Roof Drainage for Low Pitched Metal Roofs

Presentation for Architects

Presented by **Rowan Gregory**, BE (Civil) Hons, Grad Dip Comp. Sci., MIEAust., CPEng

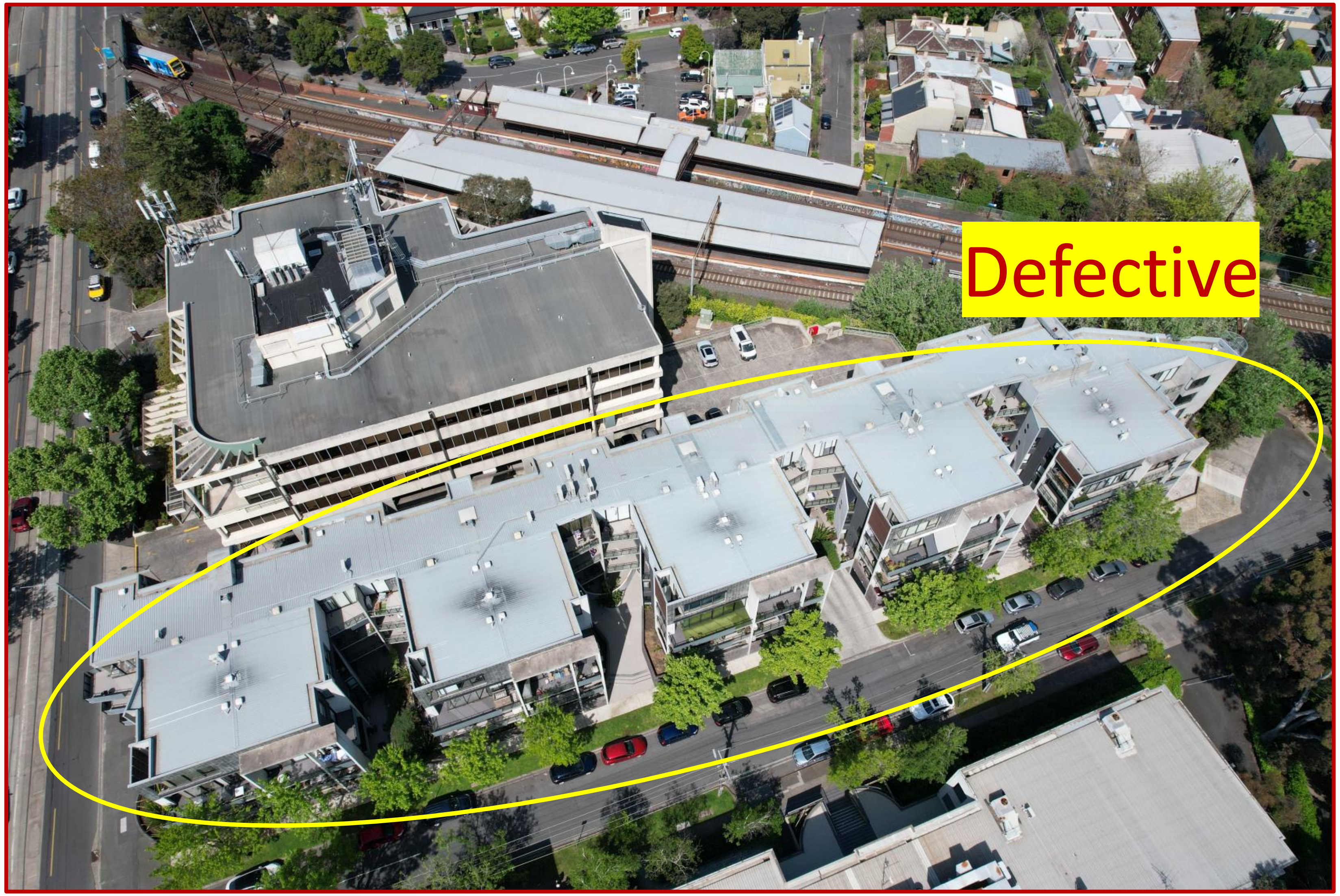
Registered Professional Engineer (endorsed in Civil and Structural by the BLA, Victoria)

Preventative Structural Engineering P/L, also t/a Preventative Hydraulic Engineering

Acknowledgment of Country

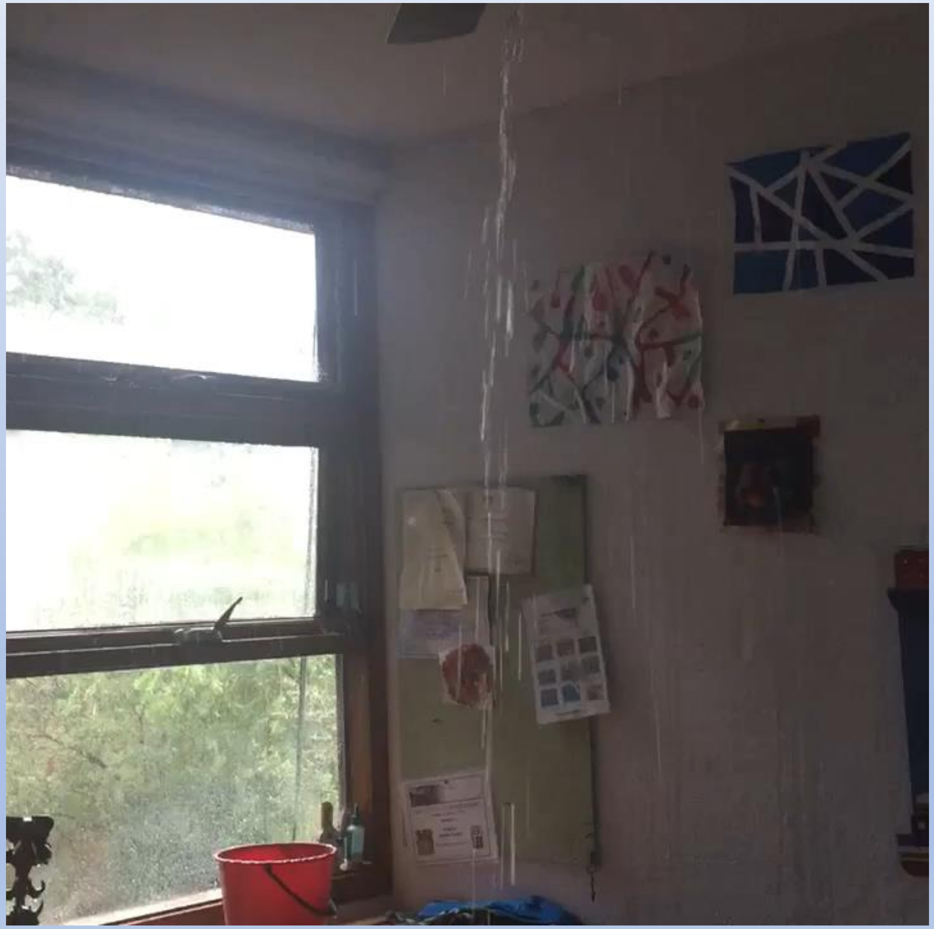
We respectfully acknowledge the Traditional Owners of the lands wherever attendees are situated, in particular the Wurundjeri People of the Kulin Nation, and pay our respects to their Elders past and present.

Non-conforming, non-compliant and not fit-for-purpose - `as built' contemporary style roof drainage exposed!



Correct design and documentation of roof drainage at building permit stage will de-risk your building !

Ceiling collapse example



During the event

And shortly afterwards

Contents

1. Why are box gutter systems currently so problematic?

Roof drainage is either not documented at building permit stage or not documented well enough

Even when hydraulic engineers are engaged to specify roof drainage, they often don’t do it very well. They generally never specify upstream and downstream box gutter depths; however, this information is fundamental to determining whether the box gutter system will fit within the architecture / structure.

The design of box gutter systems is commonly left up to roof plumbers, and this should never happen. Firstly, roof plumbers typically do not have the required skills to carry out hydraulic design, and secondly, at the time they become involved at framing stage, it is often very difficult, if not impossible to find a compliant solution that fits within the architecture and structure. As they must complete their work, they very often install a non-compliant, which has serious consequences too often.

AS/NZS 3500.3-2021 has only 3 types of box gutter overflow devices, and this has proved much too limiting. This code has had no development with respect to box gutters since the late 1990’s, whereas box gutter systems have become much more prevalent, and roofs are becoming more complicated.

2. The good news – there is a solution

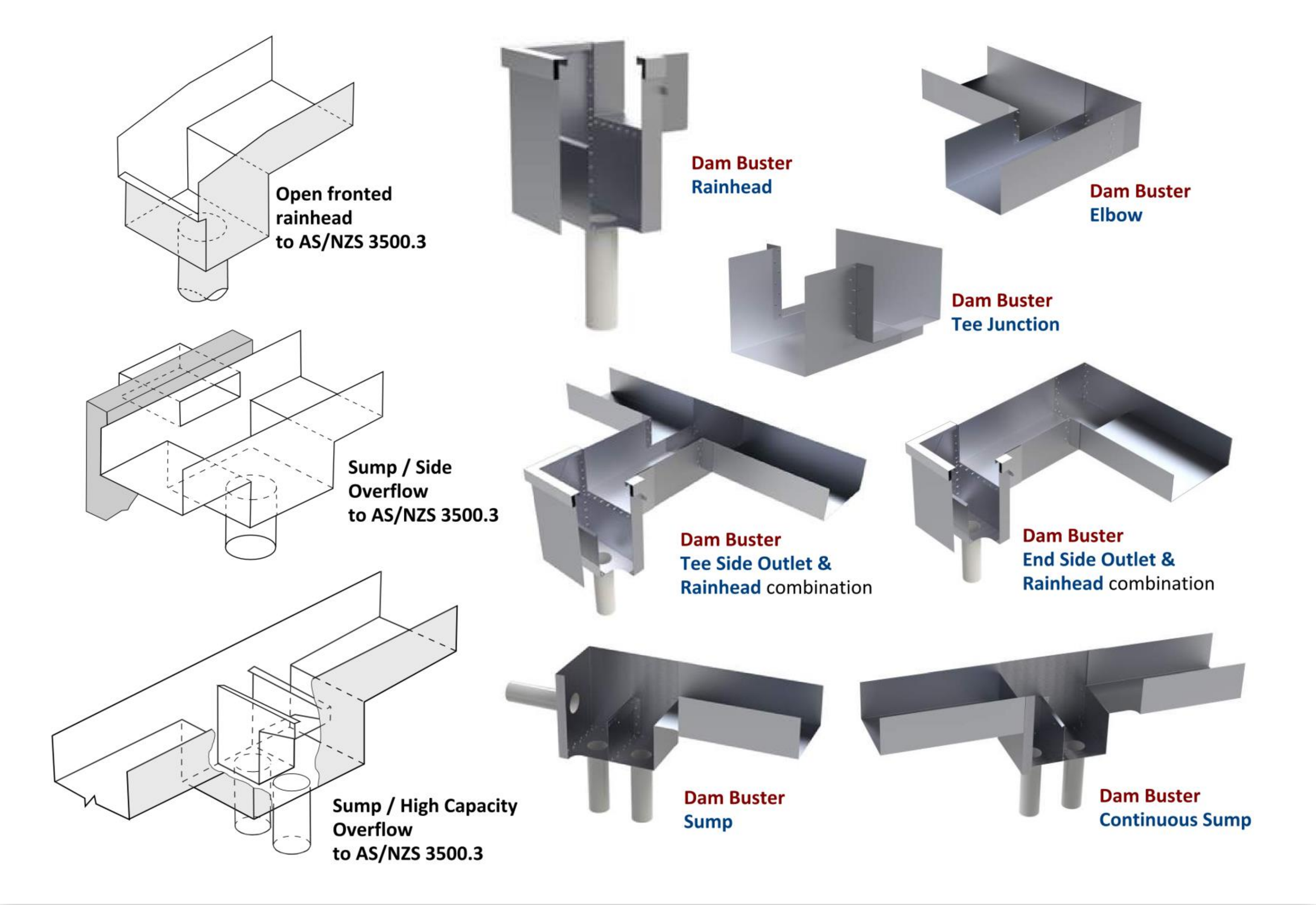
The problems plaguing this part of the construction industry are eminently fixable

The first point to make is that Dam Buster P/L products, which have now been on the market for over 5 years, provide many additional solutions, including change of direction, which means that, in combination with the AS/NZS 3500.3 devices, there is virtually always a solution.

However, the solution must be determined at Building Permit stage; and this solution must be properly coordinated with the architecture and structure. Where there are proprietary timber or metal roof trusses, the roof drainage must also be provided to the roof truss fabricator for coordination purposes.

Architects MUST STOP half specifying roof drainage and then stating *'roof drainage to comply with AS/NZS 3500.3'* or similar on their drawings. Architects also need to have a much better understanding of the fundamentals of roof drainage design. Instead, a detailed roof drainage design is required for every project including box gutters.

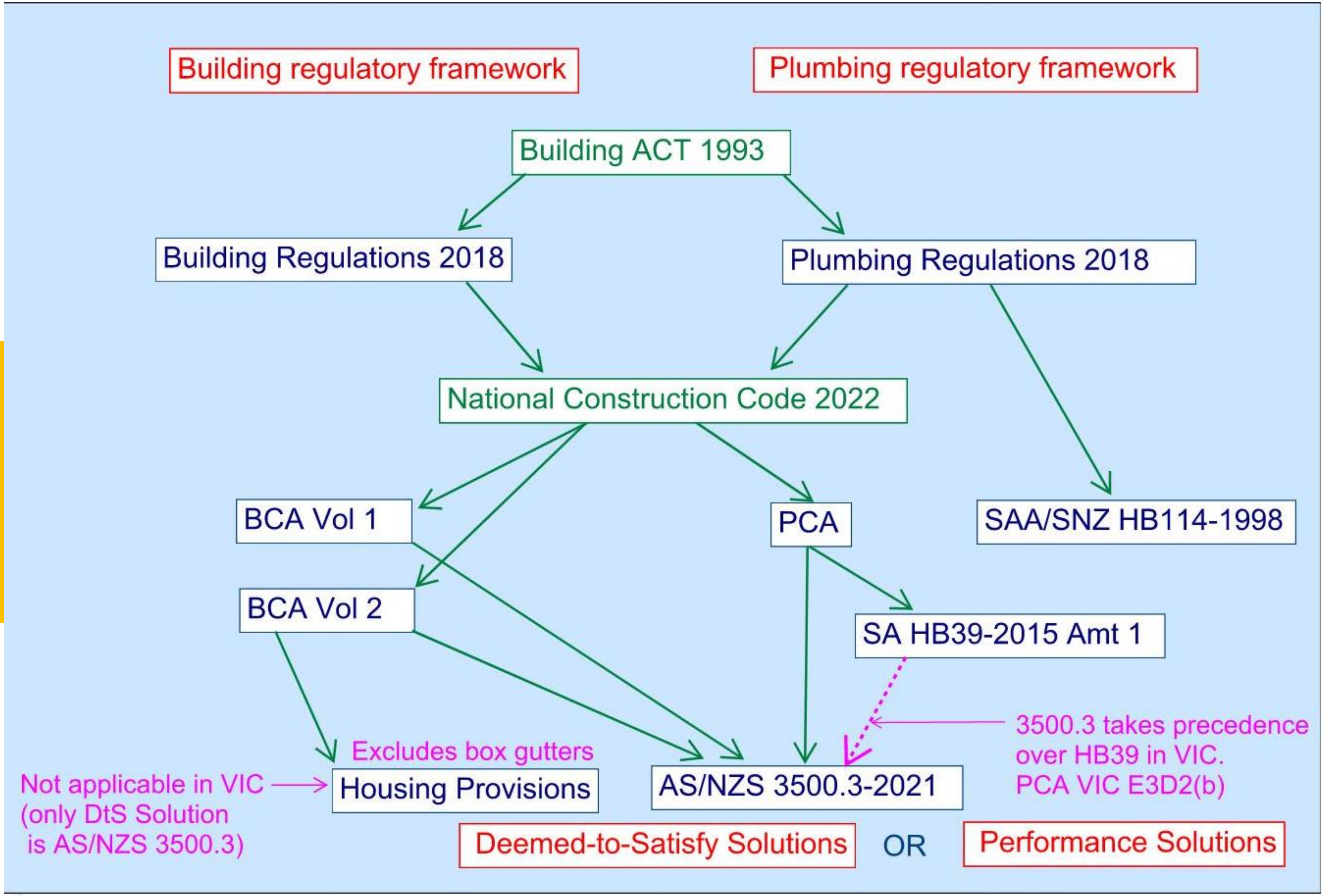
Building surveyors MUST STOP accepting building documentation without a detailed roof drainage design. Roof drainage falls within all three volumes of the NCC in Victoria, not just the PCA, and they should stop ignoring it and *'passing the buck'* to the roof plumber.



