SRI LANKA STANDARD 876 : Part 1 : 1999
UDC 691.424 : 666.961

CODE OF PRACTICE FOR

INSTALLATION OF ASBESTOS-CEMENT CORRUGATED SHEETS AND FIXING ACCESSORIES

PART 1 : COMPONENTS AND DESIGN CONSIDERATIONS

(FIRST REVISION)

SRI LANKA STANDARDS INSTITUTION

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PART 1 : COMPONENTS AND DESIGN CONSIDERATIONS
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SLS 876 : Part 1 : 1999

Gr. 14

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SRI LANKA

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

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CODE OF PRACTICE FOR INSTALLATION OF ASBESTOS-CEMENT CORRUGATED SHEETS AND FIXING ACCESSORIES
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FOREWORD

This code of practice was approved by the Sectoral Committee on Building and Construction Materials and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 1999-02-11.

Asbestos-cement corrugated sheets are commonly used in Sri Lanka for providing surfaces exposed to weather, such as roofs of industrial, institutional, commercial, temporary and residential buildings and walls of industrial and temporary buildings. Asbestos-cement corrugated sheets have many advantages, such as lightness, ease and quickness of construction, durability, long maintenance free service life, better security and greater economy. During construction it is also necessary to exercise caution in drilling, cutting and handling these sheets. Thus to realize the full potential of this type of covering, proper selection of various accessories, sound design and good workmanship are essential. This Code is intended to give necessary guidance on those aspects to obtain optimum performance in the use of asbestos-cement corrugated sheets.

The information given in the Appendix of the now superseded **CS 9** served as a nucleus in developing this Standard. This information was suitably modified and was considerably enlarged to bring in line with the latest developments before incorporation herein.

This Part of the Standard deals with components and design considerations whilst Part 2 of this standard covers installation and maintenance of asbestos-cement corrugated sheets in walls and roofs. This is the first revision of part 1 of this standard and it was revised mainly to give details on lap sealing materials, modify Table 2, and to incorporate details on proportioning of single-storey roof structures of houses without making structural design calculations.

For the purpose of deciding whether a particular requirement of this Code is complied with, the final value, observed or calculated, expressing the result of a test or measurement shall be rounded off in accordance with **CS 102**. The number of significant figures to be retained in the rounded off value should be the same as that of the specified value in this Code.

The Sri Lanka Standards Institution gratefully acknowledge the use of the following standards as guidance documents in the perpetration of this standard :

ISO 8108 : 1986 - Directive for fixing asbestos cement corrugated and asymetrical section sheets and fittings for roofing

BS 5247 : 1975 - Code of practice for sheets roof and wall coverings
Part 14 - Corrugated asbestos cement

IS 3007 : 1964 - Code of practice for laying of asbestos sheets.
Part 1 - Corrugated sheets

1. SCOPE

This part of the Standard deals with components and design considerations related to the installation of asbestos-cement corrugated sheets and all other fixing accessories for walls and roofs. This standard specifically refers to zoon 3 buildings. for buildings in other zoons reference should be made to the Ministry of Local Government, Housing and Construction Publication titled "Design for High Winds".

2. REFERENCES

BS	CP 3	Basic data for the design of buildings Chapter V : Part 2 : Wind loads
BS	1494	Fixing accessories for building purposes. Part 1 ; Fixing for sheets, Roofs and Wall Coverings
BS	6367	Drainage of roofs and paved areas.
SLS	9	Asbestos-cement products (First Revision) Part 2 : Corrugated sheets

3. DEFINITIONS

For the purpose of this part of the standard, the following definitions shall apply.

3.1 abutment : Sloping intersection of a roof surface with a part of the structure which rises above it.

3.2 accessories : Purpose-made fittings, such as ridge capping, ridge finials, apron flashing pieces, eaves filler pieces, barge boards, expansion pieces, ventilators, skylights and similar fittings.

3.3 apron flashing piece : Flashing, the lower edge of which is lapped over the roof covering.

3.4 asbestos cement : A material composed of asbestos fibre and Portland cement.

3.5 eaves : The lower edge of an inclined roof.

3.6 eaves filler or closure piece : Asbestos-cement accessory used to fill or close the corrugation spaces under the roof sheeting at the eaves.

3.7 finial or ridge end : Asbestos-cement accessory to form waterproof covering at the end of a ridge.

3.8 gable : Part of wall above the general eaves level at the end of a ridged or partially hipped roof.

3.9 gutter : Any form of roof-water channel.

3.10 hip : Inclined meeting line of two slopes in a pitch roof forming a salient angle.

3.11 hip ridge or capping : Asbestos-cement accessory used to form waterproof covering to a hip.

3.12 mitre : Cutting the joining surfaces of two sheets at an angle.

3.13 pitch slope : Angle of inclination with the horizontal of the rafters or substructure surface on which the roof covering is laid.

3.14 ridge : Line of intersection of two inclined roof surfaces at the apex of a roof.

3.15 ridge capping : Asbestos-cement accessory to form a waterproof covering to a ridge.

3.16 top edge : Upper edge of a roof surface finishing at a ridge or against part of a structure rising above the roof surface.

3.17 valley : Meeting line of two slopes in a pitched roof forming a re-entrant angle.

3.18 verge : Slopping edge of a pitched roof.

4. COMPONENTS

4.1 Asbestos -cement corrugated sheets

Asbestos-cement corrugated sheets shall comply with **SLS 9 : Part 2**

4.2 Fixing accessories

Hook bolts shall comply with the requirements of **BS 1494 : Part 1** and shall be of L-shape, standard-shape or J-shape as specified and unless otherwise specified shall be of galvanized steel. The diameter shall be 6 mm. The bolts shall have a grip of not less than 25 mm on the far side of the purlin. Each bolt shall have a diamond shaped bitumen washer of 38 mm side and 2.0 mm thick, a diamond shaped galvanized iron limpet washer of 38 mm side and 1.6 mm thick, and a square nut.

Roofing bolts, nuts and clips drive screws ect. shall all be of galvanized steel and generally shall conform to **BS 1494 : Part 1.**

4.3 Gutters and flashiness

Asbestos-cement gutters (inclusive of valley gutters, boundary wall gutters) and flashing can be used without any additional protective measures.

Asbestos-cement is not affected by contact with any of the materials commonly used for gutters or flashings or by rainwater which has run off these materials. Being a Portland cement product, however, asbestos-cement releases some alkali until fully matured. Materials which are liable to attack by alkalis, such as aluminium, lead, zinc contact with water running off asbestos-cement sheeting. Two coats of bitumen or any other equivalent paint provide suitable protection, and renewal is normally unnecessary because the risk will have diminished before the original coating has ceased to be effective.

4.4 Particular fittings for roofing and walling

4.4.1 Particular fittings for roofing made of asbestos-cement and/or other materials shall be as follows:

a) for ridges : two piece close fitting adjustable ridges (see Figure **1**) or serrated adjustable ridges (see Figure **2**) or plane adjustable ridges (see Figure **3 b**) or ventilator adjustable ridges (see Figure **3 a**).

