BRITISH STANDARD

CP 143-12: 1970

Incorporating Amendment Nos. 1 and 2

CONFIRMED DECEMBER 2007

Code of practice

Sheet roof and wall coverings —

Part 12: Copper: Metric units

Sub-Committee BLCP/4/4
Copper roof coverings

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This part of this Code of Practice has been prepared by a committee convened by the Codes of Practice Committee for Building. It was published under the authority of the Executive Board on 31 July 1970

First published April 1960 as Part 4 imperial units. Published in metric form as Part 12 July 1970
Part 12 incorporates the amendment to CP 143 issued in October 1961 (PD 4348)

The following BSI reference relates to the work on this Code of Practice:
Committee reference BLCP/4/4

ISBN 580 06281 3

Amendments issued since publication

Amd. No.	Date of issue	Comments
863	February 1972	
5193	January 1987	Indicated by a sideline in the margin

Contents

Foreword

This part of the Code of Practice makes reference to the following British Standards and Codes of Practice:

BS 219, *Soft solders.*

BS 747, *Roofing felts.*

BS 1210, *Wood screws.*

BS 476, *Fire tests on building materials and structures — Part 3: External fire exposure roof test.*

BS 2870, *Specification for rolled copper and copper alloys: sheet, strip and foil.*

BS 5268, *Structural use of timber — Part 2: Code of practice for permissible stress design, materials and workmanship — Part 5: Preservative treatments for constructional timber.*

CP 326, *The protection of structures against lightning.*

This metric edition of CP 143, which has been designated Part 12, is the metric version of Part 4 published in imperial units in April 1960.

Part 12 is not a technical revision of the Code and has been prepared as part of the change to the metric system in the Construction Industry, giving values in SI units. For further information on SI units, reference should be made to BS 3763, "*International System (SI) units*", and PD 5686, "*The use of SI units*".

Wherever it has been necessary to apply dimensional co-ordination, recommendations of Technical Committee B/94, Modular Co-ordination in Building, have been reflected in this metric version. For further information on dimensional co-ordination reference should be made to BS 4011, "*Recommendations for the co-ordination of dimensions in building. Basic sizes for building components and assemblies*", BS 4330, "*Recommendations for the co-ordination of dimensions in building. Controlling dimensions*", and PD 6444, "*Basic spaces for structure, external envelope and internal sub-division*".

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 23 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 General

1.1 Scope

This Code deals with methods of covering a roof or wall with copper sheet or strip in accordance with established practice. There are alternative methods of laying which are not included in the techniques described, as they are generally variations of traditional roof practice.

Recommendations are given in regard to the whole of the coverings above the wooden rafters for pitched roofs, and above the joists or the upper surface of the constructional base for flat roofs and walls.

Flashings and gutters are dealt with in so far as they are integral parts of the covering.

The dimensional co-ordination recommendations of Technical Committee B/94, Modular Co-ordination in Building, are embodied where appropriate to the Code.

1.2 Definitions

For the purposes of this Code the following definitions apply.

1.2.1
bay

a unit of sheet covering as laid between rolls or standing seams

1.2.2
capping

a copper strip, covering the top of a batten roll, welted to the edges of the sheets which are dressed up the side of the roll

1.2.3
clips

copper strips, cut to lengths to suit roll or seam, placed at intervals and securely fixed to the roof base, the ends being welted in with the edges of the sheets to hold the cladding in position

1.2.4
corner block

a short triangular wooden fillet tapered in its length, fixed against abutments, where sheets terminate at drips on roofs, walls and gutters

1.2.5
dog-ear

a box-like corner of three dimensions formed by folding a flat copper sheet without cutting

1.2.6
drip

a step formed in a flat roof or gutter across the direction of the fall

1.2.7
drop apron

a separate piece of copper fixed at the verges, eaves or gutters, to form a weathering and welted to the roof sheeting

1.2.8
lining plate

a strip of copper of suitable width which is nailed to the eaves or verges of a roof and engaged with the lower edge of the drop apron to form a secure fixing

1.2.9
lock joint

a single or double welted joint

1.2.10
patina

the thin stable insoluble film which forms on copper on exposure to air. The film consists of some combination of copper oxide, copper sulphate, copper carbonate and copper chloride, depending on atmospheric conditions. The colour varies from black to green according to the relative proportions of the compounds present

1.2.11
roll, common

a shaped core against the sides of which the copper bays are dressed or are turned up

1.2.12
roll, ridge and hip

a shaped core at ridge and hip against which the copper is dressed or is turned up

1.2.13
saddle end

the completion of a batten roll covering or a standing seam against an abutment

1.2.14
spring

the bending of the substructure under load stress and recovery after removal

1.2.15
standing seam

a double welted joint formed between the sides of adjacent bays and left standing

1.2.16
stop end (roll or seam)

the completion of a batten roll covering or standing seam at a drip or eaves

1.2.17
welting

joining copper sheets at their edges by means of folding. Welting may be by single or double folds, such joints being termed single or double welts respectively

1.2.18
work hardening

the reduction of ductility caused by bending or working during manipulation or by movement in service

1.3 Exchange of information and time schedule

The working drawings and specification should be prepared in sufficient detail to afford proper guidance in the preparation of estimates and the execution of the work. Where bills of quantities form part of the contract, they should be prepared in accordance with the Standard Method of Measurement for Building Works or the Scottish Mode for the Measurement of Building Works, as appropriate. There should be a full exchange of information between all concerned with the cladding and the work adjacent to it, in sufficient time to ensure that the covering can be carried out at the proper time and that all necessary provision for fixing has been made in advance. Early arrangements should be made on the site for rainwater disposal. Cladding should be completed before internal finishes are begun.

2 Materials, appliances and components

2.1 Characteristics of material

Bright copper changes colour when exposed to the air. This discoloration is due to the formation of an oxide film which is an important agent in protecting the copper. The preliminary oxidizing process is the first step in the formation of a patina. This patina is usually a bright green colour (considered an enhancement to architectural effect in certain circumstances) but, in some atmospheres, it may be masked to a buff, brown or black colour, dependent on the quantities and nature of the impurities deposited on the surface from the atmosphere. (The patina should not be confused with "verdigris", which is also of a green or grey colour and is formed by different chemical reaction.)

2.2 Copper

The whole of the cladding including clips, flashings, lining-plates, saddle ends, etc., should be made from copper sheet or strip conforming to BS 2870[1)].

The correct sizes and gauges are given in Table 1.

2.3 Nails

Nails used in securing the copper clips and the felt underlay should be made from copper wire not less than 2.6 mm thick. The nails should be not less than 25 mm long measured under the head and weigh not less than 1.5 kg per 1 000.

The heads should be flat and not less than 6 mm diameter and the shanks barbed throughout their length.

2.4 Screws

Screws used in securing clips or other components should be made of brass. Where screws are used to secure rolls, steel screws may be used.

All screws should conform to the relevant requirements of BS 1210.[2)]

2.5 Felt

The felt may be either BS 747[3)], Type 4A (ii) Brown No. 1 Inodorous, or a similar felt which will not adhere to the metal or understructure under temperature changes.

2.6 Solder

For the jointing of eaves, gutters and outlets from cesspools, solder should conform to the requirements of BS 219[4)], Grade A. See also **4.11.5**.

3 Design considerations

3.1 Durability

Copper possesses good mechanical properties and has ample strength for roofing purposes.

Copper is very resistant to corrosion by atmosphere and normal building materials. Some new materials may contain agents which are active under certain conditions, and advice as to their suitability should be sought from the copper cladding contractor.

Its life is equal to and often longer than that of other building materials with which it may be used. The durability of a copper roof covering is dependent upon physical considerations such as thickness, mechanical properties and practical methods of fixing and upon resistance to corrosion.

Metals other than lead may suffer from electrolytic corrosion if placed in contact with copper.

[1)] BS 2870, "*Specification for rolled copper and copper alloys: sheet, strip and foil*".
[2)] BS 1210, "*Wood screws*".
[3)] BS 747, "*Roofing felts*".
[4)] BS 219, "*Soft solders*".

3.2 Substructure

3.2.1 General. It is important that the fixings for sheet copper coverings are as permanent as the metal itself.

Cellular or foam concrete does not present a good fixing for items such as screws or nails that secure copper clips for rolls, drips or welts. Suitably treated wood rolls and drip edges, firmly cross spiked to the concrete, should be used.

Where a layer of hard board is used to cover poorly surfaced timber or over rough faced concrete the fixings for the sheet copper must penetrate the hard board and be secured to the substructure.

Where copper sheet is laid on insulating material such as compressed cork or open textured fibreboard, the method of securing the insulating material and the copper sheet should be agreed with the cladding contractor.

An underlay of felt (see **2.5**) is necessary to provide a sympathetic surface upon which to lay copper. This will give a barrier between the copper and the substructure and provide a measure of sound and thermal insulation.

3.2.2 Concrete. The surface should be laid to even and correct falls and be provided with a smooth, firm surface. Certain screeds such as those having a sulphate content require a sealing coat of bitumen. Reference may be made to Building Research Station Digests No. 110 and No. 111, published by H.M.S.O.

Provision should be made for securing the copper to the concrete by means of dovetail battens or suitable plugs. Any materials set in the concrete to receive fixing nails or screws should not be subject to decay through retained moisture or condensation.

Dovetail wooden battens should be approximately 50 mm × 25 mm, set flush with the surface and running across the slope at 300 mm to 400 mm centres to take clips for standing seam joints. They are placed at 450 mm to 600 mm centres for securing wood rolls.