With AS/NZS 3500.3 devices, Dam Buster devices and the ASHSA Research Foundation solutions, a solution is always possible

Alternative designs are also available using the AHSCA Research Foundation software, however, designs can only be carried out AHSCA members who have completed the two required training modules.

3. Regulatory Framework – Victoria



3. Regulatory Framework – Victoria (cont.)

Notes

- Roof drainage falls within all versions of BCA Vol 1 & BCA Vol 2
- Roof drainage is a state addition to the PCA in Victoria (& Tasmania) only
- For all volumes of the NCC, any solution complying with AS/NZS 3500.3 is an acceptable DtS Solution
- PCA clause VIC E3D2 (b) states AS/NZS 3500.3 takes precedence over SA HB39
- In Victoria, it is necessary to comply with both the Victorian Building Regulations and the Victorian Plumbing Regulations with respect to roof drainage.
- Section 7.4 of the Housing Provisions provide a DtS Solution to BCA Volume 2 for gutter systems excluding box gutters. Victorian variation VIC H2D6(3) requires compliance does not permit use of section 7.4 of the Housing Provision, and all gutters must comply with AS/NZS 3500.3.
- In Victoria there appears to be an inconsistency – the Housing Provisions are not referenced by the PCA

Question 1

Can you prepare a Performance Solution to modify the requirements of SA HB39-2015?

a) No, as HB39 is called up directly by the Plumbing Regulations, and not by the NCC, you can only modify HB39 by applying for a modification with the Victorian Building Appeals Board.

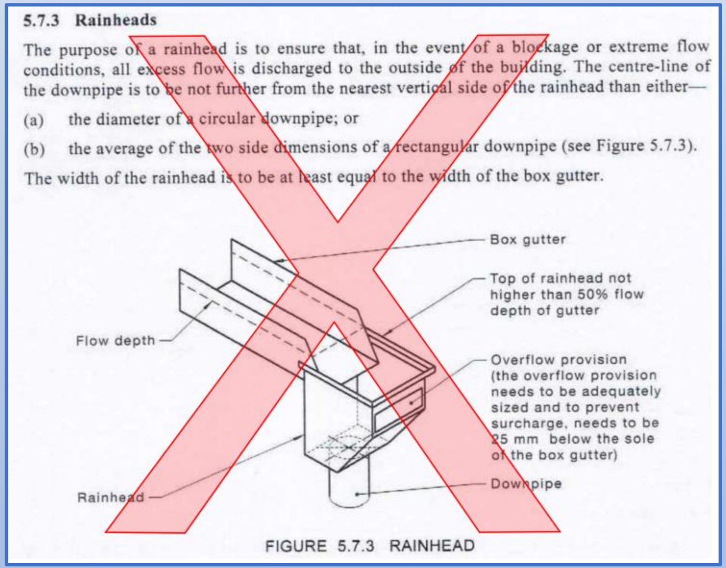
b) Yes, as PCA2022 now calls up both AS/NZS 3500.3 and SA HB 39 as a DtS Solution, a Perform Solution can be prepared in relation to SA HB 39-2015. **CORRECT**

c) Only if the item you want to modify is referred to in both in the PCA and the HB39

3. Regulatory Framework –Victorian (cont.)

SA HB 39 2015 Amt 1

- Published 30 July 2021 – Every type of rainhead **other** than as the ‘open fronted’ rainhead shown in Figure H.2 of AS/NZS 3500.3 now requires a Peformance Solution (as advised by the VBA).
- Ned Kelly style rainheads with an overflow opening in the front are no longer acceptable. Note that this form of rainhead does not comply with the requirement in Fig H.2, Note 4, that the “*front of the rainhead (be) left open above the weir*”



5.7.3 Rainheads

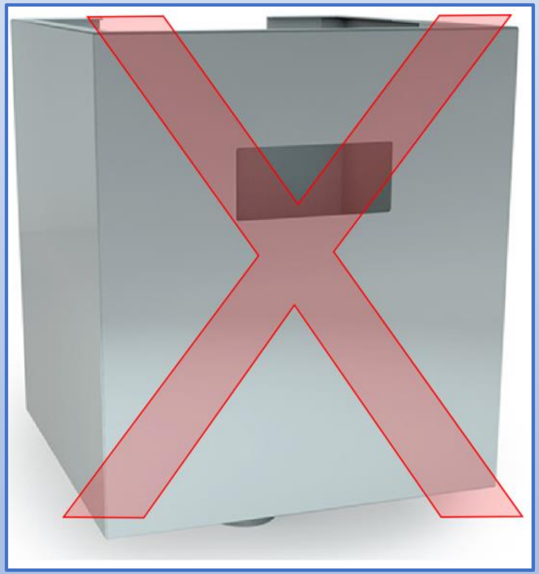
The purpose of a rainhead is to ensure that, in the event of a blockage or extreme flow conditions, all excess flow is discharged to the outside of the building. The centre-line of the downpipe is to be not further from the nearest vertical side of the rainhead than either—

(a) the diameter of a circular downpipe; or

(b) the average of the two side dimensions of a rectangular downpipe (see Figure 5.7.3).

The width of the rainhead is to be at least equal to the width of the box gutter.

Figure 5.7.3 has been deleted from SA HB9-2015



Rainheads with an overflow opening in the front are no longer permitted

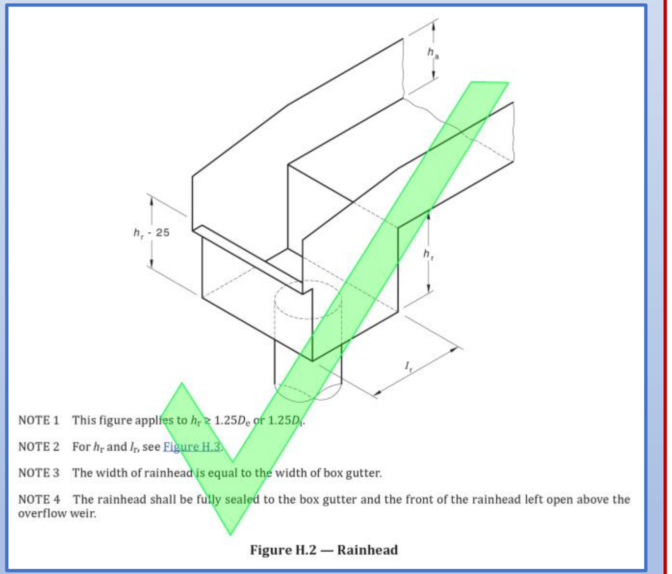
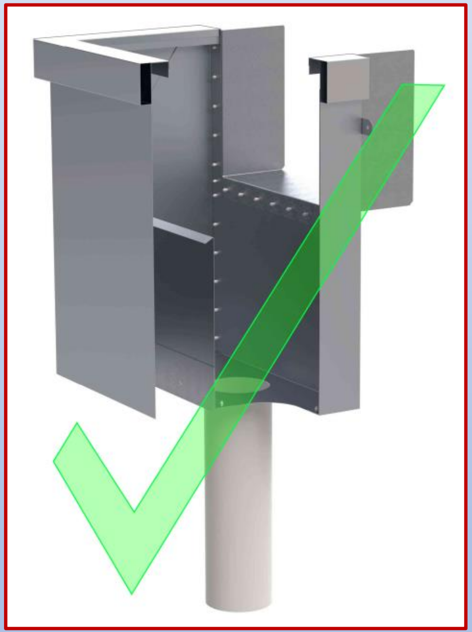
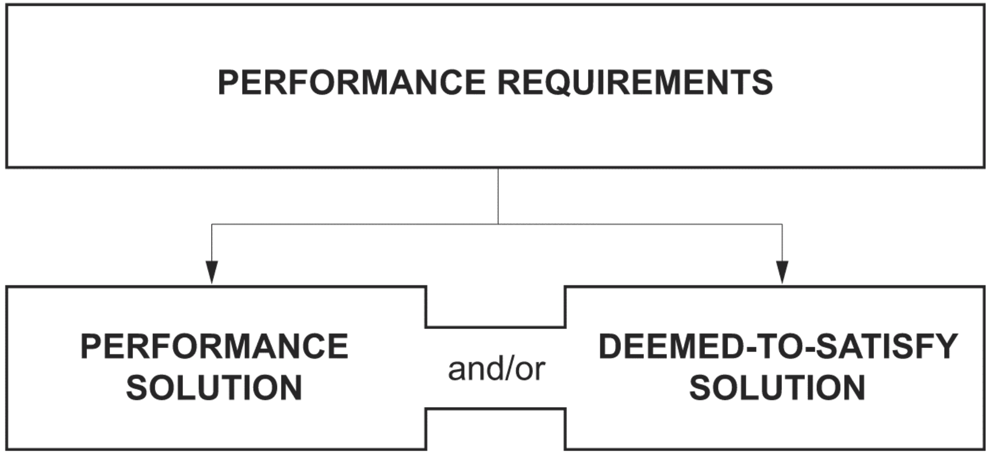


Figure H.2 from AS/NZS 3500.3-2021 (‘Open fronted’ rainhead)



Dam Buster Rainhead (Performance Solution required in VIC)

4. Compliance with the NCC



The Governing Requirements of each volume of the NCC are the same

Part A2G1 Compliance

Part A2G1 states:

(1) Compliance with the NCC is achieved by complying with-

(a) the Governing Requirements of the NCC; and

(b) the *Performance Requirements*

(2) Performance Requirements are satisfied by one of the following, as shown in Figure A2G1:

(a) *Performance Solution*

(b) *Deemed-to-Satisfy Solution*

(c) A combination of (a) and (b)

4. Compliance with the NCC (cont.)

Part A2G2 Performance Solution

Part A2G2 states:

(1) A Performance Solution is achieved by demonstrating-

(a) compliance with all the relevant Performance Requirements; **or**

(b) the solution is at least equivalent to Deemed-to-Satisfy Provisions

(2) A Performance Solution must be shown to comply with the relevant Performance Requirements through one or a combination of the following Assessment Methods:

(a) *Evidence of Suitability* in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets the relevant Performance Requirements

(b) A *Verification Method* including the following:

i. The Verification Methods provided in the NCC

ii. Other Verification Methods, accepted by the appropriate authority that show compliance with the relevant Performance Requirements

4. Compliance with the NCC (cont.)

Part A2G3 Deemed-to-Satisfy Solution

Part A2G3 states:

(1) A solution that complies with the Deemed-to-Satisfy Provisions is deemed to have met the Performance Requirements.

(2) A Deemed-to-Satisfy Solution can show compliance with the Deemed-to-Satisfy Provisions through one or more of the following Assessment Methods:

a) Evidence of suitability in accordance with Part A5 that shows the use of a material, product, plumbing and drainage product, form of construction or design meets a Deemed-to-Satisfy Provision

b) Expert Judgement.

4. Compliance with the NCC (cont.)

Part A2G4 A Combination of Solutions

Part A2G4 states:

(1) Performance Requirements may be satisfied by using a combination of Performance Solutions and Deemed-to-Satisfy Solutions

(2) (Refer to the ABCB website for NCC online for details)

(3) (As above)

5. Design Flow Rate

Q= CA [m2] * 1%AEP [mm/h] /3600 [L/s]

Catchment area ('CA') = Plan area + 50% of net vertical area (for the worst direction)

1mm over $1m^2$ = 1,000,000 mm^3

10cm x 10cm x 10cm = 1 Litre = 100mm x 100mm x 100mm

CA (m2) x AEP (mm/h) = Litres / hour

Divide by 3600 -> Litres / second

5. Design Flow Rate (cont.)

2 methods to determine the design 1%AEP flow rate (1 in 100 year ARI)

Method 1

Look up the nearest area in Table D.1, AS/NZS 3500.3-2021

NOTE - 1% AEP = 100 year ARI
ARI = Average recurrence interval
AEP= Annual exceedance probability

Example below - 1%AEP = 187 mm /h = 100I5*

* Note - 100 refers 100 years, I refers to Intensity, and
5 refers to 5 minutes = time of concentration
Note- the maximum 5 min consecutive rainfall
multiplied by 12 to convert to mm/hour

Australian location		Latitude degrees	Longitude degrees	5 % AEP (20 years ARI) intensity mm/h	1 % AEP (100 years ARI) intensity mm/h
Melbourne:					
Craigieburn		37.59	144.94	128	186
Dandenong		37.99	145.21	133	181
Frankston		38.14	145.11	123	165
Hastings		38.31	145.19	112	145
Melbourne City		37.81	144.96	132	187
Oakleigh		37.89	145.09	132	182
Portsea		38.31	144.71	106	140
Sunbury		37.59	144.74	122	171
Sunshine		37.79	144.84	131	186
Warrandyte		37.74	145.21	126	172