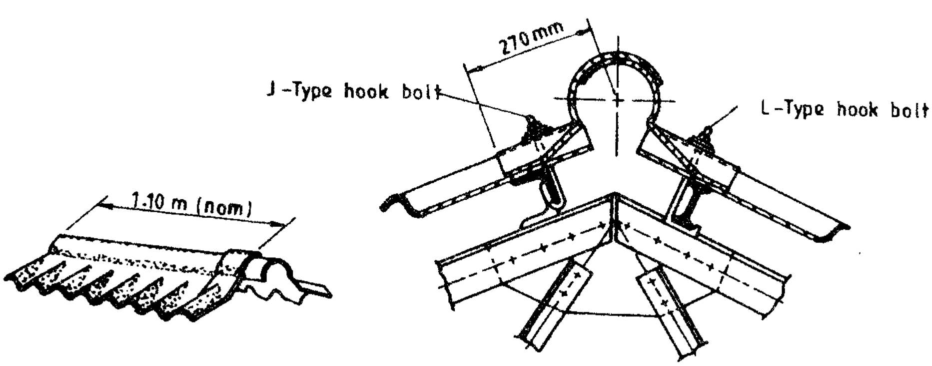


FIGURE 1 – Typical close fitting adjustable ridges

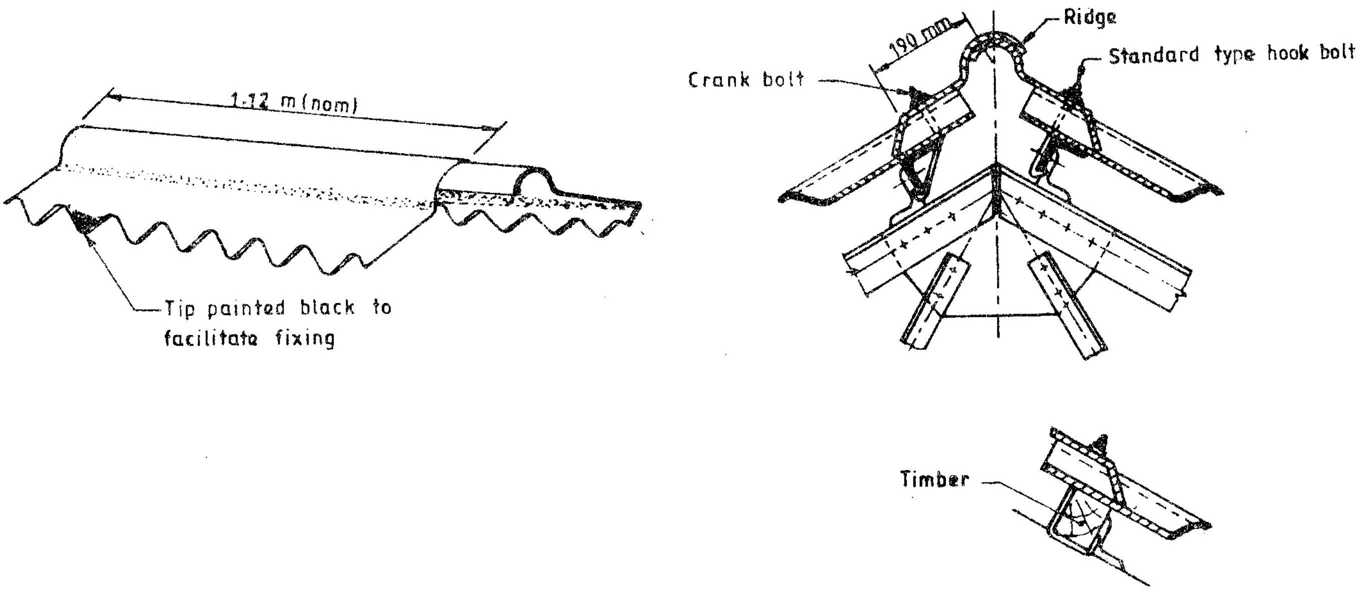


FIGURE 2 – Typical serrated adjustable ridges

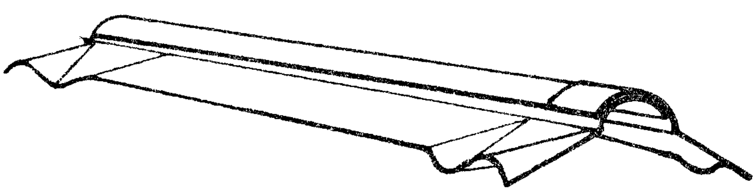


FIGURE 3a – Ventilator adjustable ridges

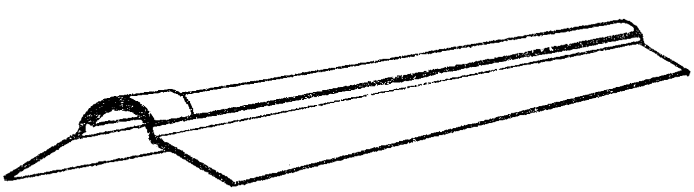
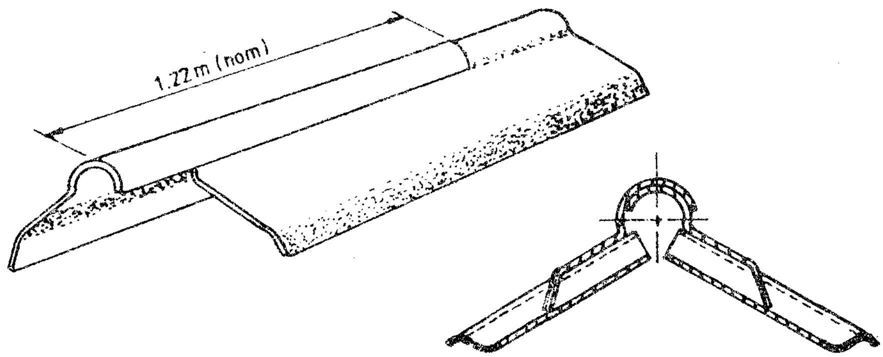


FIGURE 3b-Typical adjustable plane ridges

b) for hips : two piece plane adjustable ridges (see Figure 3) or unserrated adjustable ridges (see Figure 4) ;



Note - Serrations as desired should be cut at site to fit corrugations at hip slopes

FIGURE 4 – Typical unserrated adjustable ridges for hips

c) for verges : barge boards or corner pieces (see Figure 5),

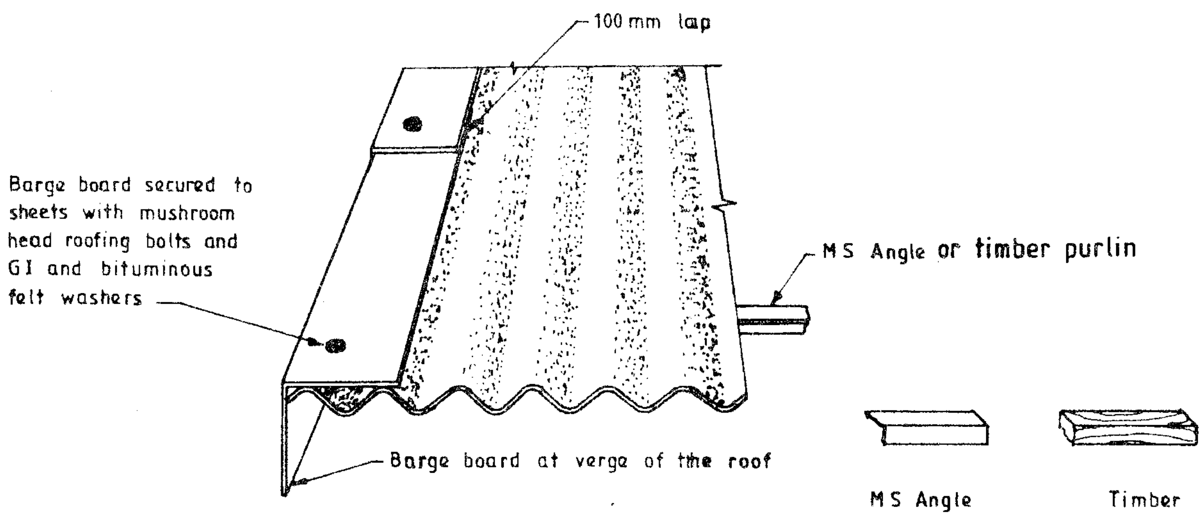


FIGURE 5 – Typical details of bargeboard or corner piece (view from eaves)

d) for continuous special mouldings : apron pieces (see Figure **6**) and north light curves (see Figure **7**) :

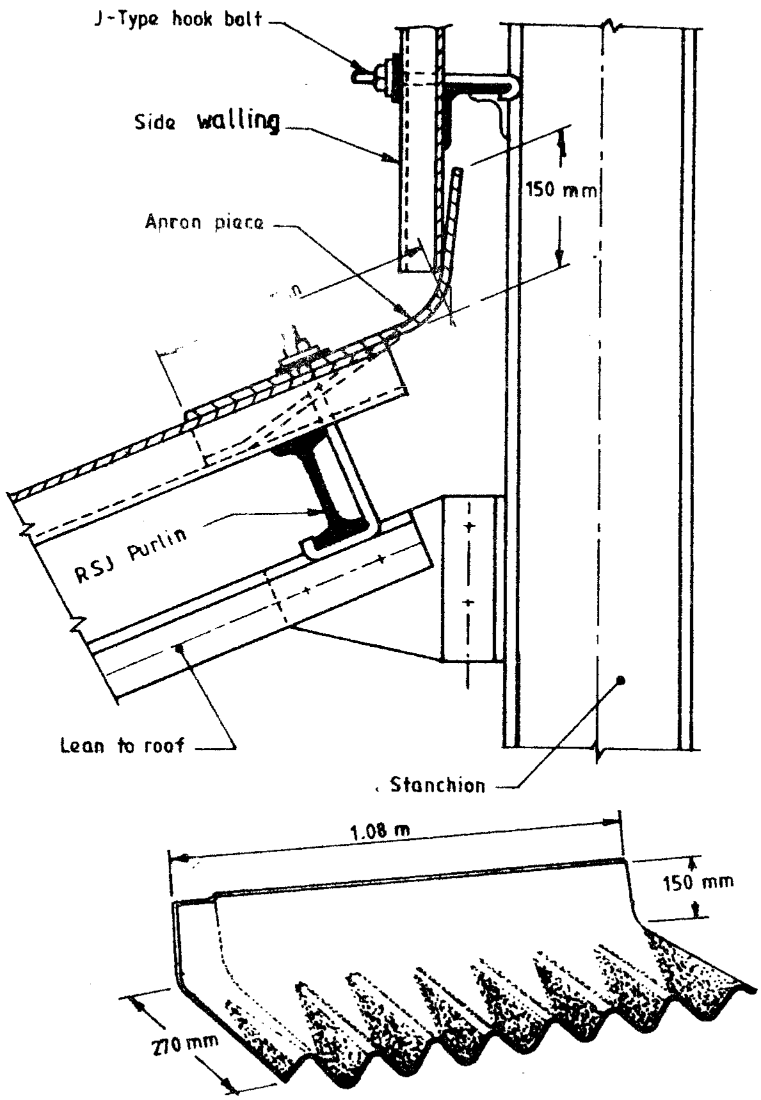


FIGURE 6 - Typical apron piece

e) for discontinuous special mouldings : special asbestos-cement profiled sheets to allow natural ventilation (see Figure **8**) or to allow for removal of combustion gases (see Figure **9**); and

