



CIS Roofing & Guttering Standard

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Table of Contents

1	PURPOSE	1
2	SCOPE	1
3	GLOSSARY OF TERMS	2
4	AUTHORITIES AND RESPONSIBILITIES	2
5	TECHNICAL REQUIREMENTS	2
5.1	Introduction	2
5.2	Design and Documentation	3
5.2.1	Design Approach	3
5.2.2	Design Input and Process	3
5.2.3	Engineering Process	3
5.2.4	Calculations	3
5.2.5	Design Conditions	3
5.2.6	Equipment Selection and Sizing.....	4
5.2.7	Thermal Efficiency	4
5.2.8	Roof Types	4
5.2.9	Future Allowances	4
5.2.10	Other Design Requirements.....	4
5.3	Technical Components	5
5.3.1	Introduction	5
5.3.2	Safety.....	5
5.3.3	Safety Systems.....	5
5.3.4	Access Hatches/Doors	5
5.3.5	Penetrations and Flashings	5
5.3.6	Silicone Boot Flashings (Dektite)	6
5.3.7	Movement.....	6
5.3.8	Galvanic Separation	6
5.3.9	Jointing	6
5.3.10	Gutters.....	7
5.3.11	Overflow & Spitters.....	7
5.3.12	Rain Heads.....	8
5.3.13	Roof Plumbing.....	8
5.3.14	Skylights	8
5.3.15	Insulation	8
5.3.16	Plant.....	8
5.3.17	Communications Equipment.....	8
5.3.18	Materials	9
5.3.19	Testing & Commissioning.....	10
5.4	Redundant Equipment	11
5.5	Product Support.....	11
6	COMMISSIONING	11
7	DOCUMENTATION AND RECORDS	11
8	OPERATIONS	11
9	AUTHORISATION OF VARIATIONS	12
10	QUALITY CONTROL	12
10.1	Design Standard Compliance	12



10.2	Design Standard Certification	12
10.3	Construction Compliance.....	12
10.4	Acceptance	13
11	REFERENCES	13
12	NOTES	13
13	DOCUMENT AMENDMENT HISTORY	13
14	ATTACHMENTS	13

1 PURPOSE

The CIS Roofing and Guttering Standard sets out the University of Sydney's minimum requirements for the design, construction and maintenance of roofing and guttering systems. 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:
 - I. Workplace Health and Safety legislation
 - II. Disability Discrimination legislation
 - III. State Environmental Planning and Assessment legislation
 - IV. All other Commonwealth and State legislation
 - V. NCC and BCA
 - VI. AS/NZS
 - VII. This standard and other University standards

2 SCOPE

These Standards describe the minimum requirements for the design, construction and maintenance of all roofing and guttering throughout all buildings owned, operated and managed by the University of Sydney.

The Standard applies to 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 Roofing and Guttering Standard provides:

- a reference document to enable consistency with the design and engineering objectives
- details of the minimum performance requirements for Planning, Architectural Design and maintenance.
- support of the University Vision for the built environment and best practice.

The Standard addresses key objectives:

- quality design which responds, enhances and complements the environment
- appreciation of the heritage context and cultural history of the campuses
- value for money in all aspects of the project
- the design of low maintenance buildings and environments
- longevity of construction approach to design
- standardization of key flashing and ancillary details
- flexible design, to future proof building usage for expansion or adaption to new uses
- safety in design

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.

4 AUTHORITIES AND RESPONSIBILITIES

This standard is owned by CIS. It is approved and signed off by the Director, CIS. CIS is responsible for maintaining the standard and keeping it up-to-date. The Standard must be reviewed biennially.

5 TECHNICAL REQUIREMENTS

5.1 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 of 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.

5.2 DESIGN AND DOCUMENTATION

5.2.1 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 education and research requirements advance at a rapid rate, usage of the buildings and areas within buildings can change a number of times within the life of a building, systems must be designed to be adaptable for such changes

5.2.2 Design Input and Process

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

- a. Building Physics - provide advice to the project team, including other design team members that would improve the inherent building thermal performance and water tightness. This may initially take the form of simple advice, and subsequently backed up by thermal modelling or similar methods. The consultant, designer or installer is expected to advise, contribute and if necessary lead such a process.
- b. Planning and Architecture – Provide advice on the appropriate type of roof and the access strategy to assist in both the planning of the building and the facilitation of improved maintenance in the future. Such advice must be provided in the early stage of the design and planning process so the above points can be taken into consideration in the architect's design. Late advice will lead to poor location of plant/assets and lack of maintenance access. Poor design of a building results in exorbitant maintenance costs during the life of the building.
- 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.

5.2.3 Engineering Process

The University expects consultants, designers and installers to be fully qualified, extensively experienced in their field. The consultants, designers and installers are to be capable of carrying out engineering design, calculations, equipment selection and construction quality checks.

5.2.4 Calculations

Engineering calculations are required to be performed to validate system design and installation, including satisfying the following:

- a. 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.
- b. 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.

5.2.5 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 AS/NZS3500.
- b. Generally, consultants and contractors are discouraged to include flat membrane roofs in their design. Full details will need to be submitted to CIS 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.

5.2.6 Equipment Selection and Sizing

In selecting equipment, the University expects consultants, designers and installers to select products of proven and reliable quality.

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.

5.2.7 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.

5.2.8 Roof Types

Full details of all proposed roof types must be submitted to CIS for approval, prior to any works commencing on site.

The following roof types are to be followed at all times:

- a. Metal Deck Roofs – Preferred application.
- b. Tiled Roofs – 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 CIS for approval.

5.2.9 Future Allowances

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 CIS for approval.

5.2.10 Other Design Requirements

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

5.3 TECHNICAL COMPONENTS

5.3.1 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.

5.3.2 Safety

Roof safety is an integral part of all work performed on all of 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 Safe Work Method Statements (SWMS).

5.3.3 Safety Systems

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 is capable of sustaining 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.

5.3.4 Access Hatches/Doors

Access hatches to roofs 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.

5.3.5 Penetrations and Flashings

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

Roof penetrations need considerable planning and design before installation. Penetrations must be located in areas of the roof that will require the minimum flashing detail. The sole purpose of a flashing is to weather proof 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 particular detail is not covered by this standard, a detailed design of the proposed penetration must be submitted to CIS for approval.

5.3.6 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.

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 to be flashed by one flashing component. Each service or piece of equipment will be dedicated its own silicone flashing.

5.3.7 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 rain water.

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 CIS for approval.

Co-efficient ratings can be found in the Australian Standards AS/NZS3500 and HB39-1997.

5.3.8 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 HB39-1997.

5.3.9 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 CIS.

Joint types include:



- a. **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.
- b. **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.
- c. **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.

5.3.10 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.

Listed are minimum requirements for guttering within the University.

a. Eaves Gutters

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

b. Box Gutters

- All box gutters are to be constructed from stainless steel or copper.
- 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).
- Overflows on internal box gutters are to be connected to a stormwater drainage system separate from the primary outlets.
- All box gutter joints are to be either soldered or welded. Silicone is not to be used.
- Box gutters must have a minimum of 300mm clear width for ease of cleaning.

c. Valley Gutters

- Valley gutters must be adequately supported by valley boards running the entire length of the gutter.
- Joints in valley gutters must be lapped.
- No welding or sealing of joints will be allowed.
- Weathering of the valley gutters must include a supported "turn up" of at least 10mm.

5.3.11 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.

5.3.12 Rain Heads

Rainheads are acceptable and encouraged to be used as when constructed correctly, offer exceptional fail safe qualities. Rainheads 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 rainhead must be included in the design. The overflow must be installed no less than 100mm from the end of any ancillary product supplying the rainhead. The capacity of the overflow is to be no less than 1 ½ times the size of the gutters/downpipes supplying the rainhead.

5.3.13 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°.
- e. Internal downpipes are not recommended. If internal downpipes are to be designed, failsafe components must be submitted to the CIS for approval.

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

5.3.14 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.

5.3.15 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.

5.3.16 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 CIS to install a platform to house the plant. 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.

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.

Steel platforms are to be hot dipped galvanised.

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

5.3.17 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.

5.3.18 Materials

Different roof types require different levels of skill and design. All materials must be of high quality with no blemishes or damage. Materials that are found to be of inferior quality will be removed at the contractor's expense. Below are the approved materials and their design requirements:

a. Steel and Aluminium

- **Roofing** – Minimum 0.48mm BMT
- **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.

b. Tiles

- **Roofing** – Glazed Terracotta
- **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.

c. Membrane

- **Roofing** – Minimum 3 layer Polyester Bitumen Sheet
- **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 moisture 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.

d. Copper

- **Roofing** - 0.7mm soft drawn
- **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.

e. Lead

- **Roofing** – Minimum 25kg/m²
- **Flashings/Guttering** – Minimum 30kg/m²



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

f. **Slate**

- **Roofing** – Welsh or Canadian
- **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.

5.3.19 Testing & Commissioning

Testing is an integral part of the commissioning of new roofing works. All roof components must be subjected to testing before Practical Completion is awarded. Photo evidence or a site visit from the University's delegate 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;

- 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. Bung 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.
- Box gutters**- these gutters must be flood tested so the highest point of the box gutter has at least 10mm coverage of water. Bung 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.
- 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.
- 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.
- 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 engineers certification for all anchor points and the entire safety system, must included in the Operational and Maintenance manuals.
- 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 engineers certification for all anchor points and the entire safety system, must included in the Operational and Maintenance manuals.

5.4 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”.

5.5 PRODUCT SUPPORT

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

6 COMMISSIONING

Detailed testing and commissioning requirements must be specified for each project by the consultant/contractor. The commissioning sections of all relevant Australian Standards are appropriate reference documents to be used.

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.

Project hand over inspection and testing plans (ITPs) must be developed by the consultant/contractor to allow the system to be handed over to the University.

7 DOCUMENTATION AND RECORDS

The following documents must be provided at practical completion

- Maintenance manual
- Commissioning records
- Product manufacturer’s specific information
- Warranties
- System schematics
- Complete as-built drawings
- Roof Safety System Certification

8 OPERATIONS

Access to all roofs within the University is controlled by a UNIVERSITY OF SYDNEY ROOF ACCESS PERMIT.

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.

9 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 alternative 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 **CIS Standards - Request for Dispensation Form (CIS-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.

10 QUALITY CONTROL

10.1 DESIGN STANDARD COMPLIANCE

Compliance with requirements of this standard must be checked throughout the design, construction and commissioning phases of projects by:

- a. The CIS project consultant
- b. The issuer of this standard or their delegate

Competent CIS representatives must check compliance with this standard during design reviews and formal site inspections. Any non-compliance with requirements of this standard must be documented in the Non-conformance Report Form, **CIS-SYS-F001** and provided to the CIS Project Manager for issue to contractors and their consultants. Project Managers must maintain a register of non-conformances and manage close out of outstanding non-conformances. Contractors and their consultants issued with non conformances must take appropriate corrective or preventive actions. Proposed corrective or preventive actions and close out of non-conformances must first be formally approved by issuer of the standard or their delegate.

10.2 DESIGN STANDARD CERTIFICATION

Contractors and their consultants must certify compliance to the design standard by completing and submitting the CIS Project Design Certification Form, **CIS-PROJ-F001** to the CIS Project Manager at each of the following project phases:

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

Notwithstanding CIS' 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.

10.3 CONSTRUCTION COMPLIANCE

Consultants and designers 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.

10.4 ACCEPTANCE

The University will only accept projects as complete when all of the above have been carried out, submitted and verified. Along with the above, it is required that the design standard compliance checklist is completed and returned to CIS Engineering and Sustainability Department.

11 REFERENCES

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

- AS/NZS 3500 Plumbing and Drainage
- HB39-1997 Installation code for metal roof and wall cladding
- National Construction Code
- AS/NZS 1891-2001 Height safety and Re-Certification
- AS/NZS 4488 Industrial Rope Access Systems
- A3 4349 1998 Building Inspections
- Australian Bureau of Meteorology
- Traditional Copper Roofing (Author: H. Glover and D.E. Toner)
- Code Of Practice Safe Work On Roofs 1993 (Work Cover)
- AS 2050 Installation of Roof Tiles

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.

12 NOTES

N/A

13 DOCUMENT AMENDMENT HISTORY

Revision	Amendment	Commencing

14 ATTACHMENTS

- **Attachment 1** – Standard Roof and Wall Services Penetration Details



UNIVERSITY OF SYDNEY

STANDARD ROOF AND WALL SERVICES PENETRATION DETAILS

INDEX

Sheet Number	Detail Number	Item Description	Current Revision
-	-	Short Form Specification of Minimum Standards for Materials and Details	C
1	1	Wall flashing folded sheet metal over membrane roof – cut in type	A
1	2	Wall flashing extruded aluminium over membrane roof – pressure seal type	A
2	3 & 4	Wall flashing copper over copper box gutter – cut in type	A
3	5	Large service box penetration, brass & copper, for membrane on concrete roof (plan)	A
4	6	Large service box penetration, brass & copper, for membrane on concrete roof (Section)	A
5	7	Large service box penetration, brass & copper, for membrane on concrete roof (Section)	A
6	8	Large service box penetration colorbond, for colorbond/ zincalume roof on timber frame (plan)	A
7	9	Large service box penetration colorbond, for colorbond/ zincalume roof on timber frame (Section)	A
8	10	Large service box penetration colorbond, for colorbond/ zincalume roof on timber frame (Section)	A
9	11	Small service box penetration copper, for membrane on concrete roof (plan)	A
9	12	Small service box penetration copper, for membrane on concrete roof (Part elevation)	A
10	13	Small service box penetration copper, for membrane on concrete roof (Section)	A
11	14	Small service box penetration copper, for membrane on concrete roof (Section)	A
12	15	Small service box penetration slate,/tile roof (plan)	A
12	16	Small service box penetration slate,/tile roof (part elevation)	A
13	17	Small service box penetration slate,/tile roof (section)	A
14	18	Small service box penetration slate,/tile roof (section)	A
15	19	Small service box penetration colorbond roof (plan)	A
15	20	Small service box penetration colorbond roof (part elevation)	A
16	21	Small service box penetration colorbond roof (section)	A
17	22	Small service box penetration colorbond roof (section)	A
18	23	Upstream cover flashing, sheet metal, for profiled metal roofs	A
19	24	Small diameter penetration spigots, lead, for slate/ tile roofs (section)	A
20	25	Small diameter penetration spigots, lead, for slate/ tile roofs (Isometric views)	A



UNIVERSITY OF SYDNEY

STANDARD ROOF AND WALL SERVICES PENETRATION DETAILS

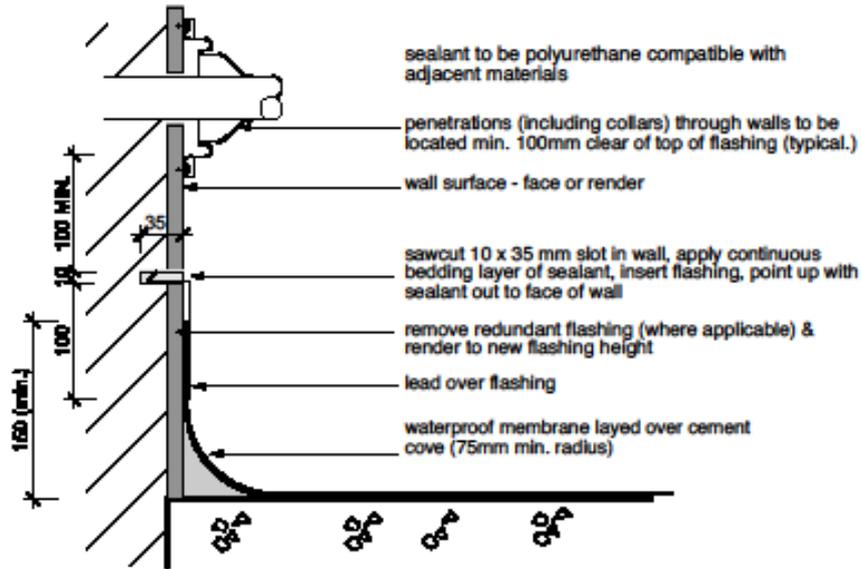
INDEX

Sheet Number	Detail Number	Item Description	Current Revision
20	26	Small diameter penetration spigots, lead, for slate/ tile roofs (section)	A
21	27 & 28	Concrete pad and unistrut bracket mounting for hydraulic, electrical and refrigeration lines transversing membrane on concrete roof.	A
22	29	uPVC fume cupboard exhaust through membrane on concrete roof (section)	B
23	30	Wall flashing, lead, over membrane/ concrete roof – no cavity	A
23	31	Wall flashing, lead, over membrane/ concrete roof – with cavity	A
24	32	Vent pipe penetration through membrane/ concrete roof (plan)	A
24	33	Vent pipe penetration through membrane/ concrete roof (section)	A
25	34	Vent pipe penetration through metal roof (plan)	A
25	35	Vent pipe penetration through metal roof (plan)	B
26	36	Structural steel pipe penetration and plant platform through membrane/ concrete roof (plan)	A
26	37	Structural steel pipe penetration and plant platform through membrane/ concrete roof (section)	A
27	38	Structural steel pipe penetration and plant platform through metal deck roof (plan)	A
27	39	Structural steel pipe penetration and plant platform through metal deck roof (section)	A
28	40	Membrane perimeter detail where bounding wall is metal clad	A
29	41	uPVC fume exhaust through slate/ tile roof	B
30	42	uPVC fume exhaust through metal roof	B
31	43	Weatherhood (removable) for wall penetrations	A
32	44	Vent pipe penetrations through slate/ tile roof.	A
33	45	Over flashing in conjunction with propriety pipe flashing ('Dektite')	A

