
Partie 1 General

1.1 RELATED REQUIREMENTS

- .1 The list of Work in this division is indicative but non-limiting. It does not exclude Work described in other specification divisions shown on the drawings or required for full execution of the Work as intended on the drawings.
- .2 Sheet metal work on exterior walls and soffits (except those included in curtain walls) illustrated for main sectors plans as identified on key plan (EAST, CENTRAL AND WEST) are included in the present section.
- .3 Section 02 41 99 Demolition.
- .4 Section 02 42 13 Deconstruction of structures.
- .5 Section 04 05 00 Common Work Results for Masonry.
- .6 Section 05 50 00 Metal Fabrications.
- .7 Section 06 15 00 Wood Decking.
- .8 Section 06 17 53 Shop-fabricated Wood Trusses.
- .9 Section 06 10 00 Rough Carpentry.
- .10 Section 07 62 00 Sheet Metal Flashing and Trim.
- .11 Section 07 92 00 Joint Sealants.
- .12 Section 08 50 00 New wood windows.
- .13 Section 08 52 05 Historic works- existing wood windows
- .14 Section 26 43 13 Lightening Protection for Structures.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A240/A240M-11a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .3 ASTM B32-08, Standard Specification for Solder Metal.
 - .4 ASTM B370-11, Standard Specification for Copper Sheet and Strip for Building Construction.
 - .5 ASTM D523-89(2008), Standard Test Method for Specular Gloss.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement.
 - .2 CAN/CGSB-37.29-M89, Sheathing, Membrane, Breather Type.
 - .3 CAN/CGSB-51.32-M77, Sheet Aluminum Alloy, Prefinished, Residential.

- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA), 1999.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Research Council Canada (NRC)/Institute for Research in Construction (IRC) - Canadian Construction Materials Centre (CCMC)
 - .1 CCMC-2011, Registry of Product Evaluations.
- .6 Transports Canada (TC)
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for sheet metal roofing and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Proof of manufacturer's CCMC listing and listing number.
 - .3 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .3 Shop Drawings
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Quebec, Canada.
- .4 Samples
 - .1 Submit duplicate 300 x 300 mm samples of each sheet metal material.

1.4 QUALITY ASSURANCE

- .1 Mock-ups:
 - .1 Submit mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Prepare roofing and roofing component mock-ups from deck to metal roofing based on approximate surfaces indicated on drawings A-115a, A-115b and A-115c, using intended roofing materials and methods; surface mock-ups must show typical assemblies.
 - .3 Mock-up will be used.
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
 - .4 Locate as indicated on drawings A-115a, A-115b and A-115c.
 - .5 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with sheet metal flashing work.

- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work.
- .7 Approved mock-up may not remain as part of finished Work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect sheet metal roofing from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.6 ACCEPTABLE PRODUCTS AND MATERIALS

- .1 Where a particular brand name is stipulated, see Instructions to Bidders for procedure for requesting approval of substitute materials and products

Partie 2 Products

2.1 SHEET METAL MATERIALS

- .1 Copper sheet: to ASTM B370, H00 temper designation, 2% yield strength for roofing, 060 temper designation for flashing.
 - .1 Minimum weight: (16 oz/sq.ft.) 455g, 0.53 mm thick for main roof surfaces and according to items defined in Part 3 of this section. Metal sheets: 915 mm x 3,000.
 - .2 Minimum weight: (20 oz/sq.ft.) 570g, 0.68 mm thick, sheet metal for flashing and, counter-flashing, valleys, edging and other, and as indicated on plans.
- .2 Plain stainless steel sheet: to ASTM A167, Type A167 with No. 316 finish (contact with copper roofing, matte finish; unpainted finish 0.76 mm minimum thickness, sheet width 915 mm x 2,440 mm length.

2.2 ACCESSORIES

- .1 Battens: white pine, No. 1 and No. 2, tapered, 38 mm x 45 mm x 38 mm.
- .2 Ridges: white pine, No. 1 and No. 2, shape and size as indicated on plan.
- .3 Hips: white pine, No. 1 and No. 2, shape and size as indicated on plan.
- .4 Framing and ornamental moulding: white pine, No. 1 and No. 2, shape and size as indicated on plan.
- .5 Sealant: bituminous antibase paint.

- .6 Underlay: self-adhering air and vapour barrier, asphalt free and waterproof, 0.6 mm thick, 3-ply polypropylene top, removable silicon sheet bottom.
 - .1 Application: -7 °C to 40°C.
 - .2 CAN/CGSB 51.32-M89, ASTM 3330.
 - .7 Sealant: Asbestos-free sealant, compatible with systems materials, recommended by system manufacturer. See Section 07 92 00 - Joint Sealants.
 - .1 Application temperature: 4 °C to 38°C.
 - .2 To CAN/ONGC 19.13-M87, classification MCG-2-40-B-N.
 - .8 Primer: compatible with sealant and copper adhering.
 - .9 Rubber-asphalt sealing compound: to CAN/CGSB-37.29.
 - .10 100% solid preformed polyisobutylene cross-linked butyl preformed sealant, required width and length.
 - .11 Cleats: of same material, and temper as sheet metal: 50 mm minimum wide.
 - .1 Thickness same as sheet metal being secured 0.53 mm minimum.
 - .12 Fasteners: concealed throughout except where copper sheet is secured to masonry or impossible to use cleats or welds.
 - .13 Metal sections: stainless steel, 316 gauge, shape and dimensions as indicated on plans.
 - .14 Metal bars: copper, to ASTM B187, according to shape and dimensions as indicated on plans.
 - .15 Fasteners and collars: for bronze/copper downspout.
 - .16 Snow guards: formed copper stops, anchors 25 mm x appropriate length, 4.5 mm thick.
 - .17 Bug screen: CUI-36 copper, 18 x 14 x .011.
 - .18 Bird screens: 12.5 mm x 12.5 mm copper, 3.05 mm wire.
 - .19 Filter media: Polypropylene, non-woven, non-aligned, 95% air flow, 25 mm minimum thickness.
- Blind rivets: copper, with backing washer, appropriate length and 4.0 minimum diameter.
- .20 Rivets: peening copper, rod 4.0 mm diameter minimum x appropriate length, 12 mm penetration minimum.
 - .21 Nails: copper, flat head, appropriate length.
 - .22 Screws: No. 8 copper, appropriate length.
 - .23 Plugs: lead for masonry.
 - .24 Lead shims: for masonry joints.
 - .25 Washers: same material as sheet metal, 1 mm thick, with rubber.
 - .26 30 mm diameter round caps, embossed with same material as metal roof to conceal mechanical fasteners.
 - .27 Solder: to ASTM B32, 97% tin and 3% copper alloy.