Dovetail battens should be pressure treated with wood preservative in accordance with BS 5268-5[5)].

Copper clips may also be secured to the concrete by means of brass screws and a durable plug.

Wood rolls may be secured by rag bolts let into the concrete. The hole in the rolls should be recessed so that the nuts and ends of the rag bolts do not project above the top of the roll.

3.2.3 Timber. For structural aspects and decay of timber, reference should be made to BS 5268-2 and BS 5268-5[5)].

In so far as copper cladding is concerned, the following precautions should be observed.

The timber substructure should be wind-tight, be free from "spring" and present a firm surface. The boarding should preferably be tongued and grooved, well seasoned and wrought, and not less than 25 mm nominal thickness. For slopes less than 20°, the boards should be laid either in the direction of the fall or diagonally. The boards should be fixed securely at centres decided upon between the architect and the copper roofing contractor. The heads of nails used for fixing boarding and rolls should be well punched in and all screws should be countersunk.

3.2.4 Other decking materials. Other decking materials may be used provided that they meet the following requirements:

1) freedom from "spring",

2) means for adequate fixing of cleats or rolls,

3) wind-tightness,

4) a smooth surface,

5) enough rigidity to allow firm dressing of the copper without forming indentations,

6) no adverse effect upon the metal covering or any other adjacent material,

7) dimensional stability.

3.2.5 Falls and drips on roofs. The minimum fall for any copper roof is 1 in 60 (40 mm in 2.4 m). Copper can be laid to all pitches greater than this, including vertical surfaces.

Drips should be used on roofs of 5° pitch or less and should be spaced at not more than 3 m centres and be 65 mm deep.

Where, however, the pitch is 20° or less, any double lock cross welt should be sealed with boiled linseed oil. This is done by painting the edges of the copper with the oil before welting together.

3.2.6 Falls and drips in gutters. Gutters should be laid to a minimum fall of 1 in 80 (30 mm in 2.4 m). Where the sole of the gutter is very wide, it can be broken up by the use of wood rolls, placed longitudinally. The gutters should be designed to carry away the rainfall without flooding.

Where the drips are required in gutters, they should be a minimum depth of 50 mm (Figure 19) and should be spaced at the distances given in Appendix C, which also specifies corresponding gauge of copper to be used.

[5)] BS 5268, "*Code of practice for the structural use of timber*", Part 2 "*Code of practice for permissible stress design, materials and workmanship*" and Part 5 "*Preservative treatments for constructional timber*".

The gutter should discharge into a cesspool or sunk chute, which should be formed below the sole of the gutter. In no case should the width of the cesspool be less than the width of the gutter or the depth be less than 75 mm.

Where the gutter can be continued through the gable wall without a change in direction, it can be discharged into a rainwater head without cesspools (see Figure 12).

3.3 Types of copper roof and wall covering

The traditional systems of copper roofing construction are known as the "standing seam" and the "wood roll" (see Figure 1 and Figure 2).

A standing seam system consists of a double welted joint formed between the sides of adjacent bays and left standing approximately 20 mm (see Figure 8).

A wood roll system consists of a shaped core against the sides of which copper bays are dressed or turned up. The finished height is normally 38 mm for common rolls and 75 mm for ridge and hip rolls (see Figure 5).

The choice of system depends upon the architectural treatment required, but in the case of roofs which are subject to pedestrian traffic, the wood roll system should be used. With pedestrian traffic which is concentrated on one particular spot, such as in the vicinity of doorways, duckboards should always be provided. Duckboards of a minimum width of 380 mm should always be provided to prevent damage to the metal roofing.

3.4 Copper roof coverings

A copper roof covering consists of a number of sheets joined along the edges; it is held down to the roof by means of clips inserted in the folds (see Figure 5 and Figure 8). In the direction of the fall the joints are raised; across the fall they are flattened to allow water to flow freely over the sheets. The raised joints are either formed into a standing seam (see Figure 1) or dressed to a wood roll with a separate welted cap (wood roll system, see Figure 2).

The joints across the fall are formed by means of flattened welted seams. Where the pitch is greater than 45°, a single lock welt seam is used (see Figure 6). Where the pitch is less than 45°, a double lock cross welt is essential (see Figure 7). Welts on the vertical side of a drip can be single lock.

Where sheets are jointed by double lock cross welts between standing seams, the cross joints should be staggered to avoid the difficulty of welting too many thicknesses of copper into the standing seam.

The maximum width of the bay size selected is governed by the thickness of the material used (see Table 1). Experience shows that the bay widths quoted in Table 1 should not be exceeded.

NOTE For the purpose of dimensionally co-ordinated buildings designed to BS 4330, "*Recommendations for the co-ordination of dimensions in building. Controlling dimensions*", standing seams and wood rolls would be at 500 mm and 500–600 mm respectively.

These recommendations apply to plain areas under normal conditions; in exposed situations subject to high winds, the heavier gauges of copper should be used or the width of the bays reduced, especially at gables and verges. Where an increase in rigidity can be obtained by the shaping of the sheets, such as in domed or ornamental work, the width of the bay may be increased.

3.5 Rolls

Common rolls (see Figure 5) are spaced at intervals to suit the width of the bay (see Table 1). The minimum finished sizes are 38 mm high × 44 mm base × 32 mm across the top.

The ridge and hip rolls (see Figure 4) should stand 38 mm above the top of the common roll. The minimum finished sizes are 75 mm × 63 mm × 32 mm.

It has been found that where wood rolls are in contact with copper, condensation containing a weak solution of copper salts which acts as a wood preservative, tends to be formed, so that preservative treatment of wood rolls in contact with the sheeting is unnecessary.

3.6 Special features

3.6.1 Edge details. When a tiled or slated roof discharges on to a copper flat, a copper apron flashing should be nailed to the sloping roof, taken down over the tilting fillet and welted to the copper flat (see Figure 15).

When a copper roof discharges on to a slated roof, a drip should be formed by welting the edge of the copper roofing to the vertical upstand of an independent copper apron. The apron should be dressed down over the sloping roof and fixed in such a manner that the copper cannot lift in the wind. Some alternative methods of fixings are given in Figure 16.

3.6.2 Ridge details. Where the copper passes over the crown or ridge of a roof, a ridge roll 38 mm higher than the wood roll should be provided along the ridge.

Where the standing seam system is used, the ridge and hips can be formed by a normal standing seam 25 mm high, but generally a wood roll is preferred.

Table 1 — Maximum bay widths and lengths to be used with various thicknesses of cladding sheet

Thickness	Bay widths for standing seams	Width of sheet to form bay	Bay widths for wood roll	Width of sheet to form bay	Length of each sheet
mm	mm	mm	mm	mm	m
0.45	525	600	500	600	1.8
0.60	525	600	500	600	1.8
0.70	675	650	650	750	1.8

3.6.3 General. All bays of a copper cladding should discharge freely and be finished with a separate apron piece or gutter.

When a copper roof is enclosed by abutments, a box or parapet gutter should be formed (see Figure 12).

Flashings to abutments should be formed by a separate piece of copper (see Figure 9).

3.7 Thermal insulation

Owing to the high conductivity of copper it may be necessary to provide some form of thermal insulation to protect the substructure from the effect of solar radiation or to maintain an equable internal temperature. The effect of the copper covering can be neglected in calculating the thermal resistance of the cladding.

3.8 Ventilation

Provision should be made to give adequate ventilation of the voids beneath the decking to minimize the effect of condensation.

3.9 Fire resistance

Copper has a high melting point, is non-combustible and will, therefore, not contribute to the spread of fire. Whether laid on square-edged or tongued-and-grooved boarding or concreted, the cladding is graded P 60 according to BS 476-3[6], and may be used without restriction.

3.10 Weight

The weight of copper sheeting, per unit area, is comparatively small (see Appendix A) and in certain circumstances advantage may be taken of this in designing the substructure.

3.11 Protection against lightning

Copper roofs are no more likely to be struck by lightning than any other form of roof covering. Generally, no special precautions are necessary apart from those required by the particular type of structure. Where a lightning protection system is to be installed, the recommendations of CP 326[7] should be followed and each case receive special consideration.

4 Methods of laying and workmanship

4.1 Protection and storage

The sheets should be delivered to the site rolled up and stored on a thoroughly clean surface. For cutting the material provision should be made for rolling out the sheet to its full width on a clean surface as flat as practicable.

4.2 Preparatory work

No special scaffolding is required beyond that normally provided for the building work and which permits ready access to all parts of the surface to be clad. Facilities for hoisting should be provided and also workshop accommodation suitable for a 3 m bench. The cladding specialist should ensure that the condition of the surface is as recommended in **3.2**. The surface of the substructure should be dry and swept clean before laying the underlay, which in turn should be dry when the copper is applied. The intervals between the laying of boarding and underlay and covering with copper sheet should be kept to the minimum to avoid exposure to wet weather.

4.3 Sequence of operations

After the roof surface has been completed and swept clean, only that quantity of underlay should be laid as can be covered with copper the same day. The prepared copper should then be laid in the following sequence:

(1) cesspools, (2) gutters, (3) aprons, (4) main roof sheeting, (5) cover flashing.

4.4 Setting out the work

The setting out of the work is governed by the width of sheet to be used (see **3.5**).

4.5 Felting

Felt should be laid with butt joints and secured with copper nails. On vertical surfaces extra nailing is recommended. For types of felts see **2.5**.

[6] BS 476, "*Fire tests on building materials and structures*", Part 3, "*External fire exposure roof tests*".

[7] CP 326, "*The protection of structures against lightning*".

