THE UNIVERSITY OF SYDNEY

Roofing and Guttering Standard

Design, Engineering, Planning & Sustainability

University Infrastructure

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Contents

1 Purpose

The UI Roofing and Guttering Standard sets out the University of Sydney's minimum requirements for the design, construction and maintenance of Essential Fire Safety Measures. It ensures new and refurbished systems are energy efficient, fit-for-purpose, made from durable good-quality materials, contain no or minimal environmentally harmful substances, and are cost efficient to operate and maintain.

Applicable requirements documented in Workplace Health and Safety legislation, Disability Discrimination legislation, State Environmental Planning legislation, Commonwealth and State legislation, National Construction Codes (NCC), the Building Code of Australia (BCA) and Australian and New Zealand Standards (AS/NZS) are the minimum and mandatory compliance requirements.

Where any ambiguity exists between this standard and the aforementioned mandatory requirements then:

a. The highest performance requirements must apply.
b. Applicable requirements must follow this order of precedence:
    1. Workplace Health and Safety legislation.
    2. Safety in Design Legislation.
    3. Disability Discrimination legislation.
    4. State Environmental Planning and Assessment legislation.
    5. All other Commonwealth and State legislation.
    6. NCC, BCA and PCA.
    7. AS/NZS.
    8. This standard and other University of Sydney standards.

2 Scope

This standard describes minimum requirements for design, purchase, construction, and operation and maintenance of fire services plant, equipment and infrastructure for buildings and spaces owned, operated, maintained and/or managed by the University of Sydney. It applies to:

a. New Building Construction.
b. Refurbishment spaces within existing buildings
c. Facilities maintenance services.

The standards apply to all planners, project managers, consultants, contractors, sub-contractors, tenants, managing agents and University staff involved in the design, construction and maintenance of existing, new and proposed University buildings and facilities.

The standard provides:

a. A reference document to enable consistency with the design and engineering objectives.
b. Details of the minimum performance requirements for planning, architectural design and maintenance.
c. Support of the University vision for the built environment and best practice.

The standard addresses key objectives:

a. Quality design which responds, enhances and complements the environment.
b. Appreciation of the heritage context and cultural history of the campuses.
c. Value for money in all aspects of the project.
d. The design of low maintenance buildings and environments.
e. Longevity of construction approach to design.
f. Standardization of key flashing and ancillary details.

g. Flexible design, to future proof building usage for expansion or adaption to new uses
h. Safety in design.

All Roofing and Guttering systems products and services provided or specified by designers, consultants, staff and contractors must conform to this standard.

Where specific applications are not explicitly covered, or ambiguity exists, the intent of the design standard must be satisfied. In such cases a return design brief must be provided for review and approval by the issuer of this standard or their appointed delegate who must have relevant technical competence in the subject matter. Additional more stringent requirements may apply on a project-specific basis dependent upon risk management and insurance requirements.

3 Glossary of Terms

Flashing	Components used to weatherproof or seal the roof perimeters, penetrations, walls and other places where the roof covering is interrupted or terminated
Anchor Point	Any single or multiple fixed anchor point or static line support point, whether part of a work positioning, abseiling or fall arrest system.
Fall	A free fall, impeded fall, or uncontrolled slide down a roof or similar structure, at any height.
Mechanical Fixings	Fixings that utilise friction as the locking device.
Dry Joints	A joint between any two sections of material. A dry joint does not rely upon sealants such as silicone, solder or electric welding to seal the joint.
Wet Joints	A joint between any two sections of material. A wet joint includes a substance such as silicone, solder or the use of electric welding to seal the joint.
Surface Mounted	Any anchor that is fastened (by means of friction, mechanically or "clipped") to a roof sheet, eave or batten.
IFD	Intensity Frequency Duration - This is a calculated rain fall intensity graph created by the Australian Bureau of Meteorology.
AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
BCA	Building Code of Australia
BMCS	Building Management & Control System
CCTV	Closed circuit television
COS	Central Operations Services
DPI	Department of Primary Industries
EPA	NSW Environmental Protection Authority

EP&AR	Environmental Planning & Assessment Regulation
NCC	National Construction Code
PCA	Plumbing Code of Australia
PC	Practical Completion
PUG	Project User Group or Project Working Group
USYD	University of Sydney
UI	University Infrastructure
WHS	Work Health & Safety
WSUD	Water Sensitive Urban Design

4 Roles and Responsibilities

This standard is issued by UI. It is approved and signed off by the Chief University Infrastructure Officer. UI is responsible for maintaining the standard and keeping it up-to-date.

5 Existing Buildings

The design for projects within existing buildings must be assessed on a case by case basis and developed in conjunction with this standard. The project scope will drive the design requirements.

Any items not included in the scope must not be priced into the overall project to achieve the following aim; To reduce the need to value engineer any services.

New projects within existing buildings must assess what the expectation of the refurbishment will be. This will enable the right outcome for the given project.

These specific requirements must be included in the scope of works specification for design and construction of the roofing and guttering in a building:

Obtain the Gate Paper from the Project Manager and understand the scope of works in relation to the space and fit out requirements. Understand the expectation from the end user.

5.1 Reuse of Equipment

Reuse existing services where identified in the Gateway Paper scope of works and the approved Return Brief.

Equipment must be suitable for the intended new purpose and life expectancy of the works, comply with current codes and achieve energy targets.

Equipment must be cleaned, have consumables replaced, tested, relabeled and re-commissioned.

Remove redundant pipework, equipment and wiring, including inaccessible ceiling spaces, and make good exposed surfaces before commencing the installation of new services.

Remove redundant underground services unless otherwise approved by the project superintendent.

6 Technical Requirements

6.1 Introduction

The buildings within the University's campuses range from mid 19th century constructions to modern contemporary design. Each building shows significant design details of that period. Due to this, careful planning and consideration is needed when designing or repairing these assets.

This document is intended to inform designers and installers of the need to properly plan future works. All the items included in this design standard have been identified as best practice by the University of Sydney.

Sustainability is a key factor when designing new infrastructure. Recycled materials and usability will be highly regarded when evaluating the design.

6.2 Design and Documentation

6.2.1 Design Approach

The University requires consultants and designers to provide designs that meet all of the requirements of this standard. Consultants, designers and installers are to reflect the following priorities in their design documents:

a. Provide roof and guttering systems that meet or exceed the requirements listed in this standard.
b. Take a long term and balanced view of capital costs, maintenance costs and longevity.
c. As educational and research both progress at rapid rates, usage of buildings and areas within buildings are subject to multiple changes within the life of the building, systems must be designed to be adaptable for such changes.
d. Ensure that assets and equipment are designed with access and visual impact taken into consideration.

It is the designers and the installing contractor's obligation to document and install systems, equipment and materials that are "fit for purpose" from both a WH&S and operational perspective. Any disputes in regard to the interpretation of this clause shall be referred to NSW Fair Trading and/or the UI Project Manager for a final determination.

6.2.2 Design Input and Process

The University expects consultants and designers to proactively inform, advise and contribute to the design process. In particular, the following aspects:

a. Building Physics - provide advice to the project team, including other design team members that would improve the inherent building performance, which may lead to reductions in both capital and energy costs. This may initially take the form of simple advice relating to existing infrastructure capacity and location, which may affect the siting of the building, and subsequently backed up by modelling or similar methods. The process may take a number of iterative steps. The consultant or designer is expected to advice, contribute and if necessary lead such processes.
b. Planning and Architecture – provide advice on the appropriate location of plant rooms and reticulation strategy to assist in both the planning of the building and the facilitation of

better maintenance in the future. Such advice must be provided in the early stages of the design and planning process so that this is taken into consideration for the architect's design and to be incorporated into his planning. Late advice will lead to poor location of plant and lack of maintenance access, thus a building of poor quality that will suffer from either poor or lack of maintenance and high owning costs to the University.

c. The University of Sydney – provide advice on the availability of options, assist in assessing the advantages and disadvantages, provide analysis of life cycle costs and life expectancies, offer recommendations and assist in making decisions.

6.2.3 Engineering Process

The University expects consultants and contractors to be fully qualified, experienced and capable of carrying out all engineering design, calculations, equipment selection and construction quality checks.

As part of the design development, the University expects consultants and designers to select proven and reliable roofing and guttering systems.

6.2.4 Equipment Selection and Sizing

In selecting equipment, the University expects consultants and contractors to select products of proven and reliable quality, with reputable support and after sales service.

Products which are of closed systems and proprietary in nature, thus locking the University into exclusive dependence of one manufacturer must be avoided and only used if there are no other options.

In the sizing of equipment, the University expects consultants, designers and installers to follow good industry practice. Sizing of all roofing components are to equal or preferably exceed the relevant Australian Standards. This is especially important for the sizing of downpipes and stormwater infrastructure.

The provision of spare capacities for roof platforms and access to cater for future services and equipment upgrades, must be considered for all projects. In making such considerations, careful analysis of spare capacity against all applications must be considered. The practicality of proposed future equipment sizing, and selection must be submitted by the consultant and contractor to UI for approval.

6.3 Design and Construct Contract

6.3.1 General

This section outlines the extent of the services to be provided by the contractor under a Design and Construct contract.

The contractor shall be fully responsible for the complete design of the roofing and guttering installations, including the selection, sizes and quantity of materials and equipment, and shall provide calculations and drawings and other documentation as necessary to demonstrate conformance with the design parameters, industry practice, UI requirements, codes, regulations and standards. This includes all calculations required to confirm that existing infrastructure is sufficient to supply the proposed systems installed under the project.

The contractor shall allow to fully co-ordinate the documentation with the Architect, Structural Engineer and all other services consultants / contractors.

6.3.2 New Buildings

As a minimum, roofing and guttering systems provided in University buildings must be designed and installed in accordance with the minimum legislative requirements incorporating all Statutory Regulations, Australian Standards, Local Council, Fire & Rescue NSW, Work Health & Safety (WHS) and WorkCover requirements.

Each building must be equipped with the appropriate roofing and guttering as a full system, all designed and installed in accordance with the requirements of the NCC.

6.3.3 Refurbishments

The requirements for the refurbishment of existing roofing and guttering within existing buildings will often be the same as for new buildings.

Whilst every endeavor is made to comply with current NCC regulations during refurbishments and upgrades, it is unlikely that the full extent of the building regulations can always be met.

Within any building proposed for refurbishment, the Standard of Performance for all existing systems must be reviewed by the consultant/contractor for compliance with the current NCC and Australian Standard requirements. The details of this review together with a proposed roofing and guttering upgrade strategy must be submitted to UI for approval during the initial design development.

6.3.4 Calculations

As part of the contractor's design, it is expected that the following design calculations as a minimum are produced for review by UI for approval prior to finalising design:

a. Stormwater drainage calculations, inclusive of roof and in ground drainage, overflows, rainwater harvesting, on site detention, permitted site discharge and water quality.
b. Use of computer-based load modelling/simulation/estimation programs that account for building elements are recommended. The building performance data is to be part of the information provided for the design advice.
c. All roofing components and design are to withstand a 250mm/hr IFD (Intensity Frequency Duration). This is equivalent to a 1% Annual Exceedance Probability (AEP) or a 1 in 100-year rainfall event.
d. All other calculations necessary to illustrate equipment reticulation and components have been selected fully in accordance with the project requirements and this specification.

6.3.5 Design Conditions

The following minimum design conditions must be incorporated into the design and installation:
a. Estimations are to be performed using established weather design data for each specific project location in HB39 1997 - Installation code for metal roof and wall cladding and AS3500.
b. Generally, consultants and contractors are discouraged to include flat membrane roofs in their design. Full details will need to be submitted to UI for approval. Pitch metal roofs are preferred.
c. Roofing and guttering materials are to be common and widely available within Australia.
d. Materials used are to be of a high standard with a life expectancy of at least 20 years.
e. Warranty of workmanship to be the standard 7 years for all trades.

6.3.6 Thermal Efficiency

Thermal efficiency is to be included in designing any roof or ancillary product. Thermal efficiency is to be included in any maintenance work completed within the University.

6.3.7 Roof Types

Full details of all proposed roof types must be submitted to UI for approval, prior to any works commencing on site. All new buildings are to have a roofing system submitted as a full system for approval. Existing heritage builds are to be referred to the University's Heritage Architect for direction on refurbishment and install of the roofing and guttering system. The following roof types are to be followed at all times:

a. Pitched Metal Deck Roofs – Preferred application.
b. Tiled Roofs (heritage) – Not recommended.
c. Flat Roofs – Not recommended.
d. Glazed Roofs – Not recommended.
e. Lead, Slate, Copper, Muntz metal roofs – replace like for like.
f. Other roof types such as green roofs may be permissible subject to full details being submitted to UI for approval.

6.3.8 Other Design Requirements

Platforms, plant, antennas and telecommunication equipment is to be factored into the overall design of the roofing.

6.3.9 Drawings and Documentation

The contractor shall provide design, construction and as-built drawings, which may be either design drawings produced by the contractor or shop drawings produced by equipment manufacturers.

For each service, present on the schematic layout for that service, a "Basis of Design" summary. The summary shall identify how the system works, basis of design, any departures form Australian or UI standards and all substantial information are required to review the adequacy of the design intent. The basis of design is to include pressure and flow information from the Sydney Water Pressure inquiry or the on-site fire flow test results.

It shall be maintained up to date using Revision Numbering throughout the checking and review process.

The contractor is responsible for producing all design and as-built documentation, including, but not limited to:

a. Concept Design documentation (as required).
b. Detailed Design documentation, including:
    i. Layout drawings.
    ii. Details.
    iii. Schematics, including a Basis of Design Statement for each service.
    iv. Design certification.
    v. Equipment details.
    vi. Testing / commissioning procedures.
    vii. Workshop drawings, including:
    viii. Drawings for the purpose of system manufacture.
    ix. As Built drawings, including:
    x. Detailed drawings demonstrating the as installed system.
    xi. Operations and Maintenance manuals.
    xii. Training manuals.

6.3.10 Technical Submittals

Technical submittals shall be provided with the full technical and spatial requirements of each proposed plant item. The technical submissions shall include, where applicable, but not be limited to:

a. Certified shop drawings of each item complete with sectional weights and point loads.
b. Maintenance zones and requirements including weights of any replaceable components.
c. Manufacturer's recommendations for installation including repairs and penetrations.
d. Confirmation of product lifespan assuming maintained to manufacturers recommendations.
e. Where equipment model numbers / references are stated these are indicative only and the Contractor MUST ensure the selected plant fully complies with the standard.

6.4 Technical Components

6.4.1 Introduction

The standards below are intended to provide a basis for the construction and management of new and existing installations within the University of Sydney.

6.4.2 Safety

Roof safety is an integral part of all work performed on all the university roofs.

Roof safety is to be achieved through the provision of permanent edge protection such as handrails, balustrades or parapets.

Persons wanting to use a roof safety system for access must be suitably qualified and have approved Permit and Safe Work Method Statements (SWMS).

Must be applied through the University's Roof Permit Process – located on the Design standards page - link

6.4.3 Safety Systems

Anchor points are not to be used as a method of safety system. Where permanent fixtures cannot be installed, a built for purpose harness-based system is to be installed.

All safety systems installed must be of the "Work Positioning" type. This allows workers to access the edge of the roof or structure eliminating the chance of a fall.

Safety harnesses are to be tied off onto either a certified anchor point, static line or to a suitably engineered structure.

All anchor points installed must be accompanied by a structural engineer's certification. The certification must identify the roof structure the anchor point is connected to. The certification must confirm the structure can sustain the loads that could be applied to it in the event of a fall.

Roof anchors being attached to a timber framed roof requires structural certification of the roof frame. A report detailing the species and condition of timber is also required for attachment of anchors.

At no time must "**surface mounted**" anchor points be installed on any University owned roof. All anchors must be mechanically, chemically, clamped or braced to the roof structure.

All safety systems must be installed complete with data plates and appropriate signage. Data plates and signage are to be installed in accordance with the relevant Australian Standards.

6.4.4 Access Hatches/Doors

For all plant and equipment installed at the University of Sydney, internal access is preferred. Where the plant or equipment is proposed to be stored on the rood, access hatches must be

constructed with a steel or aluminium frame with either a frosted glass (only in non-trafficable areas) finish or finished with material suitable for the surrounding roof area.

An access hatch must have a stair or step built underneath for ease of access. A platform or level area must be provided outside the hatch to provide safe access onto the roof.
The access hatch must also incorporate a chain or metal strap fixed to the lid to securely prop the lid open. All access hatches are to be secured by means of a hasp staple and padlock. This padlock is to be keyed to the University Roofing Barrel.

6.4.5 Penetrations and Flashings

Penetration of the roof covering must be avoided where possible. Particular attention must be payed to the location and service runs of the equipment being installed.

Roof penetrations need considerable planning and design before installation. Penetrations must be in areas of the roof that will require the minimum flashing detail. The sole purpose of a flashing is to weatherproof the penetration. The flashing is not to be used to support equipment or structures.

Flashing details are to be made of the same if not similar material to what it is being attached to.

All tile or slate flashings must extend up the roof and under the next full tile or slate.

Flashings will need to be designed so as they facilitate the southern weather pattern that is regular in the Sydney area.

Roof penetration and flashing details are attached in the appendix in the rear of this standard. Where a detail is not covered by this standard, a detailed design of the proposed penetration must be submitted to UI for approval.

6.4.6 Silicone Boot Flashings (Dektite)

Silicone Boot Flashings may only be used when fastened to a pan flashing. Only rubber boot flashings with a tolerance of -50°C to 200°C are to be used on penetrations. To prevent multiple penetrations through the roof structure, the provision of a 100mm hard pipe with a turn down is to be installed where future penetrations may be required. This is to be sealed around the protruding cabling or pipework.

The pan flashing is to cover at least one ridge either side of the penetration. The pan flashing must extend up to the ridge.

Multiple pipes are not be flashed by one flashing component. Each service or piece of equipment will be dedicated its own silicone flashing.

6.4.7 Movement

Roofs and roofing components are invariably constructed from a number of materials which may adjoin or overlay one another. Each material has its own physical properties, including the degree the material will move with changes in temperature and moisture. Wherever two different materials meet or overlap they must be detailed in such a way as to allow the primary function of the roof to perform, which is to exclude rainwater.

The co-efficiency of each roofing material will need to be considered in the design. Each material has a different rate of expansion and contraction. Expansion joints or overlapping of materials needs to be taken into consideration when planning long runs of materials. All expansion joints and roof overlap details must be submitted to UI for approval.

Where possible use similar materials.

a. Rubberised (silicone) expansion joints must not be used within box gutters.
b. Co-efficient ratings can be found in the Australian Standards AS/NZS3500 and HB39.

6.4.8 Galvanic Separation

Dissimilar metals must not be fixed in contact with each other or where rainwater may run from a more noble metal to a less noble metal. Fixings such as pop rivets, roof screws, astragals and fittings must also abide by this rule.

Where contact between dissimilar metals cannot be avoided, suitable galvanic separation materials must be placed between those metals to eliminate direct contact. Separation materials must be weather resistant, UV stable, durable and chemically inert.

Galvanic separation is to comply with Australian Standards AS/NZS3500 and HB39.

6.4.9 Jointing

Only soft soldered, welded, brazed or lapped joints will be approved for use. If proven that a silicone joint is the only possible solution, full details of the joint must be submitted for approval by UI.

Joint types include:

Dry Joints

Dry joints are the pinnacle of all flashing detail. This jointing detail allows movement between a number of materials. Dry joints do not depend on silicone or any other sealant as the waterproofing component. Dry joints can be adapted to any surface, component or structure.

Wet Joints

Wet joints are approved to be used within the University. The wet joint must be used with a means of mechanical fixing. For mechanical fixings, a staggered pattern of the fixings must be adopted across the joint. The mechanical fixings are to be installed then the jointing compound is to be sweated in and around the rivets.

Silicone joints

Silicone must only be used when sandwiched between two surfaces by means of mechanical fixings. The mechanical fixings must be installed in a staggered pattern. Silicone is not to be used as a gap filler. Silicone is designed to be sandwiched between two surfaces.

6.4.10 Gutters

Gutters are one of the major causes of leaks into the University's buildings. Gutters are susceptible to blocking, overflowing and causing damage to the buildings external and internal fabric. Fail-safe designs are to be achieved to alleviate any possible malfunction of the gutter.

Box gutters must not be installed without specific approval from UI. Listed are minimum requirements in order of preference for guttering within the University.

6.4.10.1 Eaves Gutters

a. The face of eaves gutters must not finish higher than the back of the gutter.
b. Eaves gutters to have an aluminium silicone coated leaf guard installed.
c. All gutter guards are to be easily removable.
d. All leaf guards must be submitted for approval by UI.

6.4.10.2 Valley Gutters

a. Valley gutters must be adequately supported by valley boards running the entire length of the gutter.

b. Joints in valley gutters must be lapped.
c. No welding or sealing of joints is permitted.
d. Weathering of the valley gutters must include a supported "turn up" of at least 10mm.

6.4.10.3 Box Gutters

a. All box gutters are to be constructed from stainless steel or copper.
b. All box gutters must be designed with an in-built overflow capacity not less than 1 ½ times the capacity of the primary outlet(s).
c. Overflows on internal box gutters are to be connected to a stormwater drainage system separate from the primary outlets.
d. All box gutter joints are to be either soldered or welded. Silicone is not permitted.
e. Box gutters must have a minimum of 300mm clear width for ease of cleaning.
f. Box Gutters shall be installed with 1:200 minimum fall.

6.4.11 Overflow & Spitters

Overflows and spitters must be provided for all roofs to allow for adequate redundancy in roof drainage. Locations of spitters and overflows in all gutters and flat roof designs must accommodate the potential for blockages of downpipes and overflows.
Discharge locations of all spitters and overflows must not be located directly in the vicinity of building entry and egress paths. Locations of overflows discharge points must consider the stormwater overland flow paths and civil stormwater drainage systems in the vicinity of the building to ensure all roof water dispersed by the overflow is directed away from the building.

6.4.12 Rain Heads

Rain heads are acceptable and encouraged to be used as when constructed correctly, offer exceptional fail-safe qualities. Rain heads are to be constructed from materials matching the roofing and building materials.

A slotted overflow no less than three quarters of the length of the rain head must be included in the design. The overflow must be installed no less than 100mm from the end of any ancillary product supplying the rain head. The capacity of the overflow is to be no less than 1 ½ times the size of the gutters/downpipes supplying the rain head.

6.4.13 Roof Plumbing

Roof plumbing is an integral part of the roof design. Roof plumbing must consist of failsafe components that will alleviate any chance for water ingress, including but not limited to:
a. All roof plumbing must be oversized at least one and a half times the calculated size.
b. All downpipes/elevated stormwater drainage must terminate over a sink stone or grated pit.
c. All roof plumbing incorporating close coupling joints must be statically tested.
d. Inspection openings must be installed on or below any junction or bend greater than 85^0.
e. Internal downpipes are not recommended. If internal downpipes are to be designed, failsafe components must be submitted to the UI for approval.
f. Syphonic roof drainage systems may be considered for flat roofs with adequate rain heads. Before proposing a Syphonic roof drainage systems, submit to UI for approval the design proposal with the complete with manufacturer's warranty and maintenance requirements and budget costing over the life cycle of the equipment.

For further information regarding roof plumbing please refer to the UI Hydraulic Services Standard.

6.4.14 Skylights

Skylights are permissible. The design must be one that incorporates a steel or aluminium frame. The glass must be tinted and double glazed.
The skylight must also incorporate a mechanical opening mechanism for ease of operation.