FROM TABLE D1 OF AS/NZS 3500.3-2021

5. Design Flow Rate (cont.)

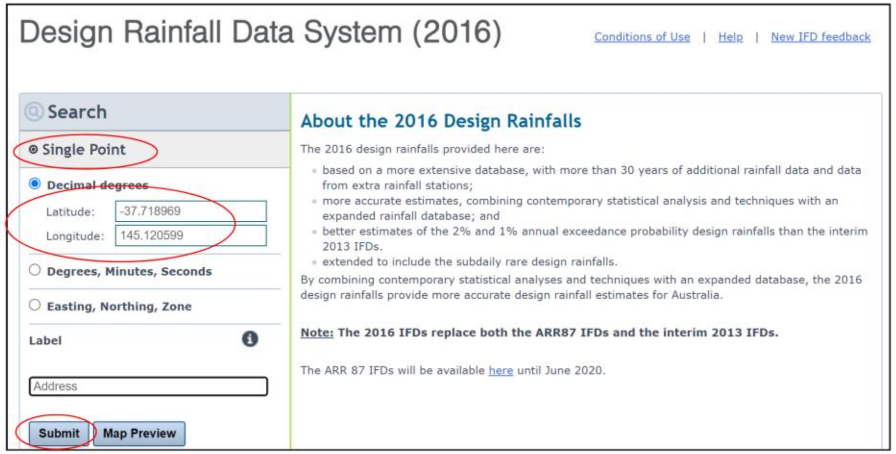
Method 2

Use the BOM's IFD website - MORE ACCURATE

a) Determine the Latitude & Longitude for the site address eg
https://addressfinder.com.au/features/geocode/ EXAMPLE LAT = -37.718969

LONG = 145.120599

b) Use the BOM's Intensity-Frequency-Duration (IFD) website
http://www.bom.gov.au/water/designRainfalls/revised-ifd/



Design Rainfall Data System (2016)

Conditions of Use | Help | New IFD feedback

Search

Single Point

Decimal degrees

Latitude: -37.718969

Longitude: 145.120599

Degrees, Minutes, Seconds

Easting, Northing, Zone

Label

Address

Submit Map Preview

About the 2016 Design Rainfalls

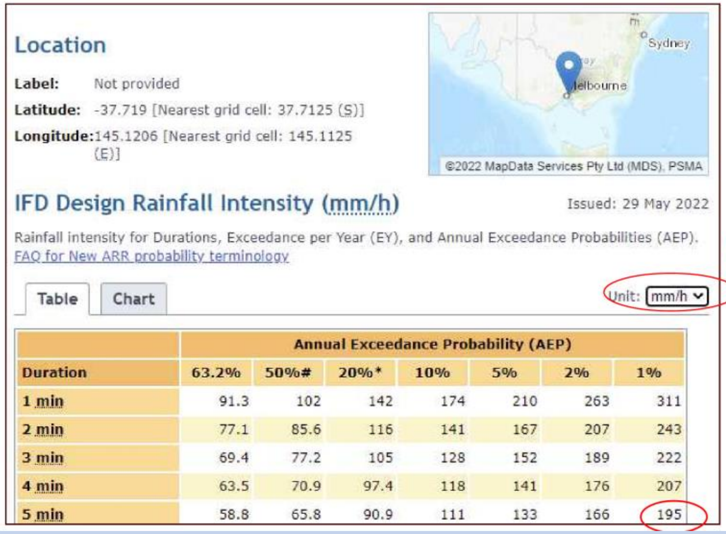
The 2016 design rainfalls provided here are:

- based on a more extensive database, with more than 30 years of additional rainfall data and data from extra rainfall stations;
- more accurate estimates, combining contemporary statistical analysis and techniques with an expanded rainfall database; and
- better estimates of the 2% and 1% annual exceedance probability design rainfalls than the interim 2013 IFDs.
- extended to include the subdaily rare design rainfalls.

By combining contemporary statistical analyses and techniques with an expanded database, the 2016 design rainfalls provide more accurate design rainfall estimates for Australia.

Note: The 2016 IFDs replace both the ARR87 IFDs and the interim 2013 IFDs.

The ARR 87 IFDs will be available here until June 2020.



Location

Label: Not provided

Latitude: -37.719 [Nearest grid cell: 37.7125 (S)]

Longitude: 145.1206 [Nearest grid cell: 145.1125 (E)]

IFD Design Rainfall Intensity (mm/h) Issued: 29 May 2022

Rainfall intensity for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

Table Chart Unit: mm/h

	Annual Exceedance Probability (AEP)						
Duration	63.2%	50%#	20%*	10%	5%	2%	1%
1 min	91.3	102	142	174	210	263	311
2 min	77.1	85.6	116	141	167	207	243
3 min	69.4	77.2	105	128	152	189	222
4 min	63.5	70.9	97.4	118	141	176	207
5 min	58.8	65.8	90.9	111	133	166	195

SELECT mm/h

Question 2

What is the design flow rate for Melbourne City at 1% AEP?

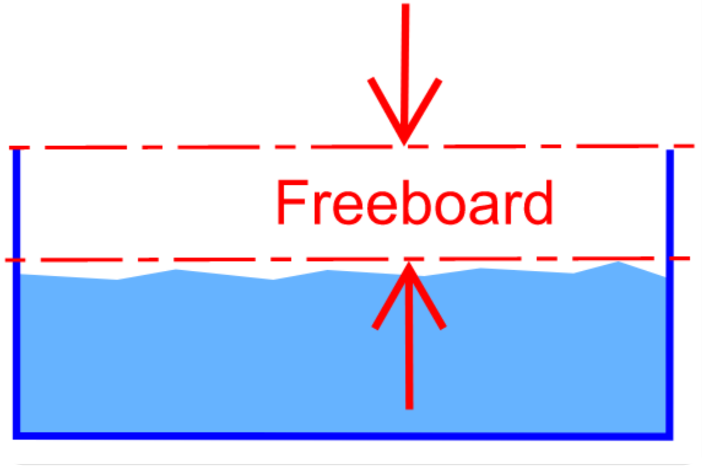
a) 165mm/h

b) 187 mm/h **CORRECT – Note in Victoria the range is from 127mm/h (Colac) to 237mm/h (Mallacoota)**

c) 206 mm/h

d) 127 mm/h

6. The main principles of AS/NZS 3500.3-2021



Three main principles governing the design of box gutters:

1. **Freeboard (must be maintained in all locations)**
   - Design condition (free flow)
     - 60mm for all 3 overflow devices

       (50mm + 10mm allowance for turbulence)
   - Overflow condition
     - 60mm for Rainhead (free flow maintained)
     - 30mm for Sump / Side Outlet (backwatering required – hydraulically complex)
     - 45mm for Sump / High-Capacity Overflow (backwatering also required)

2. **Minimum design flow rate**
   - 3.0 L/s (refer to AHSCA Research Foundation paper by A/Prof Terry Lucke)
   - Note, AS/NZS 3500.3 is currently limited to a maximum of 16 L/s due to a lack of research and development.

3. **Overflow capacity must be at least equal to the design flow (1% AEP)**
   - Piped overflows from sumps must discharge visibly to atmosphere and to the surface drainage system

6. The main principles of AS/NZS 3500.3-2021 (cont.)

Recommended technical reading in relation to AS/NZS 3500.3

1.

Contents lists available at ScienceDirect

Journal of Building Engineering

journal homepage: www.elsevier.com/locate/jobe

ELSEVIER

BUILDING ENGINEERING

Comparing empirical water depth observations of a box gutter roof drainage system to three different international design guidelines

CrossMark

Luke Verstraten[a,*], Terry Lucke[a], Geoffrey O'Loughlin[b]

2.

AHSCA

Association of Hydraulic Services Consultants Australia – Research Foundation

Box Gutter Design Using General Methods of AS/NZ3500.3:2018: Minimum Design Flowrates and Gutter Depths

Discussion paper by:

A/Prof Terry Lucke

PhD, FIEAust, CPEng, EngExec, RPEQ, NER, APEC Engineer, IntPE(Aus)

AHSCA Research and Training Coordinator

3.

AHSCA

Association of Hydraulic Services Consultants Australia – Research Foundation

Performance Solutions: Is it appropriate to use the overflow equations from AS/NZS3500.1 to design box gutter systems as per AS/NZS3500.3?

Discussion paper by:

A/Prof Terry Lucke

PhD, FIEAust, CPEng, EngExec, RPEQ, NER, APEC Engineer, IntPE(Aus)

AHSCA Research and Training Coordinator

4. Technical Appraisal of the Dam Buster Roof Drainage System, by
Adjunct A/Prof Robert Keller.
Refer to Appendix A of the Dam Buster 'Evidence of Suitability' document.
NOTE
This document includes detailed discussions regarding AS/NZS 3500.3

7. Can box gutters change directions?

Changes in direction are commonly seen in practice as contemporary building roof design may necessitate this. Apart from hydraulic concerns, there is also potential for build-up of debris to lodge at the change of direction.

Question 3

Can box gutters change directions ?

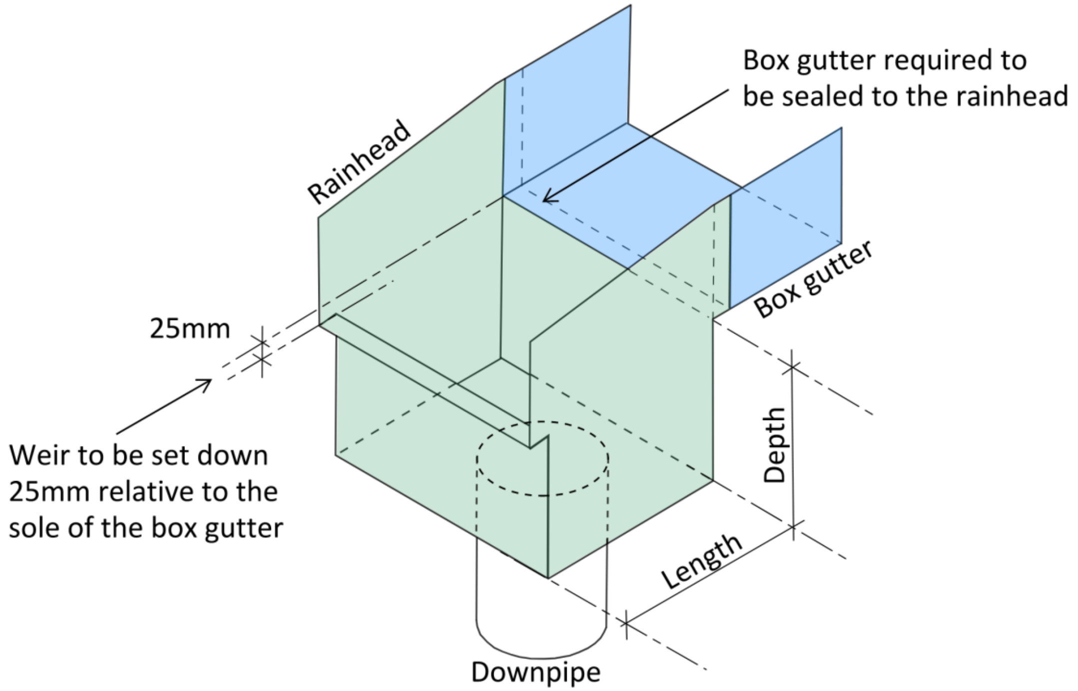
a) No, this is not permitted under AS/NZS 3500.3-2021, which states “*Box gutters shall be straight (without change in direction).* **CORRECT**

b) Yes, this is permitted under AS/NZS 3500.3-2021, but only for low flow rates (less than 3 L/s).

c) Yes, if you introduce a vertical step, box gutters can change directions, provide the step is great enough to overcome the loss of energy and loss of freeboard. However, this can only be done as a Performance Solution, because change of directions is beyond the scope of AS/NZS 3500.3-2021. **CORRECT.**

d) A & C

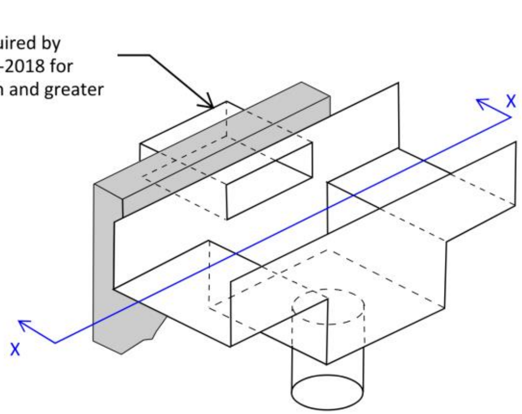
8. Deemed-to-Satisfy Solutions for box gutter overflow devices per AS/NZS 3500.3-2021 - Rainhead



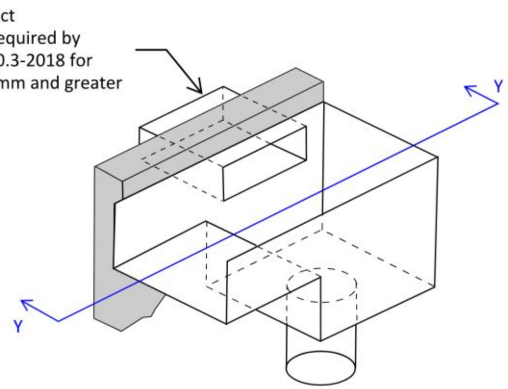
<u>Rainhead to AS/NZS 3500.3-2021</u>

<u>'Open fronted' rainhead</u>

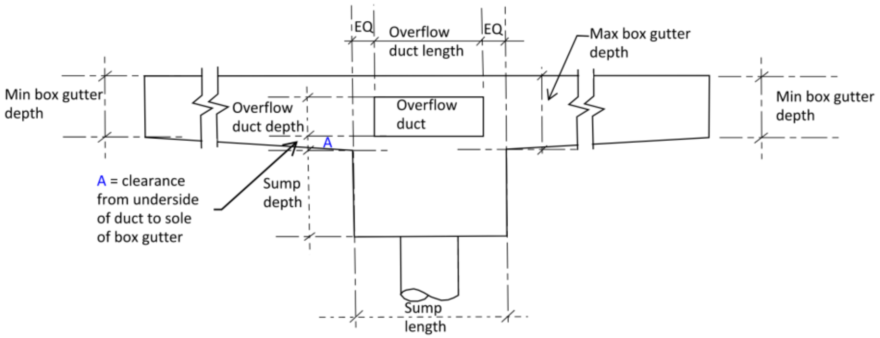
8. Deemed-to-Satisfy Solutions for box gutter overflow devices per AS/NZS 3500.3-2021 – Sump & Side Overflow



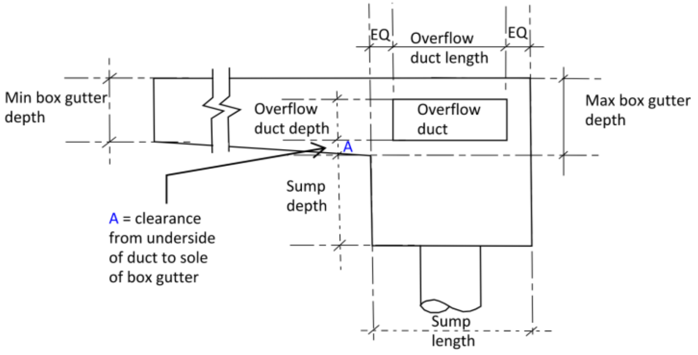
TYPICAL SUMP & SIDE OVERFLOW TO AS/NZS 3500.3-2021
(BOX GUTTERS BOTH SIDES)