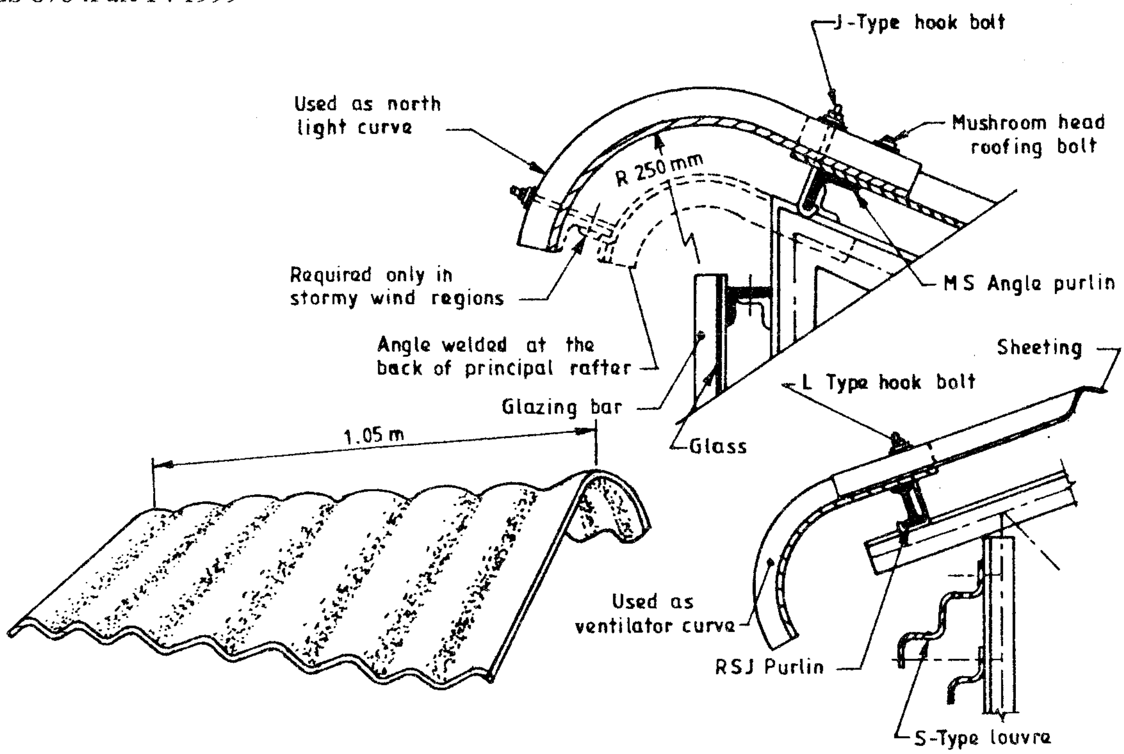


FIGURE 7 - Typical northlight curves

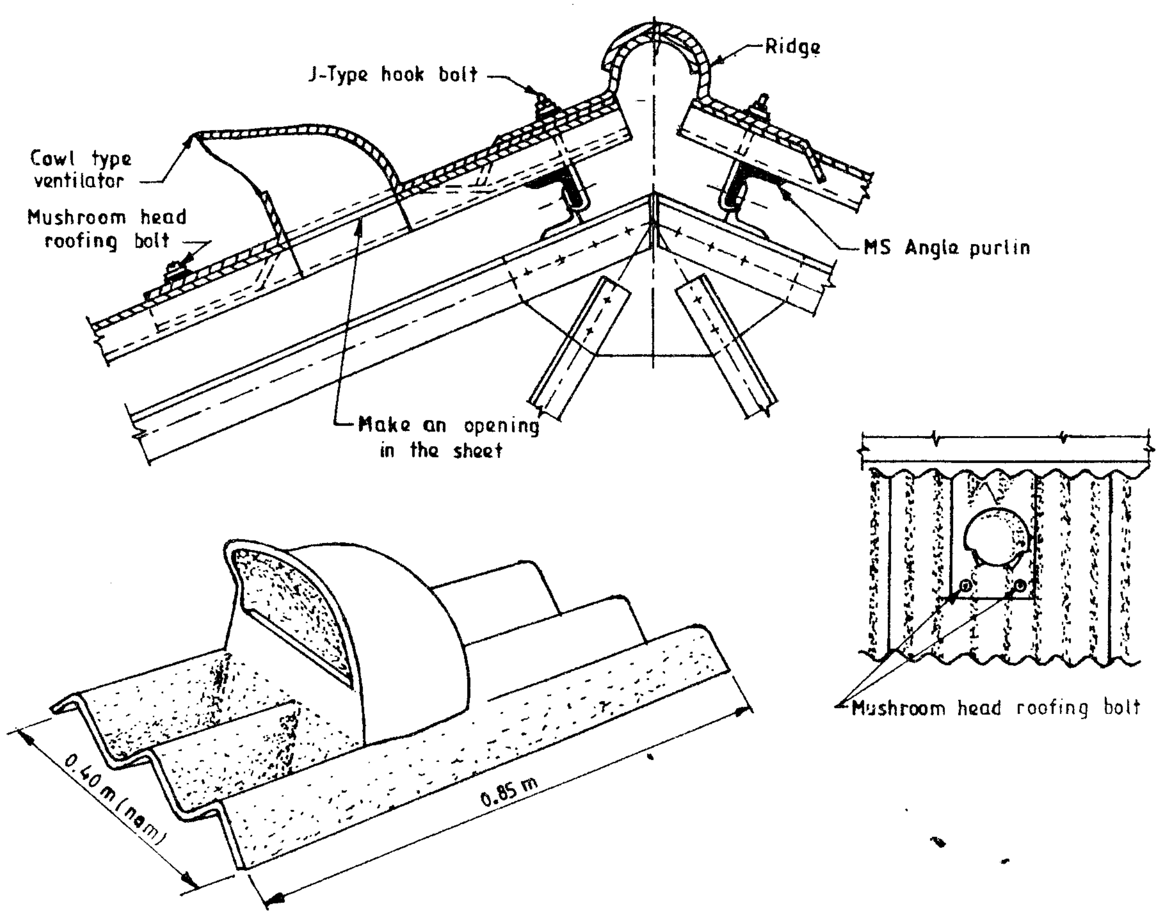


FIGURE 8 - Typical cowl type ventilator

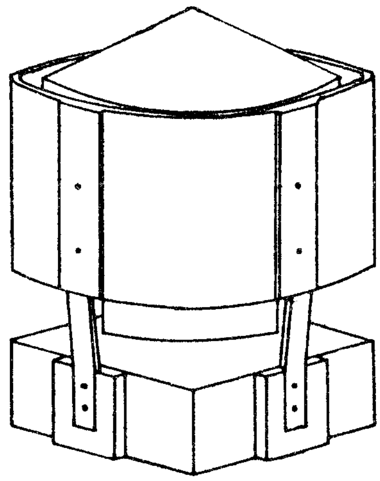


FIGURE 9 – Roof extractor

f) for drainage : open valley gutters, boundary wall gutters, box gutters, half round gutters, ornamental gutters (see Figures **10, 11 12, 13** and **14** sump outlets, down pipes, sawn necks, bends, plinth bends and shoes (see Figure **15**) made of asbestos-cement.

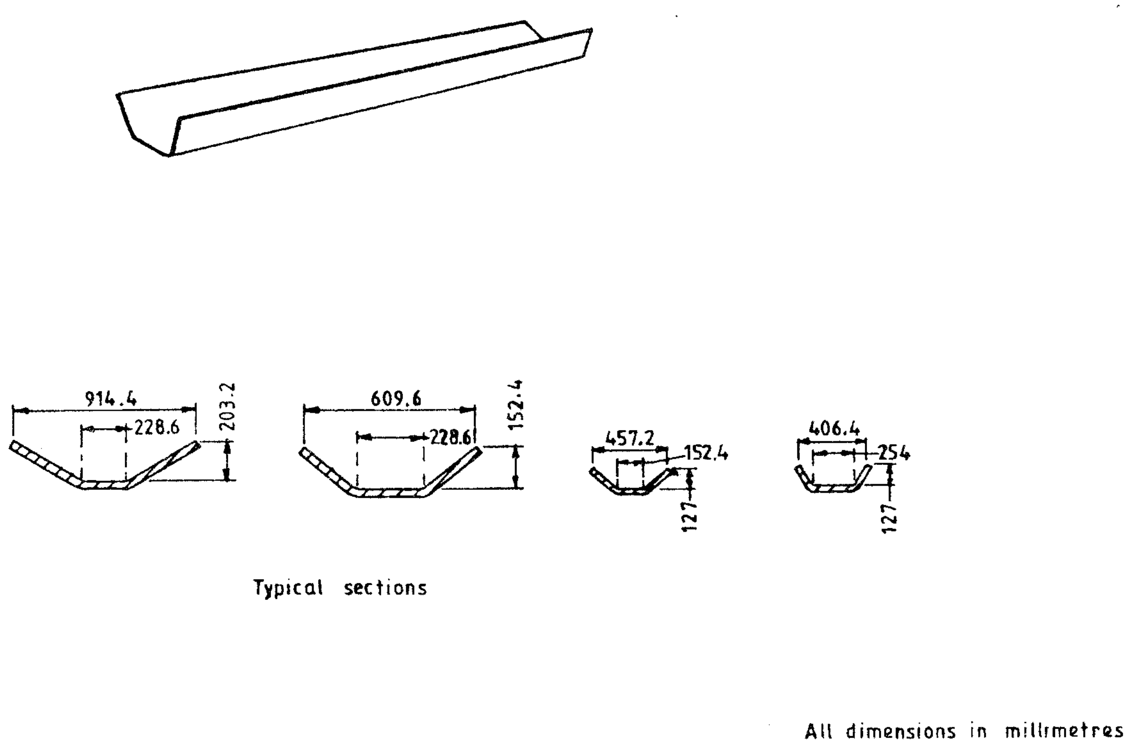
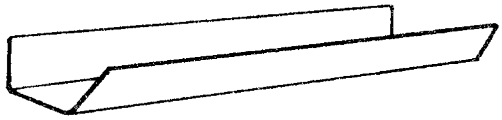
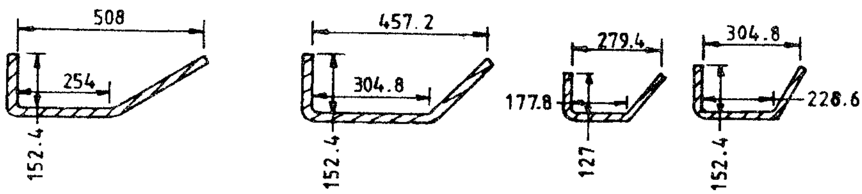