6.4.15 Insulation

All new roofs must achieve a system thermal resistance of R-value 2.5 or greater. Insulation fixed at the rafters is recommended over ceiling batts. Thermal requirements must meet or exceed those outlined in Section J of the National Construction Code, and the Building and Architecture Standard.

6.4.16 Plant

All plant and equipment must be installed in a plant room fit for purpose. This creates fewer penetrations through the roof surface.

Where unachievable, approval must be sought from UI to install a platform to house the plant. The platform must be constructed of Aluminium and is to be a prefabricated system. The platform will be constructed in such a way that the roof surface and plant equipment are easily accessible.

A minimum distance of 600mm must be provided between the roof surface and the platform. This distance also relates to the lowest point of any equipment installed on or below the platform. This clearance may be reduced for items which are liftable without mechanical assistance such as condenser units.

Platforms are to be designed so that the sections of the platform can be disassembled to allow access for roof maintenance. This also reduces cutting of the material and hot works when installing.

All platforms are to comply with the current version of AS/NZS 1657.

6.4.17 Communications Equipment

The design of all communications equipment installations must not impair access for roof maintenance or to other equipment on the roof. All installations must be self-supporting and must not rely on any plant or equipment to support the device.
All installation requests must include a DA approval together with full details of the roof penetrations and waterproofing requirements. A dilapidation report of the roof area directly affected by the installation must also be submitted.

6.4.18 Materials

Different roof types require different levels of skill and design. All materials must be of high quality with no blemishes or damage. Existing Materials that are found to be of inferior quality will be removed at the contractor's expense. Heritage roof alterations must be approved by the University's Heritage Architect and installed by a competent contractor with demonstrated experience on Heritage roofing systems. Below are the approved materials and their design requirements:

6.4.18.1 Steel and Aluminium

a. Roofing – Minimum 0.48mm BMT
b. Flashings/Guttering – Minimum 0.60mm BMT

The selected profile of the roof must be fit for purpose. Where practicable the roof sheet profile must be of the "KLIP LOK" or other internal fastening type. Aspects such as building location (coastal, inland, near chemical fall out or industrial areas), climate and classification of

building such as industrial, commercial or residential is to be taken into consideration when selecting an appropriate roofing material. Commercial and industrial buildings will have a reduced life expectancy due chemicals and foot traffic from maintenance crews.

6.4.18.2 **Tiles**

a. Roofing – Glazed Terracotta
b. Flashings/Guttering – Nil

All tiles selected for use on the university's roofs are to be of the "glazed" type. All tiles must match existing colour of building and/or match existing roof. Pitch and rafter length will dictate tile selection. Every tiled roof must include an anti-ponding board that runs down from the first batten to the top plate. Appropriate moisture resistant sarking is to be included in the construction of the roof.

6.4.18.3 Membrane

a. Roofing – Minimum 3-layer Polyester Bitumen Sheet
b. Flashings/Guttering – Minimum 3-layer Polyester Bitumen Sheet

All membrane roofs are to be of the polyester bitumen base sheet system. This system provides excellent flexibility for building movement. This membrane system also provides for quick and straightforward repairs and alterations. The bottom sheets must be a vented sheet if there is a likely hood of residual moister in the substrate. The top sheet must include a mineral layer. The membrane is to be provided with means of venting moisture either at the perimeter of the roof or with the use of vent cowls spaced across the roof area.

6.4.18.4 Copper

a. Roofing - 0.7mm soft drawn
b. Flashings/guttering - 0.7mm half hard

Joints in copper roofing, guttering and downpipes are to be seamed or welded together rather than screwed or rivet fixed. Dry joints in copper must have a minimum of a 75mm overlap. Wet joints to have a minimum of 35mm.Copper roof sheet must be separated from its supporting deck with a layer of polyester reinforced bitumen sheet for cushioning effect.

6.4.18.5 Lead

a. Roofing – Minimum 25kg/m2
b. Flashings/Guttering – Minimum 30kg/m2

Sections of ridges and valleys to have a maximum length of 1500mm. Dry joints 75mm, wet joint 35mm overlap. All lead roofing, flashing or capping must have patination oil applied upon completion of the works.

6.4.18.6 Slate

a. Roofing – Welsh or Canadian
b. Flashings/Guttering - Nil

Slate tiles are to be pre-drilled not punched and must be fixed with copper clouts that fit snugly into the hole. Copper straps 0.55mm and 20mm wide are to be used to secure the last few slates when finishing off. Slate hooks are not to be used.

6.5 Redundant Equipment

All redundant services (power, water, drainage, etc.) must be removed as part of the project. Building surfaces and finishes must be "made good".

6.6 Product Support

All materials and equipment are to be readily available in Australia and meet the relevant Australian standards.

7 Commissioning

Comprehensive pre-commissioning, commissioning and quality monitoring must be specified by the consultant/designer.

A project specific commissioning plan is to be developed and provided to the University for review and approval.

Detailed testing and commissioning records must be provided for each system and each component as appropriate. All such records must be witnessed and verified by the project consultant/head contractor prior to witness commissioning by UI Engineers and COS representatives.

Project handover plan must be developed by the consultant/designer to allow the system to be handed over to The University. A 12-month building tuning process will commence at Project handover with systems monitored monthly, reported and assessed quarterly, and include assessment of feedback from the occupants.

All roof components must be subjected to testing before Practical Completion is awarded. Photo evidence and a site visit from the UI Engineer must be organised during the testing. Detailed testing and commissioning records must be provided for each system and each component as appropriate. All such records must be witnessed and verified by the project consultant/designer.

Below are the minimum standards required for the following components;

a. Membrane roofs - these roofs must be flood tested so as all of the roof area will be covered with at least 10mm of water. All membrane roofs are to be tested after the first and last layer of membrane is applied. Bungs used to block the sumps/outlets are to be of the manufactured type or rags bundled with electrical tape. All bungs are to have rope or wire attached so it cannot be lost down the outlet. The wire or rope must be securely fastened to a nearby structure. Testing must take place for at least 24hrs.
b. Box gutters-. these gutters must be flood tested so the highest point of the box gutter has at least 10mm coverage of water. Bungs used to block the sumps/outlets are to be of the manufactured type or rags bundled with electrical tape. All bungs need to have rope or wire attached so it cannot be lost down the outlet. The wire or rope must be securely fastened to a nearby structure. All testing must take place for at least 24hrs.
c. Roof plumbing- the entire above ground stormwater system must be placed under a hydrostatic test. All rain heads and sumps must undergo hydrostatic testing. All testing must take place for at least 24hrs.
d. Penetrations – all penetrations will be subject to a half hour water test. This water test will consist of a constant spray from a hose mimicking a rain event.
e. Mechanically Fastened Safety Systems – This type of safety system includes steel or concrete as the base material. Load testing must be conducted to confirm the safety system supports the designed load. Documents confirming the test results must be signed by the consultant/contractor. A structural engineer's certification for all anchor points and the entire safety system, must included in the Operational and Maintenance manuals.
f. Clamped/Braced Safety Systems – This type of system includes timber as the base material. Load testing must be conducted to confirm the safety system supports the designed load. Documents confirming the test results must be signed by the consultant/contractor. A structural engineer's certification for all anchor points and the entire safety system, must be included in the Operational and Maintenance manuals.

8 Safety in Design

The contractor must consider risk during the design. A design safety report must be submitted to the relevant UI Project Manager for every design project. Contractors must confirm, so far as it is reasonably practicable, that the structure is without risks to health and safety.

Design risks must be considered for the asset lifecycle covering construction, operational and maintenance, refurbishments and decommissioning.

The design safety report must include the following:
a. Description of design element.
b. Description of potential risks and hazards associated with the design element.
c. A low/medium/high risk assessment considering likelihood and consequence.
d. Proposed measures to eliminate risks where practicable.
e. Control measures to mitigate and manage design risks.
f. Nominating responsibilities for managing the design risks.

This may be provided as a design risk register where appropriate and must include results of any calculations, testing and analysis etc.

9 Documentation and Records

9.1 Design Documentation

Prior to commencing construction of new or refurbishment projects, the consultant/contractor must fully investigate and document the requirements for each Hydraulic Services system required to be installed, altered or modified as part of the project works.

This must include:
a. Return Brief defining the systems proposed and any deviations from this standard.
b. Provision of a BCA/ NCC Compliance Report.
c. Calculations to be provided on the sizing of the pipe work. Any future allowances are to be included in these calculations\sizing.
d. Calculations & selections on the roofing system.
e. Budget calculations.
f. Provision of Design Certification of each Roofing and Guttering system.
g. Requests for all variations to this Standard submitted using the USYD Request for Dispensation Form (USYD-ENG-F001).

This documentation must be provided by the consultant/contractor in both electronic and hard copy formats and approved by the University.

9.2 Completion Documentation

At the completion of all projects, the following documentation must be provided for each hydraulic services system installed or altered as part of the project works:
a. O&M manual(s).
b. As-built drawings (including schematics).
c. Commissioning test results and certificates of compliance
d. Product manufacturer's specific information
e. Warranties
f. System schematics
g. Roof Safety System Certification

h. Warranty schedules for all major items of equipment.
i. Maintenance requirements.
j. Certification of compliance to the design standard by completing and submitting the **UI Project Design Certification Form (UI-PROJ-F001).**

This documentation must be provided by the contractor in both electronic and hard copy formats and approved by the University prior to Practical Completion being granted.

10 Assets and Warranties

Assets are to be tagged in accordance with the COS Asset Identification and Labelling Standard for the purpose of maintenance and operation of University Assets. For refurbishment projects the project manage is to provide the existing asset list to the contractor to ensure modified and redundant equipment are captured in the contractors submitted asset list.

Each asset required to be collected can be found in the Form COS-ASSET-F001, each asset required to be coded will be identified by a unique equipment code.

The equipment code will be one the three following types:
a. Virtual asset (This is a concatenation *Building Code - Floor - Room number*)
b. Item count asset (This is a concatenation *Building Code - Floor - Room number*)
c. Unique bar code asset (Unique bar code in the million series number affixed to the asset)

Asset lists are to be submitted prior to practical completion of the project for review and approval by COS.

Equipment Warranties are to be provided for a minimum of 12 months from the date of practical completion. Warranties are to be provided as certificates as part of the O&M from the supplier of the equipment. It is the responsibility of the installation contractor to ensure all maintenance/ servicing required to the equipment is provided to ensure warranties are valid at the end of the project DLP period.

11 Operations

Access to all roofs within the University is controlled by a University of Sydney roof access permit. This permit must be submitted at least 3 business days before the start of works.

This permit provides the University with vital information about the applicant. Permits are to be submitted to the University delegate. The University delegate will review risk assessments and SWMS before access is granted.

Access to roofs must be through a plant room, stairwell or roof space. Access must not be situated in an area freely accessible to the public. Roof spaces used to access roofs are to be fitted out with walkways and lighting.

If you require University Security patrol to give you access to a roof area, you must submit a Service Request in Campus Assist Online (ask your UI/ COS representative if you don't have access to Campus Assist Online) on the preceding business day and at least 24 hours before the requested time. You must attach the authorised Permit to Work to the Service Request.

12 Defects and Liability Period

Consultants/designers must include in the project specification detailed requirements for the defects and liability period following completion of the roofing and guttering system installation.

12.1 Maintenance and Testing

For Roofing and Guttering systems installed as part of a refurbishment project of an existing building, regular statutory maintenance and testing must be carried out by the University services maintenance contractor during the Defects Liability Period (DLP).

Any details which will affect the future performance of the new or upgraded equipment must be supplied by the installation contractor at Practical Completion.

Prior to completion of the DLP, a final inspection of the installed systems will be carried out by the: installation contractor, appropriate UI and COS staff, and University services maintenance contractor, in order to reconcile the performance of the equipment during DLP to produce a final list of project defects. All project defects identified must be rectified by the installation contractor prior to finalisation of the DLP.

13 Operations & Maintenance Manuals

Consultants/designers must include in the project specification detailed requirements for operation and maintenance manuals, including system description, operation procedures, testing and commissioning records, maintenance instructions, product support information and recovery protocols for any computer related systems. Contractors must provide these to the satisfaction of the consultant/designer. Providing a collection of manufacturers' brochures and catalogues is not acceptable to the University.

Discuss with UI to understand what format to submit the O&M Manuals. Typical submissions come via soft copy (editable) and used via a system like Aconex.

Contractors must submit the university designed Asset Management Master Asset Data Capture Spreadsheet (COS-ASSET-F001) designed for recording operational and maintenance activities including materials used, test results, comments for future maintenance actions and notes covering asset condition. Completed logbook pages recording the operational and maintenance activities undertaken for Practical Completion and during the Defects Liability Period must also be provided.

Facilities Maintenance must establish, document and implement procedures for operation and maintenance of fire services, plant and equipment to ensure fire services are fit-for-purpose, provide secure, efficient, safe and reliable electrical power, and comply with requirements of this standard.

14 Authorisation of Variations

Project managers, consultants, contractors, commissioning agents and facilities maintenance personnel must ensure compliance with these requirements is achieved.

Variations to this standard must only be considered where:
a. The University Standard's requirement cannot physically or technically be achieved.

b. The Performance solution delivers demonstrated and proven superior performance for the same capital and life cycle cost or better.

Consultants and contractors must identify and justify requirements of the standard that do not apply to the project or which need to be varied and these which must be approved by the issuer of this standard. Formal requests for all variations to this Standard must be submitted using the UI Request for Dispensation Form (UI-ENG-F001). The issuer of this standard or their delegated authority must review and consider requirements of stakeholders from clients, projects and facilities management before deciding whether to approve variations. Their formal sign-off is required for acceptance of any non-compliances and departures from this standard's requirements.

15 Quality Control

15.1 Design Standard Compliance

Compliance with requirements of this standard must be checked throughout the design, construction and commissioning phases of projects by UI' services consultant. Any issues or deviations from this standard must be reviewed and approved in writing by the issuer of this standard.

Competent UI consultants and representatives must check compliance with this standard during design reviews and formal site inspections. Any non-conformances with requirements of this standard must be documented and provided to the UI Project Manager for issue to contractors and their consultants.

Project Managers must maintain a formal register of non-conformances and manage close out of outstanding non-conformances. Contractors and their consultants issued with non-conformances must take appropriate corrective actions. The UI Project Manager must ensure:
a. Proposed corrective actions are implemented.
b. Close out of non-conformances in relation to this standard is formally approved and signed off by the author of the standard or their delegate.

15.2 Design Standard Certification

Contractors and Consultants must certify compliance to the design standard by submitting a company Design Certification Form to the UI Project Manager at each of the following project phases:

a. Design and Documentation.
b. Tender.
c. Construction.

Notwithstanding UI's internal quality control processes, contractors and their consultants must implement their own robust quality assurance and control procedures to ensure compliance with requirements of this standard.

15.3 Construction Compliance

Consultants and contractors are expected to include check sheets for each system component detailing each item that needs to be checked, tested and verified during the installation process. Such check sheets must be completed and verified by the project

consultant/contractors, including the identification of any defects and the closing out of such defects.

15.4 Acceptance

The University will only accept projects as complete when all of the above have been carried out, submitted and verified.

The above standards are not an exhaustive list of the relevant requirements. The consultant/contractor must incorporate all relevant standards and Authorities requirements into project specific design, documentation and installation.

Consideration must be given by the consultant/contractor to the original standard of performance relevant to the construction date of the individual Essential Fire Safety Measures.

16 References

Design and documentation utilising these standards is to incorporate the requirements of the following current standards and requirements as a minimum:

a. AS/NZS 3500 Plumbing and Drainage
b. HB39-1997 Installation code for metal roof and wall cladding
c. National Construction Code
d. AS/NZS 1891-2001 Height safety and Re-Certification
e. AS/NZS 4488 Industrial Rope Access Systems
f. A3 4349 1998 Building Inspections
g. Australian Bureau of Meteorology
h. Traditional Copper Roofing (Author: H. Glover and D.E. Toner)
i. Code of Practice Safe Work on Roofs 1993 (Work Cover)
j. AS 2050 Installation of Roof Tiles
k. The above standards are not an exhaustive list of the relevant requirements. The consultant/contractor must incorporate all relevant standards into project specific design and documentation.

17 Document Amendment History

Provision	Amendment	Commencing
001	First Issue	16 August 2013
2.0	7 Year revision a. Project Definition stage added at 5.1. referring to Project "Gate Paper" and requirement for site inspection / briefing. Requirement for "Return Brief" formalised. b. Overall document review to identify any areas where the requirements showed an excessive cost / benefit; c. Documents required for Submission & Approval updated, tightened up, aggregated and clarified. d. Safety in Design legislation reinforced. e. Commissioning Checklists added. f. Scope / Technical cover increased to include; i. Updated Roof Types ii. Safety systems Revised	31 July 2020

	iii. Access hatches and doors updated iv. Penetrations and flashings updated for existing buildings v. Silicone boot flashing -Dektite details added vi. Revised Gutter preferences and requirements vii. Outdoor Plant Room updated for Aluminium platforms viii. Revised waterproofing membrane requirements ix. Added section for existing roofs x. Added flood testing requirements g. Defects period maintenance; include requirements for maintenance and testing during DLP h. Documentation and Records section updated to include new requirements i. Equipment Labelling requirements included j. Service Access and Safety Requirements section included k. Building tuning section updated to clarify Usyd requirements for tuning period in DLP l. Asset and Warranties section updated. m. Asset Standard Owner is now COS.	

18 Attachments

Attachment 1 – Standard Roof and Wall Services Penetration Details

UNIVERSITY OF SYDNEY

STANDARD ROOF AND WALL SERVICES PENETRATION DETAILS

INDEX

UNIVERSITY OF SYDNEY

STANDARD ROOF AND WALL SERVICES PENETRATION DETAILS

INDEX

LISTING OF DETAILS BY APPLICATION

Details Applicable to:

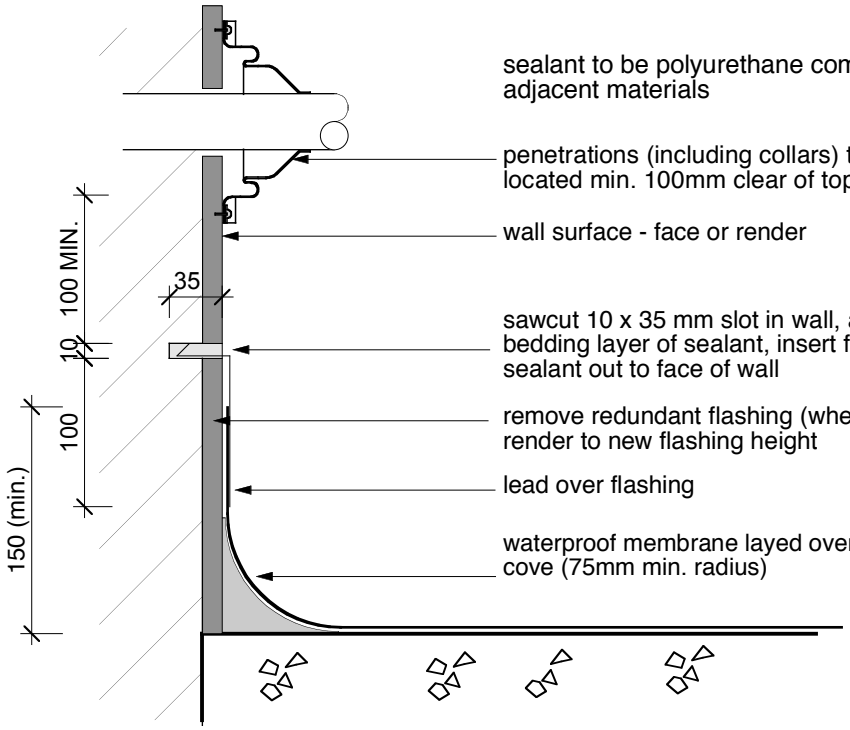
Colorbond roofs - 8, 9, 10, 19, 20, 21, 22, 23, 34, 35, 38, 39, 42, 45

Membrane roofs - 1, 2, 5, 6, 7, 11, 12, 13, 14, 27, 28, 29, 30, 31, 32, 33, 36, 37, 40

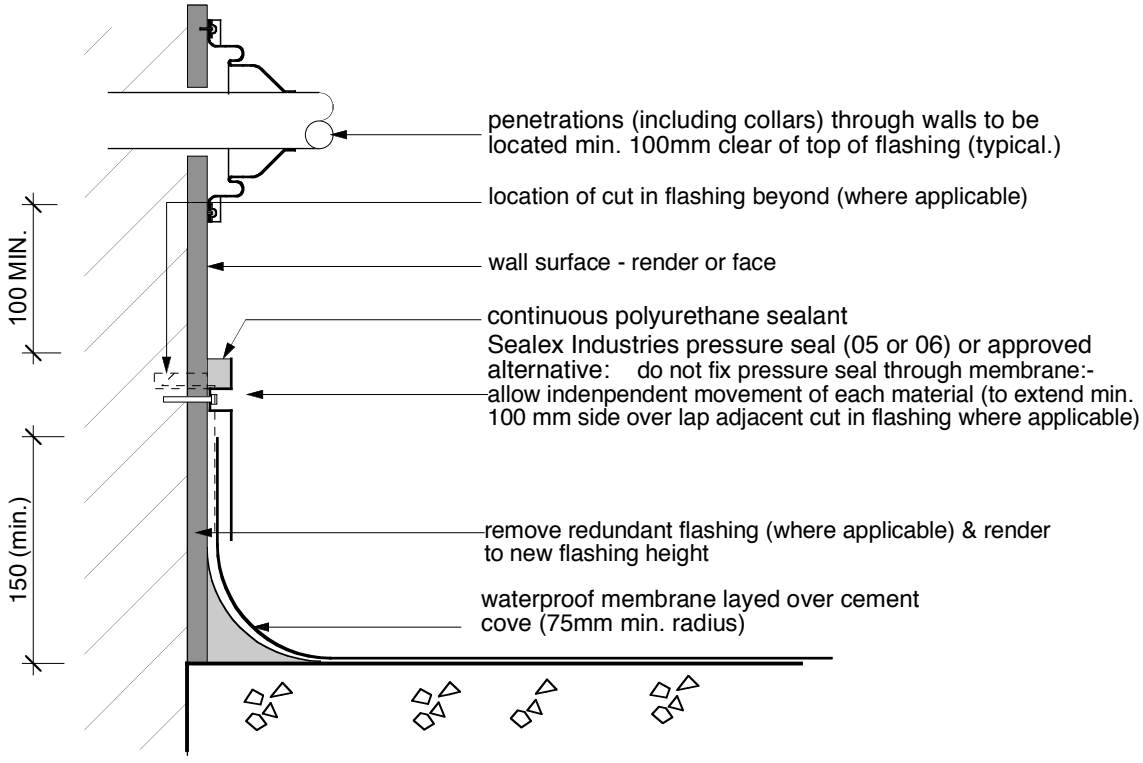
Slate/ tile roofs - 15, 16, 17, 18, 24, 25, 26, 41, 44