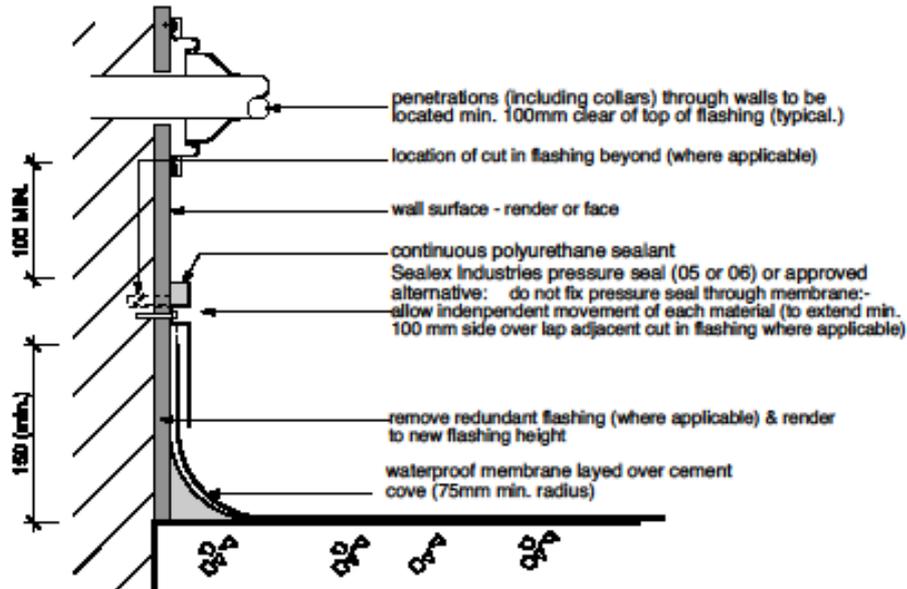
LISTING OF DETAILS BY APPLICATION

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 VERTICAL SECTION
1:5 CUT-IN FLASHING TO WALL



2 VERTICAL SECTION
1:5 PRESSURE SEAL FLASHING TO WALL

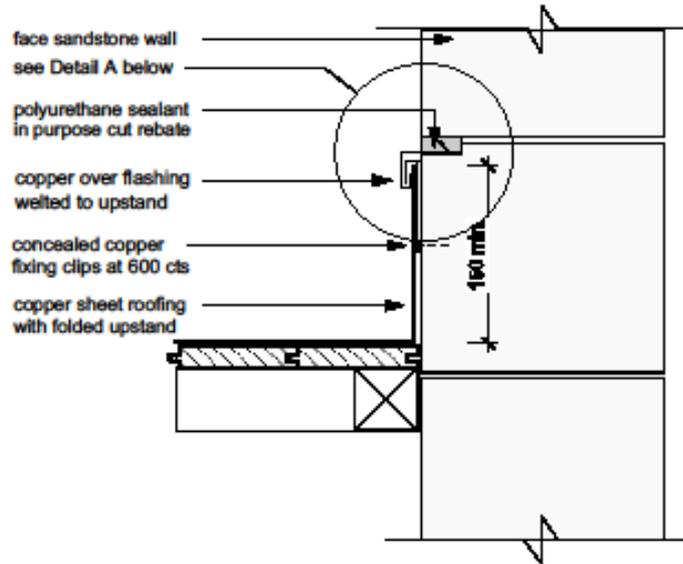
UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

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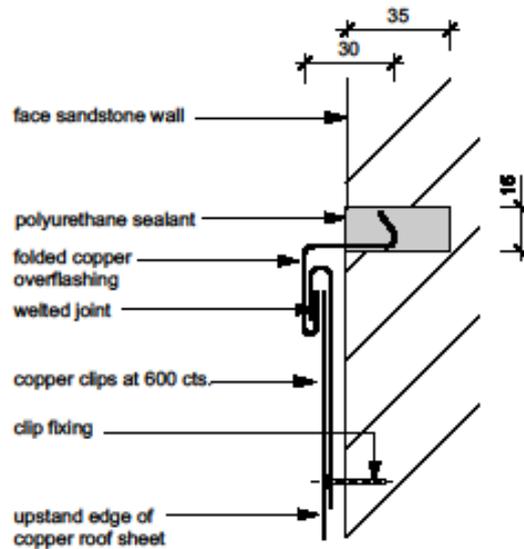
Prepared by DTB Architects Pty Ltd

DETAILS

①
②



3 VERTICAL SECTION
1:5 COPPER CUT-IN FLASHING TO STONE WALL



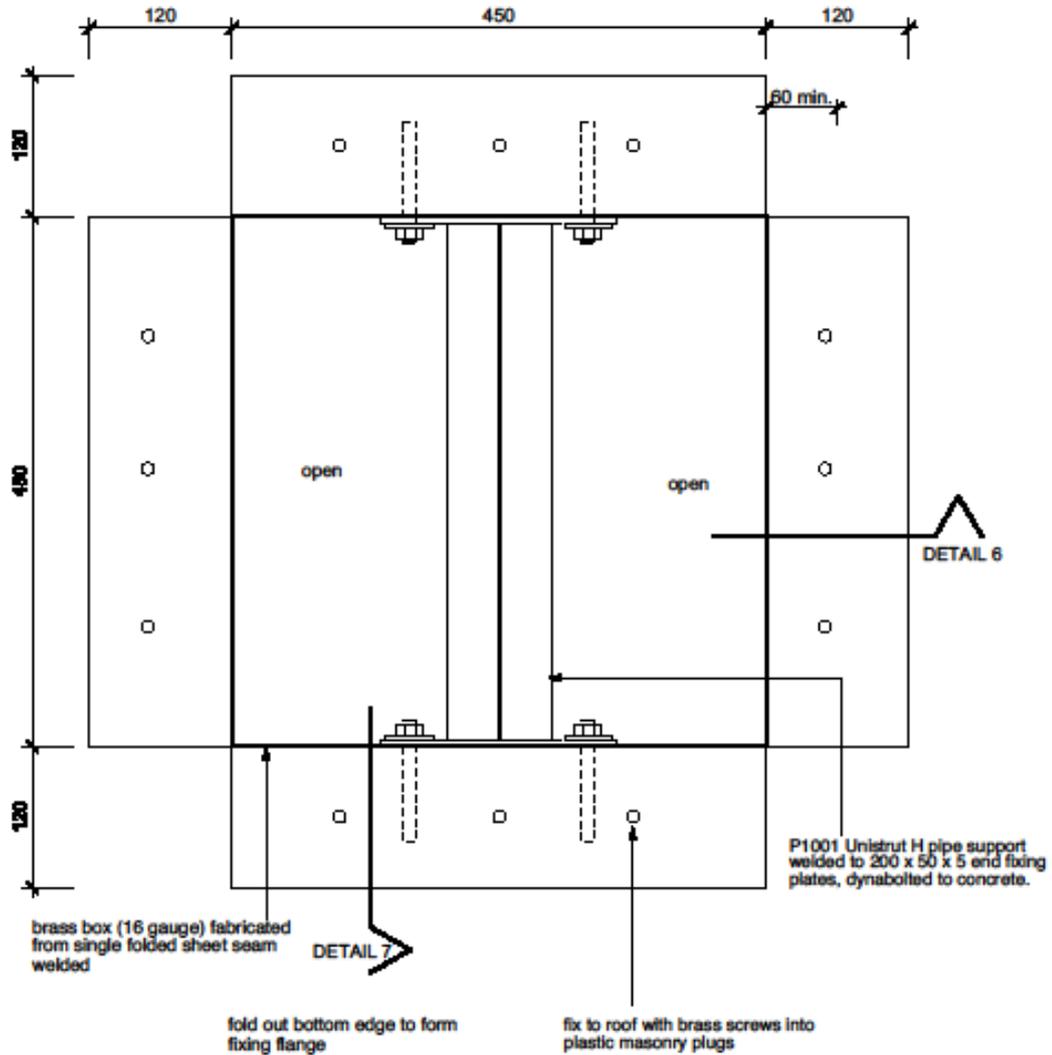
4 VERTICAL SECTION
1:2 DETAIL A

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STANDARD ROOFING AND WATERPROOFING DETAILS
SCALE: 1:5 & 1:2 DATE: 07.05.02 REV No: A SHEET No: 02
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DETAILS

3

4



5 PLAN
1:5 BOXING FOR MAJOR ROOF PENETRATIONS
CONCRETE ROOF

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 STANDARD ROOFING AND WATERPROOFING DETAILS

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

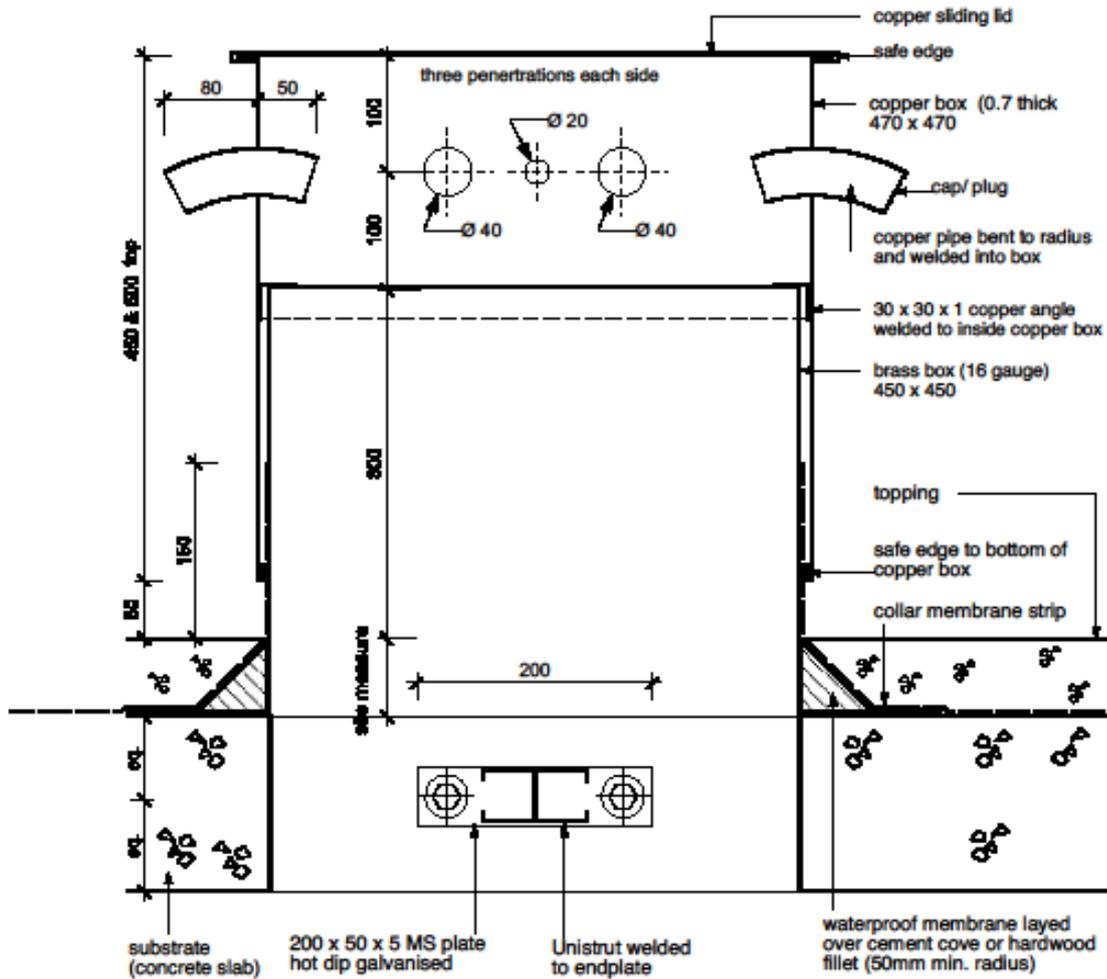
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DETAIL

5



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



6 VERTICAL SECTION
1:5 **BOXING FOR MAJOR ROOF PENETRATIONS**
CONCRETE ROOF WITH MEMBRANE AND TOPPING SLAB

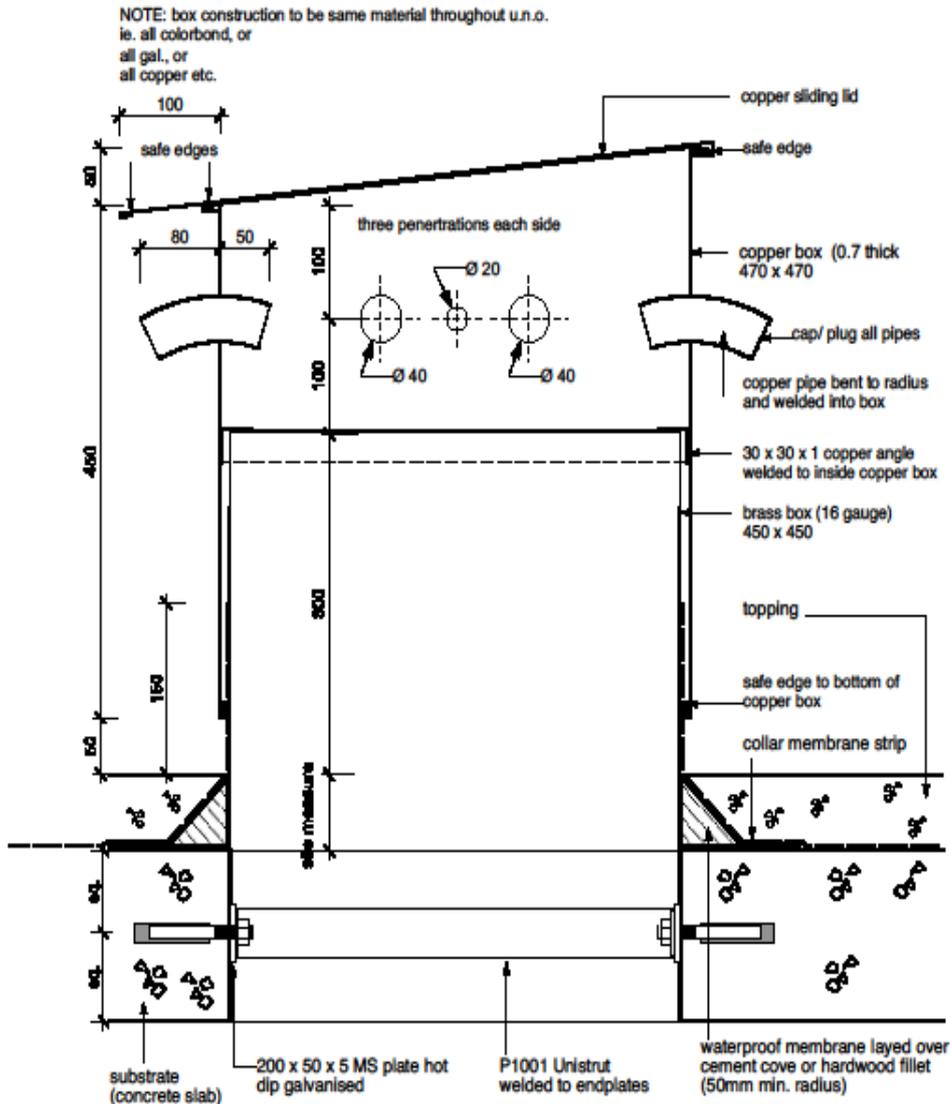
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DETAIL