- .28 Flux: rosin, cut muriatic acid or commercial preparation suitable for materials to be soldered.

2.3 FABRICATION

- .1 Form individual pieces in 2400 mm maximum lengths. Make allowances for expansion at joints.
- .2 Hem exposed edges on underside 12 mm, mitre and seal.
- .3 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .4 Apply minimum 0.2 mm dry film thickness coat of plastic cement to both faces of dissimilar metals in contact.
- .5 Protect metals against oxidization by backpainting with isolation coating where indicated.
- .6 Tin edges of copper sheets to be soldered for width of 40 mm both sides with solder.

2.4 SHOP FABRICATION

- .1 Shop fabricate components according to plans for each ornamental copper component.
- .2 Fabricate each component to prevent water infiltration on site.
- .3 Design components to enable assembly on site without exposed cleats or fasteners.
- .4 Make allowances for expansion at joints.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply minimum 0.2 mm dry film thickness coat of plastic cement to both faces of dissimilar metals in contact.
- .7 Protect stainless steel sheets against oxidation with protective coating applied to the back, as indicated.
- .8 Tin edges of copper sheets to be soldered for width of 40 mm both sides with solder.
- .9 Protect components from damage until installation on site.

Partie 3 Execution

3.1 WORK DOCUMENTS

- .1 Prior to construction, check all documents relevant to installation of sheet metal and adjacent elements to build.
- .2 Coordinate sheet metal work with adjacent work.
- .3 Refer to demolition documents to locate roof elements to remove and reproduce. Take necessary measures and photograph roof elements to reproduce.
- .4 Measure existing supports of metal sheeting to preserve or reproduce.
- .5 Refer to plans for bending, fastening and forming metal sheets.

3.2 PROHIBITED COMPONENTS

- .1 Use of cedar or treated wood is prohibited for use on copper surfaces, even if separating film is used between wood and copper.
- .2 Fasteners and materials not compatible with copper, for metal on metal installations: zinc, aluminum, galvanized steel and untreated steel.

3.3 EXAMINATION OF SURFACES AND SITE

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sheet metal roofing installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
 - .4 Inspect wood surfaces.

3.4 INSTALLATION

- .1 Install sheet metal roofing as indicated on plans and drawings.
- .2 Install self-adhering underlay on roofing decking or components (e.g.: slopes, dormers, turrets, watchtowers and others) and vertical surfaces.
 - .1 Secure in place and lap joints 100 mm minimum.
- .3 Apply slip sheet over asphalt felt underlay to prevent bonding between sheet metal and felt.
 - .1 Secure with anchorage and lap joints 50 mm minimum in direction of waterflow.
- .4 During progression of roof work, install wood components to receive copper, including battens, hips, ridges, frames, decorative components, etc.
- .5 Place wood components for ridges and hips first, according to plans.
- .6 Make openings for attic ventilation and related roof components as indicated on plans before placing metal sheets and according to work schedule.
- .7 Before installing battens, pans and metal panels, install 200 mm metal anchor sheet for low slopes, 100 mm for edges and 100 mm for valleys, creating 10 mm space for movement due to temperature variations.
- .8 Install tapered battens over 50 mm wide copper cleats fastened with two flat head copper nails, with a maximum 300 mm between cleats. Fasten battens with copper screws every 300 mm, length required to penetrate a minimum of 10 mm into decking, and a maximum of 150 mm from end.
- .9 Maximum spacing between battens must not exceed 705 mm centre, as indicated on plans, in some areas less to allow for bending at walls and edges.

- .10 Install metal sheets using cleats of appropriate length (75 mm minimum) x (50 mm wide) and spaced maximum 300 mm centre. Secure cleats using two flat head nails, folded over 12 mm.
- .11 Conceal cleat fastenings in areas where cleats cannot be used in folds or welded cleats, use blind rivets or masonry rivets.
- .12 Secure cleats with 2 fasteners each and cover with cleat tabs.
- .13 Stagger transverse seam in adjacent panels at 610 mm.
- .14 Flash roof penetrations with material matching roof panels, and make watertight. For batten roofs, use copper sheets of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick. Transverse seams may be prefabricated or fabricated on site, and sealed on site.
- .15 Lock cleats into seams and flatten smooth in the direction of the flow.
- .16 Double fold joints where cleats are used.
- .17 Clean and flux metals before soldering.
 - .1 Perform soldering with well heated coppers, heat seam thoroughly and sweat solder through its full width.
 - .2 Follow sheet metal manufacturer's recommendations for soldering procedures.
 - .3 As work progresses, neutralize excess flux with 5% to 10% washing soda solution, and thoroughly rinse. Leave work clean and free of stains.
- .18 Install lightening rods and conceal ground wires. Secure ground wires on roof surface with strips inserted in lock seam at 400 mm centre. Follow electrical engineer's and lightening consultant's instructions on plans.
- .19 To prevent buckling of metal sheets and displacement of clips, allow for movement due to temperature variations (10 mm at transverse seams and edges)(5 mm at batten edges, hips and ridges)(100 mm at valleys and flashing).

3.5 **BATTEN SEAM ROOFING** (main roof surfaces and dormers)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .3 Install tapered battens to enable 5 mm movement at base. Install copper caps 50 mm long x length required for bending (width of batten x twice the height of batten x twice 30 mm fastened to copper cleats with two flat head copper nails, with a maximum 300 mm between cleats. Fasten battens with copper screws every 300 mm, length required to penetrate a minimum of 10 mm into decking, and a maximum of 150 mm from end.
- .4 Form pan using sheet metal same width between two battens, turning edges to extend 15 mm above top of battens.
 - .1 Bend 15 mm pan edges at right angles to battens.
 - .2 Bend 30 mm strips at right angles with battens and fold over 15 mm under pan edges.

- .5 Use 100 mm wide x 3000 mm long strips to cover battens, fastening together with single seam transverse seams, at lower edges towards the top, folding top of strip 90° with 20 mm fold and cut the two corners 30° at 25 mm from batten, bend following strip 90° with 50 mm fold, fold flat 20 mm over previous fold towards bottom of slope, up to ridge.
 - .1 Hook 20 mm fold on lower end of pan into 50 mm fold on upper end of undelaying pan.
- .6 Starting at eaves, install metal sheets over anchor sheets.
- .7 Place cover strips over battens, locking edges with flanges of pan malleted down against sides of battens.
 - .1 Cover batten ends with cap folded and locked into extensions of batten covers and vertical legs of pans.
- .8 At intersections of roof slop with ridge and hip battens, turn up edges of roof pans against sides of battens and terminate in 15 flange at top of battens.
 - .1 Install cover strips over top of hip and ridge battens.
- .9 At eaves without gutters, hook pan over edge strip (minimum weight 20 oz/sq.ft.) 570g and 0.68 mm thick). Extend edge strip up under metal roofing 100 mm and secure with nails at 100 mm centres, at 25 mm from upper end.
- .10 Unless indicated otherwise, install batten flush with gable. Extend batten cover exterior face down exterior face and lock into edge strip.
- .11 Install shop formed cornices before edge sheet, using clips 300 mm centre, single fold.