TYPICAL SUMP & SIDE OVERFLOW TO AS/NZS 3500.3-2021
(BOX GUTTER ONE SIDE ONLY)



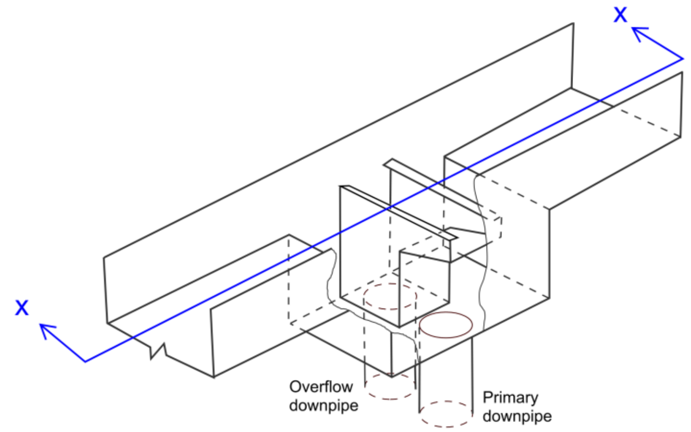
Section X-X



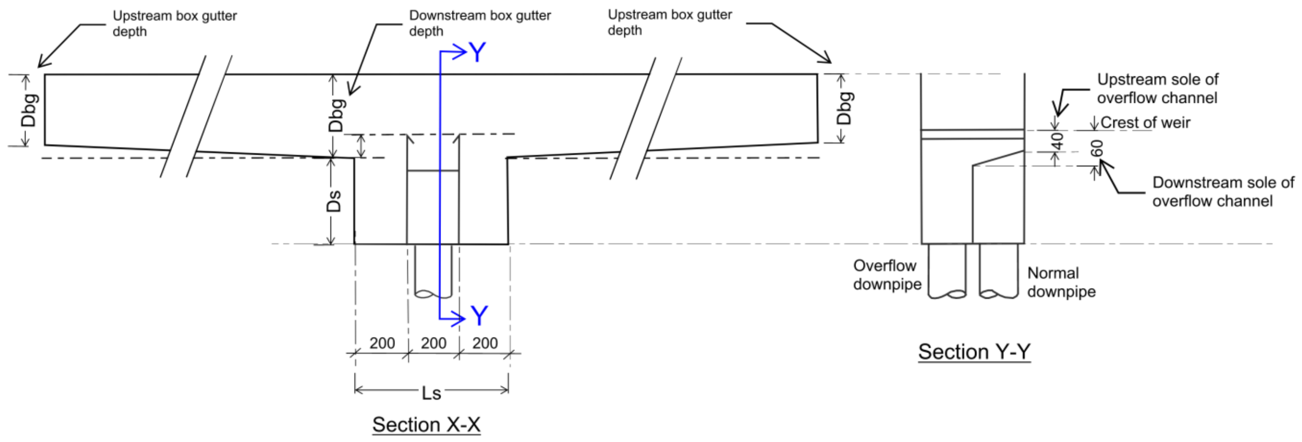
Section Y-Y

SUMP & SIDE OVERFLOW DEVICE TO AS/NZS 3500.3-2021

8. Deemed-to-Satisfy Solutions for box gutter overflow devices per AS/NZS 3500.3-2021 – Sump / High-Capacity Overflow device



Sump / High Capacity Overflow Device to AS/NZS 3500.3-2021



SUMP / HIGH CAPACITY OVERFLOW DEVICE TO AS/NZS 3500.3-2021

Question 4

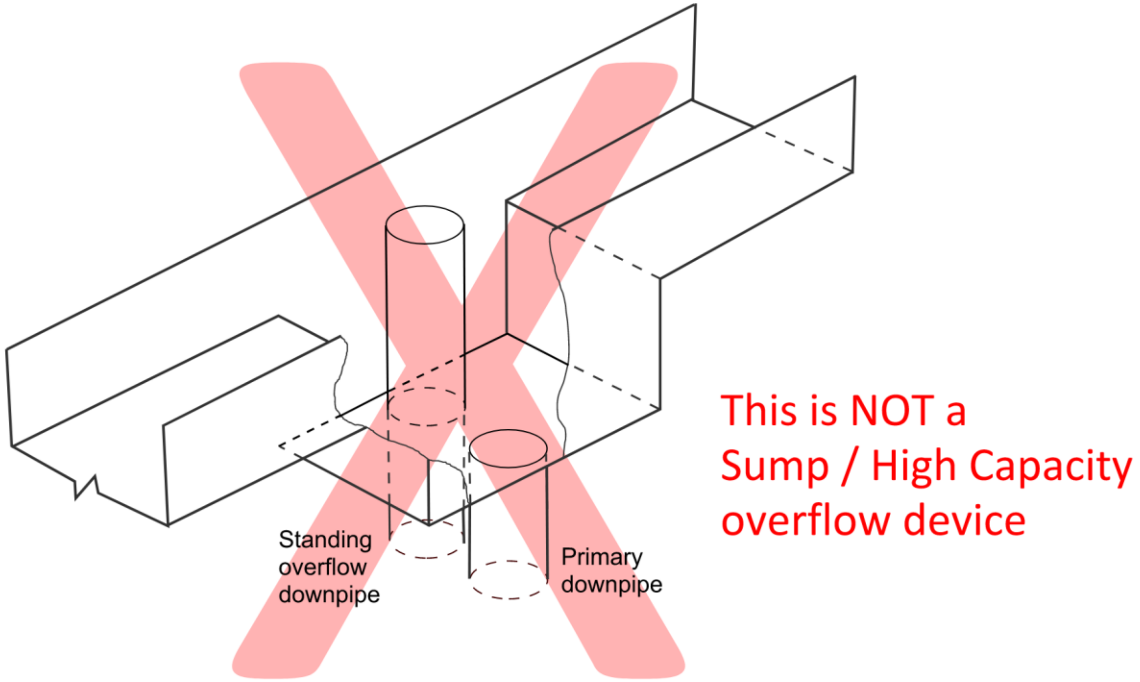
For the Sump / Side Outlet and Sump / High-Capacity Overflow, is the design of box gutters independent of the design of the sump?

a) Yes, the box gutters are designed first using the appropriate charts in AS/NZS 3500.3, and then the sump is designed using the appropriate chart in this code.

b) No, the sump is designed first using the appropriate chart in the code, and then the box gutter depth is determined from the code and increased in depth if necessary to match the sizing of the sump.

c) Yes and No. In the normal flow condition, the flow in the box gutters is described as 'free flow', and the box gutters could be designed independently of the sump. However, in the overflow condition (which the critical design condition) the box gutter and sump must be designed together because 'backwatering' must occur for water flow into the side overflow duct / over the internal weir in the high-capacity device. This is hydraulically very complicated. **CORRECT**

8. Deemed-to-Satisfy Solutions for box gutter overflow devices per AS/NZS 3500.3-2021 (cont.) – Vertical pipe overflows not DtS Solutions



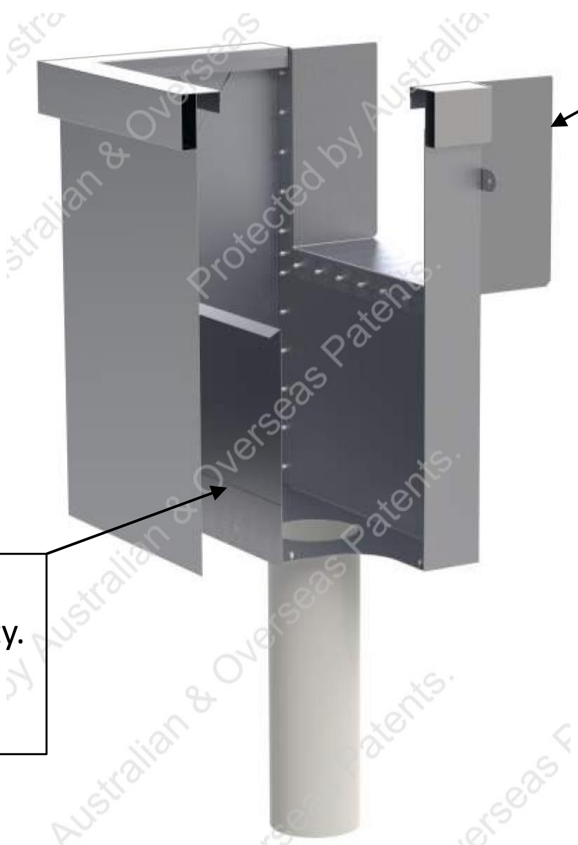
Sump with Standing Overflow Pipe

A sump with a 'Standing overflow pipe' / 'Vertical pipe overflow' is very commonly used in lieu of the DtS AS/NZS 3500.3 Sump / High-Capacity overflow device however, this is non-compliant.

9. Performance Solutions for box gutters –

Example - The Dam Buster Roof Drainage System

Box gutter receiver
Permits riveted and silicone joint between box gutter and rainhead.
AS/NZS 3500.3 requires box gutters to be sealed to rainheads and sumps



Vertical overflow chute
Very high overflow capacity.
Greater than 16 L/s for
smallest rainhead (R-200)

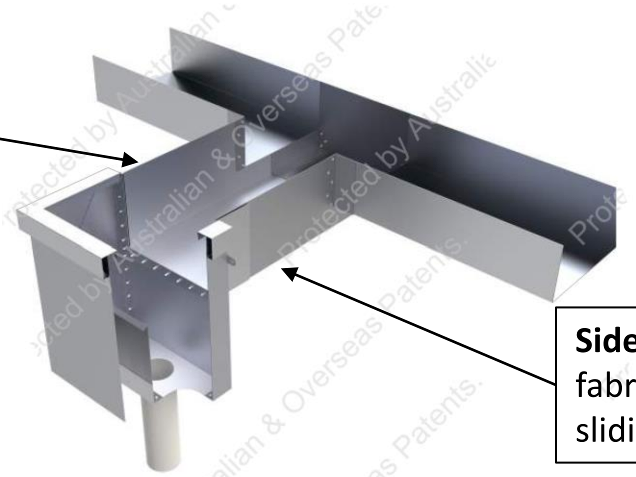
Dam Buster Rainhead

Dam Buster Curved Fronted Rainhead

9. Performance Solutions for box gutters –

Example - The Dam Buster Roof Drainage System

SBG
Short (deep) outlet
Box gutter
(1200mm max long)



Side outlets
fabricated in 2
sliding components

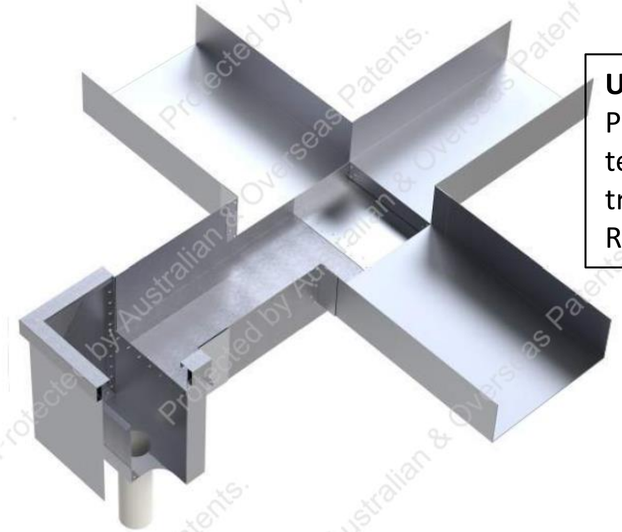
Dam Buster T Side Outlet & Rainhead

Dam Buster END Side Outlet & Rainhead
(LH & RH forms available)

Useful for a Trussed Hip End with parapet walls
- See also slide on Hip Truss Lintel

Dam Buster CORNER Side Outlet & Rainhead
(LH & RH forms available)

Uncommon device
Possible use is a row of terrace style house with hip truss roofs and parapet wall
Rear gutter over party wall

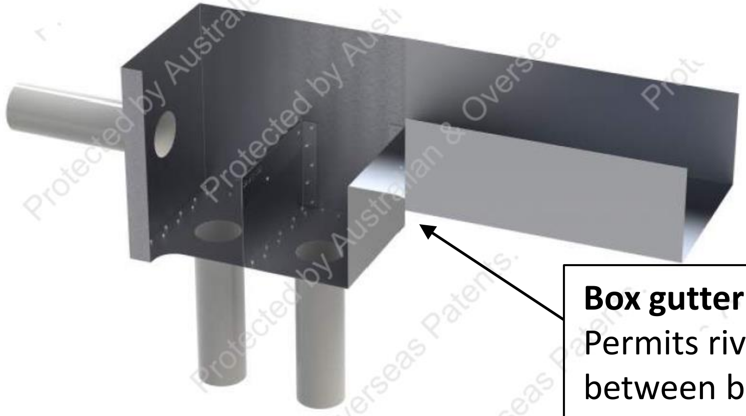


Dam Buster CRUCIFORM Side Outlet & Rainhead

9. Performance Solutions for box gutters –

Example - The Dam Buster Roof Drainage System

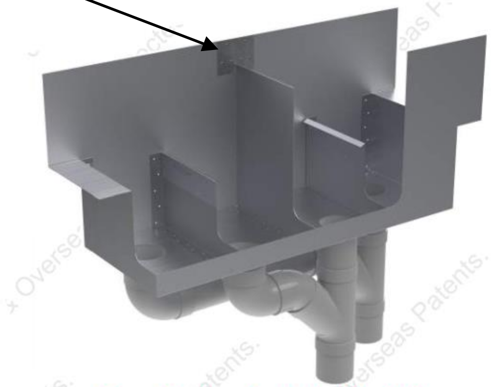
Full blockage overflow indicator
- Recommended additional safety feature
- Used where possible
- Can be installed on side of overflow chamber



Dam Buster Sump

Box gutter receiver
Permits riveted and silicone joint between box gutter and rainhead. AS/NZS 3500.3 requires box gutters to be sealed to rainheads and sumps

Rear walls cut down 60mm



Dam Buster Back-to-Back Sump

Back-to-Back Sumps
- Alternative to 3500.3 Sump / High-Capacity overflow device
- Rear walls cut down 60mm as a safety feature, similar to the continuous sump