4.6 Technique of laying copper sheeting

The sheet should be laid truly flat or true to the surface of the substructure. Before laying, the material should be prepared by cutting, bending and seaming to fit accurately into the bay for which it is intended, thus avoiding unnecessary forming, dressing and cold working. Due allowance should be made in dimensions for expansion and contraction (see also **3.1**). To avoid work-hardening of copper, care should be taken in the manipulation to avoid excessive and repeated dressing.

The sheeting is commenced from the more convenient end and sufficient additional material should be allowed in the sheeting for the first bay for forming an upturn against the abutment or for welting to the verge apron. The next bay is placed in position and the vertical edges joined by a welted standing seam or dressed up the sides of the rolls.

Up to and including 45° pitch, all cross joints should be double lock cross welts. Single lock welts may be used where the pitch is over 45°.

4.7 Standing seams

After the sides of adjoining sheets are turned up vertically with the fixing clip incorporated between, they are welted together. The three members (clip and two vertical sides) are finished with an upstand approximately 20 mm high (see Figure 8).

4.7.1 Clips for standing seams. For standing seam systems clips should be not less than 38 mm wide, spaced at a maximum of 380 mm centres along the length of the standing seam joint and secured with two copper nails or brass screws close to the turn up. See also **3.4** and Figure 8.

4.7.2 Double lock cross welts. Double lock cross welts should not be fixed in line, but staggered in adjoining bays.

4.7.3 Ridge and hips. Standing seams should be finished at the ridge and hips by a wood roll or another standing seam. Where the latter is used the standing seams on the roof slopes should be staggered on either side of the ridge.

4.7.4 Standing seam to square abutment. See Figure 9. Where a standing seam meets an upstand the joint should be formed to give a web.

4.8 Roll system

The edges of the adjoining sheets are dressed up the side of the roll with a 12 mm projection above its top. This, together with the ends of the fixing clips, is then turned outwards at the top level of the roll. A capping strip with the welted edges is prepared and slid over the roll, the welted edges being incorporated with the welts of the sheets as shown in Figure 5.

Care should be taken to ensure that the wood rolls, with the clips in position, are securely fixed to the substructure, otherwise there is danger that the rolls might be displaced when dressing the copper into position.

4.8.1 Clips for rolls. Clips not less than 38 mm wide should be passed under the wood roll and turned up each side as stated in the previous paragraph. They should be spaced at not more than 460 mm centres. See also **3.2.1**.

4.8.2 Cross welts. Cross welts may be staggered or in line.

4.8.3 Wood roll to square abutment. At the highest point of the roll where it meets drips, abutments and ridges, a triangular-shaped timber fillet piece should be fixed to the top of the roll (see Figure 17).

4.8.4 Ridge and hips. Common rolls should finish at the apex and hips of the roof with a ridge roll (see Figure 4 and **4.7.2**).

4.9 Parapet and box gutters

With standard construction the roof side-gutter cheek is jointed to the roof sheeting by means of a single lock welt. Using special construction, the roof side-gutter cheek is turned up and left free, but is weathered by means of a separate drop apron which is in turn jointed to the roof sheeting.
See Section 3, **3.6.3**, and also Appendix C.

All internal corners occurring in a parapet gutter at drips, stop ends and upstands should be made in one piece by dog-ears.

Tapered corner blocks should be incorporated in the sole of the gutter where it passes over a drip or discharges into a cesspool (see Figure 19).

4.10 Cesspools

A cesspool should be constructed from one piece of copper and shaped by dog-earing corners. The sides of the cesspool are taken up and welted or weathered in with the adjacent copper work.
See Figure 12.

4.11 Details

4.11.1 Drips. Where a roof contains drips (see **3.2.5**) upper and lower bays are welted together by means of a single welt on the drip edge. The turned up edges between the standing seam or wood roll and the upstand of the drip are dog-eared together. Tapered corner blocks are fixed against an abutment such as parapet wall, and a tapered corner block is required on the upper edge (see Figure 19).

4.11.2 Square abutments. At the angles of square abutments the turned up edges of the copper are dog-eared (see Figure 19).

For external angles, the joint is formed with either a standing seam or wood roll, to avoid the use of soldering or brazing (see Figure 18).

4.11.3 Aprons and flashings. All aprons and flashings to walls and upstands should consist of an independent strip of copper of not more than 1.8 m in length, welted to the roof sheet. The upper edge should be folded 25 mm minimum into the wall, with 12 mm check welt to act as a water-stop wedged firmly with hardwood, lead or copper wedges and pointed (see Figure 9).

No apron pieces should exceed 1.8 m in length. The vertical joints between two apron pieces should be single lock welted.

At caves and verges the main roofing sheet should be welted to an independent apron, which is firmly fixed by means of a lining-plate. Alternatively, the lining-plate and apron may be combined in one piece (see Figure 13 and Figure 14).

4.11.4 Clips in cross welts. Clips should be incorporated in all cross welts except in pitches below 5° where drips are provided.

In double lock cross welts one 50 mm wide clip, and in single lock welts two 50 mm wide clips should be used. They should be secured by two copper nails or brass screws. Single lock welts at drips and eaves should have two clips per bay.

Clips against upstands should be not less than 38 mm wide and fixed with two copper nails or brass screws per clip at not more than 460 mm centres.

Clips should not be placed at the junction of two welted seams, such as a cross welt and a standing seam, but at equal distances on each side of the junction.

4.11.5 Jointing by solder. The use of solder as a method of jointing between roofing sheets is bad practice and should not be permitted, as the solder may fail due to the differential rates of expansion and contraction. Where, however, stress due to movement at the joint is not anticipated, solder may be used in certain details, such as lap joints in eaves gutters and outlets from cesspools when the meeting surfaces have been pretinned.

5 Inspection and testing

5.1 Preparatory work

5.1.1 Substructure. The surface of the substructure should be checked for smoothness and firmness and, in the case of boarded areas, to ensure the absence of protruding nail heads, etc. (see **3.2**).

5.1.2 Copper sheet. The material should be tested (1) for thickness by weighing a measured area of sheet and checking with the values given in Appendix A or by gauging, and (2) for ductility by applying the double bend test described in BS 2870[8)]. See also Appendix B.

5.1.3 Felt. The felt should be of the type specified, and laid with butt joints and fixed with copper nails (see **2.3** and **2.5**).

5.2 Work in progress

Care should be taken to ensure that all recommendations of the Code are being carried out. In particular the number and centres of clips (see **3.2**) should be maintained. All joints between adjacent sheets, aprons and flashings should be welted, except in the case of sides of long gutters (see **3.6.3**).

5.3 Completion

A general inspection of welted seams and all places where cold working may have taken place should be made to ensure that there are no cracks or splits.

At places where the copper is liable to touch another metal, as for instance where a copper roof discharges into an iron gutter, contact between the two metals should be avoided.

The copper sheets should be laid flat on the substructure.

All aprons and flashings should be secured against lifting by wind.

All pointing to flashings should be completed and should be secure and free from cracks.

The final surface should be freed from all debris, loose nails or similar objects which may be trodden on and injure the sheets. If final building operations are not complete, protection should be provided.

[8)] BS 2870, "*Specification for rolled copper and copper alloys: sheet, strip and foil*".

Appendix A Table of approximate weights of cladding sheet

(based on a density of 8 900 kg/ms^3)

Thickness	Approximate weight per square meter
mm	kg
0.45	4.0
0.60	5.4
0.70	6.3

Appendix B Properties of copper

Tensile strength:	
Annealed	210 N/mm^2 minimum
Half-hard	245 N/mm^2 minimum
Hard-wrought:	
(up to and including 500 mm width)	310 N/mm^2 minimum
(over 500 mm width)	285 N/mm^2 minimum
Elongation on 50 mm:	
Annealed	35 % minimum
Half-hard	15 % minimum
Density	8 900 kg/m^3
Melting point	1 083 °C
Coefficient of linear expansion	0.000 017 per degC

Appendix C Table of dimensional details for copper gutters

Width of sole	Thickness	Length unbroken by drop where welted to roof sheet	Length unbroken by drop where separate drip apron is used
mm	mm	50 mm min. depth of drop m	75 mm min. depth of drop m
150	0.45	3.6	4.5
	0.60	4.5	6.0
	0.70	4.5	15.2
230	0.45	3.0	3.0
	0.60	4.2	4.2
	0.70	4.5	9.1
300	0.45	2.4	2.4
	0.60	3.6	3.6
	0.70	4.5	8.0
380	0.45	1.8	1.8
	0.60	3.3	3.3
	0.70	4.5	7.0
460	0.45	1.5	1.5
	0.60	2.7	2.7
	0.70	4.5	6.4