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

6

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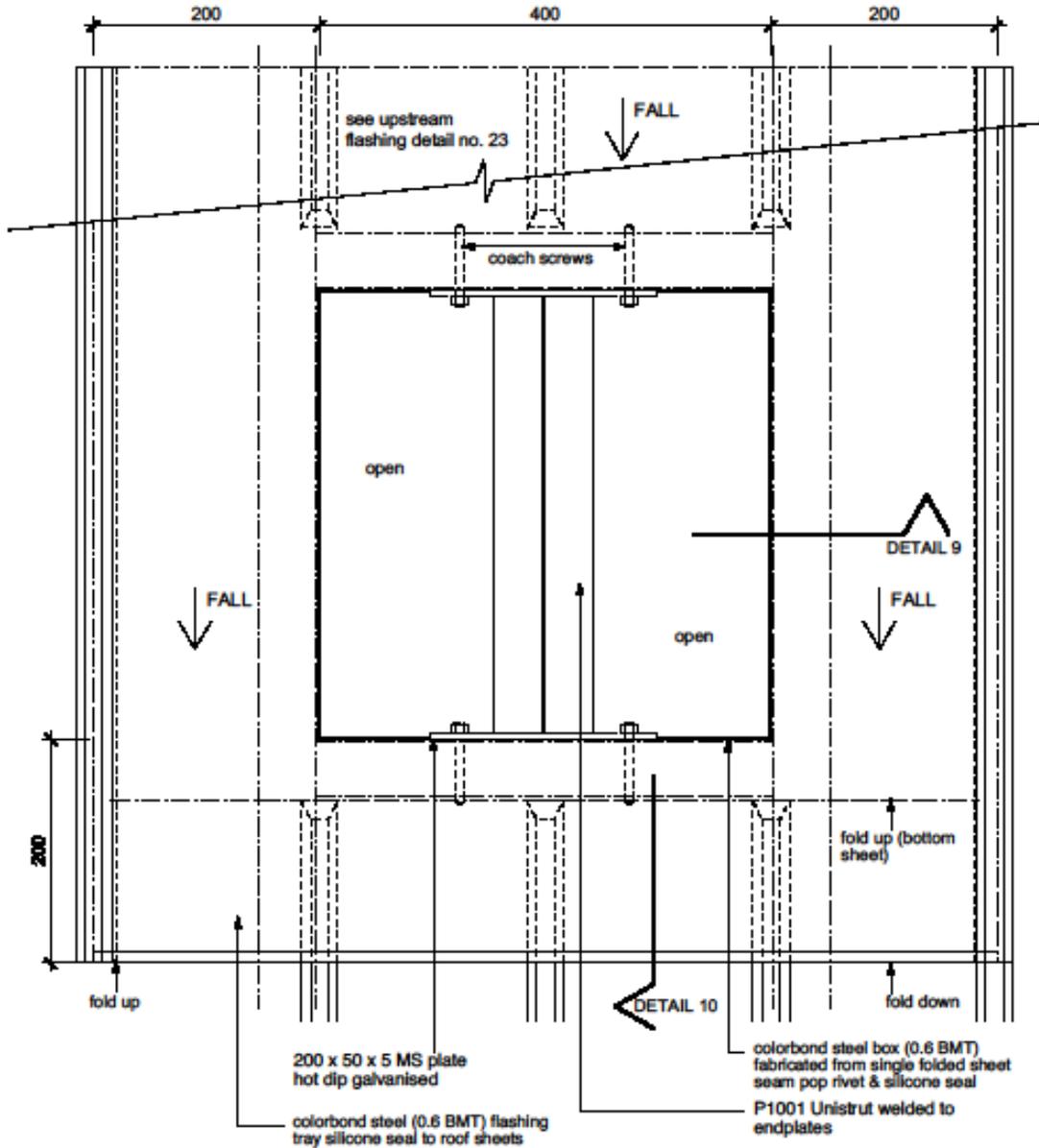
7 VERTICAL SECTION
1:5 **BOXING FOR MAJOR ROOF PENETRATIONS**
CONCRETE ROOF WITH MEMBRANE AND TOPPING SLAB

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STANDARD ROOFING AND WATERPROOFING DETAILS

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

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DETAIL
7



8 PLAN
1:5 BOXING FOR MAJOR ROOF PENETRATIONS
METAL DECK ROOF ON TIMBER FRAME

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STANDARD ROOFING AND WATERPROOFING DETAILS

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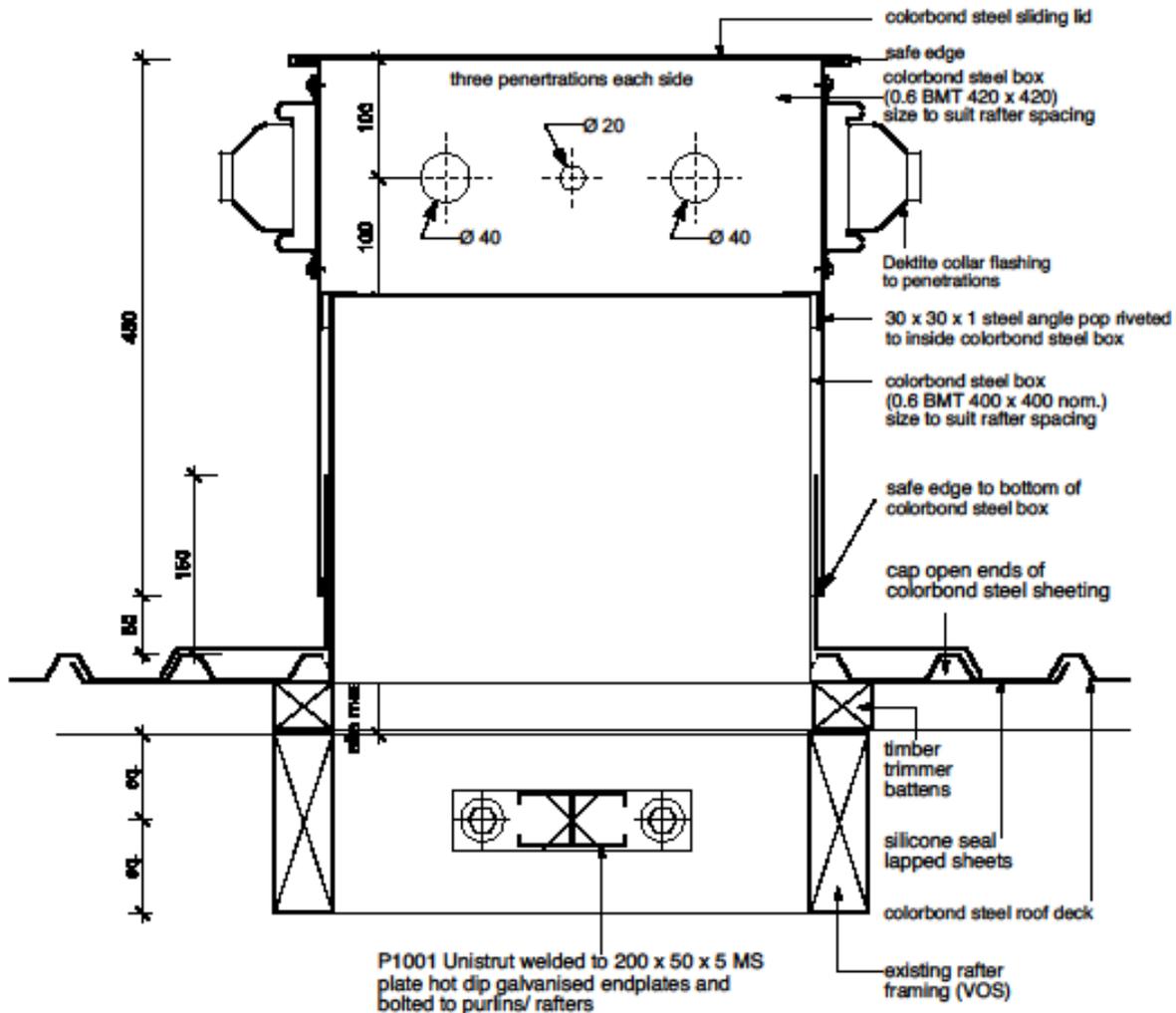
Prepared by DTB Architects Pty Ltd

DETAIL

8



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



9 VERTICAL SECTION
1:5 **BOXING FOR MAJOR ROOF PENETRATIONS
METAL DECK ROOF ON TIMBER FRAME**

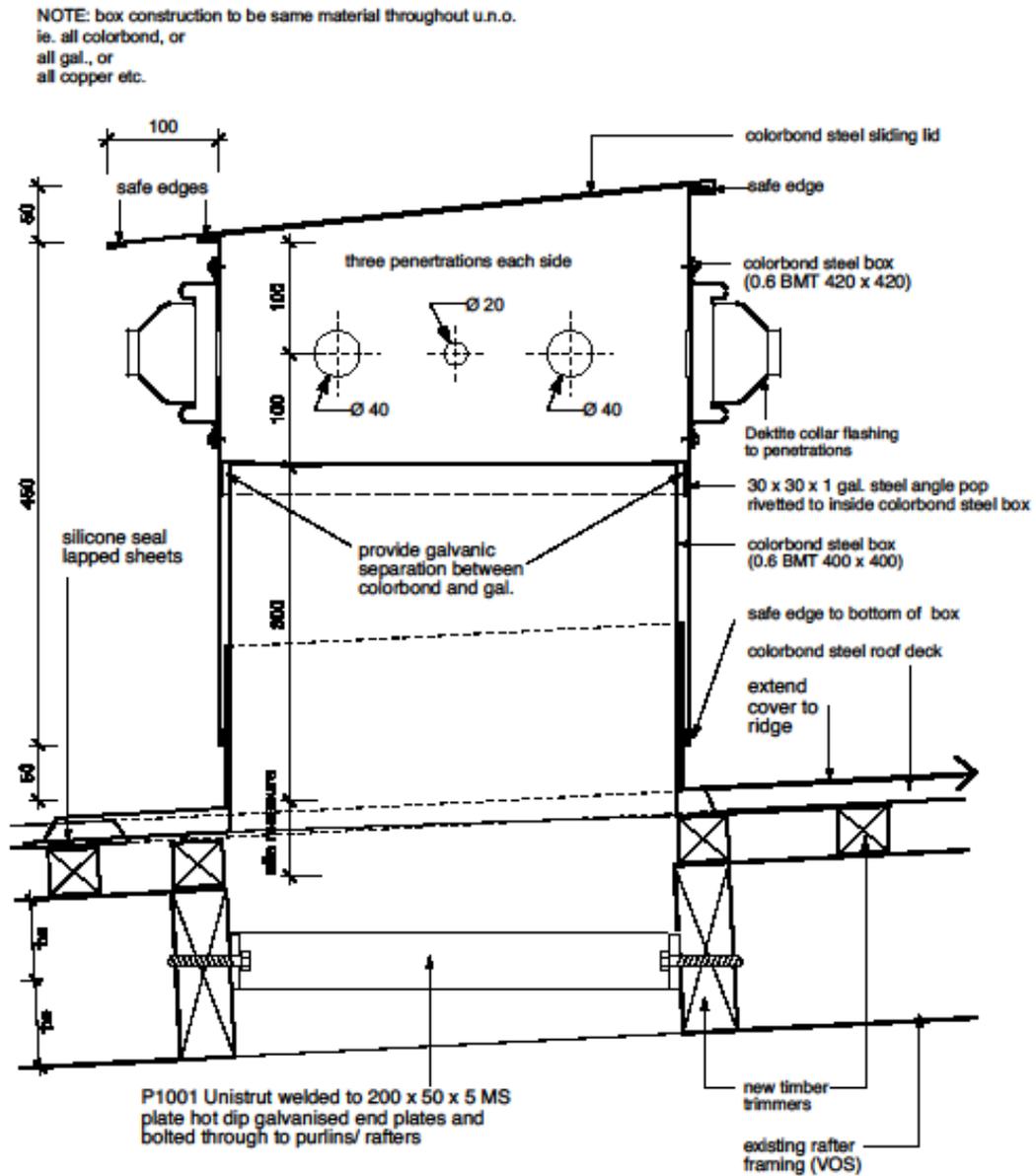
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DETAIL

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

9

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10 VERTICAL SECTION
1:5 **BOXING FOR MAJOR ROOF PENETRATIONS
METAL DECK ROOF ON TIMBER FRAME**

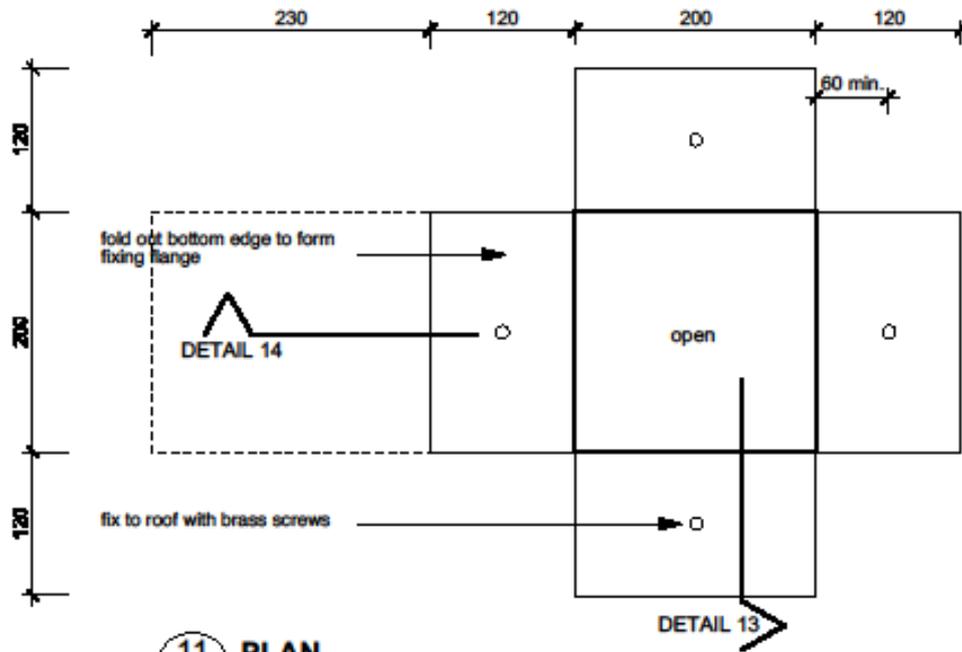
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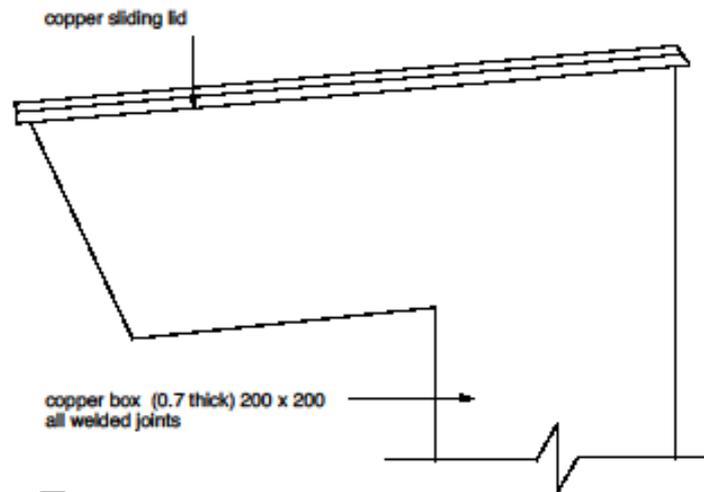
Prepared by DTB Architects Pty Ltd

DETAIL

10



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



12 ELEVATION
1:5 **BOXING FOR MINOR ROOF PENETRATIONS**
TOP PORTIONS - CONCRETE ROOFS

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STANDARD ROOFING AND WATERPROOFING DETAILS

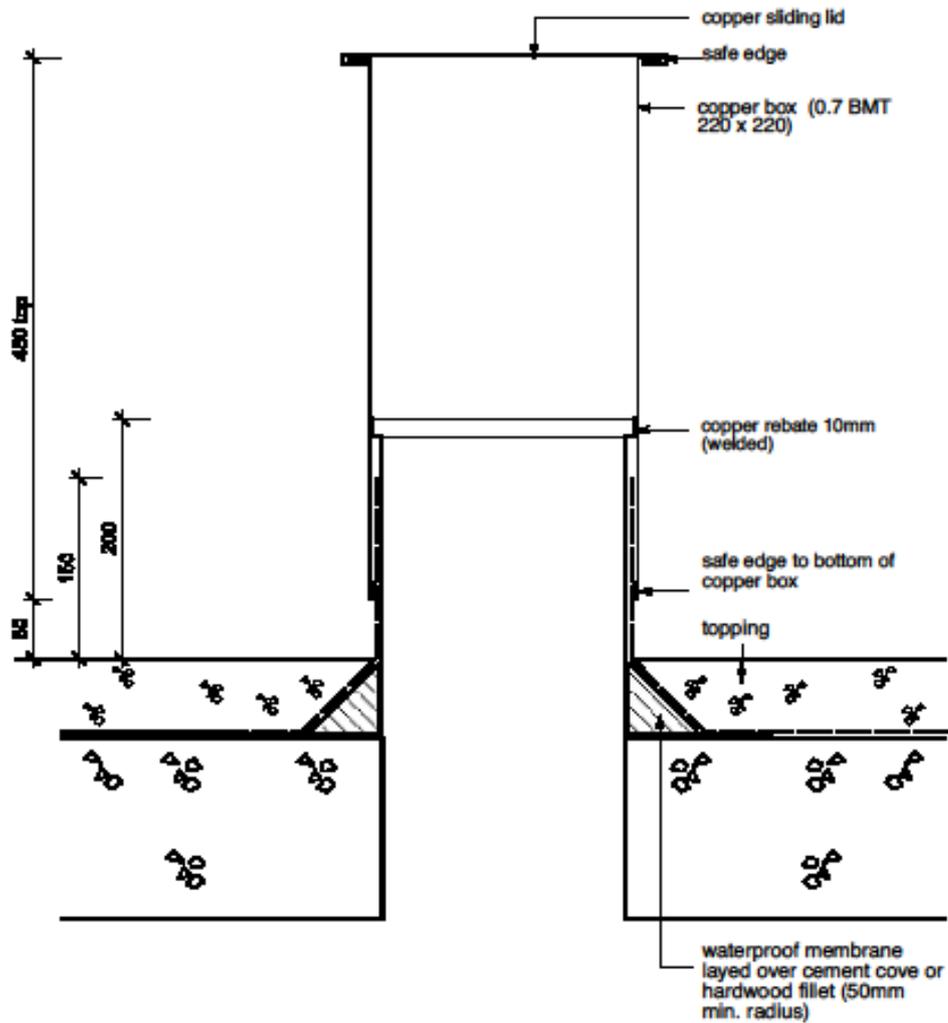
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DETAILS