Copper roofs - 3, 4, 23

Walls - 1, 2, 3, 4, 30, 31, 40, 43



1 1:5 **VERTICAL SECTION**
CUT-IN FLASHING TO WALL



2 1:5 **VERTICAL SECTION**
PRESSURE SEAL FLASHING TO WALL

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 01

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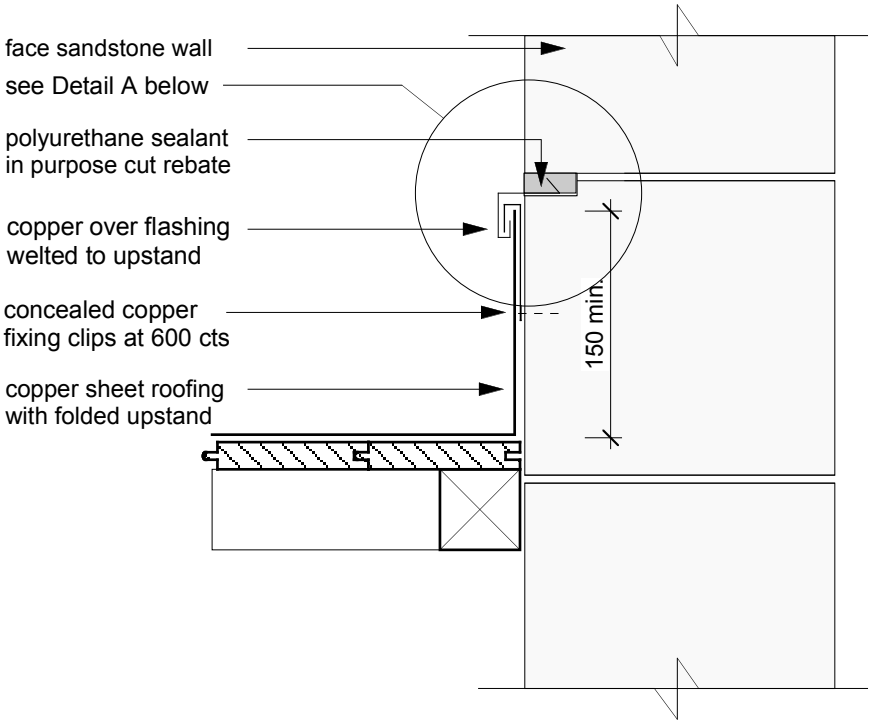
DETAILS
1
2



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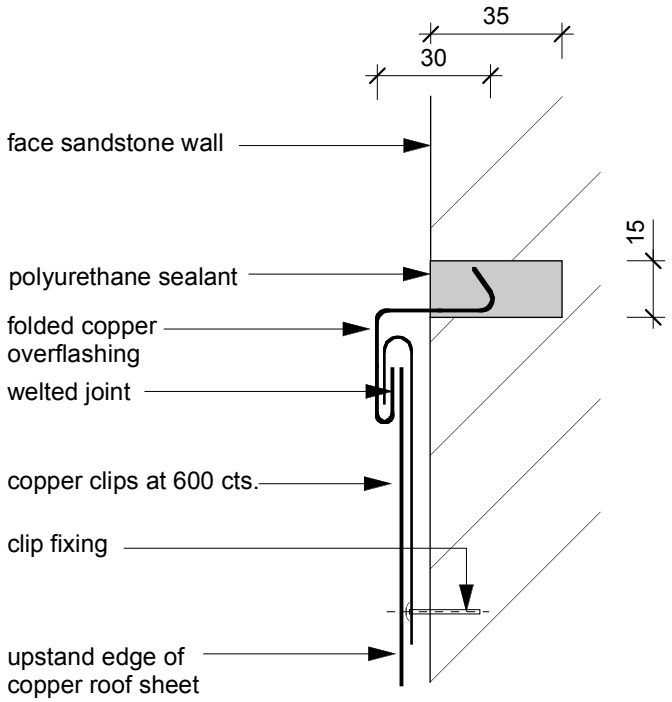
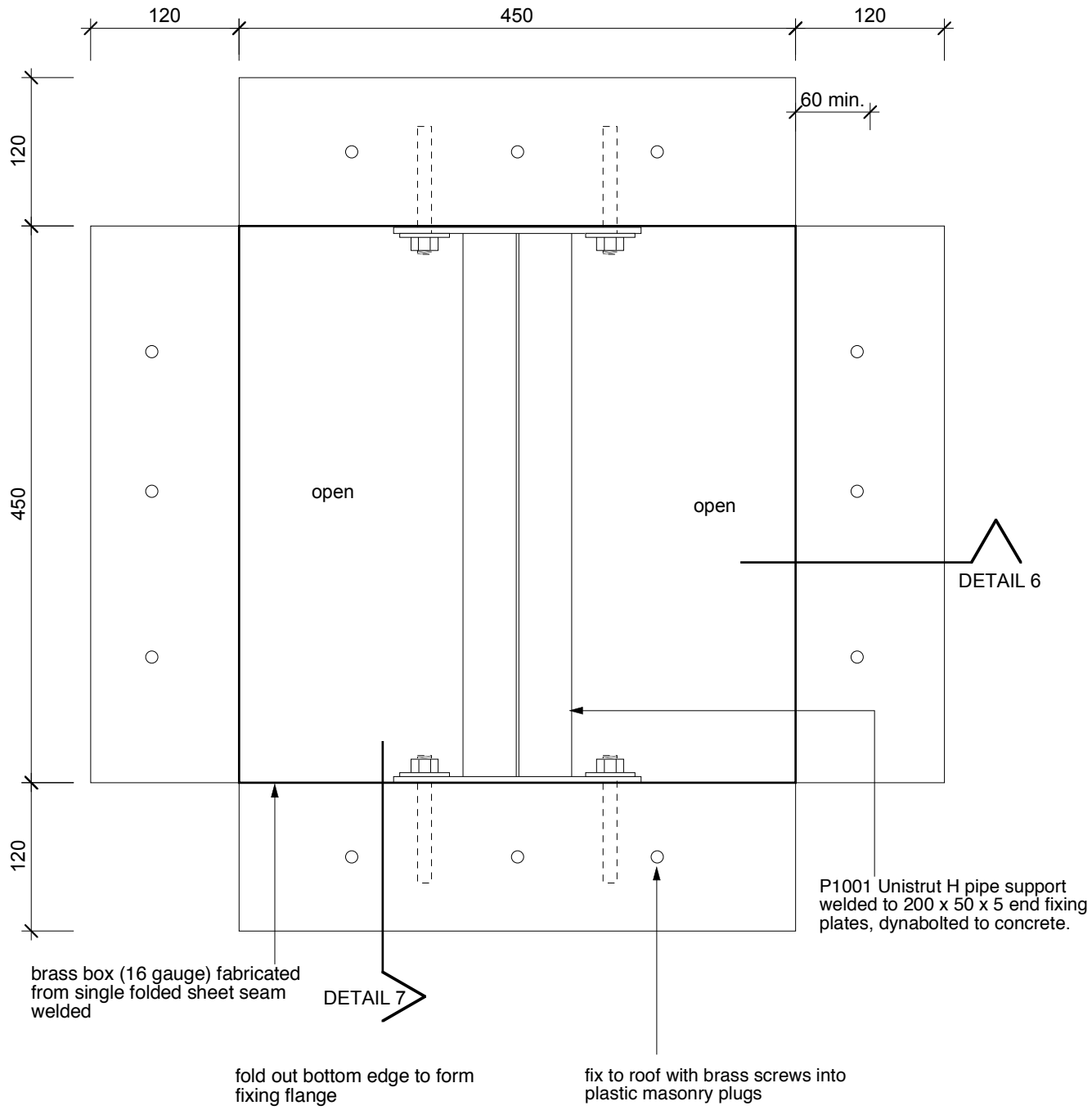
COPPER CUT-IN FLASHING TO STONE WALL



4 / 1:2 VERTICAL SECTION
DETAIL A



5
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PLAN
BOXING FOR MAJOR ROOF PENETRATIONS CONCRETE ROOF

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 5

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 03

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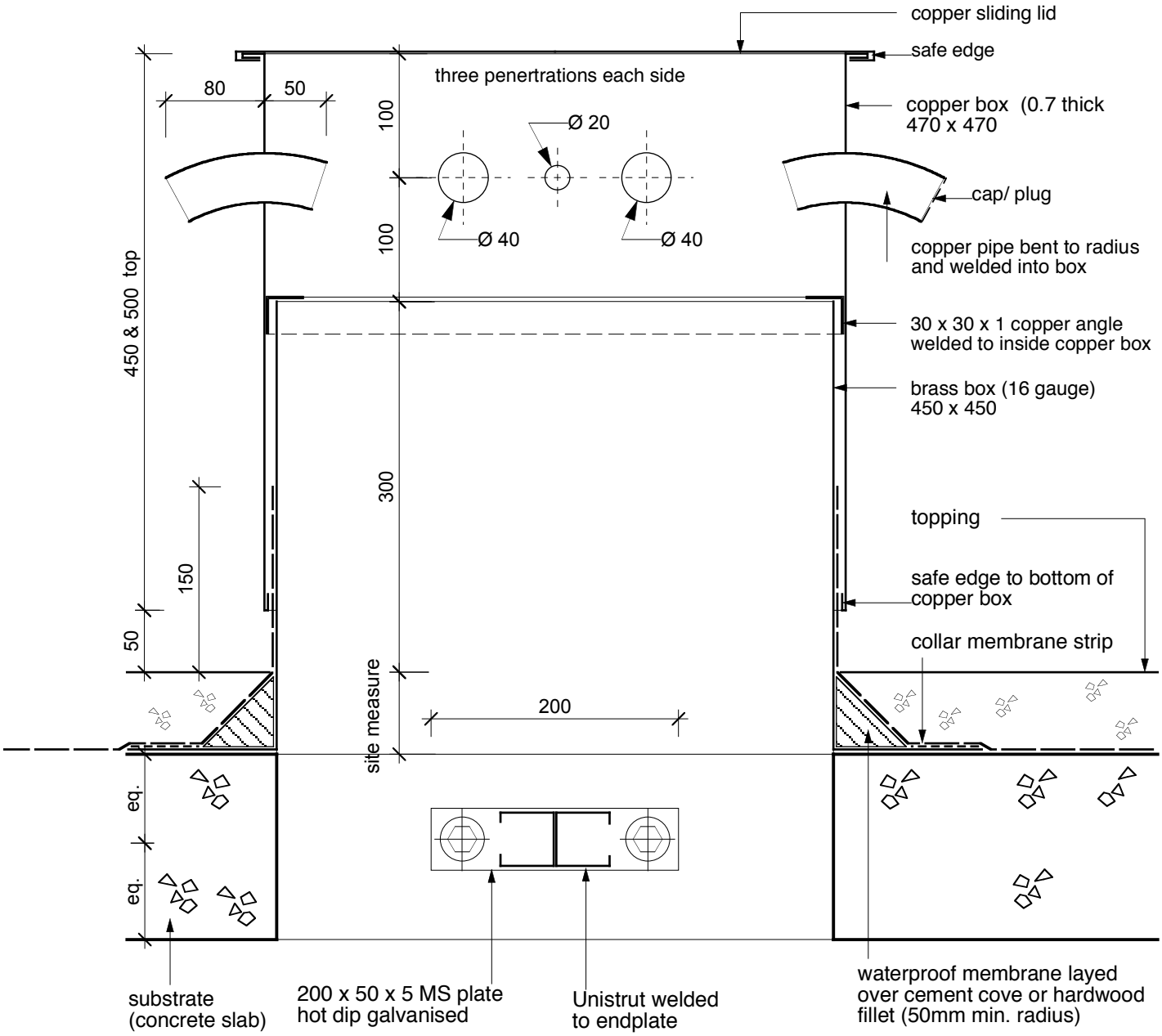
NOTE: box construction to be same material throughout u.n.o.
ie. all colorbond, or
all gal., or
all copper etc.



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VERTICAL SECTION
BOXING FOR MAJOR ROOF PENETRATIONS
CONCRETE ROOF WITH MEMBRANE AND TOPPING SLAB

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL
6

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 04

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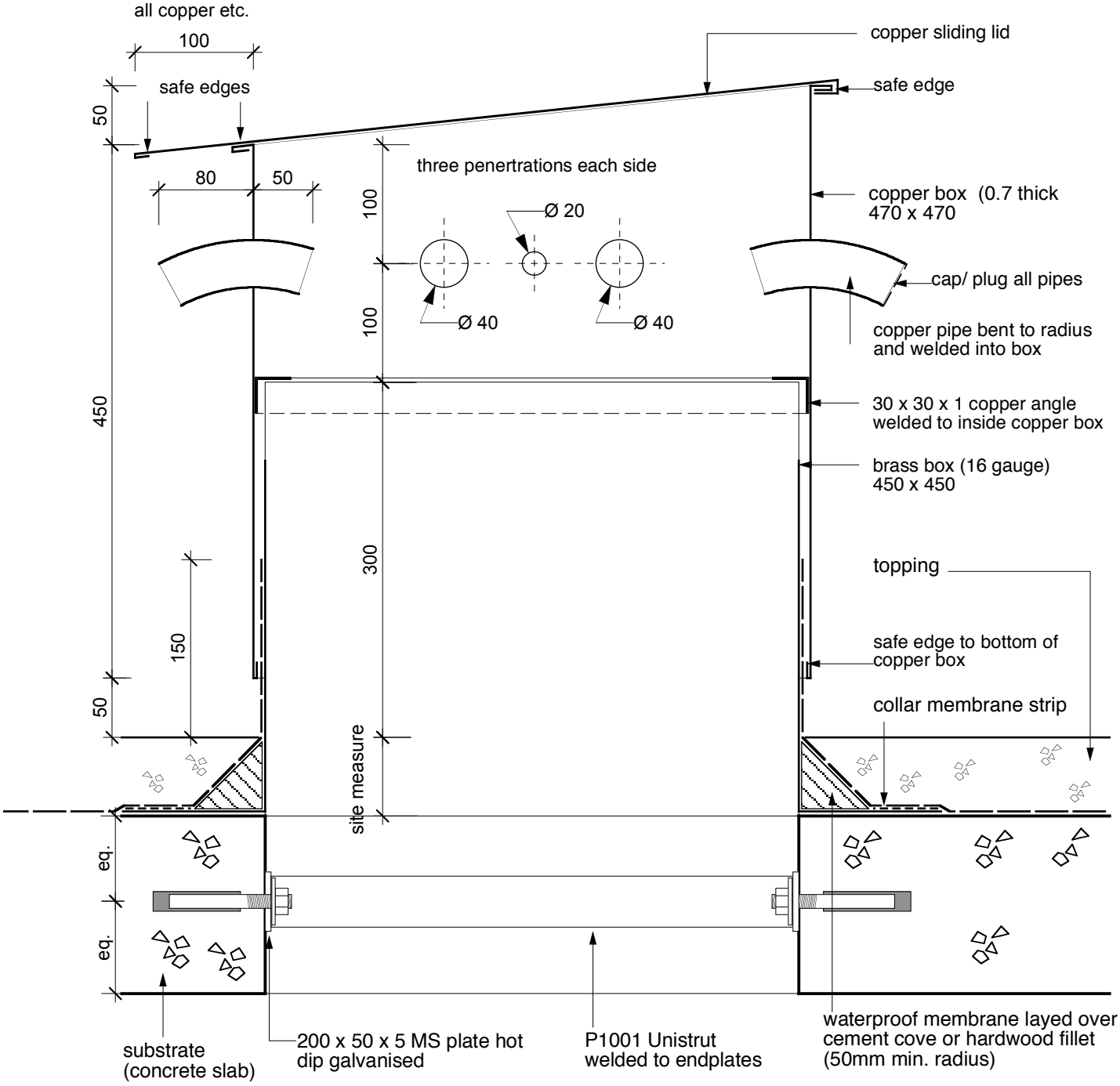
NOTE: box construction to be same material throughout u.n.o.
ie. all colorbond, or
all gal., or
all copper etc.



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VERTICAL SECTION
BOXING FOR MAJOR ROOF PENETRATIONS
CONCRETE ROOF WITH MEMBRANE AND TOPPING SLAB

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 7

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 05

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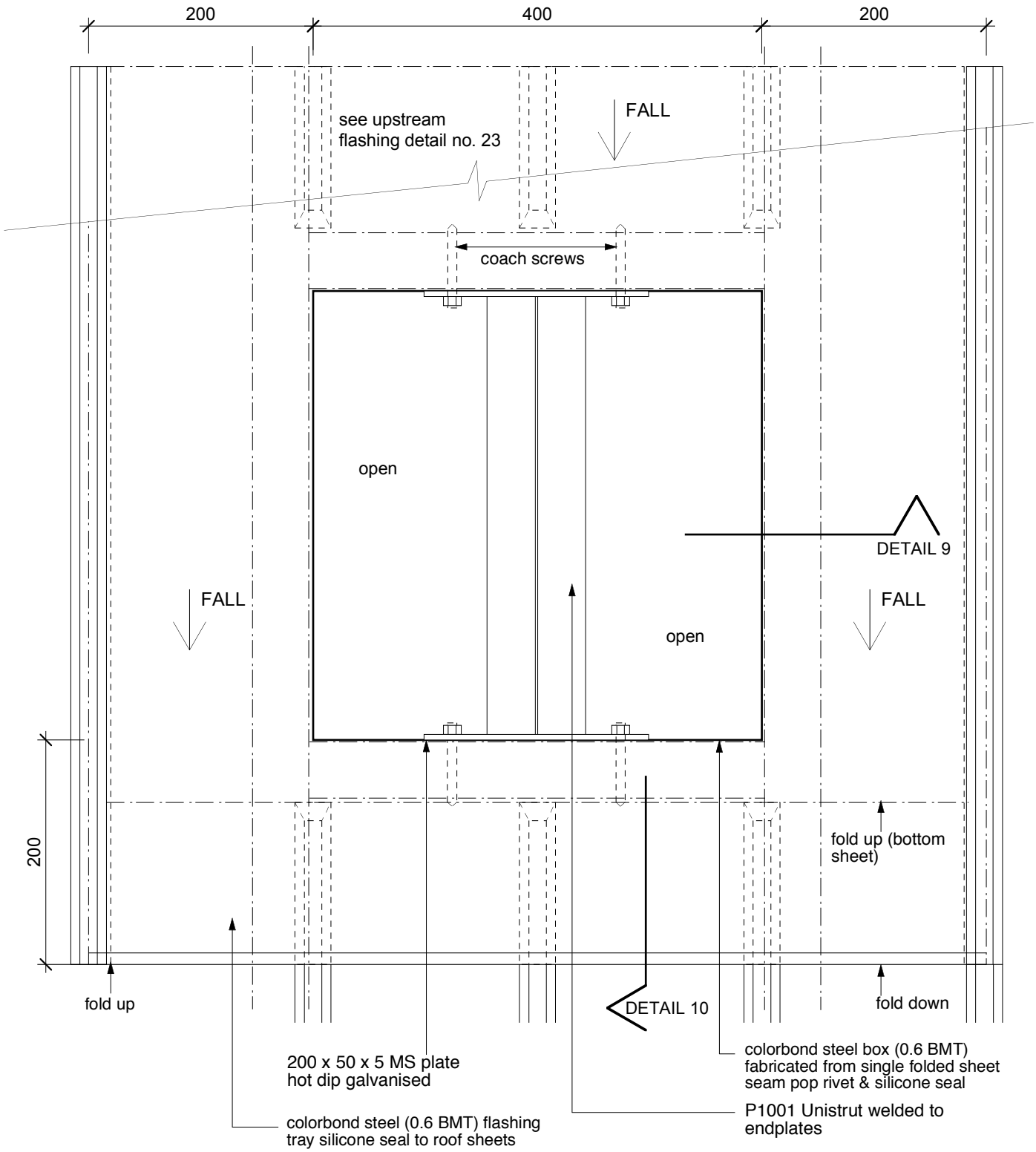

8
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PLAN
BOXING FOR MAJOR ROOF PENETRATIONS
METAL DECK ROOF ON TIMBER FRAME

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL
8

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 06

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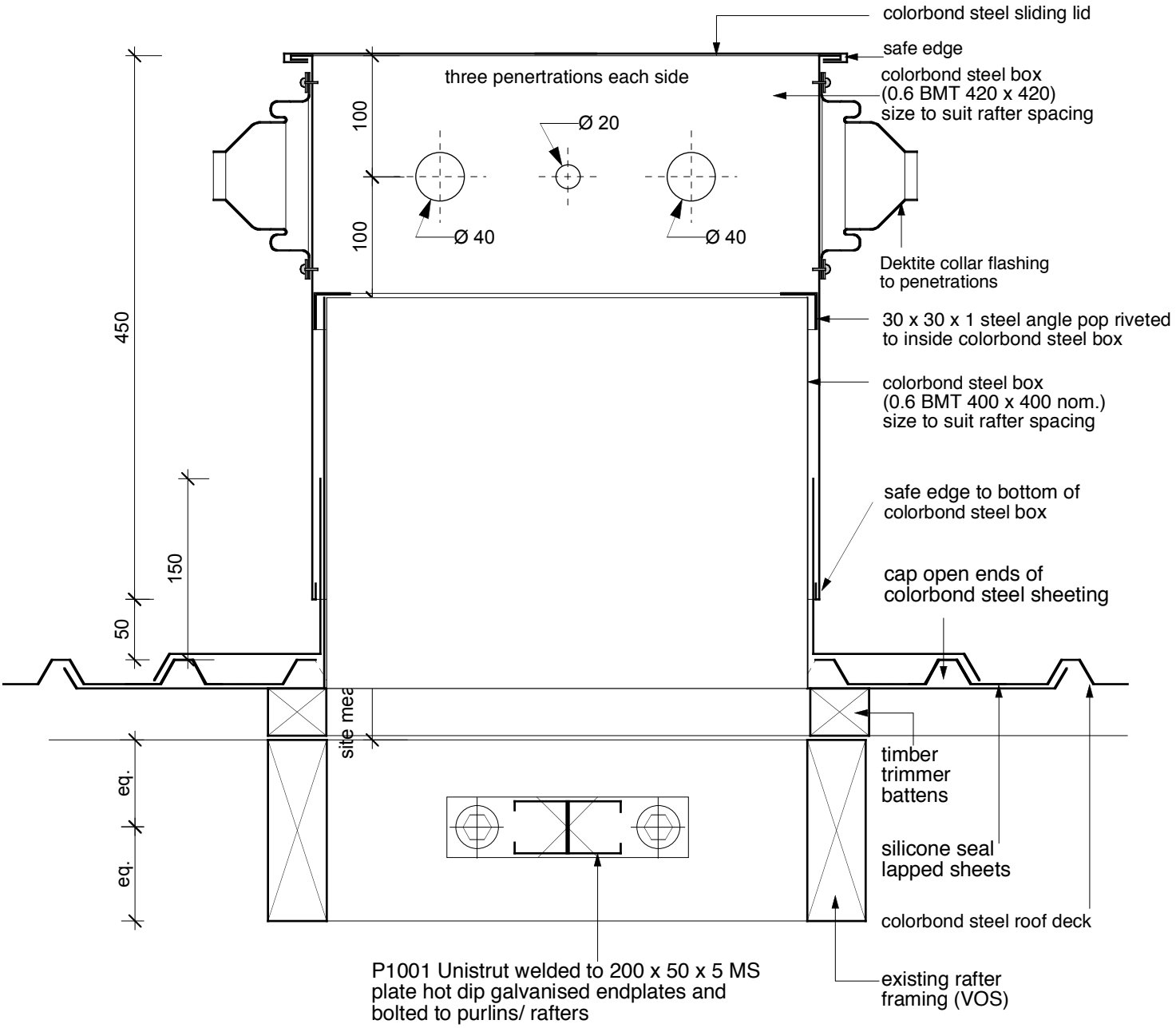
all copper etc.



