

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

Discussion paper by:

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Background

It appears that there may be different interpretations of requirements for minimum allowable box gutter depths and minimum allowable flowrates for the design of box gutters using the three different general design methods recommended in AS/NZS3500.3:2018. This discussion paper examines these requirements in more detail to clarify their correct usage.

NCC Deficiencies

The National Construction Code Performance Requirements have a number of fundamental deficiencies related to roof drainage systems. Primarily, blockages, which are the most common cause of box gutter flooding, are ignored in the NCC and this can ultimately lead to inadequate Performance Solutions being developed. For example, the NCC theoretically allows for an internal box gutter conveying low flows to be fitted with a 40 mm diameter downpipe (or even smaller). Experience has shown that downpipes smaller than $\text{Ø}90$ mm are easily blocked. However, the NCC stipulates no minimum downpipe size. The NCC also does not require independent overflow provisions, and this omission, in concert with the lack of minimum component sizing dimensions results in the design of systems that are likely to flood and cause property damage. Inadequate Performance Solutions erode the basic principles of acceptable roof drainage design and the historical safeguards incorporated in AS/NZS3500.3.

Allowable Flowrates

The general method of box gutter design outlined in AS/NZS3500.3:2018 stipulates a maximum allowable flowrate in each box gutter of 16.0 L/s. There is no minimum allowable flowrate stipulated in AS/NZS3500.3:2018. However, all three general methods provided in AS/NZS3500.3:2018 (Figures 3.7.4A-C) for the design of box gutters, require that the design flowrate (Q) and minimum depth of box gutter shall be determined from Figure I1 (Figure 1).

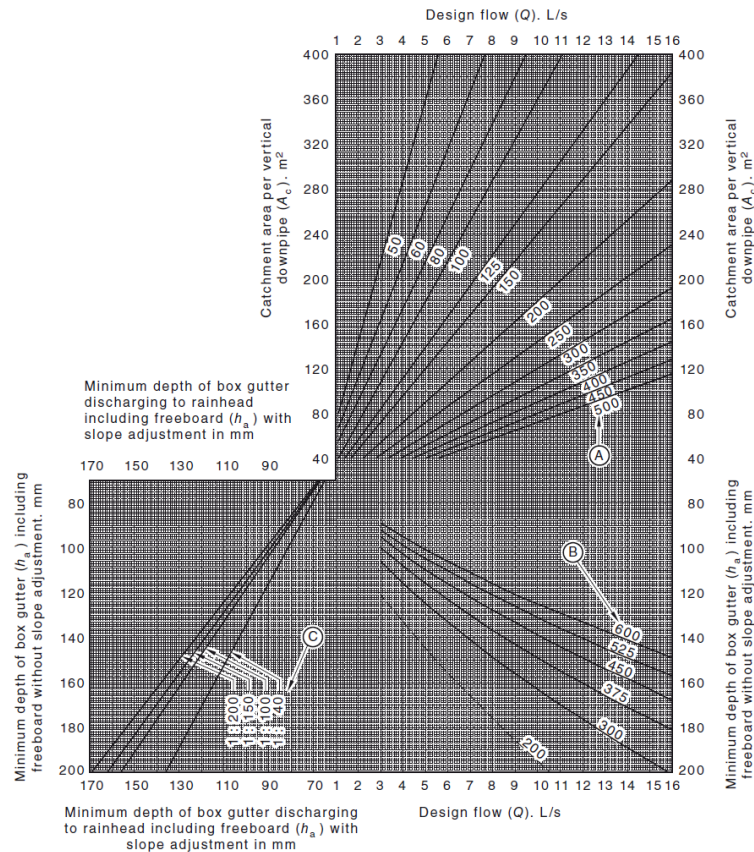


Figure 1 - Design graph for a freely discharging box gutter (Figure I1 - AS/NZS3500.3:2018)

The design curves provided for the six different recommended box gutter widths (200, 300, 375, 450, 525 and 600 mm) in Figure I1 of AS/NZS3500.3:2018 (Figure 1), all start with a minimum flowrate of 3.0 L/s. There is no box gutter design guidance provided for flowrates below 3.0 L/s in AS/NZS3500.3:2018.

The design curves in Figure I1 of AS/NZS3500.3:2018 (Figure 1) provide the minimum sizing recommendations that incorporate provision for reasonable blockage potential. The minimum allowable design flowrate for box gutters designed using the general method of in AS/NZS3500.3:2018 is therefore 3.0 L/s.

It is inappropriate to specify design flowrates lower than 3.0 L/s to design box gutters using the general method in AS/NZS3500.3:2018. While gutter flowrates lower than 3.0 L/s can occur in real gutter systems, the 3.0 L/s minimum design flowrate is not a hydraulic performance restriction, rather, it is a practical requirement to allow for potential downpipe blockages that may occur during low flows due to the accumulation of sediment and debris. As a rule of thumb, the lower the flow in the gutter, the less ability there is for any accumulated debris to be flushed through the system and the greater the blockage potential.

The potential for blockages in downpipes is addressed in AS/NZS3500.3:2018 with the incorporation of a minimum downpipe diameter of Ø90 mm¹. The minimum gutter sizing configurations based on a minimum flow of 3.0 L/s replicate this principle.

¹ Note: Clause 3.7.8 in AS/NZS3500.3:2018 states: "Downpipes shall be at least 90 mm in diameter or 100 mm x 50 mm rectangular..." However, no designs curves are provided for 100 mm x 50 mm downpipes in the Standard. The AHSCA believes a 100 mm x 50 mm downpipe has inadequate cross-sectional area (< Ø90 mm) and does not recommend the use of this downpipe for box gutter systems.