11

12



13 VERTICAL SECTION
1:5 BOXING FOR MINOR ROOF PENETRATIONS
 CONCRETE ROOF WITH MEMBRANE & TOPPING SLAB

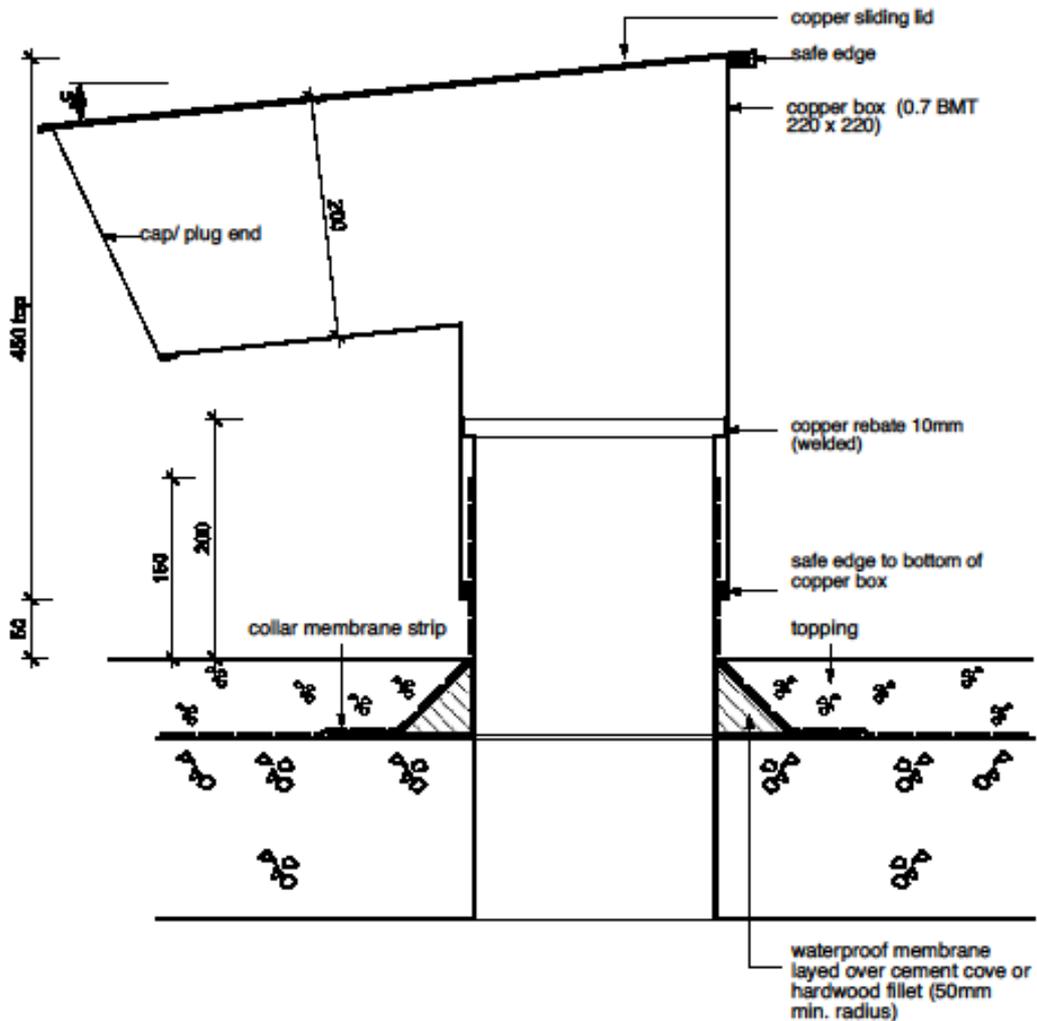
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 STANDARD ROOFING AND WATERPROOFING DETAILS

SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 10

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DETAIL

13



14 VERTICAL SECTION
1:5 **BOXING FOR MINOR ROOF PENETRATIONS**
CONCRETE ROOF WITH MEMBRANE & TOPPING SLAB

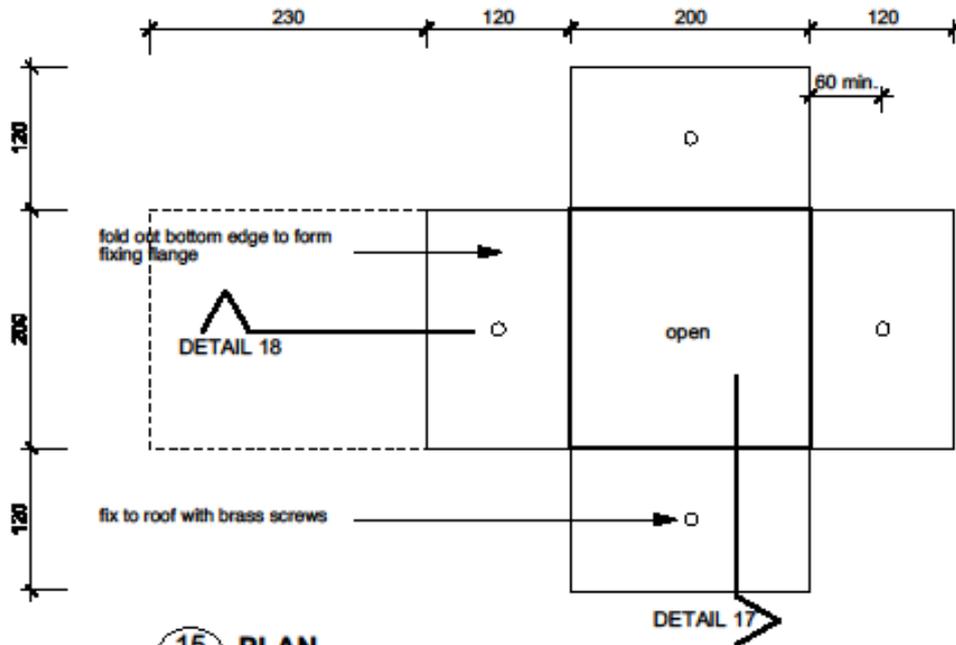
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STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL

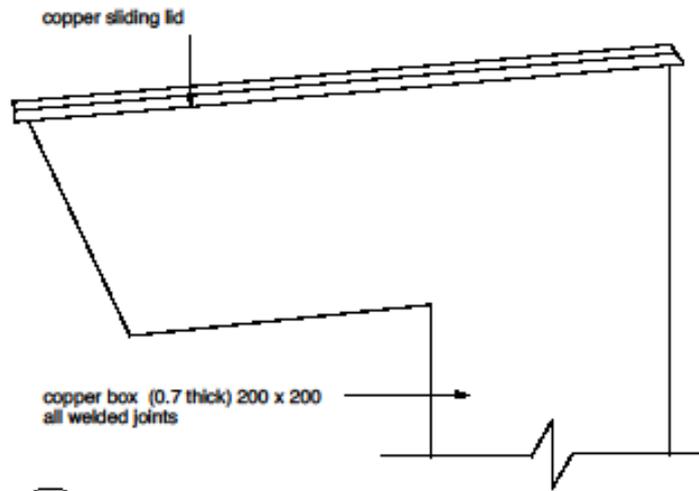
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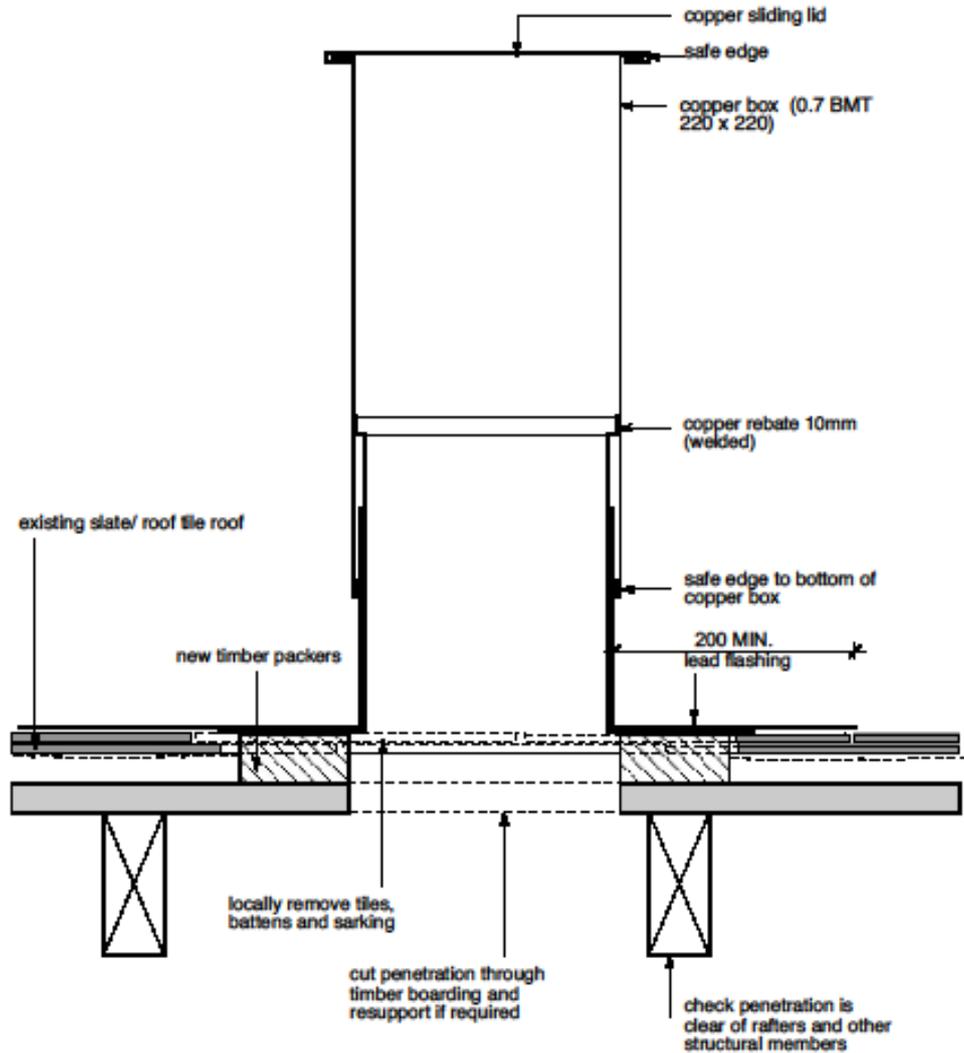
15 PLAN BOXING FOR MINOR ROOF PENETRATIONS 1:5



16 ELEVATION BOXING FOR MINOR ROOF PENETRATIONS TOP PORTION - TILE AND SLATE ROOFS 1:5

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 STANDARD ROOFING AND WATERPROOFING DETAILS
 SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 12
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DETAILS
 15
 16



17
1:5
VERTICAL SECTION
BOXING FOR MINOR ROOF PENETRATIONS
TILE & SLATE ROOFS

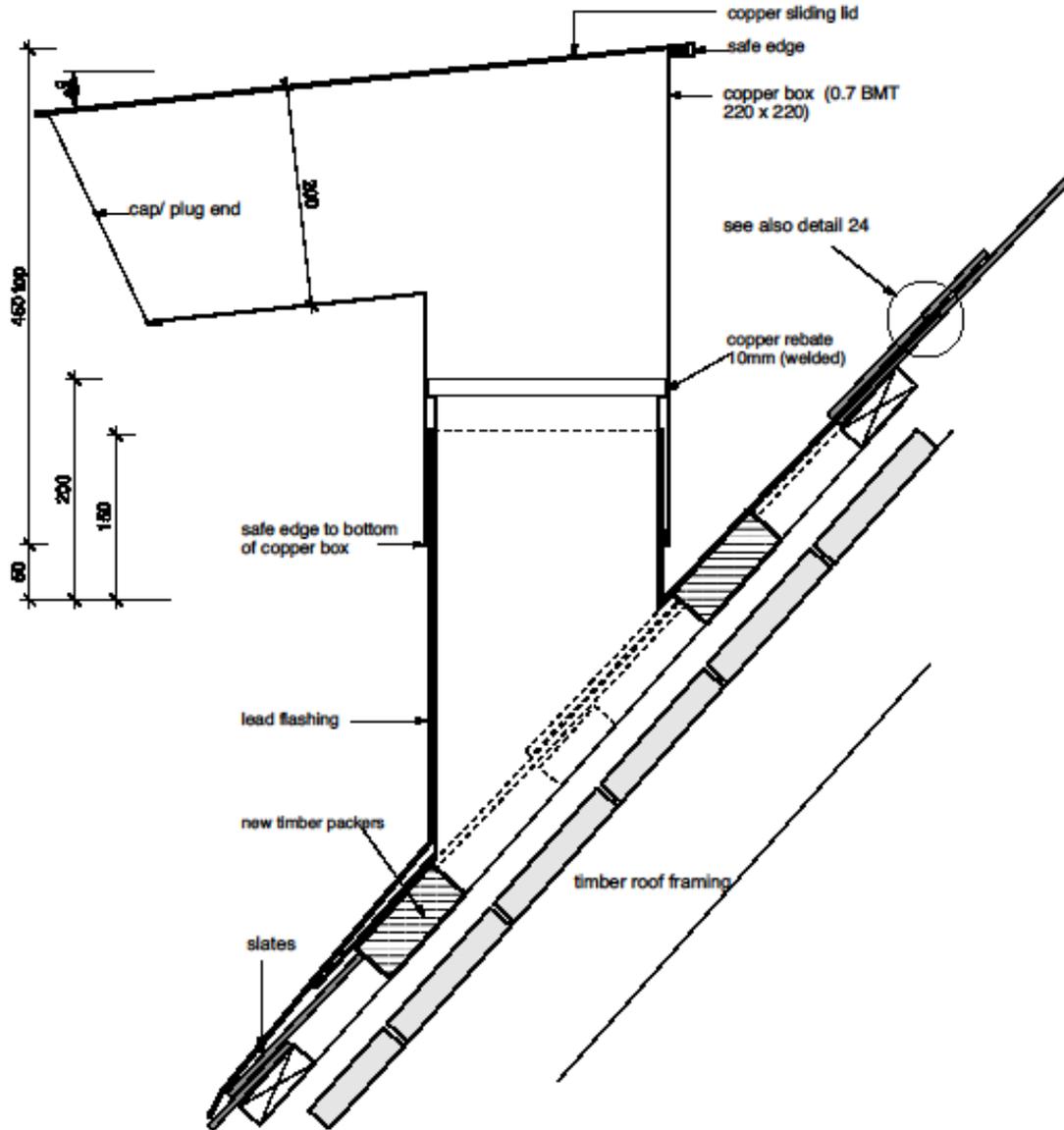
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SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 13

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DETAIL

17



18 VERTICAL SECTION
1:5 BOXING FOR MINOR ROOF PENETRATIONS
SLATE & TILE ROOFS

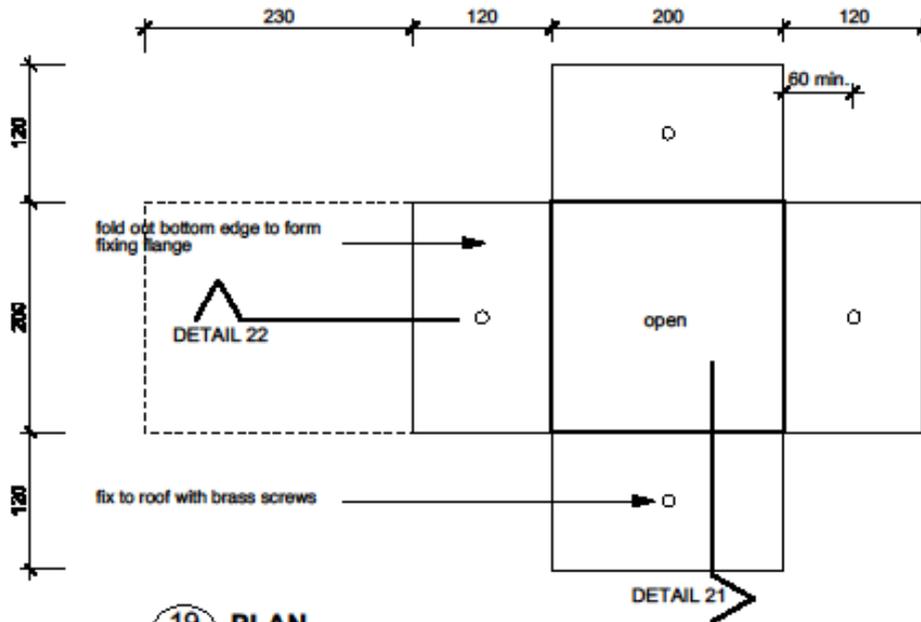
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STANDARD ROOFING AND WATERPROOFING DETAILS