3.6

ROOF BREAK

(single pitch roof at junction of west tower)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .3 Use same method as battens and pans to install metal sheets.
- .4 Bend pans and batten caps at junction between west tower eaves and upper edge, continuously, folding downwards. Make transverse seams 150 mm below bend.
- .5 Lower edge to span expansion joint, with expansion joint cap bent up where it meets parapet wall of new elastomeric membrane roof of West wing.

3.7

VALLEYS (folded, fully welded joints, see plans)

(junction of roof slope with another at lowest point)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick.
- .3 Form valleys of sheets not exceeding 3 m in length and 915 mm in length. Lap joints 150 mm in direction of flow.
 - .1 Extend valley sheet minimum 150 mm under roofing sheets.
 - .2 At valley line, double fold valley and roofing sheets.

- .3 Fasten valley sheets parallel to valley, sheet seams and valley transverse seams using 75 mm x 50 mm cleats.
- .4 Allow 10 mm for movement due to variations in temperature in winter and summer.
- .4 Form valleys for pediment dormers 300 mm, 150 mm each side of valley line.
- .5 Form valley for pitched roof and vents 300 mm, 150 mm each side of valley line.
- .6 Form valleys for conical turrets, watchtowers, cleanouts 350 mm, 175 mm each side of valley line.
- .7 Transverse seams 200 mm in length are used at the intersection of valley sheets, fastened with 75 mm long x 50 mm wide cleats.

3.8

HIPS

(external angle forming summit at which adjacent slopes meet)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick.
- .3 Before installing hips, notch chants 705 mm centre, 38 mm deep, fasten fixing sheets of same material as cover sheets under hips between each batten.
- .4 Allow 25 mm for top fold x 38 mm for vertical fold x 60 mm for bottom fold of fixing sheets, and fasten to back of hip, attach bottom fold with vertical fold towards the top with flat head nails 150 mm centre.
- .5 Taper hip cants 5 mm to 0 mm from bottom of cant strips to allow for sheet metal movement.
- .6 Tuck battens into hip notches.
- .7 Use same method as battens to install joint covers, using cleats 300 mm centre.

3.9

RIDGES (folded, fully welded joints, see plans)

(junction of two roof slopes at their highest point)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick.
- .3 Refer to plan details for variations in ridge construction.
- .4 Before installing ridges, notch chants 705 mm centre, 38 mm deep, fasten fixing sheets of same material as cover sheets under hips between each batten.
- .5 Allow 25 mm for top fold x 38 mm for vertical fold x 60 mm for bottom fold of fixing sheets, and fasten to back of hip attach bottom fold with vertical fold towards the top with flat head nails 150 mm centre.
- .6 Taper hip cants 5 mm to 0 mm from bottom of cant strips to allow for sheet metal movement.
- .7 Tuck battens into hip notches.
- .8 Use same method as battens to install joint covers, using cleats 300 mm centre.

3.10 TOP EDGE

(high point of sloped roof)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Install wall edges in the same way as the hips, using wood pieces 38 mm thick x 90 mm deep tapered and notched 705 mm centre.
- .3 Attach counter-flashing of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick, 200 mm high minimum secured to base with 75 mm long x 50 mm wide cleats 300 mm centre and fasten in counter-flashing to flashing inserted 38 mm in masonry, secure with lead cal 100 mm centre, end joint in masonry using mortar or sealant recommended by copper sheet manufacturer, clean and apply primer to copper flashing before sealing.

3.11 LOW EDGE

(low point of sloped roof)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 At eaves without gutters, hook pan over edge strip (minimum weight 20 oz/sq.ft.) 570g and 0.68 mm thick). Extend edge strip up under metal roofing 200 mm and secure with nails at 100 mm centres, at 25 mm from upper end.
- .3 Install batten flush with gable unless otherwise detailed. Extend batten cover down exterior face and lock into edge strip.

3.12 OUTSIDE EDGE

“sloped roof, exterior side, not supported by wall)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 No battens on vertical edges. Fasten sheets to edge of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick. Extend edge strip 150 mm under cover sheets and fasten using nails 100 mm centre, 25 mm from top end. Do not stretch cover sheets.
- .3 Extend edge strip 150 mm under cover sheets and fasten using nails 100 mm centre, 25 mm from top end. Do not stretch cover sheets.
- .4 Install shop formed cornices before edge sheet, using clips 300 mm centre, single fold.

3.13 WALL EDGE

(sloped roof, exterior side, supported by wall)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 No battens less than 400 mm from wall edges. Fasten sheets to edge of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick, edge strip extending minimum 150 mm on decking and 200 mm up wall, 100 mm from bottom. Fasten using continuous cleats and conceal counter-flashing 150 mm minimum height.
- .3 Attach counter-flashing of a minimum weight of 20 oz/sq.ft.) 570g, 0.68 thick, 200 mm high minimum secured to base with 75 mm long x 50 mm wide cleats 300 mm centre and fasten in counter-flashing to flashing inserted 38 mm in masonry, secure with lead shim 100 mm centre, end joint in masonry using mortar or sealant recommended by copper sheet manufacturer, clean and apply primer to copper flashing before sealing.

