecting the feet of each pair of rafters in the side planes of a couple-close roof.

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.

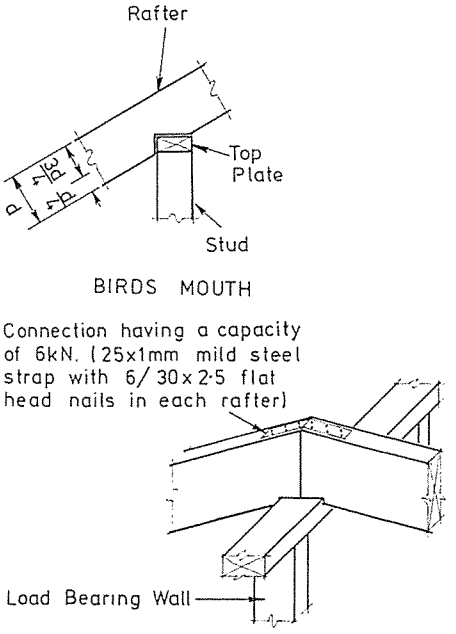


Fig. 50 : Fixing of rafters

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 150 mm on each side of the centreline of the support and nailed together from both sides; or

(b) Be butted and flitched with 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 joist from both sides.

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.

Table 24

CEILING RUNNERS

Ceiling runner size	*Maximum span of ceiling runners at a maximum spacing (m) of:*		
	2.0	*2.4*	*3.0*
(mm x mm)	(m)	(m)	(m)
200 x 25	2.30	2.10	1.95
150 x 5	2.30	2.10	1.95
150 x 75	2.60	2.40	2.20
150 x 100	2.90	2.65	2.45
200 x 50	3.25	2.90	2.60
200 x 75	3.70	3.30	2.95
200 x 100	4.10	3.65	3.30
225 x 75	4.20	3.80	3.30
225 x 100	4.65	4.20	3.65
250 x 75	4.60	4.20	3.65
250 x 100	5.10	4.65	4.05

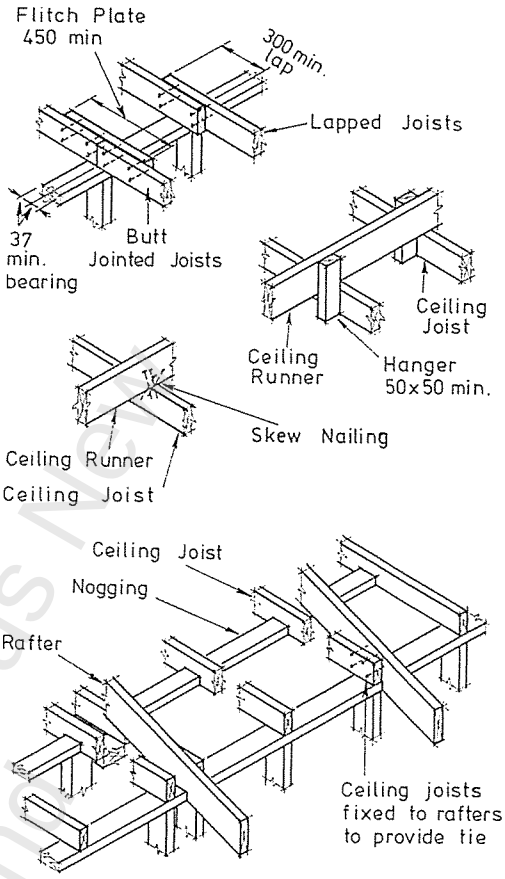


Fig. 51 : Fixing of ceiling framing members

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.

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.

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

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 As shown in fig. 52, underpurlin struts shall be provided to support an underpurlin and shall:

(a) Be at right angles to the underpurlin;

(b) Be at right angles to the plane of the roof, or be vertical, or lie at any inclination between those two.

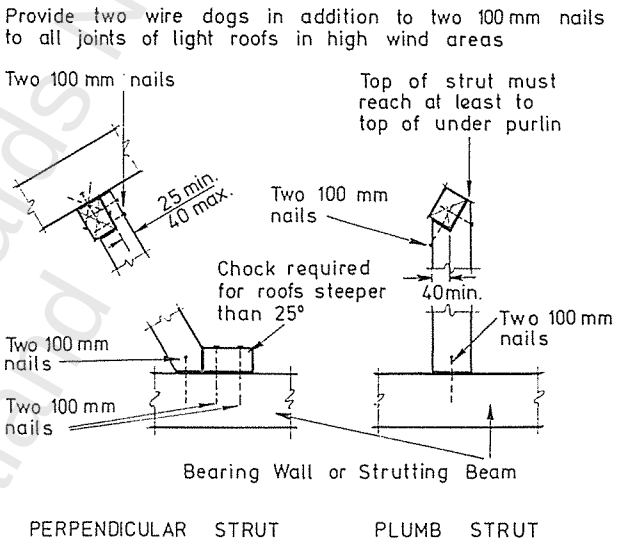


Fig. 52 : Fixing of underpurlin struts

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.

10.3.8.4 Underpurlin struts shall be fixed to underpurlins, strutting beams, top plates, and lintels as shown in fig. 52.

10.3.9 Strutting beams

10.3.9.1 Strutting beams shall be of the dimensions given by table 26.

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	3.95	2.55
	2.40	3.05	2.40	1.95
	3.00	2.35	2.40	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

10.3.9.2 Strutting beams shall be lifted not less than 25 mm clear of the tops of ceiling joists by packing at the supports.

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:

(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 in addition to the ceiling joist that connects their feet:

(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 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 150 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.

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.

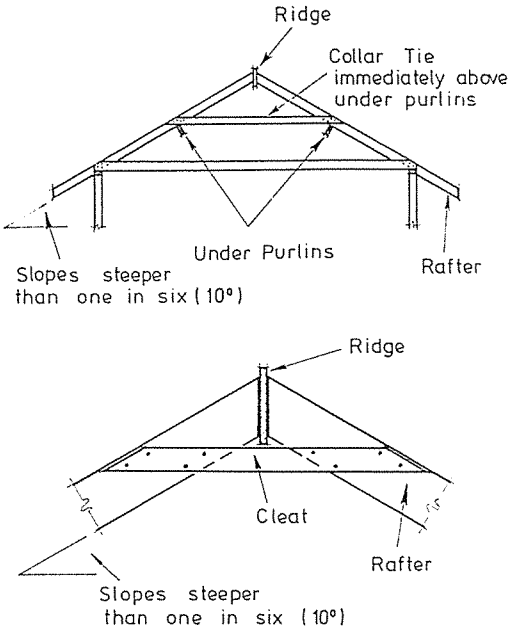


Fig. 53 : Collar ties and cleats

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 50 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.