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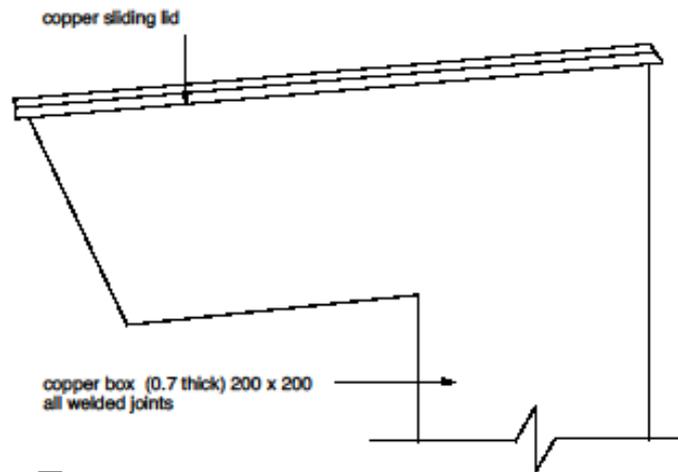
Prepared by DTB Architects Pty Ltd

DETAIL

18



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



20 ELEVATION
1:5 **BOXING FOR MINOR ROOF PENETRATIONS
TOP PORTION - METAL DECK ROOFS**

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STANDARD ROOFING AND WATERPROOFING DETAILS

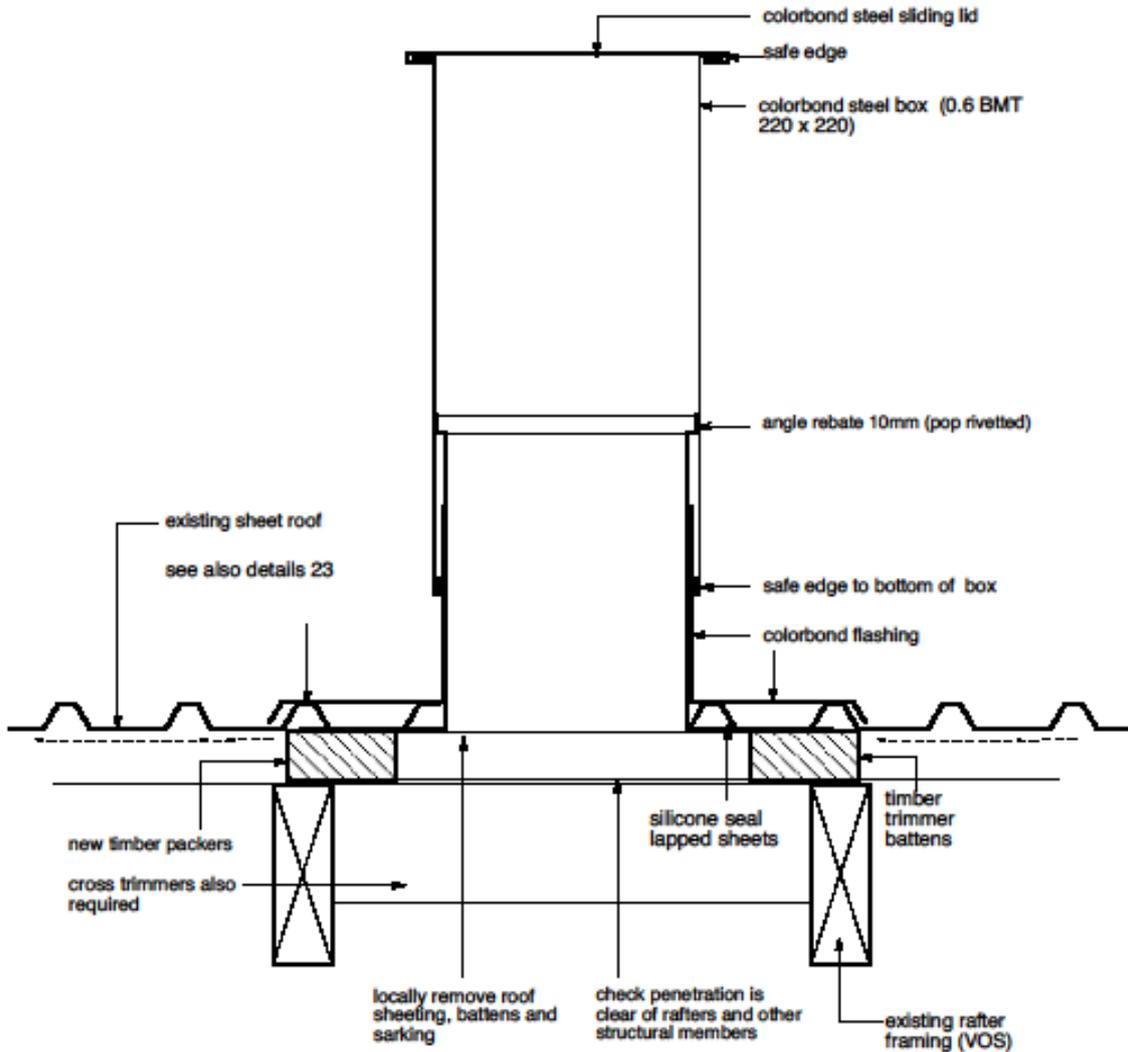
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DETAILS

19

20



21 VERTICAL SECTION
1:5 **BOXING FOR MINOR ROOF PENETRATIONS**
METAL DECK ROOFS ON TIMBER FRAMES

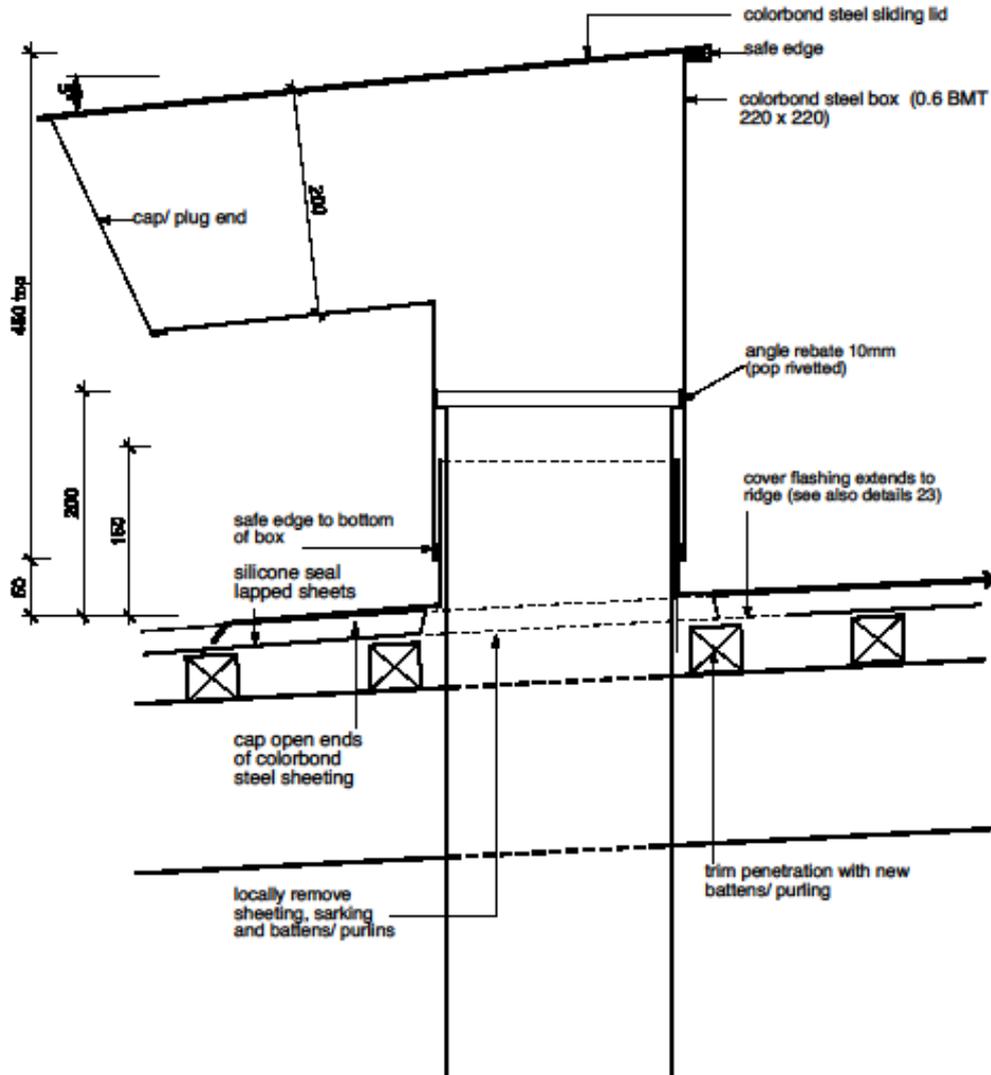
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STANDARD ROOFING AND WATERPROOFING DETAILS

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

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DETAIL

21



22 VERTICAL SECTION
1:5 **BOXING FOR MINOR ROOF PENETRATIONS**
METAL DECK ROOFS ON TIMBER FRAMES

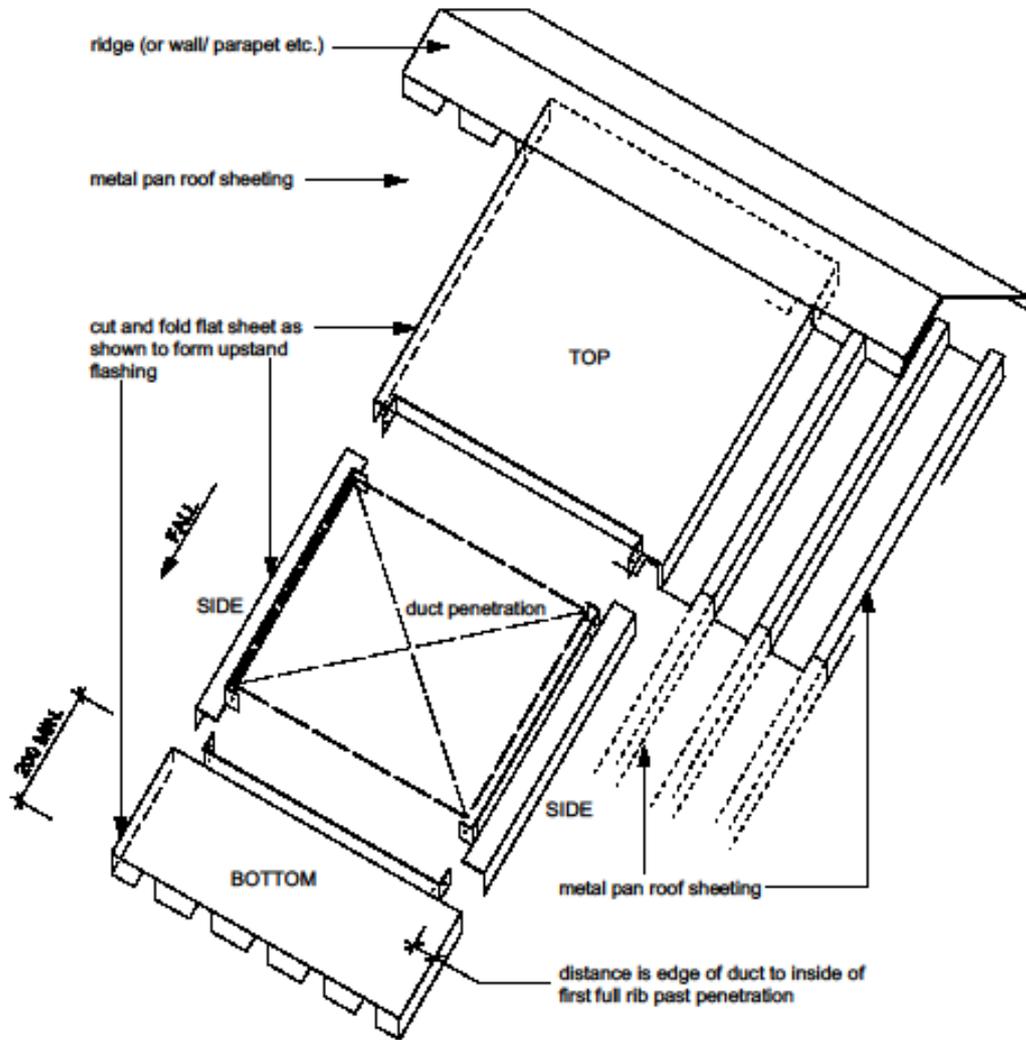
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STANDARD ROOFING AND WATERPROOFING DETAILS

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DETAIL

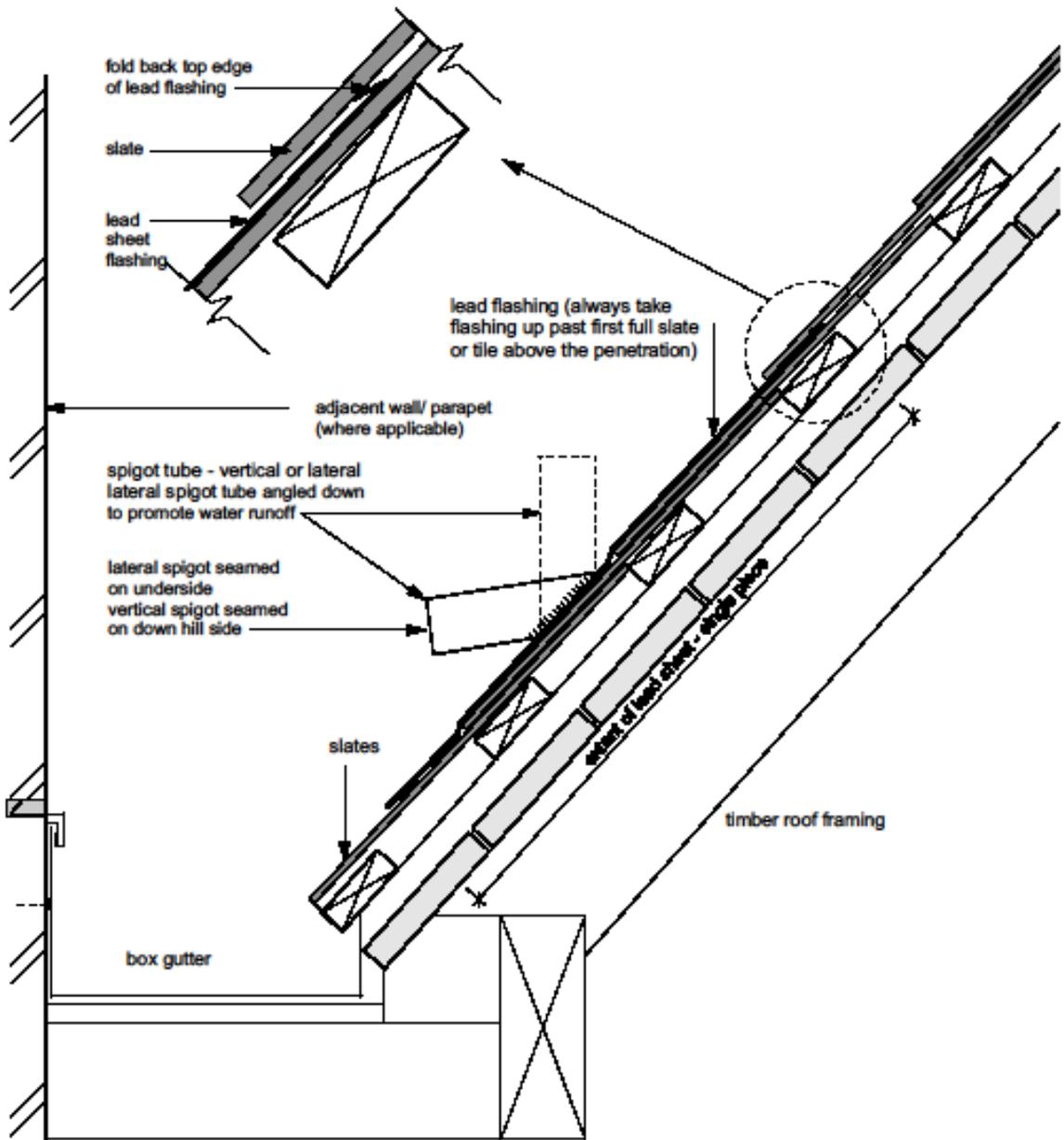
22



23 ISOMETRIC - EXPLODED
 1:5 FLASHING FOR MAJOR ROOF PENETRATIONS
 METAL DECK ROOFS

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 STANDARD ROOFING AND WATERPROOFING DETAILS
 SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 18
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DETAIL
23