Minimum Box Gutter Depths

Figure I1 provides design guidance on minimum allowable box gutter depths for all three general design methods outlined in AS/NZS3500.3:2018 (Figures 3.7.4A-C) corresponding to the design flowrates (Q) obtained. Design curves are provided in Figure I1 for six different box gutter widths, namely 200, 300, 375, 450, 525 and 600 mm wide. As discussed above, the minimum and maximum allowable design flowrates for each box gutter are 3.0 L/s and 16.0 L/s, respectively. An enlargement of the bottom half of Figure I1 is shown in Figure 2.

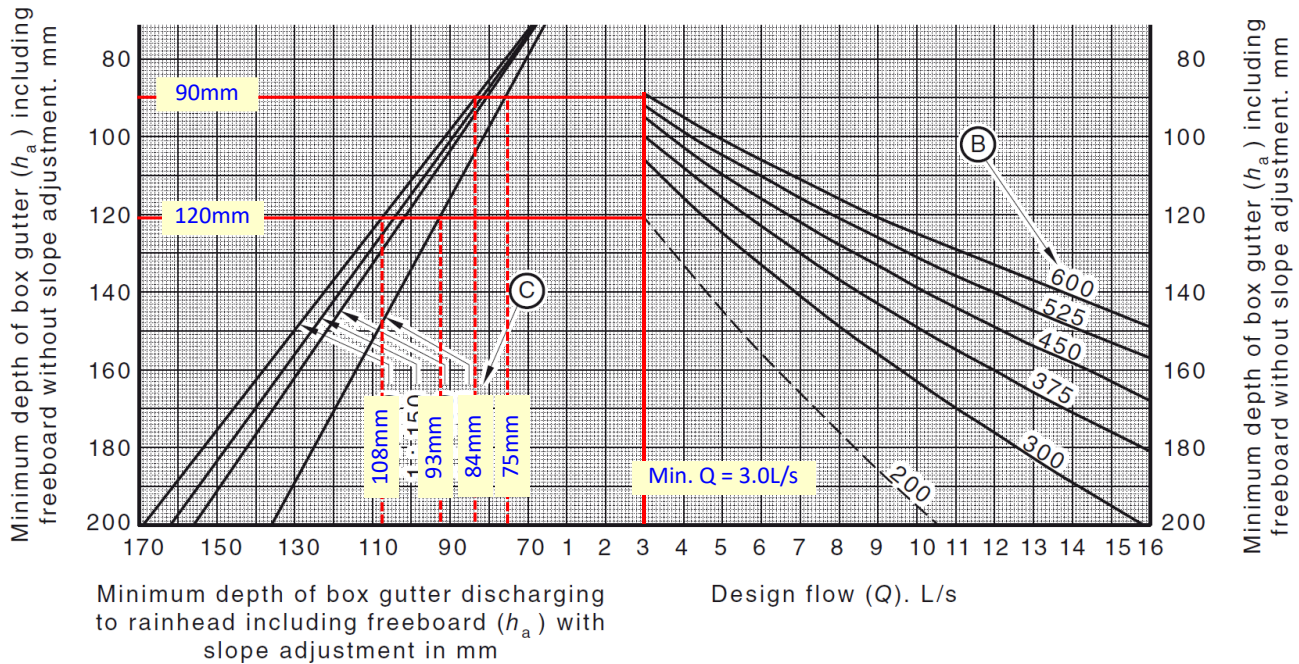


Figure 2 – Enlarged Bottom Half of Figure I1(AS/NZS3500.3:2018)

The red horizontal lines projected across Figure 2 show the minimum allowable box gutter depths for flat (no grade) gutters 600 and 200 mm wide. These minimum gutter depths are 90 and 120 mm, respectively. AS/NZS3500.3:2018 general method requires that box gutters shall have a constant longitudinal slope (grade) between 1:200 and 1:40.

Figure I1 allows for small reductions in gutter depth as gutter slope increases. The dashed red vertical lines projected downwards on Figure 2 indicate the minimum allowable box gutter depths for slope-adjusted gutters 600 and 200 mm wide. The minimum allowable depths for a 600 mm wide box gutter at slopes of 1:200 and 1:40, are 84 and 75 mm, respectively. The minimum allowable depths for a 200 mm wide box gutter at slopes of 1:200 and 1:40, are 107 and 93 mm, respectively. See Table 1 for recommended minimum gutter depths.

The minimum box gutter depth allowed using the AS/NZS3500.3:2018 general design method is 75 mm. However, this is only valid for a 600 mm wide gutter at a slope of 1:40. Box gutter slopes of 1:40 are difficult to achieve in most roof drainage situations and slopes of around 1:200 are generally more common. For example, the minimum allowable box gutter depth for a typical 300 mm wide box gutter at a slope of 1:200 is 97 mm.

Conclusion

This discussion paper has examined the minimum box gutter depths and minimum flowrates for the design of box gutters using the three different general design methods recommended in AS/NZS3500.3:2018.

The paper has shown that it is inappropriate to nominate minimum gutter and component sizing for flow rates less than 3.0 L/s due to a disproportionate increase in blockage potential.

The paper has also shown that the minimum box gutter depths, as detailed in AS/NZS3500.3:2018 and provided in Table 1 below should not be reduced in Performance Solutions. It is not recommended that these sizes be reduced for any flows lower than 3.0 L/s due to increased blockage potential associated with such endeavours. It is also recommended that independent overflow provisions rated to 100% flow be incorporated into all designs.

Table 1 – AHSCA Recommended Minimum Box Gutter Depths

Gutter Width	Gutter Slope			
	1:200	1:150	1:100	1:40
200 mm	107	104	101	93
300 mm	97	94	92	85
375 mm	92	89	87	82
450 mm	88	86	84	78
525 mm	86	84	82	77
600 mm	84	82	80	75