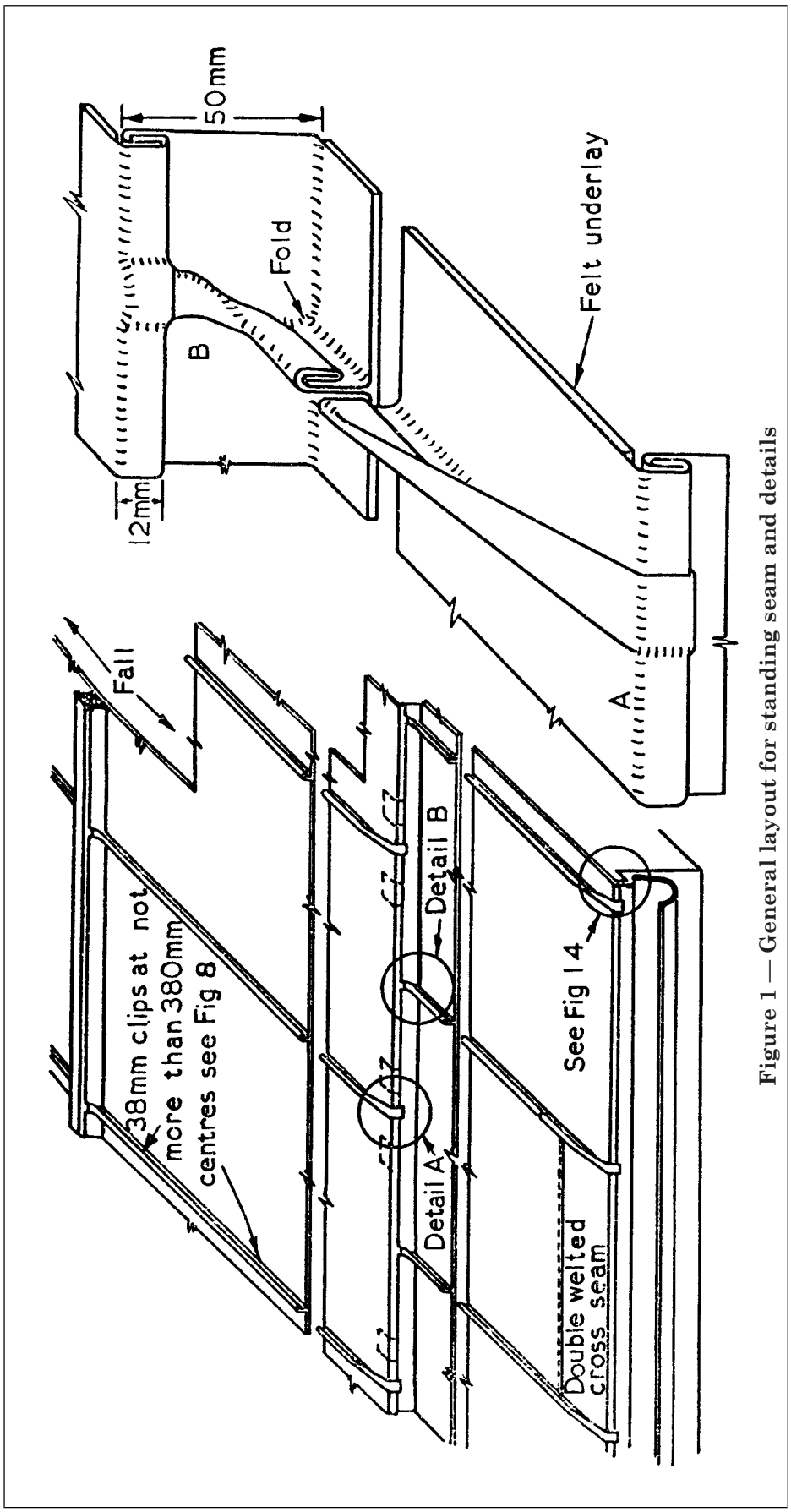
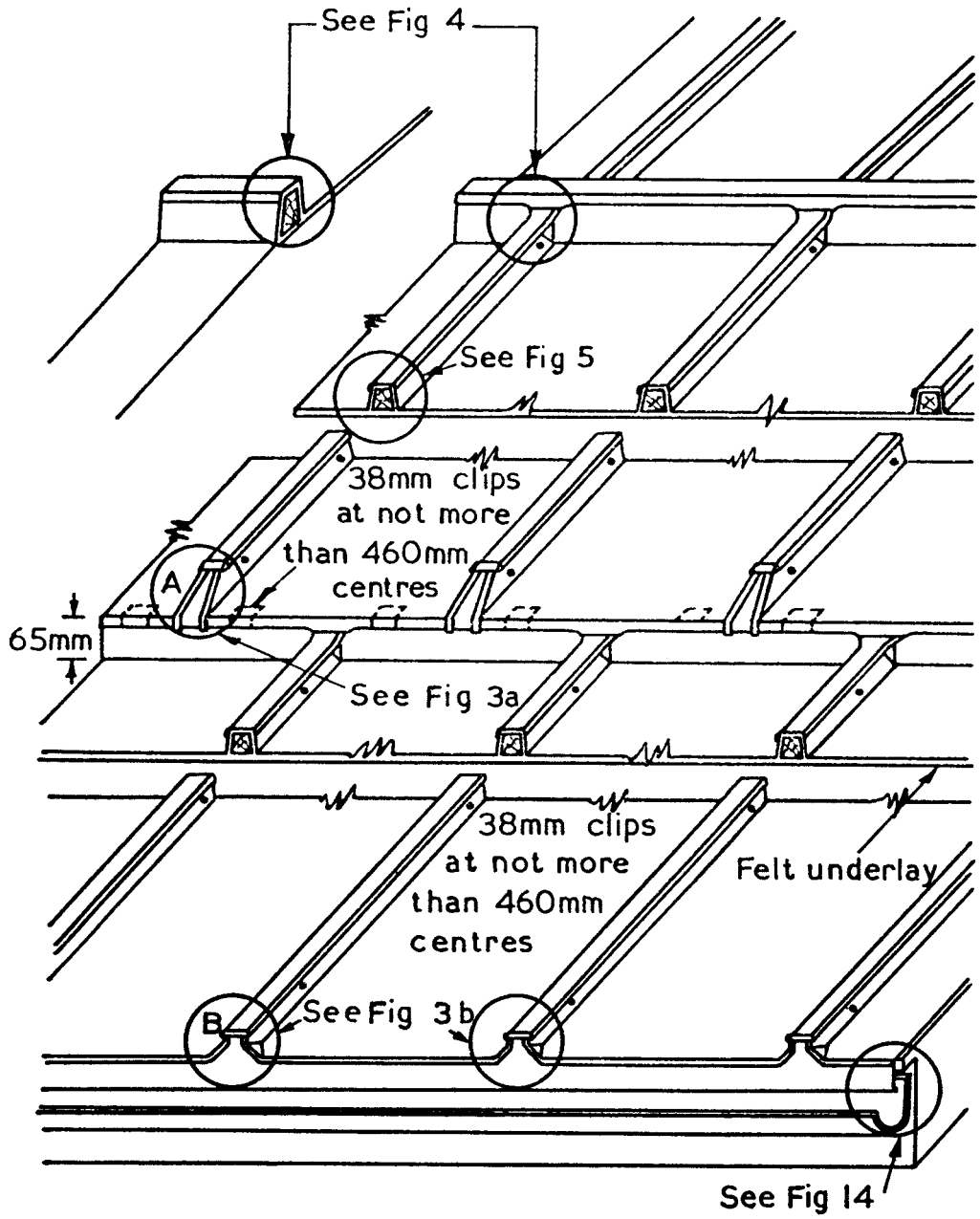


Figure 1 — General layout for standing seam and details



NOTE A and B are alternative types of stop ends.