24 VERTICAL SECTION
 1:5 **LEAD FLASHING FOR PIPE OR CONDUIT PENETRATION - SLATE AND TILE ROOFS**

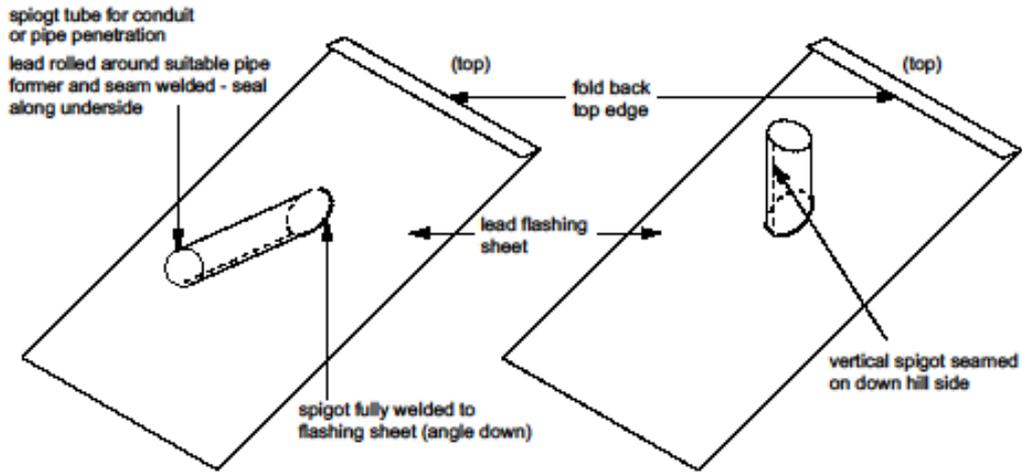
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 STANDARD ROOFING AND WATERPROOFING DETAILS

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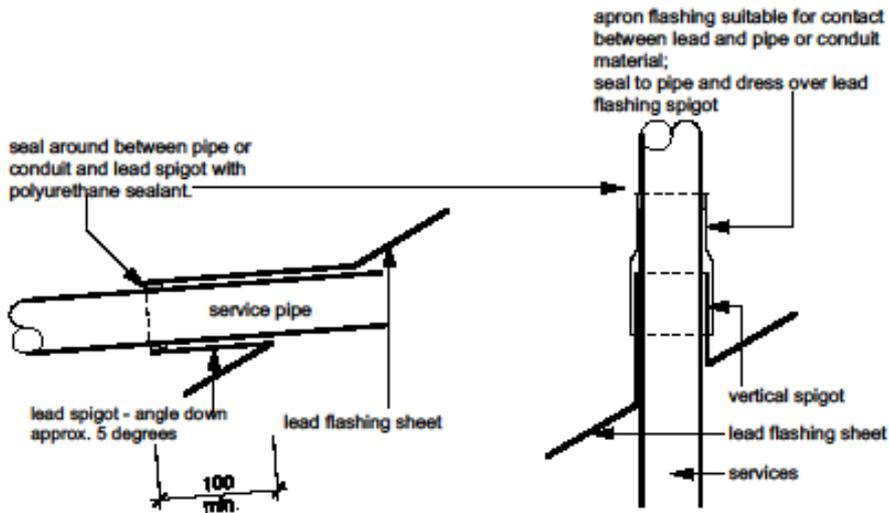
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DETAIL

24



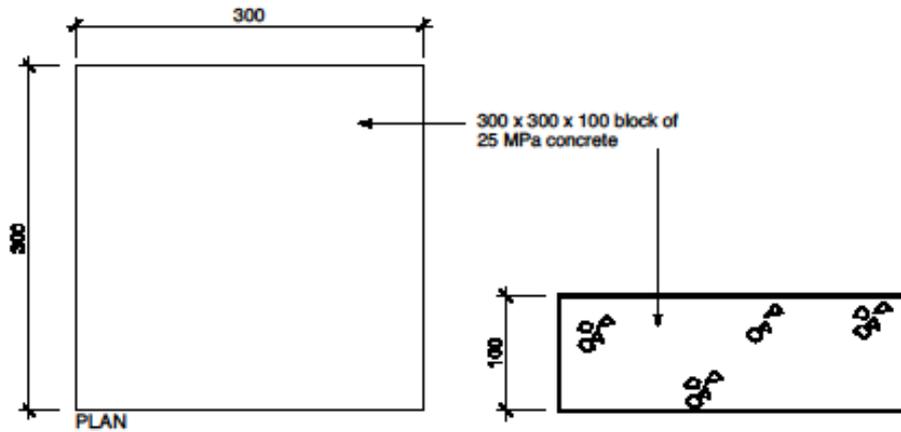
25
1:5 **ISO VIEWS**
LEAD FLASHING FOR SERVICES PENETRATION - SLATE OR TILE ROOF



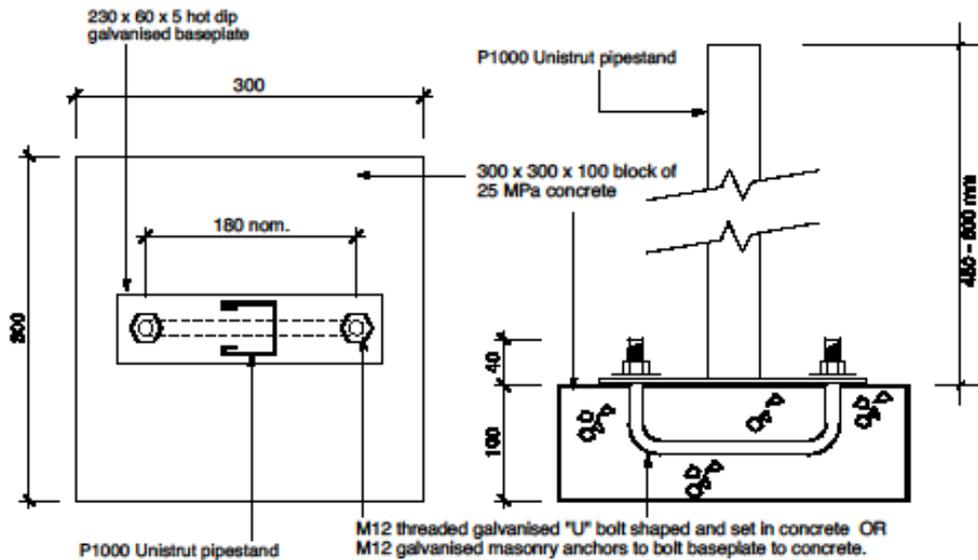
26
1:5 **VERTICAL SECTIONS**
LEAD FLASHING FOR PIPE OR CONDUIT PENETRATION - SLATE AND TILE ROOFS

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STANDARD ROOFING AND WATERPROOFING DETAILS
SCALE: 1:5 DATE: 07.05.02 REV No: A SHEET No: 20
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DETAILS
25
26



27 PLAN & SECTION
1:5 CONCRETE MACHINERY PAD MOUNT



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

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STANDARD ROOFING AND WATERPROOFING DETAILS

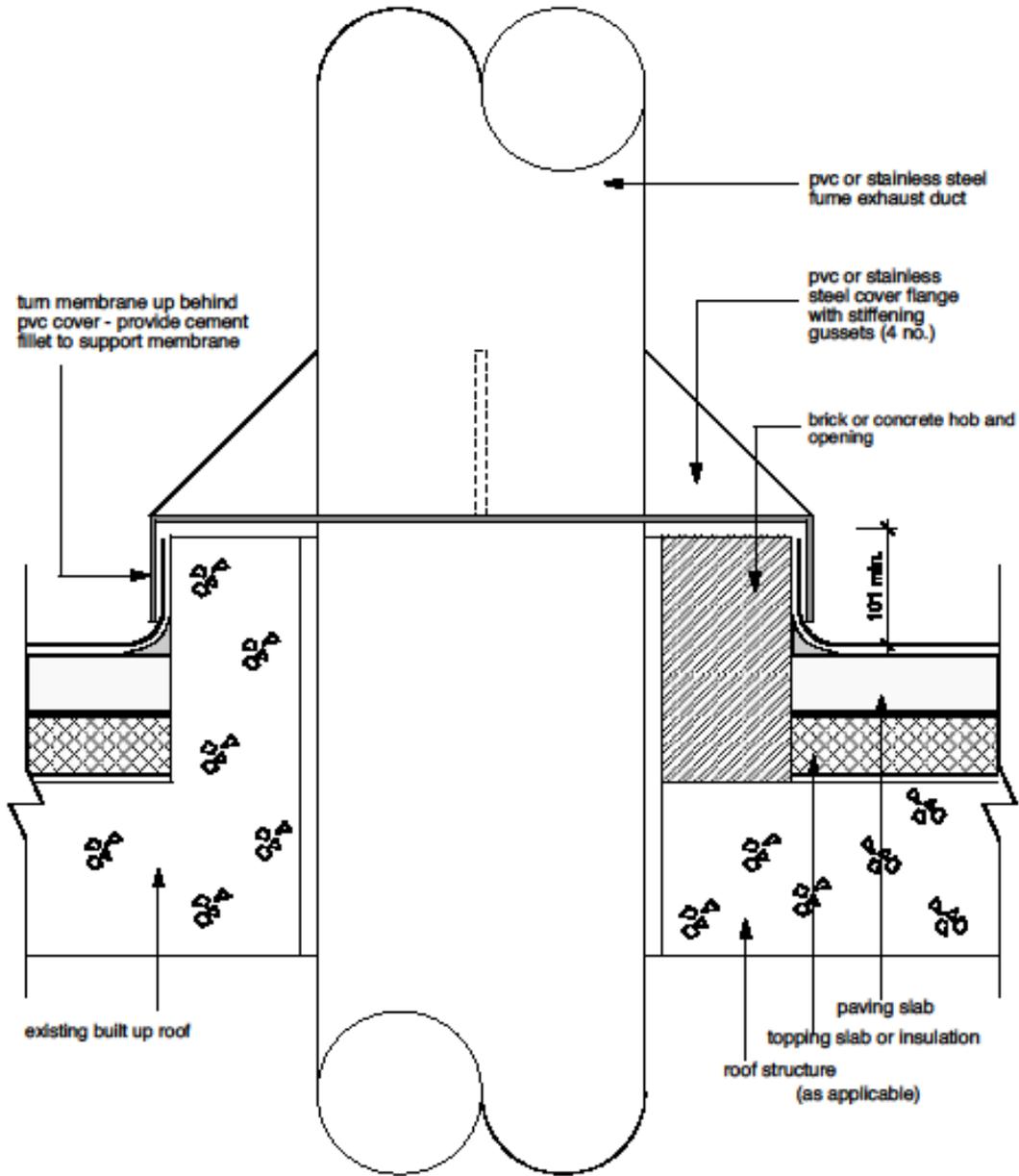
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DETAIL

27

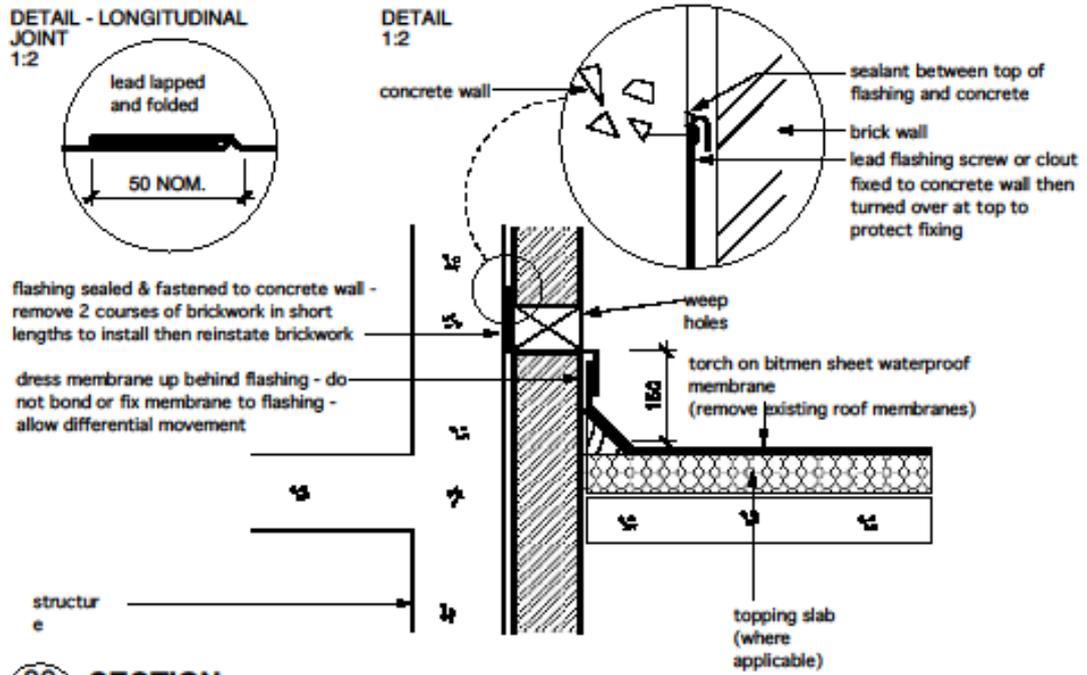
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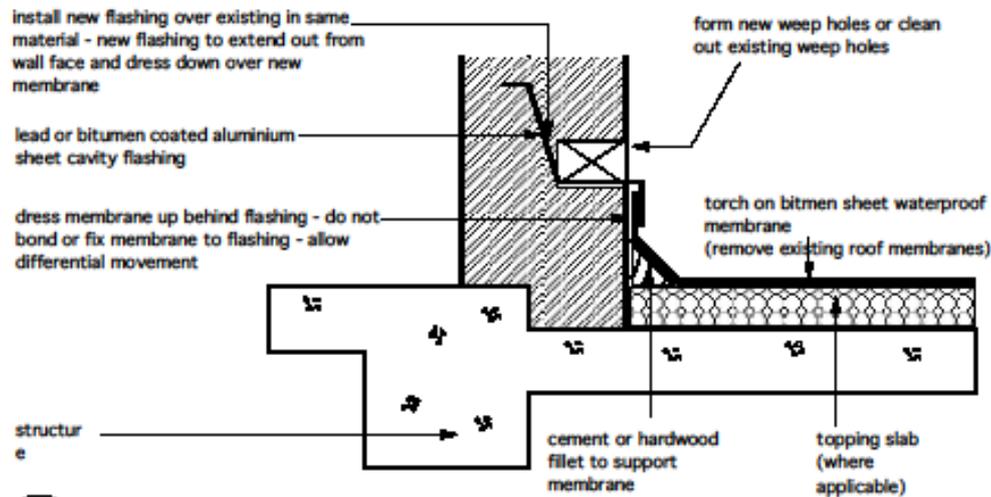
29 SECTION
 1:5 **FLUE PENETRATION**
CONCRETE ROOF WITH MEMBRANE AND TOPPING

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 STANDARD ROOFING AND WATERPROOFING DETAILS
 SCALE: 1:5 DATE: 05.03.04 REV No: B SHEET No: 22
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DETAIL
29



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



31
1:1
SECTION BRICK FLASHING AT CAVITY WALL

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STANDARD ROOFING AND WATERPROOFING DETAILS

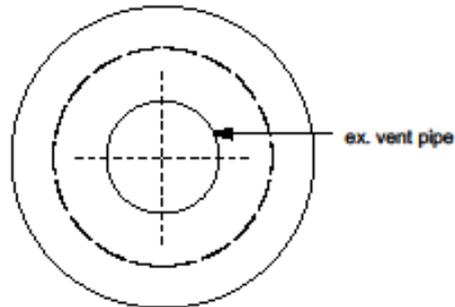
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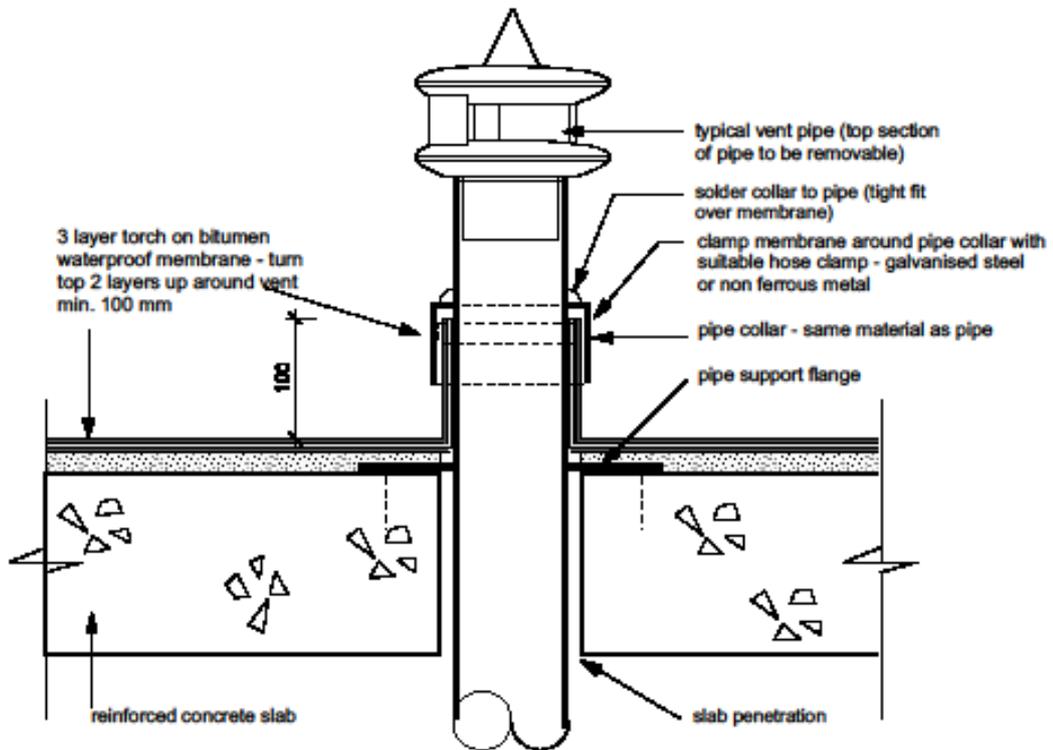
DETAILS