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VERTICAL SECTION
BOXING FOR MAJOR ROOF PENETRATIONS
METAL DECK ROOF ON TIMBER FRAME

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL
9

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 07

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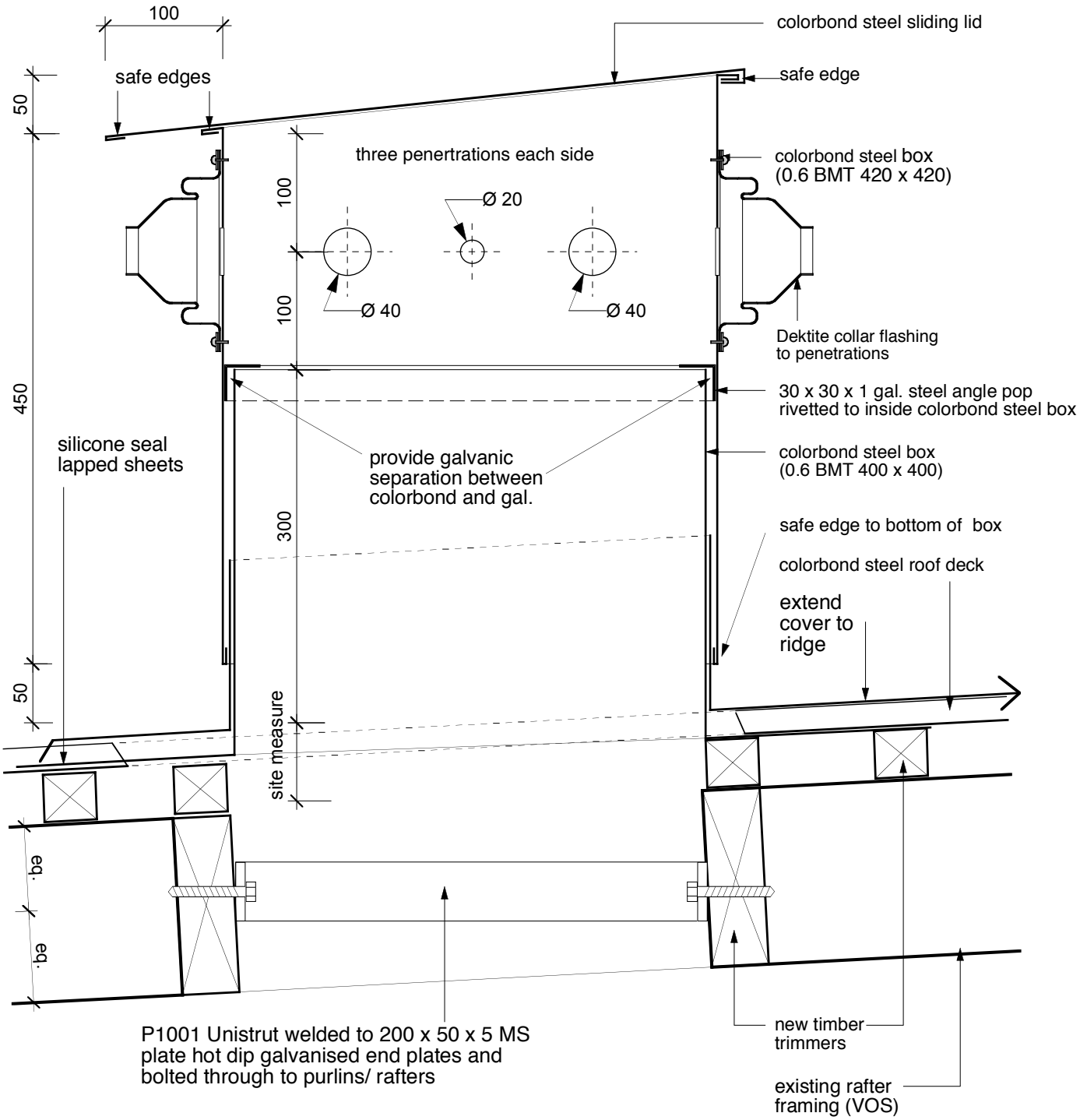
all gal., or
all copper etc.



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VERTICAL SECTION
BOXING FOR MAJOR ROOF PENETRATIONS
METAL DECK ROOF ON TIMBER FRAME

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL
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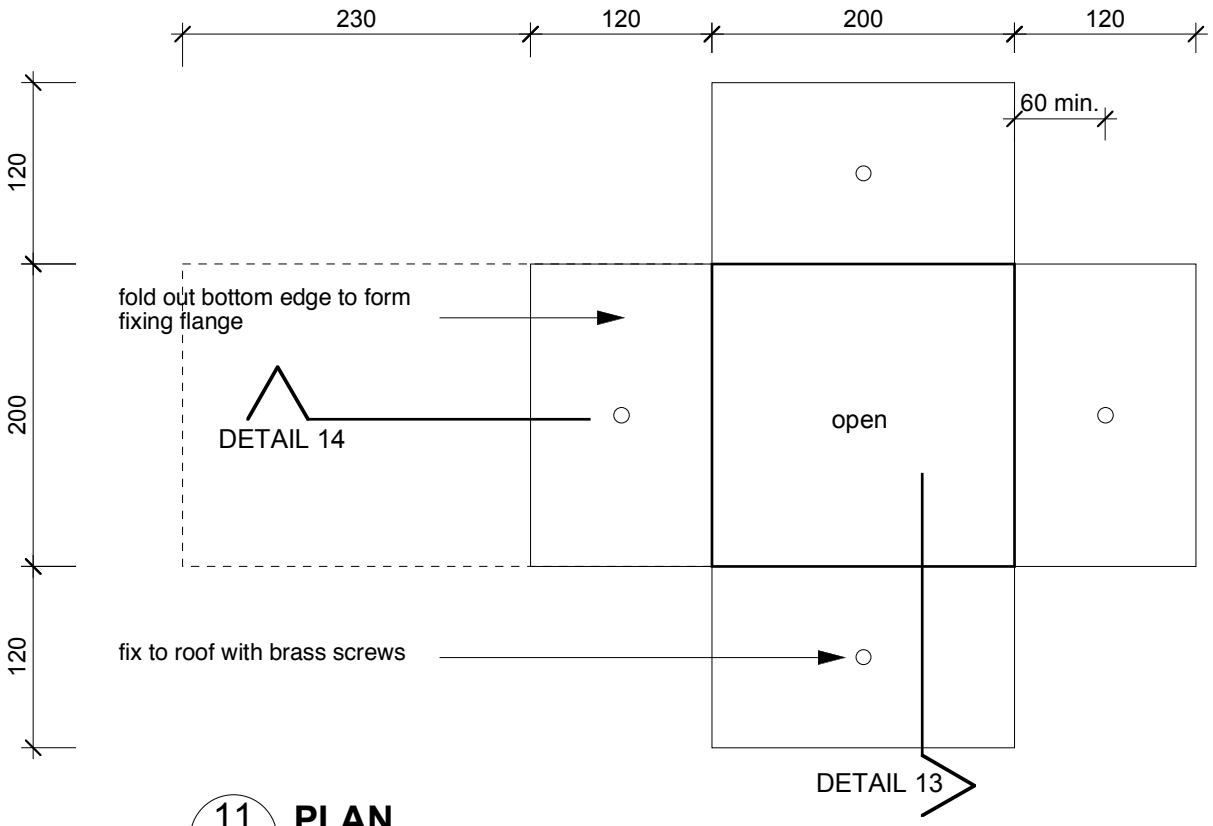
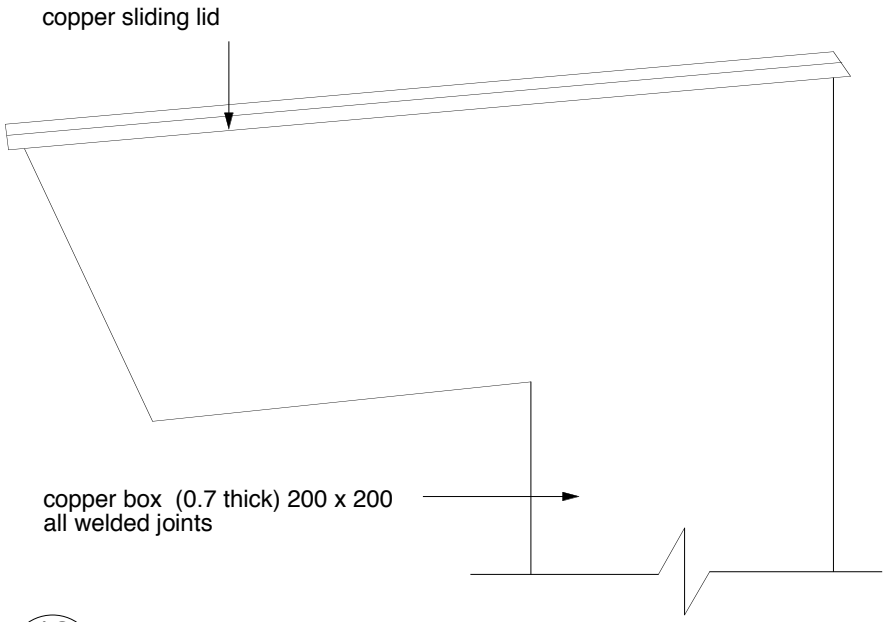


11 1:5 **PLAN**
BOXING FOR MINOR ROOF PENETRATIONS



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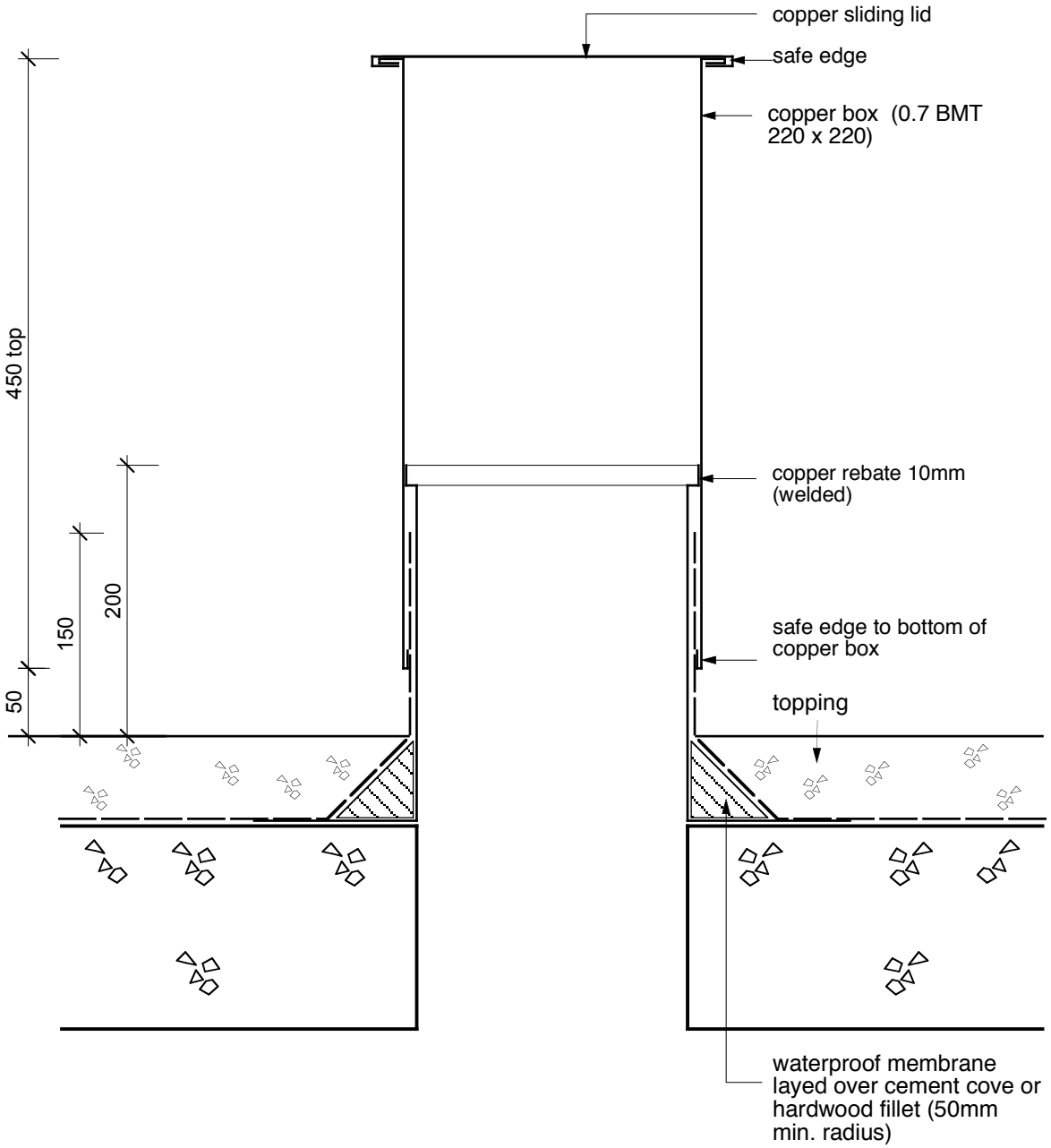
BOXING FOR MINOR ROOF PENETRATIONS
TOP PORTIONS - CONCRETE ROOFS



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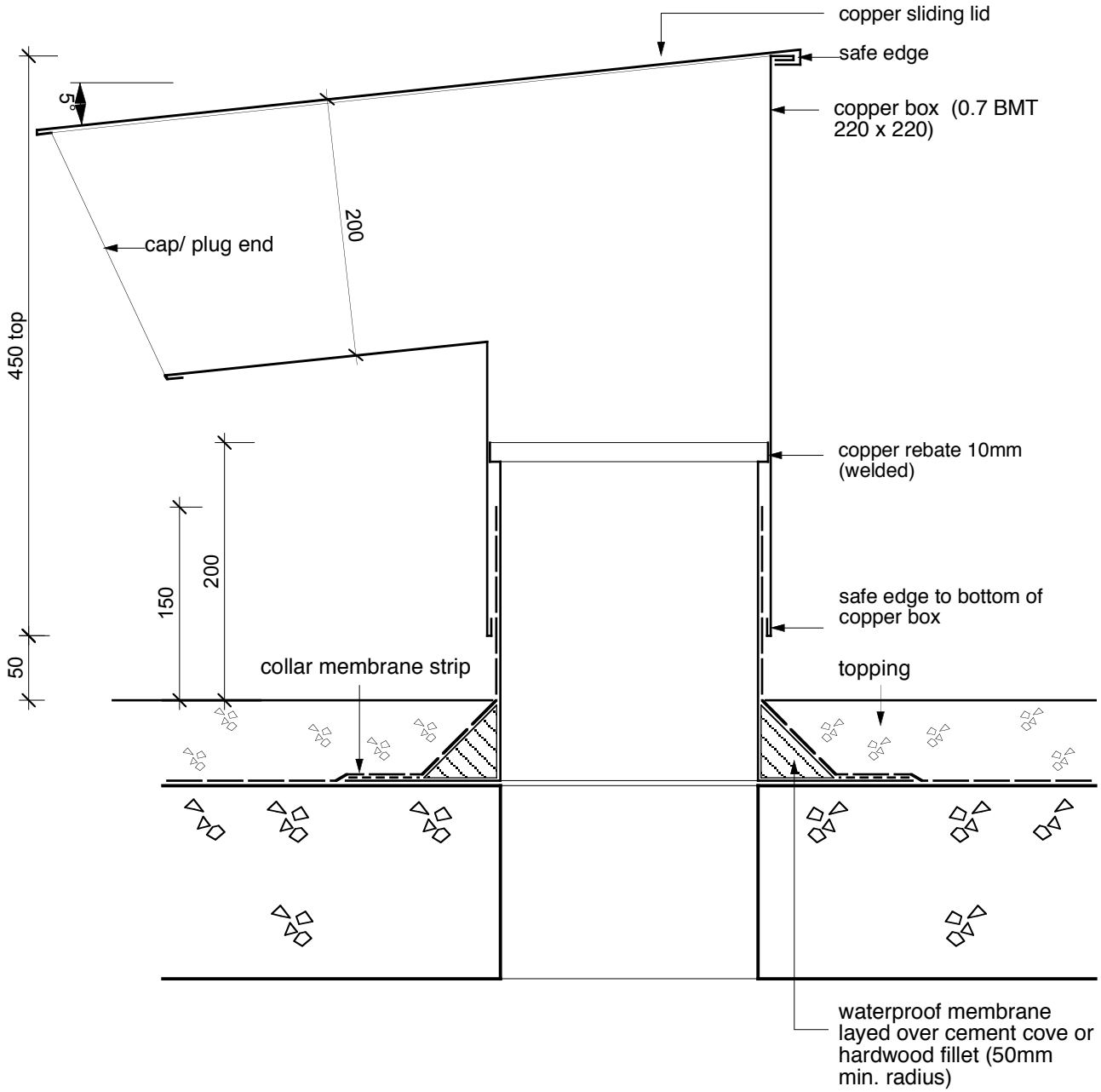
VERTICAL SECTION
BOXING FOR MINOR ROOF PENETRATIONS
CONCRETE ROOF WITH MEMBRANE & TOPPING SLAB



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VERTICAL SECTION
BOXING FOR MINOR ROOF PENETRATIONS
CONCRETE ROOF WITH MEMBRANE & TOPPING SLAB

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 14

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 11

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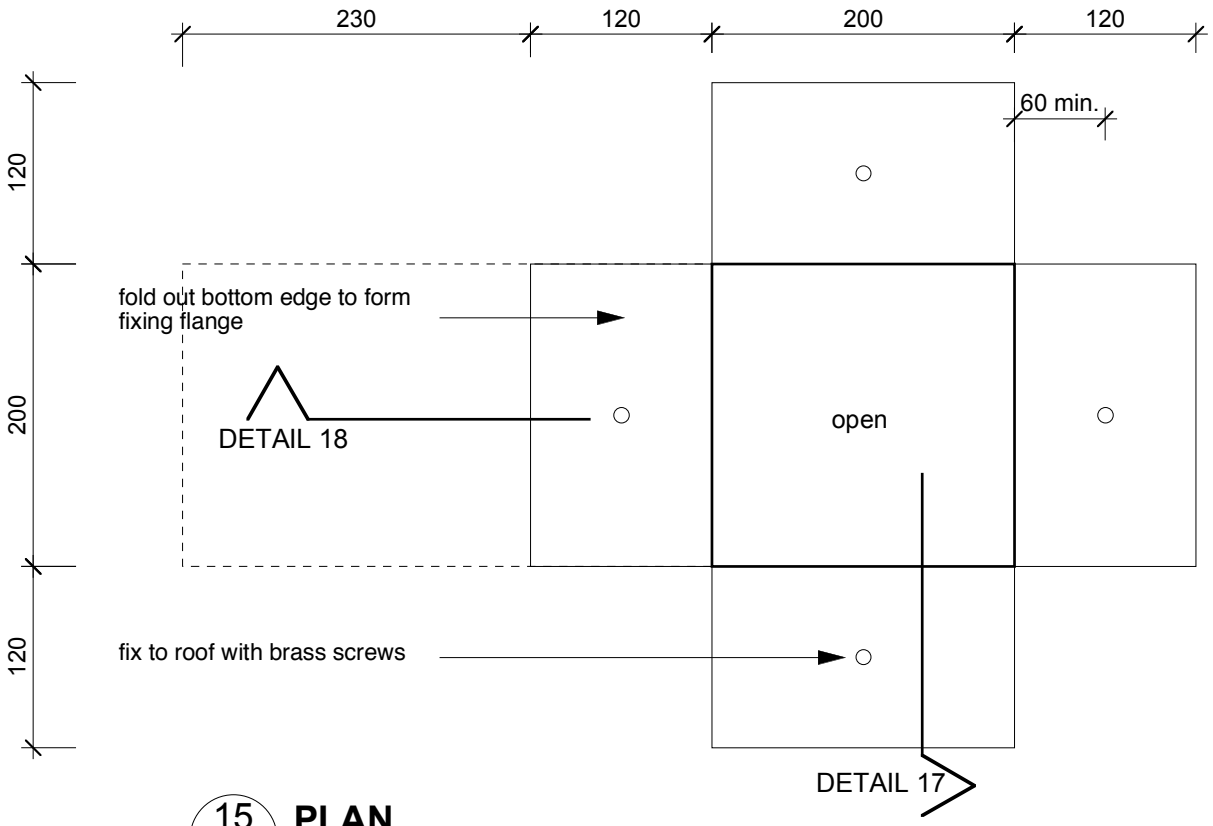

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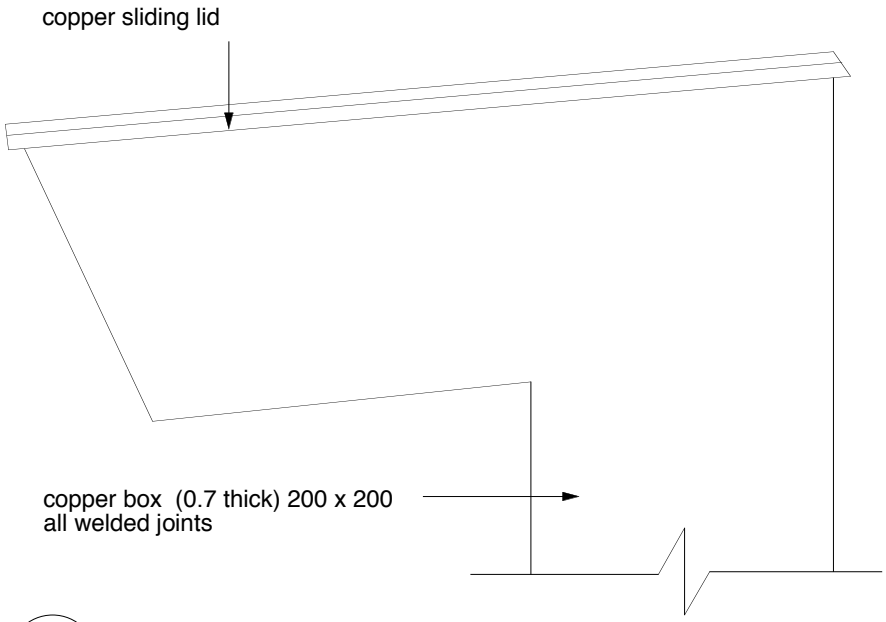
BOXING FOR MINOR ROOF PENETRATIONS