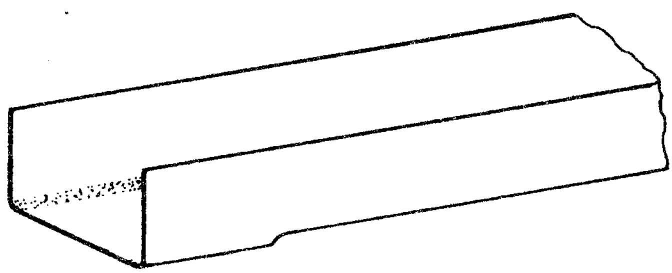
FIGURE 10 - Open valley gutters

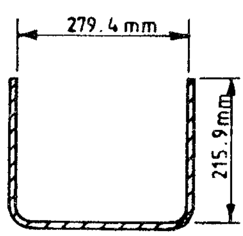




Typical sections

FIGURE 11- Boundary wall gutters





Section

FIGURE 12 - Box gutter

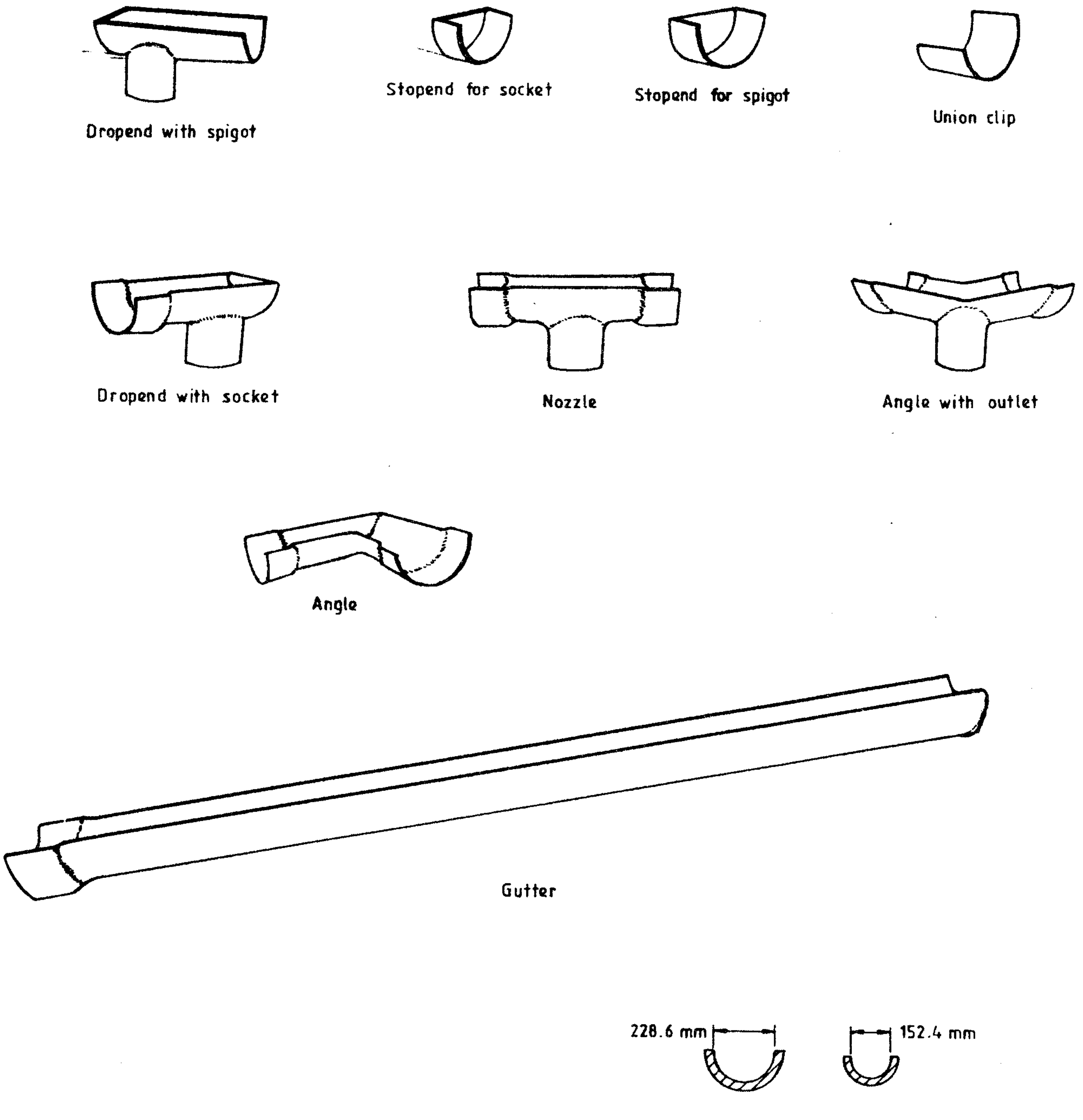


FIGURE 13 – Half round gutters

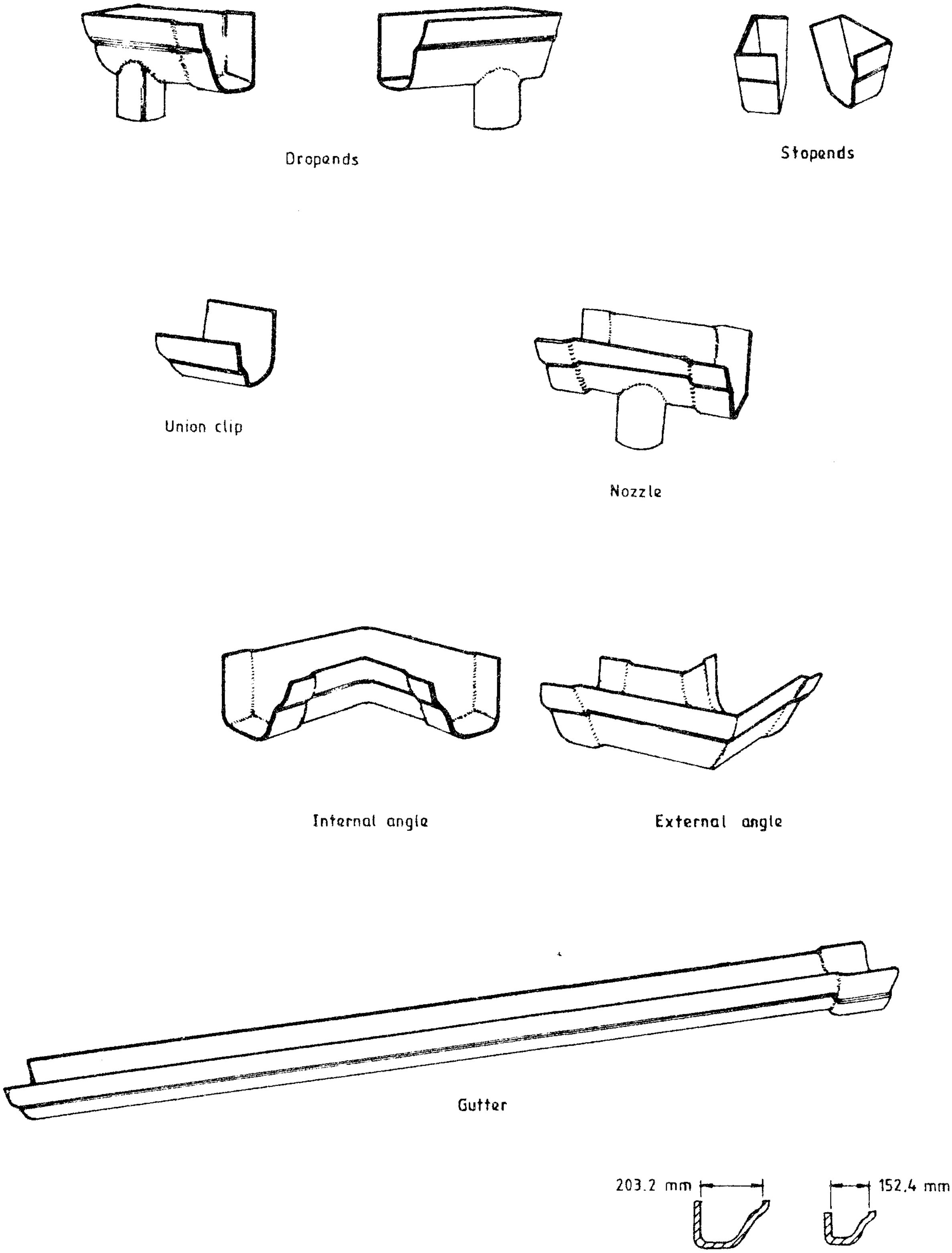


FIGURE 14 – Ornamental gutters

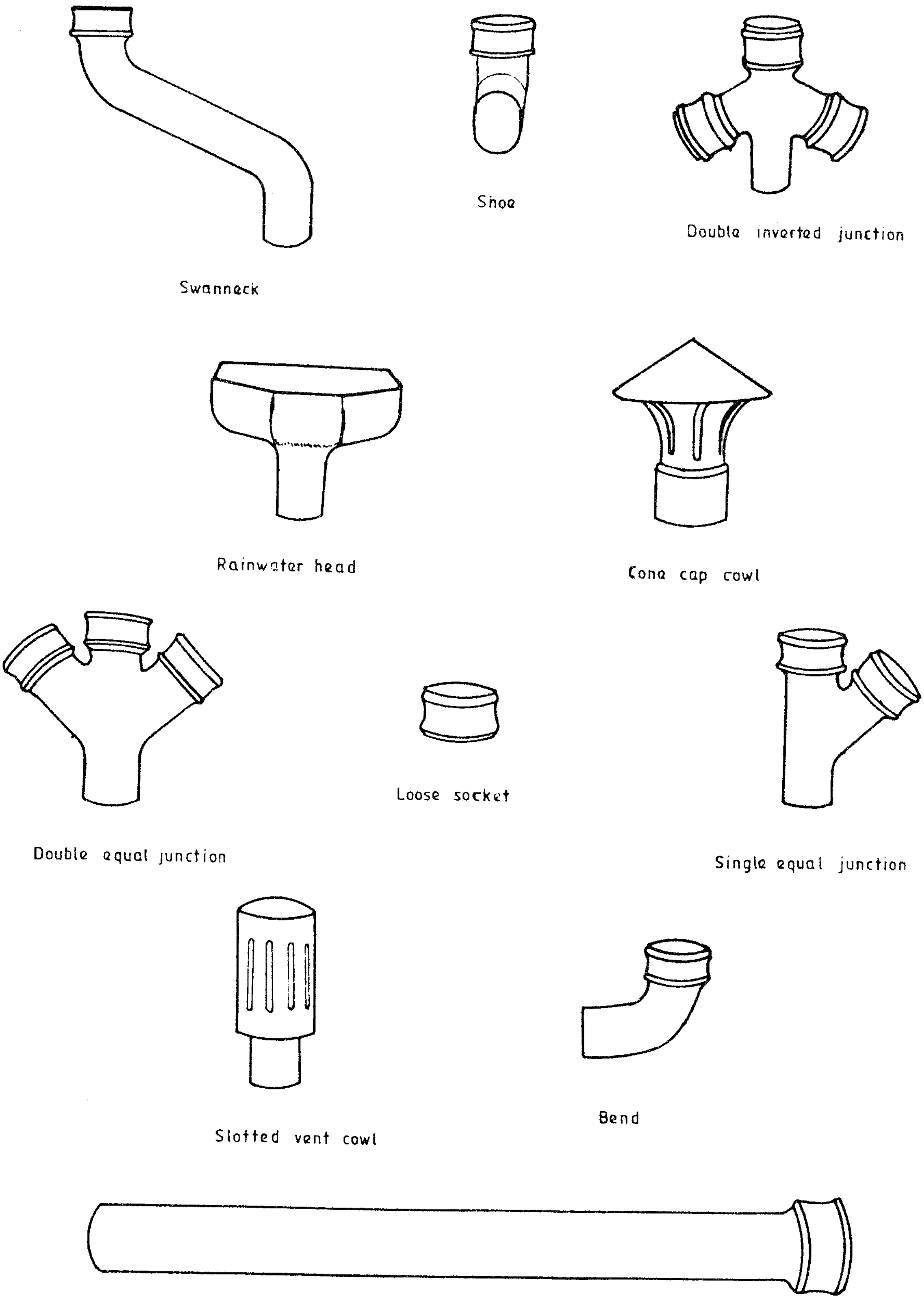


FIGURE 15 – Rainwater pipes and fittings

4.4.2 Particular fittings for walling made of asbestos-cement and/or other materials shall be as follows;

a) for continuous special mouldings : apron pieces ; and
b) for discontinuous special mouldings : special asbestos-cement profiled sheets to allow for removal of combustion gases.

4.5 Lap sealing materials

A variety of plastics seals are available. They may be extruded or gum applied mastics, or impregnated plastic strips. The section or amount of mastic should be such that it can be evenly laid and, when it is compressed on the side walls of the corrugations, it is of adequate section to seal on the crowns and valleys of the sheet. With gum mastic it is important to avoid over compression which leaves insufficient 'body'in the material to maintain seal.

The minimum joint thickness of the seal should be 1 mm when compressed and 3 mm before compression.

Before placing mastic in position it is important to remove all the cutting and drilling dust from the two sheet surfaces that are to be sealed and ensure that contact surfaces are dry. It is then important to dress or place the mastic extrusion into the sheet valley corrugations and not to run it across corrugations leaving it to sag into position. Excessive thumbing when placing mastic in position should be avoided and it should be maintained in a constant section until compressed by the sheet. Mitred joints should be filled with mastic on crowns of corrugations. All mastic should be laid so that it is not disturbed or damaged during the drilling and bolting of the sheets.

5 DESIGN CONSIDERATIONS

5.1 General

To secure maximum economy, the roof plan and wall elevations should be simple and designed to use sheets of a standard size wherever possible. In addition to spacing purlins to suit sheet lengths, end overlaps should be considered. The correct overlap, with the majority of the end lap below the fixing accessory, is particularly important on low pitch roofing.