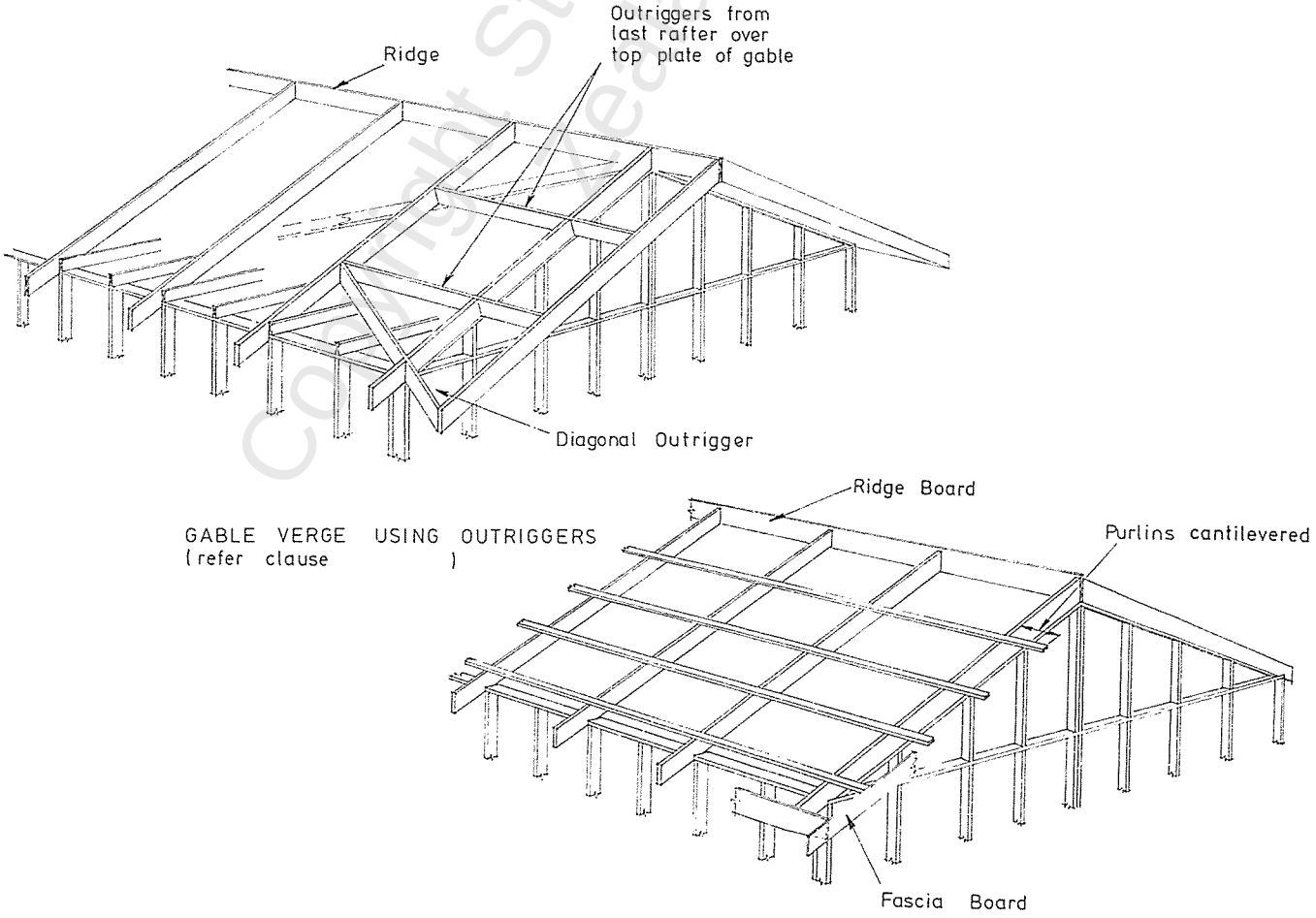


Fig. 54 : Gable verge framing.

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 As shown in fig. 54, outriggers shall:

(a) Be the same size as the rafters;

(b) Be located at not more than 900 mm centres and beneath purlins;

(c) Extend beyond their end supports for a distance not exceeding 600 mm.

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.

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:

(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 m^2 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.

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 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 area, minimum 2 per plane	or	At each end of ridge and maximum 7.5 m centres between	–	–	–	–
Heavy gable	One per 25 m^2 roof plane area, minimum 2 per plane	and	One per 12 m^2 roof plane area, parallel to ridge but not less than 2 m from a parallel external wall	–	–	–	–

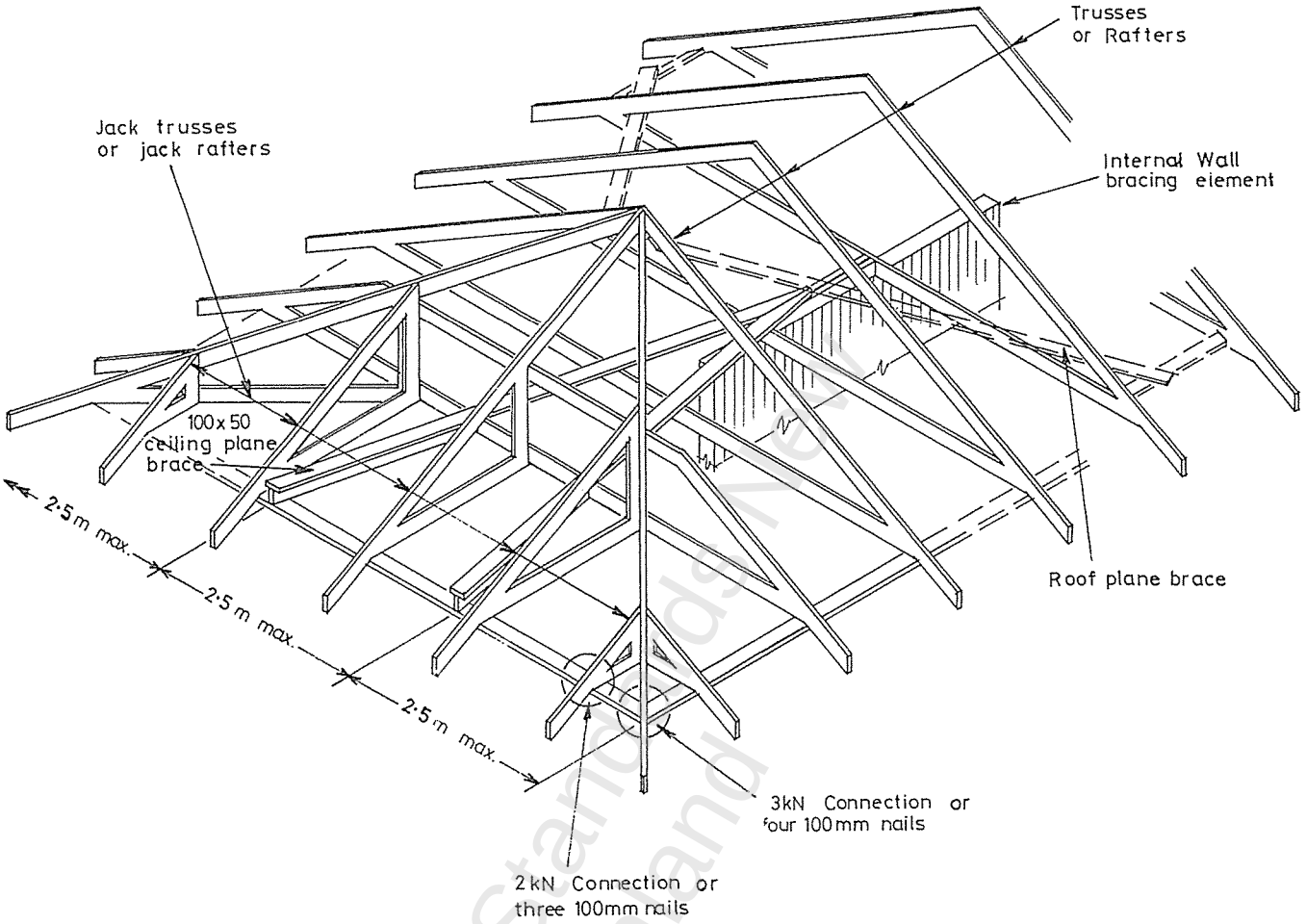


Fig. 55 : Bracing of heavy hip roofs

10.4.2.2 A top plate supporting hip-end jack trusses or jack rafters shall be connected at not less 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.