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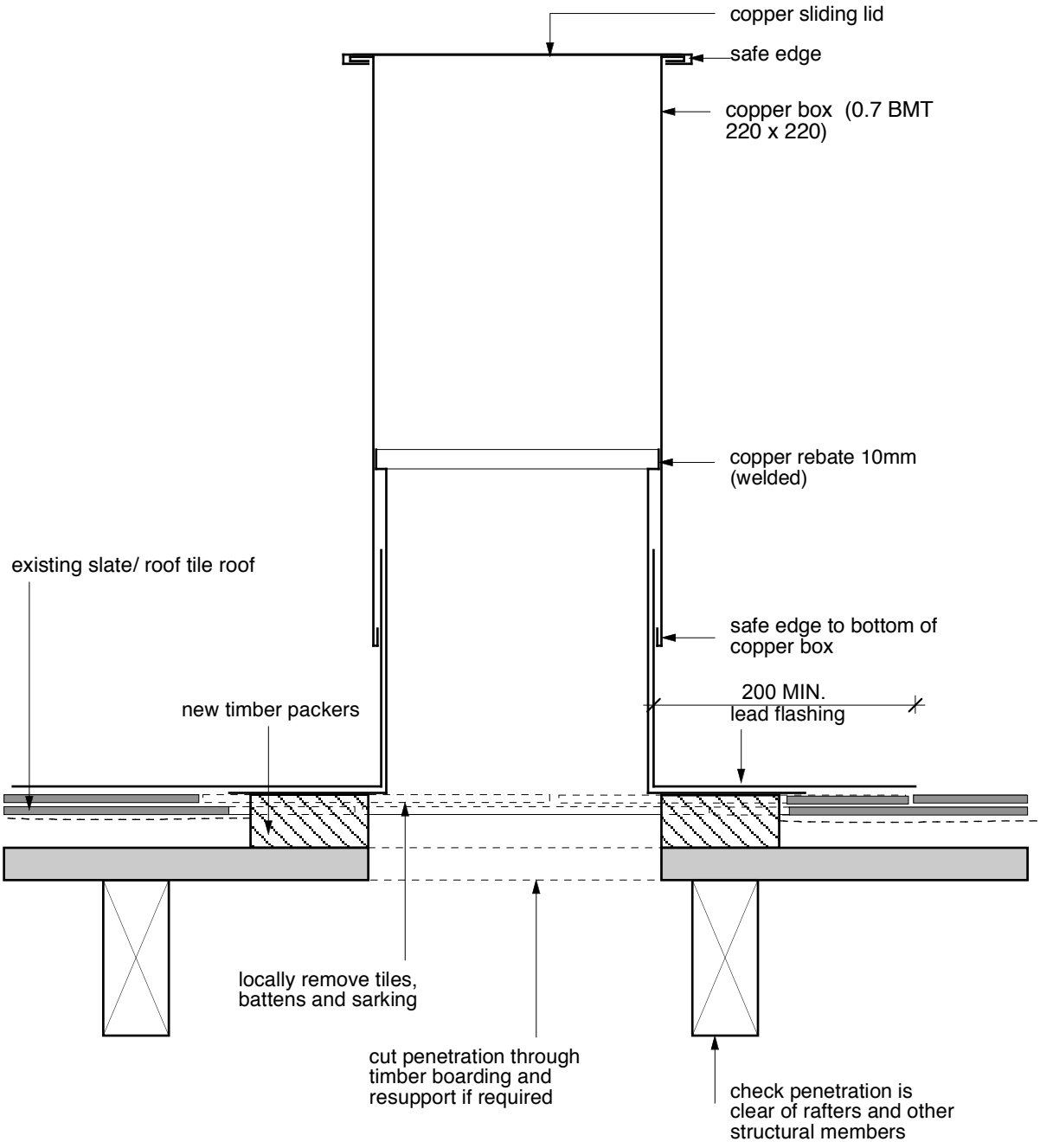
BOXING FOR MINOR ROOF PENETRATIONS
TOP PORTION - TILE AND SLATE ROOFS



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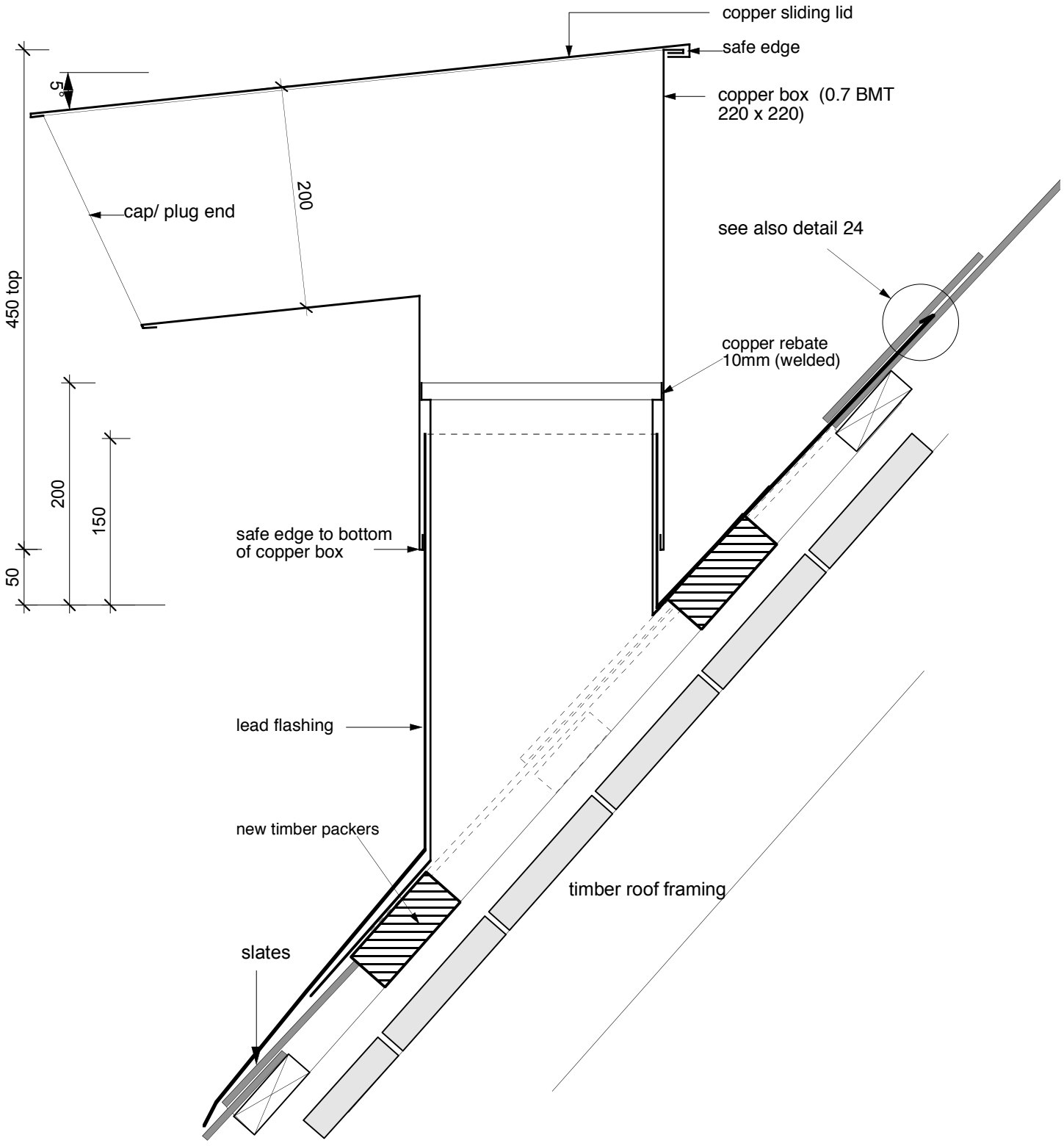
VERTICAL SECTION
BOXING FOR MINOR ROOF PENETRATIONS TILE & SLATE ROOFS



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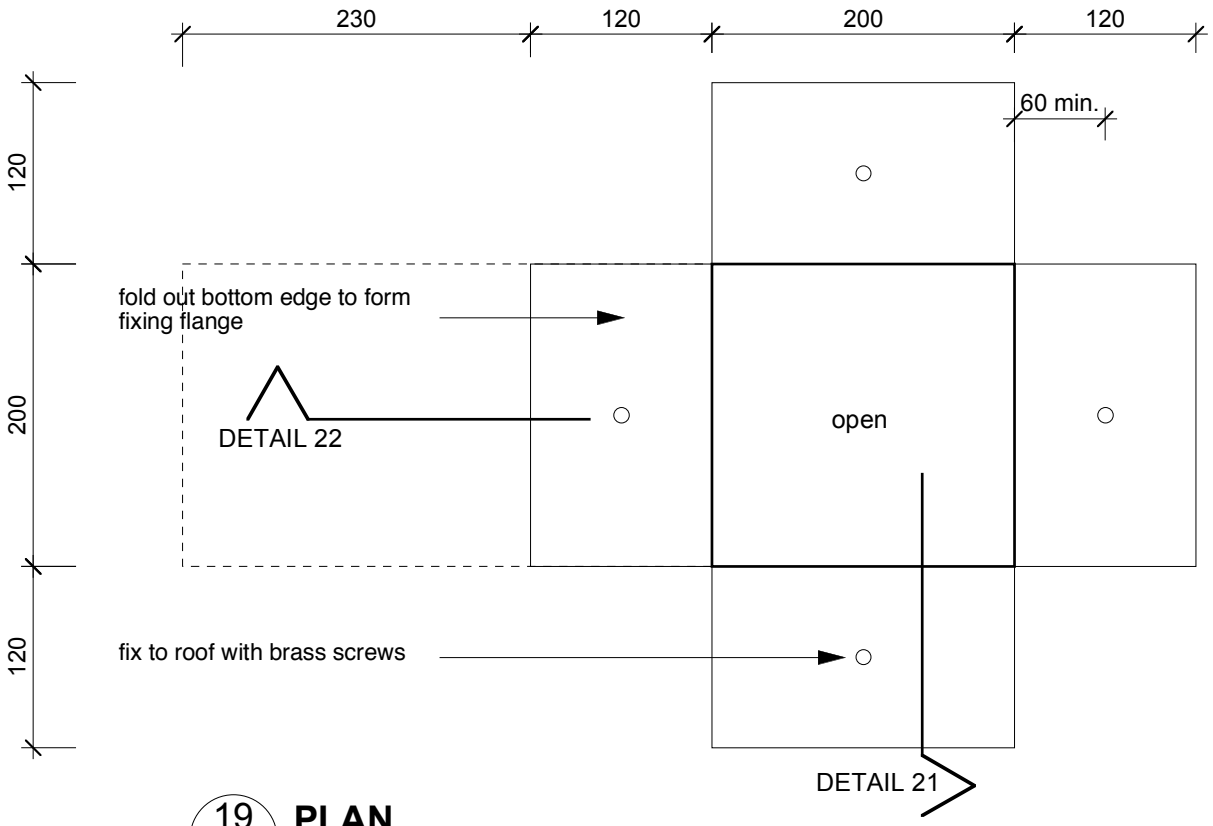
VERTICAL SECTION
BOXING FOR MINOR ROOF PENETRATIONS
SLATE & TILE ROOFS

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL
18

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 14

Prepared by DTB Architects Pty Ltd



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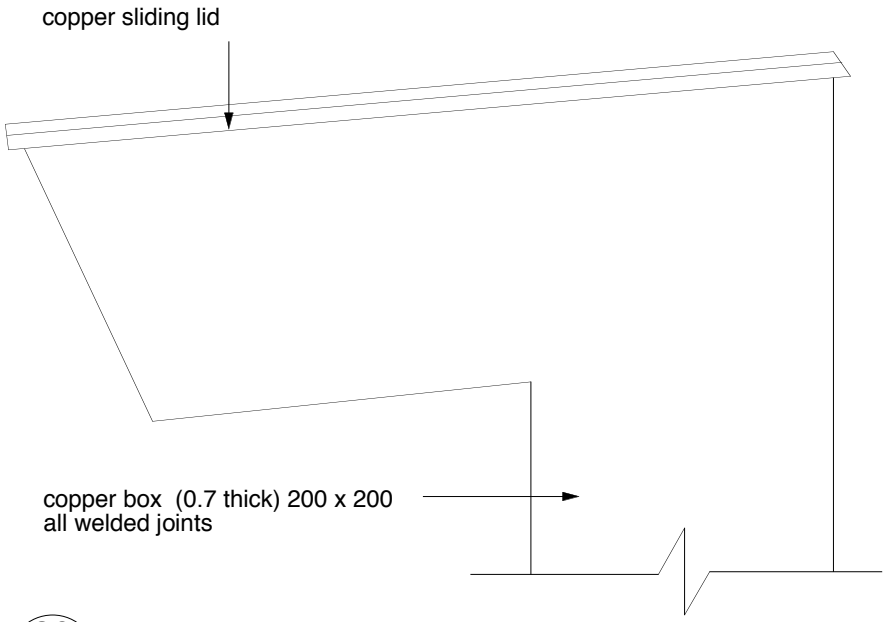
BOXING FOR MINOR ROOF PENETRATIONS



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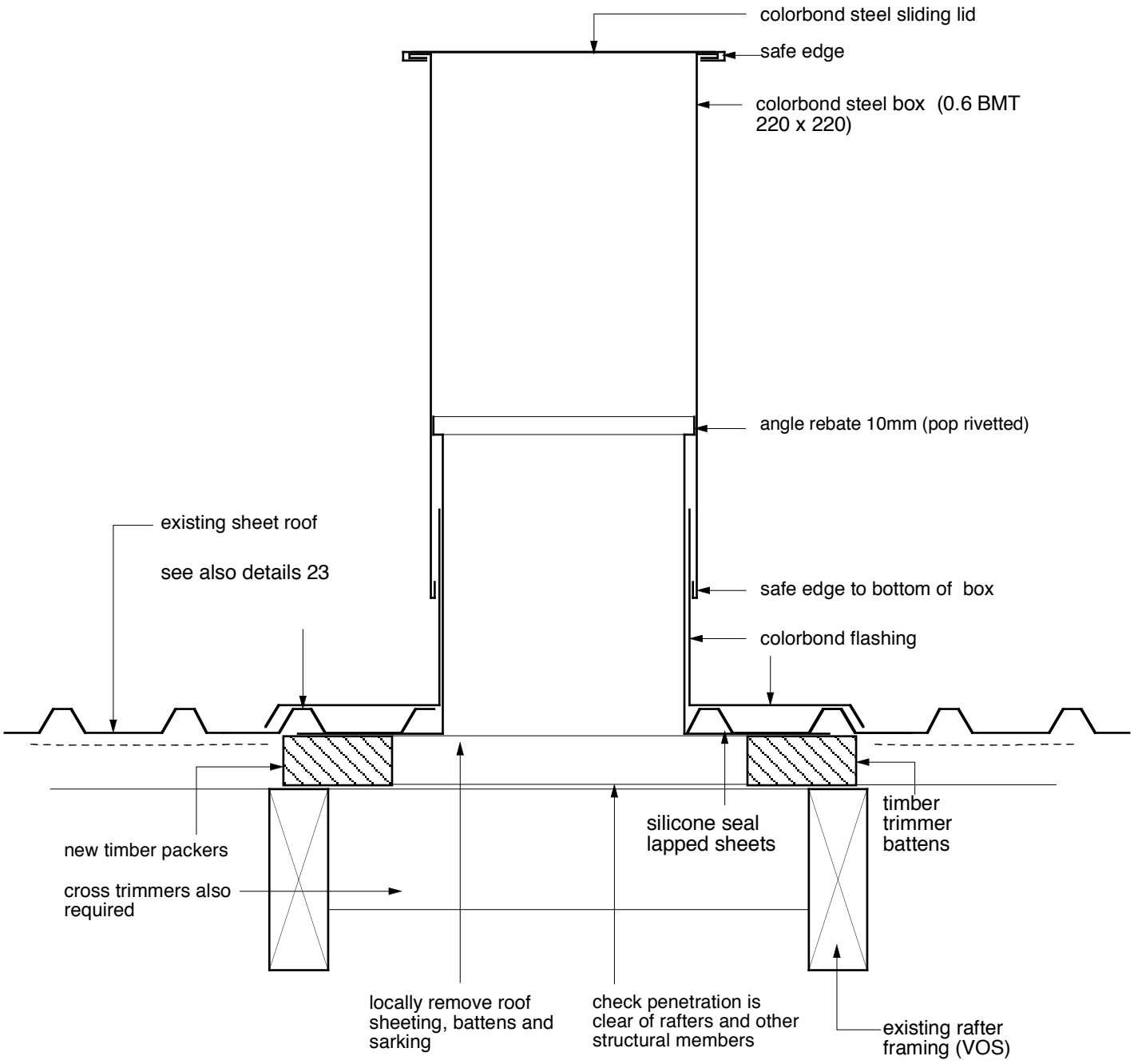
BOXING FOR MINOR ROOF PENETRATIONS
TOP PORTION - METAL DECK ROOFS



21
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VERTICAL SECTION
BOXING FOR MINOR ROOF PENETRATIONS METAL DECK ROOFS ON TIMBER FRAMES

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 21

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 16

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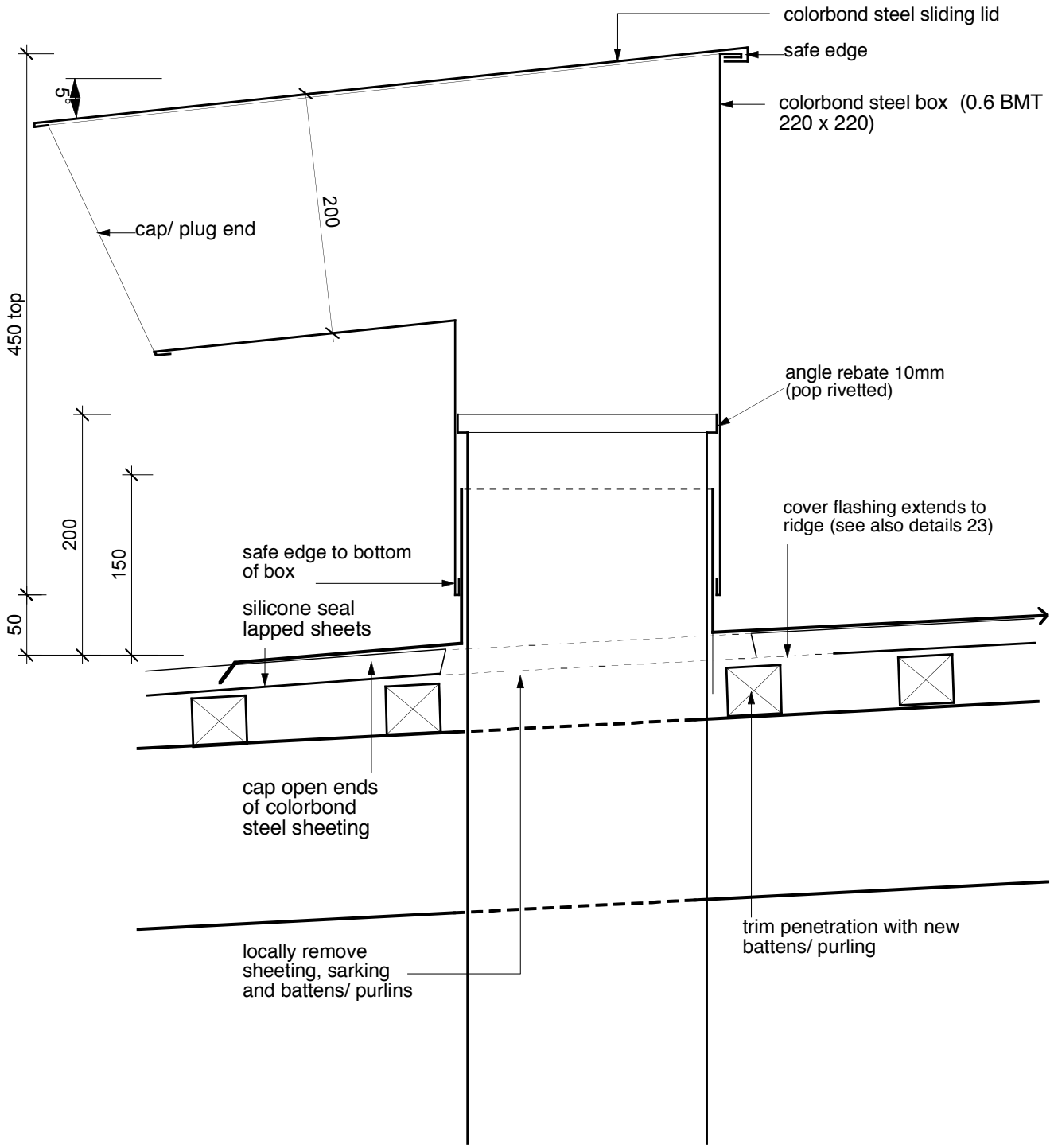


