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Edition 4

SOUTH AFRICAN NATIONAL STANDARD

Timber frame buildings

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Table of changes

Change No.	Date	Scope

Foreword

This South African standard was approved by National Committee StanSA SC 5120.61D, *Construction standards – Timber structures*, in accordance with procedures of Standards South Africa, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in October 2007. This document supersedes SABS 082:1988 (second revision).

Introduction

The housing shortage in South Africa could be alleviated if alternative building materials and methods were more readily used. Timber frame buildings, the traditional construction method in North America and the Scandinavian countries, offer an economical and flexible solution to both residential and non-residential needs. Timber frame buildings that were originally erected in South Africa during the late 1800s prove the durability of timber as a building material.

Timber frame buildings are very suitable for all types of building sites, especially sloping sites and those with problematic soil conditions, for example, sloping dunes. The low mass of a timber frame building and its capacity to absorb substantial movements and shocks without damage to walls, allow the use of less costly foundations. A further advantage of a timber frame building is that it can easily be extended or altered at a later stage.

The ability to prefabricate wall frames and roof trusses off-site not only reduces on-site construction time, but leads to cost reductions and a shorter period between the signing of the building contract and final payments. The need for a smaller variety of materials and tools is also an advantage.

Cladding materials other than those covered by this document are available or being developed, but it was considered advisable to include only materials that have been tested and found suitable by a recognized testing body or have been found satisfactory in service under South African conditions.

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Timber frame buildings

1 Scope

This standard covers materials and practices used in the design and construction of single-storey and double-storey timber frame buildings and portions of such buildings.

NOTE 1 When higher buildings or alternative designs are required, SANS 10163-1 or SANS 10163-2 should be consulted.

NOTE 2 Unless otherwise stated, the dimensions of timber are the nominal sizes of rough-sawn timber.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from Standards South Africa.

SANS 227, *Burnt clay masonry units.*

SANS 248 (SABS 248), *Bituminous damp-proof courses.*

SANS 266, *Gypsum plasterboard.*

SANS 298 (SABS 298), *Mastic asphalt for damp-proof courses and tanking.*

SANS 457-2 (SABS 457-2), *Wooden poles, droppers, guardrail posts and spacer blocks – Part 2: Softwood species.*

SANS 457-3 (SABS 457-3), *Wooden poles, droppers, guardrail posts and spacer blocks – Part 3: Hardwood species.*

SANS 540-2 (SABS 540-2), *Fibreboard products – Part 2: Coated fibreboard.*

SANS 678, *Primers for wood.*

SANS 681 (SABS 681), *Undercoats for paints.*

SANS 803, *Fibre-cement boards.*

SANS 820, *Mild steel nails.*

SANS 929, *Plywood and composite board.*

SANS 952 (SABS 952), *Polyolefin film for damp-proofing and waterproofing in buildings.*

SANS 1077 (SABS 1077), *Sealing compounds for the building and construction industry, two-component, polyurethane-base.*

SANS 1090 (SABS 1090), *Aggregates from natural sources – Fine aggregates for plaster and mortar.*

SANS 1349, *Phenolic, aminoplastic and one-part polyurethane resin adhesives for the laminating and finger-jointing of timber, and for furniture and joinery.*

SANS 1460, *Laminated timber (glulam).*

SANS 1504 (SABS 1504), *Prestressed concrete lintels.*

SANS 1707 (SABS 1707), *Eucalyptus brandering and battens.*

SANS 1783-1, *Sawn softwood timber – Part 1: General requirements.*

SANS 1783-2, *Sawn softwood timber – Part 2: Stress-graded structural timber and timber for frame wall construction.*

SANS 1783-4, *Sawn softwood timber – Part 4: Brandering and battens*

SANS 3575/ISO 3575 (SABS ISO 3575), *Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock-forming and drawing qualities.*

SANS 4998/ISO 4998, *Continuous hot-dip zinc-coated carbon steel sheet of structural quality.*

SANS 9933/ISO 9933, *Products in fibre-reinforced cement – Long corrugated or asymmetrical section sheets and fittings for roofing and cladding.*

SANS 10005, *The preservative treatment of timber.*

SANS 10021, *The waterproofing of buildings (including damp-proofing and vapour barrier installation).*

SANS 10043, *The installation of wood and laminate flooring.*

SANS 10109-1 (SABS 0109-1), *Concrete floors – Part 1: Bases to concrete floors.*

SANS 10109-2, *Concrete floors – Part 2: Finishes to concrete floors.*

SANS 10124, *The application of soil insecticides for the protection of buildings.*

SANS 10142-1, *The wiring of premises – Part 1: Low-voltage installations.*

SANS 10160 (SABS 0160), *The general procedures and loadings to be adopted in the design of buildings.*

SANS 10161 (SABS 0161), *The design of foundations for buildings.*

SANS 10162-1, *The structural use of steel – Part 1: Limit-states design of hot-rolled steelwork.*

SANS 10162-2 (SABS 0162-2), *The structural use of steel – Part 2: Limit-states design of cold-formed steelwork.*

SANS 10163-1, *The structural use of timber – Part 1: Limit-states design.*

SANS 10163-2 (SABS 0163-2), *The structural use of timber – Part 2: Allowable stress design.*

SANS 10237 (SABS 0237), *Roof and side cladding.*

SANS 10243, *The manufacture and erection of timber trusses.*

SANS 10249 (SABS 0249), *Masonry walling.*

SANS 10400 (SABS 0400), *The application of the National Building Regulations.*

SANS 50312-5/EN 312-5 (SABS EN 312-5), *Particleboards – Specifications – Part 5: Requirements for load-bearing boards for use in humid conditions.*

SANS 50312-7/EN 312-7 (SABS EN 312-7), *Particleboards – Specifications – Part 7: Requirements for heavy-duty load-bearing boards for use in humid conditions.*

3 Definitions

For the purposes of this document, the following definitions apply.

3.1
acceptable
acceptable to the authority administering this standard, or to the parties concluding the purchase contract, as relevant

3.2
beam
structural member that supports transverse loads and that is subject to flexural stresses

3.3
bottom plate
horizontal side-framing member, attached to the studs and secured on top of a sole plate or to the subfloor

3.4
cladding
material that forms the exposed covering of external walls
See also **lining** (3.9)

3.5
competent person
person who is qualified, by virtue of his experience and training, to make a determination regarding the performance of a building or part thereof in relation to a functional regulation

3.6
composite board
board that consists of plies glued as cross bands to each side of a core of solid timber or particleboard

3.7
fire stop
length of timber or other acceptable material used in concealed air spaces to prevent flames from extending up or across a cavity

3.8
joist
structural member that is used for the primary support of floorboards and ceilings, and that is subject to flexural stresses

3.9
lining
material that forms an interior surface covering
See also **cladding** (3.4)

3.10
nogging
short length of timber used between studs for stiffening purposes and for the attachment of sheetings and linings

3.11
permanent building
structure in which people live, work or play or in which animals are accommodated or in which goods are preserved, manufactured, processed, stored or sold; as well as a bridge, cooling tower, water tank tower, watch tower, pylon, waterworks or similar structure

3.12
sheathing
material that is fastened directly to the wall stud and that forms a base to which the cladding is attached

3.13
sheathing membrane
layer of material that is highly resistant to penetration by moisture but not by air, is either a plastics material or paper treated with tar or asphalt and is used between the exterior wall cladding and the sheathing as protection against the passage of water

3.14
sole plate
horizontal side-framing member that rests directly on a foundation wall, foundation beam or floor slab

3.15
structural timber
all timber which forms part of a permanent building or which is destined to form part of a permanent building, for example, roof structures, frame-wall construction, flooring, panelling, window frames, door frames, suspended wood floors, foundation structures, decks, stairs and railings

3.16
stud
vertical timber member of rectangular cross section that is intended for use as a concealed framing member or supporting element in a wall or partition

3.17
subfloor
lower layer of timber or concrete flooring to which the wearing surface is attached

3.18
timber frame building
building in which the load-bearing structure is of timber, in the form of wall framing, columns, beams, trusses or any combination of these

3.19
top plate
horizontal side-framing member attached to the tops of the studs

3.20
truss
triangulated combination of members and joints which, when fitted together, form a rigid structural component capable of withstanding loads

3.21
wall plate
horizontal member attached to a top plate

4 Structural timber

4.1 Introduction

Timber is a very versatile building material and it is widely used by all sectors of the building and manufacturing industries. As timber is a readily available, renewable national resource, the increased use of timber should be encouraged. The successful execution of any project depends on the knowledge of timber as a structural material acquired by the builder.

The quality of all materials used shall, wherever standards exist, comply with the requirements of the relevant standard. In the absence of a standard, proof of the quality and performance of the material shall be established by means of tests or by reference to existing structures.

4.2 Sizes

4.2.1 Dimensions of SA Pine structural timber

The dimensions of pine structural timber available in South Africa are given in table 1.

Table 1 — Dimensions of SA Pine structural timber

Dimensions in millimetres

1		2	
Nominal dimensions		**Minimum rough-sawn dimensions**	
Thickness	**Width**	**Thickness**	**Width**
38	38	36	36
38	50	36	48
38	76	36	73
50	50	48	48
50	114	48	111
76	152	74	149
76	228	74	225

4.2.2 Nominal dimensions of SA Pine Stocklam

Thickness, mm:	32, 45, 70, 100 and 145
Width, mm:	100 to 600 in increments of 33,3
Thickness of each lamination, mm:	33,3

4.2.3 Non-standard sizes

When the dimensions of timber are non-standard, the actual measured sizes for design should be used in all cases.

4.3 Machining

All timber shall be of the correct shape and size as specified in the design. Pieces which are damaged or no longer comply with the appropriate grade requirements of SANS 1783-2 and SANS 1460, or any other relevant standard specified by the designer, shall be rejected unless the structural strength is proven to be acceptable.

Surfaces at any joint in an assembly shall be such that the components may be brought into contact over the whole area of the joint before the fasteners are inserted or any pressure or restraint from the fastener is applied. The surfaces shall have an acceptable sawn or planed finish. Butt joints, formed with nail plates, shall have a close fit in compression, with a gap of not more than 1 mm. For a member under tension, the gap shall not exceed 3 mm.

Where notches in locations other than at the ends of the beams are specified by the designer, they shall be formed by parallel drilled holes within the notch area. For narrow notches, the diameter of the hole shall be equal to the width of the notch.

When splitting of a member, due to moisture ingress or egress, is likely to occur after machining, it should be effectively treated with a durable sealant. Where treated timber is used, all cuts, holes, etc., shall be locally treated using the same treatment. Where holes are required for bolts, these shall, if possible, be drilled at the manufacturer's factory.

4.4 Stress grades

All structural timber members used shall be legibly marked in compliance with SANS 1783-2. The marking on timber is an indication of the stress grade, in megapascals, according to which a member can be designed. Stress grades describe the combined effect that species and quality will have on the strength of a timber section, and are given in SANS 1783-2.

4.5 Use of graded structural timber

The builder and also the engineer or authority supervising the project shall at all times be satisfied that the timber used is of the quality specified. Only timber that is stress-graded in accordance with SANS 1783-2 or SANS 1783-4, shall be used in structural applications.

4.6 Seasoned timber

Only seasoned timber shall be used in structural applications. Timber is seasoned when the maximum moisture content within any cross section does not exceed 17 % (in accordance with SANS 1783-1).

4.7 Preservative treatment of timber

4.7.1 General

SANS 10400 requires that all timber be treated against termites, woodborer attack and fungal decay. Treatment shall be in accordance with SANS 10005, and the local authority may require proof of such treatment.

4.7.2 Cutting after preservation

Where timber which has been treated with preservatives is subjected to cutting and drilling to any extent, the cut and drilled surfaces shall be treated with the same preservatives by brushing or spraying. The preservation of the cut ends of poles is vital to the lifespan of the poles and an untreated pole shall never be put in the ground.

4.7.3 Working timber on site

When working timber on site, particular care shall be taken to ensure that sawdust, timber off-cuts, etc., which could provide a source of nourishment for fungi, termites and borers, are not left on the site or beneath suspended timber floors.

4.8 Fire retardants

NOTE No building can ever be completely fireproof because most fires are caused by the combustible contents of the property. Proper design, effective evacuation procedures and proper use of fire-retarding materials cannot make a building fireproof, they can only render a building fire-safe. Although timber is a combustible material, it has properties that provide temporary structural integrity even under extreme temperature conditions.

Housing timber can be treated with high pressure impregnated fire retardants. However, in the case of exposed timber, these chemicals can leach out of the timber. The following points shall therefore be taken into account:

a) Leaching can be reduced by normal painting of the timber.

b) The effectiveness of the weathering resistance provided by Copper-Chrome-Arsenic (CCA) is reduced when the timber is also treated with a fire retardant.

c) Ammonium sulfate is corrosive to any steel fittings, including nails. Fire-retarding formulations should therefore not contain ammonium sulfate when used for the treatment of housing timbers.

d) Intumescent paint, which provides enhanced fire resistance, can be applied to the timber.

4.9 Transportation, storage and erection

Due to the nature of the material, special care shall be exercised in the handling and transportation of manufactured components. All materials and assemblies shall be protected from water, especially during the rainy season. Care shall be taken when loading and unloading timber structure components to prevent damage. Special care needs to be exercised when hoisting from the horizontal to the vertical position to avoid distortion of the structural elements. When in doubt, advice and guidance on lifting procedures shall be sought from the designer.

Where storage before erection is necessary, all timber shall be kept well clear of the ground. The timber shall also be kept dry and ventilated. Long and flexible components, such as trusses, may best be stored flat on timber or other bearers spaced closely enough to prevent distortion. During erection, full attention shall be given as required, and especially to bracing.

5 Site preparation

5.1 Cleaning of the site

Before any structure is erected on the site and before any foundations are laid, the area to be covered by the building shall be cleared of all vegetation (stumps, roots, logs, etc.), debris, refuse and any material contaminated with faecal matter.

5.2 Water

Where the proposed site for the erection of a building is water-logged or saturated, or where a building will be so situated that water will drain towards it, acceptable drainage shall be provided to direct such water away from the building so that there will be no adverse effect on the soil supporting the building. Decay in timber structures can be prevented if the moisture content of members is kept below 20 %.

5.3 Termite control

The site shall be thoroughly investigated for evidence of termite infestation and acceptable measures shall be taken to eradicate any colonies found, for example, by excavation of a colony or by the use of toxic smoke. This may be followed by the local application of a soil poison, in accordance with the relevant requirements of SANS 10124. Where toxic smoke applicators are not available, liquid fumigants, such as petrol, carbon disulfide and solvent naphtha, may be used.

NOTE The above-mentioned liquid fumigants are, in general, not as effective as toxic smoke. Methods of eradication, such as the removal of the queen, fumigation with calcium cyanide, the introduction of automobile exhaust fumes and flooding the nest with water, are completely unreliable and should not be used.

Ground water can interfere with soil-poisoning operations. If the soil is very wet, the poison will not be absorbed properly and will be carried away with the surface run-off water.

When dry, the ground shall be sprayed with only enough water to absorb the chemical and the site shall be kept well drained. The surface shall not be disturbed once it has been treated.

6 Construction

6.1 General

The only construction methods acceptable with reference to this standard are port and beam construction, platform construction and balloon construction.

The timber sizes, methods of attachment and types of materials to be used are described in this clause. Where sizes other than those in this clause are used, the structure shall be designed in accordance with the relevant part of SANS 10163.

The prefabrication or construction of frames on site and the use of factory-made units (such as complete wall panels) might, however, be economically viable. Where such units are used, the resulting structure shall comply with the recommendations for in-situ construction. Where deviations in detail occur, the structure shall have at least the same performance as that which would be obtained in the type of construction required. In addition, the design shall be such that the units are able to withstand the stresses imposed during transportation from the factory to the site and during erection.

Figures 1 to 60 are more or less arranged in the sequence that a designer would refer to during the design stage.

6.2 Substructures

6.2.1 Excavations for strip foundations

All excavations for a foundation shall be in accordance with SANS 10161. Before the commencement of any design work, the building site shall be investigated to ascertain the subsoil condition. The extent of the site investigation depends on a number of factors, for example, information available (previous investigations of surrounding areas), and the type of building to be erected.

Unless a foundation is placed on solid rock, the bottom of the foundation shall be at least 300 mm below natural ground level. The base of all excavations in ground other than rock shall be horizontal except that, where such a base is in the form of steps, the steps shall have horizontal and vertical surfaces.

Where a foundation is placed on solid rock, the bearing area shall be cleaned and, where necessary, so stepped or dowelled as to prevent lateral movement of the foundation.

6.2.2 Foundations

The general considerations for the foundation design and the detailed requirements for the construction of foundation footings as set out in the relevant part of SANS 10400 shall be adhered to for structures carrying light or heavy roofing. For other applications, the necessary design information shall be determined from SANS 10161. (See table 2 for foundation widths, table 3 for foundation heights, table 4 for footings to timber building stumps and table 5 for the maximum stump spacing.) (See figure 19.)

NOTE 1 Heavy roof construction is any roof structure with a mass greater than 250 N/m^2, but less than 800 N/m^2.

NOTE 2 Light roof construction is any roof construction with a mass less than 250 N/m^2.

Table 2 — Foundation width for timber frame buildings

1	2	3	4	5
Supporting ground (see SANS 10161)		**Foundation width** mm		
Type	**Class**	**One storey**	**Double storey**	**Double storey with a suspended ground floor**
Rock	1 – 3	The greater of 250 or the thickness of the wall		
Non-cohesive soils	4 – 6 7	250 400	300 600	– 400
Cemented soils	9	The greater of 250 or the thickness of the wall		
Cohesive soils	11 – 12 13 14 15	250 300 450 600	– – 300 350	– – 400 450

6.2.3 Foundation walls

6.2.3.1 Foundation walls that support load-bearing walls shall, in the case of heavy construction, be at least 190 mm thick when constructed of masonry or unreinforced concrete with 10 MPa min. strength, and be at least 150 mm thick when constructed from reinforced concrete, provided that the foundation walls are designed in accordance with SANS 10161. Walls of solid masonry or solid plain concrete, and reinforced concrete foundation walls of less than 1,5 m in height need only be checked for overturning or sliding.

6.2.3.2 To ensure acceptable anchorage of buildings against the effects of wind uplift, the minimum height of a foundation wall shall be in accordance with one of the options set out in table 3, which applies to all types of terrains in the regions given in figure 1. Where a building site located in Regions B or C is exposed to the wind, construction details may also be as required by a qualified structural engineer.

If the foundation walls exceed 1,5 m in height, they shall be regarded as normal external load-bearing walls and shall be designed accordingly.

NOTE Where a minimal height of foundation wall is required, it may be necessary to anchor the brickwork to the strip footing in order to ensure acceptable anchorage. Table 3 (see also 6.2.3.6) provides requirements for a masonry foundation wall and figure 2 shows the recommended construction details.

6.2.3.3 In the case of double-storey buildings, the thickness of masonry walls or unreinforced concrete foundation walls shall be at least 190 mm. Where foundation walls are subjected to excessive horizontal forces resulting from soil pressure or the effects of compaction or fill, care shall be taken in the design to prevent overturning, displacement or any other form of instability.

6.2.3.4 The cross-sectional area of masonry or concrete piers for external walls and for post construction and beam construction shall be at least 53 000 mm^2 (230 mm × 230 mm), and for sleeper piers approximately 36 000 mm^2 (190 mm × 190 mm). No pier may extend above ground level by more than four times its smallest dimension, and this dimension shall be at least 190 mm.

6.2.3.5 Proper anchorage (see table 3) at the base of the wall shall be provided according to the geographic location of the structure (see figure 1). Acceptable construction details are shown in figures 2, 3, 4, 5, 19, 20, 21, 22 and 44. Anchorage requirements are given in table 3. The anchors shall be located close to the intended stud positions, and comply with the following requirements:

a) Roof pitches that exceed 30°:

   No specific requirement.

b) Roof pitches up to 30°, except light roof construction with pitches less than 15°:

   Anchors shall be within 50 mm of the intended stud position. When an anchor falls between the studs, the stud on either side of the anchor shall be fixed to the bottom rail of the frame by means of galvanized (preferably stainless steel) perforated steel strapping to obviate the sheathing of the frame, if required.

c) Light roof construction with roof pitches less than 15°:

   Anchors shall be placed immediately adjacent to studs, or alternatively, anchor straps may be nailed directly to studs.

   Anchor straps shall be of steel, galvanized in accordance with SANS 3575 or SANS 4998, or stainless steel. About a 50 mm portion of galvanized strap on either side of the point of emergence from the foundation masonry or concrete shall be coated with an acceptable bituminous paint.

6.2.3.6 Expanding bolts (see table 3) shall be of sufficient length to be anchored to the main pour of the concrete and not to the surface screed and shall be installed in accordance with the manufacturer's recommendations with respect to edge distances, required torque, etc. Expanding bolts shall not be anchored in the masonry.

Access to the underfloor space for inspection purposes shall be provided by means of traps or openings in the floor. Such openings in external walls shall be fitted with doors that will exclude rain, termites (in their flying stage), reptiles and vermin. To allow access to all portions of the underfloor space, openings shall be left in appropriate internal foundation walls. Where the area of the space under a combustible floor exceeds 300 m^2, it shall be divided by walls in accordance with the relevant part of SANS 10400.

Damp-proof courses that comply with the relevant requirements of SANS 248, SANS 298 or SANS 952 or are the subject of a current Agrément certificate, shall be provided on all foundation walls, between timber sole plates or bearers and any masonry or concrete work, and under posts on pedestals. Where screeds are laid, a turn-up shall be provided to protect the adjacent timber.

Where timber beams (other than joists) are framed into masonry or concrete foundation walls, the pocket shall be lined with damp-proofing material. The beams shall have a bearing length of at least 90 mm, and a clearance of at least 10 mm shall be provided between the end of the beam and the pocket formed in the wall. Alternatively, the beam may be supported on a concrete or masonry pier on a layer of damp-proofing material, as shown in figure 5.

Table 3 — Minimum height of foundation wall and anchorage

Dimensions in millimetres

1	2	3	4	5	6	7	8	9
Roof slope	Geographic region	Height of foundation wall				Anchorage		
		190/220 walling		290/330 walling		Strap	Bolts	
degrees	(see figure 1)	Timber floor	Concrete floor	Timber floor	Concrete floor	30 × 1,6	6	8
Lightweight cladding and light roof construction						**Spacing of anchors**		
< 15	A	660	250	500	250	1 200	700	1 200
	B	1 080	580	750	420	900	600	1 200
	C	1 500	1 000	1 080	660	700	500	1 000
15 – 30	A	500	250	330	250	1 200	1 000	1 200
	B	660	250	420	250	1 200	800	1 200
	C	1 080	580	750	250	1 000	800	1 200
> 30	A and B	250	250	250	250	1 200	1 200	1 200
	C	420	250	330	250	1 200	1 200	1 200
Lightweight cladding and heavy roof construction								
< 15	A	250	250	250	250	1 200	1 200	1 200
	B	500	250	330	250	1 200	1 200	1 200
	C	660	250	500	250	1 000	700	1 200
> 15	All	250	250	250	250	1 200		
Brick veneer cladding and light roof construction								
< 15	A and B	250	250	250	250	Similar to lightweight cladding		
	C	580	250	500	250			
All	All	250	250	250	250			
Masonry veneer cladding and heavy roof construction								
All	All	250	250	250	250	1 200		

NOTE 1 These values apply to single-storey and double-storey constructions as differences in requirements for single-storey or double-storey buildings are negligible because the higher mass of a double-storey building is largely countered by the higher wind loads that apply to the taller building.

NOTE 2 For practical reasons, a minimum height of 250 mm should be allowed for between the top of strip footings and the damp-proof course.

NOTE 3 In built-up areas the height may be reduced by 75 mm and the anchor spacing may be increased by 100 mm.

6.2.4 Foundations and foundation walls for elevated timber frame buildings

6.2.4.1 On sloping sites, especially for smaller houses, it is practical and feasible to use timber poles for bases. Although the spacing of stumps (or posts) shall be determined by the dimensions and make-up of the bearer and its ability to minimize the deflection when loaded with floor joists, etc., recommended footing sizes and stump spacing are given in tables 4 and 5. These data are based on an allowable foundation bearing pressure of 100 kPa, which is generally considered to be a safe average.

Table 4 — Footings to timber building stumps

1	2	3
Minimum stump section pole (Ø) or section size mm	**Minimum bearing area** mm^2	**Recommended sizes for mass concrete footings** mm
110 Ø 120 Ø, 140 Ø, 180 Ø 114 × 114/152 × 152 190 × 190	45 000	230 × 230 × 100 250 Ø × 100
	90 000	300 × 300 × 150 350 Ø × 150
	120 000	350 × 350 × 200 400 Ø × 200
152 × 152 190 × 190 180 Ø, 200 Ø	180 000	500 × 500 × 200 500 Ø × 200

Table 5 — Maximum stump spacing

Dimensions in millimetres

1	2	3	4	5	6	7
Type of roof	**Footing type**	**Maximum spacing**				
		Rafters		**Span of truss**		**Other than under load-bearing walls**
		Ridge strutted	**Ridge not strutted**	**6 000**	**9 000**	
Light roof construction	A	1 900	1 600	1 400	1 200	2 000
	B	3 800	3 200	3 000	2 500	4 100
	C	5 000	4 200	3 800	3 200	5 800
	D	7 600	6 400	6 000	5 000	8 200
Heavy roof construction	A	1 400	1 000	1 000	[a]	2 000
	B	2 000	2 100	1 900	1 500	4 100
	C	3 600	2 700	2 500	2 000	4 800
	D	5 600	4 300	3 800	3 000	8 200
[a] Not acceptable						

6.2.4.2 Timber posts shall comply with SANS 457-2 or SANS 457-3, and shall have a cross-sectional area of at least 9 500 mm^2 (110 mm diam.) when they are to support a floor and load-bearing walls, and at least 7 500 mm^2 (100 mm diam.) when they are to support a floor and non-load-bearing walls. When the height above ground level of a post exceeds 1 m, the post shall be designed as a column. Posts shall be fixed as shown in figures 3 and 4.

6.2.4.3 The poles shall be pressure-treated, or dip-treated, against insect infestation, termites and fungal attack in accordance with SANS 10005. Preservatives shall not be applied by brushing. Holes drilled for bolts shall be surface-treated.

NOTE It is standard practice to notch the top of the pole to the thickness and width of the bearer. A threaded rod, 12 mm in diameter, washers and nuts are commonly used. The rod and components may either be galvanized or stainless steel, as required.

An end of a pole on which notching and cutting has been carried out shall not, under any circumstances, be put into the ground before it is brush-treated with a preservative and sealed.

6.2.4.4 The posts of timber foundations shall be cut to the exact length before use and the freshly-cut surfaces preservative treated.

The layout of the stumps (pole foundations) shall be determined by taking into consideration the support required for floor joists, and the maximum spacing distances given in tables 6 to 9. The spacing of stumps under bearers parallel to walls shall not exceed 1 800 mm. The posts of timber foundations shall be cut to the exact length before use and freshly-cut surfaces shall be preservative treated as described in 4.7. Typical examples of foundation post footings and concrete surface beds are given in figures 3 and 4.

Fibre-reinforced cement stub columns shall have a minimum diameter of 200 mm when they support a floor and load-bearing walls. When the height of a fibre-reinforced cement pipe exceeds 1,0 m above ground level, the pipe shall be designed as a column with acceptable reinforcing and concrete fill.

6.2.4.5 Particular care shall be taken when working with timber on site, to ensure that sawdust, timber off-cuts, etc., which could provide a source of nourishment for fungi, termites and borers, are not left on the site or beneath suspended floors.

6.2.5 Termite and ant capping

If wood-devouring termites are prevalent in the locality where a new building is to be erected, the sole plate shall be protected against their attack by being elevated at least 450 mm above the ground on a foundation wall, or by piers of brick or concrete being laid in high quality mortar.

An ants shield shall be provided on both sides of the sole plate to prevent access. Attention shall be given to the quality of the bricks, concrete and mortar, as termites can burrow through poor quality mortar or porous concrete. In spite of all precautions, inhabitants should be aware of the problems posed by termites. If termites are observed in the immediate vicinity, the site shall be inspected, and depending on the findings, the site might need to be treated again.

6.3 Floors — Concrete, timber and finishes

6.3.1 General

Where the floor is placed on a concrete base, the method of laying and the finish shall be similar to those used in conventional masonry construction and shall be in accordance with SANS 10109-1 and SANS 10109-2. Any service pipes and cables that penetrate a concrete floor slab on solid ground or filling shall be in position before the floor is cast. A gap shall be left around each pipe or cable and, after the slab has been cast, the gap shall be filled with bitumen or pitch. Wherever possible, services shall be brought vertically through the slab.

Where the floor is of timber, the framing shall consist of posts or piers, sole plates, beams, joists and (when used) a subfloor, except that masonry or concrete foundation walls may be used in place of beams and posts or piers.

6.3.2 Insulation requirements for concrete floors on the ground

Floor insulation is not commonly used, but can vastly improve the thermal performance of the building unit at comparatively low initial costs. To prevent heat loss through the floor, the installation of perimeter insulation is recommended. The thickness of the material to be used depends on the climate and the type of material used. The insulation values of materials vary from product to product and installation shall be in accordance with the manufacturer's recommendations.

Properties of the materials which shall be taken into consideration are

a) high resistance to heat transmission,

b) permanent durability when exposed to damp conditions and frost,

c) resistance to crushing or tearing due to floor loads,

d) fire resistance, and

e) rodent resistance.

6.3.3 Concrete surface bed

6.3.3.1 The area that is to contain the concrete surface bed shall be levelled and well compacted to 90 % Mod AASHTO OMC in 150 mm layers, and any additional filling up to the required level of the underside of the concrete surface bed shall consist of inert material, such as clean coarse sand, graded crushed stone or hard clinker ash applied in well-compacted layers of thickness not exceeding 150 mm. The area within the foundation walls shall be covered with a damp-proofing polyolefin membrane at least 250 µm thick, or materials which have been certified by Agrément SA as fit for purpose, and this membrane shall be laid under the surface bed (see figure 23) so as to provide a complete seal against ground moisture, and it shall be turned up around the perimeter of the slab for the full thickness of the surface bed. For a complete seal against ground moisture, the membrane shall be turned in to overlap the damp-proof course by at least 50 mm, or run under the timber sole plates. Any joint in the membrane shall have an overlap of at least 100 mm and be effectively sealed. Special care shall be taken to ensure that the damp-proofing membrane is not punctured.

6.3.3.2 The concrete used for an unreinforced slab shall have a characteristic compressive strength of at least 10 MPa at 28 d, and the thickness of such a concrete surface bed shall be at least 75 mm. However, in cases where light superstructures are to be attached to concrete, the characteristic compressive strength of the concrete shall be 15 MPa. To limit cracking due to shrinkage in a slab that is not subdivided into small panels by internal foundation walls, as is often the case in conventional masonry construction, the concrete surface bed shall be reinforced with light steel mesh, placed 20 mm to 30 mm below the top surface of the slab. Interior, non-load-bearing timber frame walls may be supported directly on the concrete slab. Internal masonry walls shall be supported on conventional brick foundation walls and concrete footings or on a thickened slab.

6.3.3.3 The finished floor level shall be high enough above the natural ground level so that the finished surface around the building can slope away for good drainage. The top of the floor shall be not less than 150 mm above the finished ground level.

6.3.3.4 A damp-proofing polyolefin membrane of at least 250 :m or materials which have been certified by Agrément SA as fit for purpose shall be placed between all timber resting on a concrete floor at ground level. No timber shall penetrate a solid floor, but if this is unavoidable, the surface of the hole formed for this purpose shall be liberally coated with chlordane or aldrin, and the area shall be kept clear so that any termite attack can be observed.

6.3.4 Floor finish on concrete beds

The laying of timber floors shall be in accordance with SANS 10043. Wood finishes are normally wood blocks or strip flooring glued to the concrete slabs. As timber is sensitive to moisture changes, wood flooring shall not be used in bathrooms, kitchens or other areas where the floor will be washed periodically, or will be splashed with water, or where a high percentage of vapour exists.

6.3.5 Suspended timber floors

6.3.5.1 A suspended timber floor is particularly appropriate for timber frame housing since it is constructed by the same trades as the main structure, it is of dry construction and can readily be insulated to the same standard as the walls and the roof. A suspended floor can result in savings on sloping sites as it precludes deep-fill areas, which shall be properly compacted to prevent settling. The suspended timber floor provides a level and accurate base and an acceptable platform for fixing wall frames.