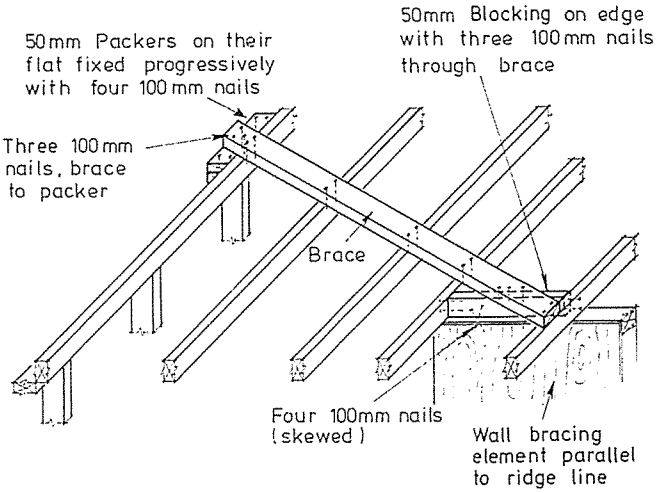


Fig. 56 : Ceiling braces connecting hip-end top plates to wall bracing elements

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 provided that no plane shall contain less than two such braces; 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, provided that no plane shall contain less than two such braces; and

(b) One roof space diagonal brace complying with clause 10.5.3 for each 12 m² or part thereof of plan area of the roof; such braces shall:

(i) Be parallel to the ridge line;

(ii) 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;

(iii) Be evenly distributed along the length of the roof.

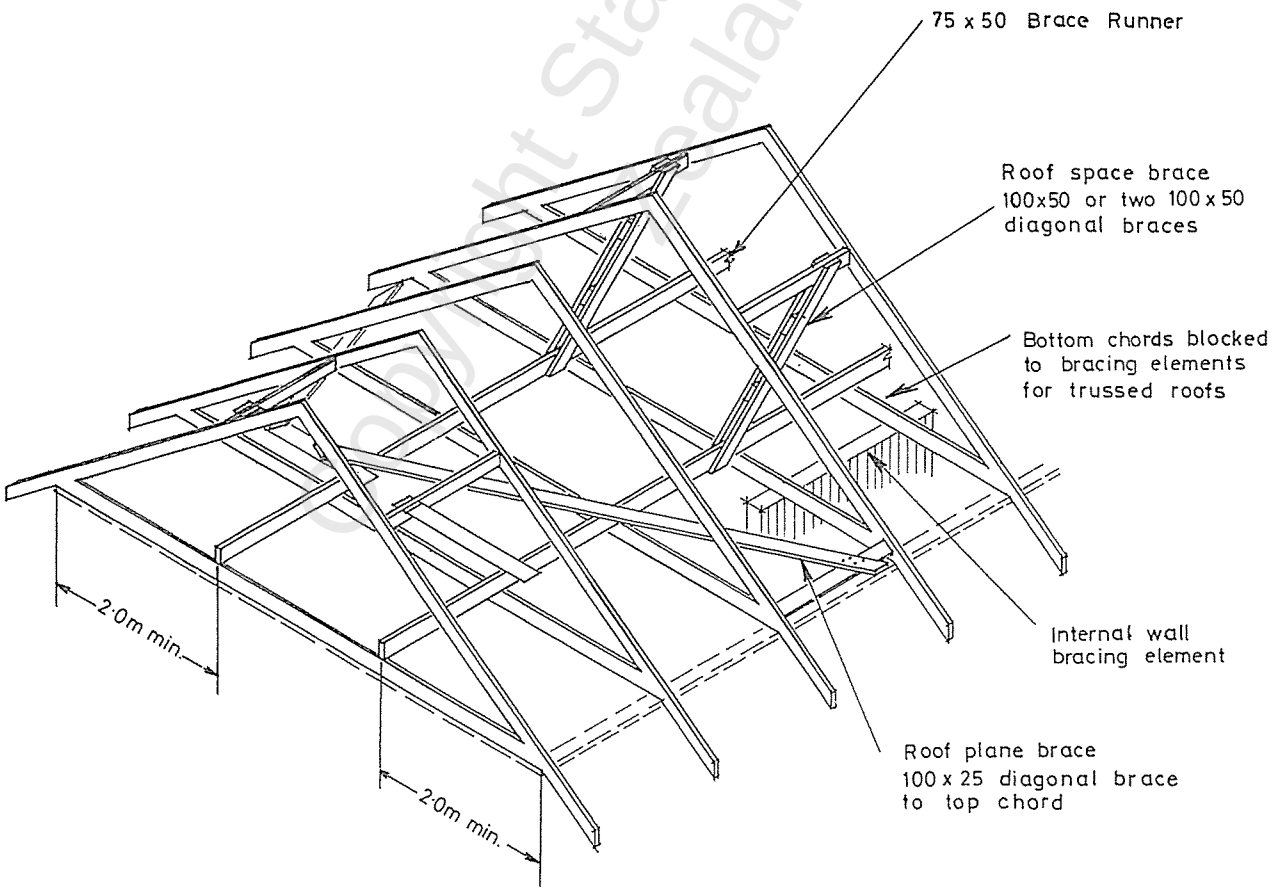


Fig. 57 : Bracing of heavy gable roofs

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 is provided.

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 a continuous length of 100 mm x 25 mm timber fixed to the underside of each top chord or rafter that it intersects 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) Not exceeding 2 m long: A continuous length of 100 mm x 50 mm timber;

(ii) Not exceeding 5.2 m long: 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.