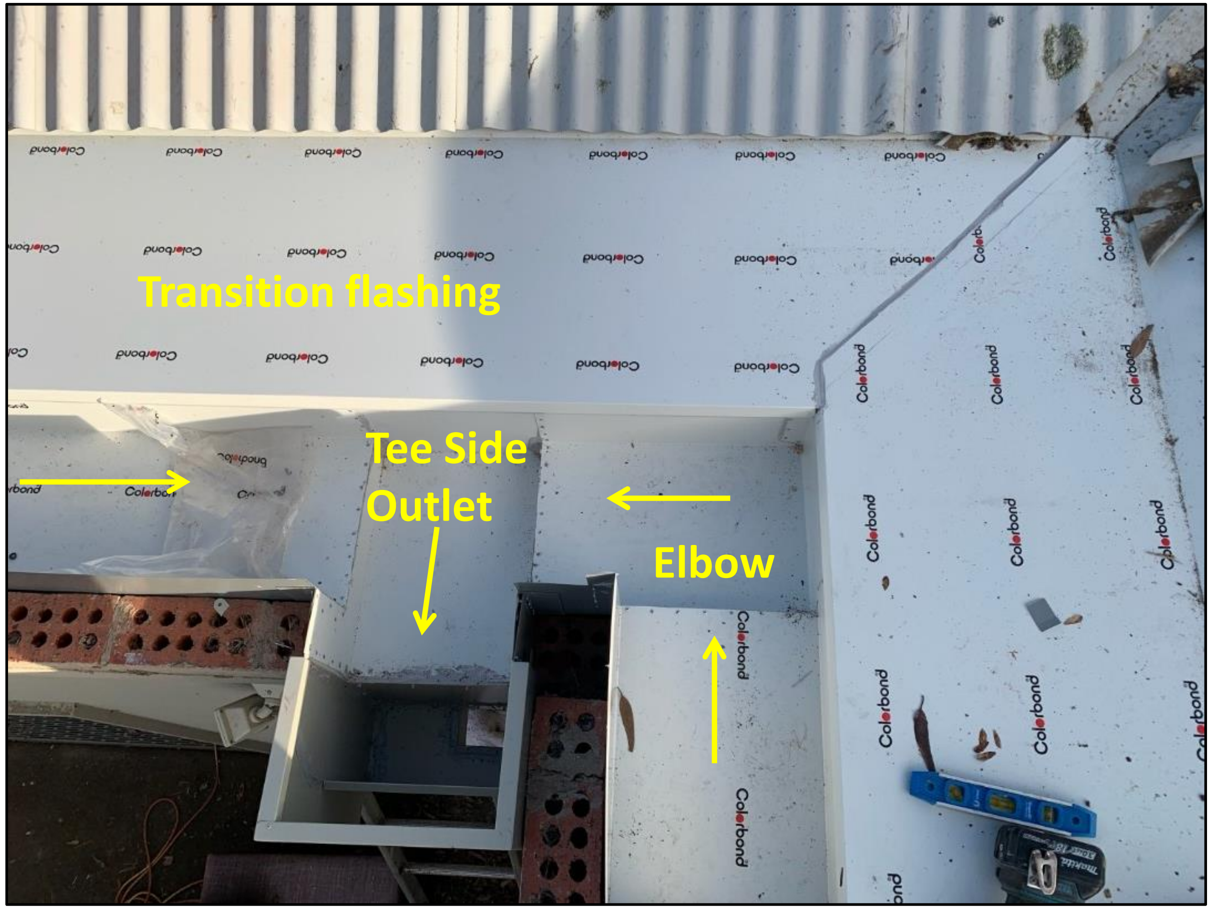
Continuous Sump
- Installed in series
- Wall cut down 60mm as a safety feature to allow flow between bays
- Would commonly have a rainhead at the end of a series of continuous sumps
- Expansion joint can be installed at the downstream box gutter, refer to the Standard Details drawings (note the upstream end of the downstream gutter is a high point i.e. required installation location for expansion joints

Rear wall cut down 60mm

Dam Buster Continuous Sump

9. Performance Solutions for box gutters –

Example - The Dam Buster Roof Drainage System

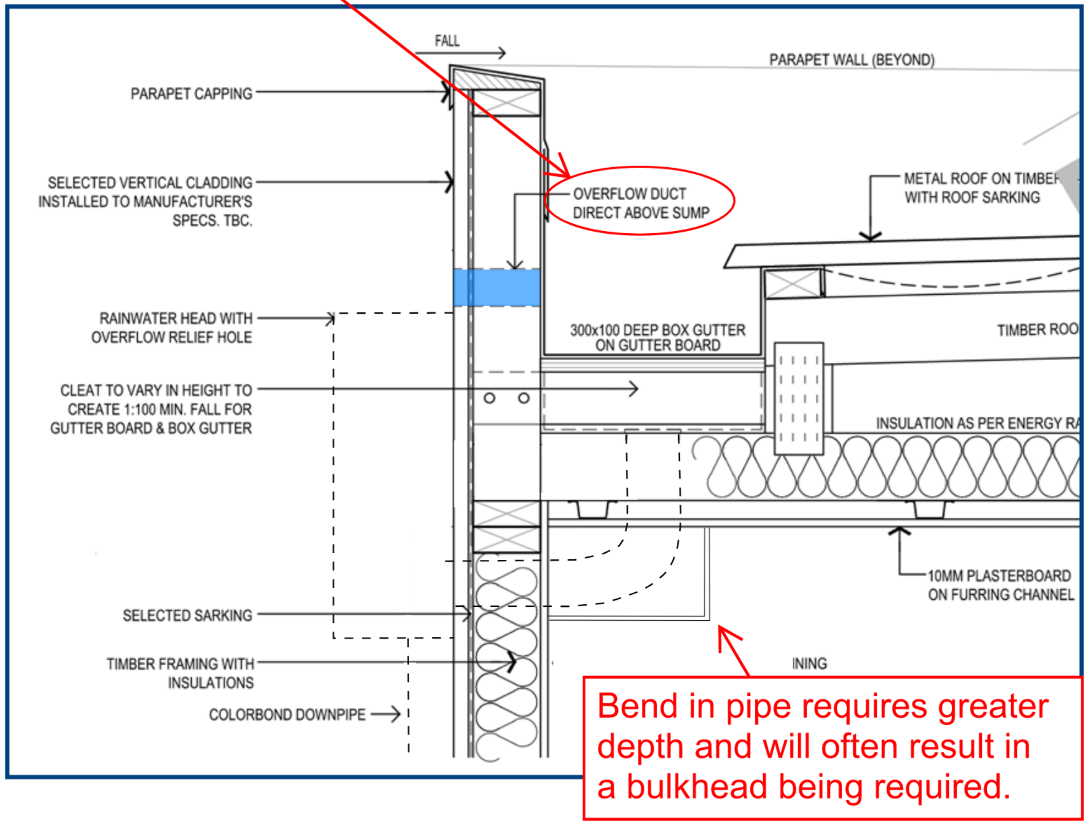


Example of a compliance upgrade using transition flashing to obtain additional depth

9. Performance Solutions for box gutters –

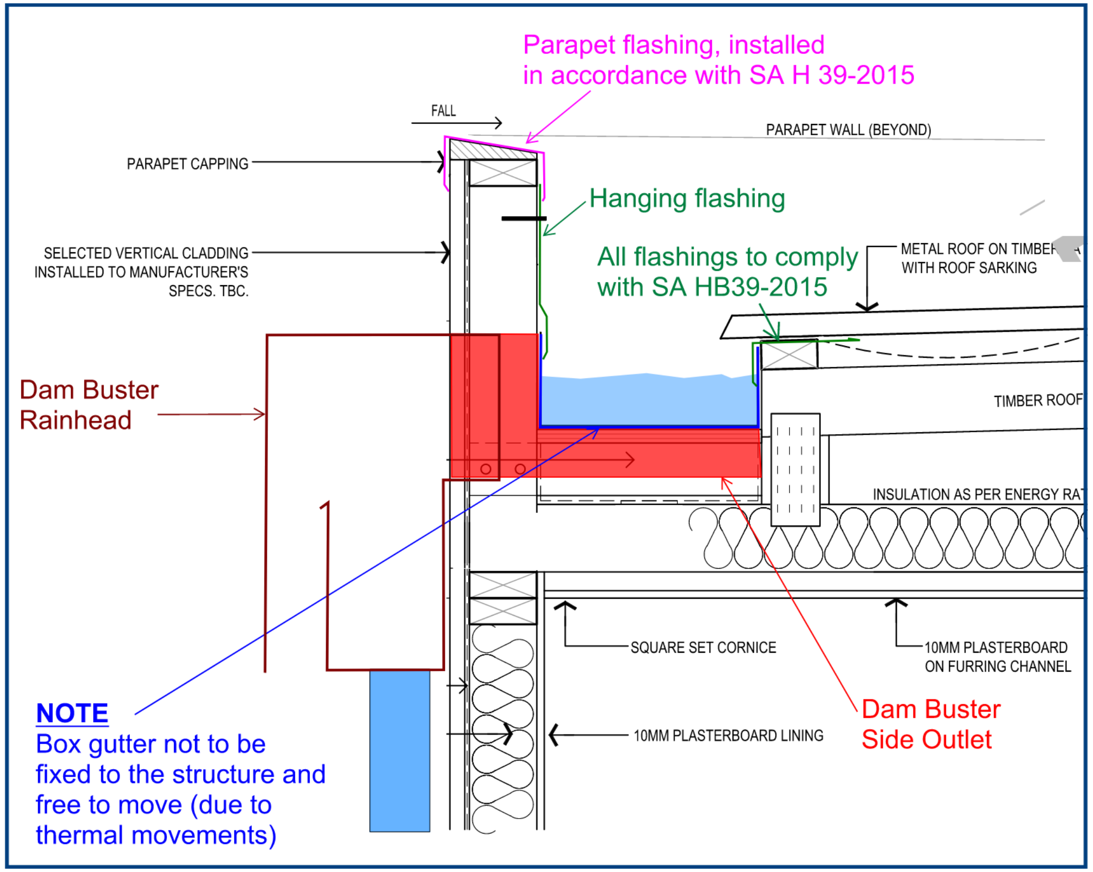
Example - The Dam Buster Roof Drainage System

The Dam Buster Side Outlet and Rainhead combination often eliminates bulkheads whilst also providing a compliant solution.



Original architectural detail

Non-compliant and often requires a bulkhead below the sump



Dam Buster Sump & Side Outlet & Rainhead combination

Compliant & eliminates bulkheads

10. Valley gutters

Design of valley gutters to AS/NZS 3500.3-2021 is very limited:-

- Maximum catchment area is 20m^2
- Roof slopes must be 12.5^{O} min
- Nominal side wall slope is 16.5^{O}
- Freeboard = 15mm

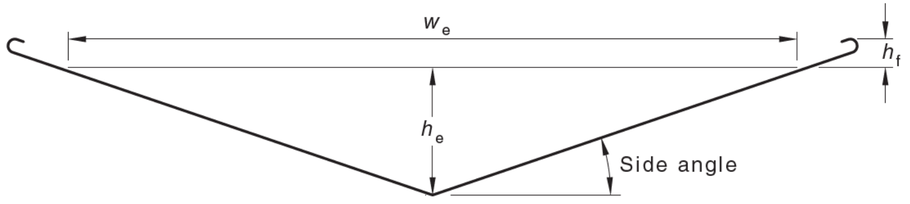


Figure 3.6.1 — Profile of a valley gutter

Beware non-regular valley gutters

- When two roofs of different slopes intersect, one of the side wall slopes can become very low
- The geometry in surprisingly complicated, the general solution is follows:

In the general case, it can be shown that for a valley gutter formed from intersection roofs with roof slope angles A1 and A2, the slopes of the side walls, S1 and S2, respectively are as follows:

$$S1 = \tan^{-1}(\tan(A2)*[1-k1*\sin(k2)/SQRT(1+k1^{2})]/(k1*\cos(k2))$$

$$S2 = \tan^{-1}(k1*\tan(A2)*(k1-\sin(k2)/SQRT(1+k1^{2}))/((k1^{2})*\sin(k2))$$

where

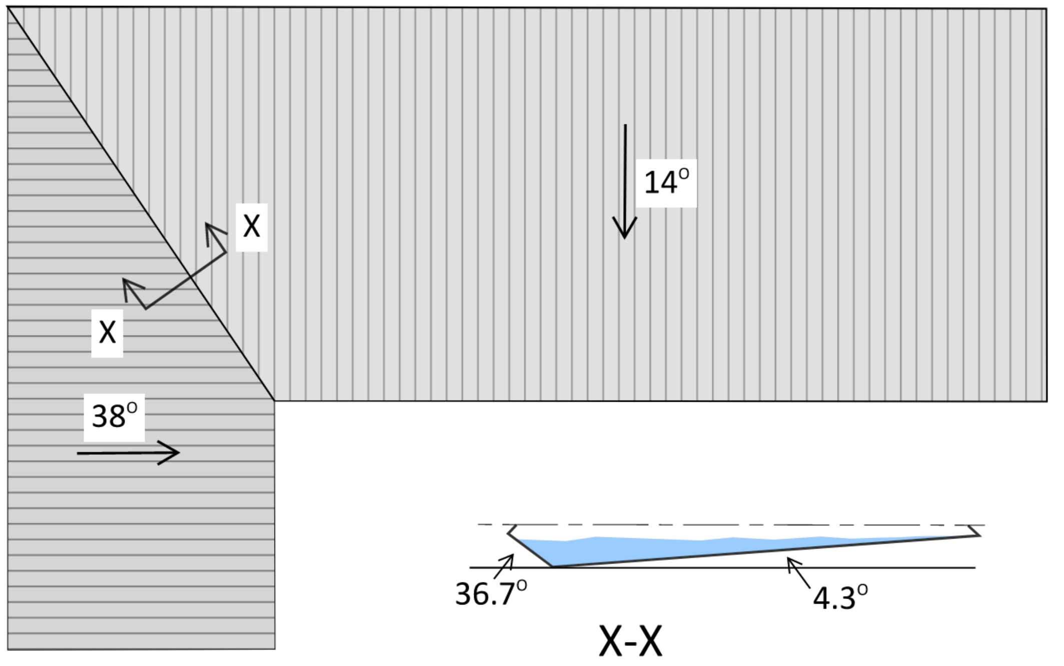
$$k1= \tan(A2)/\tan(A1) \text{ and}$$

$$k2= \tan^{-1}(k1)$$

The slope of the valley gutter itself is determined as follows:

$$\text{Valley Gutter Slope} = \tan^{-1}(\tan(A2)/SQRT(1+k1^{2}))$$

10. Valley gutters (cont.)

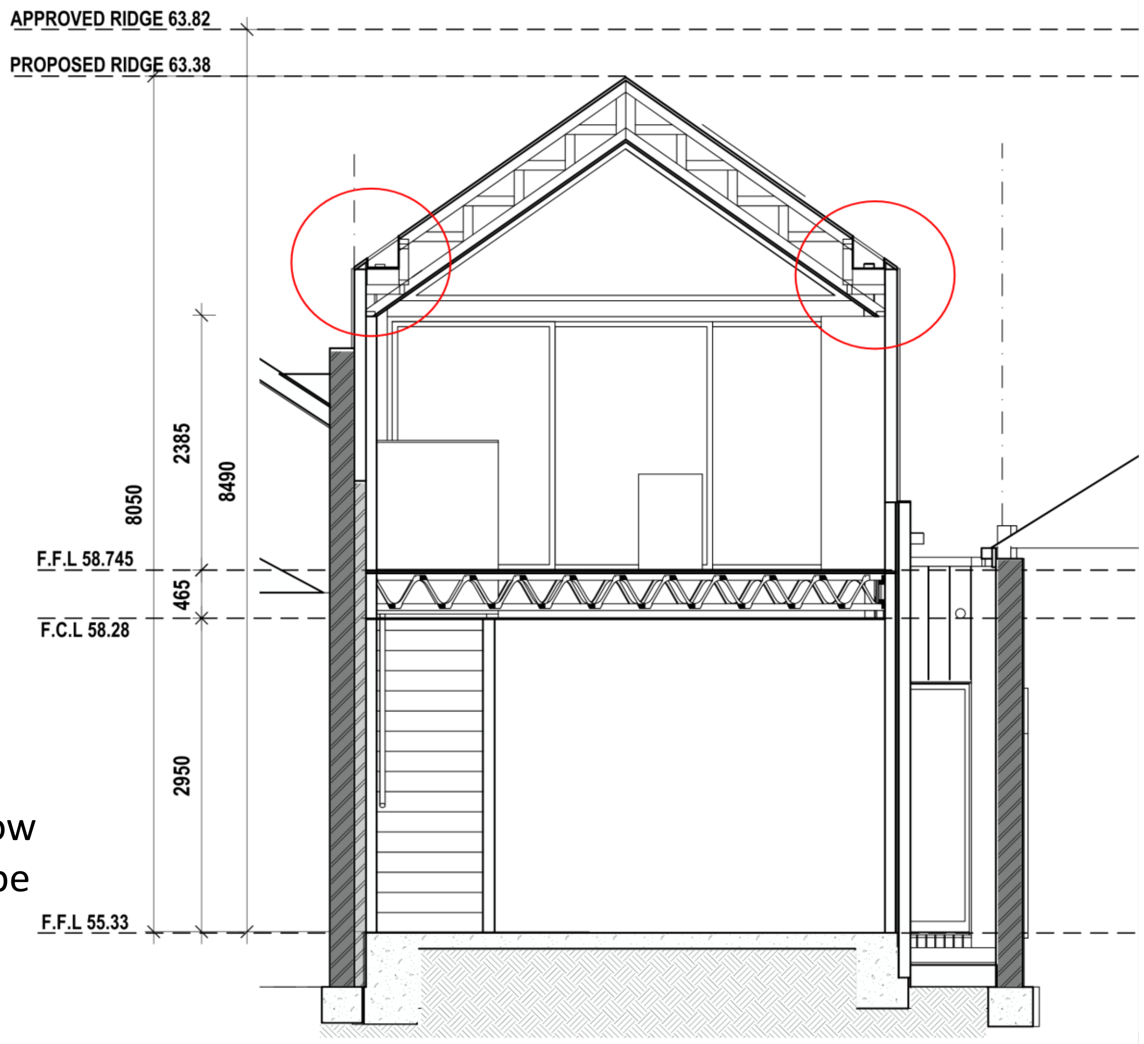


Example

Two roofs with slopes of 38° and 14° intersect.

- Valley gutter slope = 13.4°
- LHS Side Wall slope = 36.7°
- RHS Side Wall slope = 4.3°   Not intuitive !

11. Access to box gutters for maintenance and cleaning



SECTION B - B

‘Concealed’ box gutters – not a good idea !

- Eaves gutters have continuous overflow provision and if properly installed, do not flood the building when they overflow
- However, box gutters have dedicated overflows, and need to be maintained / cleaned because when they overtop, they flood the building
- Are architects responsible for ensuring safe access is available to clean out box gutters in the future?

11. Access to box gutters for maintenance and cleaning (cont.)

Architects responsible for safe access to roofs for maintenance / cleaning of box gutters?

- What are the architect's duties under the WHS Act?
- Does the architect have any responsibility for building owners or contractors carrying out maintenance / cleaning of the box gutters, which is foreseeable, in the future?
- Does the architect need to document safe access to the roof such as (for example) anchor points for rope access by contractors with rope access qualifications?
- The legal article can be Googled (page 1 of 4 provided)
- Advice could be sought from WorkSafe Victoria

THYNNE & MACARTNEY

MEMBER OF THE KENNEDY STRANG LEGAL GROUP

Work Health and Safety:

Some Considerations for Architects and Designers

By Cameron Solley, Partner
Insurance, Litigation & Risk Management Group

Workplace Duties

The Work Health and Safety Act 2011 (the WHS Act) applies at any work place, including a construction site and residential premises when a contractor is engaged to carry out work there.

While work is being carried out, for example, to construct a building or do renovation work at a residential premises, an architect or designer will likely be a person conducting a business or undertaking (PCBU), and therefore have health and safety duties to others under the WHS Act.

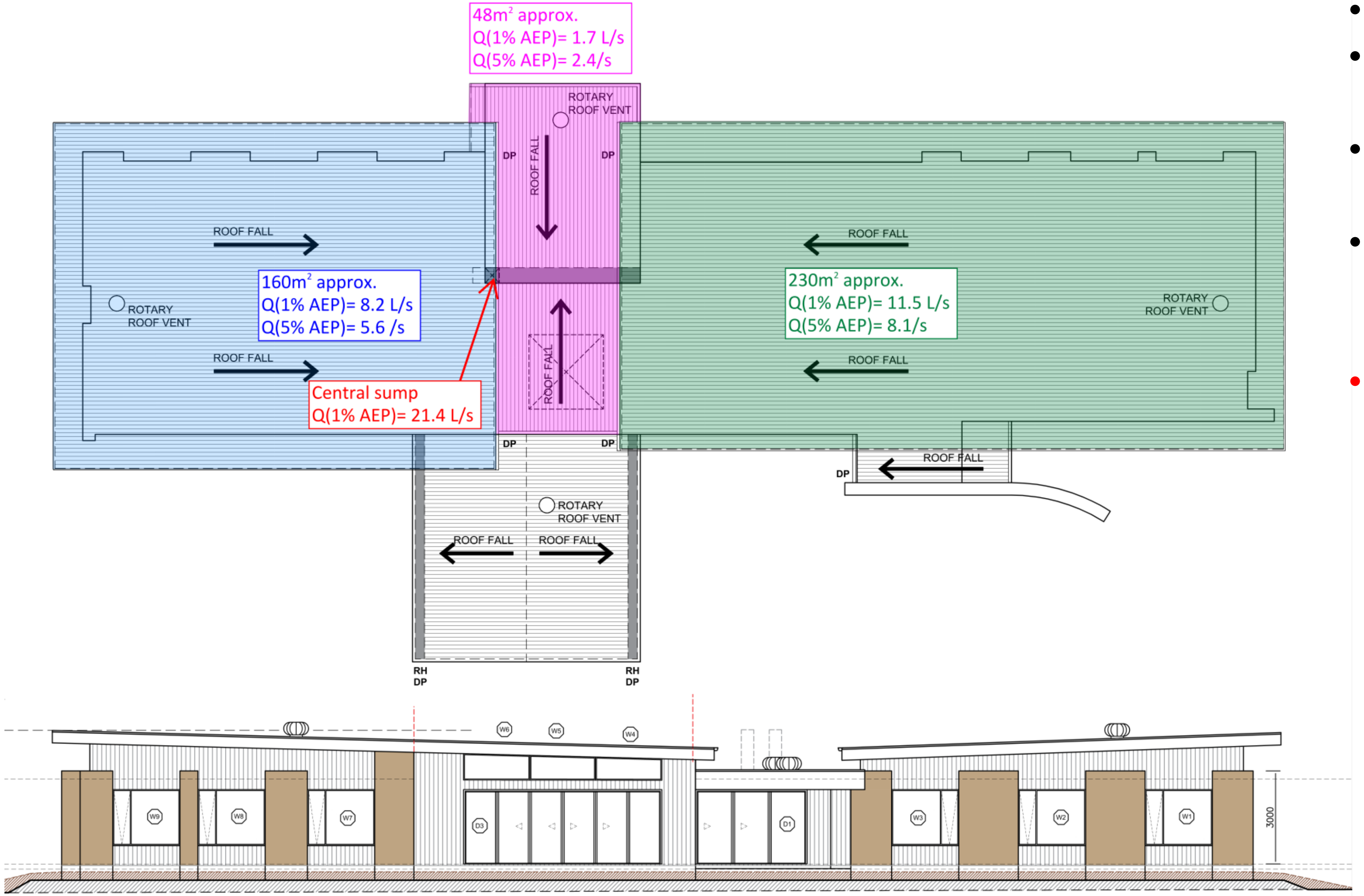
- The Architect owes a duty as a PCBU to their workers and themselves while they are at work at the premises to ensure their workers' and their own health and safety while at work. The Architect also has a duty of care to ensure, so far as is reasonably practicable, that the health and safety of other people is not put at risk from the work being carried out. This would include the health and safety of residents and any visitors who are there when work is being carried out.
- There is also a duty imposed on any workers carrying out the work for the business operator to:
  - take reasonable care for their own health and safety
  - take reasonable care that their actions or omissions do not adversely affect the health and safety of others, such as residents and visitors
  - comply with reasonable instructions given by the PCBU.
- Interestingly, in the case of a residential premises, the home owner/residents and any visitors while work is being carried out at the premises have a duty to:

- take reasonable care for their own health and safety
- take reasonable care that their actions or omissions do not adversely affect the health and safety of other persons
- comply with reasonable instructions given by the PCBU.

The WHS Act imposes a specific duty on officers of PCBUs to exercise due diligence to ensure that the PCBU meets its work health and safety duties. This duty requires officers to be **proactive** in ensuring that the PCBU complies with its work health and safety duties.

To protect their position, Architects and Designers need to ensure that all steps have been, or are being, taken to ensure appropriate workplace systems, procedures, education processes are in place to achieve a safe working environment as contemplated by the Act. The laying of a good audit trail will be appropriate so that it can be said, and proven through written records, that workplace health and safety practices are being appropriately implemented and monitored for compliance. Obviously, you do not need to take the health

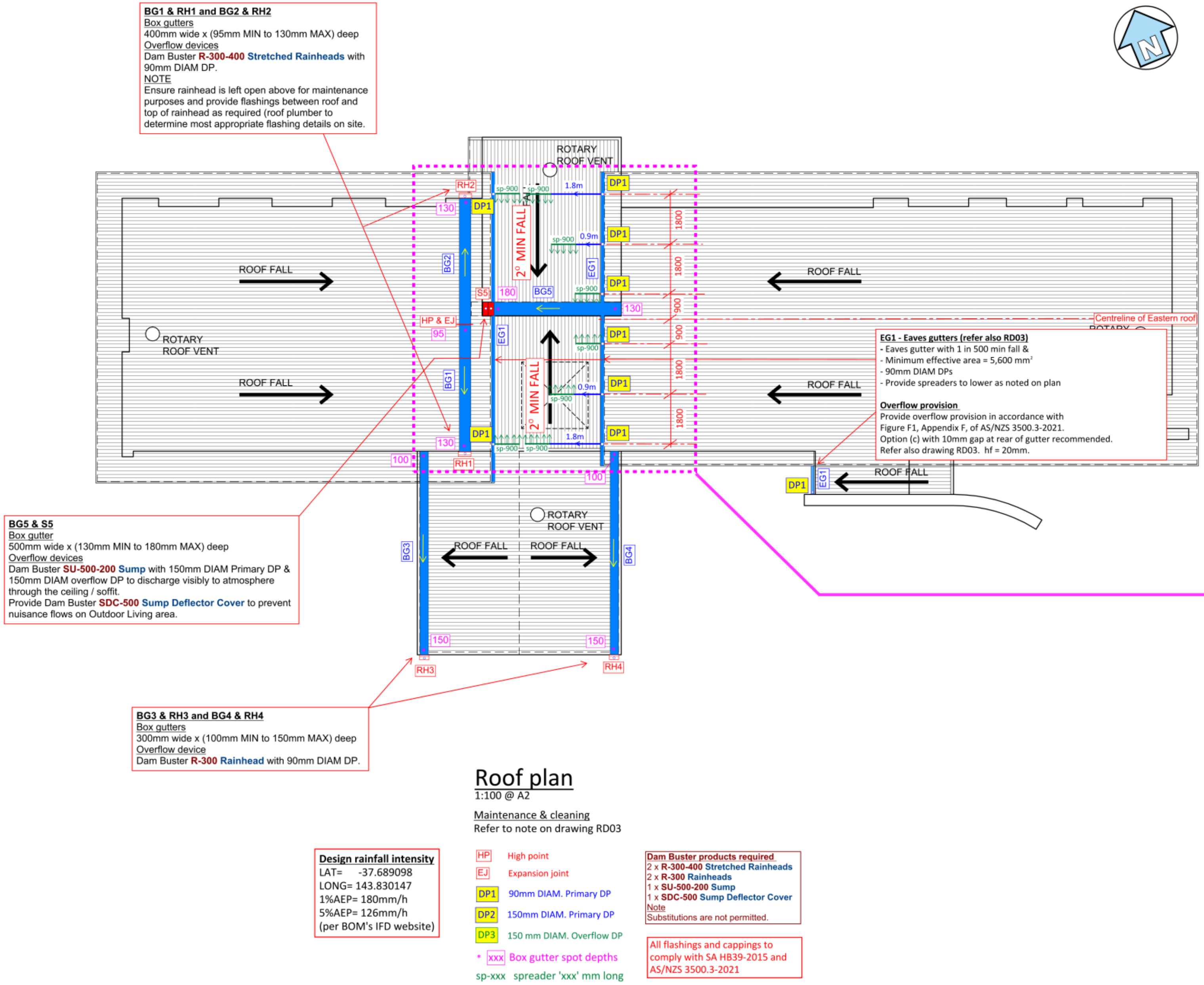
12. Design Examples



Example 1

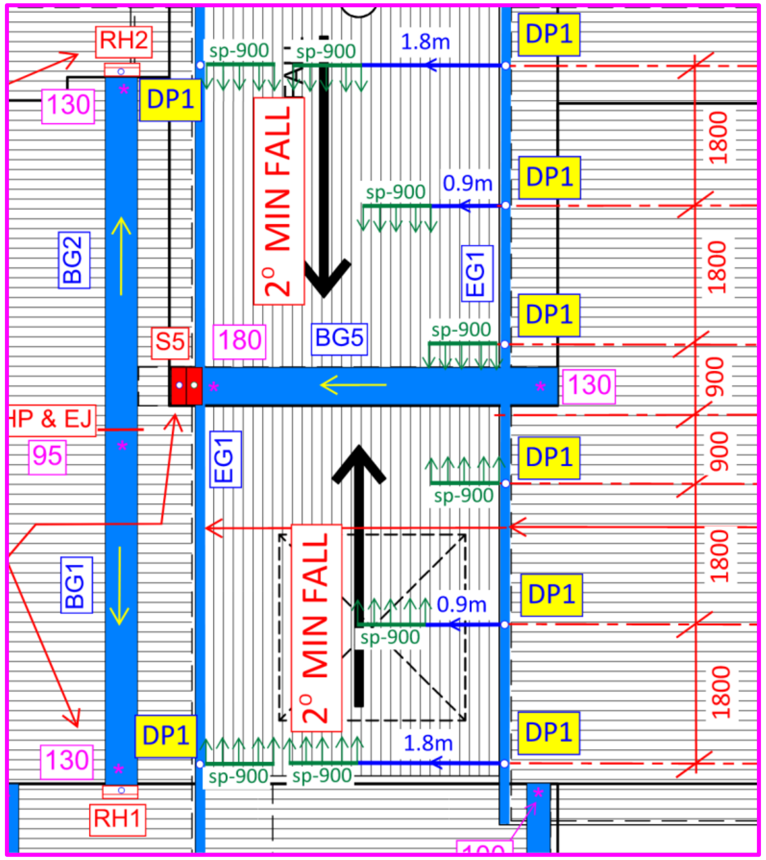
- Butterfly roof
- Eaves gutters spread to lower roof with box gutter & sump
- What is a compliant roof drainage solution?
- What would happen if no roof drainage design was carried out at Building Permit stage? …….
- It would almost certainly would have been a disaster without a design at building permit stage