6.3.5.2 Ventilation under suspended timber floors is very important and shall be provided by means of openings in all external walls spaced not more than 2,4 m apart, with at least one opening within 750 mm from each corner. An unobstructed air passage of 3 000 mm^2 shall be provided for every square metre of ground-floor area of the building. These air passages shall be fitted with corrosion-resistant screening, the aperture size of which does not exceed 1,2 mm. Sleeper piers are preferred to sleeper walls, and external foundation walls with sufficient openings to ensure acceptable cross-ventilation shall be provided. Ventilation pipes shall be carried beneath the solid concrete floor. All ventilation openings shall be placed as near as possible to the level of the sole plates or the underside of the floor joists.

6.3.5.3 A clear space of 450 mm shall be provided under the lowest flooring member to provide acceptable crawling space. Steps shall be taken to protect the dwelling from rising moisture. If necessary, the void under the floor shall be back-filled so that the finished level inside is not below the adjacent ground level outside.

A recommended practice is to level the surface with a layer of sand which is then covered with 250 µm thick heavy-duty polyolefin, or materials which have been certified by Agrément SA as fit for purpose. A 50 mm layer of concrete is then placed over the polyolefin to secure it in place.

6.3.5.4 Where the floor is of timber, the framing shall be supported on posts (piers), foundation walls, sole plates, beams and joists. The sizes of the members shall be determined with reference to the appropriate stress grade, spans and spacing.

6.3.6 Beams

6.3.6.1 Beams acting as bearers for joists shall be supported on masonry or concrete piers or on steel or timber posts. Alternatively, joists may be supported directly on masonry or concrete walls.

6.3.6.2 Steel posts shall be designed in accordance with the relevant part of SANS 10162, and shall be fitted at each end with a steel bearing plate such as shown in figure 4(a). Where steel or other metal components come into contact with timber that has been treated with a preservative containing a copper compound, the contact area shall be treated with an acceptable sealing compound, or bituminous paint.

NOTE The size of the posts and the spacing between them depend on the load to be carried and on the maximum permissible span for the size and the type of beam being used.

6.3.6.3 Beams for first-floor construction shall be designed in accordance with the relevant part of SANS 10162 for steel beams, or the relevant part of SANS 10163 for timber beams, as appropriate. Timber beams may be solid or built-up and, if of the latter type, may be of glued-laminated construction, or may consist of two or more pieces of timber securely nailed together. The top of the beam shall be level with the tops of the sole plates on the foundation walls (see figure (5a)), and the bearing length and clearances shall be as follows:

a) Where timber beams frame into masonry or concrete foundation walls, the pocket shall be lined with an acceptable damp-proof material that complies with the relevant requirements of SANS 248, SANS 298 or SANS 952. The beams shall have a bearing length of at least 90 mm on the wall, and a clearance of at least 10 mm shall be provided between the sides and the end of the beam and the pocket formed in the wall (see figure 5(a)), or the beam may be supported on a concrete or masonry pier on a layer of damp-proofing material, as shown in figure 5(b).

b) Joints in built-up ground-floor beams (that are not glued-laminated) that consist of two or more pieces of timber, shall be placed directly over a post or bearer wall, with the joints of alternate pieces staggered. A staggered joint shall be within 150 mm of the quarter point of a clear span. Built-up beams shall be nailed with two 75 mm nails at 300 mm centres and fixed to the post with a perforated galvanized hoop mild steel strap that is nailed to the beam and to both sides of the post (see figure 5(c)). Alternative methods of fixing, such as bolting or glueing members together, are also acceptable.

c) Where increased clearance under a beam is required, the beam may be raised above the base level of the sole plates by an amount that does not exceed two-thirds of the depth of the joist. Bearer strips shall be securely nailed to each side of the beam to support the joists (see figures 5, 6 and 7), and the joists shall be skew-nailed to the beam. Care shall be taken to ensure that the full bearing is obtained on the bearing strip.

NOTE In order to provide space for services in a partition supported on a beam, a spaced beam of the type shown in figure 7 may be used. Solid blocking should be fixed at 1,2 m intervals between the two members of the beam. A single support for a spaced beam usually requires a bearing plate, preferably of metal, with a span sufficient to support the two members of the beam. Alternatively, bearer-blocking pieces should be securely nailed or bolted to the post.

6.3.7 Sole plates

6.3.7.1 Timber sole plates that comply with SANS 1783-2, of nominal thickness 38 mm and of width at least equal to that of the studding and wide enough to provide a 75 mm wide bearing for joists, may be used over foundation walls or slabs (recommended sizes are given in table 4). These plates shall be levelled on a mortar bed and anchored to the foundation wall by means of 8 mm fixing bolts, by perforated galvanized mild steel straps or by other acceptable methods.

NOTE This is not necessary when the wall framing is sheathed and the sheathing is securely nailed to the bottom edge of each joist or rim joist

6.3.7.2 Where piers or timber posts are used for the foundation, these shall be bridged by bearers of acceptable size and, where necessary, a sole plate shall be fixed to the top of each bearer (see figure 7).

An acceptable damp-proof course, as previously described, shall be provided between the sole plates or bearers and concrete or masonry piers or foundation walls. Where a cast-in-situ bolt passes through the damp-proof course, the hole shall be sealed with a non-hardening mastic to prevent moisture penetration.

6.3.7.3 In platform construction (see figure 8), the sole plate acts as a support and fastening for joists. In balloon frame construction (see figure 9), the floor joists are nailed to the studs and sole plate. Wall frames may be secured to sole plates by means of 1,6 mm galvanized hoop-iron anchor straps, 30 mm wide, at centres that do not exceed 1,8 m. The straps shall be nailed to both edges of the sole plates and to the studs, as shown in figures 8 and 9. For houses with light roofs, these straps shall be provided at alternate studs, provided the centres do not exceed 900 mm. For heavy roofs, these straps shall be provided at 1 200 mm centres.

6.3.8 Joists

6.3.8.1 Floor joists shall be at least 38 mm wide, of acceptable depth for the loading and span, and shall be of a timber that complies with the requirements for SA Pine structural timber of stress grade 5 or grade 7 in SANS 1783-2, or for SA Pine Stocklam in accordance with SANS 1460. Safe spans for joists of standard sizes are given in tables 6 and 7 for SA pine structural timbers, and in tables 8 and 9 for SA Stocklam. The joists shall be placed in position after the sole plates have been levelled and anchored. The maximum spacing of joists will depend on the type of flooring used and, in the case of strip flooring, shall not exceed 20 times the flooring thickness. For board-type flooring, the manufacturer's instructions shall be followed.

6.3.8.2 In platform construction, a header shall be end-nailed to each joist, and the header and the end joint parallel to the exterior walls skew-nailed to the sole plate at 450 mm centres. Alternatively, nogging of the same cross-sectional dimensions as the joists shall be securely nailed between two joists at intervals of not less than 2,4 m and not more than 3 m. These noggings shall be positioned on the wall plates or bearers (or both) to prevent joist rotation. The joists shall be fixed to the timber bearers by means of metal framing-anchors or by skew-nailing, with one nail on either side, and they shall be fixed to the steel bearers by means of acceptable cleats.

Where the joists are lapped over the bearers, the overlap shall be at least 100 mm and the joists shall be nailed together with three 63 mm nails.

NOTE Where floor joists are supported on bearer beams, which in turn are supported on poles or columns, and where no foundation wall exists, it is good practice to let a 25 mm × 114 mm permanent diagonal brace into the upper surface of the joist. This will greatly assist in stabilizing the floor where tongue-and-groove strip flooring is used, but is not necessary where sheet materials are used as a subfloor.

6.3.8.3 Where large openings are provided in the floor for staircases, stairwells, chimneys, etc., the joists and header framing shall be doubled as shown in figure 10, and shall be designed to carry the load for which the floor was designed.

6.3.8.4 To prevent buckling under load, bracings or solid bridging shall be placed as shown in figure 11, at the bottom part of joists at or near the inner supports of a continuous joist.

The bridging of joists provides a means of stiffening floors and distributing loads. Cross bridging is composed of diagonal struts of 38 mm × 50 mm, nailed to the joist to form a cross pattern and arranged in rows running at right angles to the floor joists. (Figures 12 and 13 show cross bridging.)

6.3.8.5 The depth of notches made for piping at the top or bottom of a joint shall not exceed one-fifth of the required depth of a joist, and their distance from the edge of the support shall not exceed one-sixth of the span. Holes for piping and conduits may be drilled in the middle third (zone b in figure 14) of the depth of the joist only (preferably at, or slightly above the centre). The diameter of the holes shall not exceed one-quarter of the depth of the joist when they are in the middle third of the span of the joist. In zone a (see figure 14), their diameter shall not exceed one-fifth of the depth of the joist. An example of the positioning of holes is shown in figure 14, and the positioning of notches in beams or joists is shown in figure 15.

Table 6 — Safe spans for joists of SA Pine structural timber — SA Pine timber (domestic use)

1	2	3	4	5	6	7	8
Width	Depth	Maximum joist span m					
		Stress grade 5			Stress grade 7		
		Joist spacing mm			Joist spacing mm		
mm	mm	400	450	600	400	450	600
38	76	0,60	0,60	0,60	0,85	0,85	0,85
38	114	1,40	1,40	1,40	1,90	1,90	1,90
38	152	2,45	2,45	2,45	3,40	3,35	3,05
38	228	4,85	4,70	4,15	5,20	5,00	4,55
50	76	0,80	0,80	0,80	1,10	1,10	1,10
50	114	1,85	1,85	1,85	2,50	2,50	2,50
50	152	3,25	3,25	3,10	3,80	3,65	3,35
50	228	5,35	5,20	4,65	5,70	5,50	5,00
76	114	2,80	2,80	2,70	3,10	3,10	2,85
76	152	4,10	3,95	3,55	4,40	4,20	3,60
76	228	6,15	5,90	5,35	6,55	6,30	5,75

Live load: 1,5 kN/m^2
Dead load: 0,125 kN/m^2
Point load: 1,5 kN
Deflection criterion: 1/300th of span

Table 7 — Safe spans for joists of SA Pine structural timber — SA Pine timber (commercial use)

1	2	3	4	5	6	7	8
Width	Depth	Maximum joist span m					
		Stress grade 5			Stress grade 7		
		Joist spacing mm			Joist spacing mm		
mm	mm	400	450	600	400	450	600
38	76	–	–	–	–	–	–
38	114	0,40	0,40	0,40	–	–	–
38	152	0,75	0,75	0,75	1,00	1,00	1,00
38	228	1,67	1,65	1,65	2,30	2,30	2,30
50	76	0,25	0,25	0,25	–	–	–
50	114	0,50	0,55	0,55	0,75	0,75	0,75
50	152	1,00	1,00	1,00	1,35	1,35	1,35
50	228	2,20	2,20	2,20	3,00	3,00	3,00
76	114	0,85	0,85	0,85	1,15	1,15	1,15
76	152	1,50	1,50	1,50	2,05	2,05	2,05
76	228	3,35	3,35	3,35	4,55	4,55	4,55

Live load: 2,5 kN/m^2
Dead load: 0,125 kN/m^2
Point load: 5 kN
Deflection criterion: 1/300th of span

Table 8 — Safe spans for joists of SA Pine structural timber — Stocklam (domestic use)

1	2	3	4	5
Width Mm	**Depth** mm	**Safe span** m		
		Spacing mm		
		400	**450**	**600**
32	133	1,25	1,25	1,25
32	166	1,90	1,90	1,90
45	100	1,00	1,00	1,00
45	133	1,75	1,75	1,75
45	166	2,70	2,70	2,70
45	200	3,90	3,90	3,45
45	233	4,80	4,65	4,05
70	100	1,50	1,50	1,50
70	133	2,70	2,70	2,70
70	166	4,00	3,80	3,45
70	200	4,80	4,60	4,20
70	233	5,60	5,35	4,90
70	266	6,35	6,15	5,55
70	300	7,20	6,90	6,30
70	333	8,00	7,65	6,95
70	366	8,75	8,45	7,65
70	400	9,60	9,20	8,35
Live load: 1,5 kN/m^2 Dead load: 0,125 kN/m^2 Point load: 1,5 kN Deflection criterion: 1/300th of span				

Table 9 — Safe spans for joists of SA Pine structural timber — Stocklam (commercial use)

1	2	3	4	5
Width mm	**Depth** mm	**Safe span** m		
		Spacing mm		
		400	**450**	**600**
32	166	0,75	0,75	0,75
45	166	1,05	1,05	1,05
45	200	1,50	1,50	1,50
45	233	2,05	2,05	2,05
70	100	0,60	0,60	0,60
70	133	1,05	1,05	1,05
70	166	1,65	1,65	1,65
70	200	2,35	2,35	2,35
70	233	3,20	3,20	3,20
70	266	4,20	4,20	4,20
70	300	5,35	5,35	5,35
70	333	6,45	6,45	5,95
70	366	7,40	7,20	6,55
70	400	8,15	7,85	7,15
Live load: 2,5 kN/m^2 Dead load: 0,125 kN/m^2 Point load: 5 kN Deflection criterion: 1/300th of span				

6.3.9 Timber flooring

6.3.9.1 Flooring shall be laid in accordance with the relevant requirements of SANS 10043 or, if not applicable, in accordance with the manufacturer's instructions.

NOTE For certain types of flooring, a subfloor is essential, and it may consist of tongue-and-groove boarding, plywood, oriented strand board (OSB), wood-fibre board, composite board or particle board, other than strip flooring. Heading joints in board flooring should be formed on the joists. In the case of strip flooring, the heading joists should be end-matched and may occur between supports provided that short lengths are nailed to at least two joists.

6.3.9.2 When tongue-and-groove boarding is used as a subfloor, the boards shall be laid diagonally on the joists. This makes it possible to lay the finished floor either parallel to, or at right angles to, the joists, and this construction provides lateral bracing and stiffness to the building.

6.3.9.3 When sheet materials are used, joints shall not occur between two joists, the joints in adjacent panels shall be staggered and the sheets shall be nailed at 150 mm centres. Bridging pieces shall be provided to support the end sheets where necessary. OSBs, shall be laid according to the manufacturer's specifications.

Where balloon framing is used, blocking shall be installed between the end of joists as well as at the wall, for use as a fire stop.

6.3.9.4 For attic floors and the first floor in double-storey buildings, the construction shall be exactly as in 6.3.9.1 to 6.3.9.3.

NOTE 1 Additional soundproofing can be achieved by inserting a lightweight, inert filling between the joists and floor and ceiling. Materials such as fibreglass wool and mineral wool, will assist in reducing all airborne sound, as will carpeting with double underfelt laid on the floor above.

NOTE 2 Vibration-transmitted sound can be drastically reduced by the installation of a 40 mm to 70 mm thick sand/cement (or sand/vermiculite/cement or sand/polystyrene/cement screed). This is regarded as a rational design and should therefore be verified by a structural engineer.

6.3.9.5 In "wet rooms" such as bathrooms, laundries, kitchens and shower cubicles, where floors are subjected to splashing water or where a lot of vapour is released into the atmosphere, an impervious floor shall be used. The following constructions are acceptable:

a) a concrete floor (see figure 16); or

b) an impervious layer of metal that is protected to prevent corrosion; or

c) a corrosion-resistant material, bitumen-impregnated felt or polyolefin sheeting placed between the subfloor and the floor, which shall itself be of an impervious nature; or

d) a sheeted subfloor, tanked using an acceptable acrylic or bitumastic waterproofing system with an acceptable membrane. The waterproofing shall be continued to a maximum height of 100 mm up each wall face, and the system shall comply with the manufacturer's specifications.

Heavy fixtures, such as a bath, can cause excessive deflection of the timber floor, and joists shall therefore be doubled at the outer edges of the bath. To clear the waste outlet, intermediate joists shall be spaced. Support rails and fixing rails should be used to support the rim of the bath (see figure 17).

Trays in shower cubicles shall either be of cast-in-situ concrete or, preferably, of preformed stainless steel, porcelain or fibre-reinforced plastics, with an acceptable waterproof membrane fitted to the underside and sides of the tray and that is properly sealed at all joints and corners and to the walls to ensure watertightness. A bath or a shower tray is usually installed by supporting the edge of the bath on a ledger batten which is securely fastened (level) to the wall. The wall lining is set into an oleo-resinous type of sealant on the edge of the bath or shower tray, thereby compressing the lip of the unit down onto the ledger batten and restricting any movement which might rupture the waterproofing compounds that are subsequently applied. The tiles in the shower cubicle or bath splashbacks are then brought down to the edge of the bath or tray, leaving a 3 mm gap between the bottom of the tile and the unit. This 3 mm gap is then filled with a caulking grade mould-resistant silicone sealant (see figure 17).

Shower trays of fibre-reinforced plastic or acrylic material can be set into a trowel grade bitumastic compound which may be applied in a coating of approximately 10 mm to the surface of the floor sheet material. The shower tray should be loaded evenly and remain undisturbed until the mastic has set.

The intersection between the bottom edge of the wall tiles or other covering, and the lip of a bath, shower tray or sink, etc., shall be constructed and sealed in such a way that any water that is splashed onto the wall will not penetrate behind such an item. The joint between the wall tiles or other covering and the lip of a bath, shower tray or sink, shall be sealed by means of an acceptable sealant such as silicone or a two-part polysulfide.

NOTE It is good practice, where possible, to slope the floors of bathrooms on upper floors to a drain away from the door to prevent flooding of the rest of the house in case of overflowing.

6.3.10 Plank and beam construction

NOTE Plank and beam construction may be used as an alternative to the conventional method of floor construction. This construction consists essentially of a 38 mm to 76 mm thick plank subfloor or roof decking (that usually also acts as the ceiling of the room below) with supporting beams spaced up to 2,4 m apart instead of joists at the usual centres. It is normally used in conjunction with post framing and beam framing.

6.3.10.1 Planks shall extend over at least two beams, and shall be nailed with two nails to each beam. Joints shall be placed over beams and shall be at least 76 mm wide to provide an acceptable bearing and nailing surface for the planks. Where a floor will carry an abnormally heavy load, it might be necessary to use flooring thicker than the normal 50 mm. All openings in the floor shall be headed and framed.

6.3.10.2 The dimensions of the beams shall be calculated in accordance with the relevant part of SANS 10163. If the width exceeds the width of the supporting posts, acceptable bearing blocks shall be fixed to the sides of each post to provide an acceptable bearing area.

NOTE Where concentrated loads are applied, it might be necessary to use extra beams to provide the stiffness. In general, beams bearing over door and window openings should be avoided. However, if this is unavoidable, support for such beams may be provided by a special beam placed over the opening and supported by columns at the sides of the opening.

Table 10 shall be used as a guide to determine the thickness of the subfloor or roof decking, depending on the spacing of the beams.

Table 10 — Safe spans for plank subfloors or roof decking

Dimensions in millimetres

1	2
Nominal thickness	**Safe span**
	Grade 5[a]
38	760
50	1 000
76	1 520
[a] As in SANS 1783-2	
NOTE All plank subfloors or roof decking should be designed in accordance with the relevant part of SANS 10163.	

6.4 Wall construction

6.4.1 General

Timber frame walling is the most popular wall construction method. Primary wall framing includes vertical studs and horizontal members (sole plates, top plates, windows and door headers) of exterior and internal walls that support ceilings, upper floors and roofs (see figures 52 and 53). The wall framing can also serve as a basis for wall-covering materials.

Recommendations for securing structural timber by means of wire nails are given in table 11. In table 11, the lengths for toe-nailing are based on the nail being at an angle of 30° to the face of the first timber penetration. Permissible dimensions for timber-framed walls are given in table 12.

Table 11 — Nailing schedule for timber-framed structures — Ordinary round wire nails (see SANS 820)

1	2	3	4
Position	**Method**	**Number required**	**Minimum length** mm
Joist to sole plate or beam Joist to stud Bridging to joist	Toe Face Face	2 2 2	75 75 90
Header board Subfloor not more than 25 mm thick	Face Face	2 at each joist 1 at each joist	90 63
Subfloor more than 25 mm thick	Face	1 in boards ≤ 150 mm wide or 1 in boards > 150 mm wide at 150 mm centres at the edges of the board and at 300 mm centres elsewhere. The length shall be 2,5 times the thickness of the sheet with a minimum of 63 mm.	75
Bottom plate to studs Bottom plate to sole plate Joists to bottom plate or sole plate	Face Skew Skew	2 1 at 450 mm centres 2	90 90 75
Top plate to studs Double studs Fire stops and nogging to studs	Face Face Face	2 1 at 600 mm centres 2	90 75 75
Wall plate to top plate Top plate (laps and intersections) Brace to each stud, plate and header	Skew Face Face	1 at 450 mm centres 2 2	90 75 63
Lintel (two-piece construction) to filler blocks Lintel (two-piece construction) to stud Built-up corner posts	Face Toe Face	2 2 1 at 750 mm centres – staggered	63 75 75
Built-up joists and beams, along edges Ceiling joists to top plate Ceiling joists, laps over partition	Face Toe Face	1 at 750 mm centres – staggered 2 3	75 75 75
Bearer strips to joists and beams Support rail to studs	Face Face	Group of 2 under each joist 2	75 75

Table 12 — Permissible dimensions for timber-framed walls (see SANS 10400)

1	2	3	4	5	6	7
Wall type	**Stud size** mm	**Stud spacing** mm	**Maximum panel length** m		**Maximum height**[a] m	**Maximum storey height** m
			Supported both ends	Supported one end		
Load-bearing	38 × 114 38 × 114 50 × 76	400 600 450	4,8 4,0 3,6	2,4 2,0 1,8	6,0 6,0 3,0	4,0 3,0 3,0
Non-load-bearing	38 × 114 50 × 76	600 600	4,8 4,2	3,0 2,4	– –	4,0 3,0

[a] Maximum height is the height to the wall plate of the highest storey or the height to the top of the gable, if applicable.

6.4.2 Platform construction

6.4.2.1 In the usual type of platform construction (see figure 18), the floor extends to the exterior surfaces of the building, and the walls and partitions are erected on and nailed to this flat surface. The complete wall section shall, where practical, be assembled on the floor and then raised and fixed in position.

Studs are the main structural members of walls. All load-bearing studs shall be of stress-graded timber and their sizes shall depend on the combined vertical and horizontal loading on the walls (see table 13). Studs also provide a framework for the fixing of sheathing material.

For all load-bearing walls, the studs shall be in accordance with table 12. For the classification of roof types, see the note to 6.2.2. Other studs may be used, provided that the cross-sectional area is not less than that of the appropriate stud sizes given in table 12, and that the stud thickness is at least 38 mm.

In the case of non-load-bearing walls, 114 mm × 38 mm studs or 76 mm × 38 mm studs may be used with spacing that does not exceed 600 mm. Wall bracing shall be provided in accordance with 6.4.11.

Unless they have been specially designed to be fixed otherwise, studs shall be fixed with their larger dimensions at right angles to the direction of the wall. The nominal size of studs is subject to the tolerance permitted in SANS 1783-2. The bottom plate (of the size of the studs) shall be nailed to the studs, and window or door headers placed and nailed into position.

6.4.2.2 For houses with light roofs, it is necessary to provide metal connector plates (between the bottom plate and the studs in external walls only) in the form of a pre-drilled 1,6 mm × 30 mm wide galvanized hoop-iron strap 450 mm in length, nailed to both edges of the bottom plate and to the outer edge of the stud, with four 40 mm galvanized clout nails per member (see figure 9). The number of straps connecting studs to the bottom plate shall correspond to the number of wall anchors specified in 6.2.3.

Where the roof trusses are located directly above the studs in load-bearing walls, and are anchored directly to the studs by means of steel straps, no additional connections between the top plate and the studs are required other than nailing as specified in 6.4.1. Where trusses supporting light roofs are not located over, and anchored directly to, studs, additional connections between the top plate and the studs shall be provided. These connections shall be as specified in 6.4.1, but shall be provided at every stud. Double studs shall be used at window and door openings. A top plate shall then be nailed into position.

6.4.2.3 Each frame shall be raised and secured to the floor-framing members, and temporary stalls shall be installed. Once all the frames are raised and nailed together at all corners (see figure 54) and intersections, the frames shall be plumbed at the corners and at the window and door openings, and temporary bracing shall be installed. The wall plate may now be installed and the studs notched and blocked with bracing anchors for the installation of diagonal bracing.

For a concrete subfloor, the wall sections shall be assembled in the same way and, when the sections are raised into position, the bottom plate of each section shall be bolted to the concrete slab in accordance with 6.2.3 (see figures 19, 20 and 23).

6.4.2.4 Where the wall sections are to be fixed directly onto the brick foundation walls, they shall be anchored by 1,6 mm × 30 mm wide galvanized steel straps that are embedded under the lowest course of the foundation bricks, and taken up between the two leaves of the foundation wall, bent tightly over the top of the bottom plate, and nailed to the top of the plate by means of two galvanized 40 mm nails, ensuring that there is no slack in the strap (see figures 8, 9, 21 and 22). Anchor straps, as specified in 6.2.3, shall be provided.

Table 13 — Grade requirements for studs in load-bearing walls

1	2	3	4	5	6	7	8	9	10	11
Unsupported length[a]	Stud size		Minimum timber grade required[b]							
			Single storey				Double storey			
	Width	Depth	Heavy roof		Light roof		Heavy roof		Light roof	
			Stud spacing mm							
m	mm	mm	400	600	400	600	400	600	400	600
2,400	38	76	5	5	5	5	7	10	5	7
	38	114	5	5	5	5	5	5	5	5
	50	76	5	5	5	5	5	7	5	5
	50	114	5	5	5	5	5	5	5	5
2,700	38	76	5	7	5	5	7	10	7	7
	38	114	5	5	5	5	5	5	5	5
	50	76	5	5	5	5	7	7	5	7
	50	114	5	5	5	5	5	5	5	5
3,000	38	76	5	7	5	5	10	10	7	10
	38	114	5	5	5	5	5	5	5	5
	50	76	5	5	5	5	7	10	7	7
	50	114	5	5	5	5	5	5	5	5
3,600	38	76	7	10	5	7	10	–	10	–
	38	114	5	5	5	5	5	7	5	5
	50	76	7	5	5	5	10	–	7	10
	50	114	5	5	5	5	5	7	5	5
4,200	38	76	10	10	7	7	–	–	–	–
	38	114	5	5	5	5	7	7	7	7
	50	76	7	10	5	7	10	–	10	–
	50	114	5	5	5	5	5	5	5	5
6,000	38	76	–	–	–	–	–	–	–	–
	38	114	7	7	5	5	10	–	7	10
	50	76	–	–	–	–	–	–	–	–
	50	114	5	7	5	5	7	10	7	10

[a] Usually storey height.

[b] SA Pine visual or mechanical grades with tolerances in accordance with SANS 1783-2 for grades 5, 7 and 10.

6.4.2.5 Internal walls may be fixed to a concrete subfloor by means of 6 mm diameter bolts fixed in the concrete slab, or by 6 mm expanding bolts, or by means of shot-fired hard steel nails, provided that they penetrate at least 30 mm into the concrete slab. In all cases, the maximum spacing shall be at least 900 mm, and a large washer of diameter at least 25 mm shall be used in conjunction with the fixing bolts or shot-fired nails (see figure 23).

Both sides of door openings and the ends of unsupported walls shall be anchored.

Internal cross walls shall act as bracing for other walls and the panels shall be fixed with steel nails.

Permanent bracing in the form of properly fixed sheathing or cladding and lining, with diagonal bracing elements, where applicable, might be necessary in certain internal cross walls to ensure the lateral stability of a timber-framed structure (see 6.4.11 and 6.4.12).

6.4.2.6 After the walls have been erected, a second wall plate shall be nailed into position onto the top plate so that it overlaps the lower plate at the corners and wall intersections by at least 900 mm. If the internal walls have not been raised and braced, temporary bracing shall be left in place until the roof and ceiling framing and cladding have been completed.

6.4.3 Balloon frame construction

In balloon frame construction (see figure 24), both the wall studs and the joists rest on the anchored sole plate. If the sole plate has been accurately pre-drilled to fit the holding-down bolts, the wall section may be assembled in the horizontal position (as for platform construction) and then lifted into place. When the wall section is in place, floor joists are fitted into position, skew-nailed to the sole plate and end joists and then nailed to the studs (see figure 28). An alternative method is to use both a bottom plate and a sole plate. In all other respects, such as the size of studs, methods of temporary and permanent bracing, the construction of wall frames shall be as described in 6.4.2.

NOTE A subfloor, if used, may be laid at any time after the wall framing is complete but, because of the possibility of damage, it is not advisable to apply the finishing surface to the floor before the roof, walls and ceiling have been completed.

6.4.4 Double-storey construction

Where the first floor is of balloon frame construction, the studs shall be continuous through both storeys (see figure 24).

A 114 mm × 38 mm support rail or ledger shall be let into the studs to act as a bearer for the first-floor joists and, in addition, the joists shall be nailed to the studs.

6.4.5 Lintels

Lintels shall be provided at all door and window openings except where post and beam construction renders lintels unnecessary. The lintels shall be built up from two members (see figures 18, 25 and 26) of the appropriate size given in table 13. The members shall be securely nailed together, and spacers shall be provided, if necessary. The lintels shall be supported at the end in accordance with the manufacturer's specifications. A lintel rail should be attached to the bottom edge of both lintels to prevent any likely future movement in the lintel members.

If required, a light truss may be used in place of a lintel and, in the case of openings wider than those given in table 14, trussed headers or some other acceptable type of built-up beam shall be used and shall be designed to suit the required plan.

6.4.6 Wall intersections

Multiple-stud posts at exterior corners and interior wall intersections, may be used to secure an acceptable tie between adjoining walls and to provide nailing bases for the interior lining.

NOTE A recommended stud arrangement for an exterior corner is shown in figure 27(a), and suggested stud arrangements for interior wall intersections for platform construction are shown in figures 27(b) and 27(c).

6.4.7 Noggings

Noggings shall be spaced to suit the type of interior lining.

NOTE The installation of noggings almost trebles the vertical load-bearing strength of the framework, whilst providing stability in the frame itself. It also limits the amount of warpage in the studs as the timber dries out over a period of time. Noggings at acceptable centres are required where strip lining or cladding is fixed vertically to the framework. Noggings perform the function of fire stops within the framework.

6.4.8 Additional details

Sundry details of framing applicable both to platform and to balloon construction, are shown in figures 28 to 34.

Table 14 — Safe spans for lintels

1	2	3	4	5	6	7	8
Stress grade[a]	Size of member[b]	Top storey			Bottom storey		
		Roof span m					
	mm	6	9	12	6	9	12
Safe span for lintels for light roofs							
5	38 × 76	1,200	1,000	0,900	0,750	0,600	0,500
	38 × 114	1,900	1,550	1,350	1,100	0,900	0,800
	38 × 152	2,550	2,100	1,800	1,500	1,250	1,100
	38 × 228	3,800	3,150	1,750	2,250	1,850	1,600
7	38 × 76	1,450	1,200	1,050	0,900	0,700	0,600
	38 × 114	2,250	1,850	1,600	1,300	1,100	0,950
	38 × 152	3,000	2,500	2,150	1,800	1,450	1,250
	38 × 228	4,550	3,700	3,250	2,650	2,250	1,900
Safe span for lintels for tiled roofs							
5	38 × 76	0,950	0,800	0,700	0,700	0,550	0,450
	38 × 114	1,450	1,200	1,050	1,000	0,850	0,750
	38 × 152	1,950	1,600	1,400	1,400	1,150	0,950
	38 × 228	3,000	2,450	2,100	2,450	1,650	1,450
7	38 × 76	1,150	0,950	0,800	0,800	0,650	0,550
	38 × 114	1,750	1,450	1,250	1,200	1,000	0,850
	38 × 152	2,350	1,900	1,650	1,650	1,300	1,150
	38 × 228	3,550	2,900	2,500	2,450	1,950	1,750

[a] As in SANS 1783-2.

[b] Each lintel consists of two members.

6.4.9 Post and beam construction

6.4.9.1 The post and beam method of construction provides distinctive architectural effects and is particularly appropriate where it is necessary to provide large openings in walls. Whereas conventional framing utilizes joists, rafters and studs spaced at 400 mm or 600 mm centres, the post and beam method requires fewer members of a larger size spaced further apart.

NOTE In post and beam framing, subfloors and roofs are supported on beams spaced up to 2,5 m apart. The ends of beams are supported on posts. Wall spaces between the posts are provided with supplementary framing to the extent required for attachment of the exterior and interior finish. The wall sections may be erected on either a concrete slab or a timber floor and should be fixed and temporarily braced as described in 6.4.2.

6.4.9.2 Windows and doors shall be located between posts in exterior walls to eliminate the need for lintels over the openings.

A combination of conventional framing and post and beam framing is sometimes used. Where a plank and beam floor or roof is supported on a stud wall, posts (either solid or of the multiple-stud type) shall be placed under the ends of the beam to carry the concentrated load. The rest of the wall framing shall be as described in 6.4.2, with the stud spacing adjusted to fit between the posts. Where conventional first-floor framing or roof framing is used with post and beam construction, a lintel shall be installed to carry the load from the joists or rafters to the posts.