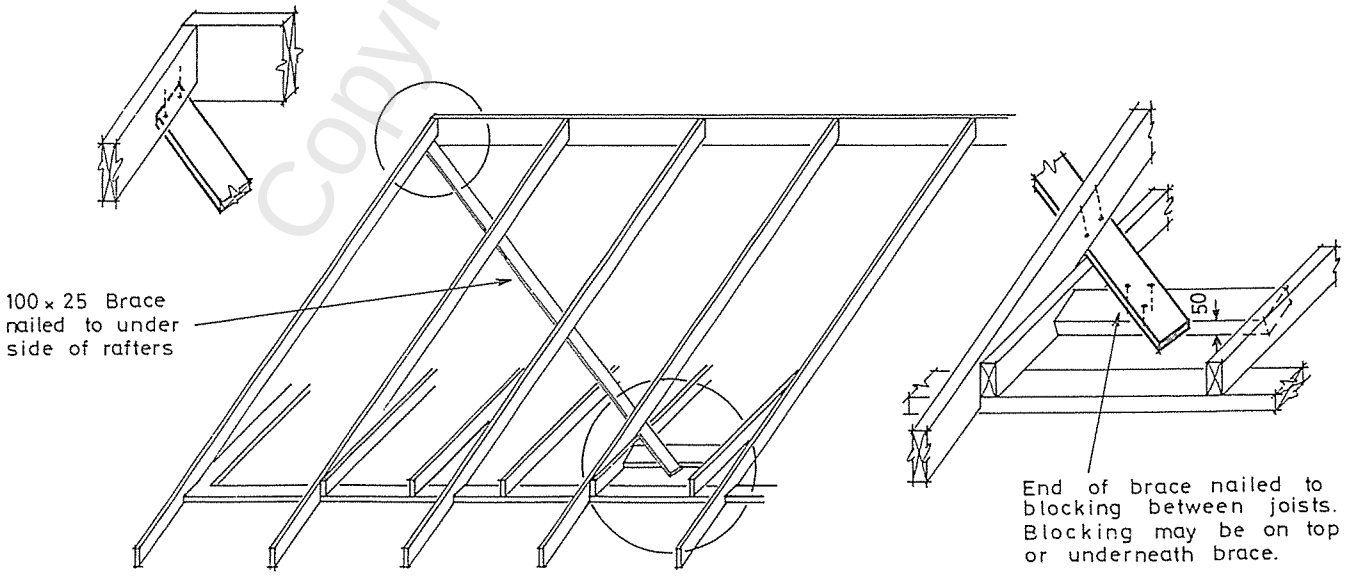


Fig. 58 : Roof plane diagonal braces

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 100 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;

(b) Spaced not more than board width apart;

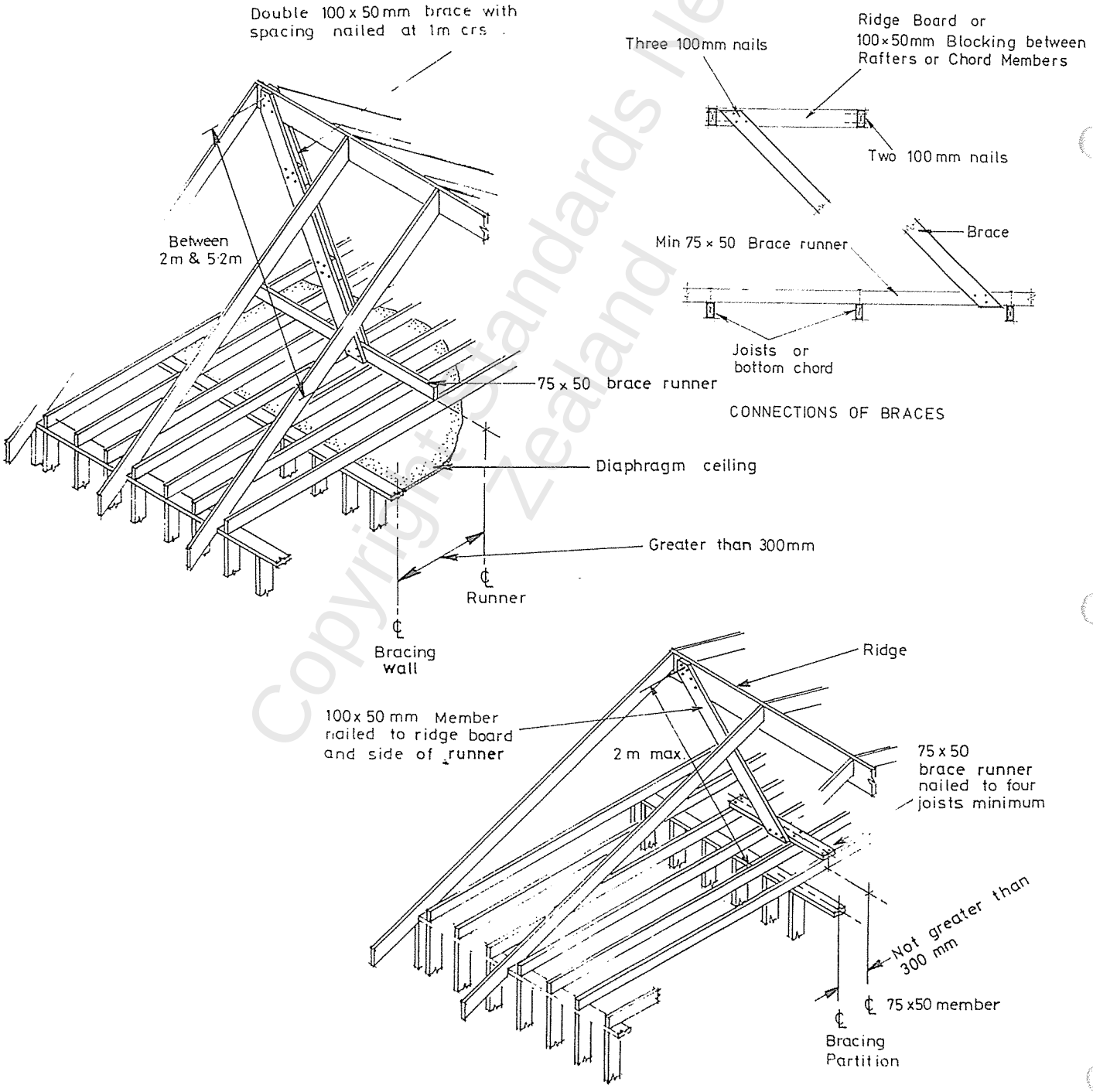


Fig. 59 : Roof space diagonal braces

(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.

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
	1200	100 x 50 on flat 100 x 50 on edge
B Heavy roof:		
450	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

10.6.4 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

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 282* 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 11.8 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 absorbancy 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 x 100 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 run horizontally;

(b) Be lapped not less than 75 mm at joins, with the upper sheet lapped over the lower sheet;

(c) Be adequately supported at not less than 300 mm centres in either direction by galvanized wire netting or other suitable corrosion-resistant material;

(d) 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

* see list of related documents

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*.

11.4.2 Corrugated asbestos cement sheets shall be fixed in accordance with NZSR 26* to purlins spaced in accordance with clearly presented and adequate technical information supplied by the manufacturer.