3.14 CONICAL TURRET (batten)
(main roof, batten)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .3 Install tapered battens to enable 5 mm movement at base. Install copper caps 50 mm long x length required for bending (width of batten x twice the height of batten x twice 30 mm fastened to copper cleats with two flat head copper nails, with a maximum 300 mm between cleats. Fasten battens with copper screws every 300 mm, length required to penetrate a minimum of 10 mm into decking, and a maximum of 150 mm from end.
- .4 Battens 705 mm centre at the base and 50 mm on top.
- .5 Before installing wood pieces at top of turrets, notch chants 95 mm centre, 38 mm deep, fasten fixing sheets of same material as cover sheets under tops between each batten.
- .6 Form pan using sheet metal same width between two battens, fasten pans using cleats and single fold, turning edges to extend 15 mm above top of battens.
 - .1 Bend 15 mm pan edges at right angles to battens.
 - .2 Bend 30 mm strips at right angles with battens and fold over 15 mm under pan edges.
- .7 Fabricate batten caps using 100 mm x 3000 mm strips, seamed together in single fold, at lower edges towards the top, folding top of strip 90° with 20 mm bold and cut the two corners 30° at 25 mm from batten, bend following strip 90° with 50 mm fold, fold flat 20 mm over previous fold towards bottom of slope, up to the ridge.
 - .1 Hook 20 mm fold on lower end of pan into 50 mm fold on upper end of underlaying pan.
- .8 Install metal cover sheets over anchor sheets on lower edge en forme de coyau using two 600 mm strips, aligning transverse seams.
- .9 Place cover strips over battens, locking edges with flanges of pan malleted down against sides of battens.
 - .1 Cover batten ends with cap folded and locked into extensions of batten covers and vertical legs of pans.
- .10 At intersections of roof slope with ridge of hip battens, turn up edges of roof pans against ridge or hip battens, and terminate in 12 mm horizontal flange at top of battens.
 - .1 Install cover strips over top of hip and ridge battens.
- .11 At eaves without gutters, hook pan over edge strip (minimum weight 20 oz/sq.ft.) 570g and 0.68 mm thick). Extend edge strip up under metal roofing 200 mm and secure with nails at 100 mm centres, at 25 mm from upper end.
- .12 Install batten flush with gable unless otherwise detailed. Extend batten cover down exterior face and lock into edge strip.
- .13 Install shop formed cornices before edge sheet, using clips 300 mm centre, single fold.

- .14 Flat seam ridge sheet metal, using copper cleats to fasten each vertical joint and top of pointed sheets.
- .15 Over metal sheets, install shop fabricated ornamental ridges designed to fit top of turrets with minimum 125 mm overlap, secure with copper screws 100 mm centre, with embossed caps welded to ridge base sheets over metal sheets.

3.15 CONICAL TURRETS (fish scale shingle)
(main roof, combination fish scale shingles and flat seams)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use 915 mm x 3000 mm sheet copper, minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, to make fish scale shingles.
- .3 Follow instructions in paragraph 3.1 before beginning conical turrets (fish scale).
- .4 Begin by placing lower edge and anchor sheets under first starter strip 200 mm. Secure with flat head nail 100 mm centre, 25 mm from edge.
- .5 Install first flat seam cover sheet, maximum 600 mm on lower edge. Secure using 70 mm x 50 mm cleats; two cleats for vertical joints and two cleats for transverse joints. Extend first starter strip 400 mm under second starter strip.
- .6 Using 240 mm x 50 mm x 1500 mm wood pieces, on decking and over first copper strip, fan out wood 100mm with tops oriented towards the tower, creating false sprockets under the second starter strips, taper wood from centre into points from 240 mm to 0.0 mm for the top and taper from centre into points 240 mm to 50 mm; before placing the pieces, mark each piece in the main support, secure metal section bent 90° at bottom and top, bottom fold 75 mm and secured with two flat head nails, the vertical fold same height as pieces in 50 mm radius, plus total weight of decking, plus weight of 16 mm veneer, the top horizontal fold will be 50 mm and reinforce with an anchor sheet.

Perforate 50% of vertical section under metal sheets placed tapered wood, with filter media to ventilate conical portion of turret.

Install decking in a radius pattern over wood pieces, over base layer before completing copper.
- .7 Install second cover sheet, flat seam, maximum 600 mm on lower edge. Secure using 70 mm x 50 mm cleat; two cleats for vertical joints and two cleats for transverse joints. Extend second strip 100 mm under third fish scale strip.
- .8 Before installing third fish scale strip, install continuous reglet 100 mm below fish scale strip for transverse joints. Install flat seam cover sheets, maximum size of anchor sheet 600 mm x 600 mm, and secured with 70 mm x 50 mm cleats for transverse joints.
- .9 Install third row of fish schale shingles (mesure and reproduce existing pattern and attachment method) and at least three samples to enable roofer to accurately reproduce the two turrets; four fish scale strips, five plain bottom strips and top strips, two six plain intermediate strips staggered with top plain 150 mm longer than lower rows and fastened with two 25 mm flat head nails at highest part.

- .10 Continue above third row with flat seam cover sheets, maximum 600 mm at edge, secured with 70 mm x 50 mm cleats, 300 mm centre for vertical joints and two cleats for transverse joints, cover sheets extended 400 mm under following strip.
- .11 Repeat for remaining strips up to top of turret cone.
- .12 Flat seam ridge sheet metal, using 70 mm x 50 mm copper cleats to fasten each vertical joint and top of pointed sheets.
- .13 Over metal sheets, install shop fabricated ornamental ridges designed to fit top of turrets with minimum 125 mm overlap, secure with copper screws 100 mm centre, with embossed caps welded to ridge base sheets. over metal sheets.
- .14 Restore metalwork of ridges of the two fish scale turrets as indicated in Section 05 50 00 Metal Fabrications.

3.16 WATCHTOWER (batten)
(main roof, batten)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .3 Install tapered battens to enable 5 mm movement at base. Install copper caps 50 mm long x length required for bending (width of batten x twice the height of batten x twice 30 mm fastened to copper cleats with two flat head copper nails, with a maximum 300 mm between cleats. Fasten battens with copper screws every 300 mm, length required to penetrate a minimum of 10 mm into decking, and a maximum of 150 mm from end.
- .4 Battens 705 mm centre at base and 50 mm at top.
- .5 Before installing wood pieces at top of turrets, notch chants 95 mm centre, 38 mm deep, fasten fixing sheets of same material as cover sheets under tops between each batten.
- .6 Form pan using sheet metal same width between two battens, fasten pans using cleats and single fold, turning edges to extend 15 mm above top of battens.
 - .1 Bend 15 mm pan edges at right angles to battens.
 - .2 Bend 30 mm strips at right angles with battens and fold over 15 mm under pan edges.
- .7 Fabricate batten caps using 100 mm x 3000 mm strips, seamed together in single fold, at lower edges towards the top, folding top of strip 90° with 20 mm bold and cut the two corners 30° at 25 mm from batten, bend following strip 90° with 50 mm fold, fold flat 20 mm over previous fold towards bottom of slope, up to the ridge.
 - .1 Hook 20 mm fold on lower end of pan into 50 mm fold on upper end of underlaying pan.
- .8 Over anchor sheets, install sprocket metal sheetes using two 600 mm strips aligned with transverse seams.
- .9 Place cover strips over battens, locking edges with flanges of pan malletted down against sides of battens.