Plank (structural) floors are designed for moderate uniform loads and are not intended to carry heavy concentrated loads. Where heavy loads (load-bearing walls, baths, etc.) occur, additional framing is needed beneath the planks to transmit the loads to the beams.

6.4.9.3 Posts shall be large enough to carry the load, and to provide full bearing for the ends of the beams. In general, posts shall be at least 114 mm × 76 mm, but where the ends of the beams abut over a post, the dimension of the post parallel to the beam shall be at least 152 mm. The posts may be solid, glued-laminated or of the multiple-stud type.

The size of beams will vary with the load, span and spacing, and shall be designed accordingly (see the relevant part of SANS 10163). Beams may be solid, glued-laminated or built-up. The attachment of beams to posts shall be by means of framing anchors, angle clips or metal connectors. Timber posts and beams shall be designed in accordance with the relevant part of SANS 10163, and steel elements shall comply with the relevant part of SANS 10162.

NOTE Alternatively, the posts or beams may be notched, provided that the strength of the notched portion remains acceptable.

6.4.9.4 Wall panels in the post and beam method of construction are usually non-load-bearing. Where load-bearing wall panels occur, they shall be placed over beams large enough to carry the additional load. If this is not possible, supplementary beams shall be placed in the wall frame.

As in conventional framing, lateral bracing is required in the exterior walls to provide resistance against wind forces. This is accomplished by installing, at appropriate intervals, solid panels in which the supplementary wall framing and the posts are all connected by diagonal bracing or acceptable sheathing. There shall be at least one panel designed in this way in each wall, except where the end walls or cross walls are of masonry construction that will effectively prevent lateral movement. (Structural details of the post and beam construction are shown in figure 35.)

6.4.10 Plank wall construction

The walls shall have a thickness of at least 50 mm where sheathing is used, and a thickness of at least 76 mm where sheathing is not used. Structural members shall be connected with dovetail joints or other joints of equivalent strength. Vertical structural members shall be at least 250 mm deep and shall be spaced not more than 2,5 m apart, and corner members shall consist of two planks set at right angles. All openings shall have both sides supported by means of vertical structural members. All the members of the plank construction shall be securely nailed together.

Sheathing membranes shall be applied over the exterior sides of all plank frame walls. Sheathing (where used) shall be of one of the types described in 6.4.12, and cladding shall be fixed in the same manner as in other types of construction (described in 6.4.13).

NOTE 1 Although this type of construction is not common in South Africa, it can, in addition to its use for dwellings, be used to advantage in various industrial, commercial and farm buildings.

NOTE 2 An alternative method of construction may be used in the case of single-storey structures. Tongue-and-groove planks, of thickness 50 mm or 76 mm, are fixed vertically in position by channel plates on the floor and at ceiling level. Corner members consist of posts acceptable grooved to receive further insulation, but in the case of 50 mm walls, it might be advisable to provide insulation by means of an insulating medium between the wall and an interior lining or by means of acceptable cladding, or by a combination of both means. Any type of interior or exterior finish may be applied directly to such a wall, whether it be 50 mm or 76 mm thick.

NOTE 3 The planks used may be of any acceptable width and may be solid or glued-laminated.

6.4.11 Bracing

6.4.11.1 General

Walls shall be stiffened by means of permanent bracing to resist horizontal forces (racking forces) caused by wind. Bracing may be diagonal solid timber (1,2 m × 20 mm × 20 mm), diagonal galvanized steel (angle iron) or structural sheeting. Braced walls shall be classified in accordance with the strength class given in table 15.

Braced walls shall be designed and located as shown in figure 36. Bracing shall be fixed as shown in figure 37. The stud spacing with the permissible design-racking strength per metre length of wall of timber-framed walls is given in table 16.

6.4.11.2 Application

To be effective, the bracing shall be applied over the full height of the wall. If walls, or a part of the walls that is shorter than 1,2 m, contribute to the racking strength of the building, their effective contribution shall be 40 % less. The minimum length of a wall shall be 600 mm. This shall be taken into account when the required length of a braced wall is calculated, as shown in figure 36. Wall sections shall be positively connected across openings by means of a lintel or a 38 mm × 114 mm nogging placed on edge underneath the top plate.

6.4.11.3 Calculation

The minimum length of braced wall required in a building shall be determined by adding the required lengths obtained from figure 38(a) together with figure 38(b), or figure 38(c), as applicable. Wind speed regions are shown in figure 1, while the minimum length of braced wall, L_R, can be determined as follows:

$$L_R = \frac{E_R}{R}$$

where

E_R is the racking force on the building, in newtons (N);

R is the permissible racking force per metre length of wall (from table 15), in newtons per metre (N/m);

$$= (0{,}5\, P_w \cdot B \cdot H_E) + (P_r \cdot B \cdot H_R)$$

where

P_w is the wind pressure on the wall (from table 17), in newtons per square metre (N/m^2);

B is the length of the building measured normal to the wind flow, in metres (m);

H_E is the height of the highest eave above ground level (double-pitched roof), in metres (m);

P_r is the wind pressure on the roof (from table 18), in newtons per square metre (N/m^2);

H_R is the height of the highest point on the roof above the eaves (monopitched roof), in metres (m).

Table 15 — Braced wall classification

1	2	3	4
Strength class	Racking strength required	Wall construction that complies with racking strength requirements	
		Stud spacing	Cladding/sheathing
	N/m	mm	
I	700 min.	600	12,5 mm plasterboard on one side (with diagonal brace)
	899 max.	400	–
II	900 min.	600	12,5 mm plasterboard on both sides (with diagonal brace)
	1 099 max.	400	12,5 mm plasterboard on one side (with diagonal brace)
III	1 100 min.	600	6 mm pine plywood on one side
	1 299 max.	400	–
IV	1 300 min.	600	4,8 mm hardboard on one side 6 mm RC pine plywood on one side with 12,5 mm plasterboard on the other side
	1 499 max.	400	6 mm pine plywood on one side 12,5 mm plasterboard on both sides (with diagonal brace)
V	1 500 min.	600	6 mm RC pine plywood on one side with 12,5 mm plasterboard on the other side
	1 699 max.	400	–
VI	1 700 min.	600	6 mm RC pine plywood on one side with 12,5 mm plasterboard on the other side
	1 899 max.	400	
VII	1 900 min.	600	–
	2 199 max.	400	6 mm RC pine plywood on one side with 12,5 mm plasterboard on the other side
VIII	2 200 min.	600	6 mm RC pine plywood on both sides
	2 499 max.	400	–
IX	2 500 min.	600	6 mm RC pine plywood on both sides with 12,5 mm plasterboard on the other side
	2 799 max.	400	–
X	2 800 min.	600	4,8 mm hardboard on both sides
	3 099 max.	400	6 mm RC pine plywood on both sides with 4,8 mm hardboard on both sides
XI	3 100 min.	600	4,8 mm hardboard on both sides with 12,5 mm plasterboard on one side
	3 399 max.	400	
XII	3 400 min.	600	–
		400	6 mm RC pine plywood on both sides with 12,5 mm plasterboard on one side

NOTE 1 When calculating the total wall length parallel to the wind direction, the following should not be included: walls of length less than 1,000 m, and wall lengths in which openings (doors and windows) occur.

NOTE 2 The contribution of racking resistance of masonry veneer and other materials that are not listed should be ignored until research on these products is finalized. Plasterboard and other lining materials that are not listed as bracing elements should not be used.

Table 16 — Stud spacing and permissible design racking strength of timber-framed walls

1	2	3
Wall construction	Stud spacing mm	Permissible design racking strength per metre length of wall N/m
Rotary cut pine plywood (6 mm, 5 ply)		
on one side	400	1 470
on one side	600	1 150
on both sides	400	2 940
on both sides	600	2 300
Rotary cut pine plywood (6 mm, 5 ply) on one side and gypsum plasterboard (12,5 mm) on the other side	400 600	1 975 1 505
Rotary cut pine plywood (6 mm, 5 ply) on one side and gypsum plasterboard (12,5 mm) on the other side	400 600	3 445 2 655
Metal cross braces and gypsum plasterboard (12,5 mm)		
on one side	400	1 010
on one side	600	710
on both sides	400	1 365
on both sides	600	960
Hardboard (4,8 mm)		
on one side	600	1 410
on both sides	600	2 820
Hardboard (4,8 mm) on one side and gypsum plasterboard (12,5 mm) on the other side	600	1 765
Hardboard (4,8 mm) on both sides and gypsum plasterboard (12,5 mm) on one side	600	3 175
NOTE Plasterboard should only be used in conjunction with diagonal braces or structural sheathing.		

Table 17 — Characteristic wind pressure on buildings — Wind pressure per unit area of walls

1	2	3
Wind speed region (see figure 1)	Wind pressure[a] per unit area of wall, P_w N/m^2	
	Wall height < 5 m	Wall height 5 m ≤ 10 m
A	810	920
B	900	1 020
C	1 110	1 255
[a] If the highest point of the roof is lower than 5 m, the wind pressure values are reduced by 12 %.		

Table 18 — Characteristic wind pressure on buildings — Horizontal component of wind pressure on roofs

1	2	3	4	5
Roof type	Roof slope degrees	Horizontal wind pressure per unit area of vertical projection, P_r N/m^2		
		Wind speed region (see figure 1)		
		A	B	C
Double-pitched roof	5	−24	−26	−32
	10	−80	−89	−109
	15	−72	−79	−98
	20	0	0	0
	30	184	204	251
	40	473	524	645
	50	705	781	958
	60	1 040	1 150	1 420
Monopitched roof	5	60	66	82
	10	120	132	163
	15	167	185	227
	20	204	255	314

6.4.12 Sheathing

6.4.12.1 General

Sheathing adds both stiffness and insulation to a building. The sheathing material shall span at least two stud spaces over three studs.

6.4.12.2 Application

6.4.12.2.1 Timber sheathing may be applied horizontally or diagonally (at an angle of 45°), as shown in figure 39(a). End joints shall be made over studs and the boards shall be nailed to each stud. The sheathing may be

a) fitted over studs and the boards nailed to each stud,

b) carried over the floor framing as shown in figure 39(b), or

c) started at the subfloor as shown in figure 39(c).

The method in figure 39(b) is preferable as it provides a further tie of the wall frame to the sole plate. Where timber sheathing is used, corner bracing of the frame may be omitted as the sheathing adds greatly to the rigidity of the wall. The application of structural sheeting is shown in figure 40.

6.4.12.2.2 Joints in sheet material shall be fitted over studs, and a gap of 3 mm shall be left between sheets. Sheets shall be nailed to every stud. If the sheets are used horizontally, or if is necessary to use more than one length of sheet vertically, noggings shall be fixed between the studs (along the line of the joint between the sheets) to allow for the fixing of the sheets.

The depth of penetration of nails into the studs and nogging should be at least 30 mm. If screws are used instead of nails, the depth of penetration into the studs should be at least 25 mm. Nails should be at least 3 mm thick and 40 mm long. Nails or screws shall be spaced at centres that do not exceed 300 mm on intermediate supports (see table 11).

Where sheet materials of width 1,2 m and of length 2,4 m or greater are applied vertically and attached with nails, normal diagonal bracing of the frame may be omitted.

6.4.12.2.3 In the case of prefabricated wall panels, the sheathing may be glued (instead of nailed) to the frame with a class 1 or class 2 type adhesive that complies with the appropriate requirements of SANS 1349, and is compatible with the type of sheathing used.

6.4.12.3 Structural sheathing

Plasterboard shall not be used as structural sheathing. The sheets shall be nailed or screwed as specified in 6.4.12.2.

6.4.12.4 Sheathing membrane

Sheathing membrane shall be used over plasterboard, plywood, particleboard and fibreboard sheets if these are not of the waterproof or exterior type, but its application to other materials is not essential. It shall be applied by starting at the bottom of the wall, and the membrane shall overlap by 100 mm at horizontal joints and 150 mm at vertical joints. Strips of sheathing membrane, of width approximately 150 mm, shall be applied behind all exterior trim and around all openings.

The sheathing, sheathing membrane and cladding shall extend down to approximately 25 mm below the top of the floor level. A corrosive-resistant trim or flashing, with weepholes at 300 mm centres, shall preferably be used, and shall be painted all round before fixing.

6.4.13 External finishes

6.4.13.1 Timber siding

6.4.13.1.1 Timber siding shall be of the ship-lap, square-edged, drop, bevel, tongue-and-groove or half-log type of horizontal siding (see figures 41 to 43) and the tongue-and-groove type may be used vertically or diagonally. The timber used shall be acceptably free from warp, loose knots, pitch pockets, wane and resin exudation. A water-repellent coating shall be applied to the end surfaces of the siding. All siding and exterior trim shall be secured with corrosive-resistant nails (for example, of copper, brass, stainless steel, galvanized steel or sherardized steel). The siding shall be acceptably fixed to the studs to prevent the effects of shrinkage, warpage and movement under impact.

Ensure that the metal of the nails used is compatible with the preservative treatment used for the timber with which it will come in contact.

Allowance shall be made for the use of power-driven nails of the same size as given in table 11, and for the use of power-driven heavy-duty staples to fix the sheathing and interior lining materials.

6.4.13.1.2 Where timber sheathing is used, siding shall be nailed to it at 600 mm centres. Where other types of sheathing are used, nails shall be driven through the siding and sheathing into the studs. Drop siding is usually used without sheathing and shall therefore be nailed directly to each stud. Where the nails are near the end of the board, the holes shall preferably be pre-drilled.

Bevelled siding and square-edged siding applied horizontally shall be lapped 25 mm and the nails shall be driven just above the lap to allow for movement caused by moisture content (see figure 41(a)). The spacing of the siding shall be so arranged that the bottom of a piece coincides with the top of the trim of the openings of doors and windows (see figure 42). The lowest part of a siding shall be at least 150 mm above finished ground level.

Where tongue-and-groove siding is used over timber sheathing, it shall be blind-nailed at 600 mm centres. Where square-edge siding is used with cover strips, the board shall be spaced approximately 6 mm apart and nailed at each edge, and the cover strip attached by nails on its centre line so that the nails pass between the boards. Where sheathing other than timber is used or where sheathing is omitted, nogging pieces, at centres that do not exceed 600 mm, shall be provided between the studs to permit nailing of the vertical siding.

NOTE Corner treatment of siding depends upon the architectural design and may involve corner boards, quadrants, mitred corners, metal corners or lapped corners.

6.4.13.2 Fibre-cement weatherboard lapped siding

Weatherboard lapped siding shall be of fibre-cement of 9 mm minimum thickness, with a minimum overlap of 20 mm along the length of each panel. The fastening of this siding to the framework shall be as in 6.4.13.1. Butt-end joints shall be formed on studs and an acceptable strip of 250 µm polyolefin shall be placed beneath the joint and shall be lapped over the weatherboard strip below. Butt-end joints shall be staggered. Before painting, the joint may be filled with a compatible, exterior grade, non-hardening acceptable paint grade sealant. (See figure 53.)

6.4.13.3 Masonry veneer

6.4.13.3.1 General

Masonry cladding to timber frames is generally regarded as a veneered wall. A timber frame structure is normally based upon either a 400 mm or a 600 mm grid to make the most effective use of the cladding material. The grid is, however, not compatible with the preferred modular size of 190 mm or 288 mm of the masonry and cutting is required unless the panels and openings are specifically designed to suit masonry unit brick dimensions, but these problems will only occur where a narrow section of masonry is required. A single leaf of masonry, with units that comply with SANS 227, shall be built up on the outside of the timber framework and supported on the foundation wall.

6.4.13.3.2 Wall ties

Masonry cladding shall be tied to the outer face of the external wall framing by means of corrosive-resistant ties that are built into the joints at vertical intervals of not more than 400 mm and fixed to alternate studs in a staggered pattern. The ties shall be formed either from galvanized hoop iron that is at least 25 mm wide and 1,25 mm thick, or from galvanized steel wire of diameter at least 4 mm. (See figure 45 for alternative types of wall ties.)

In areas where excessive corrosion is to be expected, for example, coastal areas, the ties shall be of stainless steel, or of galvanized steel coated with a coal-tar epoxy.

6.4.13.3.3 Expansion joints

Expansion joints shall be positioned not further than 10 m apart for masonry units. All expansion joints shall be 10 mm wide. Any element attached to the timber frame which overhangs the masonry shall have a clear gap of between 6 mm and 10 mm beneath it and the top of the masonry to allow for differential movement.

6.4.13.3.4 Cavities

A gap at least 40 mm wide shall be maintained between the masonry veneer and the timber wall framing. Weepholes shall be provided in the masonry cladding directly over the damp-proof course at the base of the wall panels with spacing of 1 m maximum. The gap between the wall and the roof shall be closed off with a fire stop, at ceiling level, around the entire perimeter of the building to prevent any spread of fire from the cavity of the roof space. This 40 mm gap shall be used to house plumbing pipes and electrical conduits.

To ensure that no loads are transmitted from primary roof supporting members that pass through the masonry veneer, gaps of at least 10 mm between the masonry and the underside of the roof members, and at least 6 mm between the masonry and the sides of the roof members, shall be provided.

NOTE The cavity formed by setting the framework 40 mm back from the inner face of the brick veneer should remain clear and no pipes, plumbing or electrical conduits should be placed in this space as this might form a bridge across which water and dampness can travel. Ample space will be provided within the framework itself for this purpose.

6.4.13.3.5 Lintels

Lintels over openings in the brick veneer shall be prestressed concrete lintels that comply with SANS 1504 or shall be of reinforced masonry, as follows:

a) for spans of up to 2,5 m, a minimum lintel depth of at least 400 mm is required with a single layer of masonry reinforcing or a single 6 mm diameter mild or high tensile steel rod embedded in the lowest bed joint of the lintel;

b) for spans exceeding 2,5 m but not exceeding 2,8 m, the minimum lintel depth shall be least 500 mm with the same reinforcement as for (a), and

c) for spans exceeding 2,8 m but not exceeding 3,0 m, the minimum lintel depth shall be 600 mm with single layers of masonry reinforcing in the lowest and second lowest bed joints of the lintel, or a single 6 mm diameter mild or high tensile steel rod embedded in the lowest bed joints of the lintel. To control cracking in spans that exceed 2,0 m, an additional layer of masonry reinforcement shall be used, or a single 6 mm diameter mild or high tensile steel rod shall be embedded in the topmost bed joint of the masonry lintel.

All reinforcement shall project at least 300 mm beyond the edge of the opening and, where closer than 300 mm to a corner, the reinforcement shall be taken around the corner for at least 300 mm. Joint spacing shall be as described in SANS 10249.

6.4.13.3.6 Rain penetration

In order to cope with possible rain penetration, the following measures shall be taken:

a) damp-proofing membranes shall be provided to isolate the timber framing, i.e. the bottom plate members, from water which might penetrate the masonry veneer (see figure 44);

b) good quality dense bricks shall be used for the lintels;

c) unless the walls will be plastered, all mortar joints shall be well filled and tooled with a steel jointing tool to seal their external surfaces;

d) the galvanized steel ties between the brick veneer and the wall framing shall be either so kinked as to provide a drip, or so fixed as to slope slightly upwards to the studs (see figure 45); and

e) the gap between the brick veneer and the timber framing shall be kept free from any mortar droppings which might form a moisture bridge across the gap.

Structural details of the method of construction of the timber frame brick veneer are shown in figures 44 and 46.

6.4.13.4 Aluminium and vinyl siding

Aluminium and vinyl decorative siding and finishing trims shall be attached in accordance with the manufacturer's specifications and shall be used on sheathed walls only.

6.4.13.5 Fibre-cement, composite board, hardboard, plywood and particleboard cladding

6.4.13.5.1 General

The type of exterior cladding on walls will greatly affect the appearance of the building and the cost of maintenance and should therefore be selected with care. Types of cladding commonly used are fibre-cement, composite board, hardboard, plywood and particleboard. Where applicable, cladding shall comply with the requirements of SANS 10237.

6.4.13.5.2 Fibre-cement cladding

Pressed or unpressed fibre-cement flat sheets that comply with SANS 9933 or SANS 803 may be applied to sheathed or unsheathed walls. When applied to unsheathed walls, the unpressed flat sheets shall be at least 9 mm thick, and fixed to studs at centres that do not exceed 450 mm. Fixing by means of nails and screws along the extreme edge shall be avoided. Edges shall be held in position by means of cover strips that are screwed or nailed to the studs between the adjacent sheets. If cover strips are not used, no fixing point shall be less than 10 mm from the edge of a sheet, and holes shall be drilled 1 mm larger than the size of the fixing screw or nail. There shall be a 2 mm gap between sheets, to allow for any slight movement

The butt joint shall be backed with a fibre-cement strip, a bitumen-impregnated building paper strip or a strip of 350 µm polyolefin sheeting to prevent moisture from penetrating to the timber framework. The open joint shall be filled with an acceptable non-hardening sealant as recommended by the manufacturers of fibre-cement products.

Strip weatherboard cladding of fibre-reinforced cement sheeting or unpressed fibre-cement sheets cut into strips and fixed by means of nails or screws to studs spaced at centres that do not exceed 600 mm may also be used. Corrosive-resistant nails or screws shall be used for fixing, to ensure that the painted surface will not be blemished. The nails or screws shall be spaced at 150 mm centres along (and at least 10 mm from) the edges.

6.4.13.5.3 Composite board and hardboard cladding

Pressed composite board and hardboard sheets may be applied to unsheathed walls and shall be at least 12,5 mm thick for studs that are spaced at centres that do not exceed 450 mm. After the panels have been cut, all edges shall be protected with a non-hardening sealant before installation. A 2 mm gap shall be allowed between the sides and the ends of the panel, to permit expansion without bulging. Vertical joints shall be properly filled and sealed with an acceptable exterior grade non-hardening sealant compatible with the edge sealant, such as silicone or two-part polysulfide or a polyurethane-based sealant that complies with SANS 1077, and if so required, shall be finished with a cover strip.

The edges of the panels shall be supported and fixed by means of corrosion-resistant nails or screws or by means of an acceptable type of casein-based glue or synthetic resin. When nails or screws are used, they shall be spaced at 150 mm centres along the edges, and 300 mm at intermediate supports.

Composite board and hardboard shall be of an exterior quality that complies with the requirements of SANS 929 and SANS 540-2, respectively. Composite board and hardboard may also be cut into strips and fixed either vertically or horizontally, or machined to form bevel siding and fixed horizontally.

6.4.13.5.4 Plywood cladding

Exterior quality plywood that complies with SANS 929, is also used as a wall covering. The joints may be V-grooved, flush or covered with a plain or moulded cover strip. Plywood sheets may also be cut into strips and fixed either vertically or horizontally as lap cladding or machined to form bevel siding and fixed horizontally. The minimum thickness of plywood applied directly to unsheathed wall framing shall be 12 mm.

After the plywood panels or strips have been cut, all edges shall be protected with a non-hardening sealant before installation. A 2 mm gap shall be allowed between the sides and the ends of the panels and the butted ends of the strips to permit expansion without bulging. Vertical joints shall be filled with a non-hardening mastic, or finished with a cover strip. Horizontal joints shall be flashed or lapped by at least 25 mm. The method of installation and fixing shall be as given in 6.4.13.3.2.

6.4.13.5.5 Particleboard cladding

Exterior grade particleboard that complies with the relevant requirements of SANS 50312-5 and SANS 50312-7 and of thickness at least 15 mm, may be applied to unsheathed walls.

After the panels have been cut, all edges shall be protected with non-hardening sealant before installation. The method of installation and fixing shall be as given in 6.4.13.3.2.

6.4.13.5.6 Mesh-reinforced plaster finish

6.4.13.5.6.1 In the case of a mesh-reinforced plaster finish, the base cladding on the outside face of the external load-bearing wall framing shall be of weather-resistant sheet products, such as fibre-cement, weather-resistant particleboard, or other durable boards. The boards shall be fixed horizontally to all members of the wall framing by means of 40 mm long clout nails spaced at centres that do not exceed 200 mm. The joints shall be reinforced with polyester or wire scrim, and flush-plastered with a sealing and jointing compound.

A layer of tar building paper shall be stapled to the exterior face of the weather-resistant boards, on the line of the wall studs at 300 mm vertical centres. The paper shall be applied with its long axis horizontal, starting with the lower portion of the wall. The paper covering the upper portion of the wall shall be lapped over the lower layer by at least 75 mm. Galvanized wire mesh (such as chicken mesh), with openings of nominal size 25 mm, shall be fixed as lathing over the tar paper. The mesh is usually fixed by means of 45 mm long steel nails. The nails shall be driven through the tar paper and boards into the timber framing at 200 mm centres. Each nail shall be driven through a plasticized PVC type spacer, to hold the tightly drawn mesh about 9 mm away from the face of the boards. Holes for nails shall not be pre-drilled. Where mesh is joined, a lap of at least 75 mm shall be provided. A temporary corner former shall be used during fixing, and the corner former shall be removed before plastering.

6.4.13.5.6.2 Two coats of plaster to a total thickness of 25 mm extending down to approximately 30 mm below the top of the foundation wall shall be applied. The first coat (scratch coat) shall be roughened to form a key and dried until most of the shrinkage has taken place. It shall be lightly sprayed with water before the coating, which can be finished as required (brushed, floated, Spanish-plastered, etc.), is applied. The finished plaster work shall be cured by spraying it with water at regular intervals for about 4 d. The plaster mix shall be one part cement, one part sharp river-sand that complies with SANS 1090, and four parts plaster sand that complies with SANS 1090 with the addition of a plasticizer which shall be used as prescribed by the manufacturer. A specially shaped plaster trim or flashing of corrosion-resistant material, such as pre-painted galvanized steel, may be installed along the bottom edge of the plaster, and weepholes shall be provided at approximately 300 mm centres.

6.4.14 Insulation

6.4.14.1 Blanket insulation

Blanket insulation in roll form or of the batt type and with a minimum thickness and density in accordance with 6.4.14.2, shall be used in all external walls. Such insulation may also be effectively used above ceilings or in the space between a ceiling and the floor above. Loose-fill insulation, which is poured or blown into the roof spaces may also be used. (If it is used in a ventilated roof space, some form of covering should be used.)

6.4.14.2 Thermal insulation

6.4.14.2.1 General

The overall thermal transmittance of a building element is calculated by taking into account all the resistance to heat flow, air-to-air, from one side of the building element to the other.

When thermal insulation is applied to buildings, problems which do not normally arise when considering features such as boiler plants and pipelines, are encountered.

The main problems involved are the following:

a) Wall and window structures are highly composite and complex, and their nature can vary over a 24 h period, for example, when curtains are drawn at night.

b) The effect of ventilation is large and difficult to measure. It varies considerably over a 24 h period as doors are left open, windows are not properly shut, etc.

c) The internal temperature differs from room to room, and also during the different hours of the day.

d) The strength and direction of the wind is one of the most important variables in heat transfer to the outside. This varies considerably in the different parts of a house and can only be accurately assessed by wind-tunnel tests, which are impracticable.

e) During the day, solar radiation upon the building structure produces a surface temperature which is higher than the ambient temperature. This is known as the sol-air temperature. Similarly, at night, there is radiation heat exchange between the walls, windows and roof surfaces with layers of air very high up. Radiation cooling takes place, causing the external surface temperature of the building to be much lower than the ambient external air temperature.

6.4.14.2.2 Walls

6.4.14.2.2.1 The thermal transmittance (U) through walls is expressed as 1,2 times the heat flow in watts per square metre per kelvins:

$$U \leq \frac{1{,}2\ Q}{L \cdot d \cdot T}$$

where

Q is the heat flow, in watts;

L is the length, in metres;

d is the thickness, in metres;

T is the temperature difference, in kelvins.

Table 15 gives various ways in which walls can be constructed to achieve such values.

6.4.14.2.2.2 The following insulation can be used in all external walls:

a) glassfibre insulation, which shall be at least 50 mm thick and which shall have a density of at least 16 kg/m^3; or

b) mineral wool insulation, which shall be at least 50 mm thick and which shall have a density of at least 60 kg/m^3.

Table 19 gives the thermal transmittance of certain types of construction and table 20 gives the thermal transmittance of glazing materials.

6.4.14.2.3 Roof and ceiling

6.4.14.2.3.1 The thermal transmittance (U) through the roof and ceiling can be calculated as follows:

$$U \leq \frac{0{,}9\ Q}{L \cdot d \cdot T}$$

where Q, L, d and T have the meanings given in 6.4.14.2.2.

This will usually imply a minimum thickness of 45 mm of mineral wool insulation (or equivalent material) above the ceiling.

6.4.14.2.3.2 The following insulation can be used above the ceilings of timber frame buildings:

a) glassfibre insulation, which shall be at least 40 mm thick and which shall have a density of at least 16 kg/m^3; or

b) mineral wool insulation, which shall be at least 40 mm thick and which shall have a density of at least 60 kg/m^3.

NOTE Other types of insulation used in the building industry are expanded polystyrene, extruded polystyrene, polyurethane foam, phenolic foam, expanded perlite, wood fibre, etc. These products should be used as specified by the manufacturer.

Table 19 — Thermal transmittance of certain types of construction

1	2
Materials	**Thermal transmittance** $U \leq \frac{Q}{L \cdot d \cdot T}$
20 mm timber cladding + air space + 12,5 mm plasterboard	1,9
20 mm timber cladding + air space + 12,5 mm plasterboard + 25 mm mineral wool	0,9
20 mm timber cladding + air space + 12,5 mm plasterboard + 50 mm mineral wool	0,6
20 mm timber cladding + air space + 6 mm hardboard + 25 mm mineral wool	0,9
20 mm timber cladding + air space + 6 mm hardboard	2,0
6 mm fibre-cement + air space + 5 mm hardboard + 25 mm mineral wool	1,0
20 mm timber cladding + air space + 12 mm soft board + 5 mm hardboard	1,1

Table 20 — Thermal transmittance of glazing materials

1	2
Type of glazing	**Thermal transmittance** $U \leq \frac{Q}{L \cdot d \cdot T}$
Single glazing	5,4 to 5,8
Double glazing	2,8 to 3,0
Double glazing with low emission glass (low E glass)	1,7 to 2,0
Triple glazing with low emission glass (low E glass)	1,0 to 1,2

6.4.14.2.4 Floor finish materials

In all regions, except the subtropical coastal region, preference should be given to concrete floors finished with materials such as burnt clay tiles or other materials that are less than 3 mm thick, for example, polymeric tiles, linoleum and cork.

6.4.14.2.5 Orientation of buildings

6.4.14.2.5.1 The orientation of buildings is of prime importance and the use of large glazed areas should be avoided, particularly if they are subjected to direct solar radiation in summer.

6.4.14.2.5.2 Buildings should be orientated with their long axis running as near east to west as possible, and the east-facing and west-facing walls should be as short as is practicable. Windows facing east and west should be limited in number and confined in area to the minimum required for light and ventilation.

6.4.14.2.5.3 Where the recommendations in 6.4.14.2.5.1 and 6.4.14.2.5.2 are not followed, some form of permanent external shading to glazed areas that face more than 30° away from true north, or special glass with a shading coefficient not higher than 0,3 should be provided.

6.4.14.3 Sound insulation

6.4.14.3.1 Comprehensive information and a range of values for acoustic performance used for the grading of buildings can be found in SANS 717-1 and SANS 717-2.

Table 21 gives the minimum recommendations for in-situ airborne sound insulation for dwelling units, and table 22 gives some sound-reduction indexes, in decibels.

Table 21 — Sound insulation recommendations

1	2	3
Type	**Sound insulation levels** dB	
	Between rooms in a dwelling unit	**Between dwelling units**
Minimum airborne sound insulation	33	45
Airborne sound insulation for comfort	37	50

6.4.14.3.2 The many alternative construction details possible in timber and timber frame buildings and the severe problems of flanking sound transmission in these constructions make it impossible to lay down general acoustic guidelines. A list of sound-reduction indexes for the various wall and floor materials will be misleading because it could lead non-specialists to believe that the sound insulation between dwellings is determined by the acoustic properties of those elements.

The effectiveness of a barrier as a sound insulator is determined by the following factors:

a) the mass of the barrier, whereby a heavy structure is a more efficient sound insulator than a light structure;

b) holes in walls, like gaps between walls and the floor, walls and the ceiling, walls and doors, or back-to-back electric plugs, can cause a significant loss in sound insulation across the barrier;

c) a door with a low sound index incorporated in a wall with a high sound index will adversely affect the performance of the composite barrier;

d) impact sound, in the case of a timber floor construction, can also be a problem.