11.4.3 The recommendations of NZSR 26* shall be followed in order to comply with this standard.

C11.4.3 NZSR 26 does not use the word 'shall'. Clause 11.4.3 is intended to make it clear that notwithstanding clause 1.2.1 the recommendations of NZSR 26* are to be regarded as mandatory requirements for the purposes of 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.*

* 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 strutting 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 strutting 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: general

12.2.2.1 The framing timbers required by clause 12.1.1 for the support of ceiling linings under framed roofs shall be any of the following or any combination of them:

(a) Ceiling joists complying with clause 10.3.4;

(b) Rafters complying with clause 10.3.2 (see especially clause 10.3.2.8);

(c) 75 mm x 50 mm solid strutting as shown in fig. 60 at not more than 900 mm centres and spanning between ceiling joists or rafters.

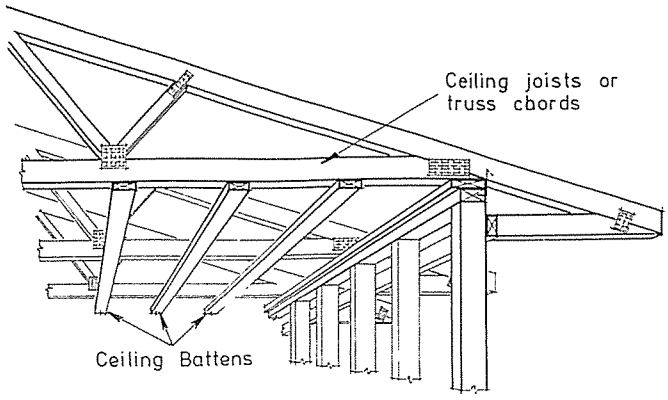
12.3 OPENINGS IN CEILINGS

12.3.1 Access to ceiling spaces shall be provided through clear openings not less than 600 mm x 500 mm.

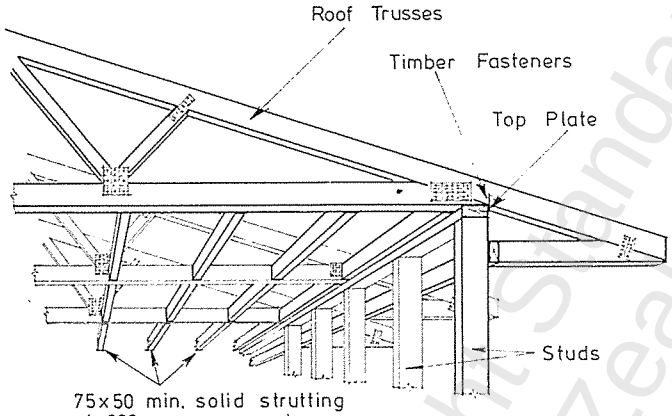
12.3.2 Openings in ceilings shall be bounded by trimmers and trimming joists.

12.3.3 Trimmers shall be the same depth as the curtailed ceiling joists and:

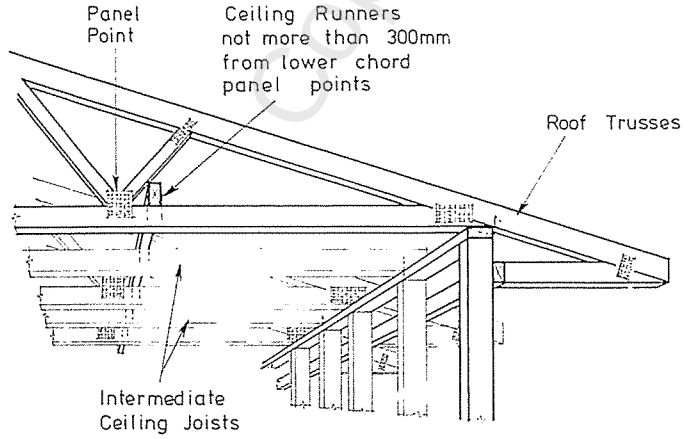
(a) Trimmer spans not exceeding 1.2 m: The same thickness as the curtailed joists;



CEILING BATTENS



SOLID STRUTTING



INTERMEDIATE JOISTS

Fig. 60 : Ceiling lining supports

(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 1.2 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 at ceiling joist level in the roof space for the purpose of supporting a water-supply tank not exceeding 200 litres capacity shall be centred over a loadbearing wall.

12.4.2 As shown in fig. 61 platforms supporting water tanks at ceiling joist level shall:

(a) Be constructed from 50 mm thick timbers laid on their flat and fixed to ceiling joists;

(b) Be provided with cleats of 50 mm thick timber fixed to each corner to prevent sliding of the tank.

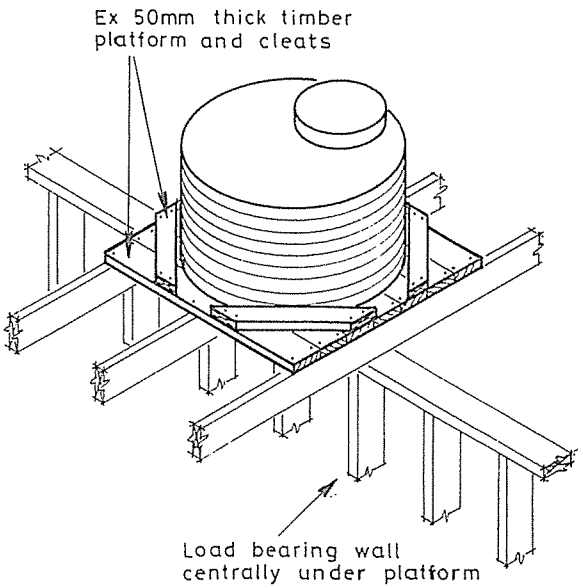


Fig.61 : Platforms in the roof space

12.5 STRUCTURAL CEILING DIAPHRAGMS

12.5.1 Ceiling diaphragms required to comply with clause 6.3.5.1 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 1800 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 10 mm from sheet edges.

12.5.2 Ceiling lining material for ceiling diaphragms shall be:

(a) For diaphragms not steeper than 25° to the horizontal and not exceeding 15 m long under light 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 12.5.2 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.

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 100 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.

* 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)
Boundary 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
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		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	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	100 x 3.75	2
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:	60 x 3.15	
(a) Plates		3
(b) Studs		1
Cut-between timber brace to stud	75 x 3.15	2 (skewed)
Sheet material used with diagonal bracing to:	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 to top plate:		
(a) Light roof in high wind areas where:		
(i) The rafter span exceeds 3 m, or	100 x 3.75 plus wire dogs	2 (skewed) 2
(ii) The rafter spacing exceeds 900 mm		
(b) Light roof in medium wind areas where rafters are spaced at 1200 mm and rafter span exceeds 3 m.	100 x 3.75 plus wire dogs	2 (skewed) 2
(c) 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 to rafter	75 x 3.15	4
Underpurlin to rafter	100 x 3.75	2 (skewed)
Flitches to ridge board and roof members from each side and on both sides of joint	60 x 2.8	2
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 roofs in high wind areas	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 roofs in high wind areas	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	100 x 3.75	2
(c) 100 mm x 50 mm brace	100 x 3.75	3
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)
Jack rafter or jack truss to top plate:		
(a) Heavy roof	100 x 3.75	3 (skewed)
(b) Light roof	100 x 3.75	2 (skewed)
Sarking to rafters:		
(a) 75 mm wide	2½ x finished thickness	1
(b) Exceeding 75 mm wide	2½ x finished thickness	2
Outrigger rafter to gable top plate:		
(a) Light roofs in high wind areas	100 x 3.75	2 (skewed)
	plus wire dogs	1
(b) Other cases	100 x 3.75	2 (skewed)
Outrigger rafter 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
Purlin or batten directly (not through sarking) to rafter or top chord‡		
Locality in roof / *Maximum purlin spacing* (mm) / *Maximum rafter spacing* (mm) / *Wind area*		
Light roofs:		
Body / 1200 / 1200 / all	100 x 3.75	2 (skewed)
Edge† / 1200 / 1200 / high	100 x 3.75	2 (skewed)
	plus wire dogs	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 area*		
Heavy roofs:		
Anywhere — 1200 — 900 — all	100 x 3.75	2
25 mm thick purlins		
Body — 400 — 1200	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 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
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 120 mm² that is driven into the ground by a steel mass of 9 kg falling freely through a distance of 500 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 m² plan area with not less than one additional test site for each 100 m² 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.