- .1 Cover batten ends with cap folded and locked into extensions of batten covers and vertical legs of pans.
- .10 At intersections of roof slope with ridge of hip battens, turn up edges of roof pans against ridge or hip battens, and terminate in 12 mm horizontal flange at top of battens.
 - .1 Install cover strips over top of hip and ridge battens.
- .11 At eaves without gutters, hook pan over edge strip (minimum weight 20 oz/sq.ft.) 570g and 0.68 mm thick). Extend edge strip up under metal roofing 200 mm and secure with nails at 100 mm centres, at 25 mm from upper end.
- .12 Install batten flush with gable unless otherwise detailed. Extend batten cover down exterior face and lock into edge strip.
- .13 Install shop formed cornices before edge sheet, using clips 300 mm centre, single fold.
- .14 Flat seam ridge sheet metal, using 70 mm x 50 mm copper cleats to fasten each vertical joint and top of pointed sheets.
- .15 Over metal sheets, install shop fabricated ornamental ridges designed to fit top of turrets with minimum 125 mm overlap, secure with copper screws 100 mm centre, with embossed caps welded to ridge base sheets. over metal sheets.

3.17 PEDIMENT DORMER (*copper covered stones, folded, fully welded seams*)
(all dormers except those with ridge caps)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use metal cover sheets for pediment dormers fully clad in copper.
- .3 Before beginning fabrication of pediment dormers with dimension stone pediment and jambages, apply procedure described in paragraph 3.1 of this section for dormers to be dismantled and rebuilt, and dormers to be preserved and restored.
- .4 Fully copper clad pediment dormers will be new, over new framing.
- .5 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .6 Use main surface cover sheets for dormer sides and counter-flashing at junctions, refer to paragraph 3.27 of this section.
- .7 Continue sheet metal on side and rear of dormer jambages, back of pediment and horizontal surfaces of pediment, apply separator membrane between dimension stone and copper, seal and secure copper sheets with concealed fasteners 300 mm centre, and screws in lead plugs and seal with polyisobutylene mastic strip.
- .8 Install tapered battens to enable 5 mm movement at base. Install copper caps 50 mm long x length required for bending (width of batten x twice the height of batten x twice 30 mm fastened to copper cleats with two flat head copper nails, with a maximum 300 mm between cleats. Fasten battens with copper screws every 300 mm, length required to penetrate a minimum of 10 mm into decking, and a maximum of 150 mm from.
- .9 Form pan using sheet metal same width between two battens, turning edges to extend 15 mm above top of battens.

- .1 Bend 15 mm pan edges at right angles to battens.
- .2 Bend 30 mm strips at right angles with battens and fold over 15 mm under pan edges.
- .10 Fabricate batten caps using 100 mm x 3000 mm strips, seamed together in single fold, at lower edges towards the top, folding top of strip 90° with 20 mm bold and cut the two corners 30° at 25 mm from batten, bend following strip 90° with 50 mm fold, fold flat 20 mm over previous fold towards bottom of slope, up to the ridge.
 - .1 Hook 20 mm fold on lower end of pan into 50 mm fold on upper end of underlaying pan.
- .11 Apply sheet metal roofing beginning at eaves.
- .12 Place cover strips over battens, locking edges with flanges of pan malleted down against sides of battens.
 - .1 Cover batten ends with cap folded and locked into extensions of batten covers and vertical legs of pans.
- .13 At intersections of roof slope with ridge of hip battens, turn up edges of roof pans against ridge or hip battens, and terminate in 12 mm horizontal flange at top of battens.
 - .1 Install cover strips over top of hip and ridge battens.
- .14 Fasten sheets to edge, minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick. Extend edge strip 125 mm under cover sheets and secure using nails 100 mm centre, 25 mm from top.
- .15 Install batten flush with gable unless otherwise detailed. Extend batten cover down exterior face and lock into edge strip.
- .16 Install perforated cornices fabricated on site to ventilate roof of both slopes, before installing edge sheets, fastened 300 mm centre, single fold, prefabricated cornices fastened to edge sheet.
- .17 Form valleys of sheets not exceeding 3 m in length. Lap joints 150 mm in direction of flow.
 - .1 Extend valley sheet minimum 150 mm under roofing sheets.
 - .2 At valley line, double fold valley and roofing sheets.
 - .3 Fasten valley sheets parallel to valley, sheet seams and valley transverse seams using 75 mm x 50 mm cleats.
 - .4 Install valley sheet joints 10 mm to allow movement due to temperature variations.
- .18 Install battens maximum 400 mm to pediment wall edges, fasten metal cover sheets to edge strip minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick, minimum 150 mm from bottom, secured with continuous cleats and conceal counter-flashing 150 mm maximum height.
- .19 Fasten 150 mm x 150 mm counter-flashing to roof metal sheet and side sheets with 75 mm x 50 mm cleats 300 mm centre maximum.

- .20 Fold metal sheet legs in joint between window and casing, install rolled and sealed copper blocks, make watertight. Continue to top and make fully clad copper pediment dormers using copper clad wood and make watertight.
- .21 Fasten copper pediment dormer alleges with 75 mm x 50 mm cleats 300 mm centre maximum.

3.18 DORMERS WITH PROJECTING EAVES (all dormers with ridges)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .3 Start with dormer sides and junction counter-flashings of main surface and dormer façade. Refer to paragraph 3.27 of this section.
- .4 Install flat seam metal sheets on dormer slopes. Install 50 mm x 70 mm copper cleats under sheets for folding, secure cleats using two flat head copper nail, maximum spacing 300 mm.
- .5 Starting at eaves, install cover metal sheets over anchor sheets.
- .6 At intersections of dormer roof slope with ridge of hip battens, turn up edges of roof pans against ridge or hip battens, and terminate in 12 mm horizontal flange at top of battens.
 - .1 Install cover strips over top of hip and ridge battens.
- .7 Install prefabricated ridges over dormers with projecting eaves, covering 100 mm over four-sided part of dormer roof. Secure ridges with watertight blind rivets and weld.
- .8 Fasten sheets to edge strip minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick. Extend edge strip 125 mm under cover sheets and secure using nails 100 mm centre, 25 mm from top.
- .9 Install field fabricated perforated cornices to enable ventilation of projected roof before installing edge sheets secured 300 mm centre, with single fold fasten cornices to edge sheet.
- .10 Use sheets 3000 mm x 915 mm to fabricate valleys. Overlap joints 25 mm in direction of water flow.
 - .1 Extend valley sheets minimum 125 mm under cover sheets.
 - .2 Double fold valley and cover sheets in valley line.
 - .3 Fasten valley sheets parallel to valley, sheet seams and valley transverse seams using 75 mm x 50 mm cleats.
 - .4 Allow 10 mm space for movement due to temperature variations.
- .11 Fasten 150 mm x 150 mm counter-flashing to roof metal sheet and side sheets with 75 mm x 50 mm cleats 300 mm centre maximum.
- .12 Fabricate false ridge at bottom of dormer façade 400 mm over main roof surface using same fastening methods as described in paragraph 3.9 of this section.
- .13 Fold metal sheet legs in joint between window and casing, install rolled and sealed copper blocks, make watertight. Continue to top and make fully clad copper pediment

dormers using copper clad wood and make watertight, same for top and bottom of window.