Table 22 — Sound-reduction indexes

1	2
Construction specification	**Sound-reduction index** dB
1. 12,5 mm plasterboard on both sides with 76 mm × 38 mm studs at 600 mm centres	36
2. As for (1), with 25 mm mineral glass wool in the cavity	40
3. 12,5 mm plasterboard with 76 mm × 50 mm studs at 600 mm centres	41
4. As for (3), with 12,5 mm plasterboard on both sides	45
5. 2 × 12,5 mm plasterboard bonded together on both sides with 76 mm × 38 mm studs at 600 mm centres	45
6. As for (5), with 25 mm mineral glass wool in the cavity	46
7. 2 × 12,5 mm plasterboard bonded together on both sides with 76 mm × 38 mm studs at 600 mm centres, and with resilient bars fixed horizontally at 450 mm centres on the inside	46
8. As for (7), with 25 mm mineral glass wool in the cavity	50

6.4.14.3.3 Provided that acceptable steps are taken to restrict flanking sound transmission, cavity-separating walls of lightweight construction can achieve a high enough grade of sound insulation to be used as a party wall. The following measures are recommended to reduce sound transmission:

a) Placing a window not less than 300 mm from the end of any wall panel will ensure that acceptable resistance to sound transmission is provided (between dwellings and between adjoining rooms).

b) By careful planning, rooms that require a higher degree of sound insulation should be separated from one another by means of buffer rooms, for example, a lobby, a dining-room or a passage. Similarly, bathrooms and toilets should not directly adjoin living rooms.

c) Where it is difficult to plan effective separation between rooms by means of buffer rooms, sound transmission can be reduced by building built-in cupboards between such rooms. The effectiveness of such measures will, however, depend on the size of the cupboard, whether it stretches the full width and height of the wall, and also the contents of the cupboard. Soft goods such as clothes will be more effective than hard contents such as books.

6.4.14.4 Resistance to moisture

6.4.14.4.1 Rain penetration in external walls

Resistance to rain penetration at the junction between window or door frames and walls is dependent on the constructional detailing, choice of materials for damp-proofing, flashings, sealants, etc., and careful supervision during construction. Where there is any doubt about the acceptability of external walls (for example, if an uncommon type of siding is used) a specimen of a typical external wall with a window installed, should be tested for rain resistance. The test shall be carried out using the relevant test in the relevant part of SANS 10400, and the wall shall meet the criteria specified therein. Waterproofing of the building shall be done in accordance with SANS 10021.

6.4.14.4.2 Condensation

In areas that are subjected to long periods of extreme cold, movement of vapour from inside the building into the stud spaces (or both) may result in condensation in the insulation or on the framing members, damage to exterior cladding and the paint, and mould growth, wood rot and corrosion of the metal fixings, etc. For protection, a vapour barrier should be used on the warm side of the wall or below the insulation in a roof. Effective barriers are formed by paper coated on both sides with asphalt, aluminium foil insulation, plastics sheeting, aluminium-foil-backed gypsum plasterboard, and paint. Certain types of blanket-type insulation material have a barrier material on one side of the blanket.

Where the membrane type of barrier is used, it shall be applied vertically over the face of the studs and tacked down, and the wall finish shall then be applied over the barrier. Because no barrier is totally effective and some vapour leakage into the wall can therefore be expected, the flow of vapour to the outside shall not be impeded by materials of relatively high vapour resistance on the cold side of the vapour barrier (for example, if sheathing paper is used, it should be of a type that is waterproof but not highly vapour resistant).

Surface condensation is a problem found in all types of buildings and is aggravated by the overcrowding of dwellings and the sealing off of all natural ventilation during the cold winter months.

Attention is drawn to the following factors, which are primarily sociological, and will directly affect the occurrence of condensation in any building:

a) If the number of occupants in a building could be limited to the number for which it was designed, the problem would be considerably reduced.

b) Where electricity is available, the use of either gas or paraffin for the purpose of cooking, heating or lighting should, as far as possible, be avoided.

c) Water vapour that is generated by the occupants of dwelling units and that condenses on the cold inside surfaces of windows during the night should not be allowed to accumulate in the form of water condensate on the sills, but should be collected and discharged directly to the outside. This can be achieved by forming a small channel at sill level on the inside of the window, with an outlet on both sides.

d) It is advisable to provide all the open sections of bedroom windows with burglar-proofing so that they can safely remain open during the day and night for ventilation.

6.4.15 Interior walls

6.4.15.1 General

Although there is little difference in the construction of load-bearing and non-load-bearing stud frame internal walls, the following is usually applicable:

a) Load-bearing walls which support floors, ceilings or roofs shall have studs of the same size and with the same spacing as those recommended for exterior walls (see 6.4.2), which are set with the greater dimensions perpendicular to the walls and capped with a continuous top plate of 38 mm timber (to suit the stud size) tied into exterior walls at the points of intersection. Where openings occur, loads shall be carried across the openings by headers similar to those recommended for exterior walls. (Floor framing over a load-bearing wall is shown in figures 33 and 34).

b) Non-load-bearing walls which carry only their own mass, may have 114 mm × 38 mm studs or 76 mm × 38 mm studs set with the greater dimension perpendicular to the wall, or 76 mm × 50 mm studs set with the greater dimension either parallel or perpendicular to the wall. Studs shall be spaced at centres between 400 mm and 600 mm, depending on the type of wall covering. (The attachment of a non-load-bearing wall to floor framing is shown in figure 29.)

NOTE 1 An alternative to the method in (b) is to add a full depth joist as a fire stop on the centre line of the frame and then use 38 mm × 38 mm battens to block out the open portion on either side of the frame to carry the ceiling board.

NOTE 2 If the layout of the first floor does not coincide with the ground floor layout (as shown in figure 31), the internal wall frames should be constructed as for platform construction (see figure 33).

6.4.15.2 Interior wall finishes

The product most commonly used for dry wall application is gypsum plasterboard that complies with SANS 266. Plywood, particleboard, fibreboard, fibre-cement sheets, glass-reinforced cement, or timber in various forms are also used for dry wall construction, the choice often being determined by personal preference. The sheet materials may be applied either vertically or horizontally, but where dimensions are such that full size sheets can be used, horizontal application might be preferable as this minimizes the number of vertical joints. (See figure 58.)

Table 15 gives racking strengths which can be employed if additional strength is required. Sheets should be fixed to every stud and can be fixed vertically or horizontally. Where flush joints are required, gypsum plasterboard sheets shall be fixed with the joints touching. All the joints should then be filled with jointing material and taped. After drying, the joints shall be sanded before final coatings of paint are applied. Interior corners may be treated in the same way as joints. Corners shall be strengthened with a metal corner piece and rendered flush with a jointing compound.

In rooms where high humidity is likely to occur and where floors are periodically washed down (for example, bathrooms, toilets, kitchens and laundries.), precautions shall be taken, for example, timber and cladding shall be protected by tiling or painting according to the manufacturer's instructions and applicable standards.

6.4.16 Fire stops and cavity barriers

To prevent fire from spreading through the timber frame structure, the spaces in timber framing described in (a) to (f) shall be fire-stopped with timber filler blocks, accurately fitted to fill the opening and arranged to prevent air flow between one space and another (for example, between storeys and between the top storey and the roof) as follows:

a) Spaces in exterior walls between studs shall be fire-stopped with 38 mm nogging halfway between the bottom and top plates at each floor level and the ceiling level to the top storey. In some cases, particularly in platform frame construction, top and bottom plates will serve this purpose, but where they are not present, additional blocking shall be necessary (see figures 18, and 24).

b) Spaces between studs in interior walls shall be fire-stopped as recommended for exterior walls (see (a)).

c) Concealed spaces between floor joists shall be fire-stopped (for the full depth of the joists) with 38 mm blocking at the ends and over the supports. Where solid bridging is provided, it will usually be accaptable as a fire stop (see figures 28, 29, 33 and 34).

d) Spaces between the timber wall framing and masonry walls shall be fire-stopped at each floor level and at the top ceiling level by timber blocking thick enough to fill the space, or by non-combustible insulation material accurately fitted into the space.

e) Spaces between the timber framing and the chimney masonry of a fireplace at floors and ceilings shall be fitted with non-combustible insulation material.

f) In separating walls, a wire-reinforced mineral wool blanket shall be used.

6.4.17 Doors and windows

The type of doors and windows used are the same as those used in conventional constructions. Where steel-framed windows are used, the metal frame and the rough timber surround shall be sealed with a non-hardening waterproof sealant. (See figures 55, 56 and 57.)

6.4.18 Framing around chimneys and fireplaces

All headers, beams, joists and studs shall be at least 50 mm away from any chimney and at least 100 mm away from the back of any fireplace, and the gaps shall be filled with non-combustible insulation material. Where the flue is of brickwork and of thickness at least 190 mm, the size of the gap may be reduced, but timber shall not be in direct contact with the brickwork. Floor framing around a fireplace is shown in figure 49. The width of the hearth, from the nearest face of the masonry to the double header, shall be at least 450 mm. All timber mantels and similar trim shall be at least 150 mm from the sides, and 300 mm from the top of the fireplace opening.

The parts of the mantel that project more than 38 mm from the face of the fireplace shall have additional clearance which is equal to the projection.

NOTE The installation of pre-manufactured steel fireplace units is common, and this should be done in accordance with the manufacturer's specifications.

6.4.19 Stairs

6.4.19.1 General

Stairways shall be designed and installed so as to afford acceptable headroom and space for the passage of furniture. Stairs shall be designed for ease and comfort and the stairway shall have at least 920 mm wide clear space.

The layout of staircases, the ratio of treads to risers, the design of handrails, etc., shall be in accordance with the relevant part of SANS 10400. Large openings in the floor for stairwells shall be suitably framed with double headers and double trimmer joists. Typical forms of staircase framing are shown in figures 50 and 51.

6.4.19.2 Ratio of tread to riser

A rise of between 177 mm and 190 mm with a run of approximately 250 mm is acceptable for both comfort and safety. As the height of a riser is increased, the width of the run should be decreased for comfort. Where space does not permit these dimensions, the following limitations should be observed:

a) maximum rise: 200 mm

b) minimum tread width: 250 mm.

6.4.19.3 Design of stairways

Once the location of the stairway is known, the height of the rise and the width of the run shall be fixed. An acceptable height for the rise shall be chosen and the height between the finished floor levels of the two storeys under consideration shall be divided by the height of the rise. If the answer results in a fraction, the next higher or lower number shall be taken and the storey height shall be divided by this number. This will give the actual height of the rise. The width of the run is established by dividing the number of treads into the total run of the staircase.

The headroom is the vertical distance from a line drawn through the outer edge of each nosing to the underside of the ceiling. The minimum headroom shall be 2 m.

The treads and risers shall be supported on stringers which can be cut out to allow for the positioning of the risers and treads. An easier method would be to nail cleats to the stringers to support the treads and risers (see figure 51).

6.4.19.4 Minimum requirements

Where stringers and other structural elements are not specifically allowed for, the following minimum requirements shall apply:

a) stringers shall have a minimum thickness of 50 mm with an overall depth of at least 228 mm;

b) a third stringer shall be used when the width of the stairway is more than 915 mm;

c) the treads shall consist of 50 mm thick boards; and

d) where risers are used, the tread thickness shall be at least 25 mm.

6.4.20 Electrical wiring

The electrical wiring system shall be installed before insulation is placed in the walls or ceilings, and before interior linings are fixed. Holes for conduits can be drilled into studs without greatly affecting their strength, but in joists, such holes shall be located at least 300 mm away from the ends of studs (and other members) (see figure 14). Holes shall be located at such a distance from the edges that the nails used for attaching the interior finish and flooring will not penetrate the conduit. (See figure 59 for the fixing of an electrical socket box.)

The entire wiring system shall be of a type approved by the authority that supplies the power and shall comply with the requirements of SANS 10142-1.

Where switches or outlet boxes are located in exterior walls, insulation shall be placed behind the box. The outlet of the box shall be marked on the vapour barrier (where applicable, see 6.4.14.4), which shall then be cut so that it will fit tightly around the box.

6.5 Timber roof framing

6.5.1 General

Light timber roof construction in timber frame buildings with a span of less than 10 m shall conform to the normal standard practices used in conventional buildings, appropriate to the type of roof covering to be used. The members shall support their own dead weight and the dead weight of the roof covering, the live and wind loads, as described in SANS 10160, as well as loads that occur during erection. The main supporting structures used in the basic roof construction shall either be trusses, which shall be designed, manufactured and erected in accordance with the relevant part of SANS 10163 and SANS 10243, or in the case of flat or low-pitched roofs, solid or laminated timber rafters. To counteract any lateral movement, roof trusses shall be acceptably stayed and braced by means of diagonal timber bracing or bracing frames that are nailed to the underside of the rafters where the roof covering does not comprise large sheets. Deep slender rafters shall also be acceptably braced or bridged to prevent buckling. Roof trusses that exceed the maximum span limit shall be specially designed in accordance with the relevant part of SANS 10163.

6.5.2 Light and heavy roof coverings

The truss spacing of roofs with heavy coverings, such as clay or cement tiles, shall not exceed 750 mm with 38 mm × 38 mm battens that are commonly used for tiles. Brandering and battens shall comply with SANS 1783-4 or SANS 1707. Where applicable, roof cladding shall comply with SANS 10237. All roofs are required to provide reasonable resistance to the passage of moisture and dust to the inside of the building. The spacing of trusses or rafters that support light roof coverings shall not exceed 1 350 mm.

NOTE Large spans cause excessively large truss reactions and difficulty in providing acceptable anchorage for purlins and trusses against wind uplift, particularly with the larger purlin spacing, which is often used with long-span roofing. The truss spacing given in this subclause is considered to be the most acceptable maximum span for the normal purlin size of 76 mm × 50 mm on edge.

6.5.3 Rafters and trusses

Timber used for rafters and trusses shall comply with SANS 1783-2. Rafters and trusses shall be correctly designed for the relevant span and loading, with special attention given to the connections between the individual truss members to prevent failure and excessive deflection. Unless the trusses are specially designed, the bearing point of the trusses on the load-bearing timber framework shall be directly under the centre lines of the rafter (top chord) and the tie beam (bottom chord). The trusses shall be manufactured and erected in accordance with SANS 10243 or the relevant part of SANS 10400.

6.5.4 Anchoring

Various acceptable methods of anchoring roof trusses and rafters to load-bearing timber wall frames may be used for different geographical regions, depending on the truss spacing and the type of roof covering that is used, as given in table 23.

Where the members that support the roof are situated over the wall studs, they shall be skew-nailed to the wall plate or top plate by means of two 90 mm nails and, in addition, anchored directly to the stud by means of a galvanized (preferably stainless steel) hoop-iron strap. This strap shall be

a) in the form of an inverted U,

b) shaped over the truss and nailed on both sides,

c) twisted and nailed to the face of the wall plate or top plate (or both) of the frame, and

d) twisted again and nailed to both sides of the stud, with at least three 40 mm round wire nails to each side (see figure 60(a)).

Alternatively, a length of galvanized hoop-iron strap shall be fixed to the face of the stud, taken up and bent over the top of the tie beam, and nailed at each end with three 50 mm round wire nails (see figure 60(d)). Where trusses are not situated directly over the stud, a U-shaped anchor, as described above, shall be twisted and nailed to the face of either the wall plate or top plate with a 40 mm round wire nail, then bent under the top plate and nailed to the underside with a similar nail (see figure 60(b)). Alternatively, the truss or rafter shall be bolted to the wall plate or top plate (or both) with a 3 mm thick angle bracket fixed with bolts and fitted with a steel washer of 25 mm diameter on the timber side (see figure 60 (c)).

The hardware used for anchoring shall be either galvanized steel, with galvanizing in accordance with the relevant standard, or stainless steel. In coastal regions, all galvanizing shall be given additional corrosion protection by means of an epoxy-based coating. The twisted ends of galvanized wire anchors shall be similarly coated.

6.5.5 Ventilation of roof spaces

For flat roofs, the blocking and bridging shall be arranged so that it will not interfere with the movement of air. These roofs may be ventilated along the overhanging eaves (see figures 47 and 48).

6.5.6 Ceiling framing

If brandering is used for ceilings, it shall be nailed to the joists, roof trusses or rafters, and to external and internal walls. The ceiling covering shall be applied in conformity with conventional building practices and in accordance with the manufacturer's instructions.

Table 23 — Anchorage of roof to wall
(see figures 47, 48 and 60)

1	2	3	4	5	6
Roof slope degrees	**Geographic region** (see figure 1)	**Truss spacing**[a] mm	**Anchor required**[b]		
			Light roof construction		**Heavy roof construction**
			Single storey	**Double storey**	**Single or double storey**
< 15	A	760	a	a	a
		1 050	b	b	
		1 350	2 × a	2 × a	
	B	760	a	a	a
		1 050	2 × a	2 × a	
		1 350	2 × a	2 × b	
	C	760	b	a	b
		1 050	2 × a	2 × b	
		1 350	2 × b	2 × b	
15 to 30	A	760	a	a	a
		1 050	b	b	
		1 350	b	2 × a	
	B	760	a	a	a
		1 050	b	b	
		1 350	2 × a	2 × a	
	C	760	a	a	a
		1 050	b	2 × a	
		1 350	2 × a	2 × a	
> 30	All regions	All	a	a	a

[a] Maximum truss or rafter spacing for heavy tiles, metal tiles and sheets for which the specified anchorage applies (see the relevant part of SANS 10400).

[b] Anchor required:

a = 30 mm × 1,2 mm steel strap or 2 × 4 diameter wires.
b = 30 mm × 1,6 mm steel strap.

6.6 Painting and finishing

6.6.1 General

Wood and wood products in a variety of types, grain patterns, textures and colours are available for exterior and interior surfaces. These wood surfaces can be effectively finished by several different methods. Painting, which totally obscures the wood grain, is used to achieve a particular colour for decorative purposes. Preservatives which penetrate the wood and pigmented stains permit some or all of the wood grain and texture to show and provide a special colour effect as well as a rustic appearance. The type of finish, painted or natural, often depends on the type of wood. Walls consisting of plasterboard, fibre-cement cladding and wood cladding in wet areas, such as bathrooms, showers and splashbacks above sinks, shall be provided with special finishes such as tiling, lining with vinyl sheets or special paint.

All exterior woodwork shall be protected by means of painting or by the application of some other type of finish. The paint manufacturer's recommendations with regard to the types of paint, primers and undercoats and the method of application shall be followed, and primers and undercoats shall comply with the relevant requirements of SANS 678 and SANS 681, as applicable.

6.6.2 Pigmented penetrating stains

Pigmented penetrating stains are semi-transparent, permitting much of the grain pattern to show through, and penetrate into the wood without forming a continuous film on the surface. They will not blister, crack or peel even if excessive moisture enters the wood.

Penetrating stains are acceptable for both smooth and rough-textured surfaces, but their performance is improved if applied to rough-textured wood. They should always be applied in two coats, the second coat being applied before the first coat dries, so that both can penetrate the wood.

6.6.3 Paints for exterior wood

The durability of paint coatings on exterior wood is affected both by variations in the wood surface and the types of paint. The following is an example of a procedure for painting on exterior wood:

a) The wall siding shall be treated with a water-repellent preservative at the joints for protection against rain and heavy dew. Exterior woodwork shall be treated by brushing or spraying the preservative especially into the laps and butt joints and retreating end cuts. The preservative shall be allowed to dry properly before painting.

b) New wood shall be treated with three coats. The first, the primer coat, is the most important and shall be applied soon after the woodwork is erected and the top coats shall be applied within two weeks thereafter. Primers shall be used by following the spreading rate recommended by the manufacturer.

c) For the final coat, the manufacturer's instructions shall be followed.

6.7 Lightning protection

Protective measures against lightning shall be taken.

6.8 Fire protection

6.8.1 The fire resistance of a structural component is the length of time during which it will continue to support the serviceability load while subjected to a fire. Timber exposed to a fire of sufficient intensity to cause it to burn, chars at a fairly constant rate, regardless of the heat intensity, provided that no timber dimension is less than 25 mm. It may be assumed that the timber behind the charring line does not distort or lose strength to any significant extent. Although the charring rate depends on various factors such as the timber density, permeability, and moisture content, the rates reflected in table 24 give an indication of the charring rates depending only on the density of the wood. Reference shall also be made to the relevant part of SANS 10400.

6.8.2 The possibility of a fire breaking out depends more on the class of occupation (see the relevant part of SANS 10400) and living habits, than on whether the structure is of timber or other materials. Similarly, fire resistance may be regarded as a property of a structure rather than of any material used in its construction. When cladding and lining materials are being selected, however, the possibility of their promoting the spread of flames and damage to the main structure shall be considered and the fire-resistance properties of these materials shall be taken into account. The resistance to damage and the contemplated frequency of redecoration and replacement are also matters for consideration in this context.

Proprietary brands of paints and chemicals (for application either to the surface or by impregnation) that will improve the fire resistance of timber may be used.

Acceptable methods of preventing the spread of fire by the use of fire stops are referred to in 6.4.16. The fire protection of floors carried on timber joists at ground level is similar to that applicable to other types of building construction.

Where roofing felts are used, they shall have low flame-spread characteristics. Not all types of combustible roof coverings are recommended.

Table 24 — Charring rates of timber

1	2
Timber species	**Charring rate**[a] mm/min
Timber of average density ≤ 450 kg/m^3	0,8
Timber of average density > 450 kg/m^3	0,6
[a] The charring rate for Stocklam members may be considered to be identical to that for solid members.	

6.9 Maintenance

6.9.1 General

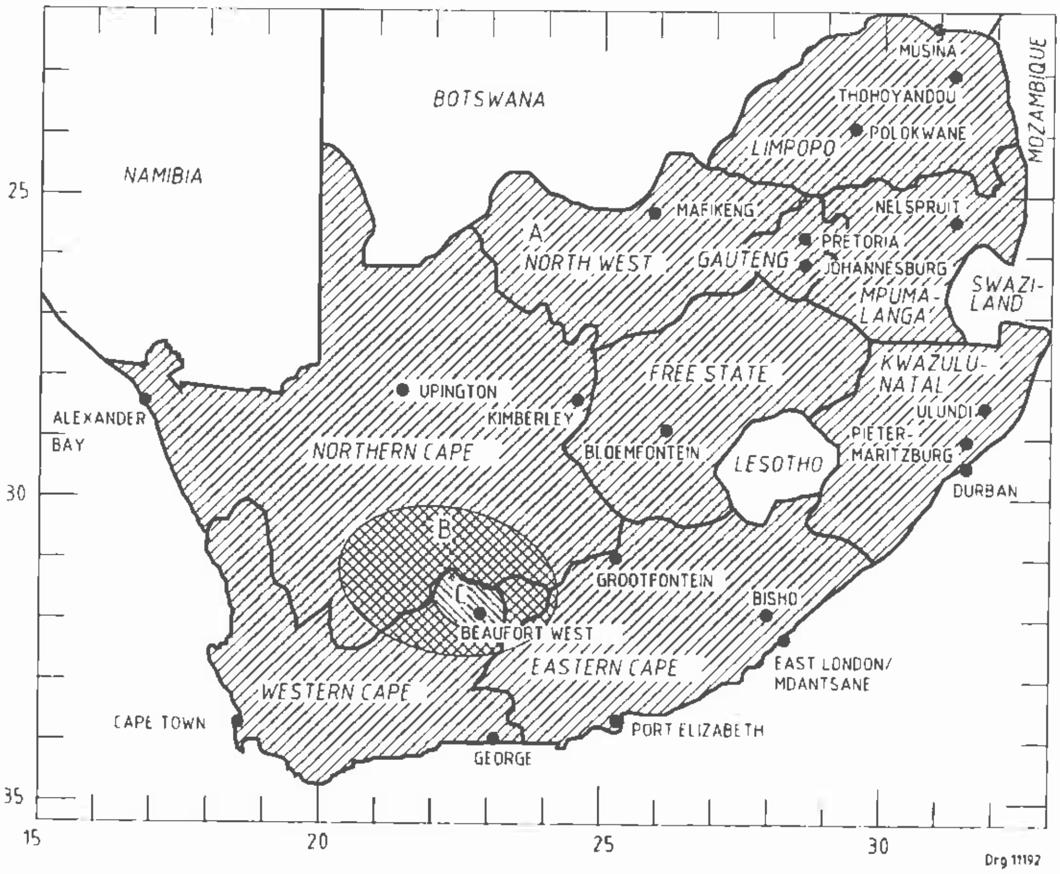
As in the case of all buildings, the life and efficiency of the constituent materials and the preservative treatments depend upon the quality of the materials and preservatives initially used, their suitability for the climate, and the purpose for which they are used.

It is impossible to lay down definite intervals for the maintenance of a timber building. Successful maintenance is best achieved by preventing deterioration. The surface treatment of cladding materials, exposed timbers, beams, frames and other components requires periodic attention and exposed surfaces shall be cleaned and retreated as soon as weathering is observed.

6.9.2 Superstructure

Where timber is subject to insect attack, it shall be examined regularly for borer attack, which might make itself apparent in the form of small holes and the deposit of fine dust from these holes. Replacement of affected timber is recommended but, if this is not practical, wet-spraying or brush-coating in situ with an acceptable insecticide shall be carried out by competent persons using the appropriate equipment.

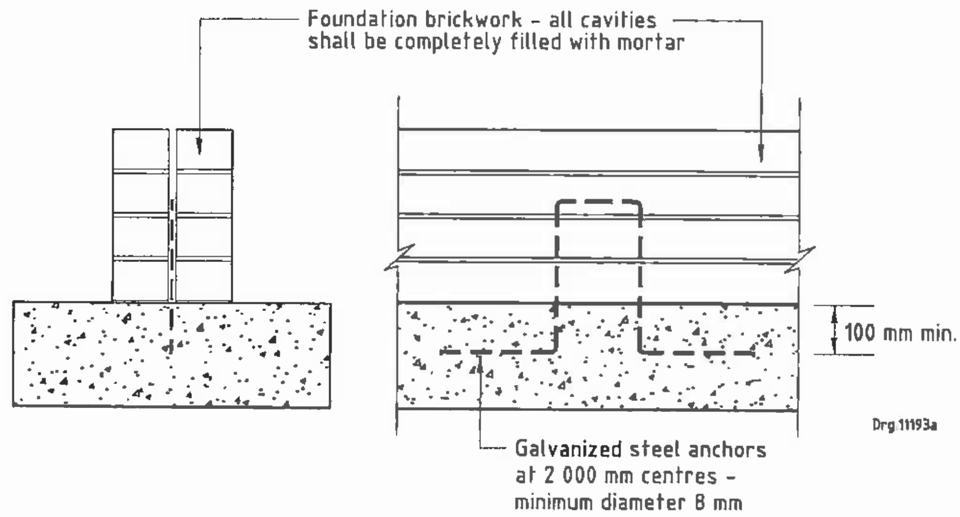
Loose bolts shall be tightened and corroded metal parts replaced or treated to prevent further deterioration.



Regional basic wind speed (see SANS 10160)

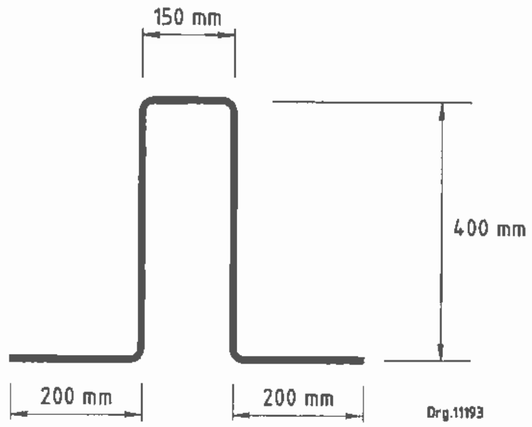
1	2
Region	**Wind speed** m/s
A	40
B	45
C	50

Figure 1 — Geographic regions related to wind speeds



a) Side view

b) Front view



NOTE This detail is required only in special cases where very squat elevations are required. See also table 3.

c) Detail of steel anchor

Figure 2 — Anchoring of foundation wall of minimal height to concrete strip footing

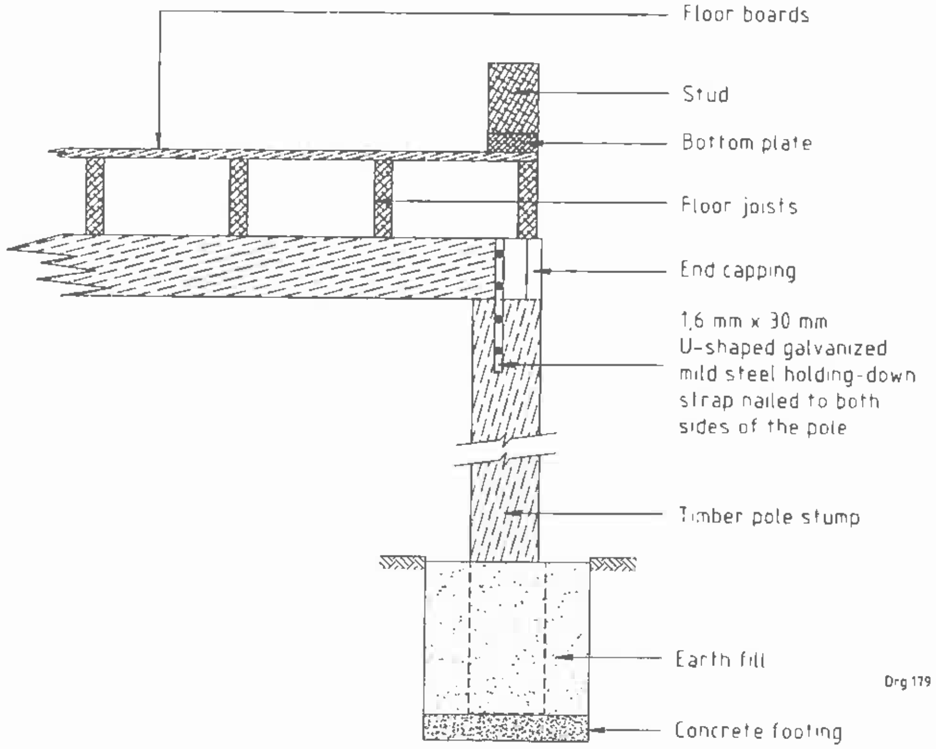
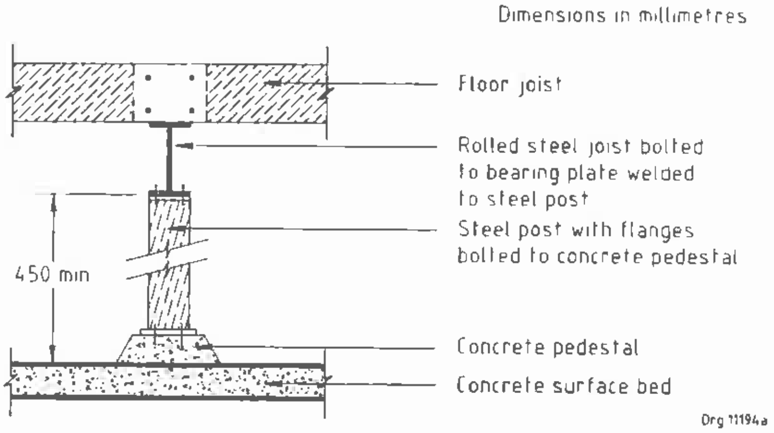
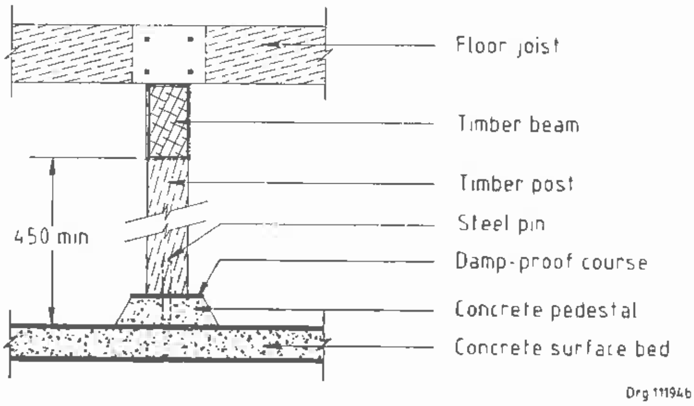


Figure 3 — Typical detail of a pole stump

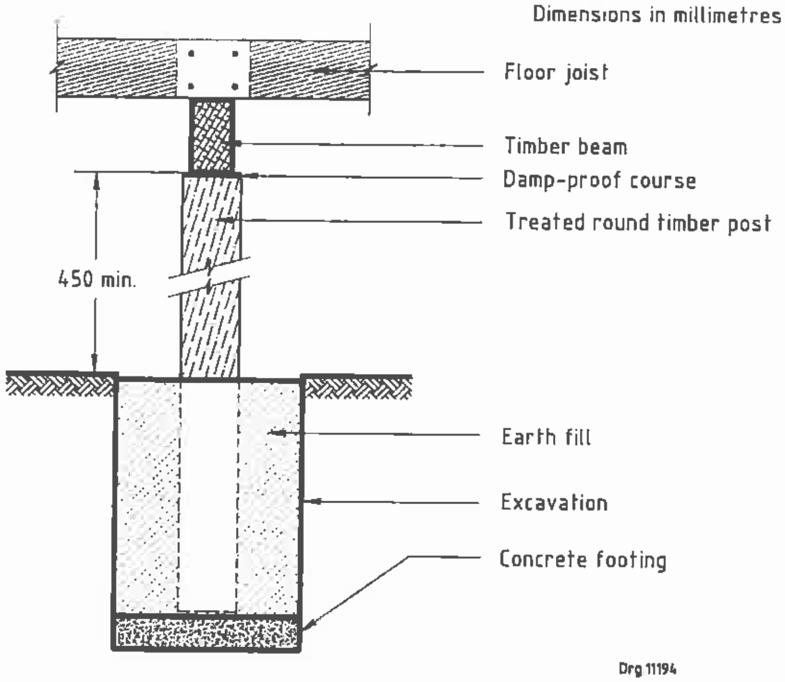


a) Steel post with steel joint in concrete surface bed



b) Timber post with timber beam in concrete surface bed

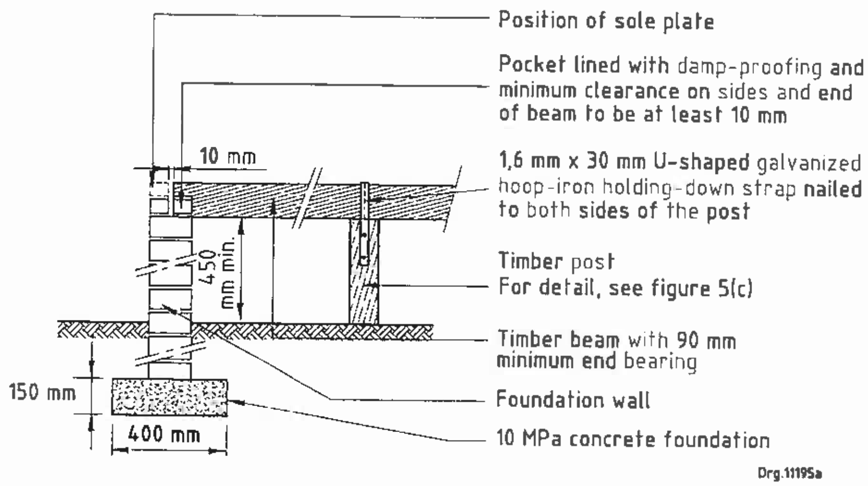
Figure 4 — Support of floors and walls



c) Round timber post with concrete footing

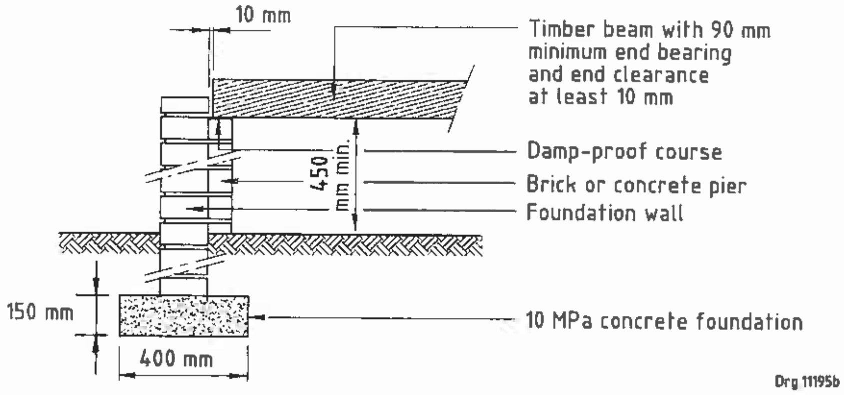
NOTE For footing sizes see table 4.