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 1 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 1.8 m above cleared ground level; and

(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.

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.

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;

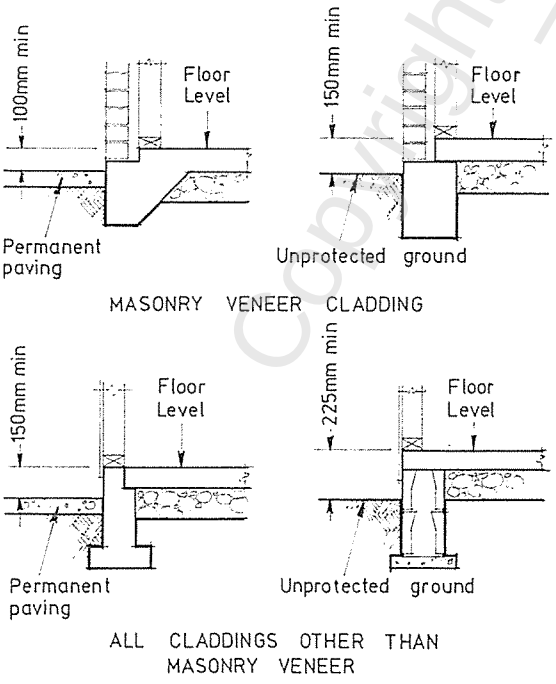


Fig. 62 : Minimum heights of finished concrete slab-on-ground floors above adjoining finished ground level

* see list of related documents

(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).

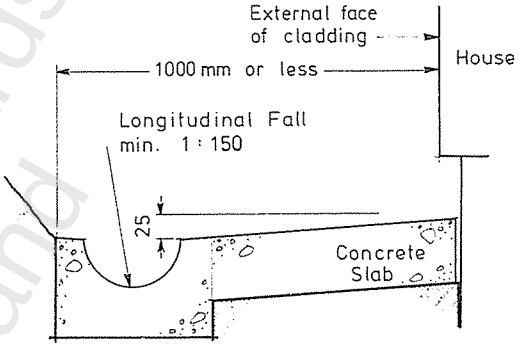


Fig. 63 : Protection of finished ground adjoining buildings with concrete slab-on-ground floors

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.*

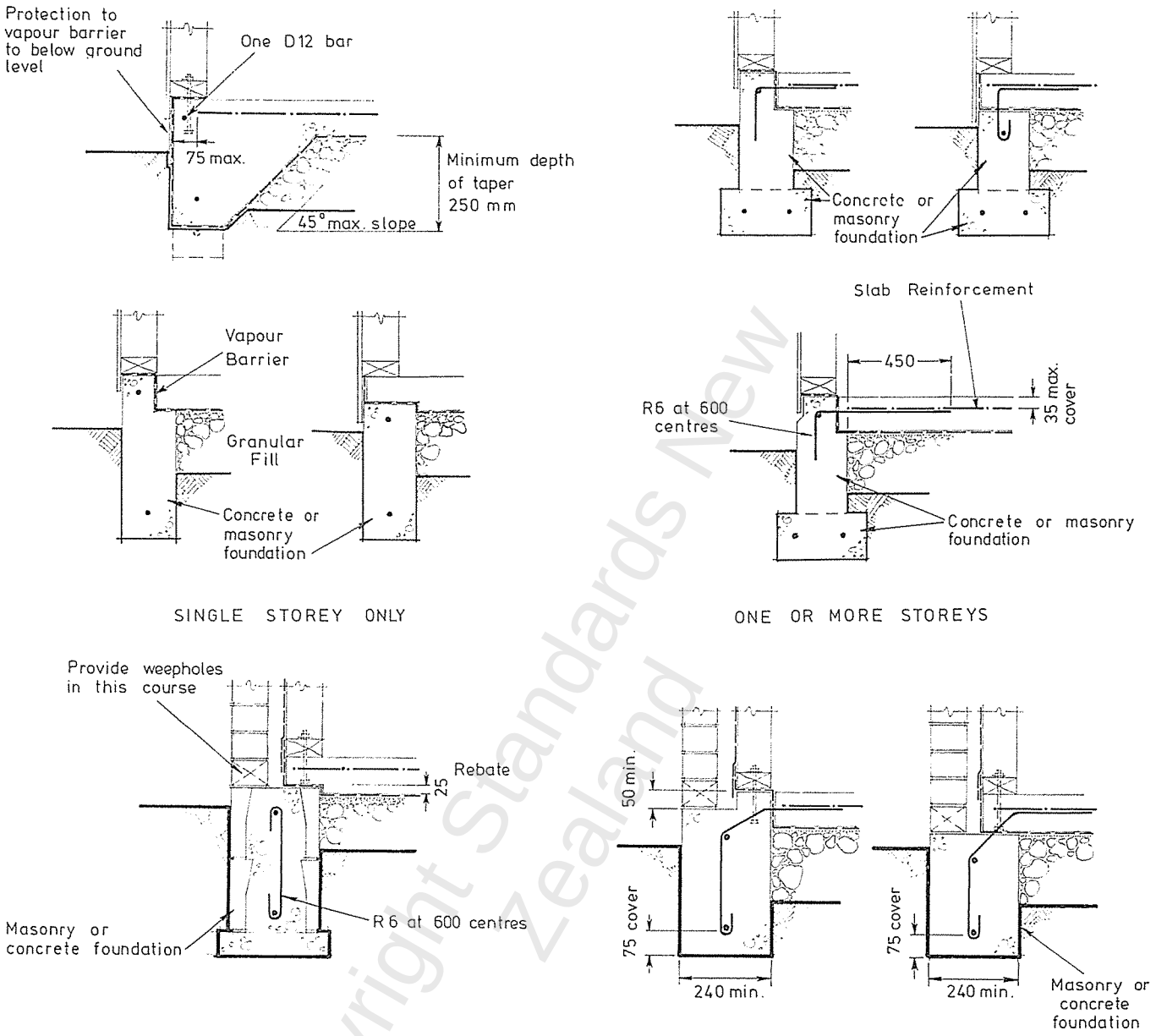


Fig. 64 : Foundation walls of concrete slab-on-ground floors

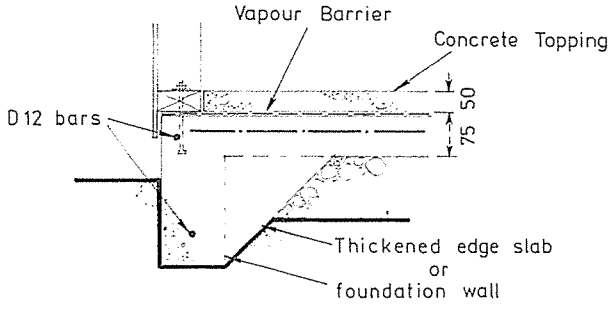


Fig. 65 : Vapour barrier laid over ground slab and protected by concrete topping

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.