3.19 PINNACLES OVER DORMER JAMBS (*folded, fully welded seams*)
(copper ornaments over dormer pediments)

- .1 Before beginning fabrication of pinnacles, follow instructions of paragraph 3.1 for pinnacles of south part of guard tower.
- .2 Refer to plans for pinnacles of north part of guard quarters.
- .3 Apply instructions of paragraph 3.4 of this section for other dormer pinnacles.
- .4 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 3000 mm in length before bending to make batten roofs.
- .5 Shop fabricate pinnacles with metal on metal 13 mm folded joints, with necessary angle for each folded sheet, fastened together using blind rivets and welds.

Install pinnacles using L metal strip 38 mm x 38 mm x 38 mm, welded to metal sheets of pediment dormer slopes, using blind rivets at base of pinnacles, weld rivets and pinnacle bases, with 10 mm V-shaped opening to evacuate water, with point towards the top to evacuate condensation at centre of lowest point of pinnacle bases.

- .6 Form pinnacles to supports in place.
- .7 Add ridge cap between pinnacles and slopes.

3.20 CHIMNEYS
(covering, ventilation and ornaments of non-operational)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Examine roof structure before beginning work to ensure suitability for installation of wood sections to recreate mouldings illustrated on plans.
- .3 Check plans to see whether chimneys must be ventilated, sealed or kept operational.
- .4 For covering chimneys, install flat seam metal sheets for all sheets directly on support panels, use copper minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick. Use metal sheets 600 mm high x maximum length, fastened with 75 mm x 50 mm cleats 300 centre maximum.
 - .1 Stagger vertical joints of sheets, alternating from one strip to the next. Do not align vertical joints.
- .5 Lay sheets with the long dimension parallel to the eaves.
- .6 Lock cleats into seams and flatten smooth in the direction of the flow.
- .7 Over panel sheets install copper ornaments illustrated on plans and shop fabricated, form vertical ornaments to minimize horizontal joints. If necessary, position joints at bottom of horizontal mouldings, fastened with 38 mm x 38 mm L type metal strips. Integrate chimney bases and ornaments. Use blind rivets and welds to fasten volutes and finials.
- .8 Install metal sheet baffle ventilation vertically and crossed 200 mm high with filter media, bird grilles and bug screens to block snow, bugs and rodents.

3.21 **FRAMED ROOF VENTS**

(large copper framed vents in soffits)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Examine roof structure before beginning work to ensure suitability for installation of wood sections to recreate mouldings illustrated on plans.
- .3 For covering vents, install flat seam metal sheets for all sheets directly on support panels, use copper minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick. Use metal sheets 400 mm high x maximum length, fastened with 75 mm x 50 mm cleats 300 centre.
 - .1 Stagger vertical joints of sheets, alternating from one strip to the next. Do not align vertical joints.
 - .2
- .4 Lay sheets with the long dimension parallel to the eaves.
- .5 Lock cleats into seams and flatten smooth in the direction of the flow.
- .6 Install evaporation pan 200 mm x 200 mm x width of dormer.
- .7 Install filter media behind louvre blades between bird grilles, insert bug screen between exterior grille and filter media.
- .8 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick for louvre blades.
- .9 Fabricate louvre blades 150 mm deep x required width, reinforce blades with horizontal reinforcing folds (double) 15 mm top and bottom of blades, at centre of blades weld 25 mm x 25 mm metal sheets by width of opening. Install blades 45 degrees top to bottom to evacuate water to outside and overlap blades 30 mm to create better block against water and snow infiltrations, secure louvre blades using blind rivets, three per blade.
- .10 Angle frame at bottom of louvres same as blades.
- .11 Position vent jambs vertically to minimize joints. If necessary, position joints at bottom of horizontal mouldings.
- .12 Install shop-fabricated copper ornaments, volutes, finials and pediments, over cover sheets using L metal strip 38 mm x 38 mm x 38 mm, using blind rivets at base of pinnacles, weld rivets. Align shop fabricated joints with field fabricated joints.

3.22 **FRAMELESS ROOF VENTS** (*folded, fully welded seams*)

(small copper roof vents)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick for shop fabricated chatières and designed to hook into roof sheet metal on site.
- .3 Form vents in pyramid shape and incline 15° top to bottom of roof slope. On plan, the chatière will have a Delta shape with delta point oriented towards roof ridge. Using press, cut 25 mm slits to create 45° louvre shaped wings, weld copper bug screen to back of façade, with 25 mm thick filter media secured with bird grille.
- .4 Shop fabricate vents with metal sheet joints, with 13 mm fold to accommodate angle of each folded sheet, fastened together with blind rivets and welds.

- .5 Install vents over transverse joints of roof cover, half the top under the cover sheets and half of bottom over cover sheets.
- .6 Install cover sheets in direction of water flow.
- .7 Coordinate position of deck openings with position of frameless vents.
- .8 Support interior face of chatière on same size opening as deck opening bent up vertically 30 mm.

3.23 RIDGE CAPS

(copper sheet ornamentation on ridges, square towers, eave dormers, conical turrets, watchtowers and certain roof)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick.
- .3 Shop fabricate ridges, designed to overlap 150 mm minimum, secured with watertight welded blind rivets.
- .4 Form ridges as illustrated on plans.

3.24 VOLUTES (*folded, fully welded seams*)

(spiral shaped sheet copper ornaments)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick.
- .3 Shop fabricate volutes, welded and fastened with L shaped metal strips 38 mm x 38 mm x required length, using blind rivets and welds.
- .4 Form volutes as illustrated on plans.
- .5 Do not close volutes on back.
- .6 Design volutes to extend 25 mm at centre of each spiral.

3.25 FINIALS (*folded, fully welded seams*)

(sculpted sheet copper to resemble vegetation)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick.
- .3 Shop fabricate finials, welded and fastened with L shaped metal strips 38 mm x 38 mm x required length, using blind rivets and welds.
- .4 Form finials as indicated on plans.
- .5 Do not close fleurons on back.
- .6 Bend finials to give impression of being skulpted.