Figure 4 — Support of floors and walls (*concluded*)

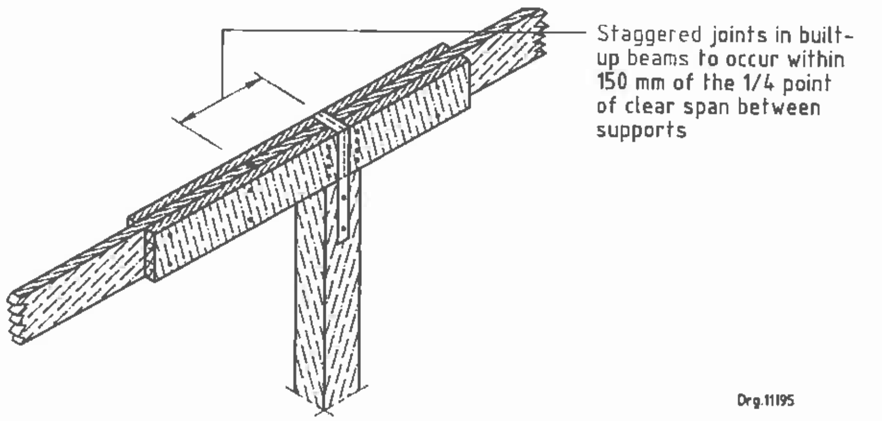


a) Beam within pocket

Figure 5 — Framing of beams into foundation walls



b) Beam on brick or concrete pier



c) Staggered joint in built-up beam

Figure 5 — Framing of beams into foundation walls *(concluded)*

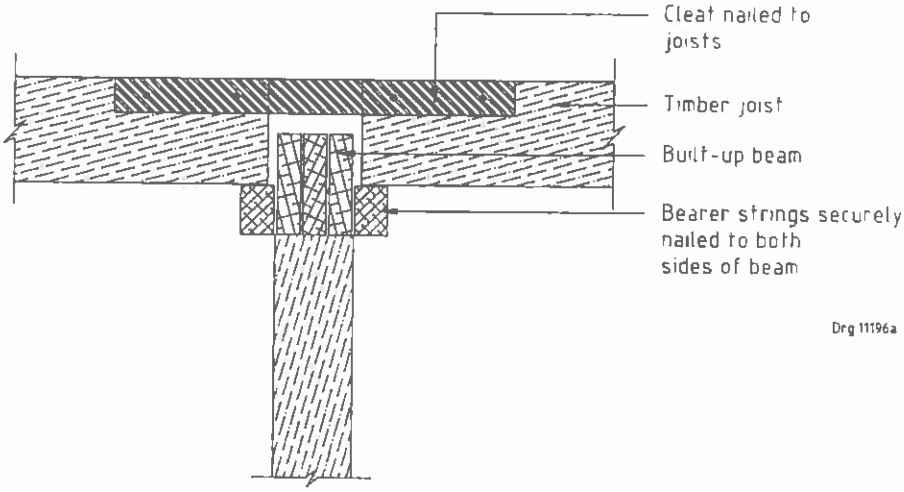


Figure 6 — Support of joists on timber beams

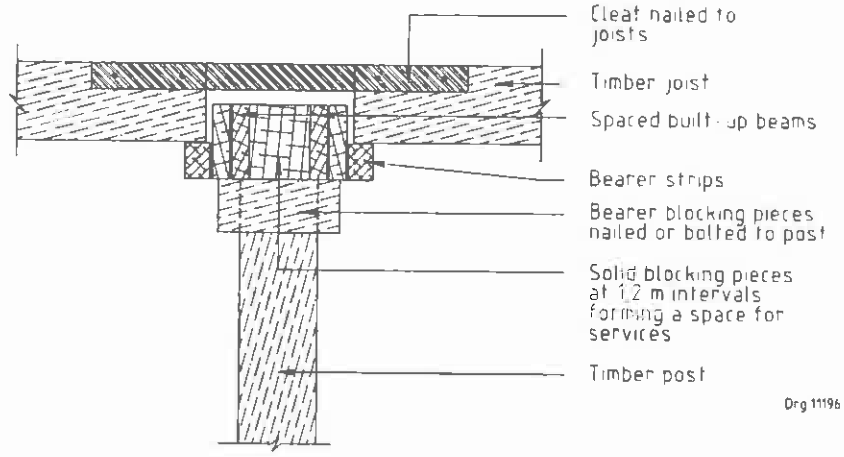


Figure 7 — Support of joists on spaced beams

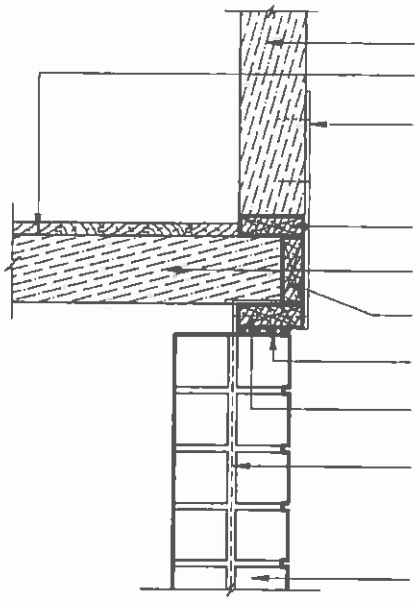


Figure 8 — Sole plate in platform construction

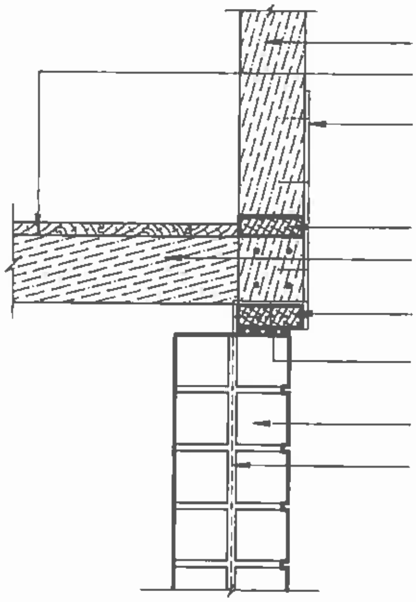


Figure 9 — Sole plate in balloon frame construction

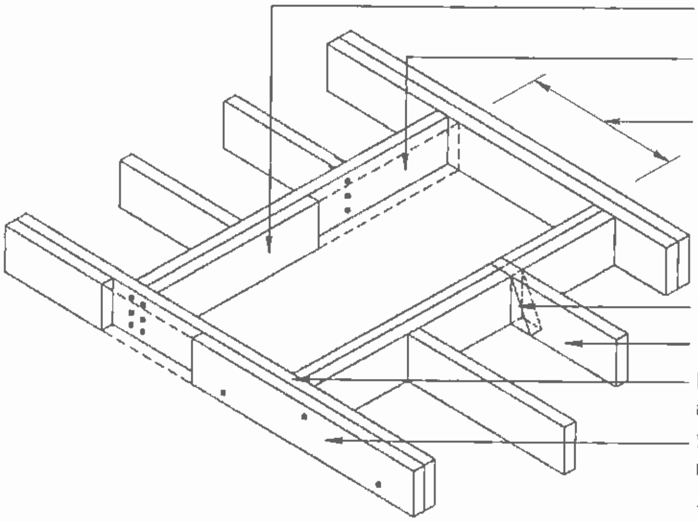
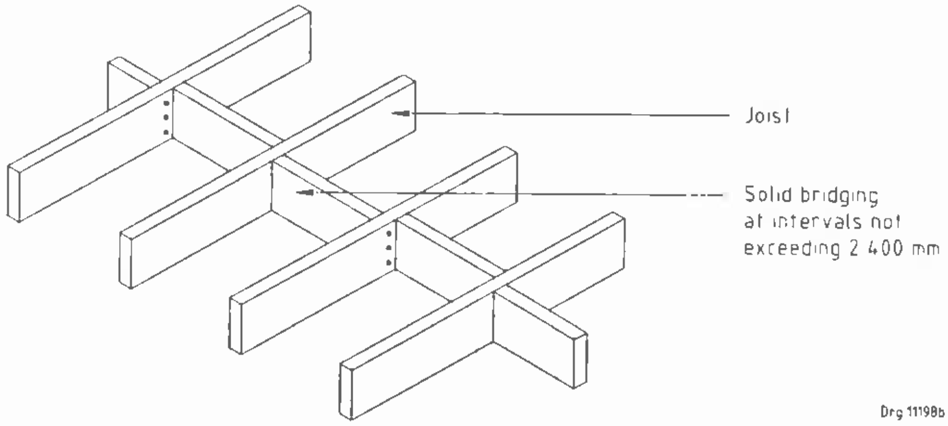
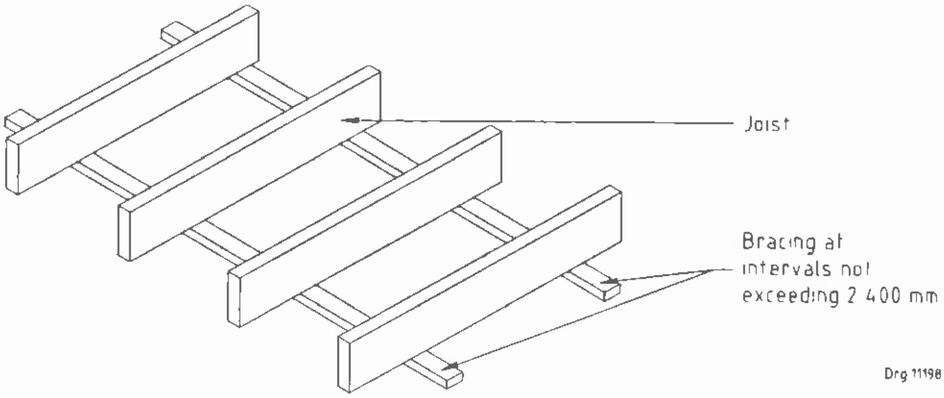


Figure 10 — Additional support at large openings in floors



a) Bridging



b) Bracing

Figure 11 — Bridging and bracing of floor joists of depth ≥ 152 mm

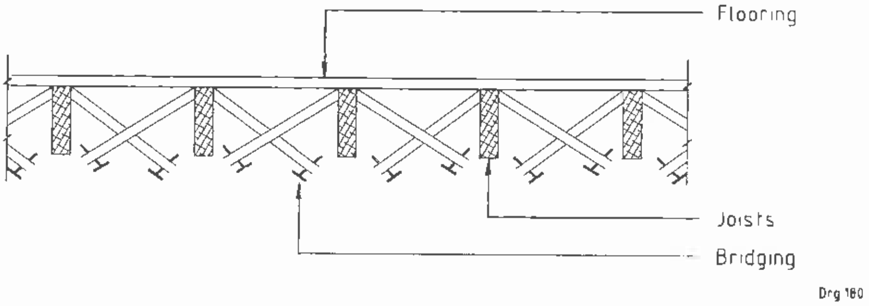


Figure 12 — How bridging should be left loose at the lower end until the subfloor is nailed in position

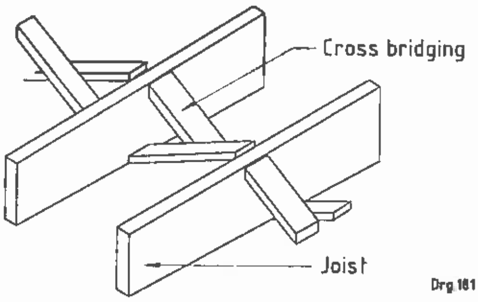


Figure 13 — Cross bridging between joists

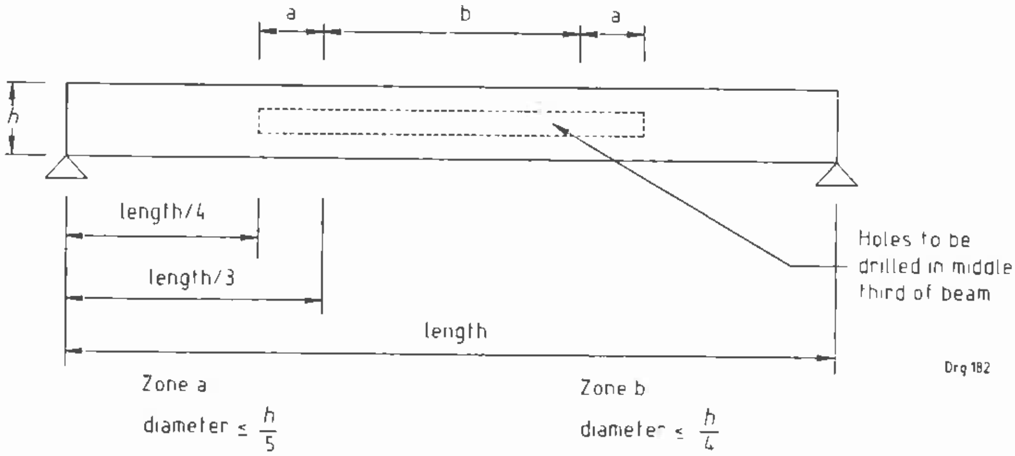


Figure 14 — Positioning of holes in beams or joists

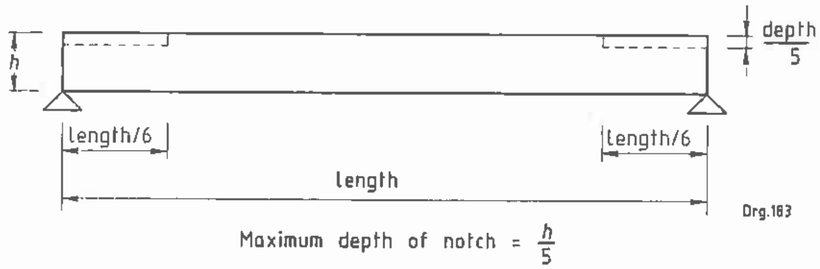


Figure 15 — Position of notches

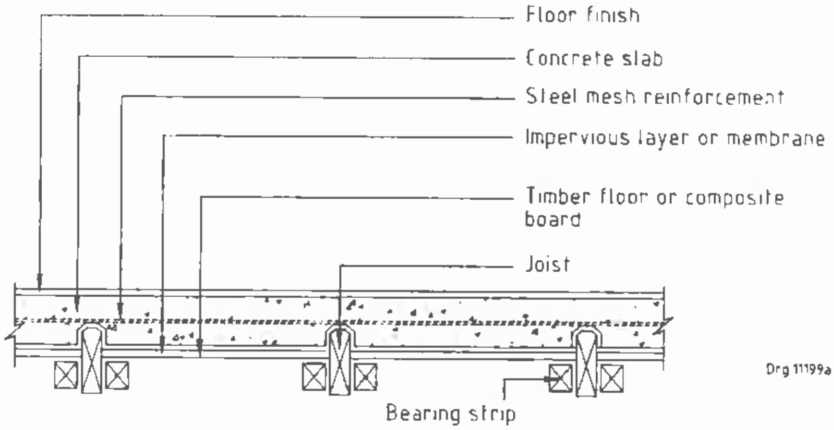


Figure 16 — Bathroom floor construction for tile covering

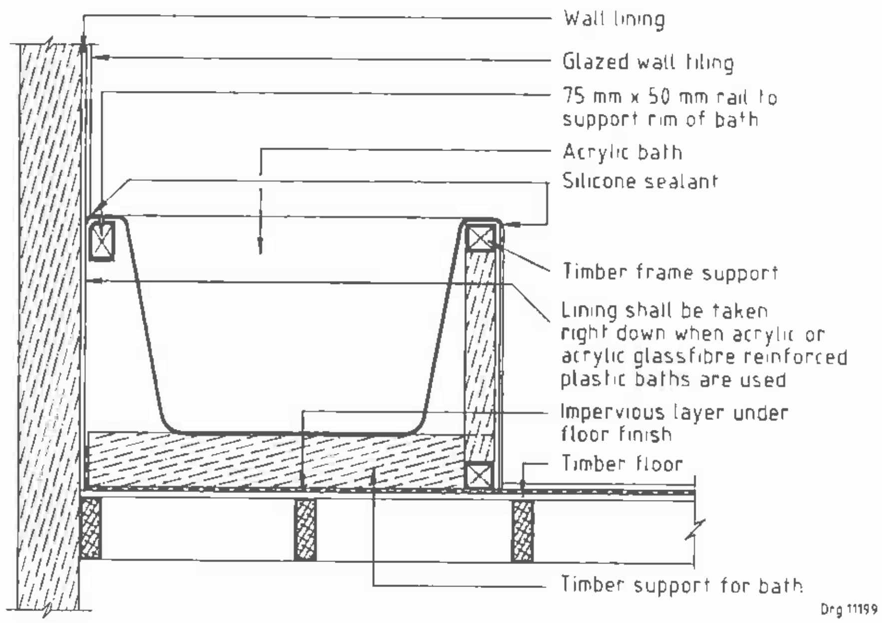


Figure 17 — Additional floor and wall supports for baths

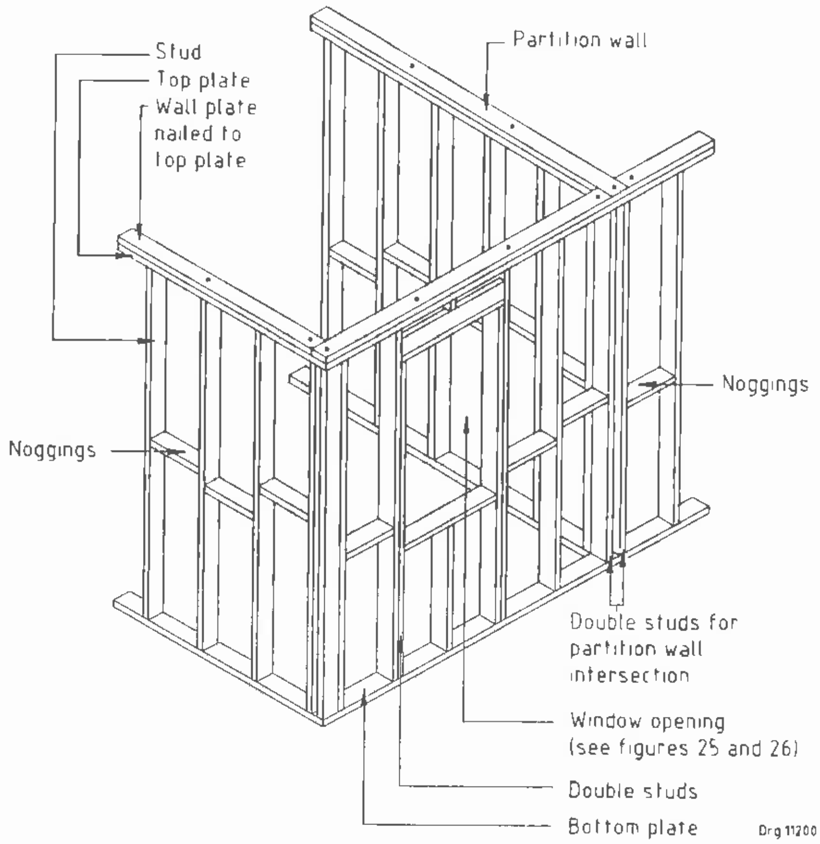


Figure 18 — Platform construction

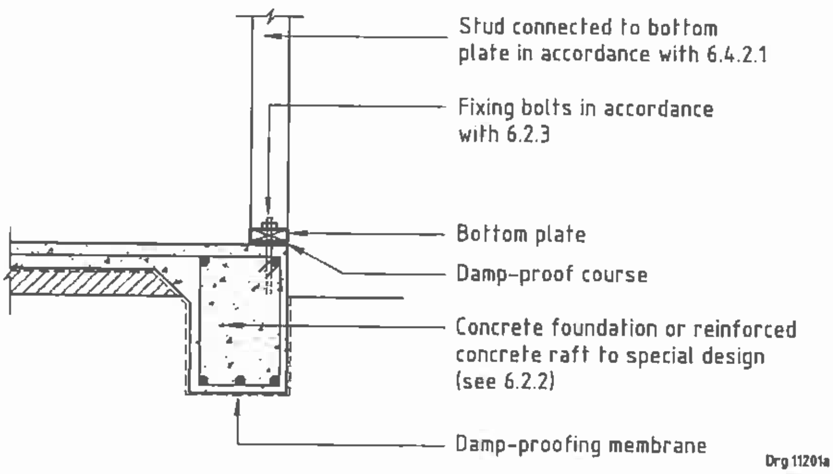


Figure 19 — Fixing of external wall framing to concrete base

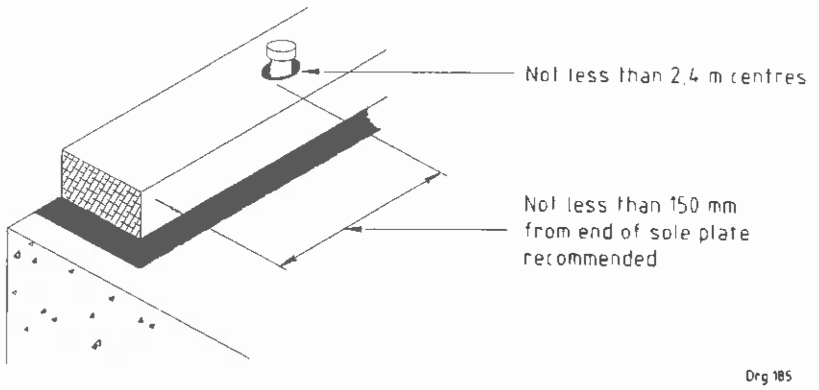


Figure 20 — Fixing sole (sill) plate to brick/block foundation walls using bolts

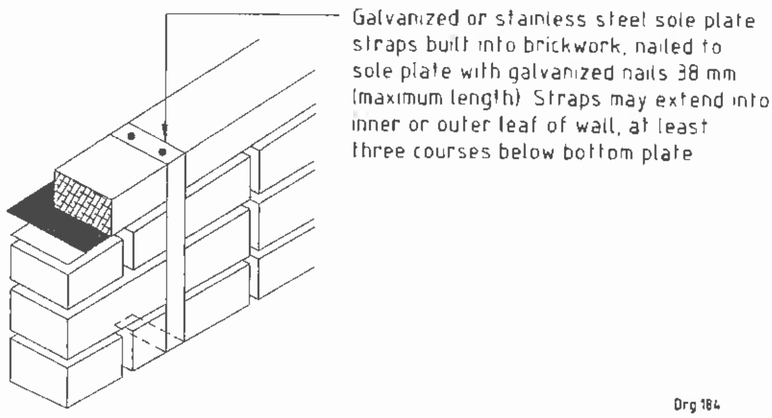


Figure 21 — Fixing sole (sill) plate to brick/block foundation walls using steel straps

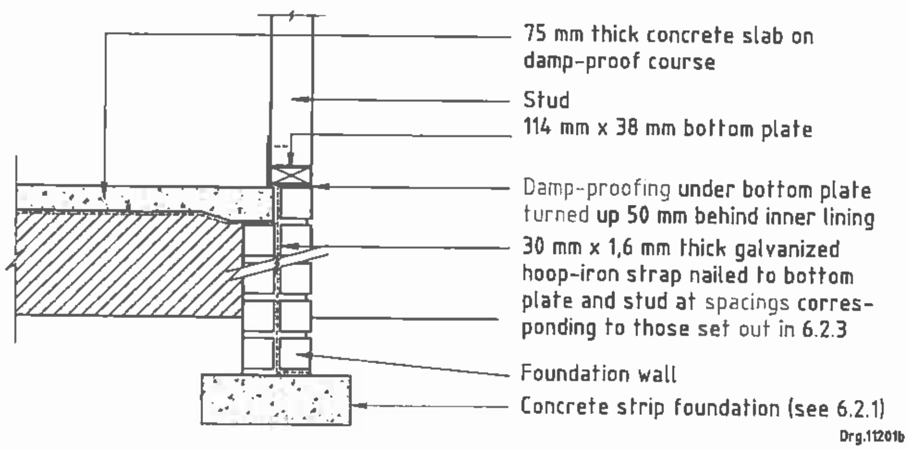


Figure 22 — Fixing of external wall framing to brick foundation wall

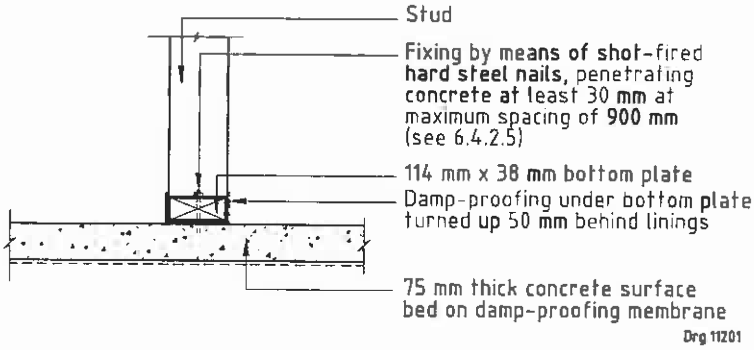


Figure 23 — Fixing of internal wall to concrete subfloor

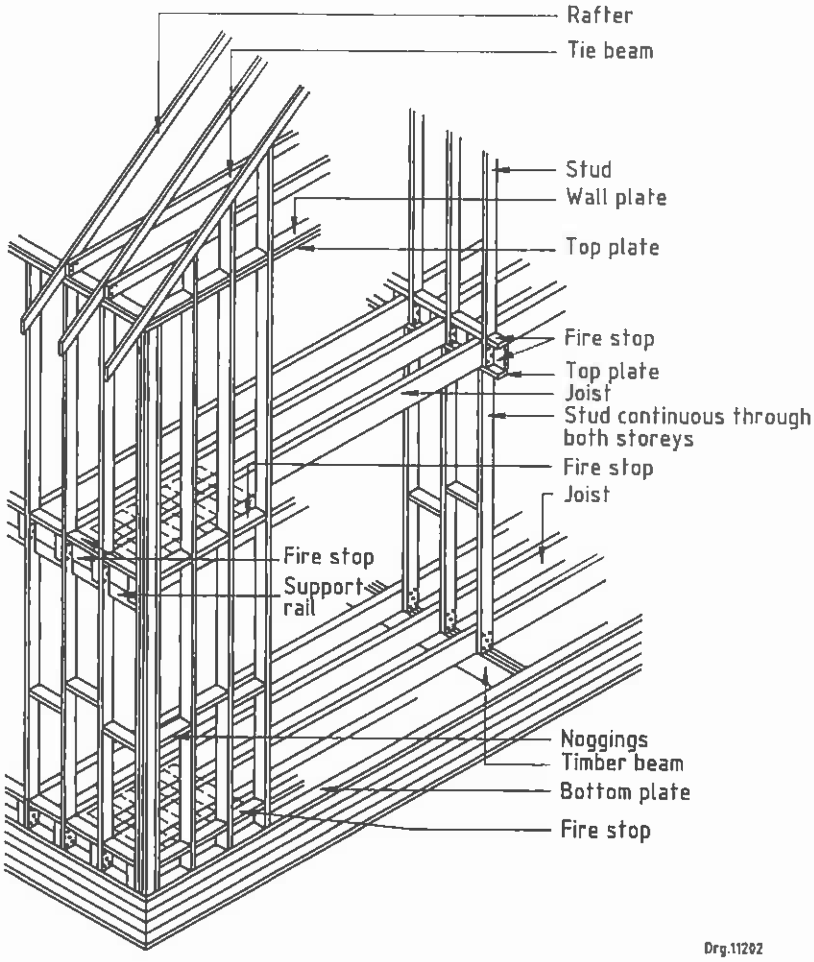


Figure 24 — Balloon frame construction

Dimensions in millimetres

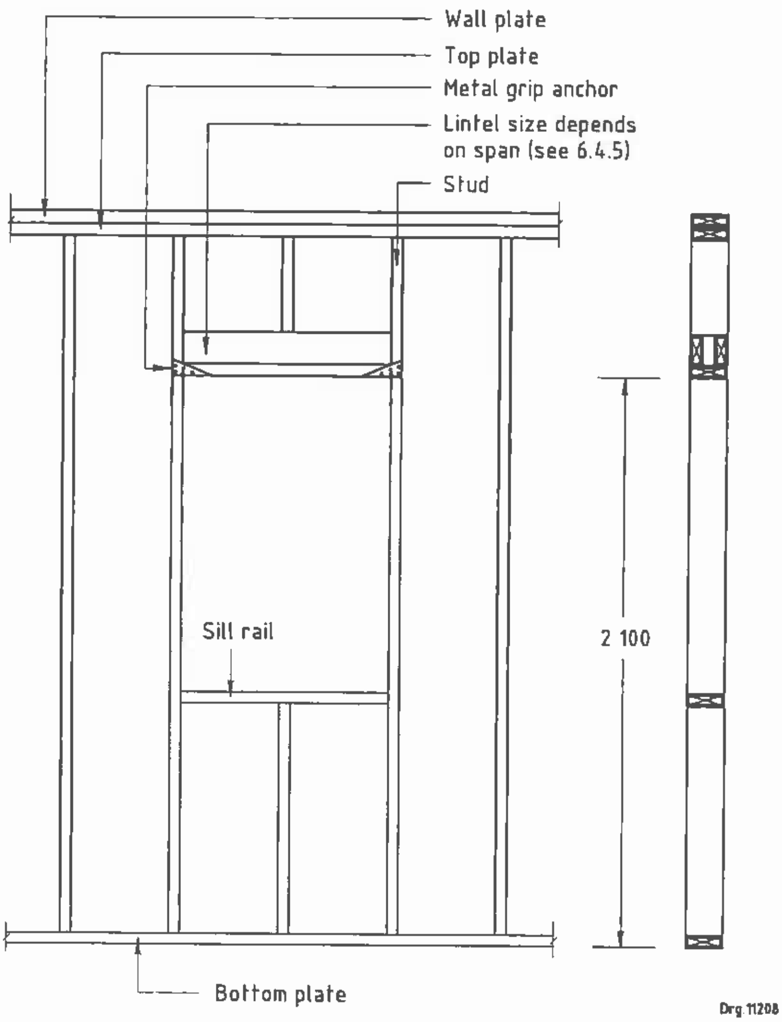


Figure 25 — Framing around external wall opening with lintel supported by metal frame anchors