22 1:5 **VERTICAL SECTION**

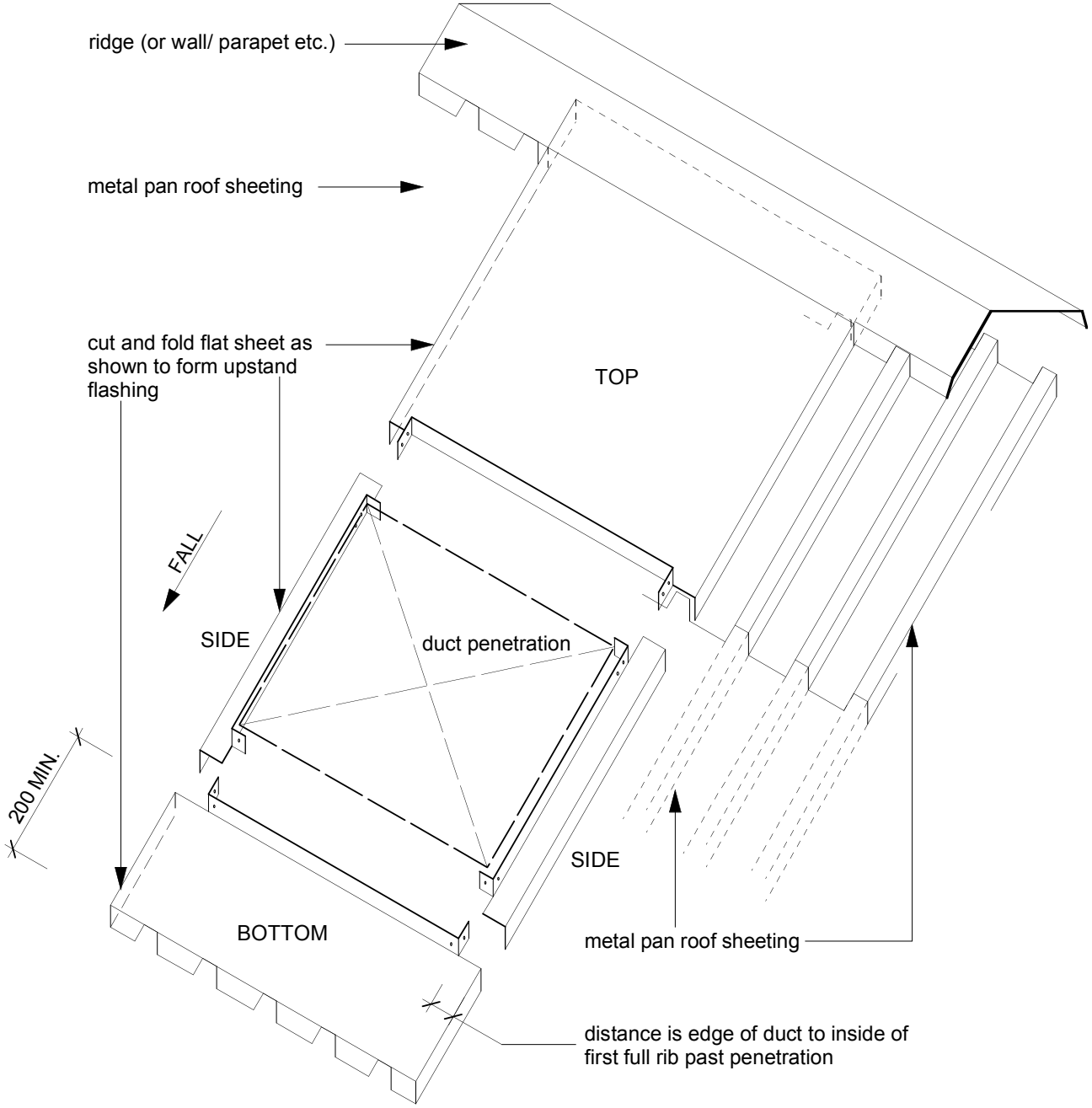
BOXING FOR MINOR ROOF PENETRATIONS METAL DECK ROOFS ON TIMBER FRAMES

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 22

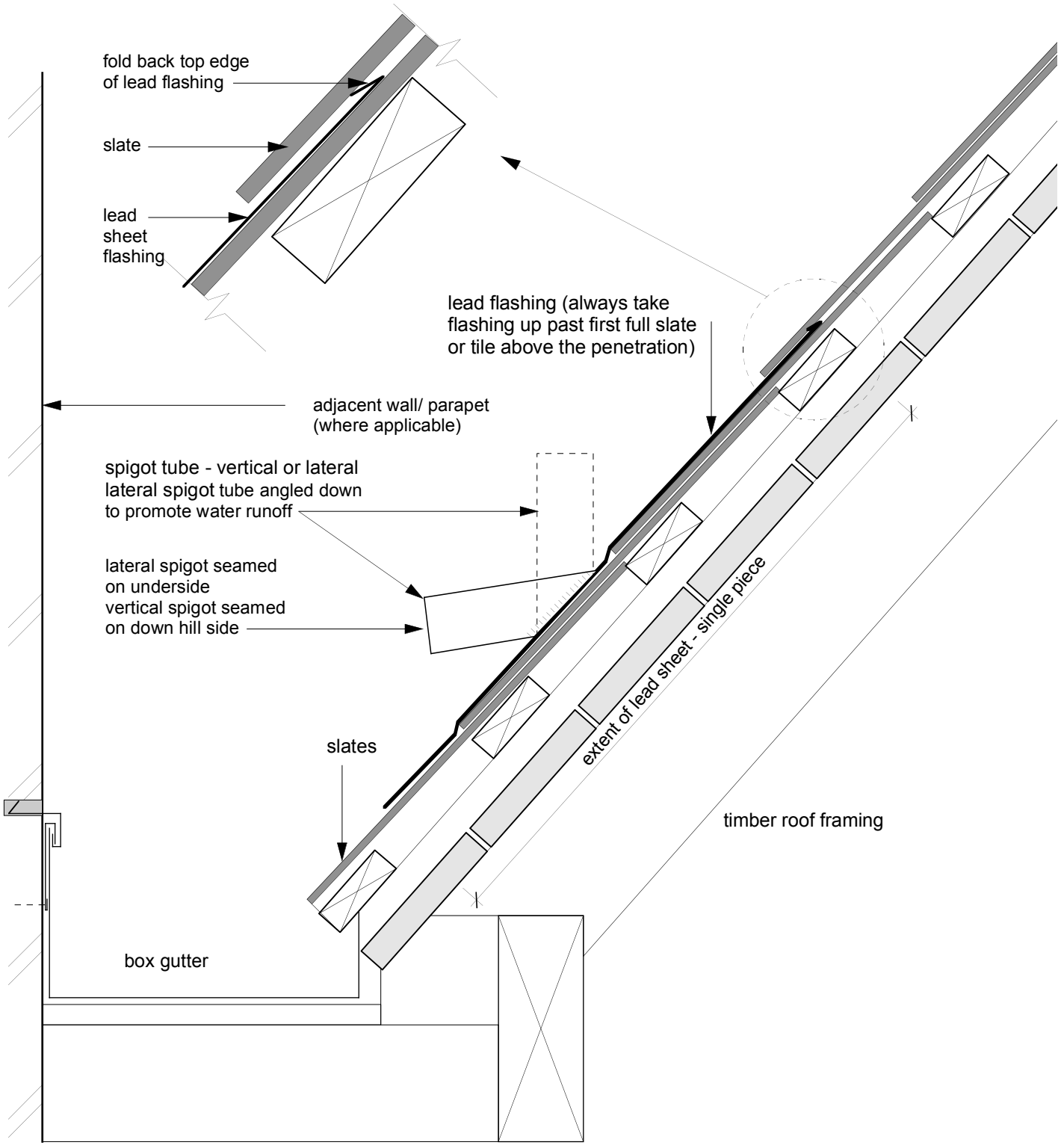
SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 17

Prepared by DTB Architects Pty Ltd



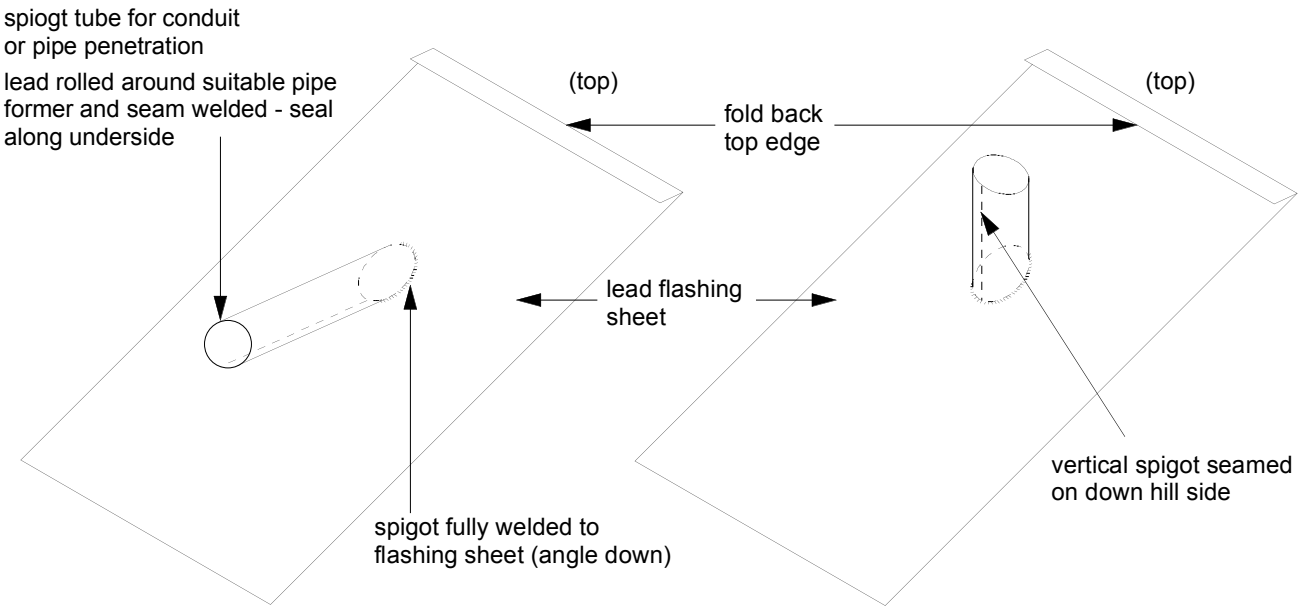
23
1:5

ISOMETRIC - EXPLODED
FLASHING FOR MAJOR ROOF PENETRATIONS METAL DECK ROOFS



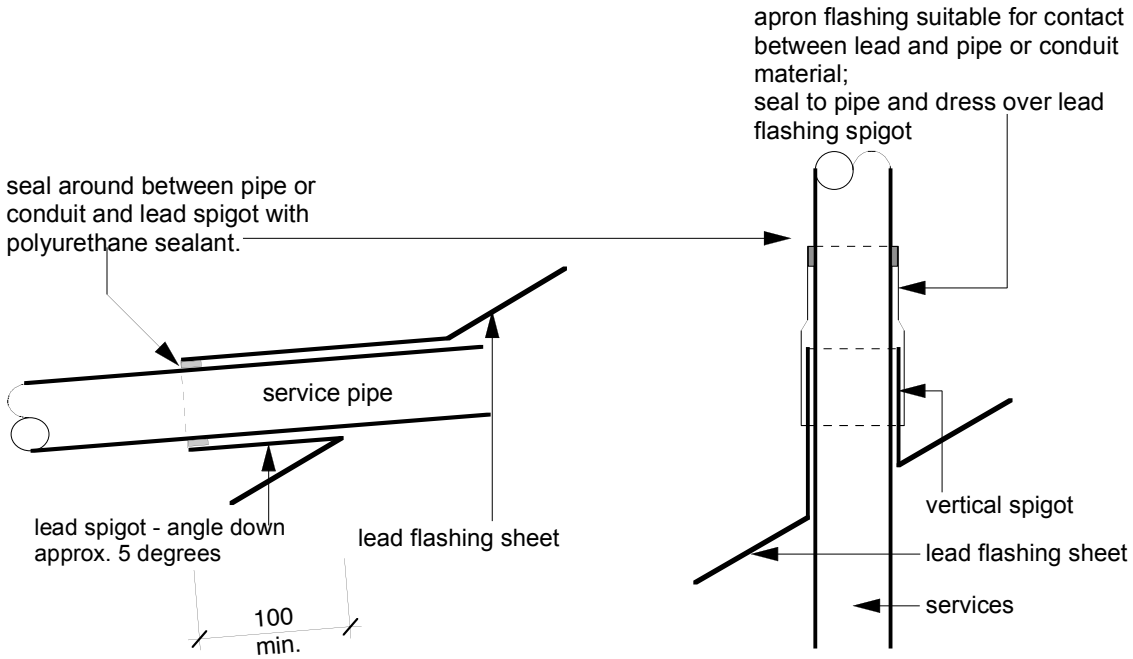
24
1:5

VERTICAL SECTION
LEAD FLASHING FOR PIPE OR CONDUIT PENETRATION - SLATE AND TILE ROOFS



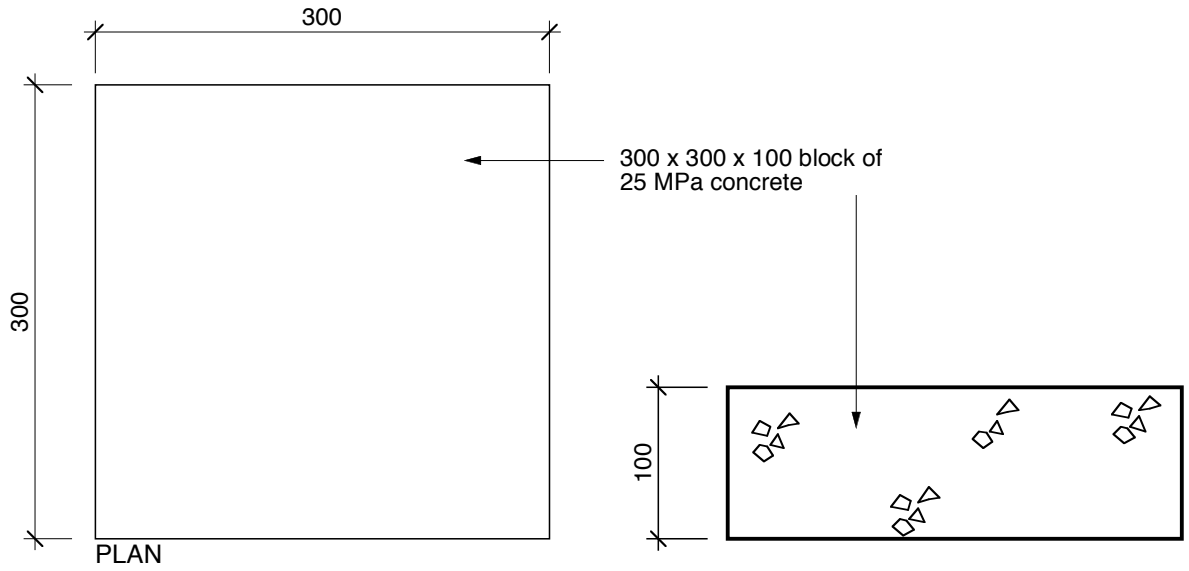
25
1:5

ISO VIEWS
LEAD FLASHING FOR SERVICES PENETRATION - SLATE OT TILE ROOF

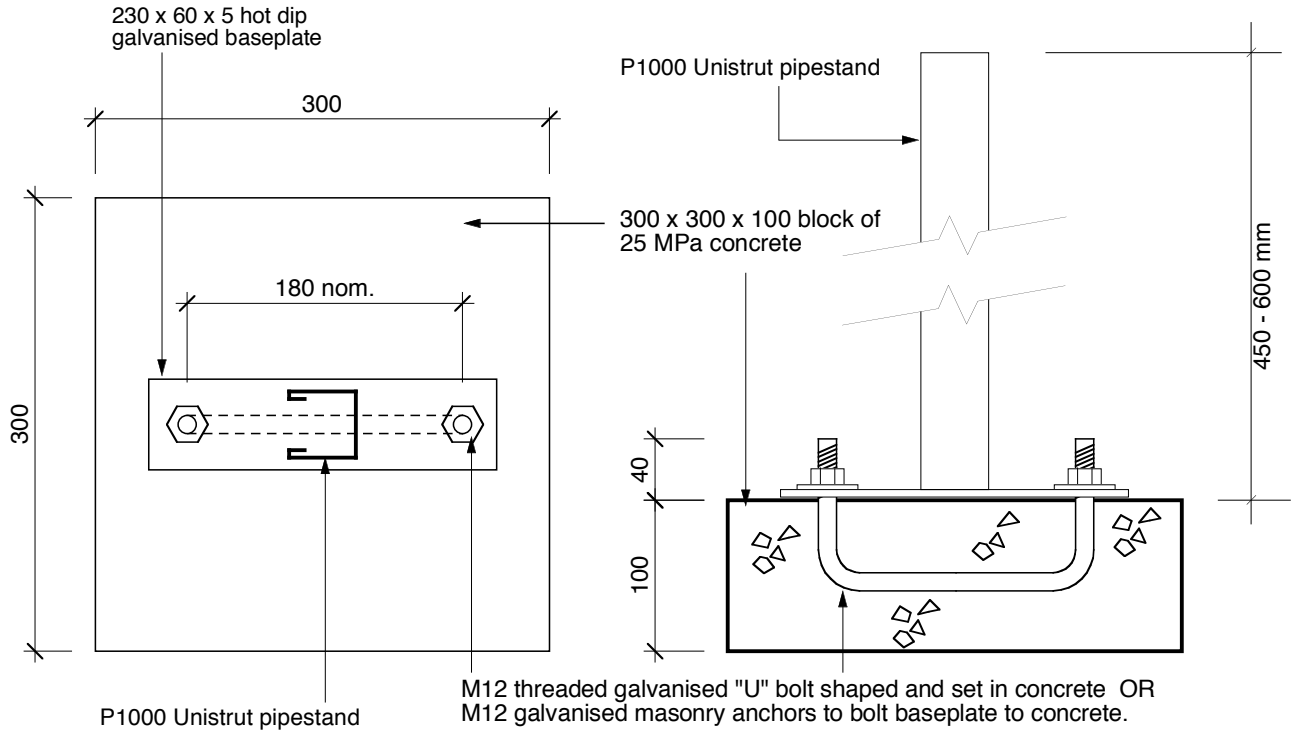


26
1:5

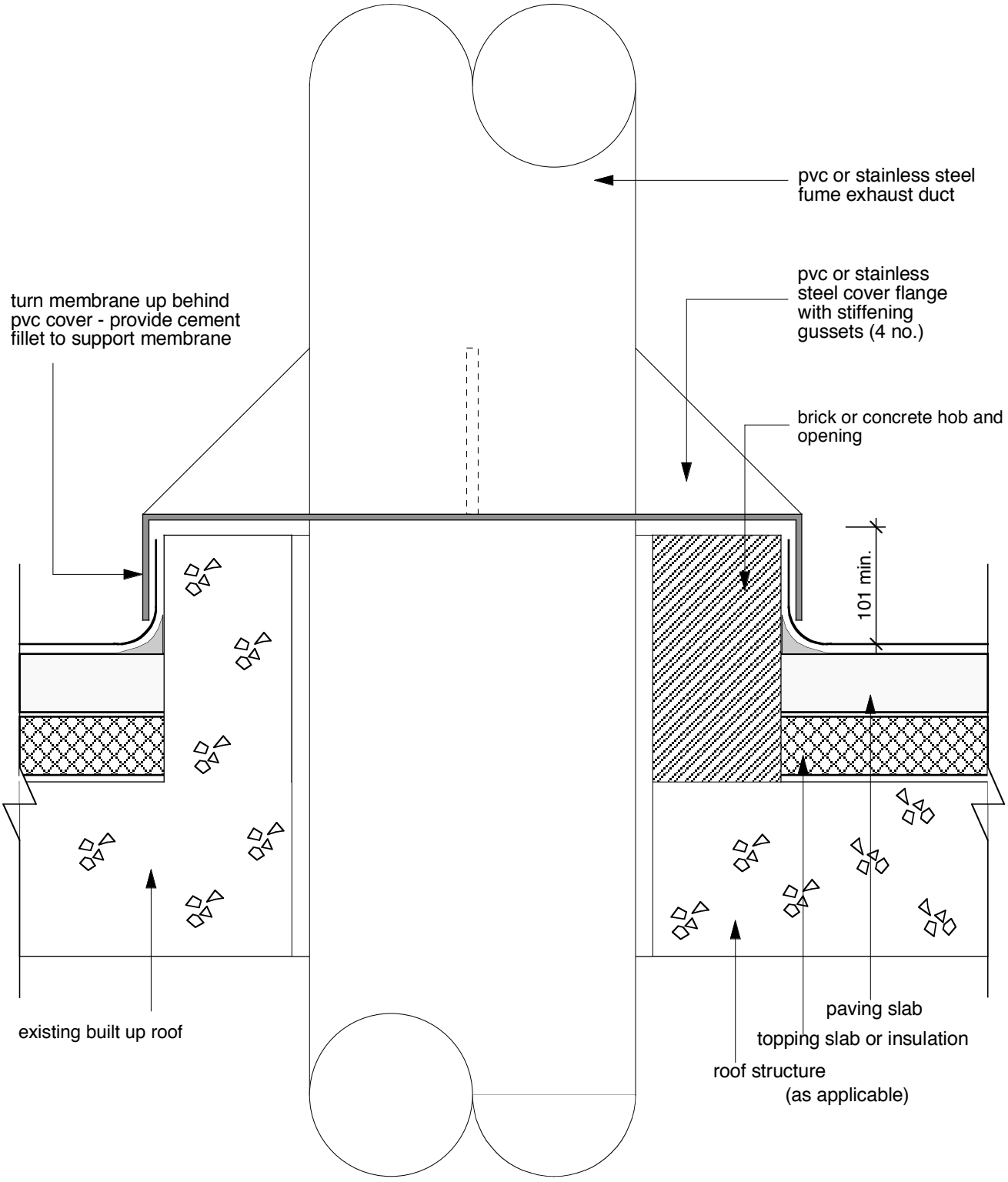
VERTICAL SECTIONS
LEAD FLASHING FOR PIPE OR CONDUIT PENETRATION - SLATE AND TILE ROOFS



27 1:5 PLAN & SECTION
CONCRETE MACHINERY PAD MOUNT



28 1:5 PLAN & SECTION
CONCRETE PAD MOUNTING BRACKET WITH PIPESTAND
CONCRETE ROOFS



29
1:5

SECTION
FLUE PENETRATION
CONCRETE ROOF WITH MEMBRANE AND TOPPING

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 29

SCALE: 1:5 DATE: 05.03.04 REV No: B SHEET No: 22

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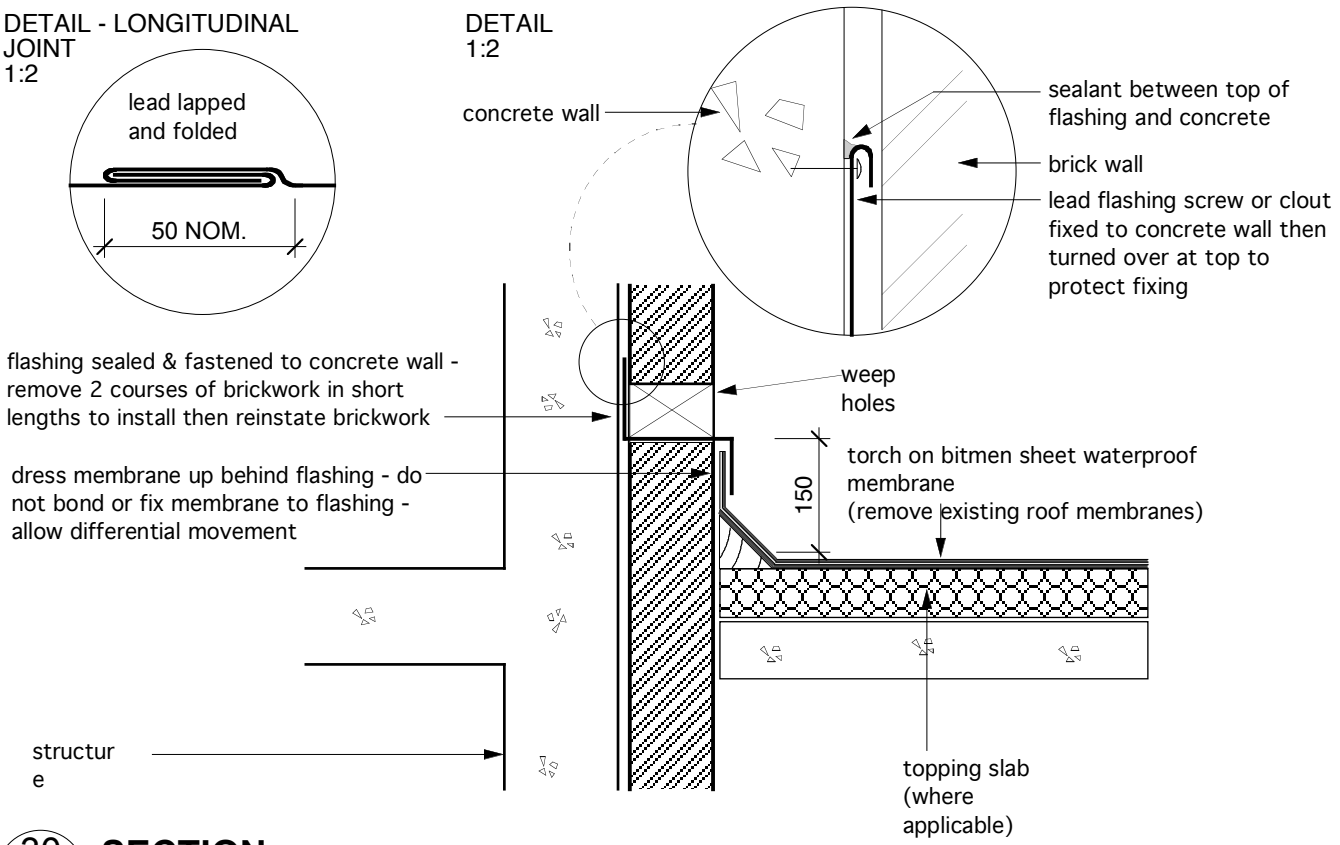
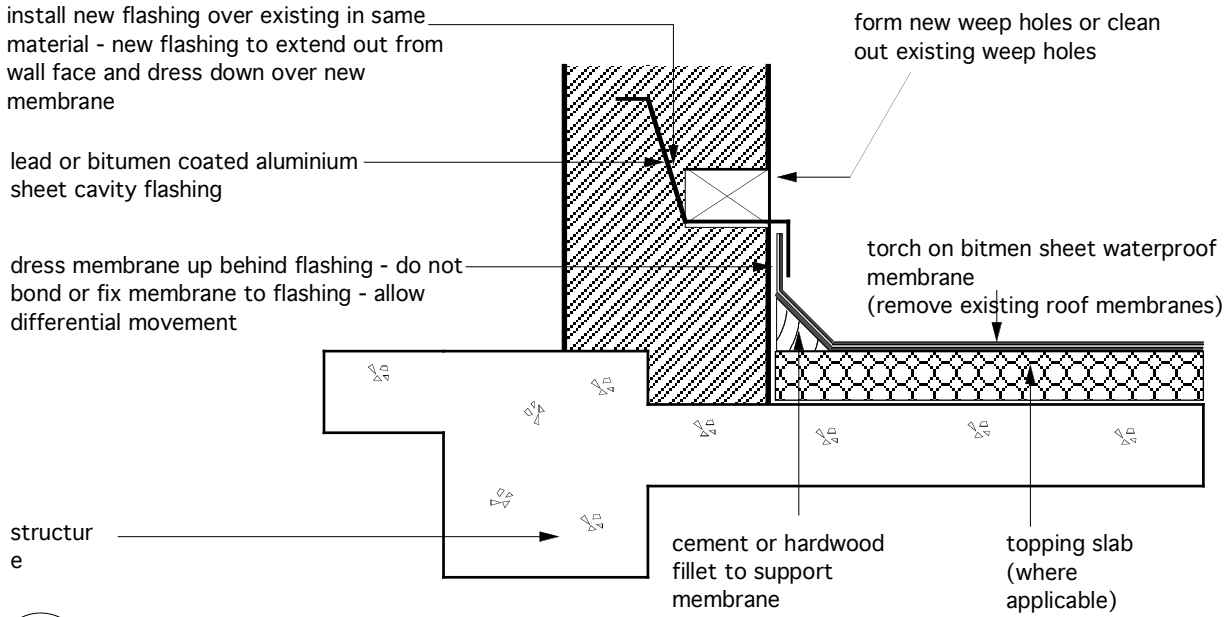
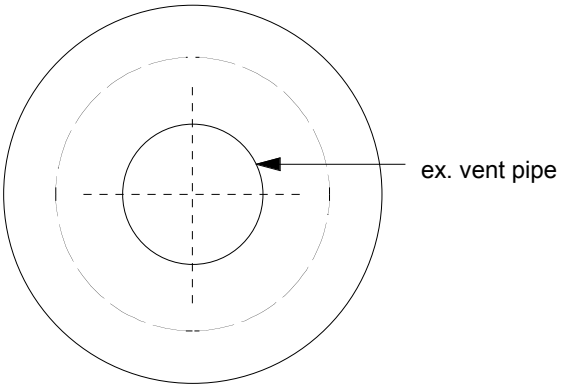