In a roof, formation of hips and valleys should be avoided, as far as possible. Isolated projections above roof should be avoided at the design stage itself, as it is difficult to make the junctions between such projections and the roof sheeting weatherproof. However, it should be noted that an asbestos sheeted roof is as versatile as a tiled roof in formation of different roof shapes, but if the economy of an asbestos sheeted roof is to be fully utilized, simple double pitched roof shape at a mild roof slope is the best option.

5.2 Roof design

5.2.1 *Site categories*

Category 1 and category 2 sites are defined in Table **1**. For the purpose of this table, a "Category 2" site is one where the wind suction on any part of the roof cladding exceeds 1200 N/m^2 when calculated in accordance with **Chapter v** of **BS : CP3 : Part 2.** In a "category 1" site wind suction on any part of a roof cladding does not exceed 1200 N/m^2

TABLE 1 - Identification of "Category 1" and "Category 2" sites

Zone No.	Height of structure		Category of site in relation to pitch					
			less than 15^0		15^0 and up to 20^0		20^0 and up to 40^0	
(1)	(2)		Exposed(3)	Sheltered(4)	Exposed(5)	Sheltered(6)	Exposed (7)	Sheltered (8)
Zone 1	Normal structure	Greater than 5.0 m	2	2	2	2	2	2
		up to 5.0 m	2	2	2	2	2	2
	Post disaster structure	Greater than 5.0 m	2	2	2	2	2	2
		up to 5.0 m	2	2	2	2	2	2
Zone 2	Normal structure	Greater than 5.0 m	2	2	2	2	2	2
		up to 5.0 m	2	1	2	1	2	1
	Post disaster structure	Greater than 5.0 m	2	2	2	2	2	2
		up to 5.0 m	2	2	2	2	2	2
Zone 3	Normal structure	Greater than 5.0 m	2	1	2	1	2	1
		up to 5.0 m	1	1	1	1	1	1
	Post disaster structure	Greater than 5.0 m	2	2	2	2	2	2
		up to 5.0 m	2	1	2	1	2	1

NOTES

*1. Zones are shown in Figure **16***

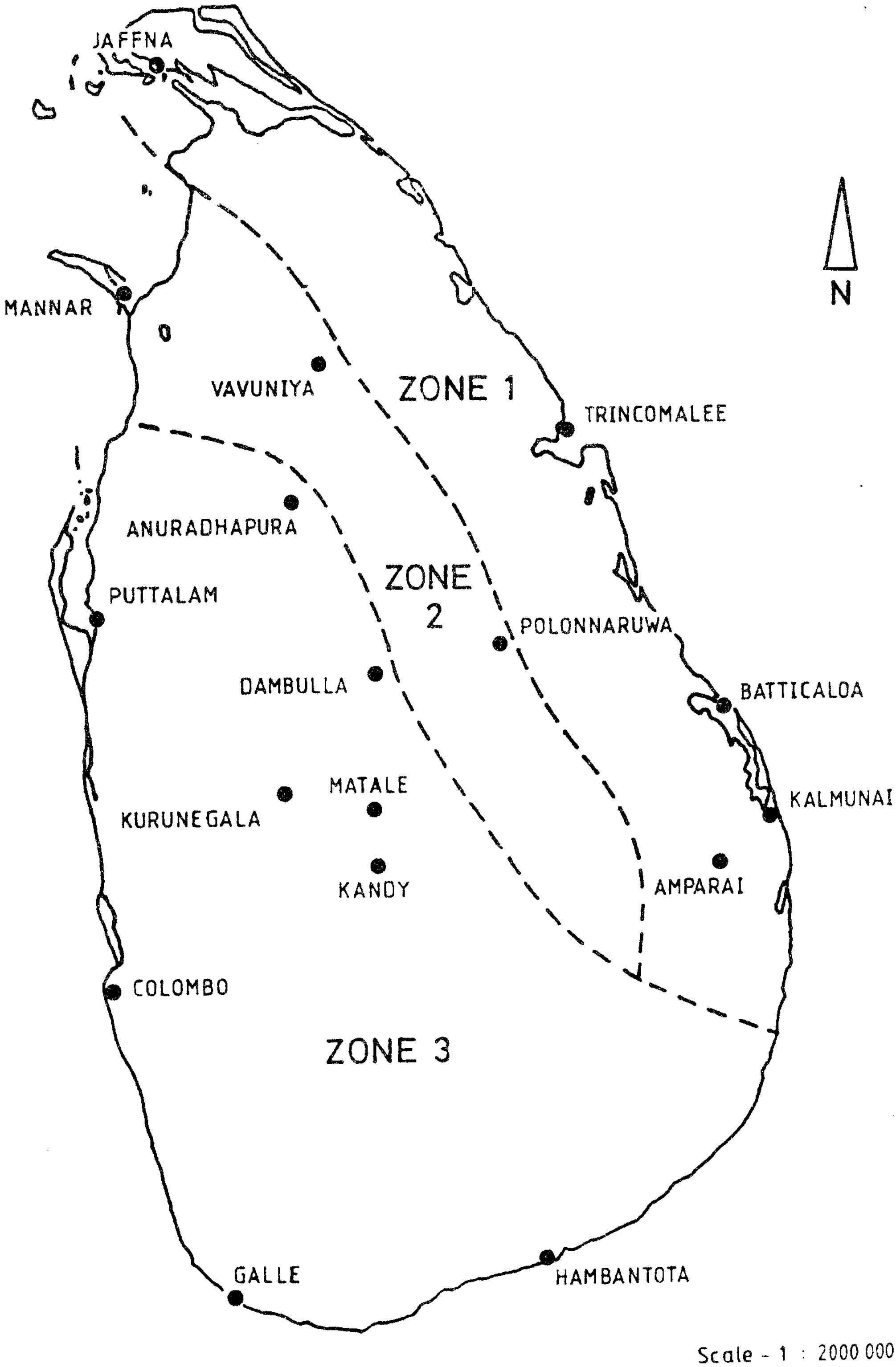


FIGURE 16 – Sri Lanka wind loading zones

2. The post disaster structures are those which should be operational even after the cyclone such as power stations, refuge shelters, air traffic control buildings, hospitals, meteorological centres, police stations, telecommunication buildings and fire stations. Normal buildings are all public and private buildings other than those above.

3. Exposed locations are those facing a large open area clear of any obstacles such as trees, shrubs, or buildings. Examples are the sea, coastal lagoons, irrigation tanks or large areas of paddy fields without trees.