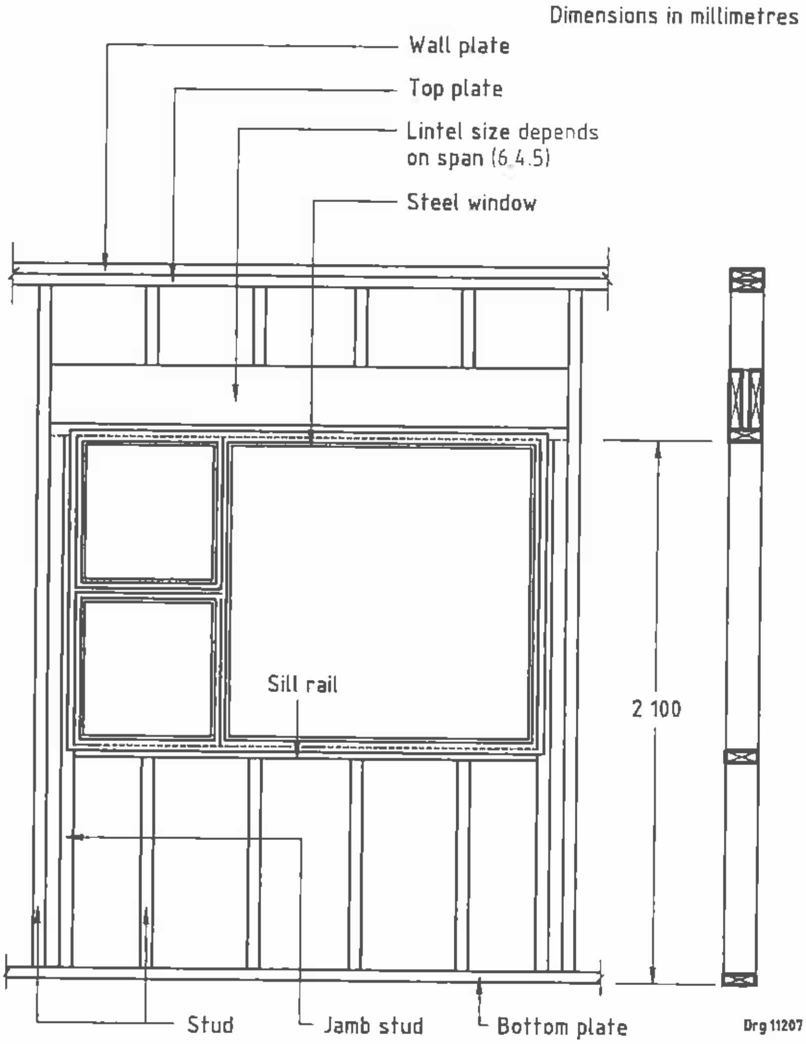
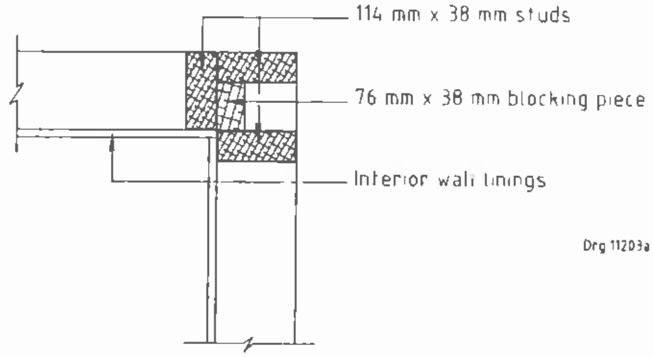
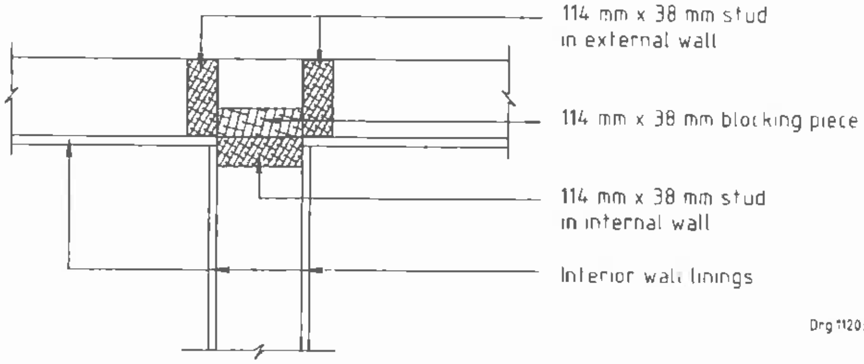


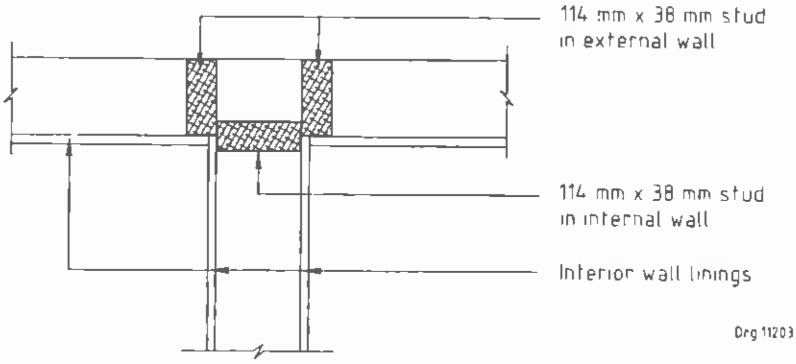
Figure 26 — Framing around external wall opening with lintel supported by inner studs



a) Corner



b) Wall intersection with blocking piece



c) Wall intersection without blocking piece

Figure 27 — Typical wall intersections

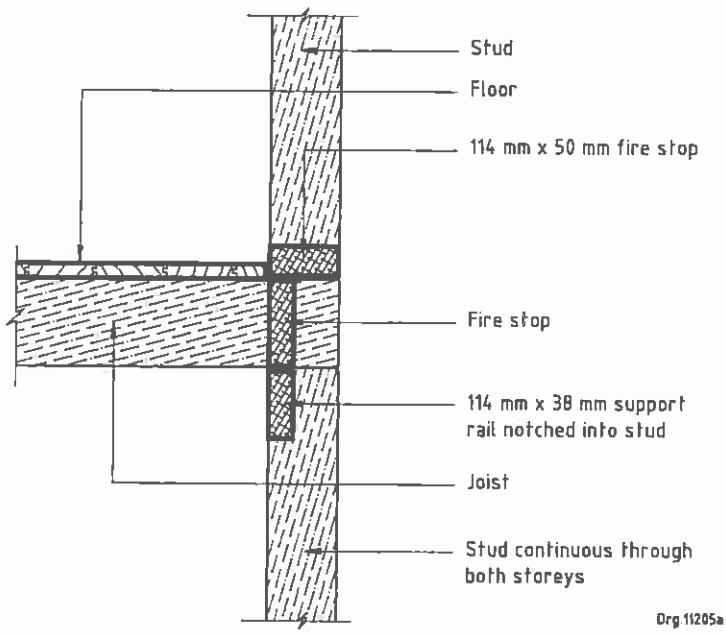


Figure 28 — Balloon frame construction — First floor framing at external wall

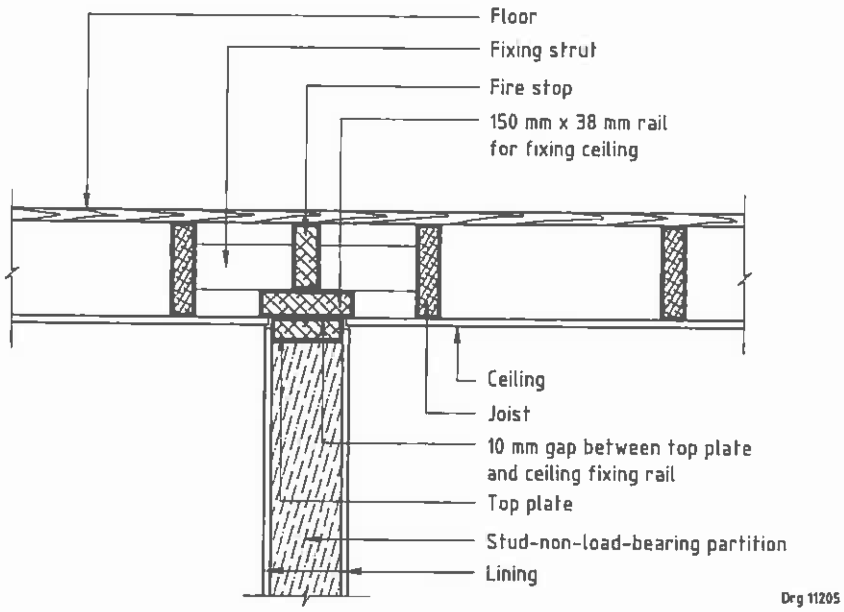


Figure 29 — Attachment of non-load-bearing wall to first floor framing

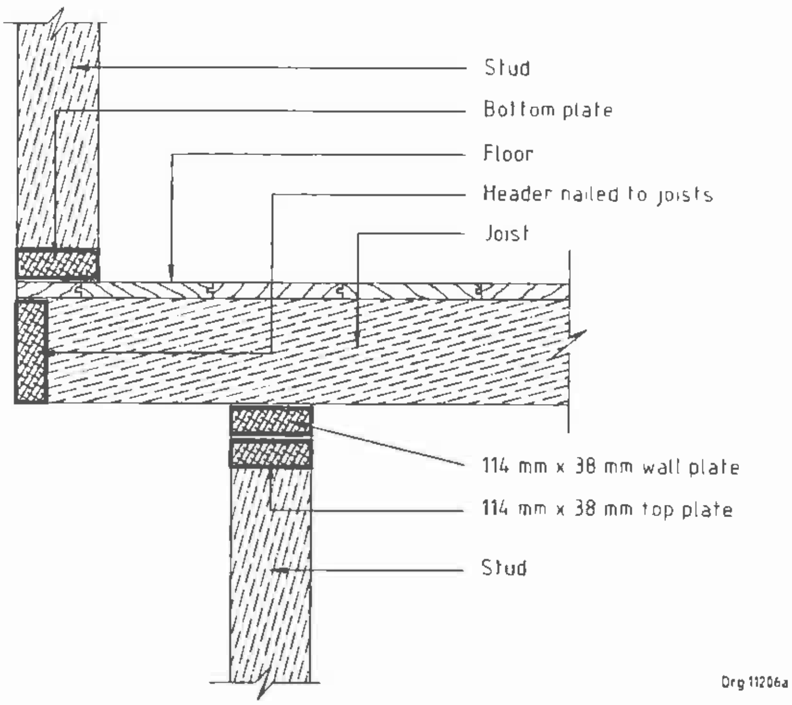


Figure 30 — Overhang of external wall at first floor with joists at right angles to wall below

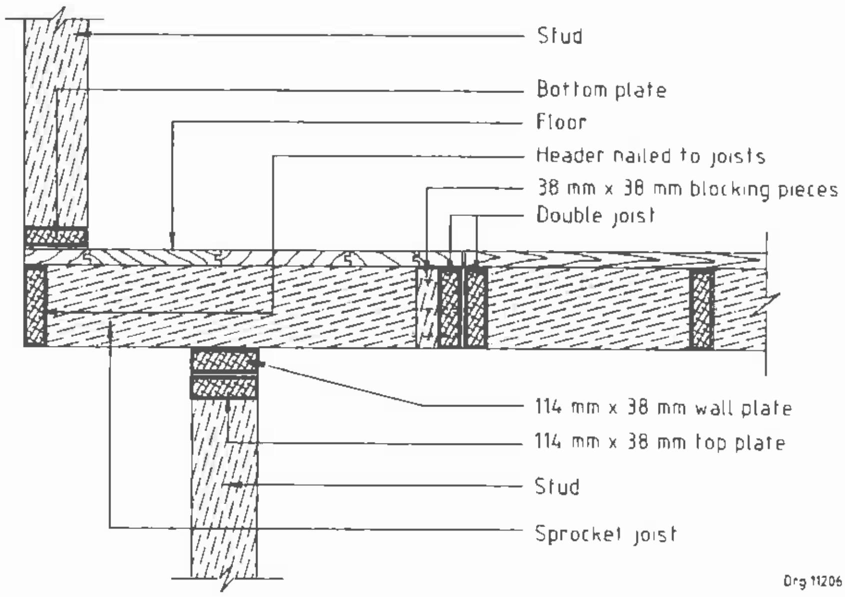


Figure 31 — Overhang of external wall at first floor with joists parallel to wall below

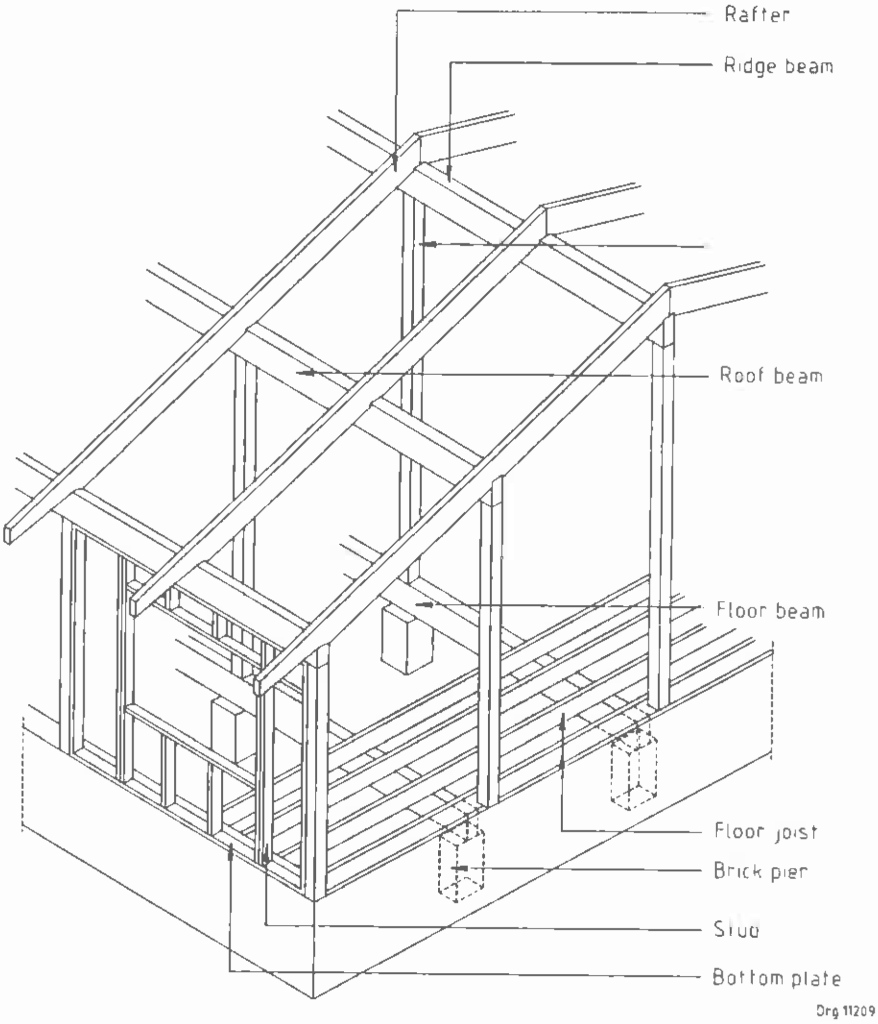


Figure 32 — Post and beam framing for single-storey building

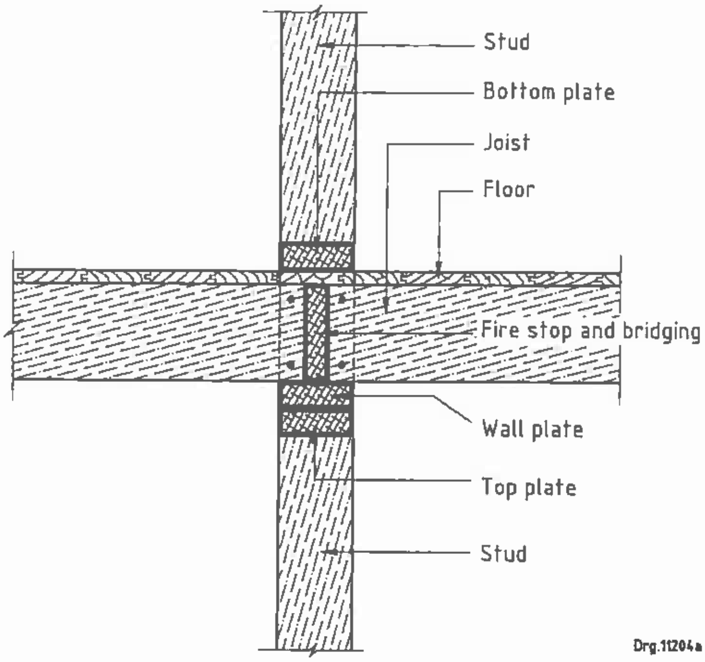


Figure 33 — Platform frame construction — First floor framing over load-bearing wall

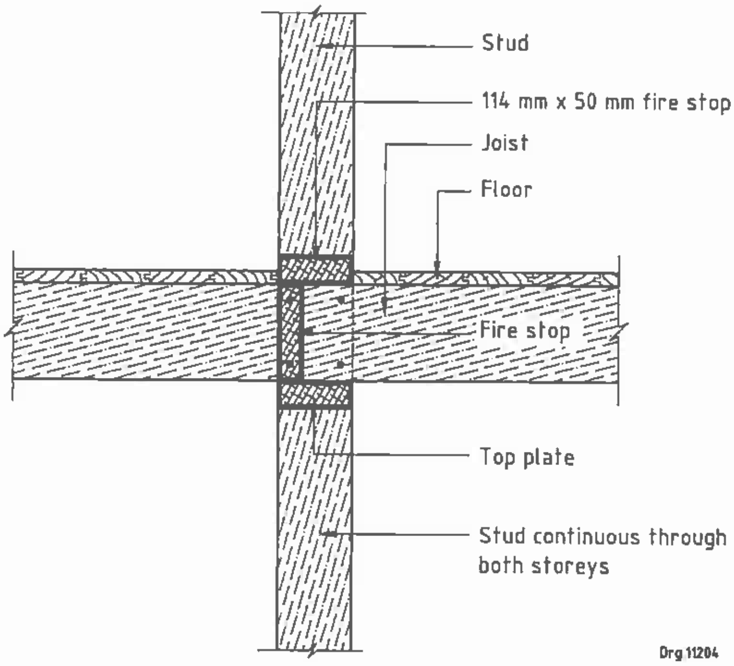
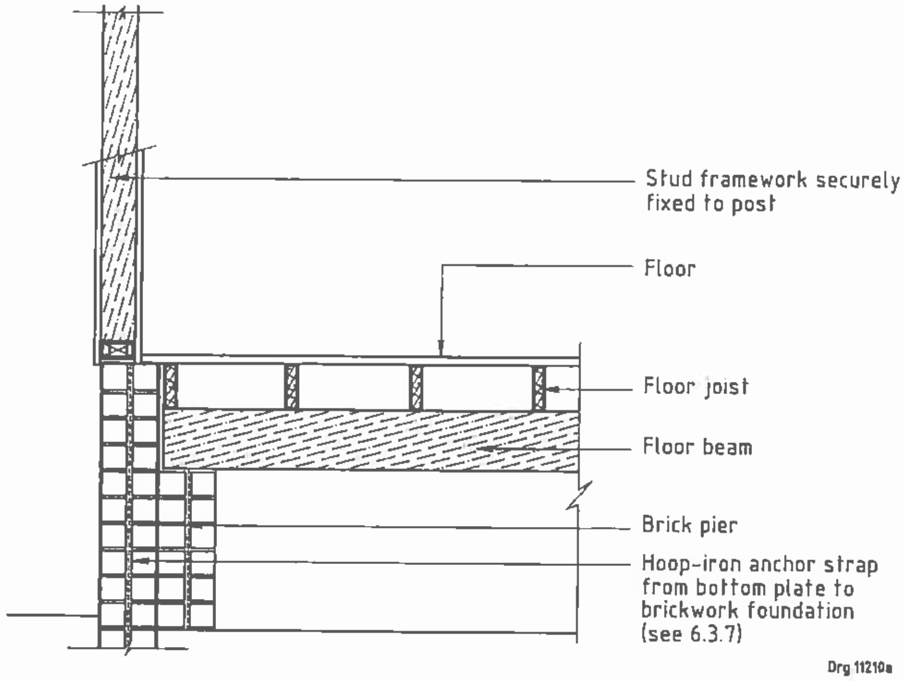
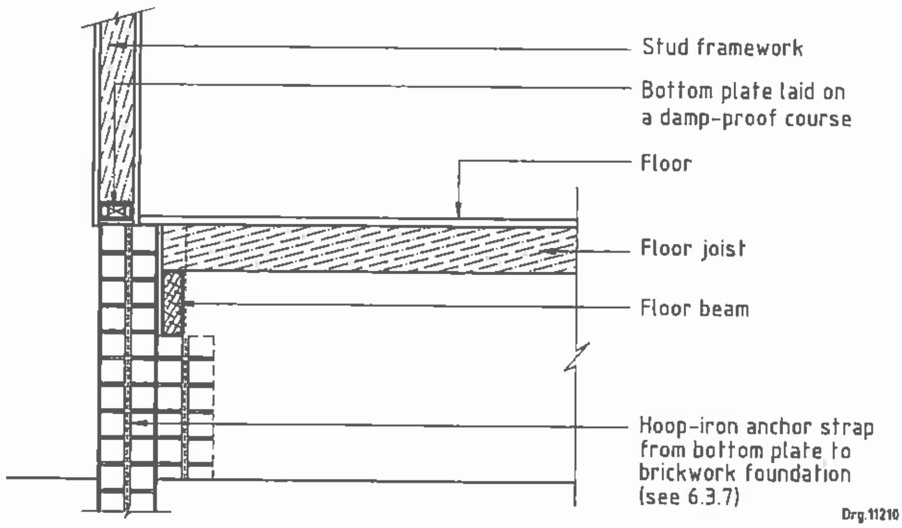


Figure 34 — Balloon frame construction — First floor framing over load-bearing wall

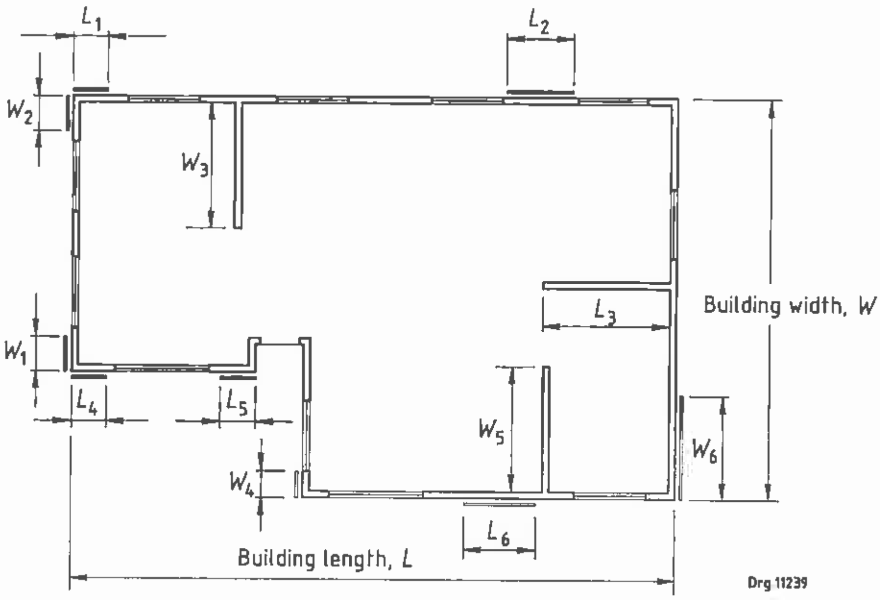


a) Cross section through joists



b) Longitudinal section of joists

Figure 35 — Fixing details for post and beam construction



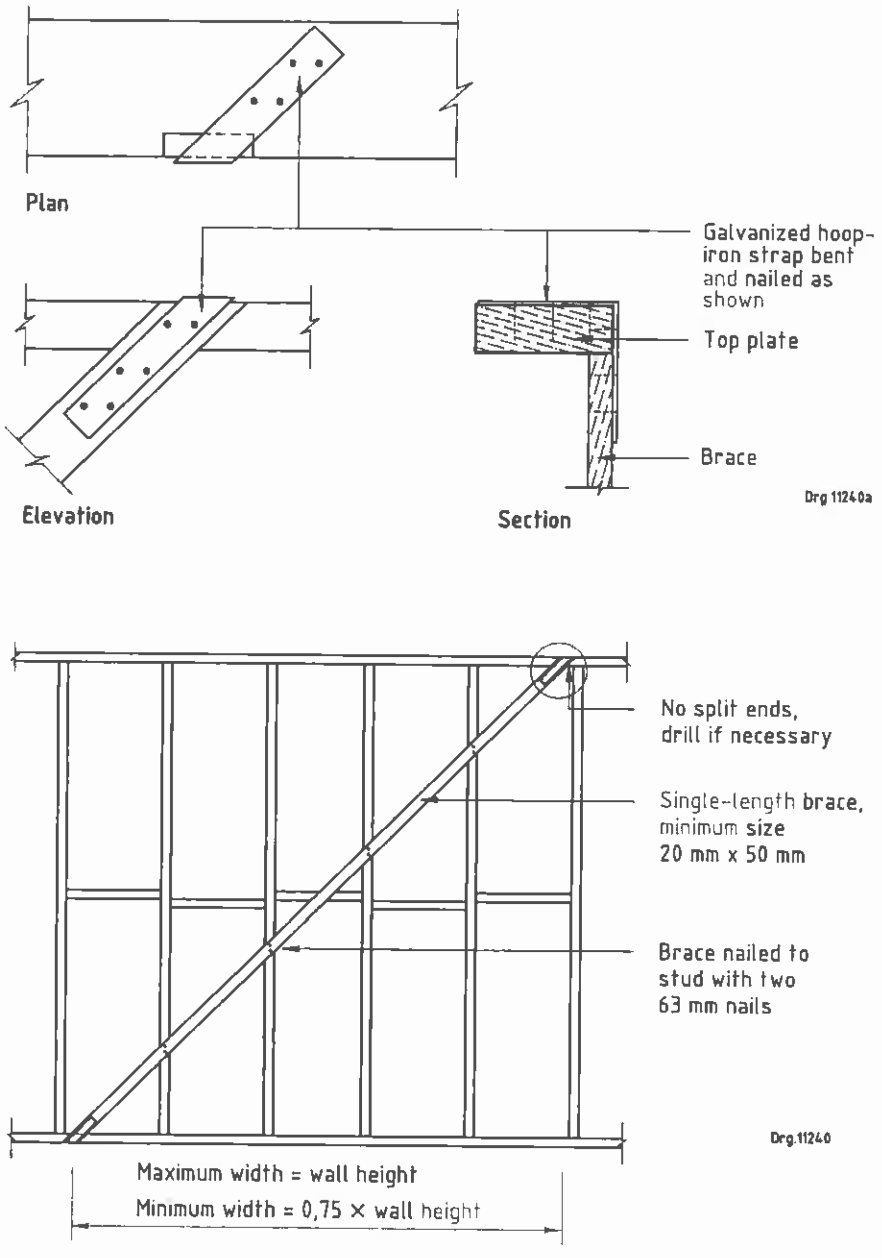
NOTE 1 In the length of the building, the total effective length of a braced wall = $L_1 + L_2 + L_3$, etc.

NOTE 2 In the width of the building, the total effective length of a braced wall = $W_1 + W_2 + W_3$, etc.

NOTE 3 The braced walls in the length of the building shall be designed to resist racking forces caused by winds perpendicular to the length of the building, and vice versa.

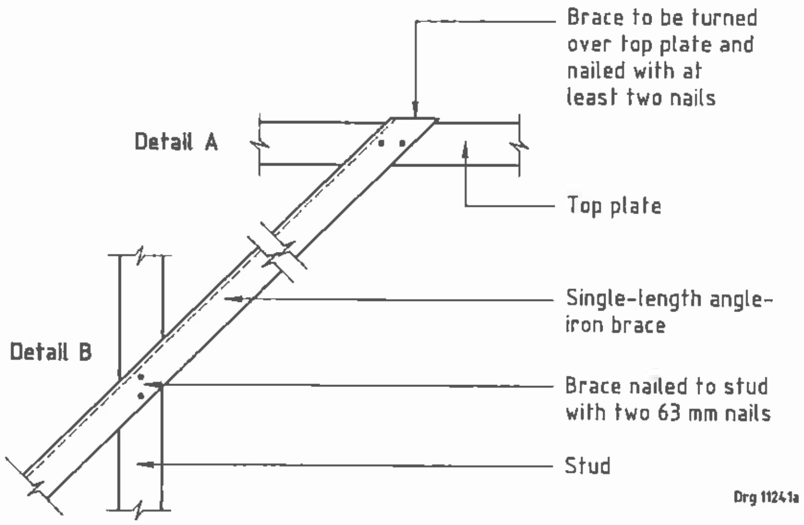
NOTE 4 The effective length of a wall or part of a wall which is shorter than 1,2 m shall be taken as 0,6L, where L is its actual length. The minimum length shall be 600 mm.