12. Design Examples (cont.)



Example 1 Solution

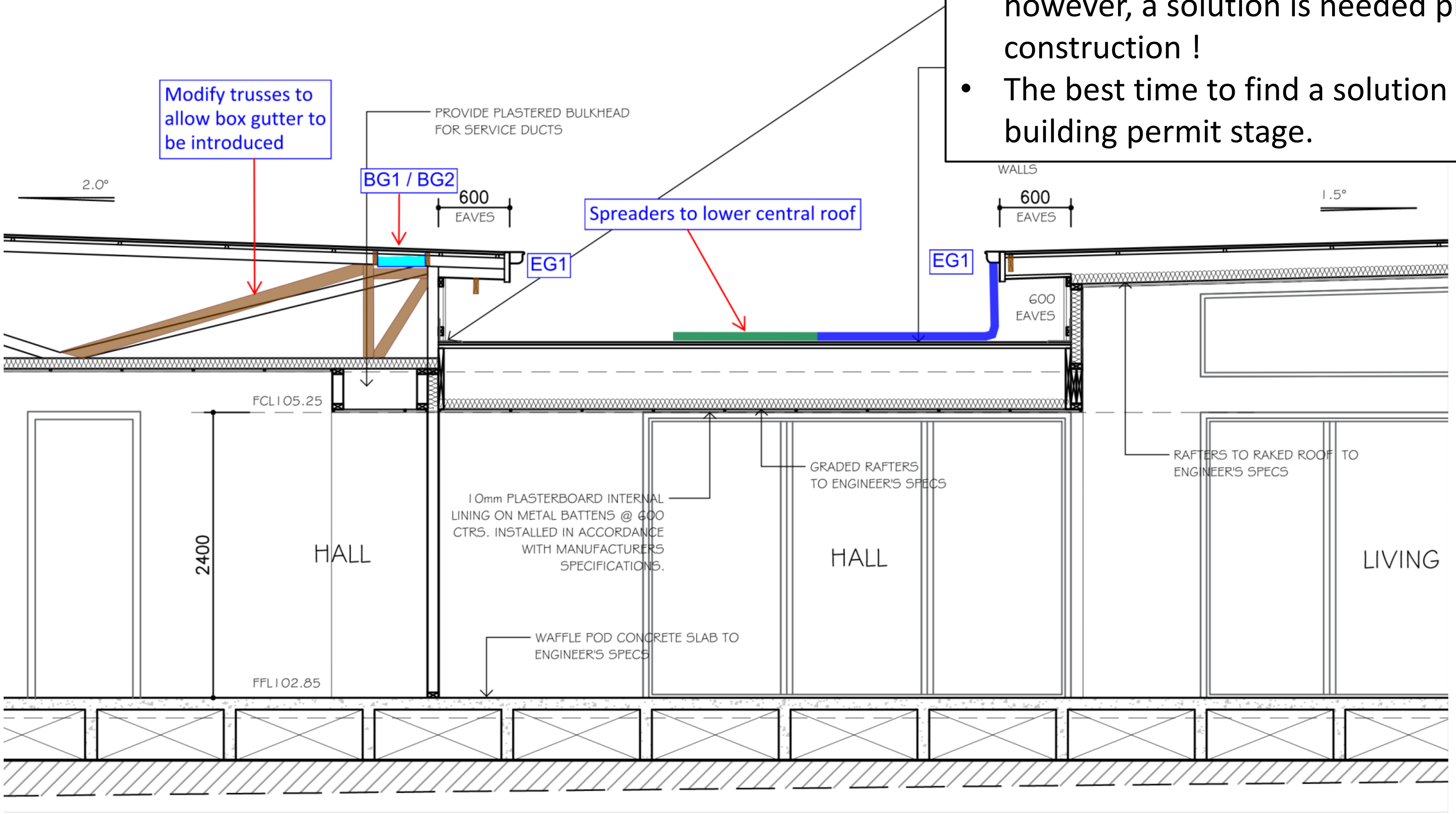
- Box gutter within western main roof
- Eaves gutter to easter main roof and spreaders to lower roof
- Design flow rate to sump reduced from 21.4 L/s to 15.7 L/s (< 16 L/s code limit)



12. Design Examples (cont.)

Example 1 Solution

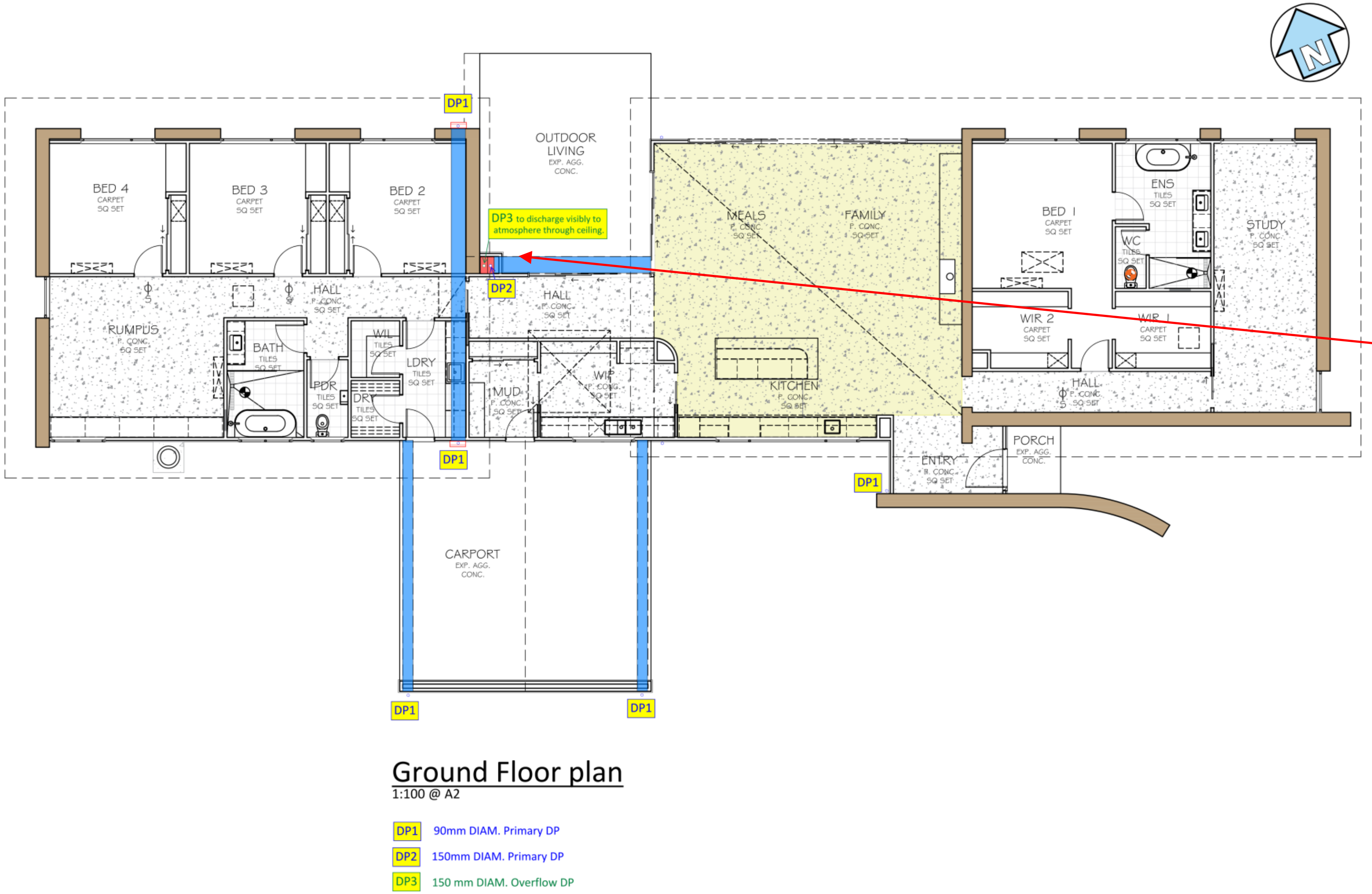
- Requires truss design to modified
- There might be other better solutions, however, a solution is needed prior to construction !
- The best time to find a solution is at building permit stage.



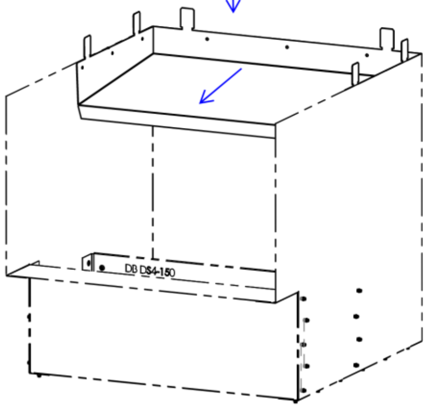
12. Design Examples (cont.)

Example 1 - Solution

- Note the Dam Buster Sump is specified with a **Sump Deflector Cover** to prevent ‘nuisance flows’ onto the Outdoor Living Area



Sump Deflector Cover redirects water entering the overflow chamber into the primary chamber

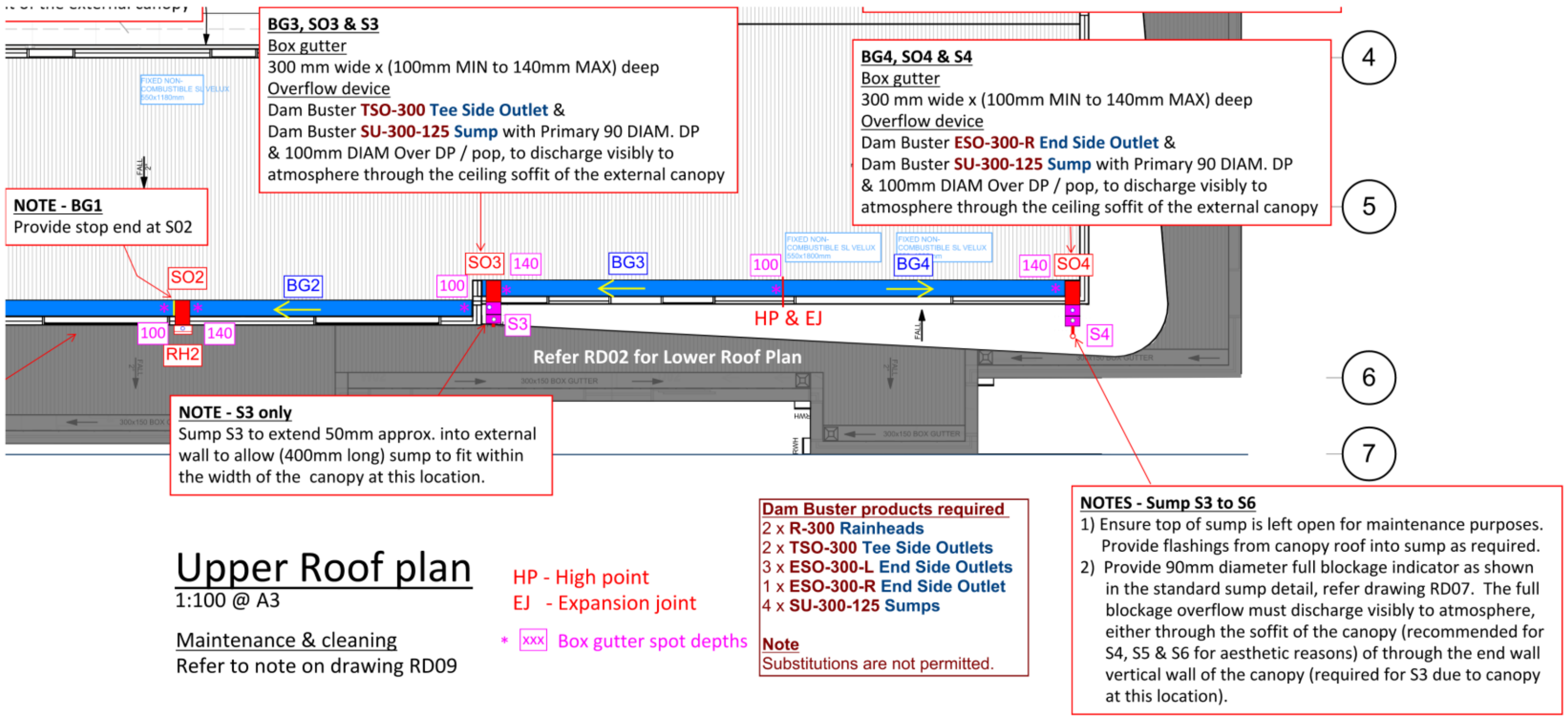


Dam Buster Sump

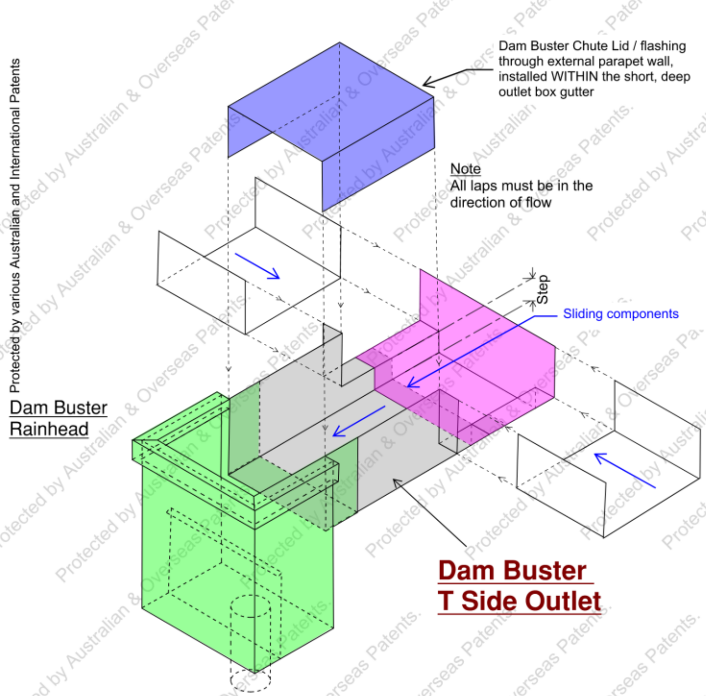
12. Design Examples

Example 2

- Two storey residence
- Curved canopy at upper roof level



12. Design Examples (cont.)



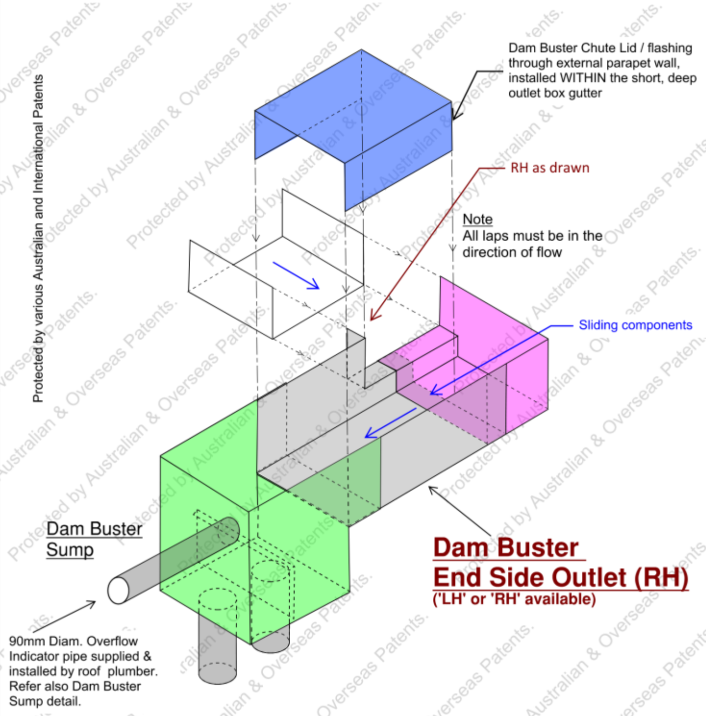
T Side Outlet Size	Side Outlet Width	Nominal Step	Rainhead size	Side Outlet Expansion range
TSO-200	200 mm	50mm	R-200 or CR-200	200 to 350 mm
TSO-300	300 mm	60mm	R-300 or CR-300	300 to 450 mm
TSO-400	400 mm	70mm	R-400 or CR-400	400 to 600 mm