4. Sheltered locations are those where a building is surrounded by other structures of about the same or greater height.

5.2.2 *Lap length*

Table **2** gives the sheet pitch and the corresponding lap length.

TABLE 2 - Sheet pitches and corresponding lap lengths.

Sheet pitch (1)	Lap length (2)
a. "Category 1" sites	
22.5^0 and over	150 mm end laps unsealed
15^0 and up to 22.5^0	150 mm end laps unsealed
10^0 and up to 15^0	150 mm end laps with end laps sealed, or 225 mm end laps unsealed
4^0 and up to 10^0	150 mm end laps with side and end laps sealed
b. "Category 2" sites	
25^0 and over	225 mm end laps unsealed
15^0 and up to 25^0	150 mm end laps with end laps sealed, or 225 mm end laps unsealed
10^0 and up to 15^0	150 mm end with side and end laps sealed, or 300 mm end laps unsealed
4^0 and up to 10^0	300 mm end laps with side and end laps sealed.

This table shall be used as a guide for roofs up to 15 m in slope length. For roofs over 15 m in slope length, roof drainage should be collected at intermediate stages not exceeding 15 m in slope length.

The side laps shall be one corrugation and, as far as possible, it shall be sheltered from the commonly prevailing wind direction.

5.3 Durability

Asbestos-cement corrugated sheets which are untreated on the exposed face will be affected in the following ways when exposed to the atmosphere:

a) The surface will become slightly softened owing to the partial dissolution of the cement by chemical action, resulting in some exposure of surface fibres;

b) Age will bring about a reduction in resistance to impacts but the transverse strength will improve; and

c) Slight expansion, shrinkage or curling may cause cracking if the sheets are fixed too rigidly to the supporting structure.

Asbestos-cement corrugated sheets are not recommended for use where it might be subject to impact. The risk of cracking and fracture due to slight movement of the structure is small if the sheeting is not too rigidly fixed.

Asbestos-cement sheeting may be regarded as having a normal life of at least 60 years. Durability depends mainly on the degree of acid pollution of the internal or external atmospheres. Atmospheric pollution is not normally sufficiently concentrated to be harmful. Measures should be taken to prevent corrosion of the fixing accessories, for example, by the use of plastic washers and caps.

Where it is known in advance that the conditions of exposure may be harmful to asbestos-cement, consideration should be given to the use of some form of preservative treatment (see **SLS 876 : Part 2 : 1999)**

5.4 Weathertightness

The principal factors affecting weathertightness of external walls and roofs covered with asbestos-cement corrugated sheets are given in **5.4.1, 5.4.2** and **5.4.3.**

5.4.1 *Roofs*

It is essential when considering pitches that the pitch of the laid sheet is used and not the angle of the rafter. The lapping of the sheets and deflection of the frame make considerable difference to the laid pitch of the sheet and shall not fall below 10. On roofs curved in section the extent of end lap shall be related to the nominal roof pitch at the laps; the nearer such end laps are to the crown of the roof, the flatter will be the pitch, and the lap shall be increased accordingly beyond those given in Table **2**.

5.4.2 *External Walls*

End laps of the sheets shall be not less than 150 mm and, in very exposed locations including high buildings, and additional fixings and/or reduced rail spacing shall be used. Similar details of fixing as for roof sheeting (see **SLS 876 Part 2 : 1999**) shall apply.

5.4.3 *Moulded asbestos-cement accessories*

Wherever possible, moulded asbestos-cement accessories should be selected from the commercially available range of patterns. Decisions regarding the uses of non-standard fittings which are to be purpose made should be made in consultation with the manufacturer. When the use of moulded accessories is impracticable, other methods such as are described in **5.7**, **5.8** and **5.9** may be employed.

5.5 Movement joints

When the horizontal length of asbestos-cement sheeting exceeds 30 m, movement joints shall be provided in the roof covering and vertical cladding. One movement joint shall be provided in continuous runs of sheeting up to 50 m in length measured horizontally and one for each additional 20 m length measured horizontally.

It is essential that movement joints in asbestos-cement corrugated sheets be designed to coincide with any such joints provided in the structure. The joints in both the roof and wall coverings should be designed to suit the type of sheeting used, and shall be used in conjunction with specially made joint accessories which are available for standard types of sheet.

5.6 Arrangement of the supporting structure

All purlins/rails shall be in one plane and properly anchored to the supporting structure. Special care shall be taken that the sheets do not deflect the intermediate prulins/rails in an attempt to make the sheets bear on such purlins/rails.

Size or sizes of asbestos-cement corrugated sheets required to cover the slope length of the roof shall be determined by considering the required eaves overhang and the lap requirements depending on roof slope (see Table **2**).

In a roof, purlins are required at a ridge, an eave, an overlap or a top edge. If the maximum purlin spacing specified (see paragraph 5 of this section) is exceeded, then intermediate purlins should also be positioned to ensure that maximum purlin spacing is not exceeded anywhere.

In a wall, rails are required at an upper edge, a lower edge or an overlap. If the maximum rail spacing specified above is exceeded, then intermediate rails should be positioned to ensure that maximum rail spacing is not exceeded anywhere. Edge rail shall be positioned so that no holes shall be within 38 mm to the edge of the sheet and the free overhang of the sheet is not more than 150 mm for 6 mm thick sheet.

For corrugated sheets of 6 mm thickness, the spacing of purlins shall not exceed 1.4 m for roof covering and the spacing of rails shall not exceed 1.7 m for wall cladding. The free overhang at eaves, measured as the length of sheet from its lower edge to the centre of boot/fixing holes shall not be more than 150 mm for 6 mm thick sheets. Overhanging verges shall be supported by purlins for the full width of the sheet.

Ridge purlins shall be fixed within 75 mm to 115 mm from the apex of the roof.

As a safety precaution additional trimmers or bridging shall be used between purlins at all points where considerable roof traffic is likely to occur, for example, adjoining valley or box gutters, below glazing and around chimneys ventilators or other uptakes. Similarly, when a course of sheets of smaller length necessitating closer purlin spacing is required to make up a roof slope, it is desirable to arrange the closer purlin spacing at eaves rather than at top edges, as this will bring additional support where it is most required to make a roof slope.

Hip and valley runners shall be provided, fixed flush with the top face of purlins and spanning between them, to give adequate support to the raking cut edges of roof sheets at hips and valleys. The runners shall run parallel to the edge of the sheeting and placed so as to permit the fixing of the sheets and hip covering accessories.

5.7 Top edges and abutments

At top edges against walling, asbestos-cement apron flashing pieces may generally be used. If the wall consists of vertical sheeting, this should lap over the roof sheeting; no other flashings are required. If, however, the wall is of brick or masonry, the apron should be secured to the sheeting and metal or felt covers flashings should be used over the upstand.

If apron flashing pieces are unsuitable, sheets shall be metal or felt flashed. On low roof pitches the importance of extending the width of the flashging, dependent on pitch and exposure, shall be considered.

At a sloping verge abutment, if the direction of the corrugations is parallel to or running away from the wall, metal or felt flashing shall be used. The flashing shall be dressed as an apron over the roof sheeting to cover at least two full corrugations of the sheeting; the upstand shall be provided with cover flashings or shall be turned into and secured to the wall overhang. If the corrugations run into the wall face, a gutter will be necessary to drain water into the eaves or valley gutter.

5.8 Pipes passing through roofs and walls

The positions of any necessary perforations of the sheeting shall be considered in relation to the position of the end laps so that the length of flashing above the pipe outlet will not be unduly extended.

5.9 Ventilators and translucent lights

Natural draught ventilation through roofs and walls can be obtained with moulded asbestos-cement accessories which include continuous ridge ventilators, ventilating ridge capping or cranked crown ventilating sheets, ventilators, louvers etc. Consideration shall be given to the proposed use of the building when selecting the type of ventilator to be use of the building when selecting the type of ventilator to be used. Open ventilating ridges for example, are not completely weathertight on low roof pitches in extreme weather conditions, and shall not be considered for warehouse type buildings where complete weathertightnes is essential.

Roof lights are made in profile to match all asbestos-cement corrugated sheets, in glazed asbestos-cement or in glass fibre reinforced plastics. Lights manufactured from unplasticized polyvinyl chloride and corrugated glass an also available in certain profiles. Security of translucent lights is important to prevent uplift in wind conditions. In addition, due to their flexibility, the use of shaped rigid supporting fillers is recommended at head and intermediate purlins.

5.10 Asbestos-cement gutters and rainwater pipes

5.10.1 *General*

For detailed recommendations for assessing the size of gutters and the size and spacing of rainwater pipes reference shall be made to **BS 6367**

5.10.2 *Supports*

Gutters shall be supported by a bracket at each joint and at centres not exceeding 900 mm.

5.10.3 *Falls*

A fall in the gutter, a minimum of 1 in 500 towards the out let is recommended.

5.10.4 *Open valley gutters*

Open valley gutters shall be of such a width that the edges of the sheeting at each sides of the gutter are at least 150 mm apart.

5.10.5 *Internal or parapet gutters*

The width of internal or parapet gutters shall be not less than 230 mm.

5.10.6 *Sump outlets*

A sump outlet from an internal or parapet gutter shall be not less than 300 x 150 x 195 mm deep.

5.10.7 *Rainwater discharge*

No gutter or rainwater pipe should discharge on to the sheeting.

5.11 Requirement of fixing accessories

5.11.1 *Size of fixing accessories*

The length of bolts for fixing asbestos-cement corrugated sheets shall be as given in Table **3.**

TABLE 3 - Length of bolt at different locations

Serial No. (1)	Situation (2)	Length of Bolt (3)
1	At horizontal (end) laps of sheets. At eaves when filler pieces are used. At ridge when corrugated sheets and ridge pieces are secured by the same bolt	Depth of purlin plus 80 in mm
2	At eaves when filler pieces are not used. At ridge when corrugated sheets and ridge pieces are not secured by the same bolt.	Depth of purlin plus 65 in mm
3	At intermediate purlins where horizontal laps do not occur.	Depth of purlin plus 65 in mm.