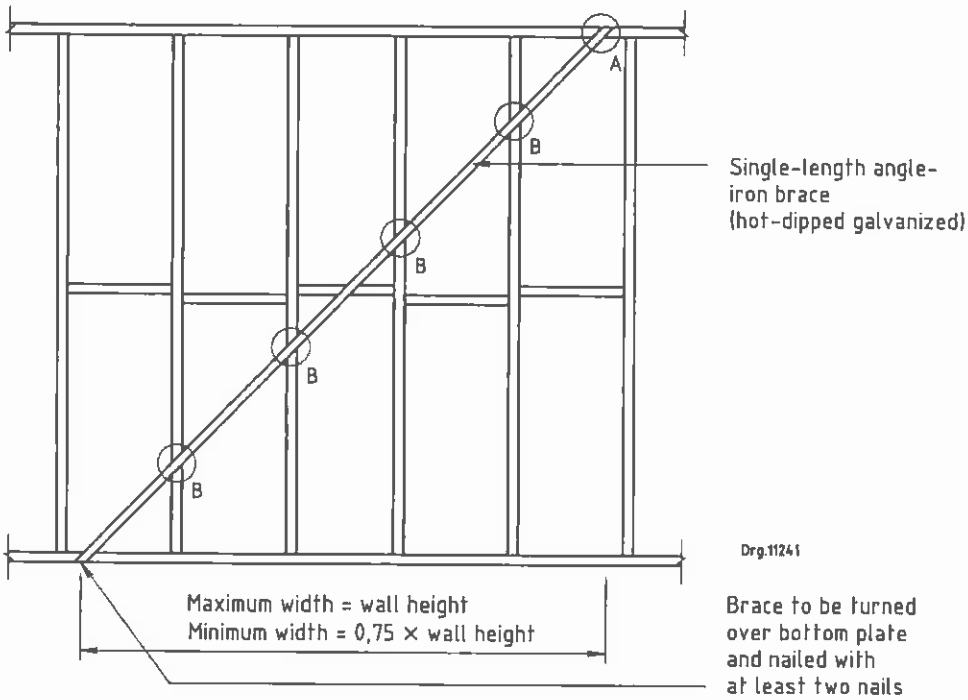
Figure 36 — Location of braced walls



a) Solid timber bracing

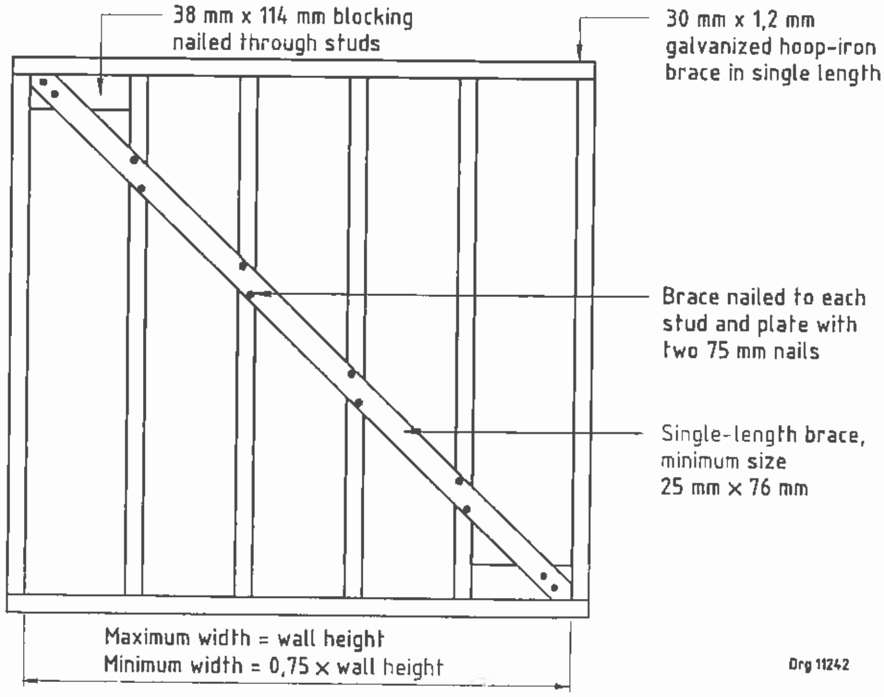
Figure 37 — Methods for fixing of bracing





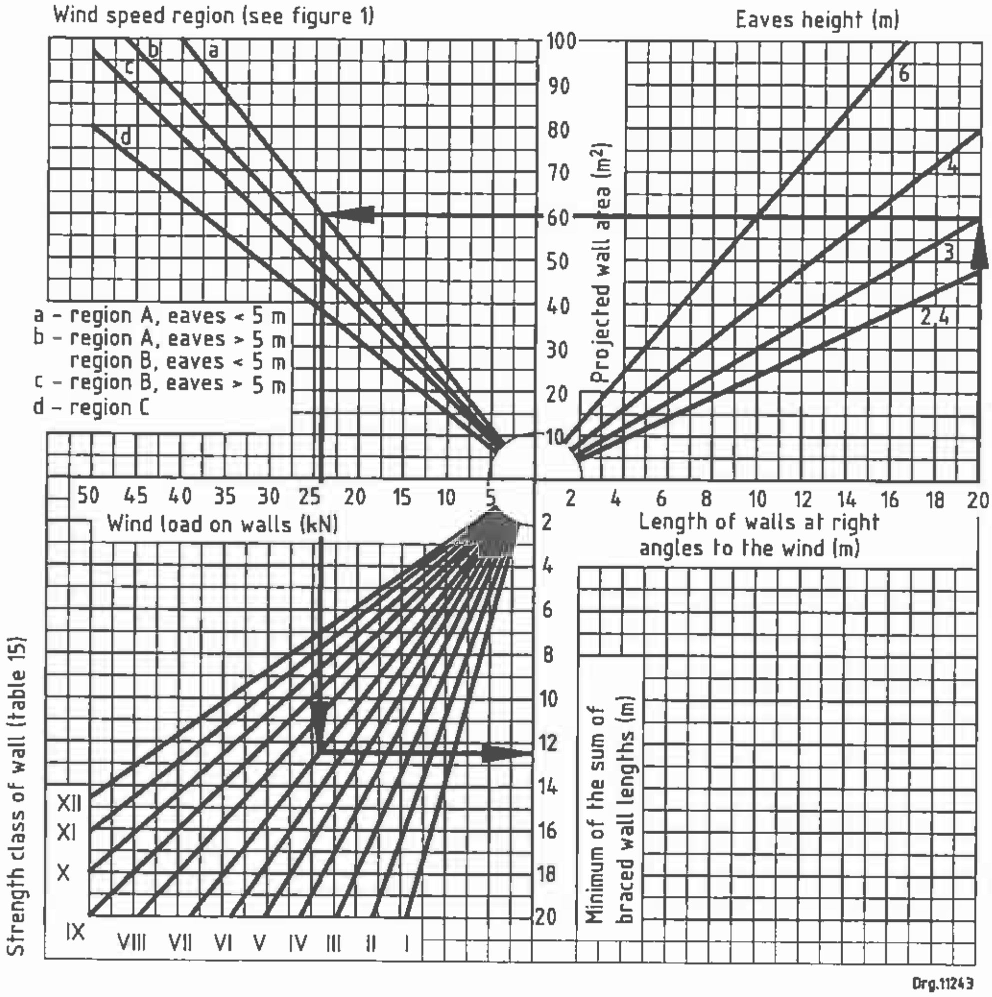
b) Angle-iron diagonal bracing

Figure 37 — Methods for fixing of bracing *(continued)*



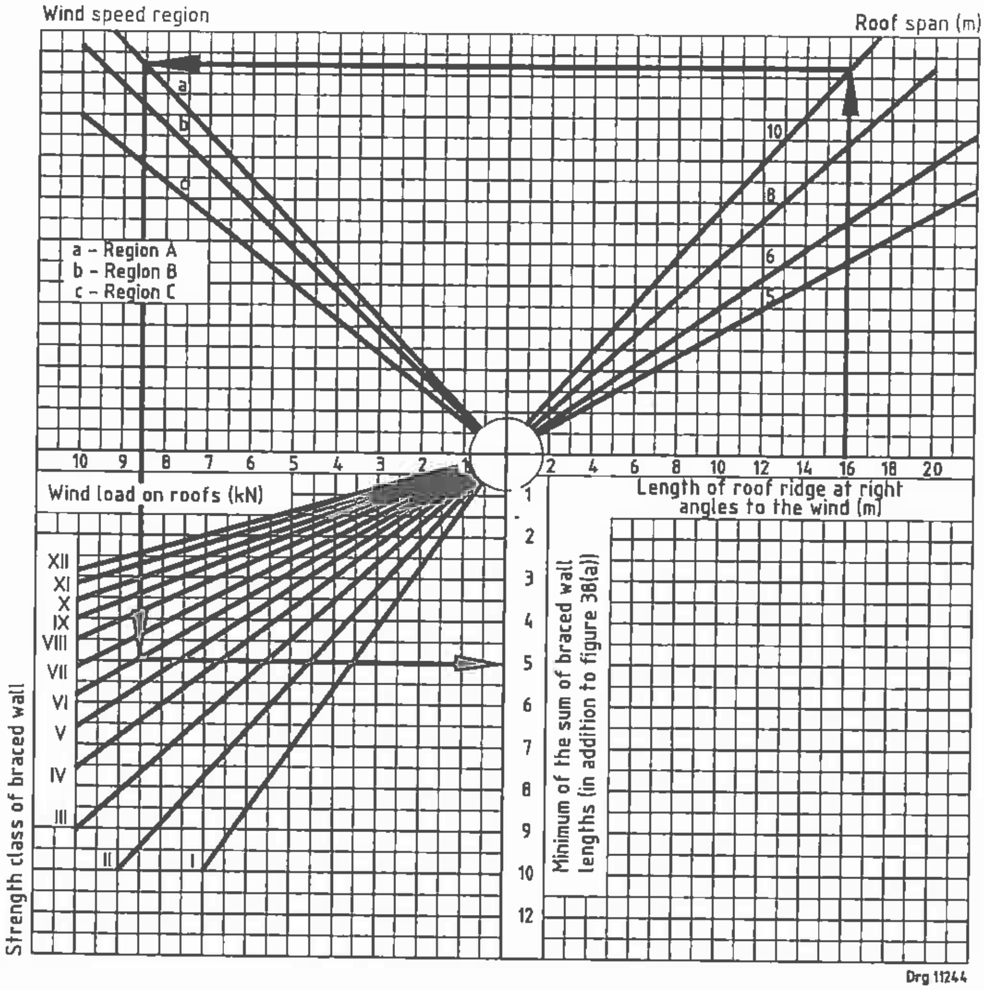
c) Flat metal cross bracing

Figure 37 — Methods for fixing of bracing (*concluded*)



a) Total length of braced wall sections required to resist wind pressure on exterior walls perpendicular to braced walls

Figure 38 — Braced wall length requirements

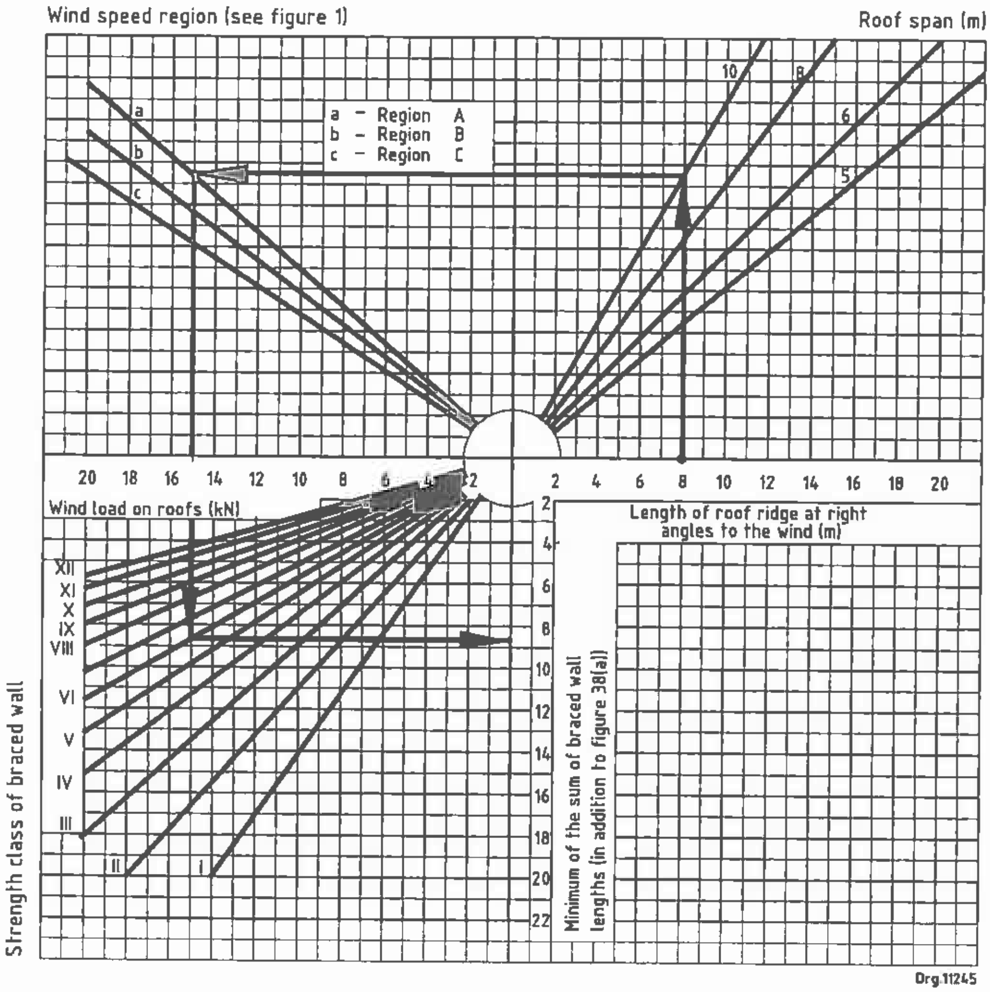


Double-pitched roof: 20° to 30° (0° to 20° no bracing required)

Monopitched roofs: 0° to 15°

b) Total length of braced wall sections required to resist wind pressure on exterior walls perpendicular to braced walls

Figure 38 — Braced wall length requirements (*continued*)

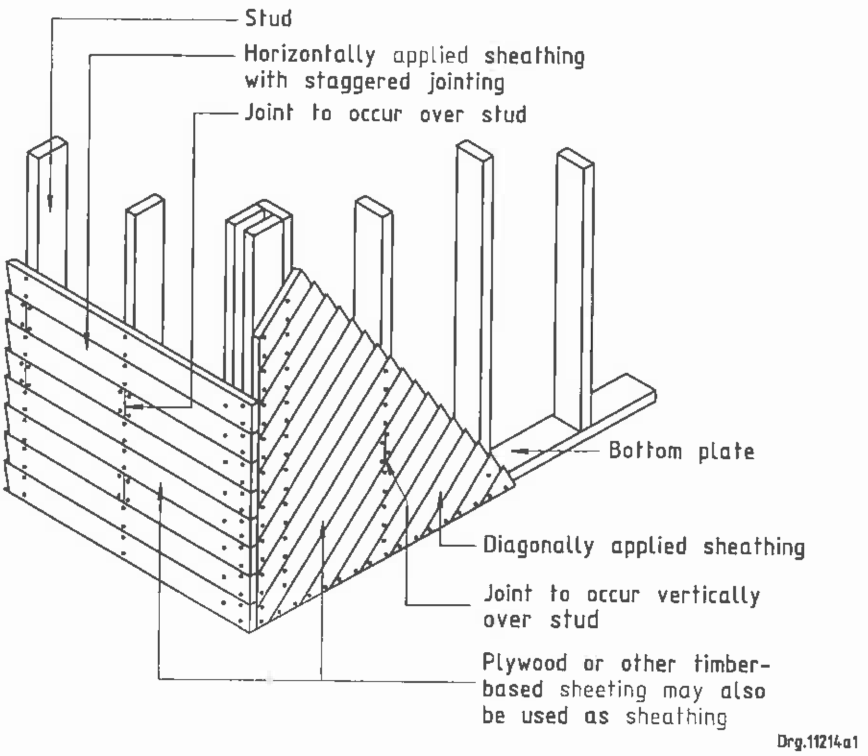


Double-pitched roof: 30° to 40°

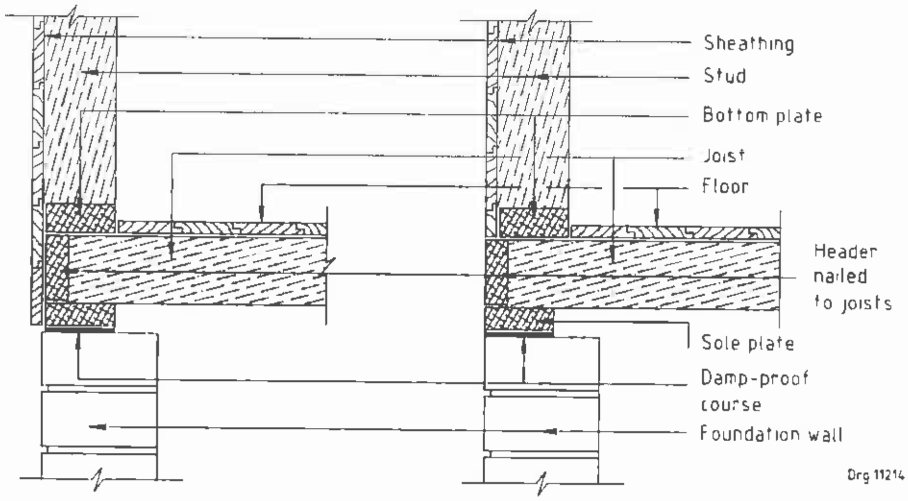
Monopitched roofs: 15° to 30°

c) Total length of braced wall sections required to resist wind pressure on exterior walls perpendicular to braced walls

Figure 38 — Braced wall length requirements *(concluded)*



a) Diagonal and horizontal sheathing



b) Sheathing over floor framing **c) Sheathing starting at subfloor**

Figure 39 — Different methods of applying timber sheathing

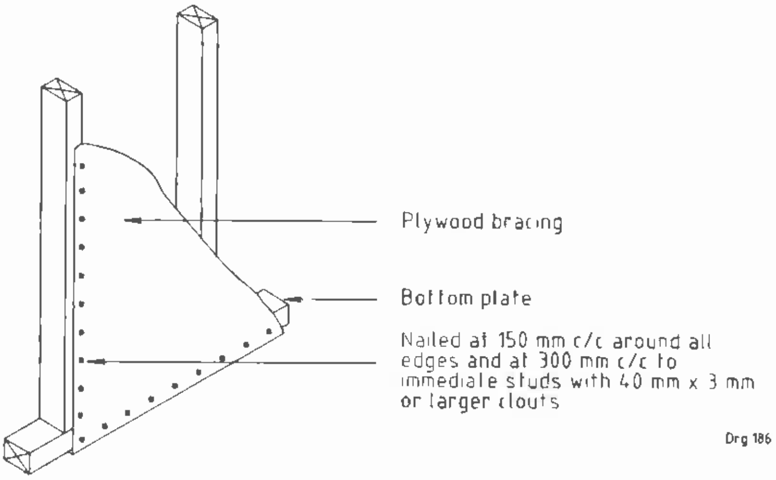
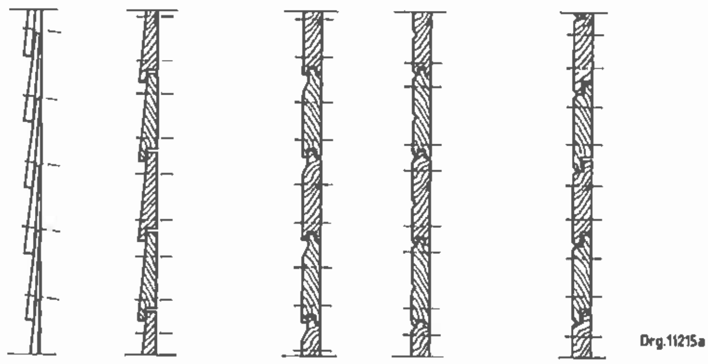


Figure 40 — Structural sheathing



a) Bevel siding **b) Drop siding** **c) Shiplap siding**

Figure 41 — Different types of timber siding

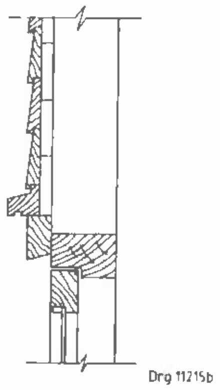
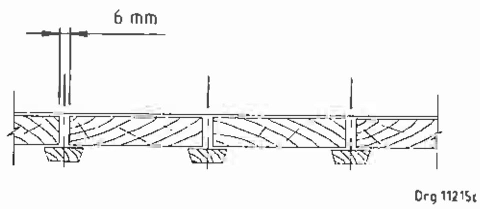
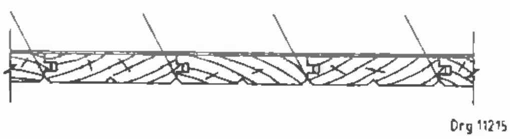


Figure 42 — Application of bevel siding over timber sheathing at top of window opening



a) Square-edge boards with cover strips



b) Tongue-and-groove boards

Figure 43 — Examples of methods of fixing vertical siding

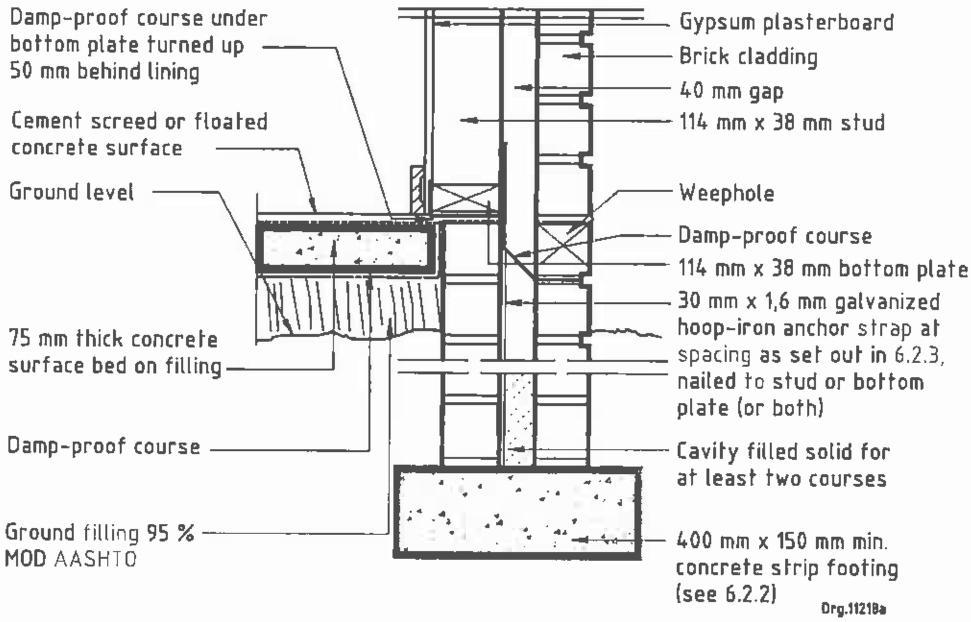


Figure 44 — Foundation details

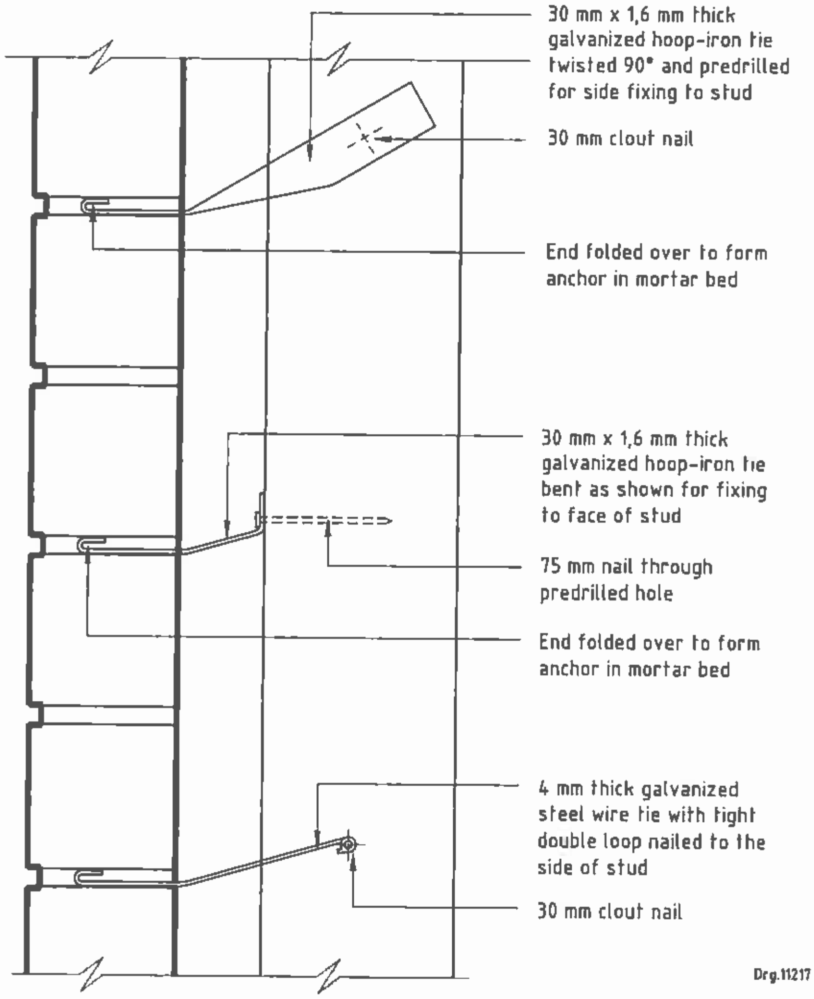


Figure 45 — Alternative types of wall ties

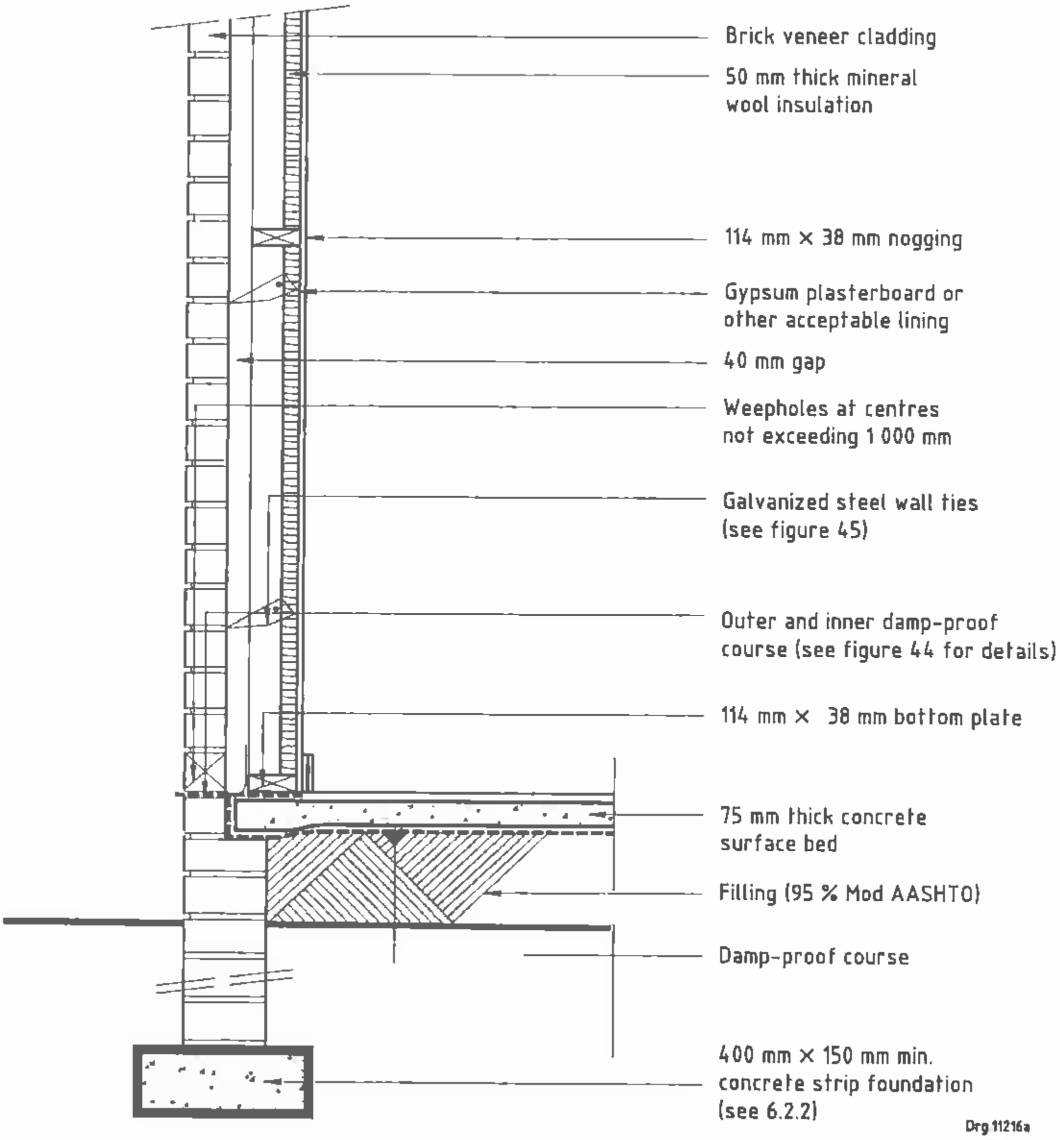
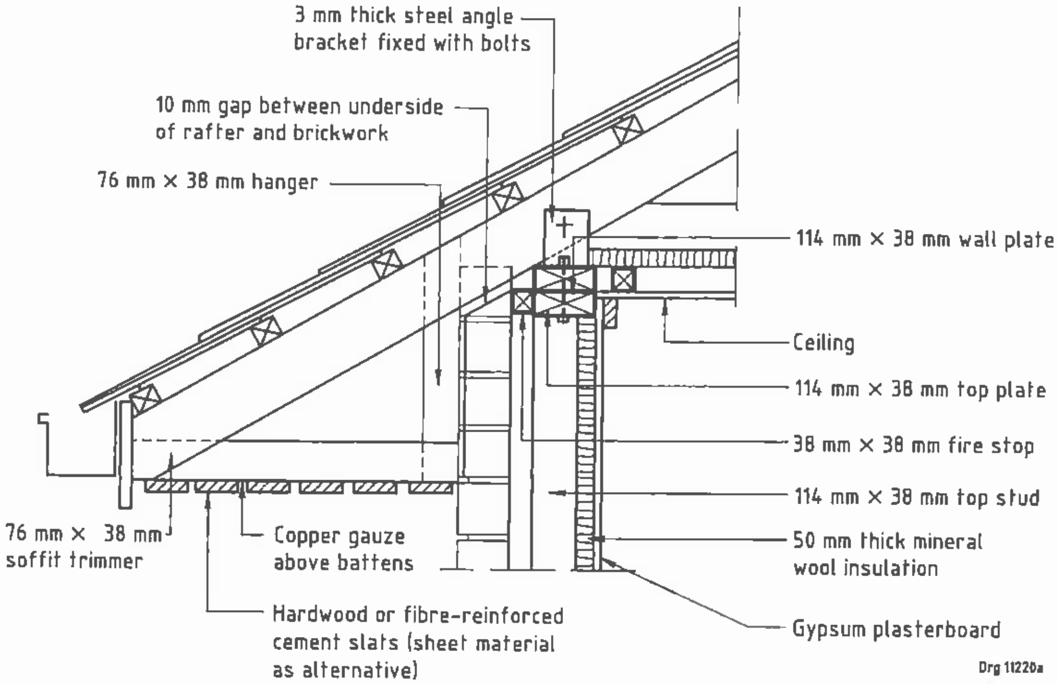
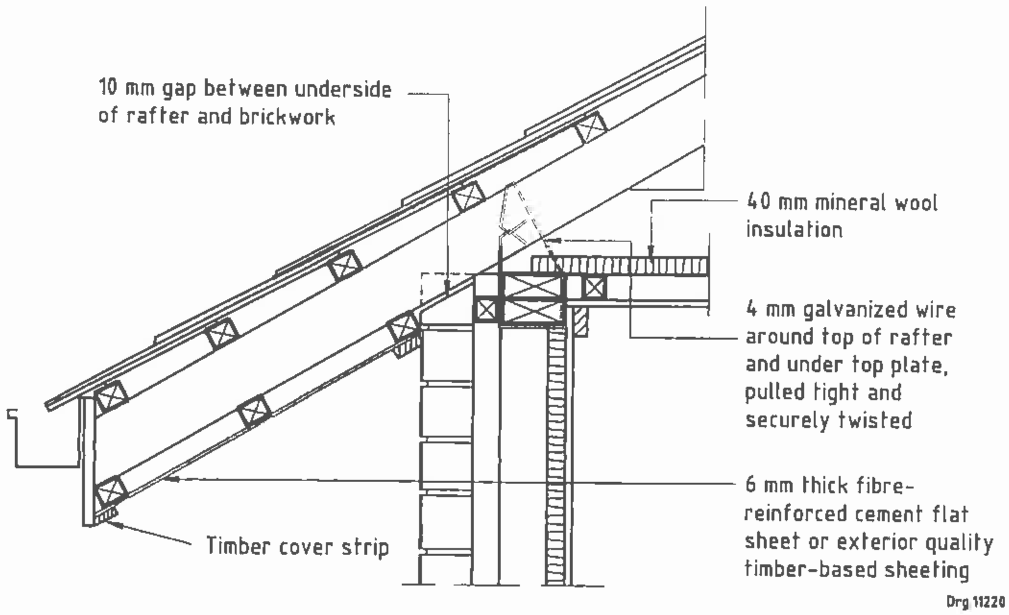