Figure 2 — General layout for common roll

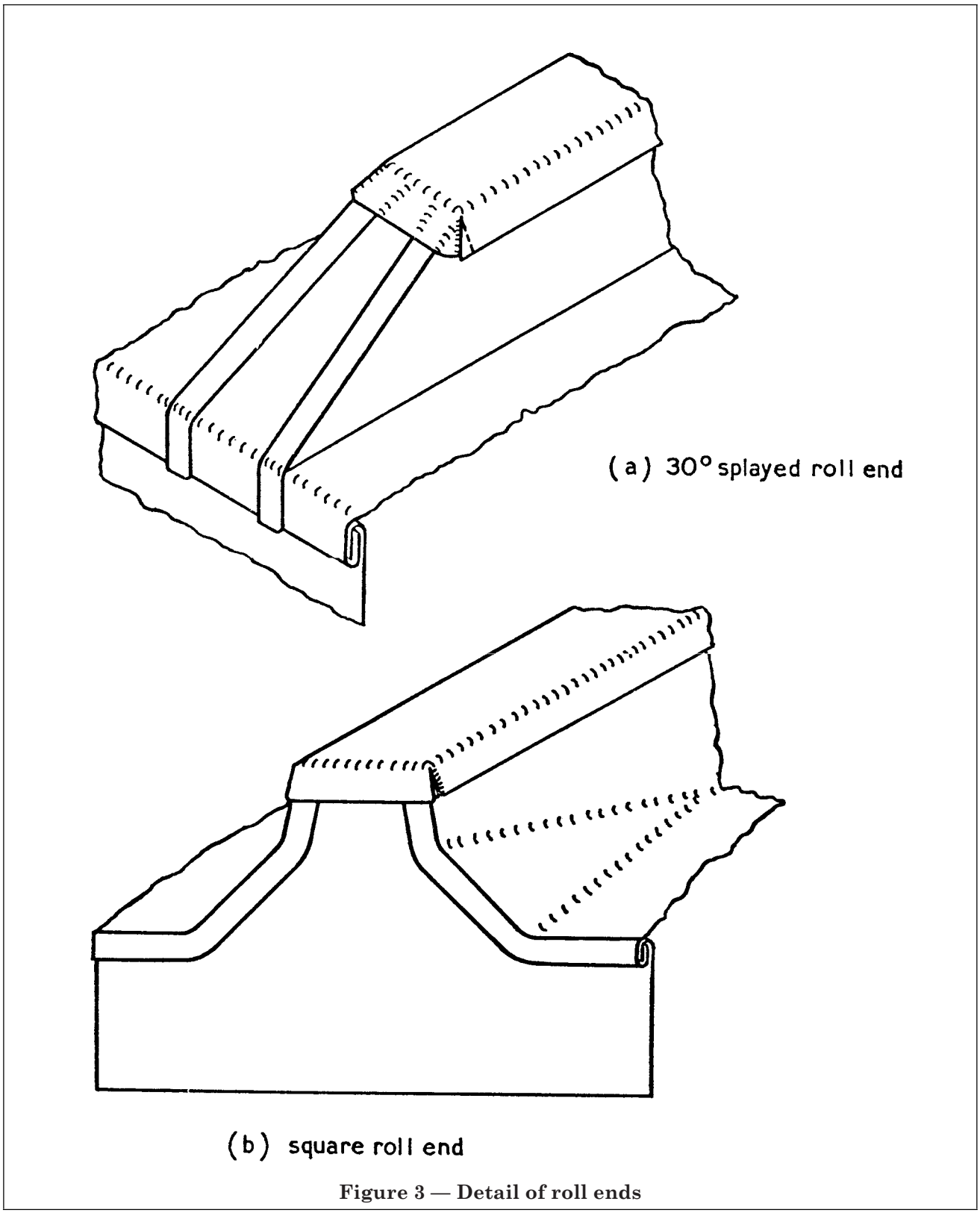


Figure 3 — Detail of roll ends

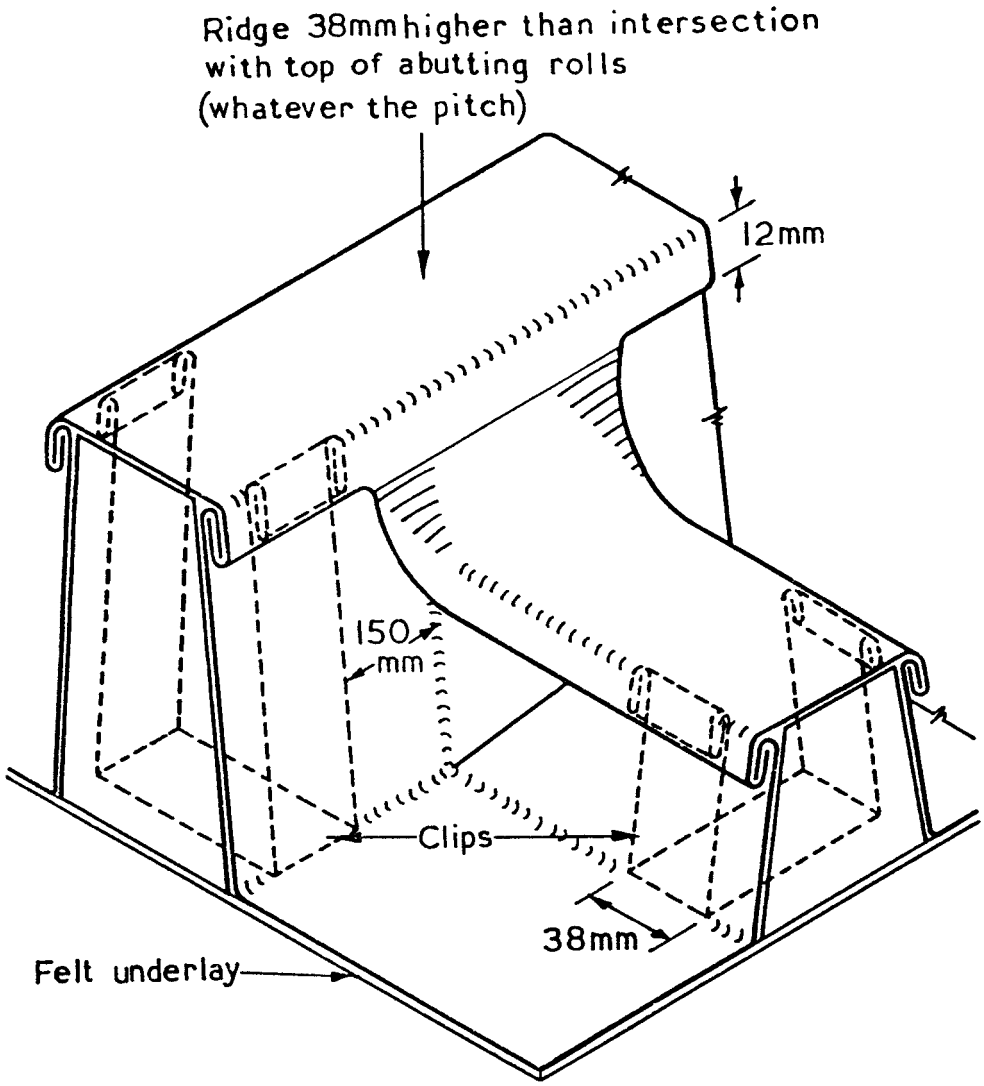


Figure 4 — Detail of ridge and hip for common roll

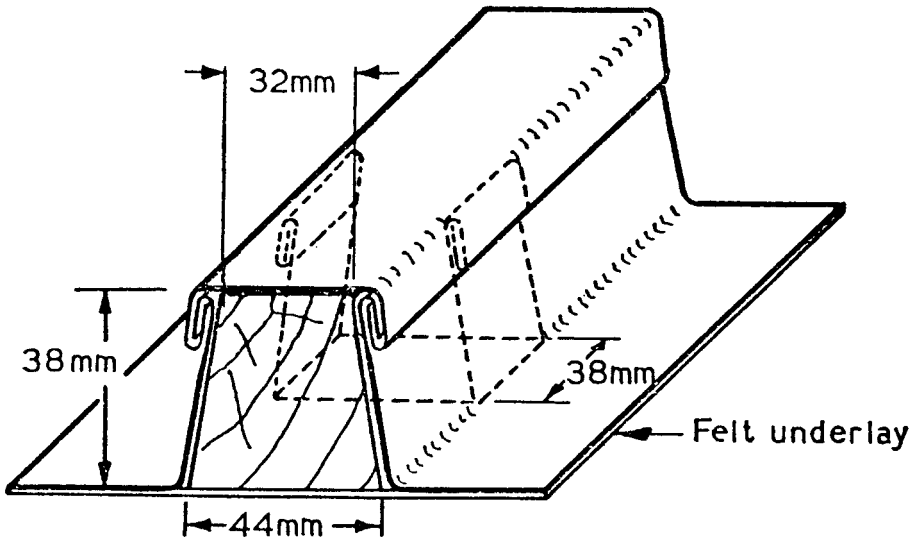


Figure 5 — Common roll

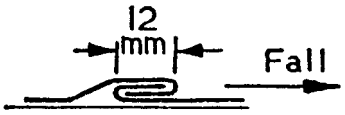


Figure 6 — Single lock welt

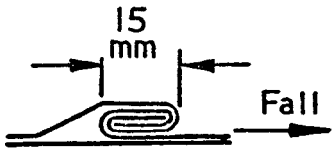