SD005 - Dam Buster T Side Outlet & Rainhead combination (NTS)

NOTES

1. Refer to the current Dam Buster manual for installation details

S02 / RH2



End Side Outlet Size	Side Outlet Width	Nominal Step	Sump size	Side Outlet Expansion range
ESO-200-(L or R)	200 mm	50mm	SU-200-100 or SU-200-150	200 to 350 mm
ESO-300-(L or R)	300 mm	60mm	SU-300-125 or SU-300-200	300 to 450 mm
ESO-400-(L or R)	400 mm	70mm	SU-400-150 or SU-400-200	400 to 600 mm

SD010 - Dam Buster End Side Outlet & Sump combination (NTS)

NOTES

1. Refer to the current Dam Buster manual for installation details

S04 / RH4

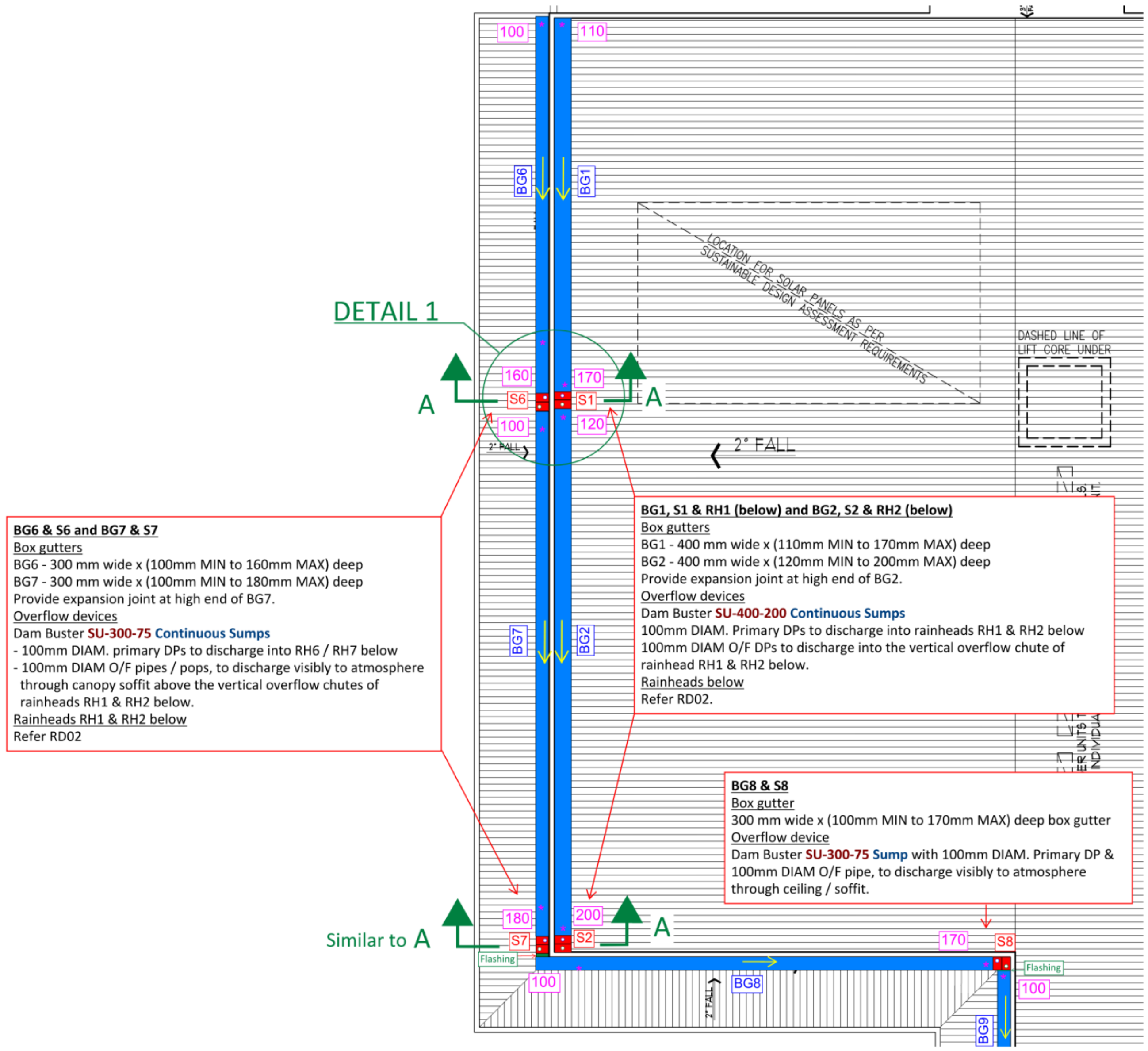
Example 2

- Tee Side Outlet and Rainhead combination => no sump or bulkhead required
- Side Outlet & Sump combination within canopy – uncommon solution

12. Design Examples (cont.)

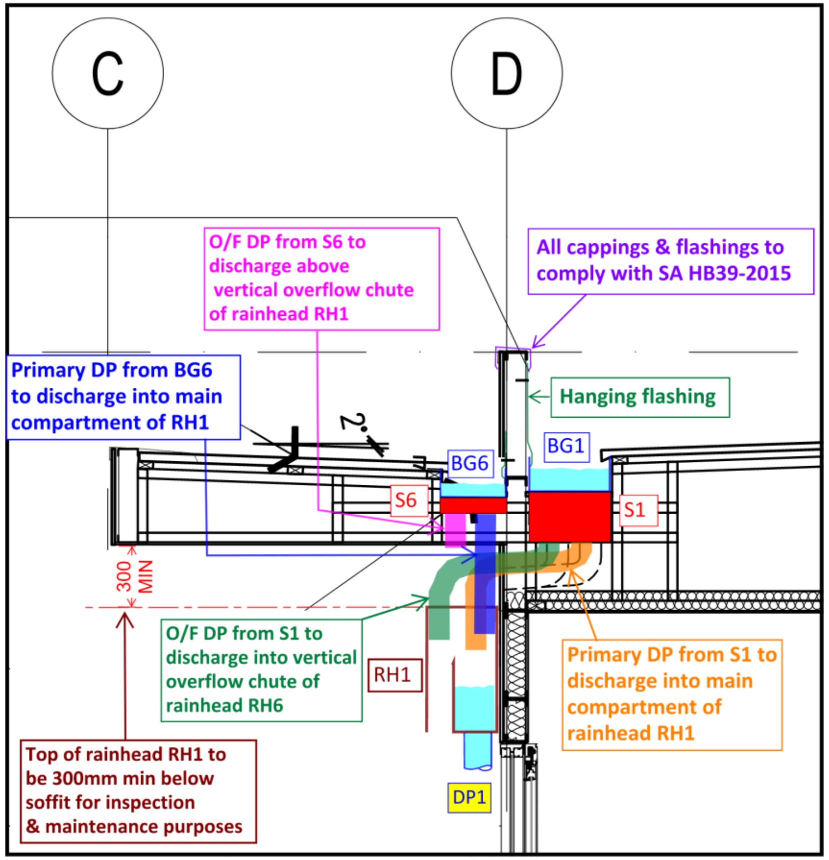
Example 3

- Childcare Centre

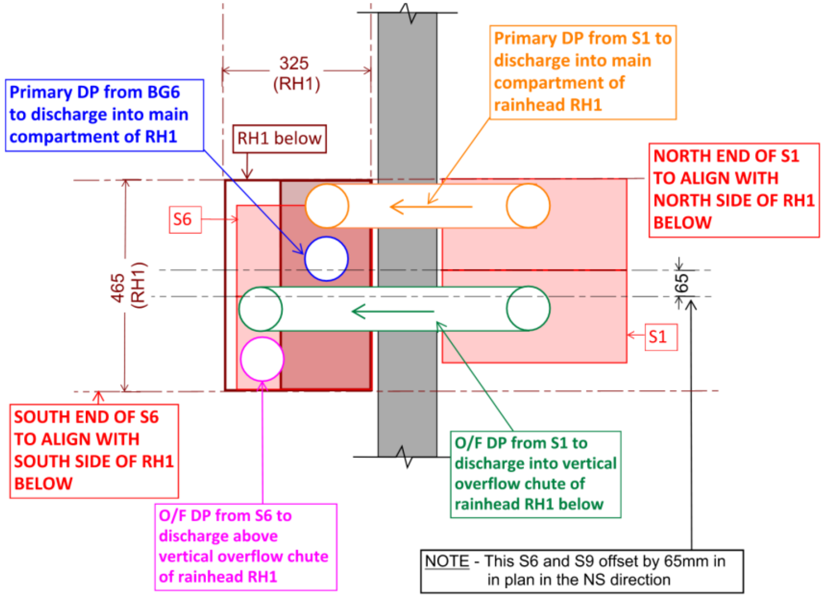


12. Design Examples (cont.)

Example 3 – Childcare centre

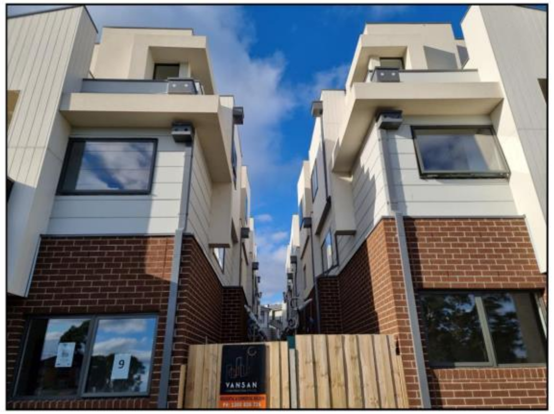


SECTION A-A
1:25@ A1



DETAIL 1
1:10@ A1

13. Examples of non-compliant roof drainage



Roof plumbing today

Wrong, wrong & Wrong !

13. Examples of non-compliant roof drainage (cont.)

Non-compliant sump with an inverted pop used as a standing overflow pipe

Both the primary and overflow pipes discharge into a rainhead – non-compliant (the overflow must discharge visibly to atmosphere and the surface drainage system)

Recently constructed, very expensive house in Toorak. The problems with roof drainage are endemic throughout the construction industry.

Proximate cause of problem – no hydraulic design for the roof drainage (roof drainage design left up to the builder / roof plumber).

14. How to fix the roof drainage industry

Recommended changes to fix the roof drainage industry:-

- Building Surveyors / Building Certifiers should require detailed roof drainage designs (which include box gutters) to be submitted during the approval process. Note, the VBA has recently issued recommendations for Class 2 buildings, which include the required level of documentation for roof drainage.

- Roof plumbers should not be responsible for roof drainage design, they should be installers only. The Victorian (and Tasmania) State Additions to the PCA for Roof drainage should be removed.

- AS/NZS 3500.3 needs various changes / improvements, including, for example:
  - Clarification that the box gutter design depth applies at the upstream end
  - Clarification that the minimum design flow rate is 3 L/s
  - Clarification on how box gutters should be sealed to rainheads
  - Clarification of the implied freeboard, which varies as previously noted

    (the code is currently quite misleading on freeboard)

- Education (to the following building professionals) regarding Dam Buster products, which when used in conjunction with the code devices, provides much greater flexibility to find solutions, particularly in relation to change of direction
  - Architects & Building Designers
  - Civil & hydraulic engineers
  - Building Surveyors
  - Builders

14. How to fix the roof drainage industry (cont.)

Recommended changes to fix the roof drainage industry (cont.)

- Minimum information required on roof drainage design drawings
  - Design rainfall intensities
  - For box gutters
    - Upstream and downstream depths of all box gutters
    - Details of all box gutter overflow devices
    - Details of any other box gutter devices eg Dam Buster change of direction devices
  - For eaves gutters
    - Minimum effective area & minimum slope
    - DP sizes and locations
    - Overflow provision details

- Coordination of the roof drainage design with architecture and structure is essential
  - The hydraulic design is the easy part !
  - It is essential that the proposed solutions meet the architectural intent and are properly coordinated with the architectural & structural design (including roof truss fabricator’s design). This is the most time-consuming aspect of roof drainage design, and it can be an iterative process to determine the most appropriate solution.

14. How to fix the roof drainage industry (cont.)

Recommended changes to fix the roof drainage industry (cont.)

- There are no longer any excuses for why roof drainage should not be fully and properly designed and documented at building permit stage
  - The days of roof plumbers trying find a solution at framing stage are over.
  - Roof drainage should no longer be a ‘free for all’ and installed in any way the roof plumber thinks might work

- Better regulation by the Regulator ?
  - Performance Solutions for roof drainage need to be properly prepared
  - Roof plumbers do not have the required skills to prepare Performance Solutions for roof drainage
  - Penalties for manufacturing non-conforming products?

Any questions?

Architects
Registration Board
of Victoria

ARCHITECTS REGISTRATION BOARD OF VICTORIA

Address
Level 10, 533 Little Lonsdale Street
Melbourne VIC 3000
Phone number
03 9417 4444
Email
registrar@arbv.vic.gov.au