The minimum length coach screw for timber purlins shall be 110 mm.

Hook bolts or coach screws of at lest 6 mm size shall be fitted with diamond shaped galvanized iron washers and bituminous washers of suitable shape to fit the outer face of sheets and inserted through holes of corresponding size drilled in the crown of the corrugation (see Figure **18**)

5.11.2 *Number of Fixing accessories*

In buildings in Zone 3, (see Figure **16**), sheets shall be secured at the intermediate purlins and through the end laps by at least two hook bolts/screws per sheet per purlin with fixings located at the second and sixth corrugations (see Figure **17**). In exposed gable-end areas and overhangs of such buildings, three hook bolts/screws per sheet per purlin may have to be provided at second, fourth and sixth corrugations.

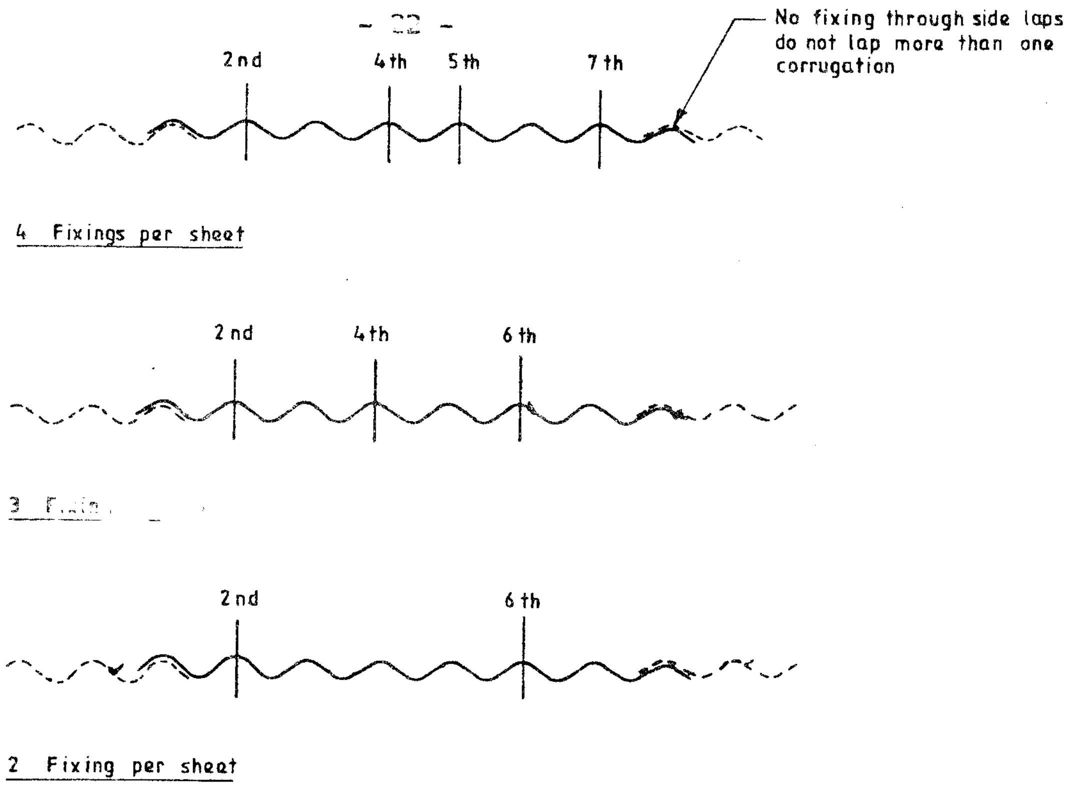


FIGURE 17 – Hook bolt locations and side laps

In normal buildings in Zone 1 (high intensity cyclones likely) and Zone 2 (intermediate intensity cyclones likely), sheets shall be secured at the intermediate purlins or through end laps by at least three hook bolts/screws per sheet per purlin with fixing located at second, fourth and sixth corrugations.

In exposed gable-end areas and overhangs of such buildings, four hook bolts/screws per sheet per purlin shall be provided at second, fourth, fifth and seventh corrugations. For these applications in Zone 1 and Zone 2 free end of hook bolt shall be fixed by a 25 mm staple (see Figure **18**) or equivalent.

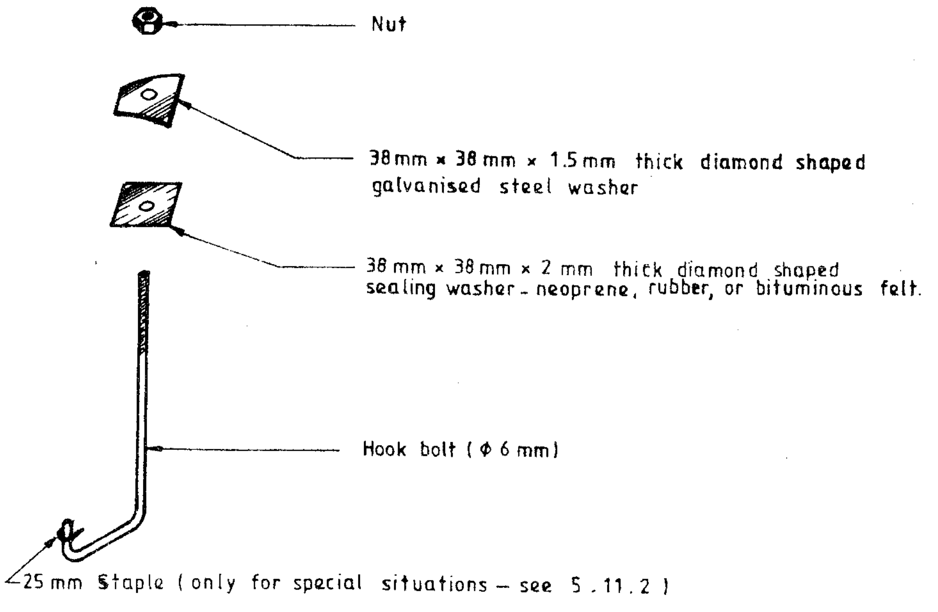


FIGURE 18 Standard type hook bolt and washer assembly - exploded view

5.12 Design of roof structure

Roof Structures of multy-storey buildings, or factory/ware-houses type buildings with no interior wall supports shall be designed using structural engineering principles to satisfy appropriate design standards. Roof structures of single-storey houses may also be designed or proportioned nominally in accordance with Appendix **A**.

6. INFORMATION REQUIRED FOR INSTALLATION

On completion of design of an asbestos-cement corrugated sheeted roof or a wall, following important information shall be made available :

a) Sizes of asbestos-cement corrugated sheets and respective numbers;
b) Type of fixing accessories and respective numbers:
c) Types of particular fittings and respective numbers;
d) Rainwater disposal scheme;
e) Spacing of purlins/rails and sizes; and
f) Details of the rest of the supporting structure.

APPENDIX A

Proportioning of Timber Roof Structures of Single-storey Houses.

Different elements in a roof structure of a typical asbestos sheeted roof of a single-storey house are shown in Figure **19**. Elements should be placed in a similar manner for other roof shapes.

A suitable timber roof structure can be proportioned for the given house plan of a single-storey house using the following design guide-lines:

a) Corrugated asbestos sheets should be laid at the minimum roof slope possible within the range 14 degrees to 22 degrees from horizontal;

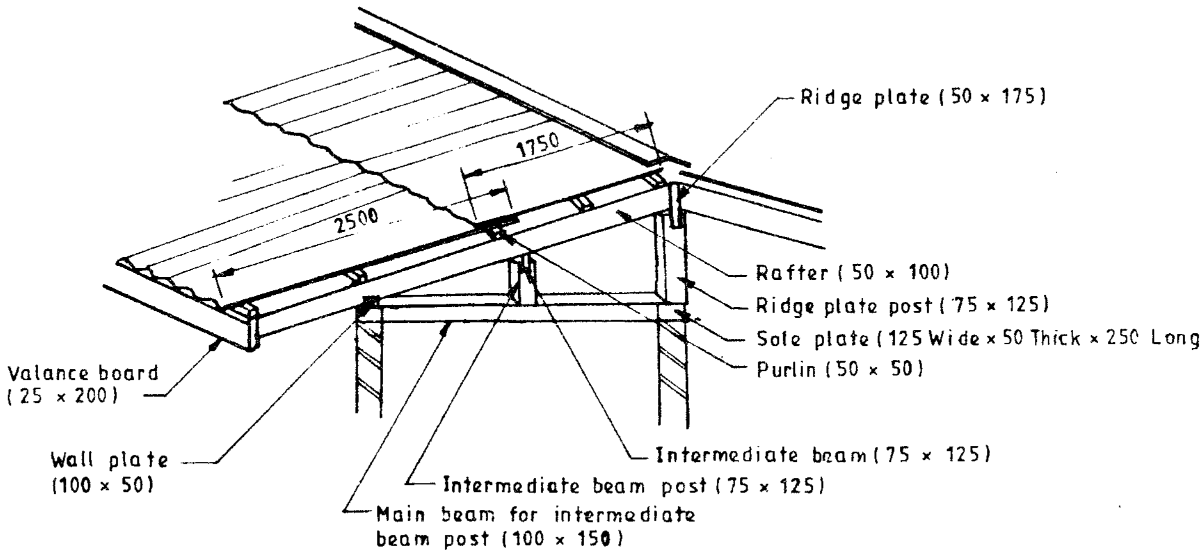
b) Asbestos sheeted roofs should be simple in form consisting, preferably, of a ridge with sloping sides on either side. The two sloping sides need not be identical. Valley gutters or hips should be avoided, whenever possible. For complex house plans, multiple ridges should be used;

c). If the house plan is very irregular, the roof should be considered to consist of several distinct portions;