Figure 7 — Double lock cross welt

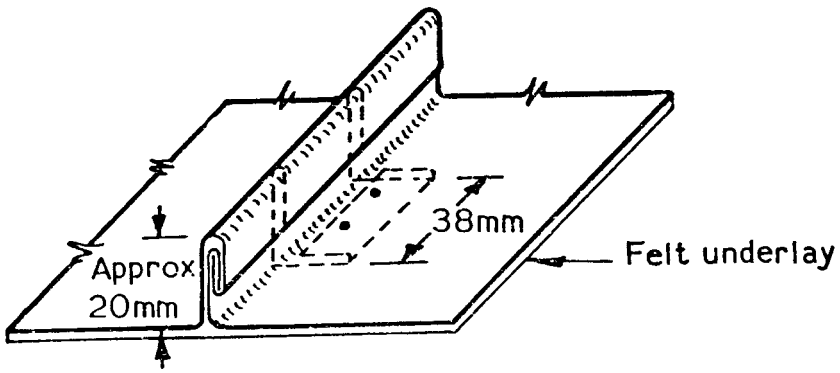


Figure 8 — Standing seam

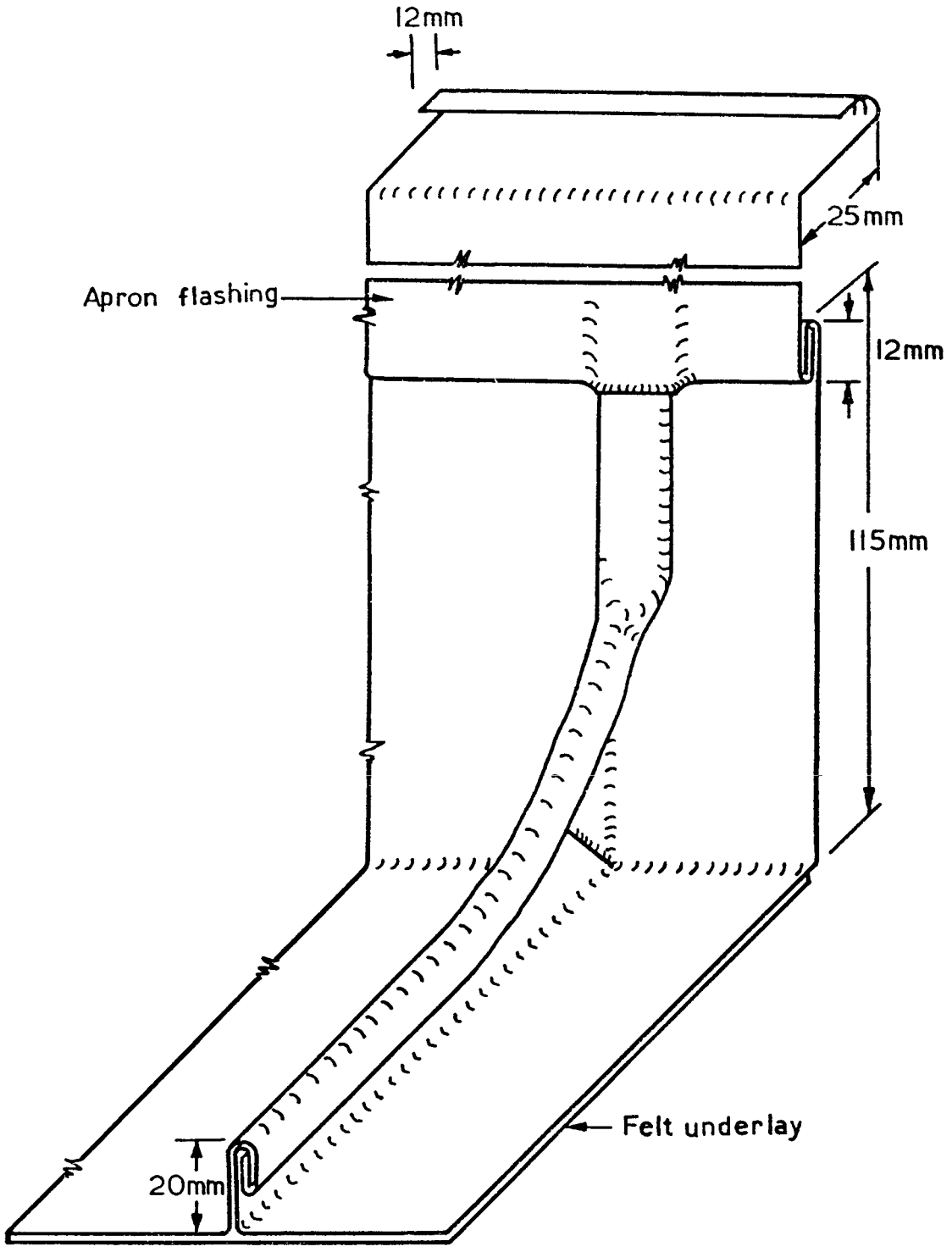


Figure 9 — Standing seam and upstand

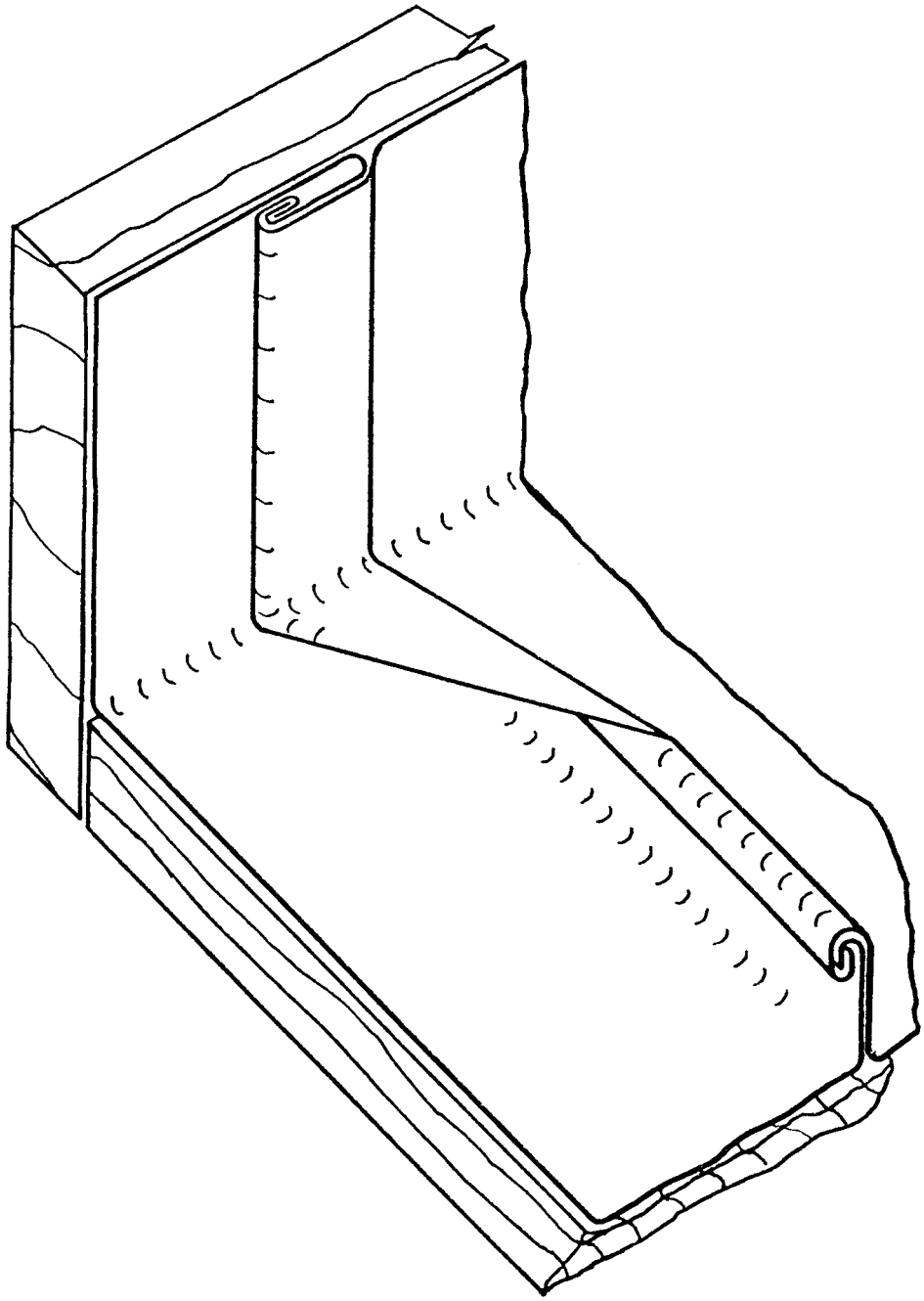


Figure 10 — Flattened standing seam

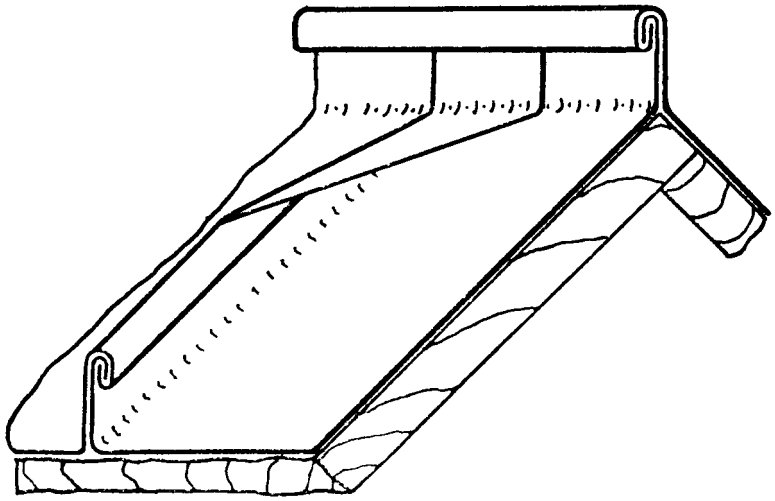


Figure 11 — Standing seam ridge

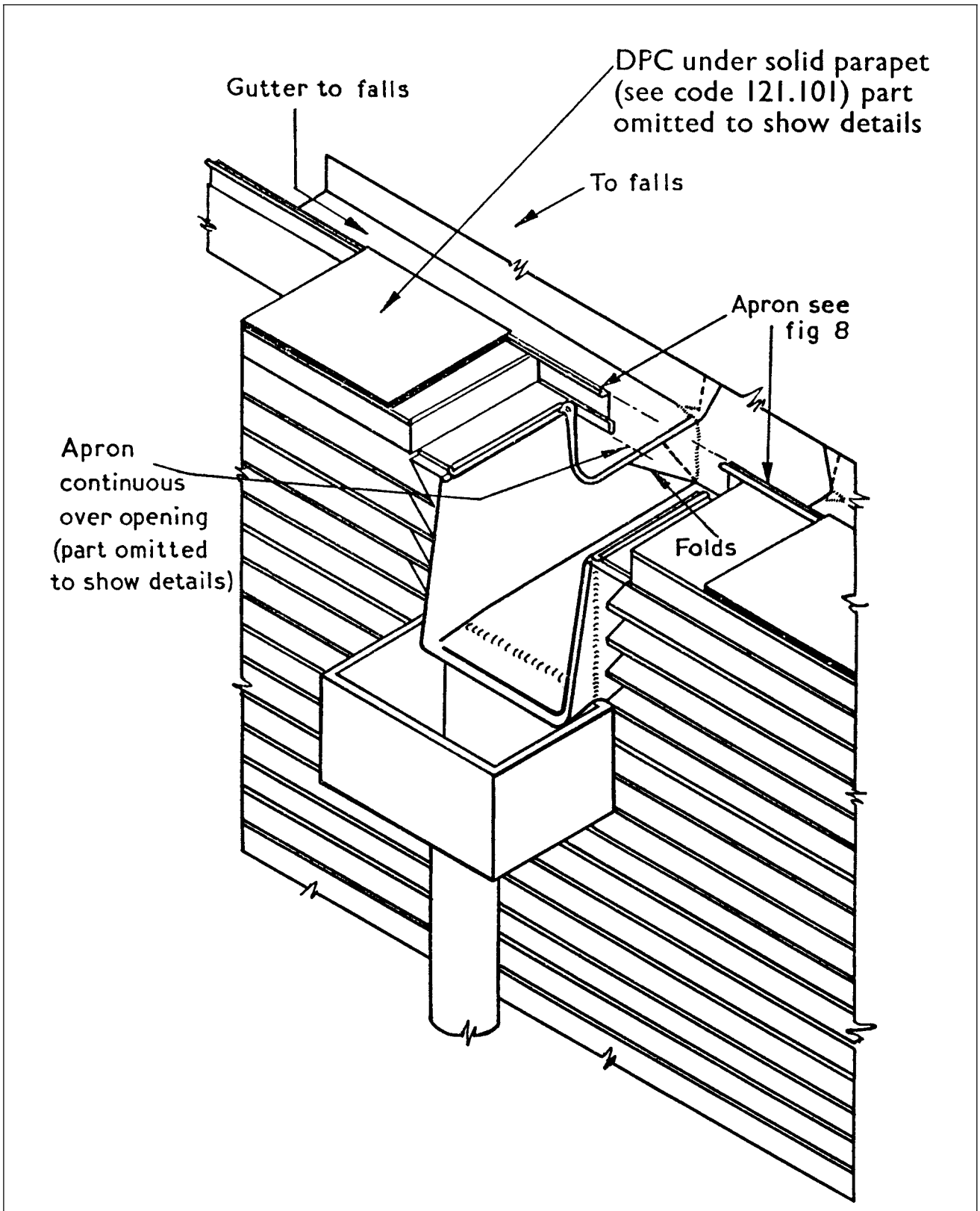