3.26 BELL TURRETS

(copper sheet ornaments over wood framing to resemble small bell on roof)

- .1 Before starting fabrication of bell turrets, follow instructions of paragraph 3.1 for bell turrets of south part of guard quarters.
- .2 Apply installation and general procedures as in paragraph 3.4 of this section.
- .3 Use copper minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick.
- .4 Fabricate identical bell turrets with evaporation pan added in crawlspace at base.
- .5 Reduce decking opening under bell turrets structure to minimize air intake from 50% ventilated roof, to balance convection effect of vents on each slope with a bell turret.
- .6 Before installing louvre blades, install filter media between two bird grilles, insert copper bug screen between grille on exterior side and filter media.
- .7 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick for louvre blades.
- .8 Fabricate louvre blades 150 mm x required length, reinforce blades with horizontal reinforcing folds (double) 15 mm top and bottom of blades, at centre of blades weld 25 mm x 25 mm metal sheets by width of opening. Install blades 45 degrees top to bottom to evacuate water to outside and overlap blades 30 mm to create better block against water and snow infiltrations, secure louvre blades using blind rivets, three per blade.
- .9 Support bell turret bottom on main surface of roof by fabricating bell turret base around entire perimeter of bell turret base, over false ridge, as indicated on plans, using same fastening methods as described in paragraph 3.9 of this section.

3.27

DORMER CHEEKS

(two lateral sides of dormer)

- .1 Before starting fabrication of dormer sides, follow instructions of paragraph 3.1 for dormers of south part of guard quarters.
- .2 Apply installation and general procedures as in paragraph 3.4 of this section.
- .3 Use copper minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 450 mm x 600 mm sheets for flat seam roofs.
 - .1 Notch corners and turn up pretinned edges 20 mm.
- .4 Place sheets with longest side parallel to eaves.
- .5 Lock seams 50 mm x 75 mm at 300 mm centre into seams and flatten smooth in the direction of the flow.
- .6 Attach cover sheets to previously installed edge strips for eaves and peaks.
- .7 At junction of dormer sides and main roof surface, fasten using cleats 50 x 75 mm, 300 mm centre, L shaped counter-flashings, 150 mm x 150 mm, fasten dormer sides to dormer sides using 50 mm double fold on face of dormer sides.

3.28

DORMER SIDES

(two lateral sides of window integrated into dormer)

- .1 Before starting fabrication of dormer sides, follow instructions of paragraph 3.1 for dormers of south part of guard quarters.
- .2 Apply installation and general procedures as in paragraph 3.4 of this section.

- .3 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, sheets 610 mm x 3000 mm to make dormer side jambs.
- .4 Form vertical dormer sides to minimize horizontal joints. If necessary, position joints at bottom of horizontal mouldings. Refer to plans for fabrication of dormer sides.
- .5 Attach dormer jambages to dormer sides using 50 mm double fold on face of dormer sides, fasten with 50 x 75 mm cleats, 300 mm centre.

3.29 SILLS (*folded, fully welded seams*)
(sloped window sill with ears and drip cap)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, sheets 610 mm x 3000 mm to make dormer side jambs.
- .3 Cover shop fabricated and site installed wood alleges with cover sheet before metal sheets, attached with L shaped 25 mm x 25 mm cleats fastened to wood sill with flat head nails 150 mm centre.
- .4 Position continuous cleats 25 mm interior shutters of windows and 25 mm under window support.
- .5 Install second reglet attached to masonry walls under wood sill.
- .6 Form copper sheet in one section over length of wood plus 100 mm on each end x depth of allège under and over with 50 mm vertical fold over and down.
- .7 Make 25 mm fold top and bottom of reglets and flat fold over top and bottom of wood sills.
- .8 Fold ends of metal sheets, starting with bottom, then front, using flat head nail, and fold top, fasten using blind rivet and welds.
- .9 Make watertight.
- .10 Make drip under edge of each sill.

3.30 HALF WALLS
(cladding on lower half of wall)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, sheets 610 mm x 3000 mm to make flat seams.
 - .1 Notch corners and turn up pretinned edges 20 mm.
- .3 Place sheets with longest side parallel to eaves.
- .4 Lock seams 50 mm x 75 mm at 300 mm centre into seams and flatten smooth in the direction of the flow.
- .5 Begin installing half walls from bottom to top, staggering vertical joints and fastening to top moulding inserted in masonry joint.

3.31 BUTTRESS

(masonry pillar wall support)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper sheets of a minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, sheets 610 mm x 3000 mm to cover flat seam buttresses.
 - .1 Notch corners and turn up pretinned edges 20 mm.
- .3 Lay sheets with the long dimension parallel to the eaves.
- .4 Lock seams 50 mm x 75 mm at 300 mm centre into seams and flatten smooth in the direction of the flow.
- .5 Begin installing metal sheets bottom to top, starting with the sides, then the front with anchor joints 50 mm from corners on side of buttresses, staggering vertical joints and fastening to caps and folding over edges, tuck into counter-flashing in masonry joints 150 mm over caps.

3.32 SHOP FABRICATED CORNICES AND VENTED DRIP

(projecting wall cap)

- .1 Before starting fabrication of door cornices, follow instructions of paragraph 3.1 of this section.
- .2 Apply installation and general procedures as in paragraph 3.4 of this section.
- .3 Use copper minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 610 mm x 3000 mm sheets for door cornices.
- .4 Make undersides as indicated on plans.
- .5 Shop form cornices and install on site using double joints and fasteners.
- .6 Make vents and weld to back of copper metal sheets of bug strips.

3.33 DOOR CORNICES

(projecting component over door)

- .1 Before starting fabrication of door cornices, follow instructions of paragraph 3.1 of this section.
- .2 Apply installation and general procedures as in paragraph 3.4 of this section.
- .3 Use copper minimum weight of 16 oz/sq.ft.) 455g, 0.53 thick, 610 mm x 3000 mm sheets for door cornices.
- .4 Make undersides using flat seam metal sheets.
- .5 Fabricate identical cornices, shop form cornices and final assembly on site.
- .6 Counter-flashings 150 mm high minimum tucked into masonry joints 38 mm with lead shim 100 cm centre, cover main surface 150 mm and fastened 300 mm centre.

3.34 LOUVRES

(horizontal, sloped blades shedding rain and allowing air to enter)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick for louvres.
- .3 Fabricate louvre blades 150 mm x required length, reinforce blades with horizontal reinforcing folds (double) 15 mm top and bottom of blades, at centre of blades weld 25 mm x 25 mm metal sheets by width of opening. Install blades 45 degrees top to bottom to evacuate water to outside and overlap blades 30 mm to create better block against water and snow infiltrations.
- .4 Secure louvre blades using blind rivets, three per blade, to L shaped copper sheet frame over 50 mm stainless steel section.
- .5 Install cover sheets with 45 degree corners from bottom to top of frame.
- .6 Stainless steel section 1.8 mm thick and fastened together using 38 mm x 38 mm x 150 mm L sections.