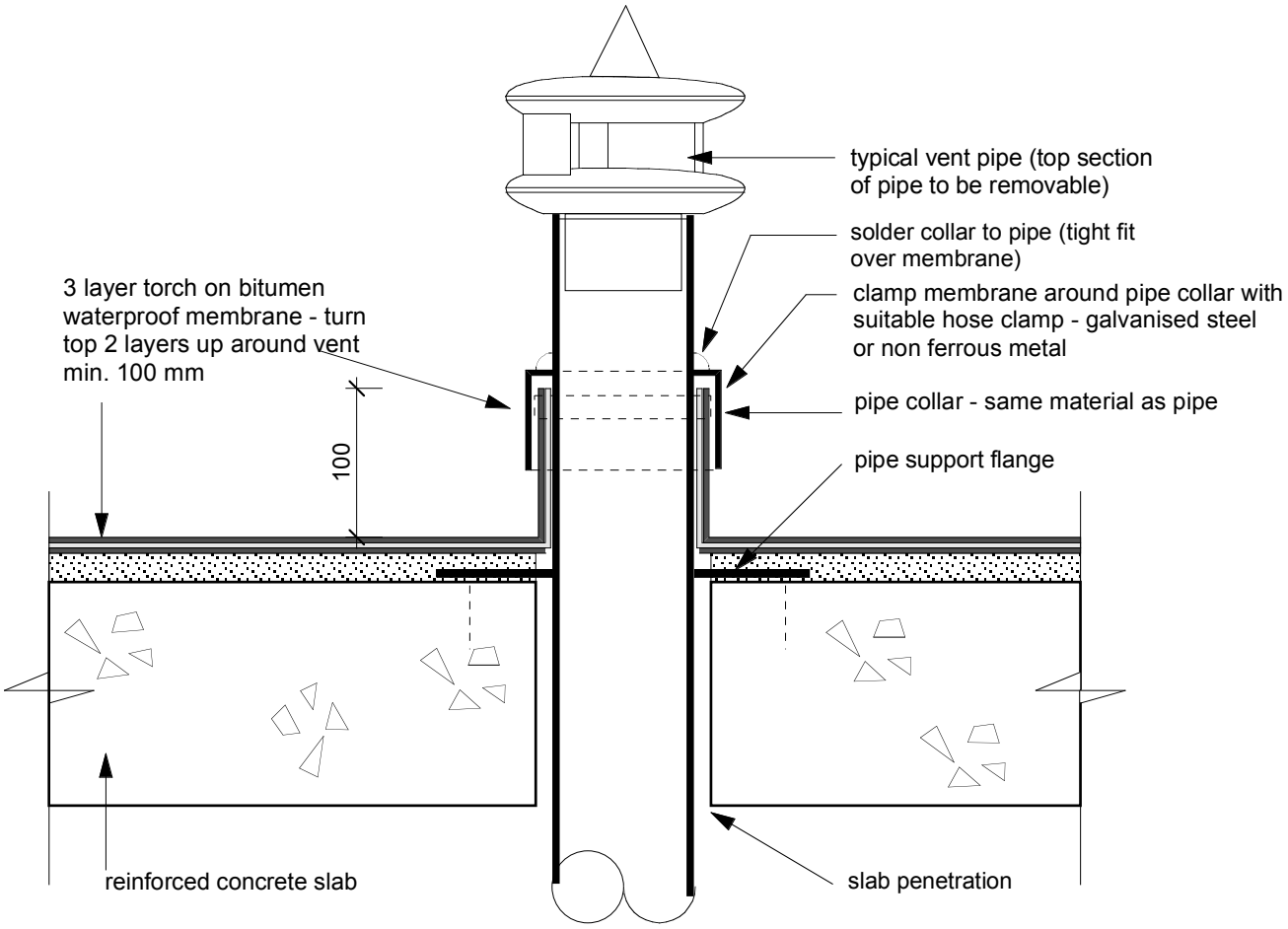
30 1:10 **SECTION**
FLASHING AT BRICK/CONCRETE WALL - NO CAVITY



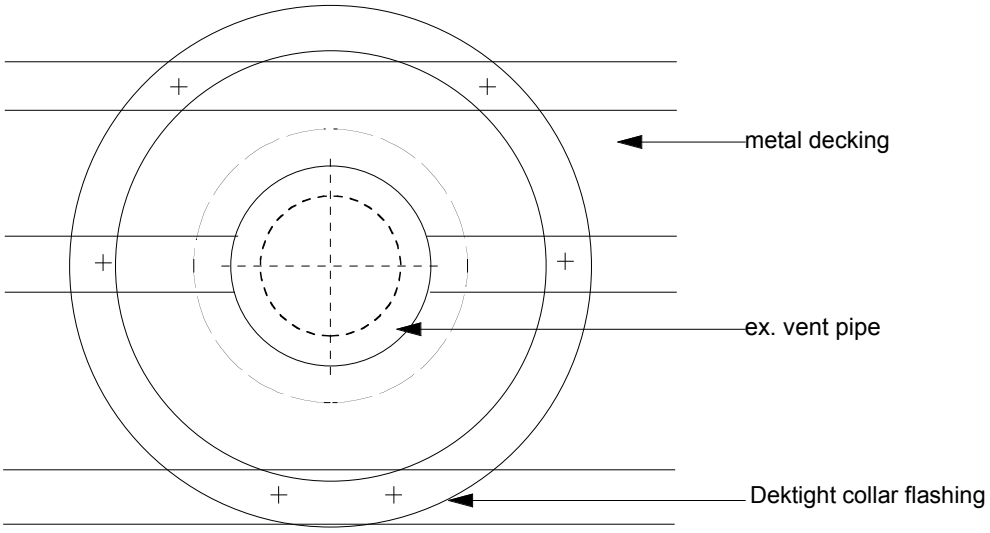
31 1:10 **SECTION**
BRICK FLASHING AT CAVITY WALL



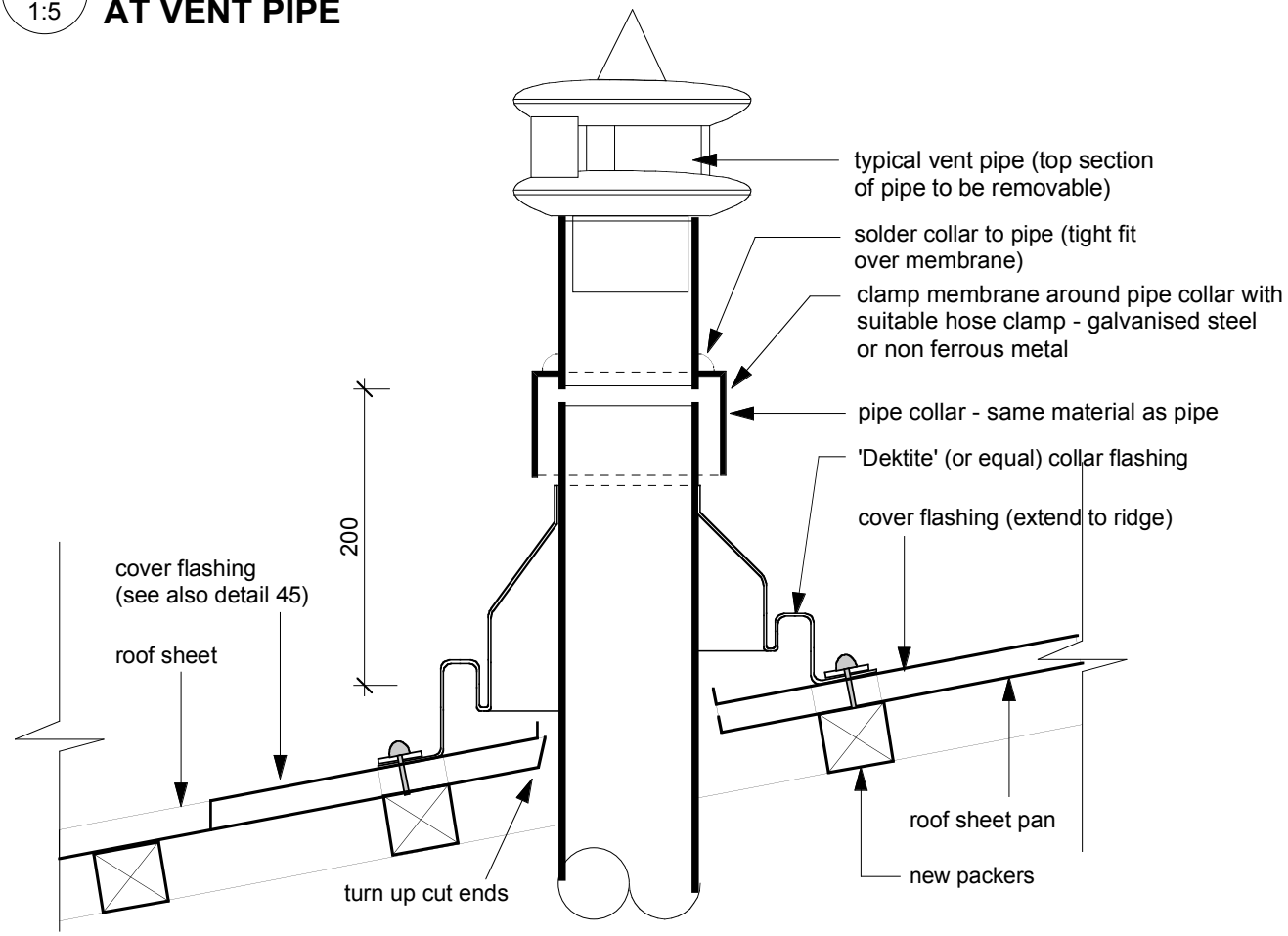
32
1:5
PLAN
AT VENT PIPE



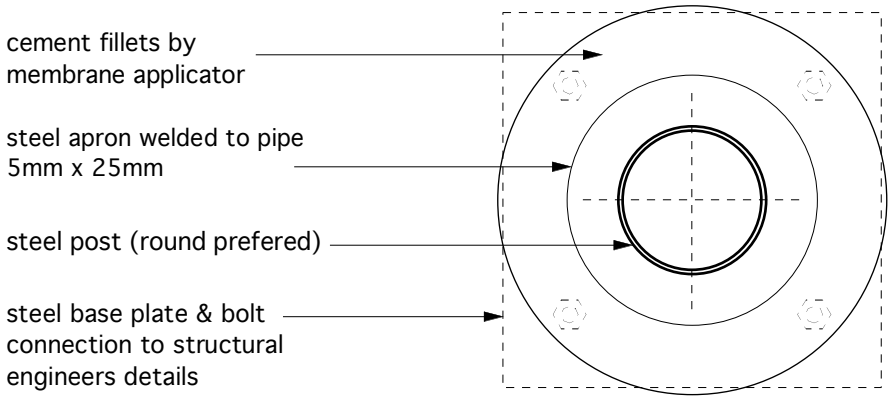
33
1:5
SECTION
AT VENT PIPE
CONCRETE ROOF WITH MEMBRANE



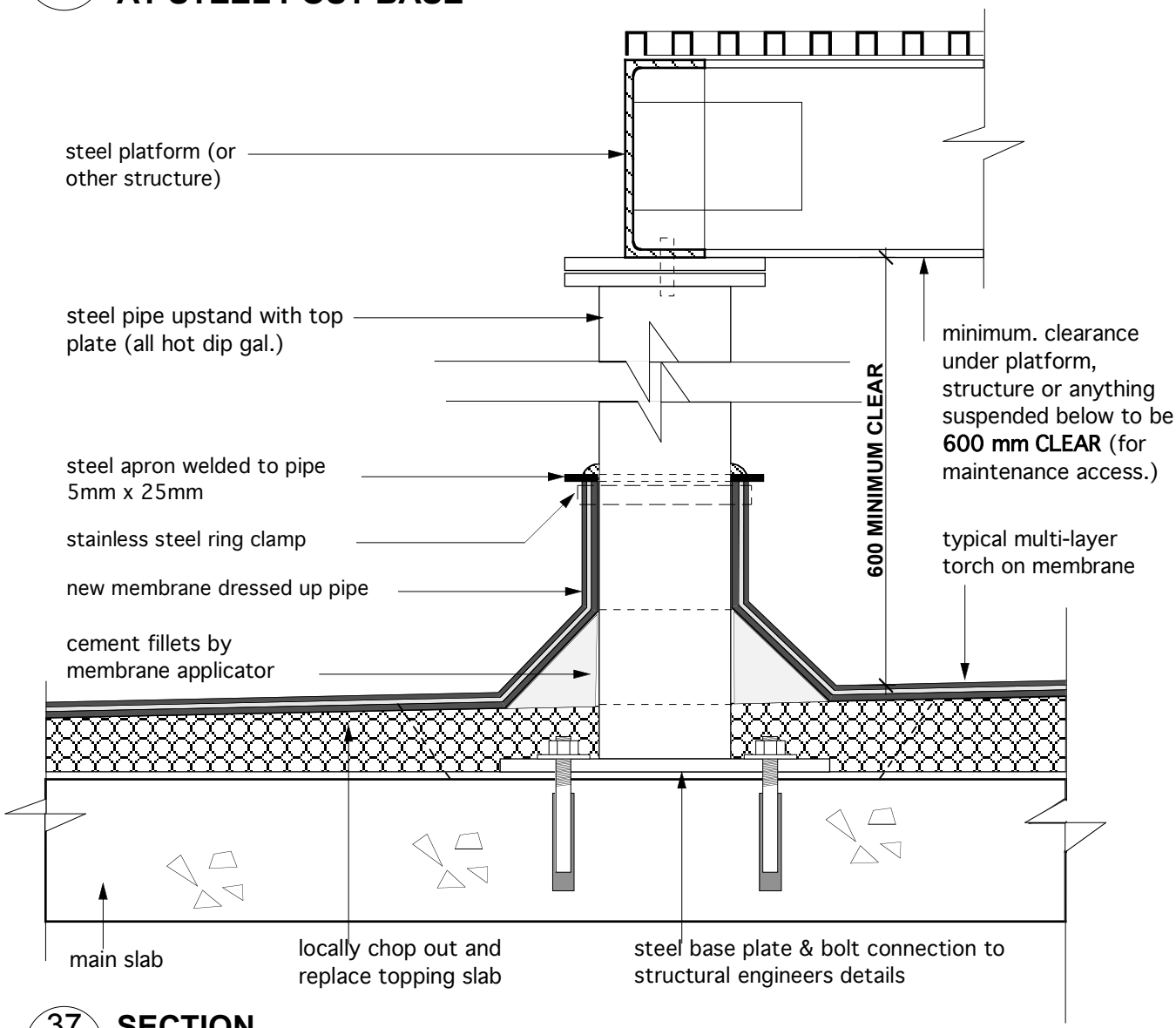
34
1:5
PLAN
AT VENT PIPE



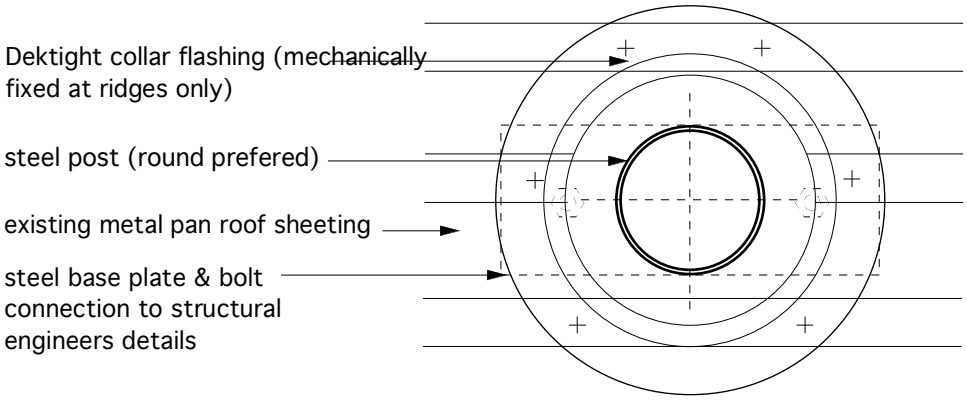
35
1:5
SECTION
AT VENT PIPE
METAL DECK ROOF ON TIMBER FRAME