Figure 12 — Gutter and outlet. Isometric sketch showing a typical arrangement

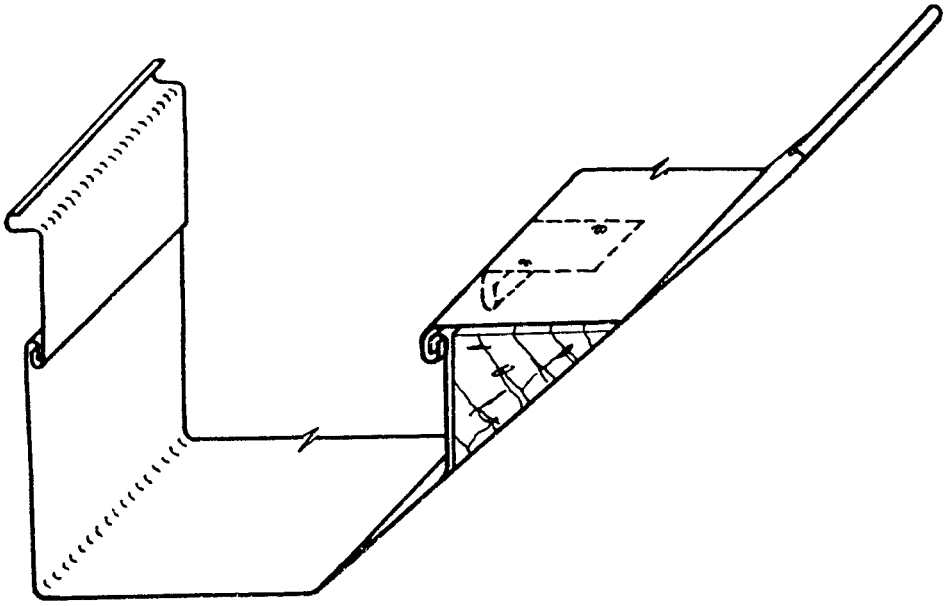


Figure 13 — Gutter to roof covered with slates or tiles

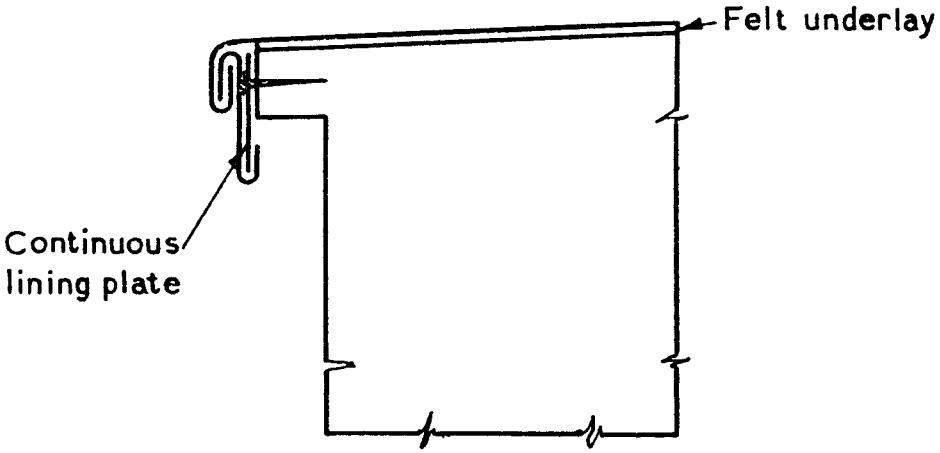


Figure 14 — Lining plate

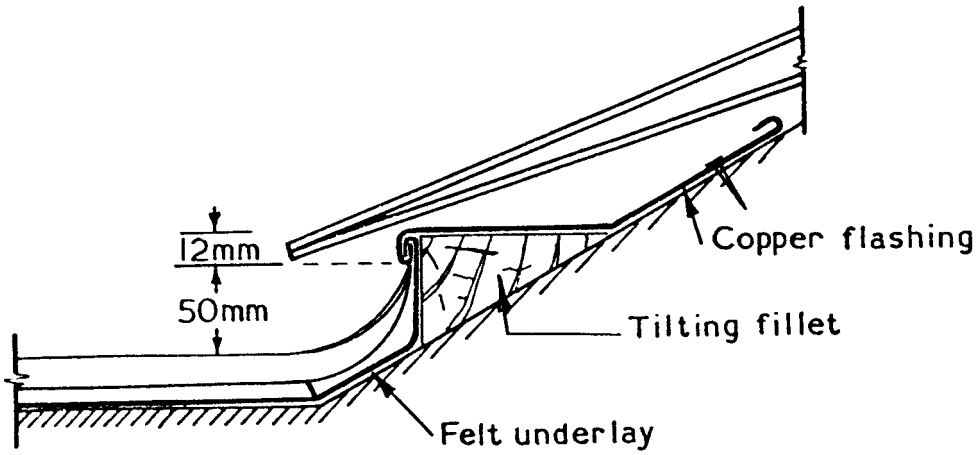


Figure 15 — Tiled or slated roof discharging on copper flat

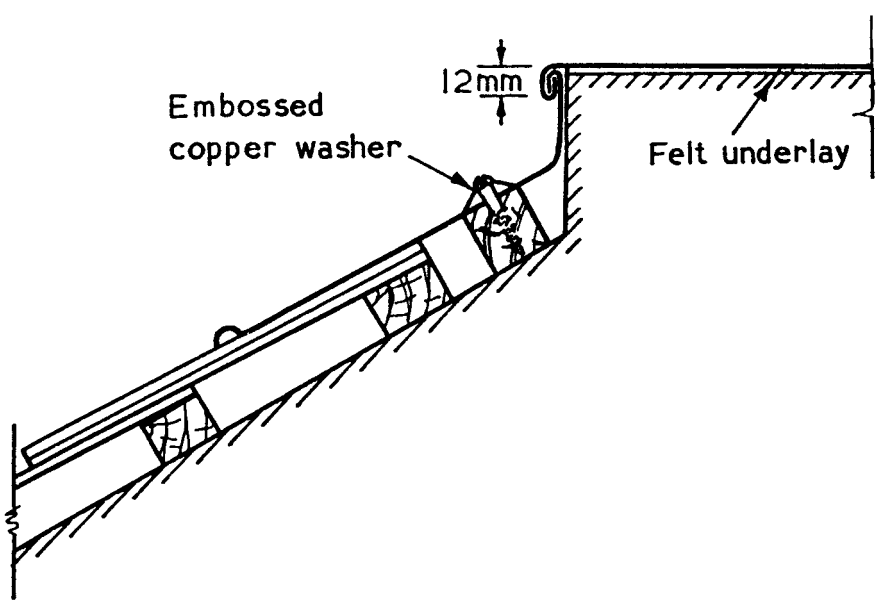
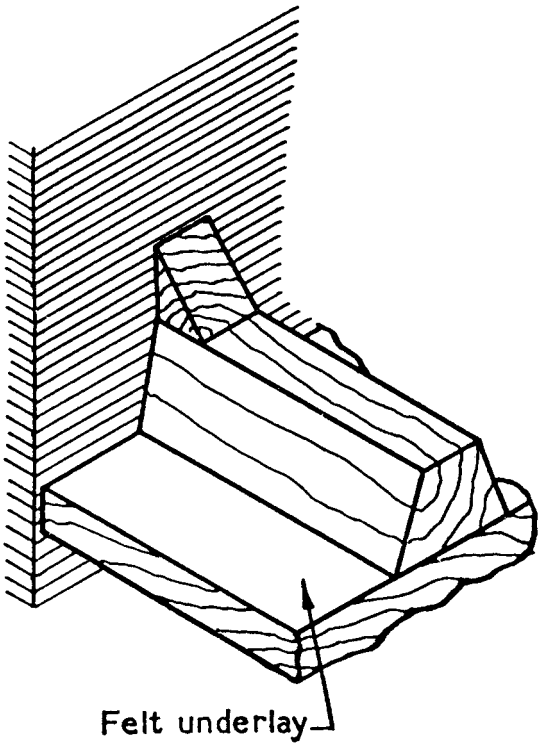