3.35 RAIN DEFLECTERS (*folded, fully welded seams*)
(rain shield deflecting water and snow)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick to cover rain deflectors.
- .3 Use 915 mm x 3000 mm sheets.
- .4 Design deflectors to shed water and snow from buttress caps on north side of multifunctional room.
- .5 Install frames as indicated on plans, align corner with former valley centres.
- .6 Install first section with flat seam joint from starting edge, attach each side of deflectors with flat seam joints 150 mm from sides.
- .7 Fabricate junction of main roof surface and deflector with two sections connected in centre to form delta, with 150 mm visible on each section on main roof surface and 200 mm under main roof surface, fastened with continuous reglets and cleats, vertical part same height as batten pans, visible part of deflector 200 mm and folded over deflector edges.

3.36 SOFFIT AIR DEFLECTERS (*folded, fully welded seams*)
(designed to control air flow)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick to cover expansion joints.
- .3 Install sheet metal deflectors under interior face of roof decking for each chatières sur bâti, create four-sided box. Width same as widest opening in decking x 600 mm long x 250 mm for three other box sides. Fasten using screws under decking.

3.37 EXPANSION JOINTS (*folded, fully welded seams*)
(joints allowing expansion and contraction according to temperature)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.

- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick to cover expansion joints.
- .3 Form metal sheets as indicated on plans.
- .4 Use 915 mm x 3000 mm sheets with longest side parallel to edge.

3.38 **PARAPET CAPS**

(peaked top of wall to protect from water infiltration)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick to cover expansion joints.
- .3 Form metal sheets as indicated on plans.
- .4 Use 915 mm x 3000 mm sheets with longest side parallel to edge.
- .5 Install 19 mm thick veneer strips over capstone using masonry nails 300 mm centre.
- .6 Cover veneer panels with self-adhering base sheet.
- .7 Install copper covering and secure 300 mm centre.

3.39 **RIDGE CAPS *folded, fully welded seams***

(raised segment of roof enabling water and snow to detour an obstacle)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Fabricate flat seam dos d'âne, using copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick, 450 mm x 600 mm sheets.
 - .1 Notch corners and turn up pretinned edges 20 mm.
- .3 Lay sheets with the long dimension parallel to the ridge.
- .4 Lock cleats into seams and flatten smooth in the direction of the flow.
- .5 At peak extremities, end cover sheets by fastening to previously installed edge strip.
- .6 Make ridges with metal sheets fastened to each slope to have 100 mm visible on each side of ridge.
- .7 Secure ridge to main roof surfaces as indicated in paragraphs 3.7 of this section.
- .8 Secure ridge to counter-flashings using copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick, fasten with 50 mm x 70 mm cleat centre maximum.

3.40 **PLUMBING VENT CAPS *folded, fully welded seams***

(cover of exterior part of gas and air vents)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Make flat seam caps, using copper minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick.
- .3 Fabricate covers for vents using single cylinder shape copper sheet, cylinder sealed with flat seam and continuous weld, 25 mm diameter bigger than plumbing vent, bend top of cylinder 100 mm towards interior of cylinder. Measure height of vent of and roof angle to cut cylinder 50 mm longer and cut 20 mm wings into sheet and fold as roof angle.

- .4 Make 400 mm x 400 mm dish with opening in centre same diameter as cylinder, fasten with blind rivets and welds, weld around perimeter of cylinder and dish.
- .5 Install vents over transverse joints of roof sheets, half under cover sheets and half over.

3.41 SNOW GUARDS

(component attached to roof to prevent snow and ice from sliding easily)

- .1 Apply installation and general procedures as in paragraph 3.4 of this section.
- .2 Use formed copper with copper cleat tucked into copper stops with notch and slide opposite end under cover sheet, anchors cleats 25 mm wide x 300 mm long x 4.5 mm thick.
- .3 Make two 300 mm starter strips from lower edge, with 300 mm overlap to stagger stops.
- .4 Double decking thickness over snow guards and fasten structural reinforcement under decking with anchors.
- .5 Install in locations indicated on plans.

3.42 METAL ORNAMENTS (ridge crowns, caps metalwork) (*folded, fully welded seams*) (metal ornamentation)

- .1 Coordinate metal ornament fabrication with Section 05 50 00 Metal Fabrications and this section.

3.43 GUTTERS, DRAINS AND DOWNSPOUTS (*folded, fully welded seams*)

- .1 Fabricate insides of gutters as illustrated on plans with copper sheets minimum weight of 16 oz/sq.ft.) 570g, 0.68 thick.
- .2 Roll exterior sides of gutters over 8 mm diameter copper rod.
- .3 Gutters 125 mm in diameters with 10 mm up each side.
- .4 Use 3000 mm sheets for gutter sections.
- .5 Longitudinal joints are not allowed.
- .6 Place gutters on copper plate supports 4.5 mm thick x 25 mm wide x length of gutter plus 250 mm support on decking notched for supports 1200 centre maximum.
- .7 Attach gutter cover to roof support using screws, washers and expansion fittings 1200 mm centre maximum, the length of the cover.
- .8 Extend gutter cover over roof edge minimum 200 mm under metal cover and finish with 20 mm fold fastened with cleats. Hook bottom of sheet or cover tin to edge to form 20 mm loose joint.
- .9 Install manchons mâles taillés en collerettes attached with blind rivets and welded over full surface of collars, 85 mm diameter x 200 mm long.
- .10 Install downspouts 90 mm diameter attached to gutters, with joint facing wall, secured with collars 100 mm long x 8 mm diameter, every 1200 mm.
- .11 Install necessary downspout elbows and extensions to 150 mm from ground.

3.44 LIGHTENING RODS (*see electrical engineering plans*)
(component designed to deflect lightening)

- .1 Following consultant's and engineer's plans, install lightening rods mounted on 3 mm thick x 50 mm wide x 120 mm long plates, conceal cables on roof surfaces to sleeves inside building.
- .2 Design and seal openings to sleeves to prevent rain, melting snow and ice infiltration.
- .3 Conceal sleeve openings to be non-visible from ground.

3.45 FINISH

- .1 Let copper roof weather through 2 heavy rains minimum after final cleaning.
- .2 Rub exposed surfaces with clean rags soaked in boiled linseed oil until desirable shade of brown is obtained.
- .3 Touch up solder with copper bronze.

3.46 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste management: sort waste for reuse/recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

3.47 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by sheet metal roofing installation.

END OF SECTION