30

31



32 PLAN
1:5 AT VENT PIPE



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

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STANDARD ROOFING AND WATERPROOFING DETAILS

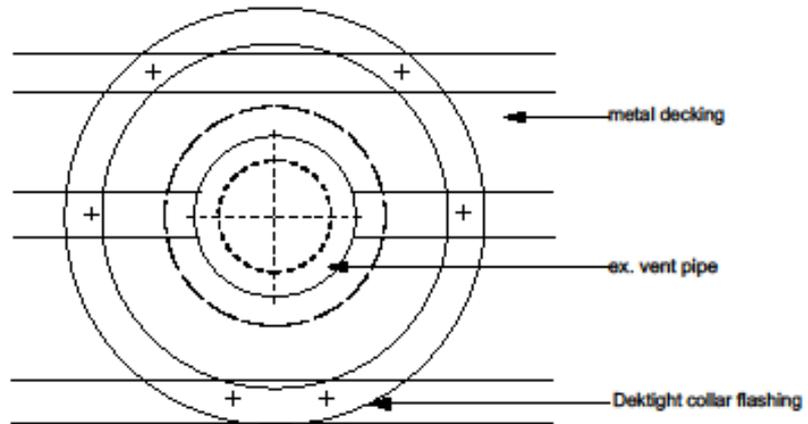
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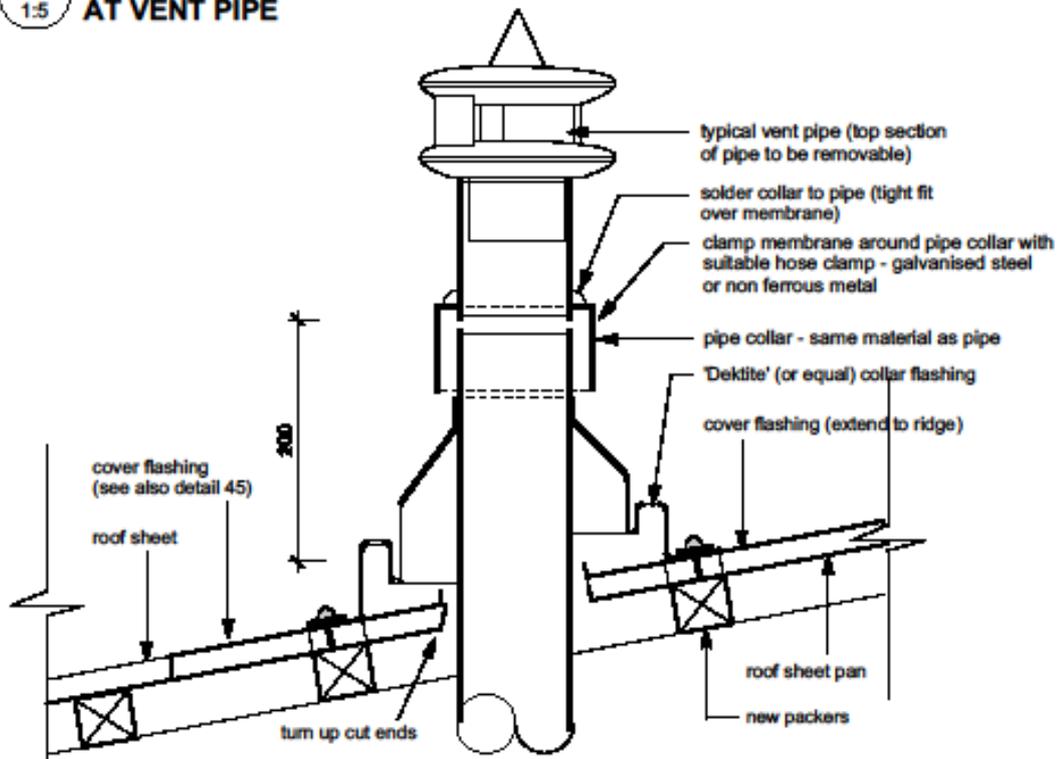
DETAILS

32

33



34 PLAN
1:5 AT VENT PIPE



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

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STANDARD ROOFING AND WATERPROOFING DETAILS

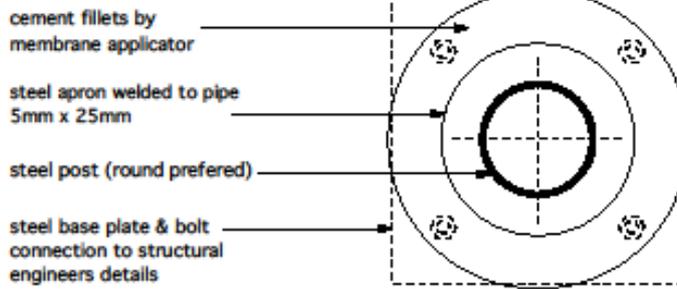
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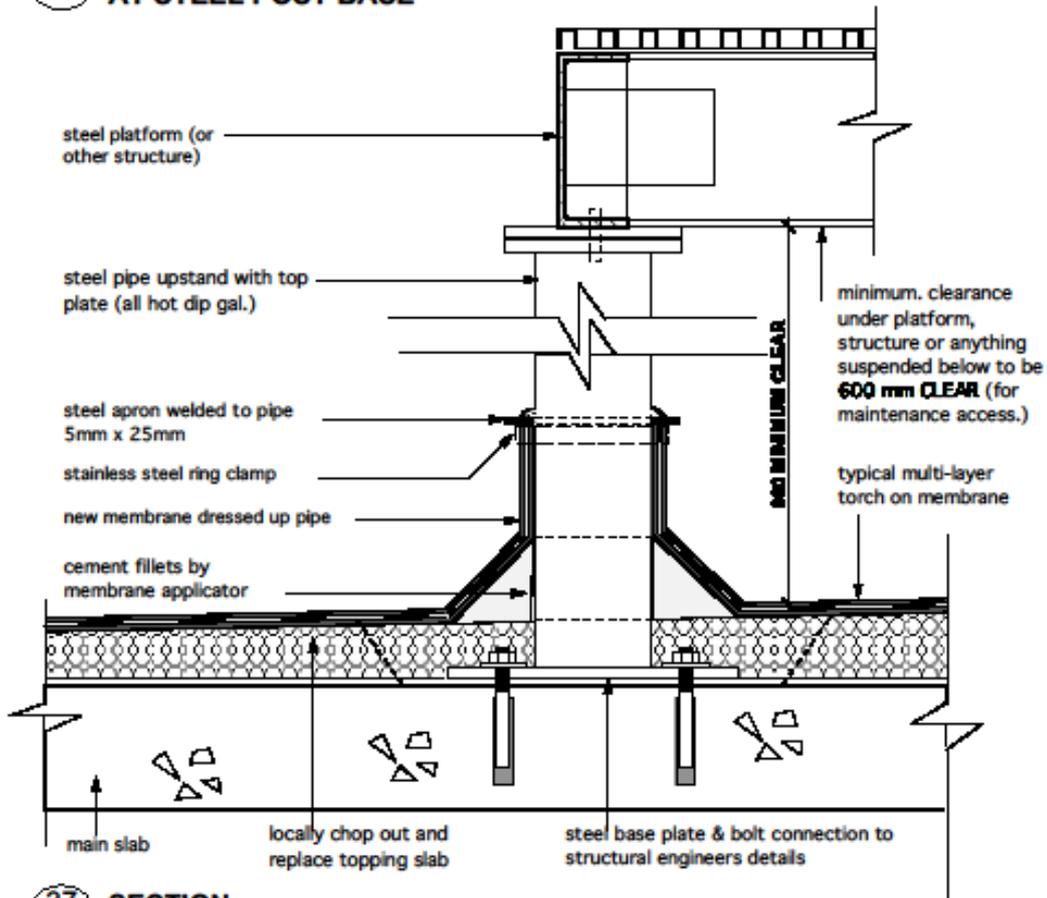
DETAILS

34

35



36 PLAN
1:5 AT STEEL POST BASE



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

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STANDARD ROOFING AND WATERPROOFING DETAILS

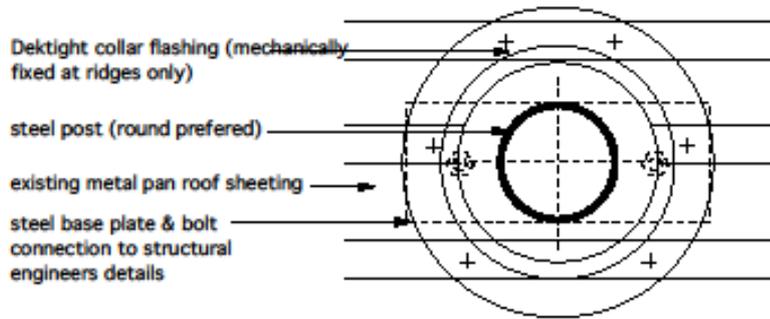
SCALE: 1:5 DATE: 21.05.02 REV No: A SHEET No: 26

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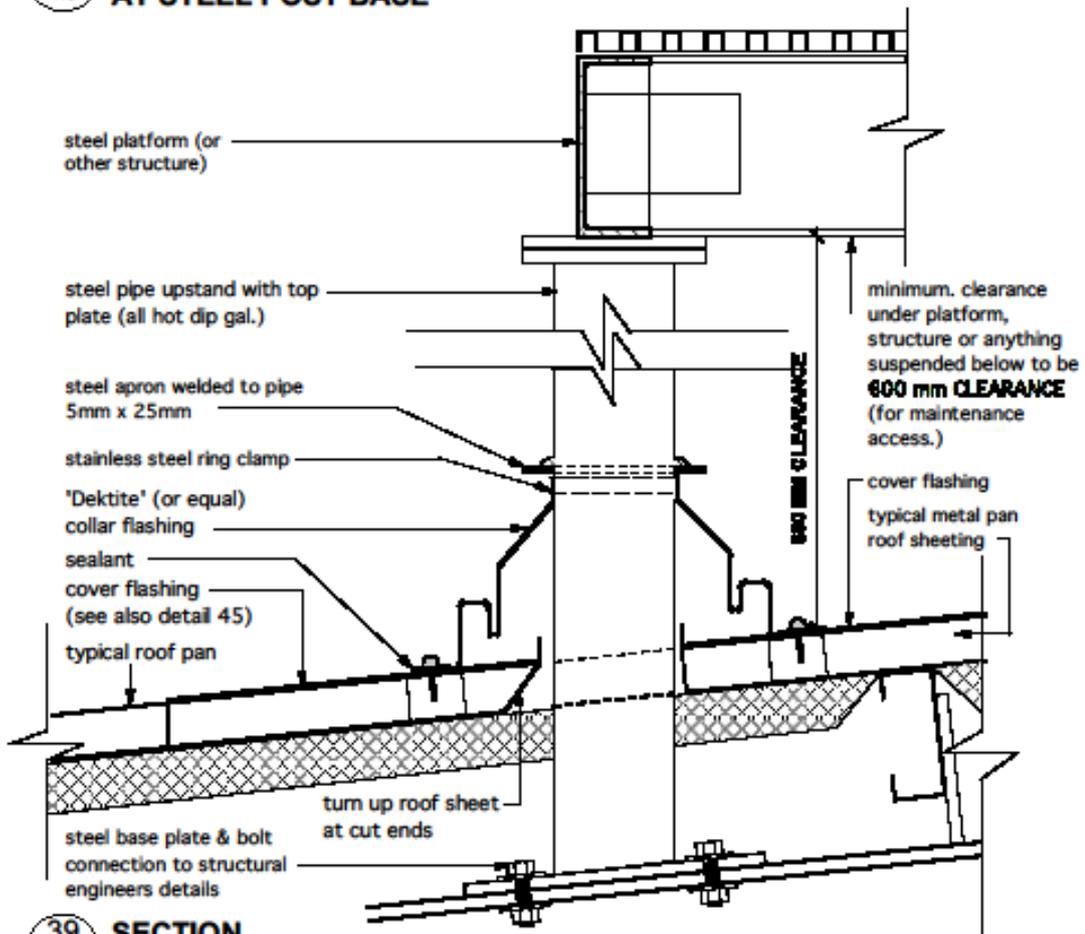
DETAILS

36

37



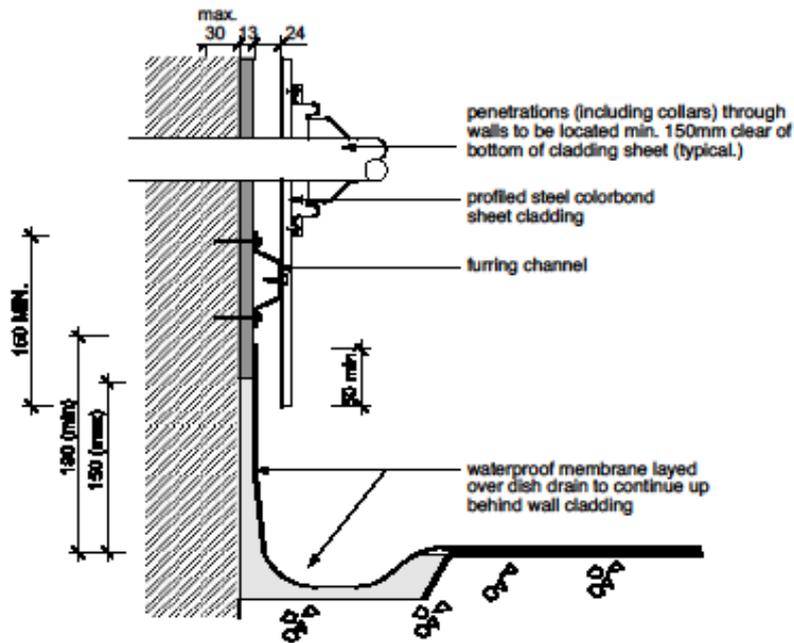
38 PLAN
1:5 **AT STEEL POST BASE**



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

UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS
SCALE: 1:5 DATE: 20.11.03 REV No: B SHEET No: 27
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DETAILS
38
39