Figure 16 — Copper roof discharging on slates or tiles



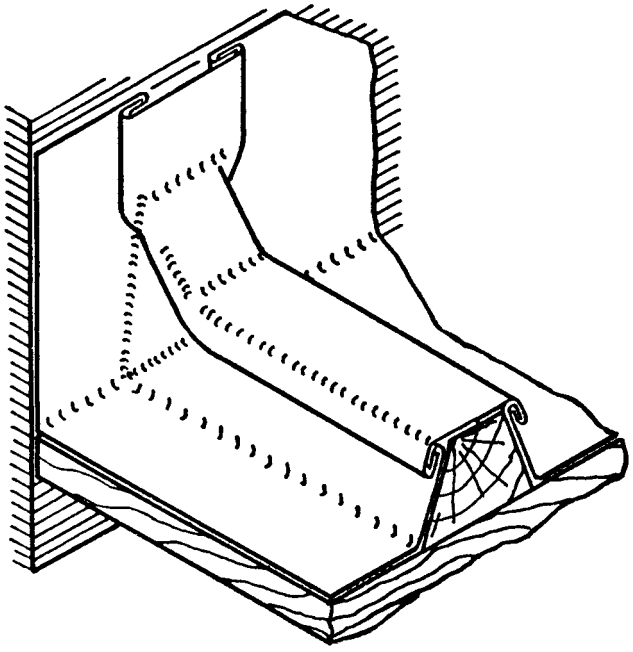
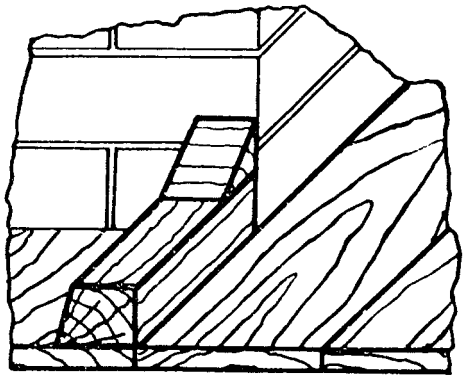


Figure 17 — Common roll to vertical upstand



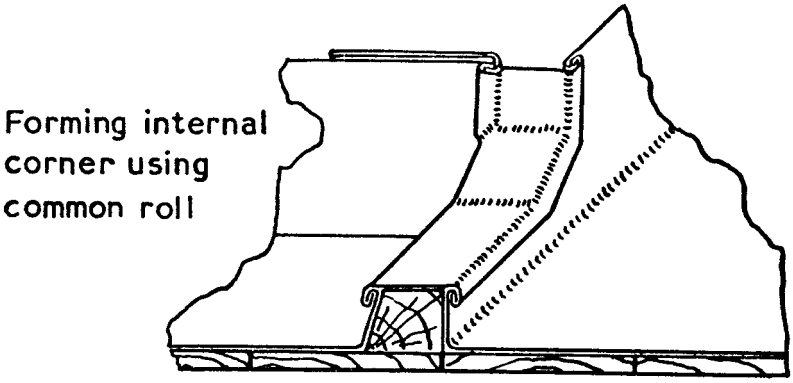


Figure 18 — Internal corner, common roll

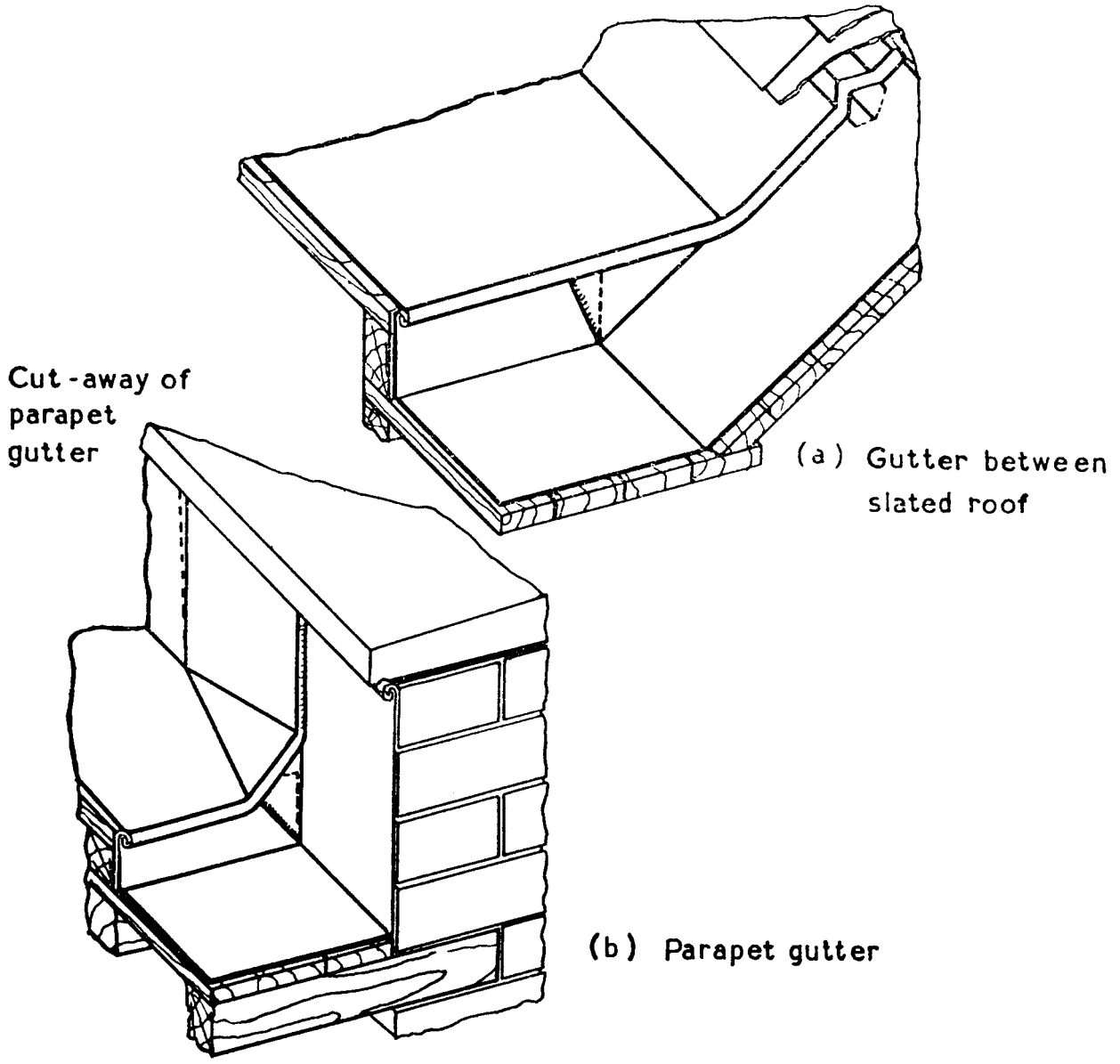


Figure 19 — Drips

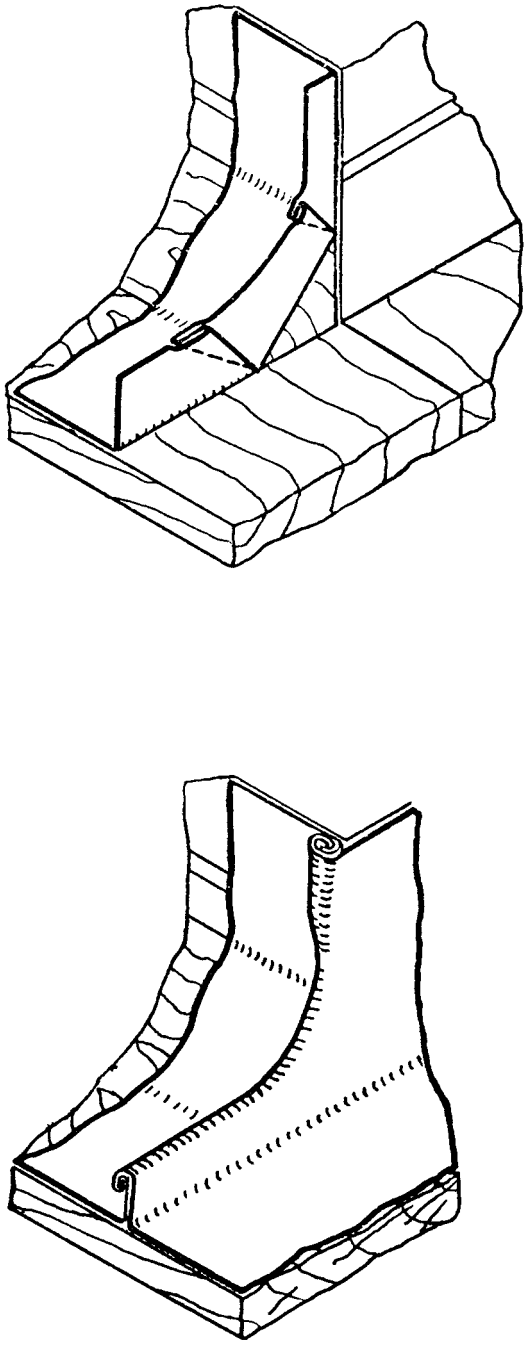


Figure 20 — Standing seam internal corner

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