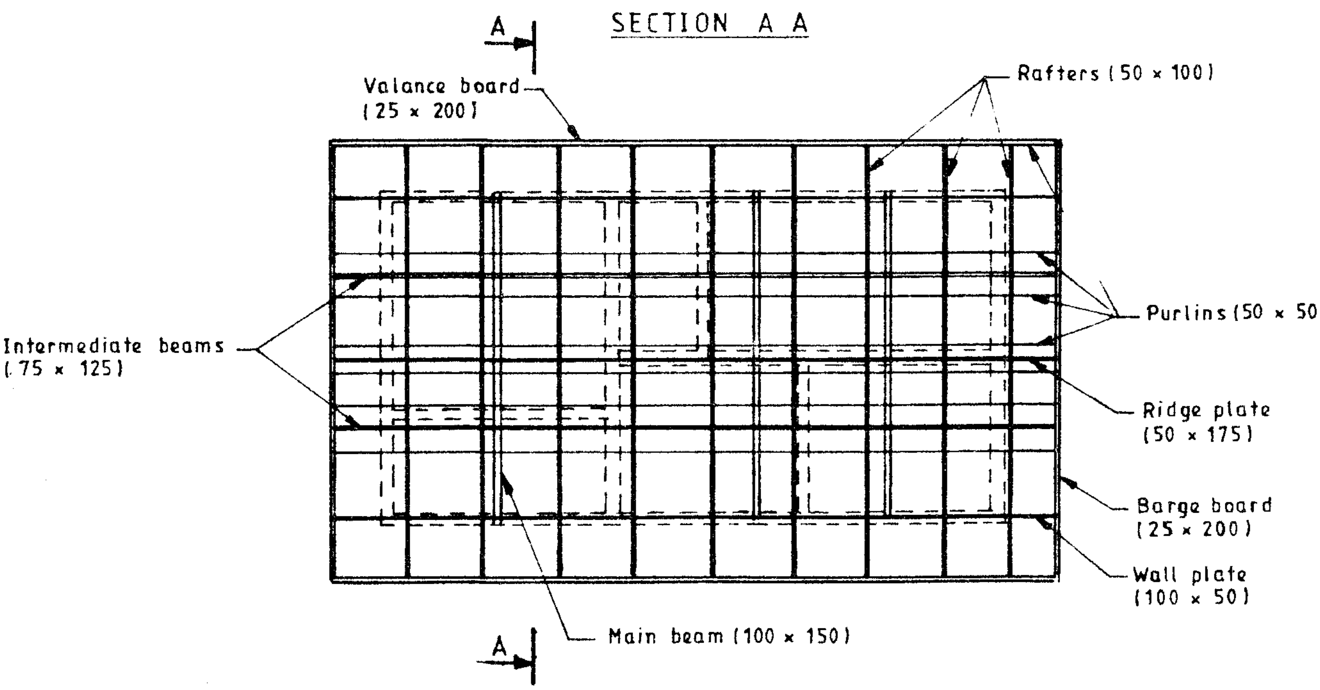
d) The size or sizes of asbestos-cement corrugated sheets required to cover the slope length of the roof should be determined by considering the required eaves overhang of the structure and the lap requirements depending on roof slope. The longer sheets should be placed over the eaves overhang. For roof slope larger than 15 m, roof drainage should be collected at intermediate stages not exceeding 15 m;

e) Purlins (50 x 50 mm) perpendicular to corrugations should be placed immediately under the asbestos sheets to satisfy the following considerations: (i) Spacing along slope shall not exceed 1400 mm; (ii) A purlin each should be placed at ridge, eave, overlap of sheets and where applicable, top edge, bottom edge or any other sloping area of the roof; (iii) No hole for fixing should be nearer than 38 mm to any edge of a sheet; (iv) The top ends of sheets should extend at least 50 mm above the fixing at an overlap; (v) Sheet end laps, should extend two-third of the lap length downslope below the fixing accessory; (vi) Ridge purlins should be fixed within 75 mm to 115 mm from the apex of the roof depending on the type of ridge capping to be used; (vii) The free overhang at eaves should not be more than 150 mm; and (viii) Overhanging verges should be supported by purlins for the full width of the sheet;

f) Flexural members such as purlins, rafters, ridge plates, wall plates, intermediate beams and main beams can overhang a distance equal to the simply supported span divided by 1.76 m;



SECTION A A



ROOF PLAN

Dimensions in millimetres

FIGURE 19 - Typical elements of an asbestos sheeted roof

g) Purlins size should be 50x50 mm and the maximum permissible span is 1.56 m. A purlin length should span at least 3 rafters to minimise deflections and purlin joints should be over rafters. Joints on two adjacent rows of purlins should not be made over the same rafter. Under special circumstances (such as roof of a multi - storeyed flat with cross walls or roof around a long chimney stack or roof void) larger purlins of sizes 50x100 mm and 50x150 mm can be used at maximum permissible spans of 2.79 m and 3.75 m respectively;

h) Rafters should be supported by the ridge plate, intermediate beam(s), and wall plate(s) as appropriate. Notching of rafters at the wall plate or intermediate beam should not exceed one fourth the depth of rafters. Jack rafters (shorter rafters) should be supported on the hip rafter, valley rafter, intermediate beam(s) or wall plate and appropriate span limit and notch limit are the same as for rafters,

i) Suitable rafter sizes can be selected as follows:
(i) 50x100 mm up to 2.63 m span; (ii) 50x150 mm up to 3.54 m span; and (iii) 50x175 mm up to 3.96 m span. In general, the smallest rafter size permissible should be used. Where it is possible to eliminate intermediate beam(s) or cantilever with a larger overhang by using stronger rafters, then a bigger size should be considered along with an alternative arrangement with small size rafters. The roof arrangement with a minimum total volume of timber should be adopted,

j) For better structural performance, the rafter/ridge plate joint should be such that rafter top end should be flush with the ridge plate top surface. The ridge plate should be selected using the following maximum permissible span lengths: (i) 50x175 mm = 2.95 m; (ii) 50x200 mm = 3.53 m; (iii) 50x225 mm = 3.94 m; and (iv) 50x250 mm = 4.34 m. In general, the smallest ridge plate size permissible should be used. Where it is possible to eliminate main beams for ridge plate posts, by using a stronger ridge plate, then that arrangement should be considered along with the alternative arrangement with smallest size ridge plate, and the roof arrangement with the minimum total volume of timber should be adopted;

k) Where hip or valley rafters cannot be avoided, they should be selected as done for ridge plates;

i) Wall plate size should be 100x50mm deep. This size can overhang 1.06m and span 1.87m, if needed;

m) Intermediate beam(s) should be selected using the following maximum permissible span lengths; (i) 75x125 mm = 2.93 m; (ii) 75x150 mm = 3.34 m; (iii) 75x175 mm = 3.80 m; and (iv) 75x200 mm = 4.34 m. The smallest size should be selected, unless it is possible to eliminate the main beam(s) required to support intermediate beam post(s) by selecting a stronger intermediate beam. Then that arrangement should be considered with the alternative arrangement using smallest intermediate beam size and that with the minimum volume of timber should be adopted;

n) Ridge plate posts or intermediate beam posts should be 75x125 mm and the height should not exceed 3.89 m. The top end of the post should be forked with each fork at least 75x25 mm in section. The bottom end of the post should have a stub tenon joint, if it rests on a timber sole plate, which should be at least 125 mm wide x 50 mm thick x 250 mm long;

o) If ridge plate posts or intermediate beam posts should be supported by main beams, the main beam size should be selected from the following maximum permissible span lengths;
(I) 100x100 mm = 1.24 m; (ii) 100x125 mm = 1.94 m; (iii) 100x150 = 2.62 m
(iv) 100x175 mm = 3.82 m; (v) 100x200 mm = 4.16 m, (vi) 125x200 mm = 4.48 m; and
(vii) 125x250 mm = 5.13 m. The main beam layout should be such that main beam span is as short as possible. Sometimes, a span can be shortened by placing it skew at 45 degrees to adjacent walls.

p) Valance boards and barge boards should be 25x200 mm deep; and

q) All joints except those involving posts (tightened by wedges) should be nailed as follows:
(i) Purlin/rafter - One nail 5 SWG (5.6 mm dia) 100 or 150 mm long with minimum 50 mm pointside penetration; (ii) Rafter/ridge plate (or intermediate beam or wall plate) - One nail as for (i) above; and (iii) Rafter/valance or barge board - one nail 8 SWG (4 mm dia) 75 mm long.

NOTE

Recommendations made for sizes of timber sections and corresponding span lengths as well as nailed joints, depend on design loads and strength parameters used. To help the user identify the extent of validity of these recommendations, assumptions made in their derivation are listed below:

i) *Basic wind speed of zone 3 in Sri Lanka (see Figure **16**);*

ii) *Roof imposed load of 0.25 kN//m² of plan area uniformly distributed or a concentrated load of 0.9 kN, over a square of 300 mm side, whichever produces greater stress;*

iii) *Roof not considered to be covered with half round burnt clay tiles;*

iv) *Ceiling not attached to the roof*;

v) *Timber properties (Dry value outside and green value inside brackets);*

a) *Basic stress for bending or tension* = *12.5 (9.0) N/mm²*
b) *Basic stress for compression parallel to grain* = *10.8 (6.3) N/mm²*
c) *Basic stress for compression perpendicular to grain* = *2.6 (1.7) N/mm²*
d) *Basic stress for shear parallel to grain* = *1.52 (1.5) N/mm²*
e) *Mean* $E = 13.8 \times 10^3$ (12.1×10^3) *N/mm²*
f) *Minimum* $E = 8.6 \times 10^3$ (7.6×10^3) *N/mm²*
g) *Basic lateral load of a 100 or 150 mm long nail (SWG 5) in single shear* *=2315.1 N;*
h) *Basic withdrawal load of a 100 or 150 mm long nail (SWG 5) = 25.57 N per mm of pointside timber depth; and*

vi) *Timber used is grade 75, so that grade stresses were obtained by multiplying above basic stresses by 0.75.*

Although the above recommendations were made for roof structures of single-storey buildings, they can be used up to 3 - storey buildings (till design load combination changes from dead and imposed load to dead and wind load for the roof timber elements.)

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