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 E6.1; 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 E5.1) 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.

* see list of related documents

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.

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 plastic 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.

E11.4 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.

E11.5 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 E11.5 (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.

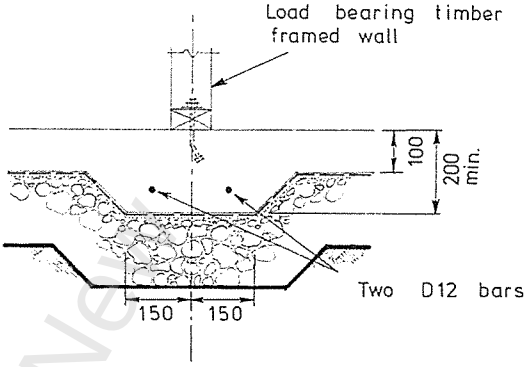


Fig. 66 : Ground slabs beneath internal loadbearing walls

E13 Fixing of timber

E13.1 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 E13.2.

E13.2 Shot-fired fasteners may be used to fix non-loadbearing 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:

(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.

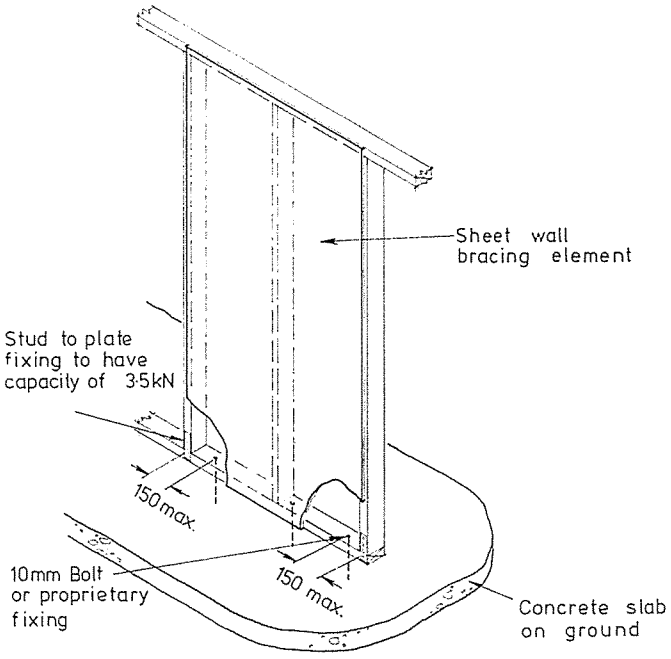


Fig. 67 : Fixing of sheet wall bracing elements to concrete slabs

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.

F2 General

F2.1 The materials and workmanship of masonry veneer shall be in accordance with NZS 1900 : 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.

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.

* see list of related documents

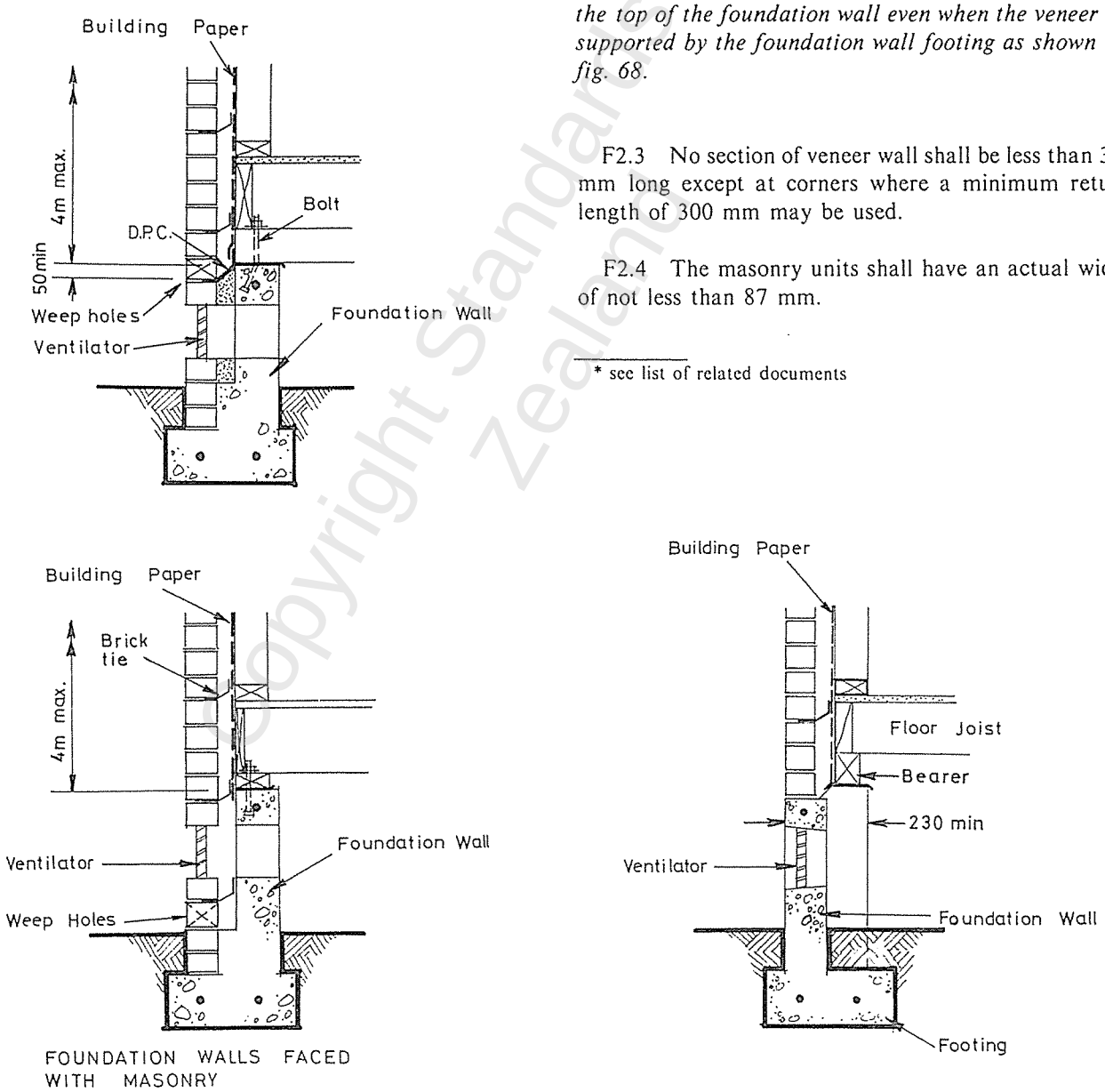


Fig. 68 : Foundation walls supporting masonry veneer

F3 Foundations

F3.1 Masonry veneer shall be supported by either the top of a foundation wall carried up to the plate or bearer supporting the floor joists, or on the footing of any such foundation wall (see fig. 68).