Figure 46 — Typical external wall section with brick veneer finish



a) Horizontal with hanger



b) Screw against rafter

Figure 47 — Typical closed eaves details

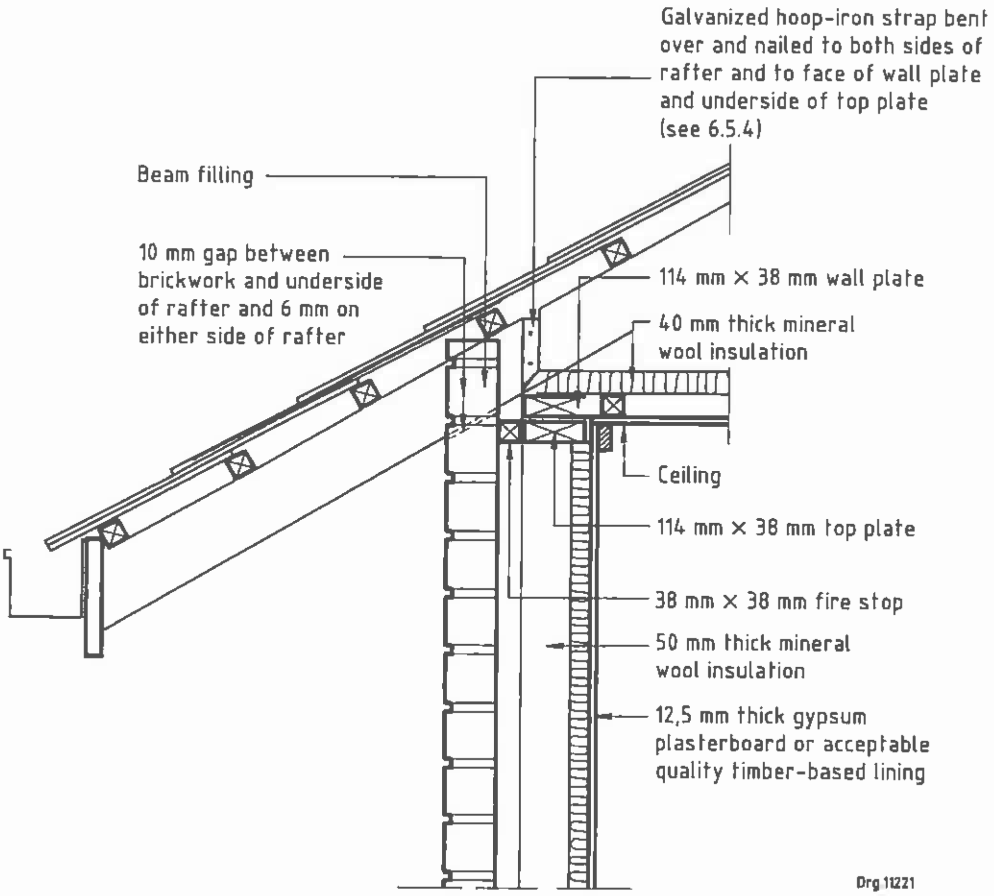
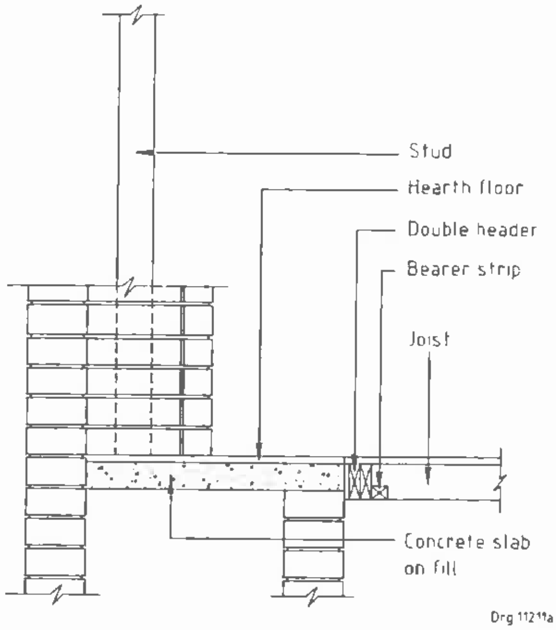
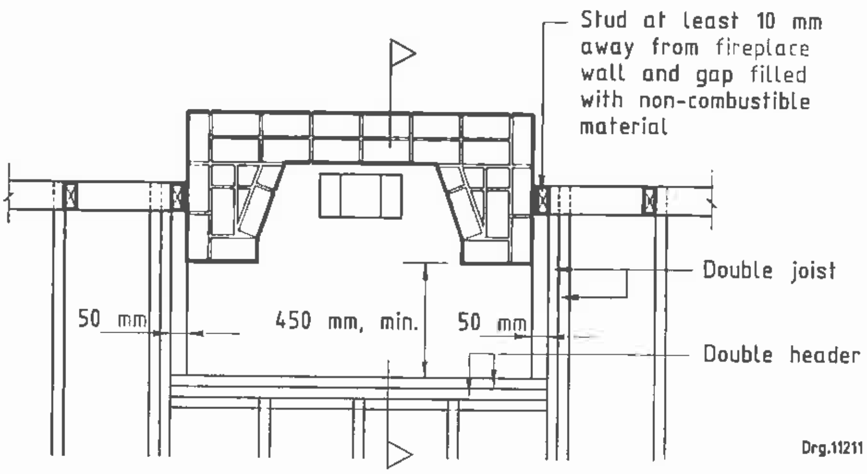


Figure 48 — Alternative detail for open eaves



a) Section through hearth



b) Plan of fireplace

Figure 49 — Floor framing around fireplace

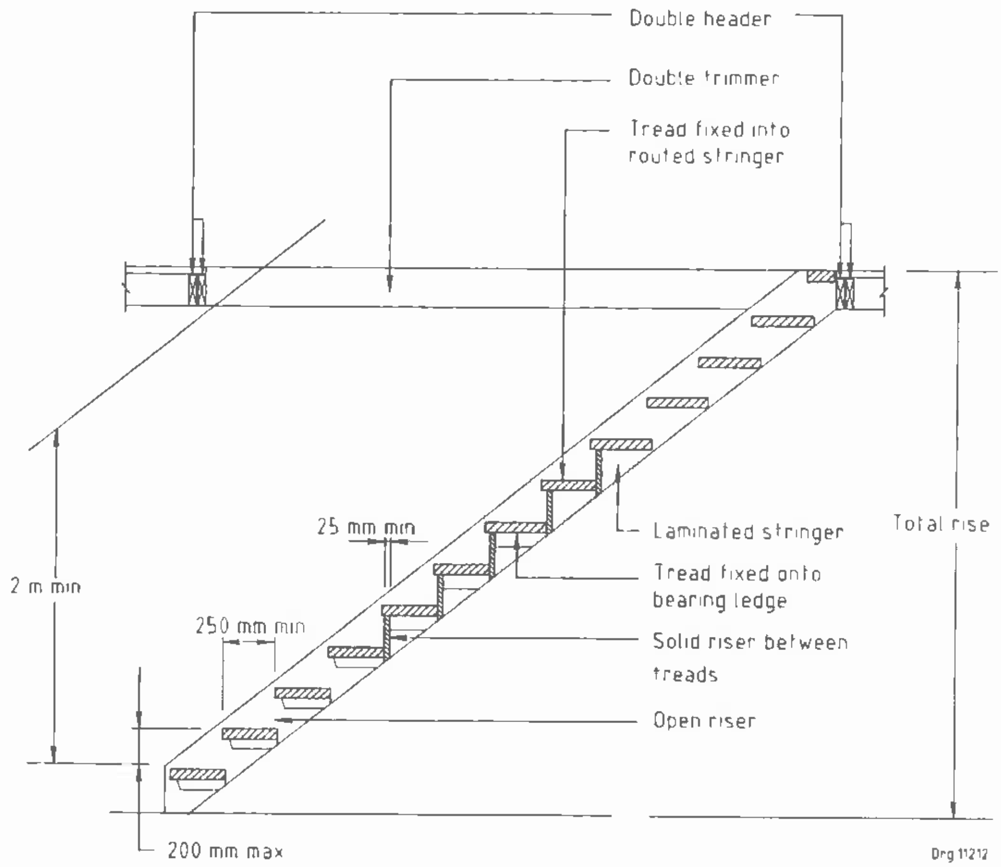


Figure 50 — Section through staircase showing typical framing

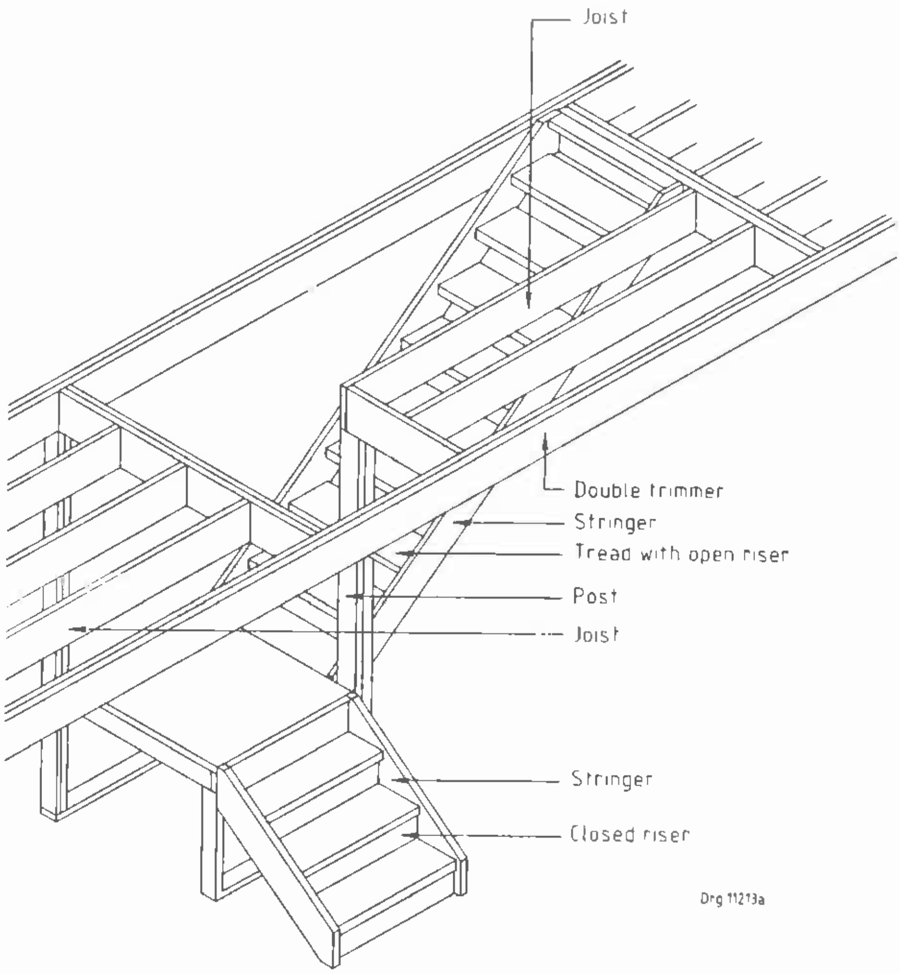


Figure 51 — Framing for staircase with landing

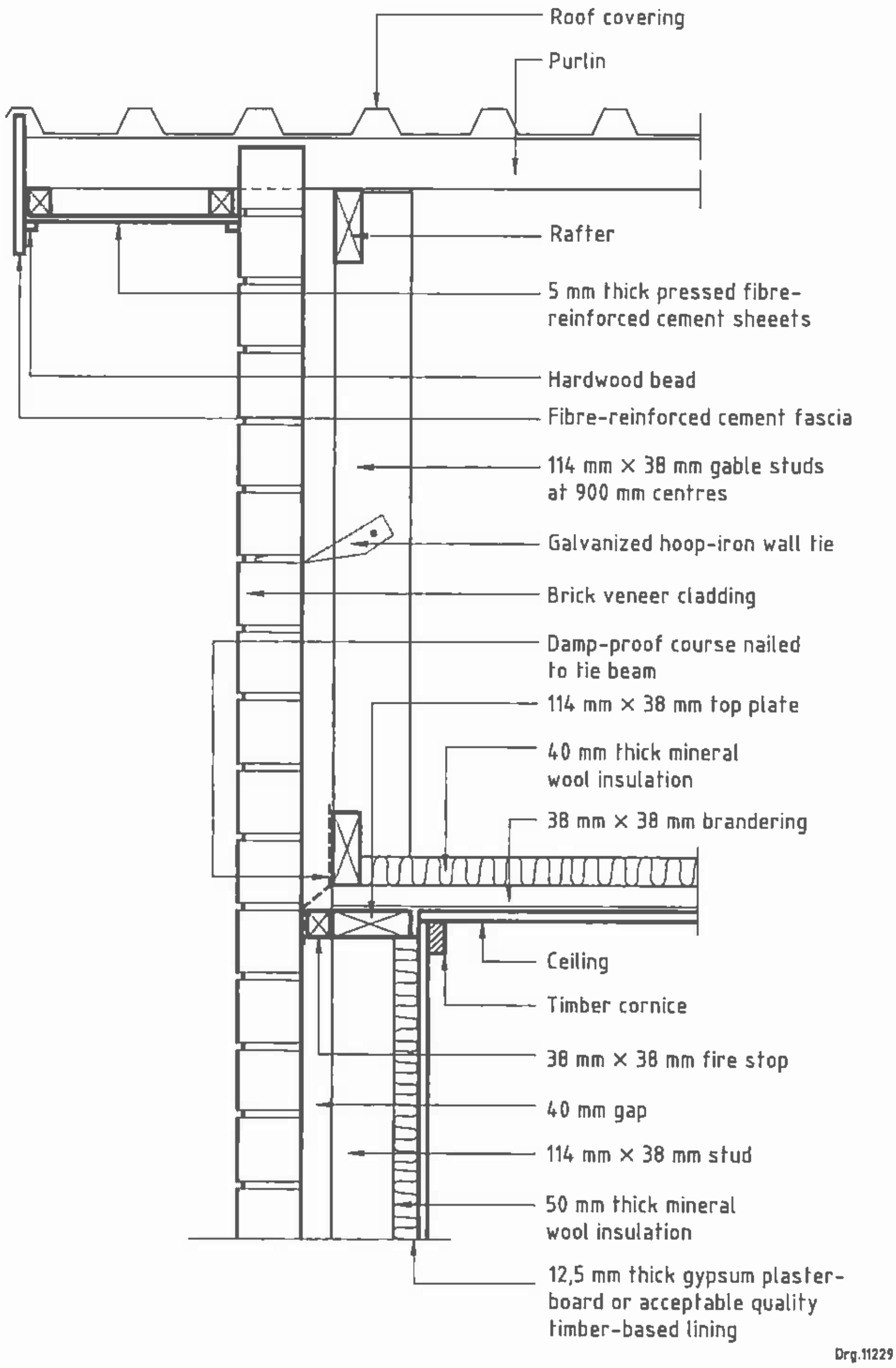


Figure 52 — Brick veneer gable detail

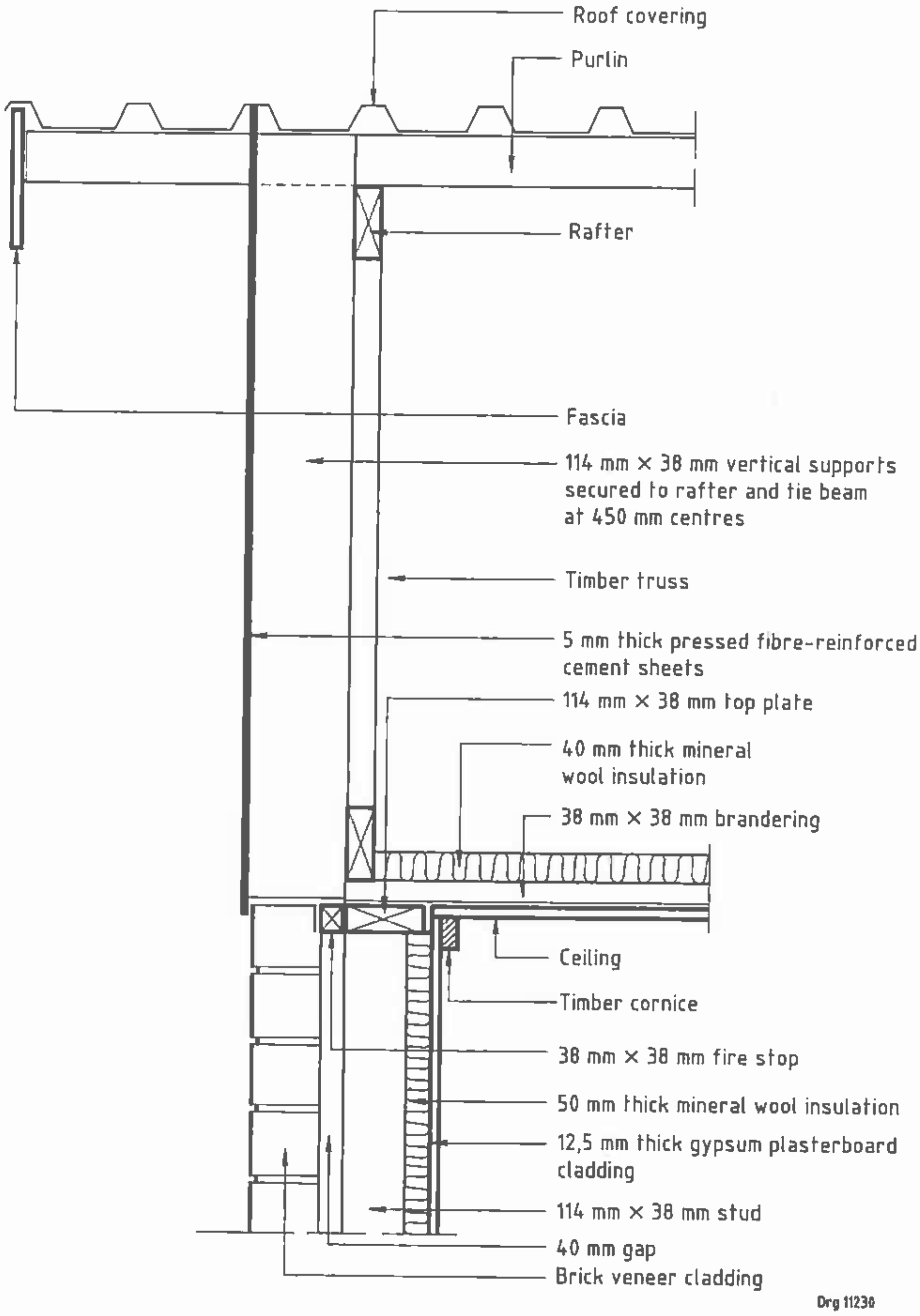


Figure 53 — Gable detail with sheet material cladding

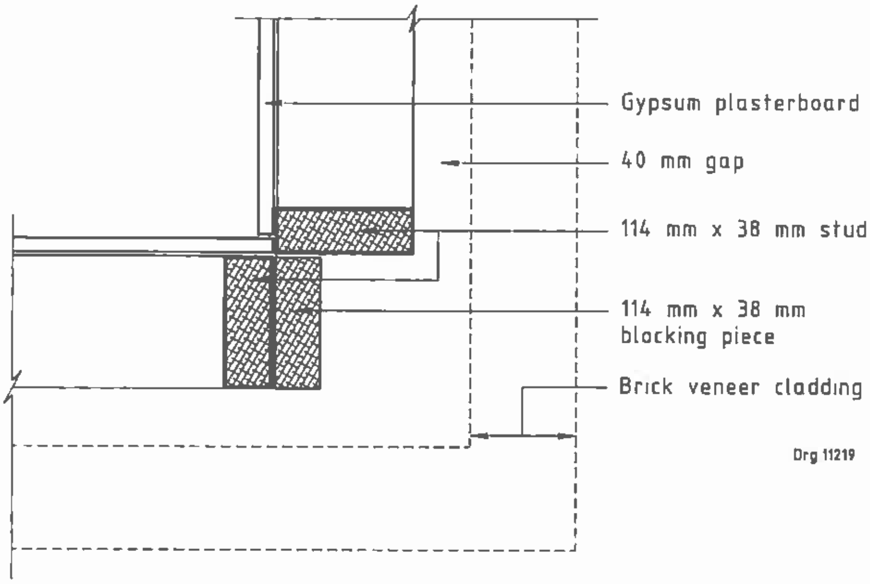


Figure 54 — Typical external corner junctions

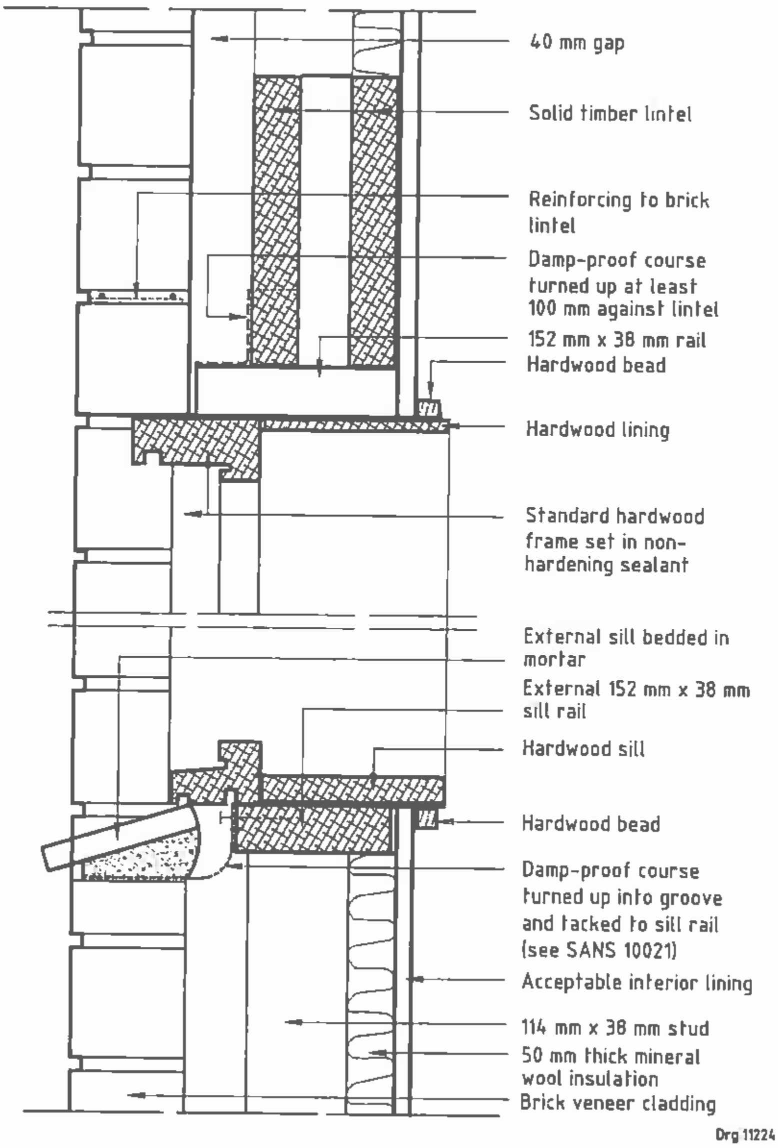


Figure 55 — Wooden window head and sill details

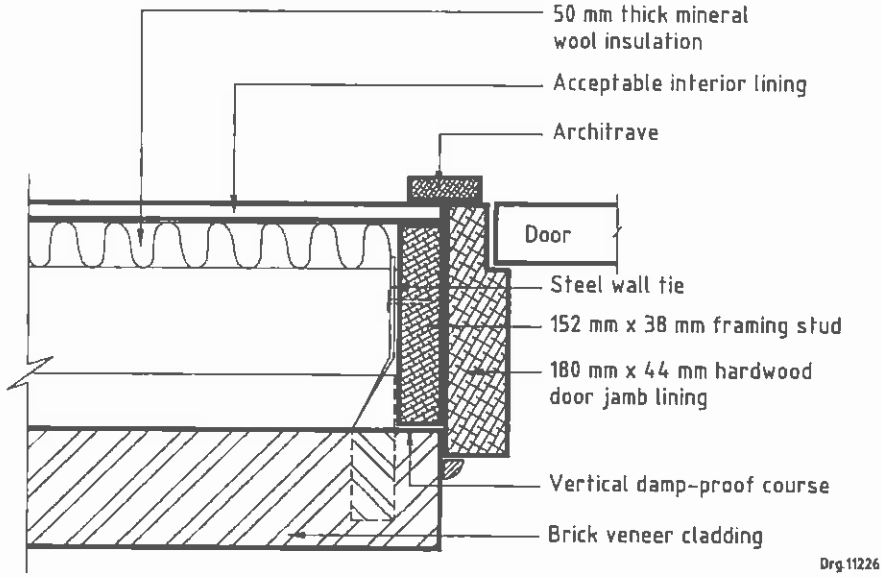


Figure 56 — External wooden door frame detail

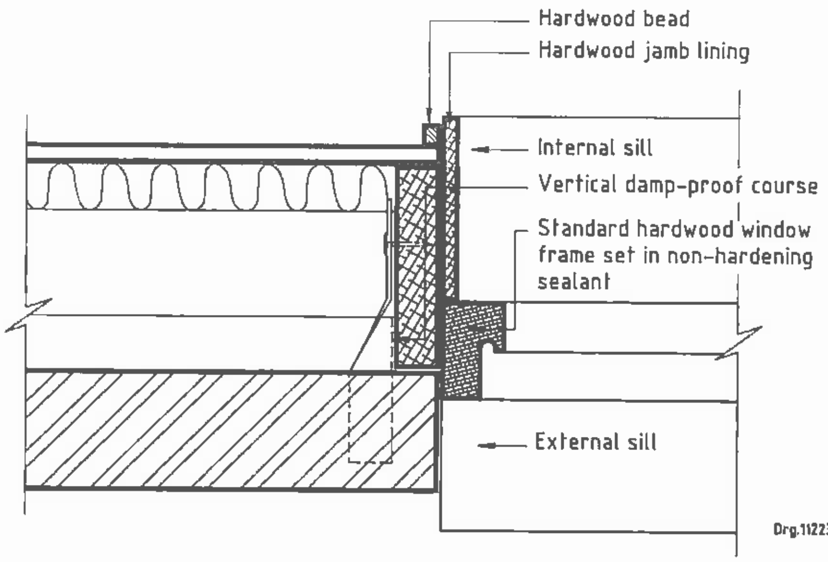


Figure 57 — Typical window reveal detail

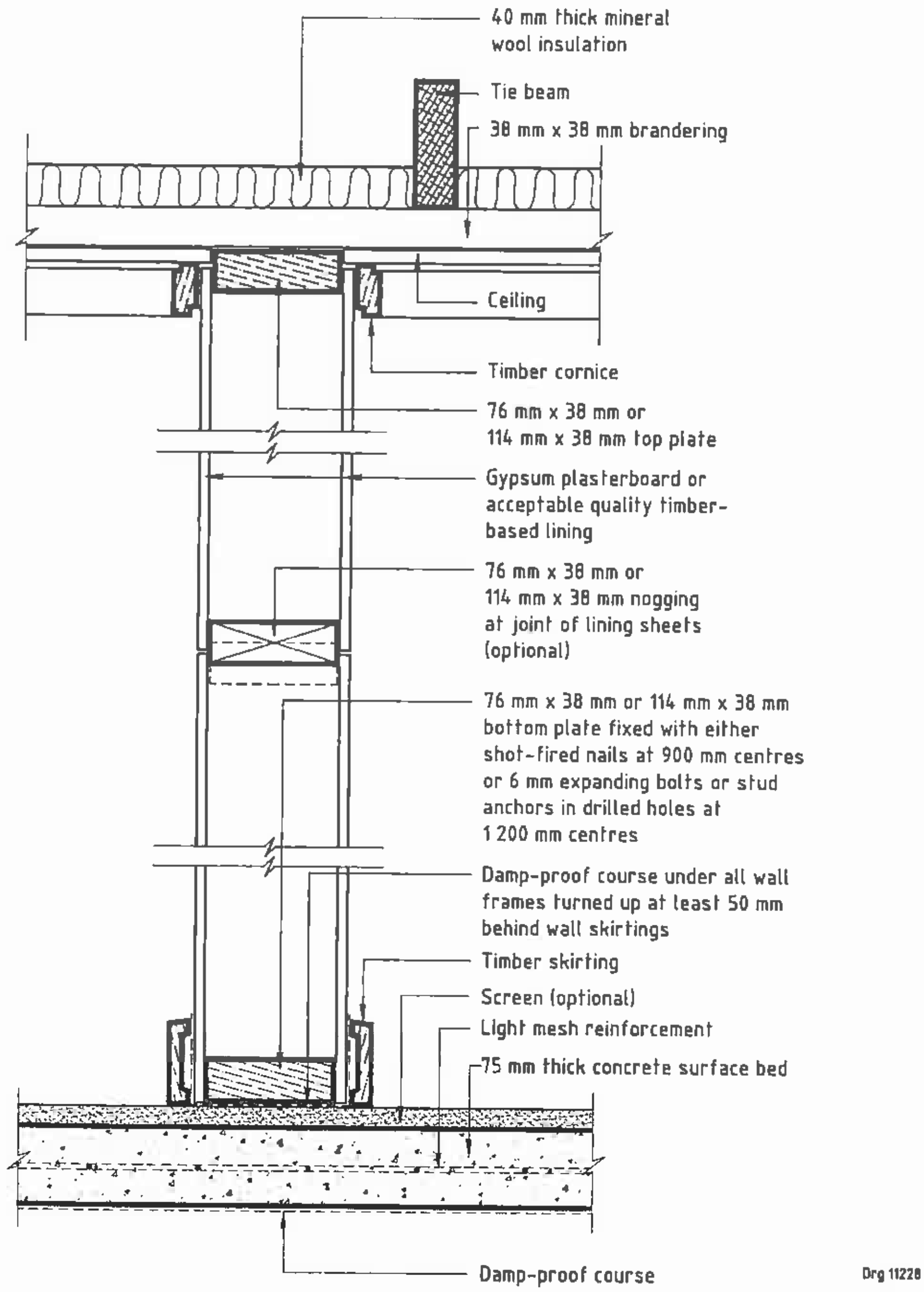


Figure 58 — Typical internal wall details

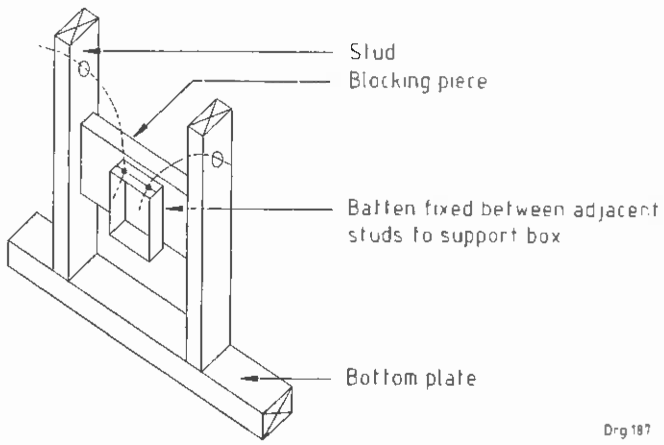
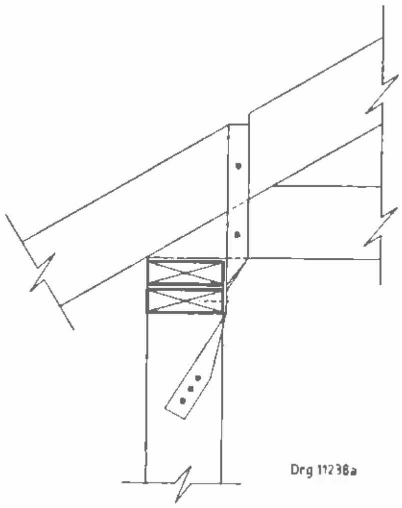
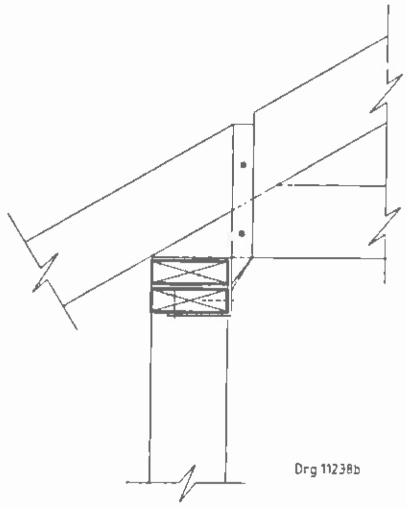


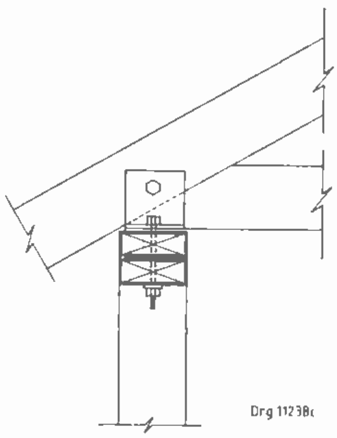
Figure 59 — Electrical socket box fixing



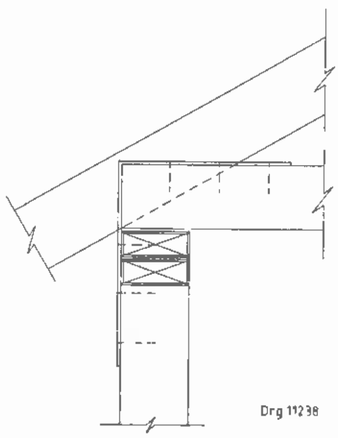
a) Strap to top plate and stud



b) Strap to top plate — Truss not directly over stud



c) Angle-iron bracket bolted to truss and top plate



d) Strap to tie beam and stud

Figure 60 — Typical details of securing roof trusses

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