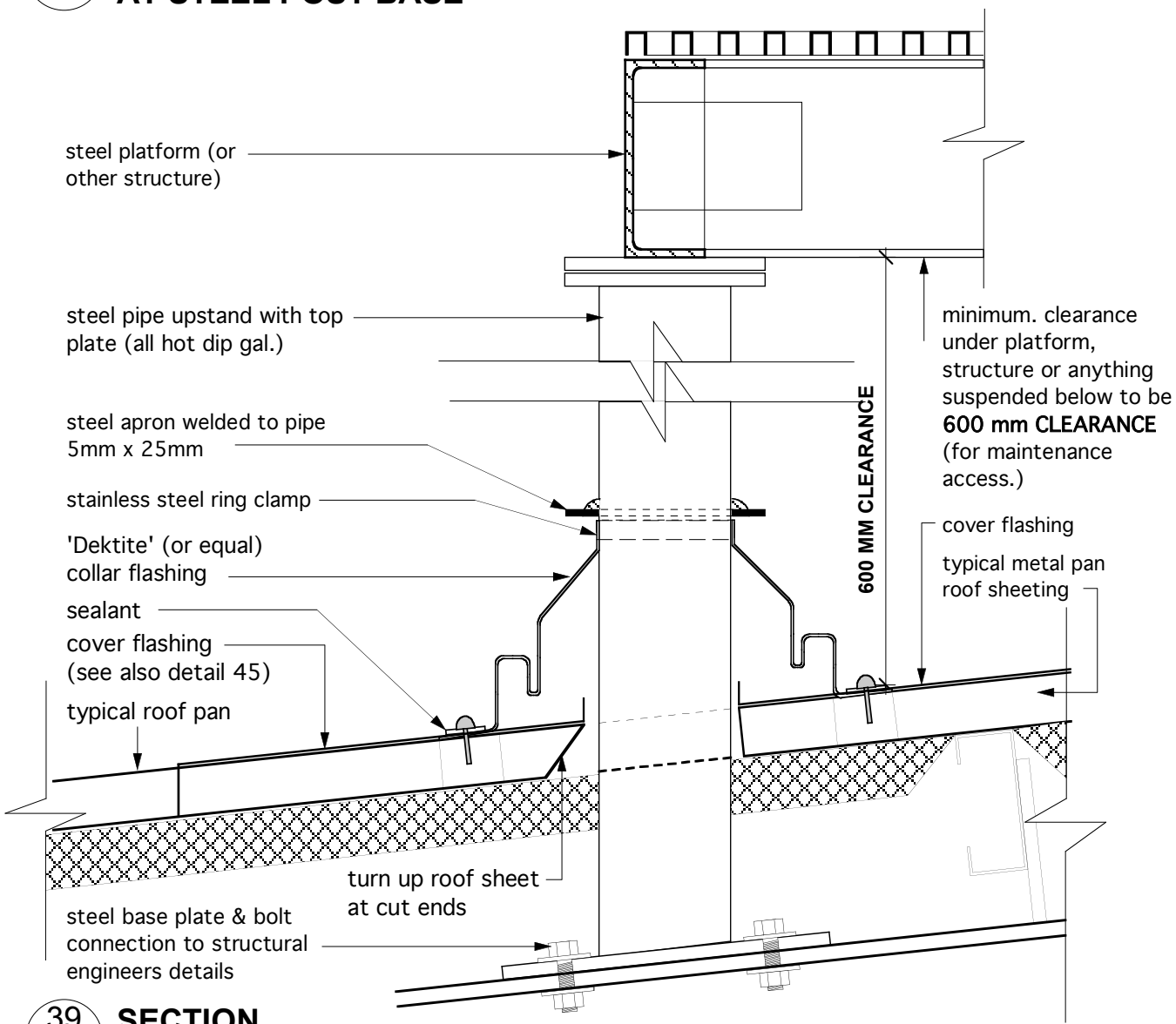
36 PLAN AT STEEL POST BASE
1:5



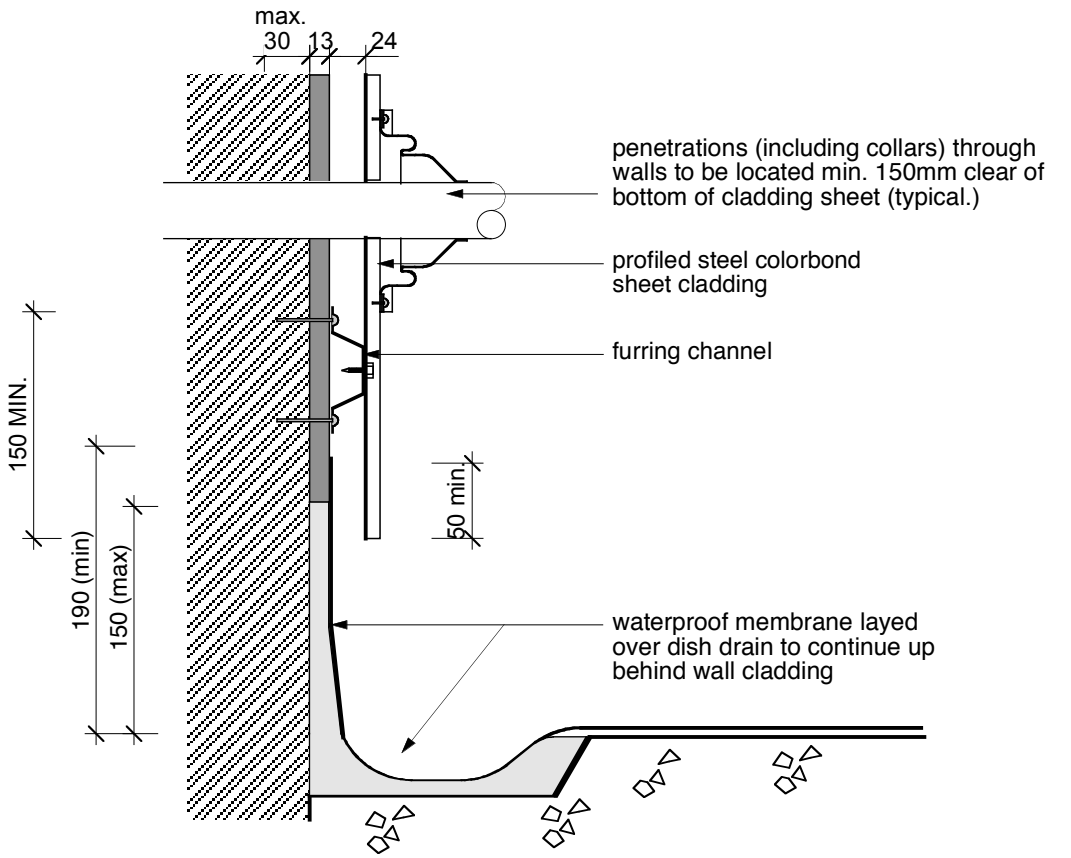
37 SECTION AT STEEL POST BASE CONCRETE ROOF WITH MEMBRANE AND TOPPING
1:5



38 PLAN AT STEEL POST BASE
1:5

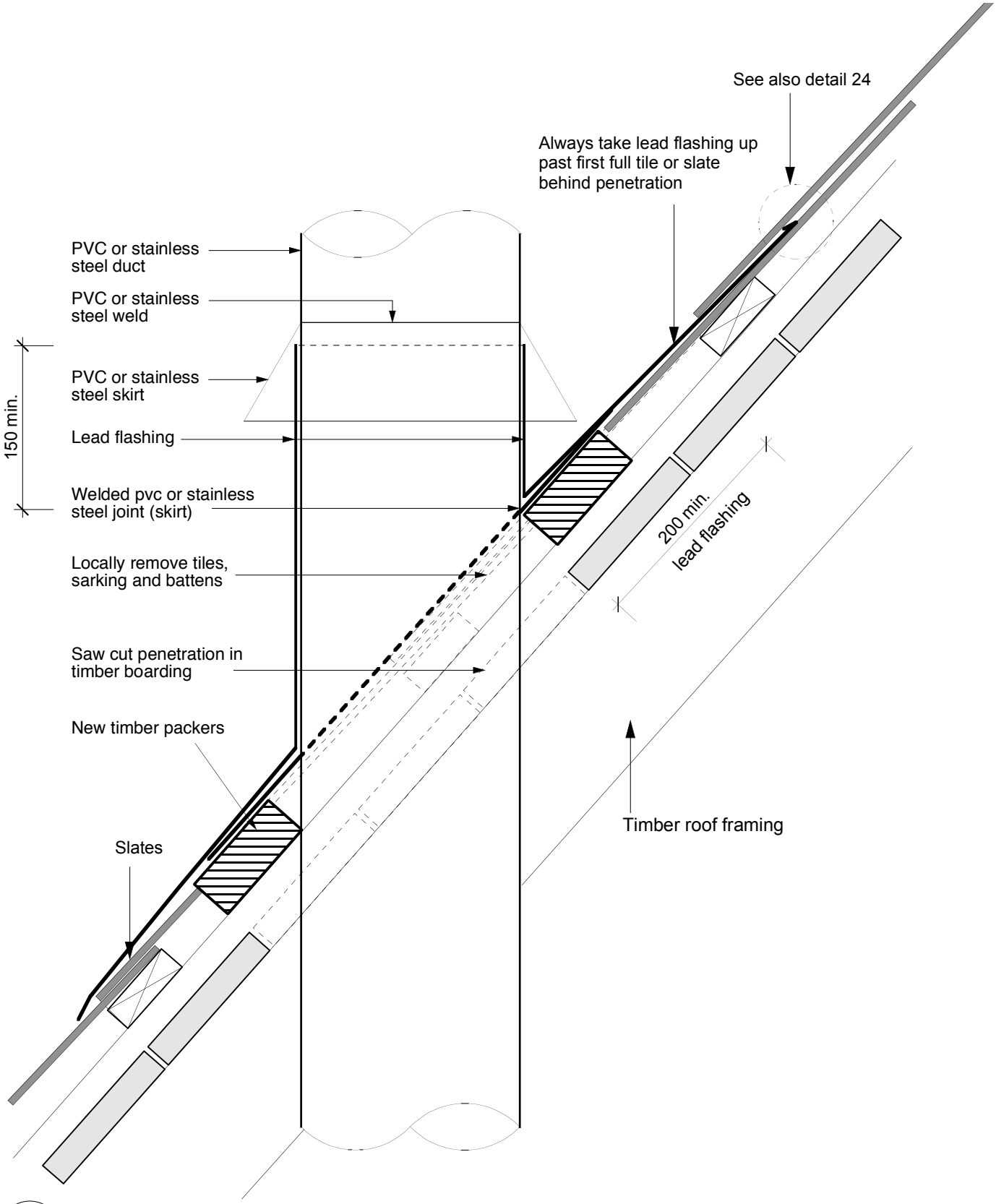


39 SECTION AT STEEL POST BASE METAL DECK ROOF ON STEEL FRAME
1:5



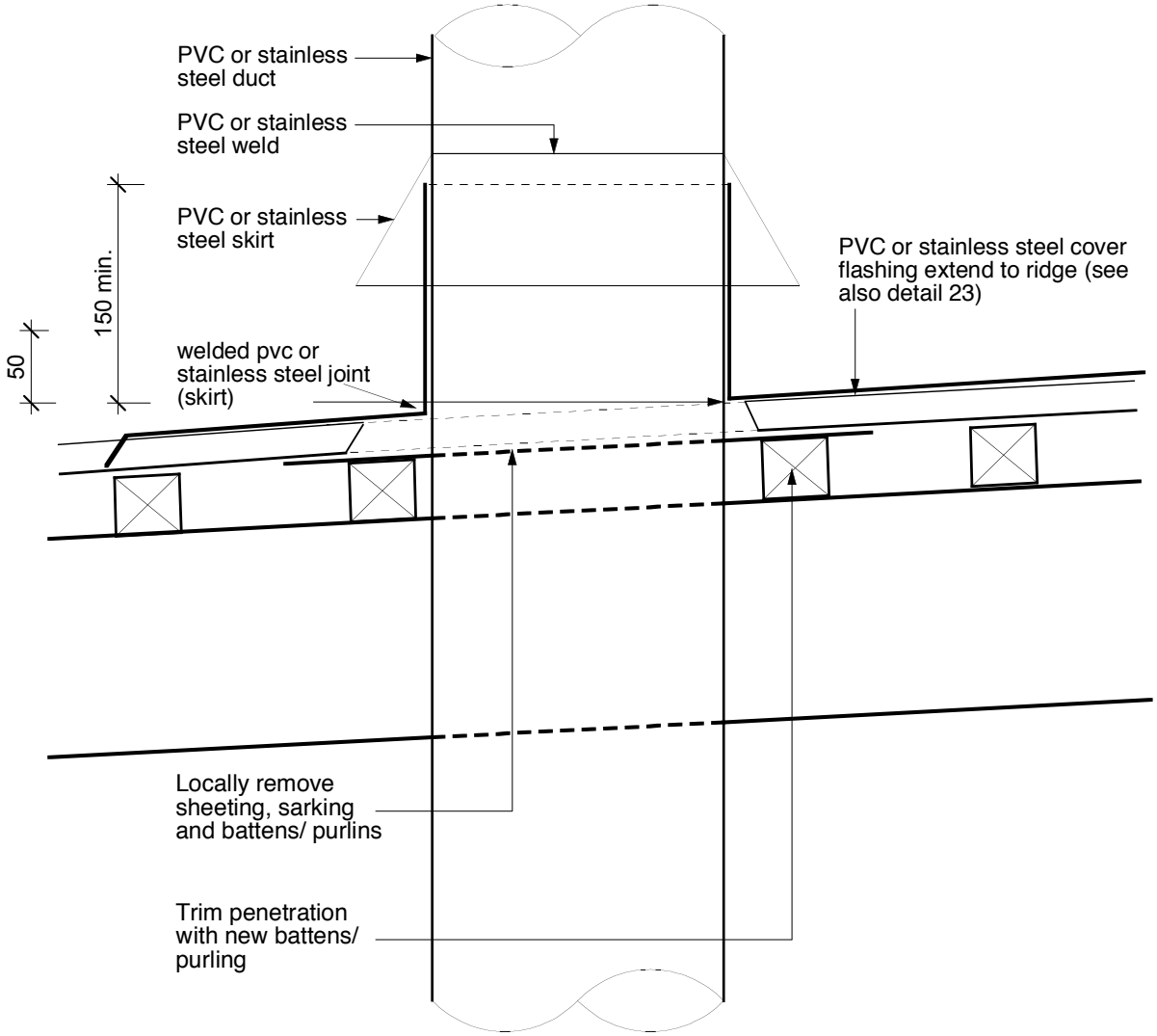
40
1:5

SECTION
MEMBRANE FLASHING AT WALL WITH OVERCLADDING & DISH DRAIN



41
1:5

SECTION
PVC DUCT PENETRATION SLATE AND TILE ROOFS



42
1:5

SECTION
PVC DUCT PENETRATION
METAL DECK ROOF ON TIMBER FRAME

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 42

SCALE: 1:5 DATE: 05.03.04 REV No: B SHEET No: 30

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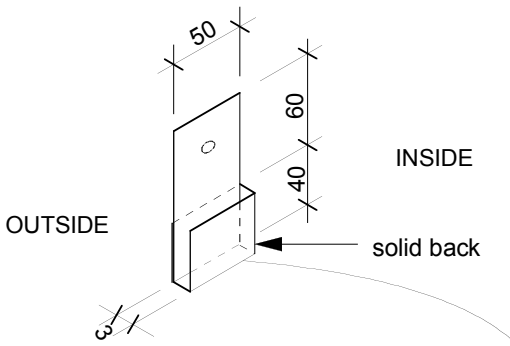
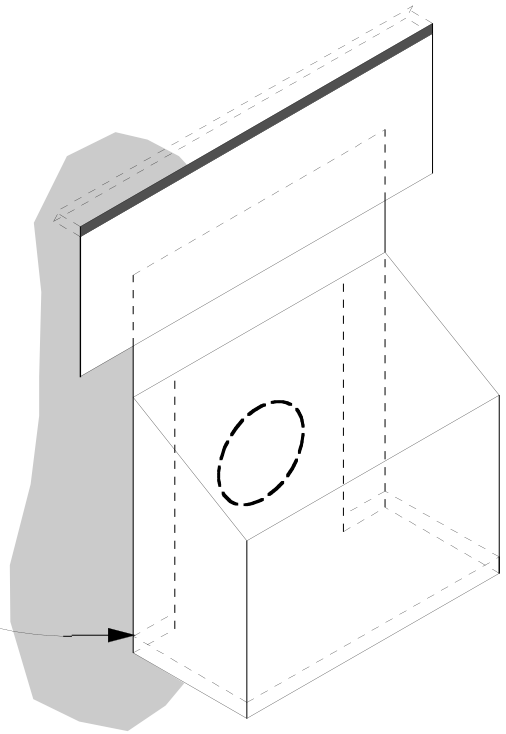
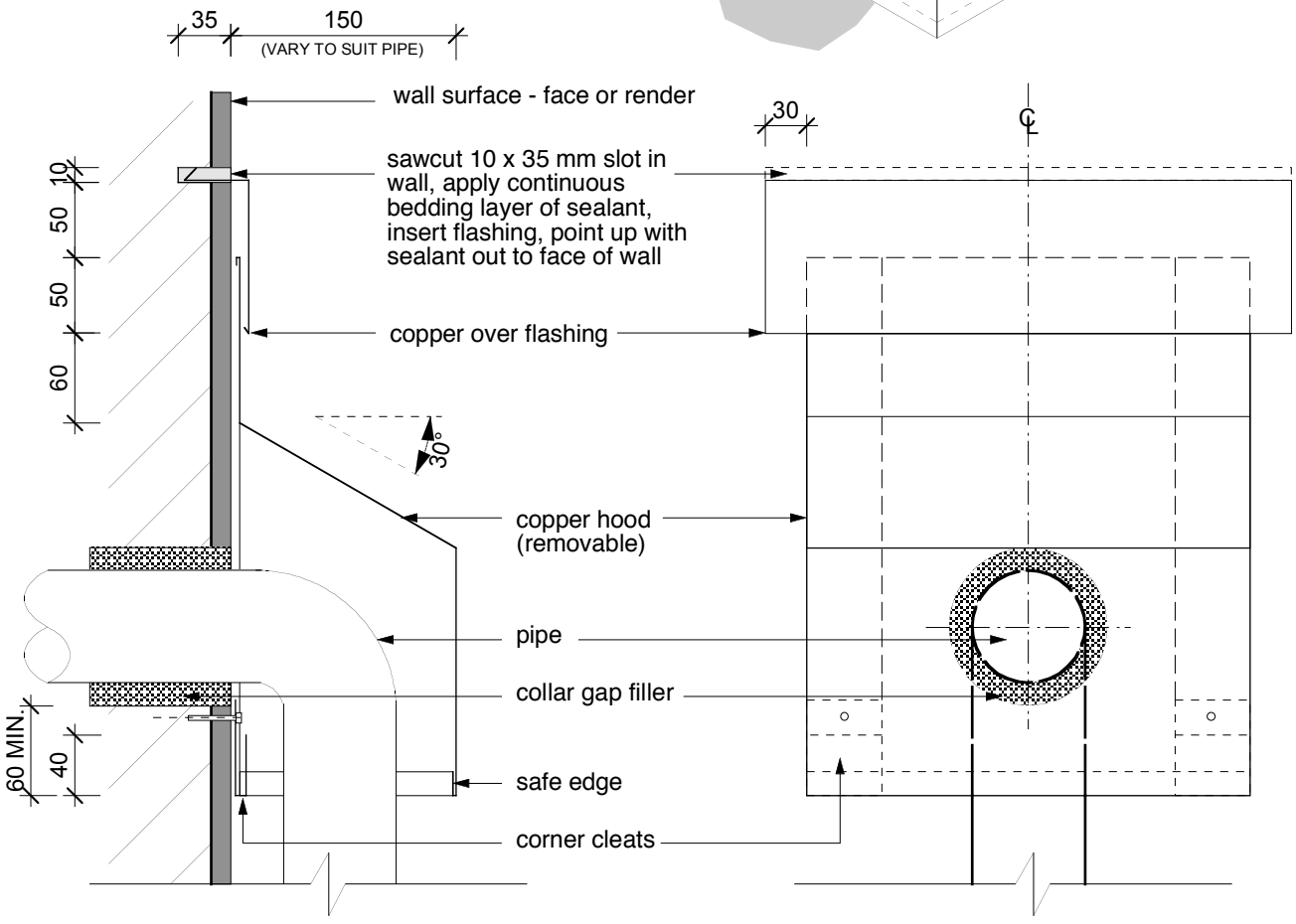
NOTE: Preferred material of construction is copper. Where copper is not possible (eg. Due to presence of other less noble metals) use colorbond steel.



corner cleat isometric view fold up from single piece of copper & weld





4 SECTION & ELEVATION
3 WALL PENETRATION - PIPE COVER
5 MASONRY WALL

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 43

SCALE: 1:5 DATE: 21.05.02 REV No: A SHEET No: 31

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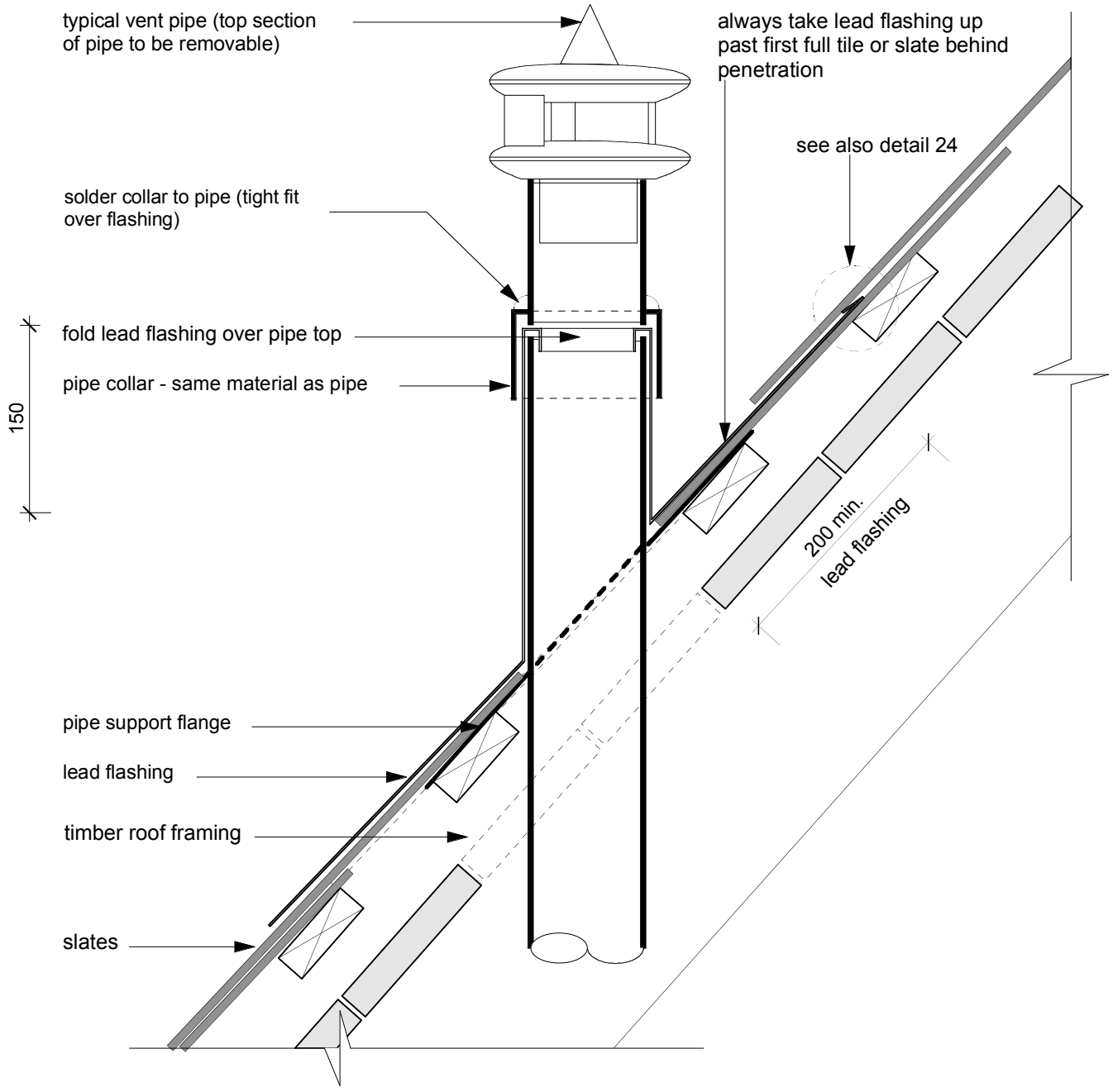

44
1:5

SECTION AT VENT PIPE SLATE AND TILE ROOFS

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 44

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 32

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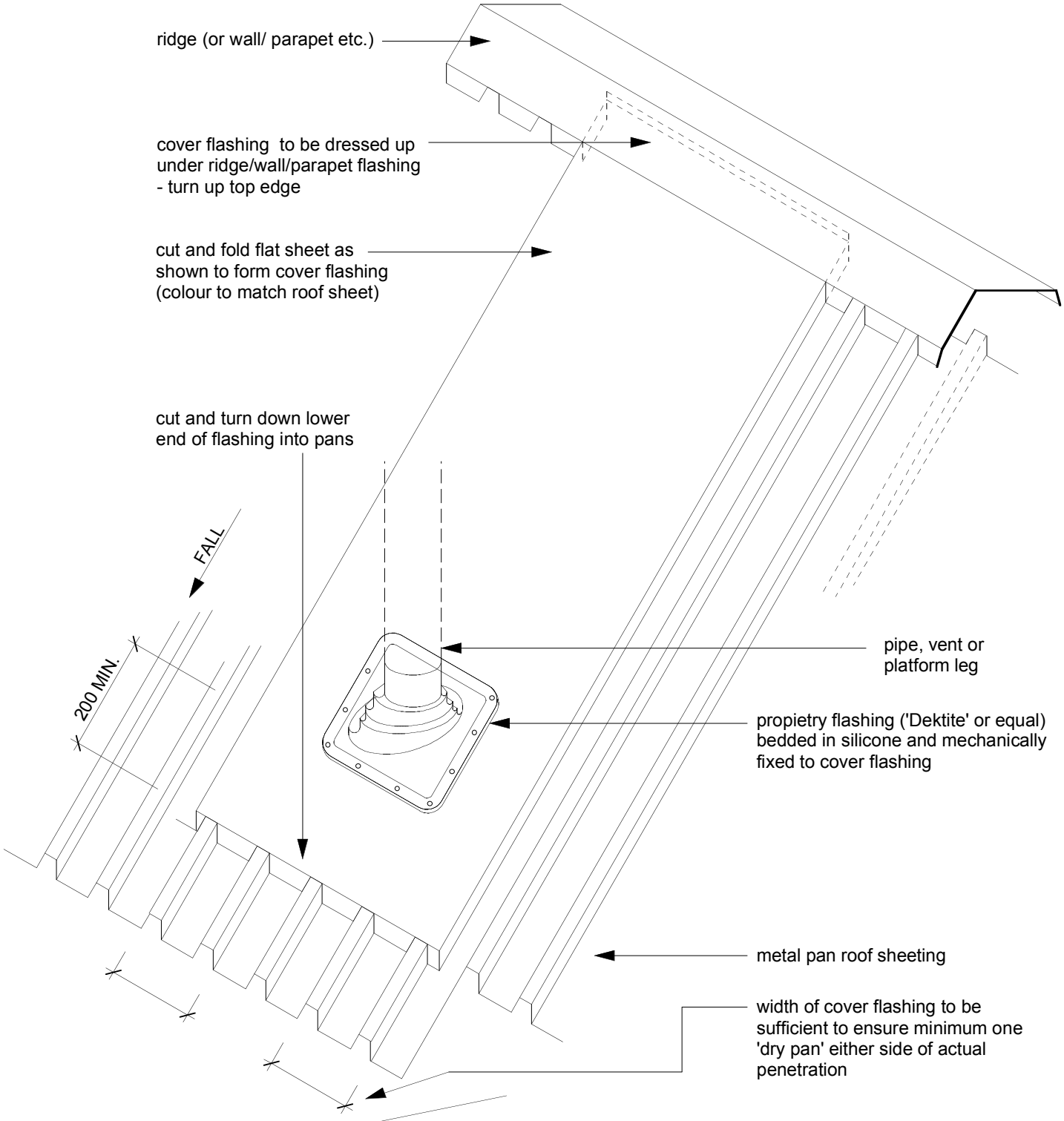

45
1:5

ISOMETRIC

COVER FLASHING FOR PENETRATIONS IN CONJUNCTION WITH PROPRIETRY PIPE/CONDUIT FLASHINGS - METAL DECK ROOFS

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL 45

SCALE: 1:5 DATE: 20.11.03 REV No: A SHEET No: 33

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