F3.2 Where masonry veneer is supported on the top of a foundation wall the top shall be stepped so that the surface supporting the veneer is not less than 50 mm below the surface supporting the timber framing member (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 and shall be shown by test to comply with clause F5.3.

F5.3 Wall ties shall be manufactured and fixed so as 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; 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, and wall ties of other corrosion-resistant material shall have equivalent stiffness.

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.

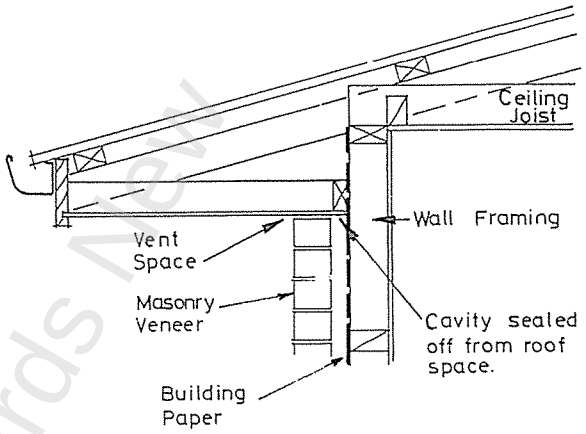


Fig. 69 : Venting and sealing of cavities between masonry veneer and timber stud walls

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.

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
2.0	102 x 76 x 6.5
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.

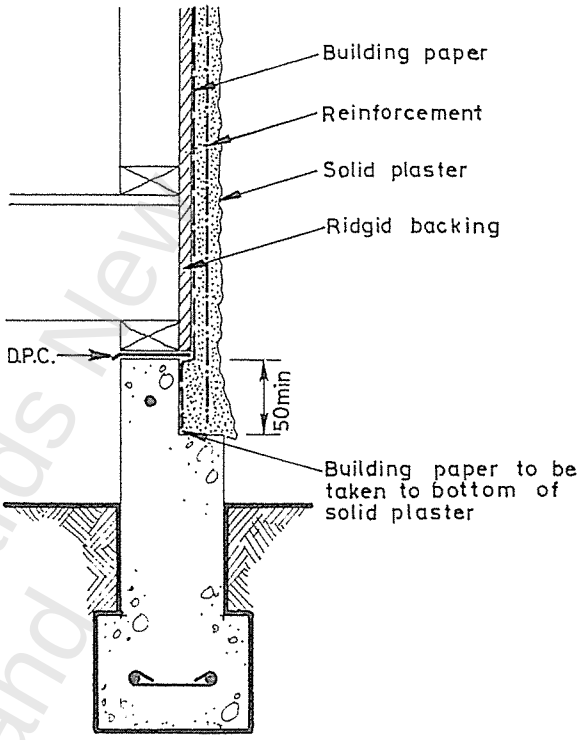
G2 General

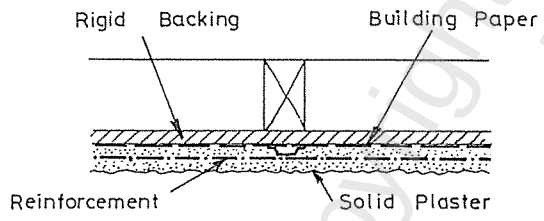
G2.1 The materials, proportions, mixes, reinforcement, and application of plaster shall comply with NZS 4251* except as specifically varied by this appendix.

G2.2 All framing and internal lining shall be completed before the finishing coat of plaster is applied.

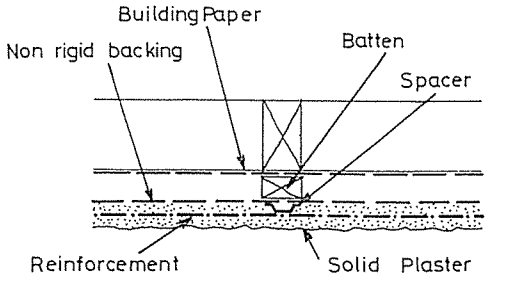
CG2.2 Vibration or jarring of external walls should be avoided from the start of plastering until curing has been completed.

* see list of related documents





RIGID BACKING DETAIL



NON-RIGID BACKING DETAIL

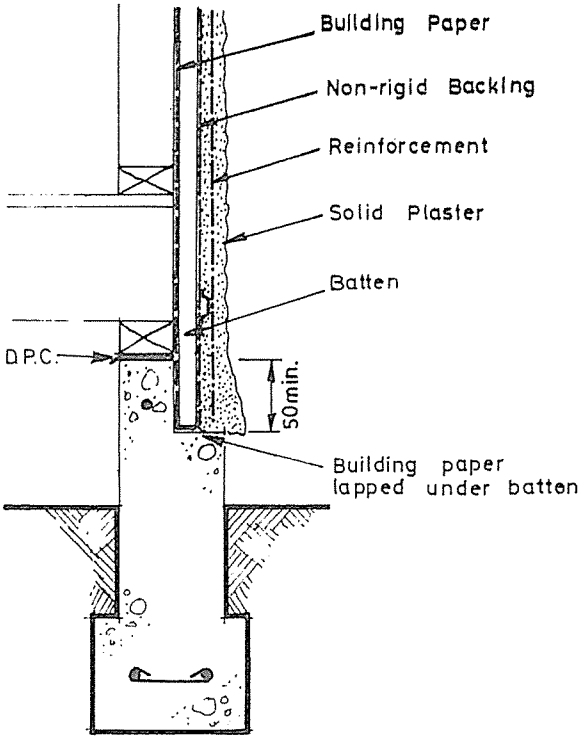


Fig. 70 : Solid plaster exterior wall coverings

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 be directly supported by foundation walls and shall be attached to timber stud wall framing.

CG2.4 Solid plaster cannot be applied to jack studs at pile spacings.

G2.5 The top of the foundation wall shall be rebated so that the surface supporting the plaster is not less than 50 mm below the surface supporting the timber framing member (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 282* and not less than 4.5 mm thick;

(c) Construction plywood complying with NZS 3614* and treated to TPA C11* and not less than 7.5 mm thick;

(d) Close boarded diagonal timber sheathing of 200 mm x 25 mm boards treated to TPA C7*.

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

H1.1 This appendix sets down requirements for 2.0 kPa and 3.0 kPa floor loads.

H1.2 This appendix applies only in conjunction with and as a supplement to the rest of this standard.

H1.3 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;

(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

(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 50
	2.00	125 x 75
	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

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	–	–	–	–

* See clause 6.4.3.

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

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.

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