40 SECTION
1:5 **MEMBRANE FLASHING AT WALL WITH OVERCLADDING & DISH DRAIN**

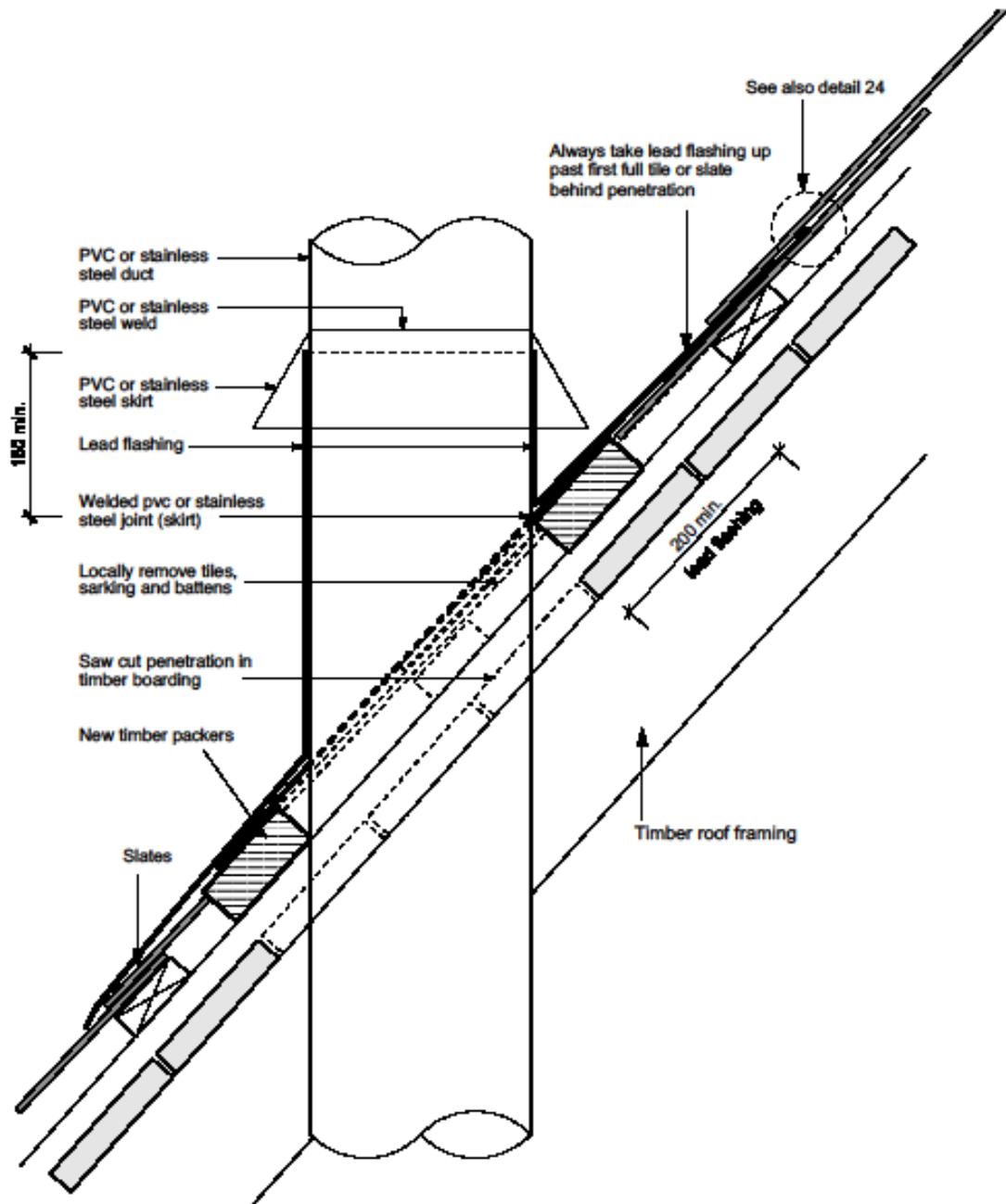
UNIVERSITY OF SYDNEY - FACILITIES MANAGEMENT OFFICE
STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL

SCALE: 1:5 DATE: 21.05.02 REV No: A SHEET No: 28

40

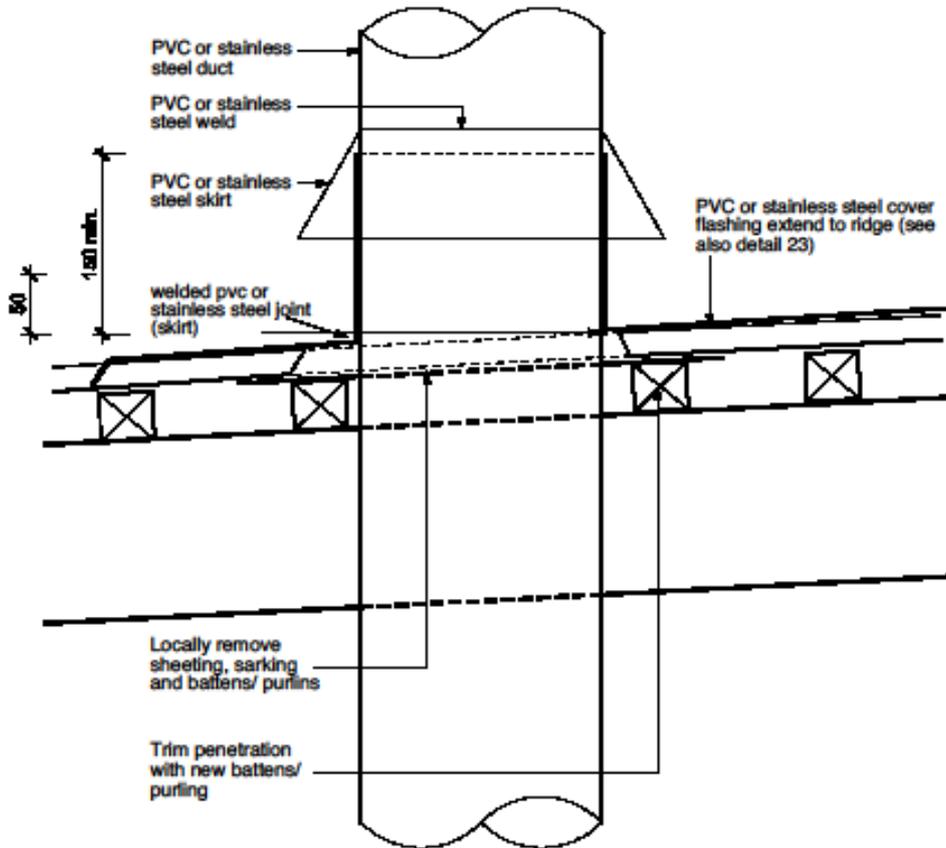
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41 SECTION
 1:5 **PVC DUCT PENETRATION**
SLATE AND TILE ROOFS

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DETAIL
41



42
1:5

SECTION

PVC DUCT PENETRATION

METAL DECK ROOF ON TIMBER FRAME

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

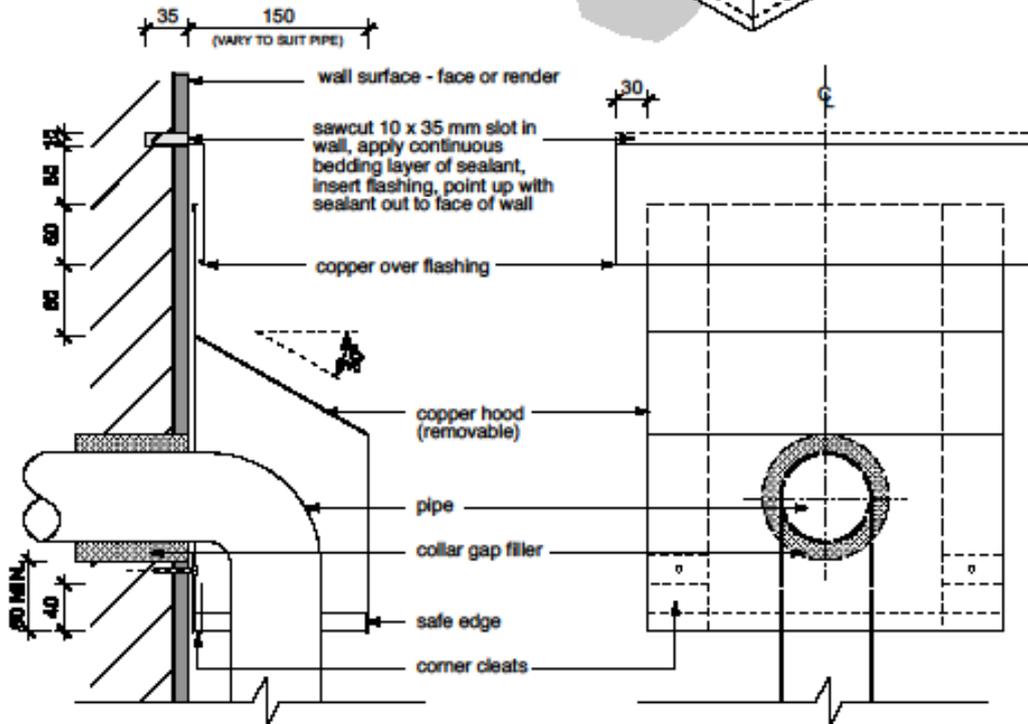
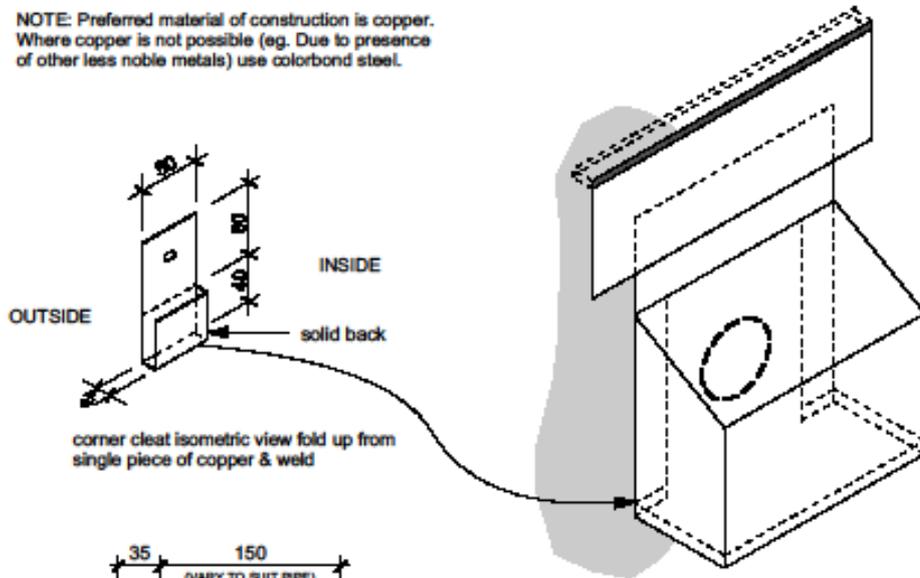
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DETAIL

42



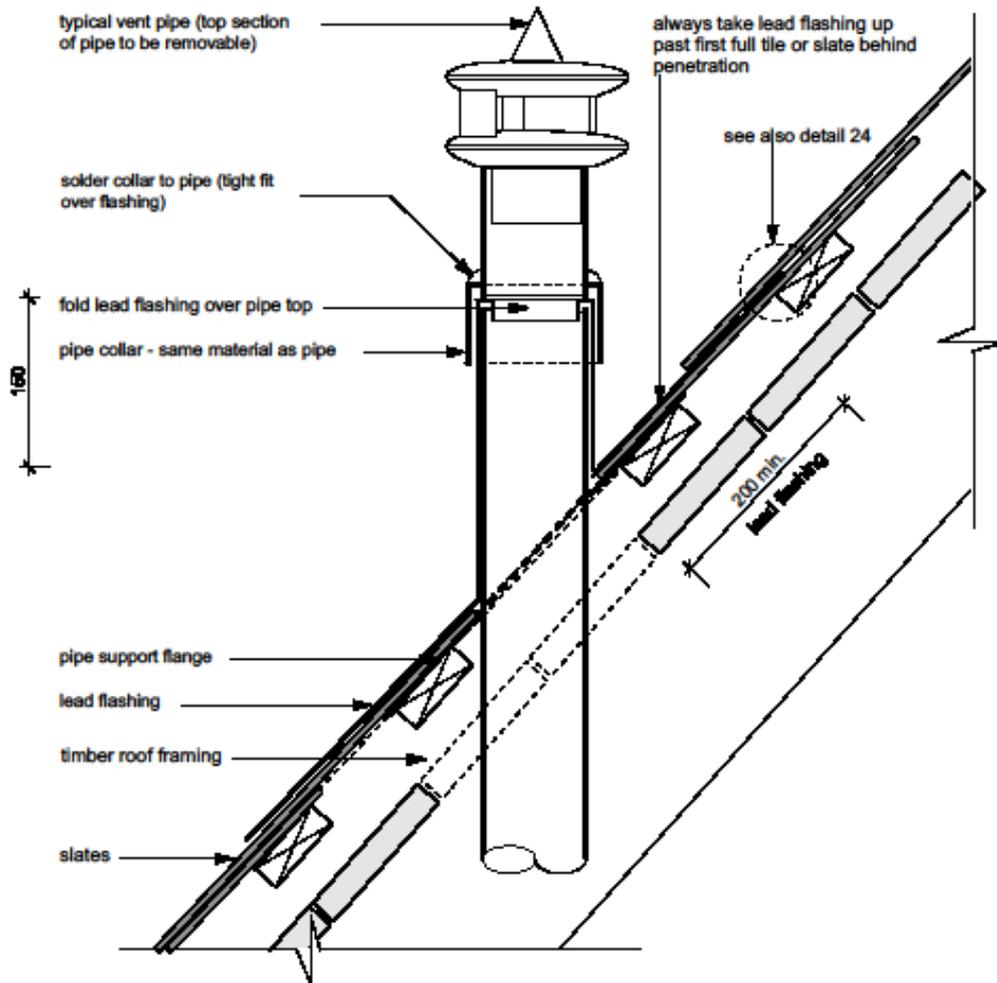
NOTE: Preferred material of construction is copper.
Where copper is not possible (eg. Due to presence
of other less noble metals) use colorbond steel.



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

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SCALE: 1:5 DATE: 21.05.02 REV No: A SHEET No: 31
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DETAIL
43



44 SECTION
1:5
**AT VENT PIPE
SLATE AND TILE ROOFS**

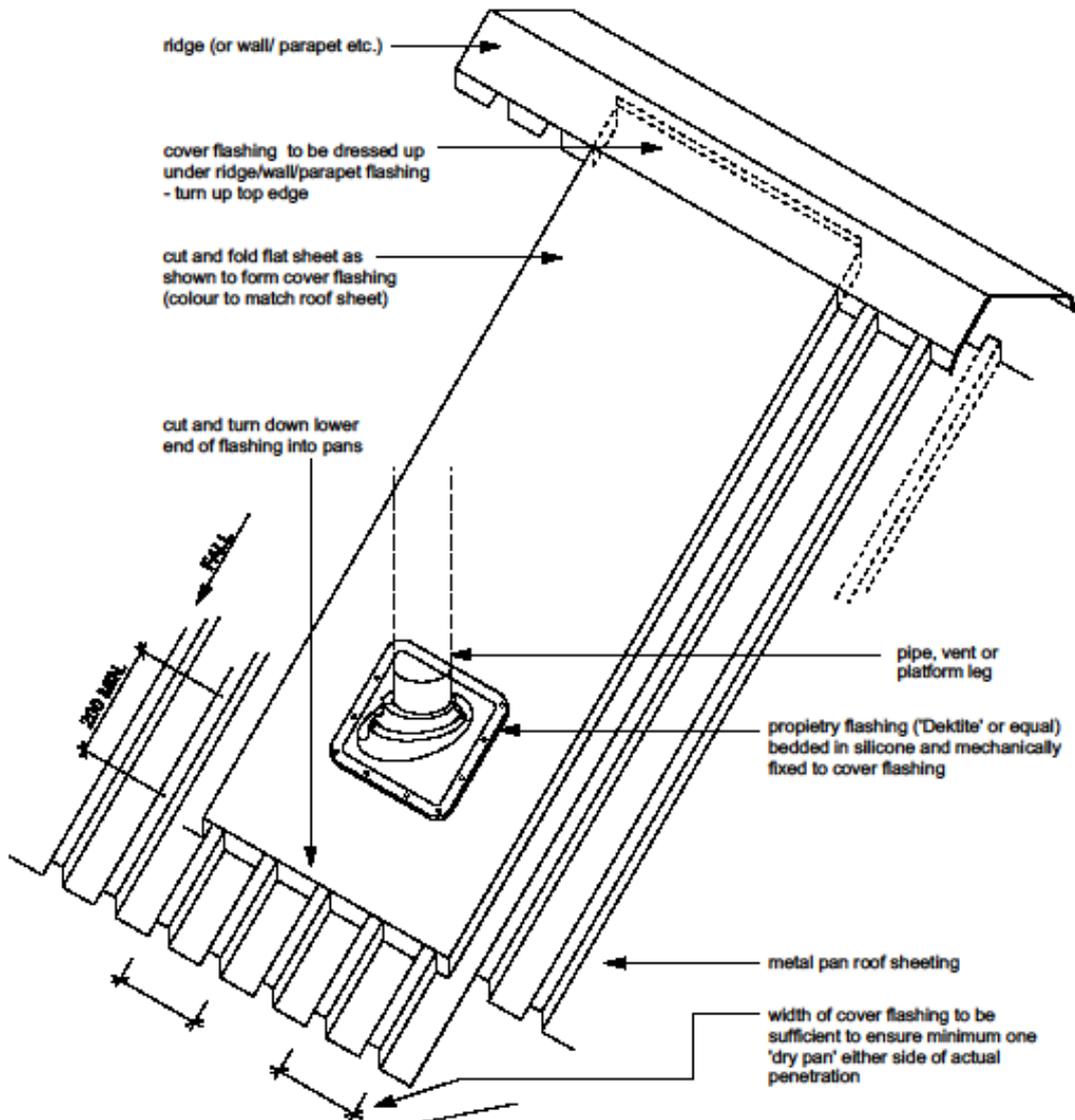
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STANDARD ROOFING AND WATERPROOFING DETAILS

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

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DETAIL

44



45 ISOMETRIC
1:5 COVER FLASHING FOR PENETRATIONS IN CONJUNCTION WITH PROPRIETRY PIPE/CONDUIT FLASHINGS - METAL DECK ROOFS

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 STANDARD ROOFING AND WATERPROOFING DETAILS

DETAIL
45

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

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