Assessment of Smartflo Guttering System

Test Work Performed For

Visshill-Tech (Patent) Pty Ltd

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DATE 21-10-99

SUBJECT Assessment Report

Assessment of the practicality of the SMARTFLO Guttering System.

EXECUTIVE SUMMARY

The SMARTFLO Guttering System was assessed for its ability to perform effectively as a superior alternative to conventional open-gutter systems. It is well known that one of the major maintenance issues for eaves gutters is the ingress of leaves and twigs resulting in poor operation of the gutter, blocking of downpipes and accelerated corrosion of metal gutters. There are a number of systems available for retra-fitting conventional open-gutters, which range widely in price and operational performance. Even the better of these systems require regular clearing of accumulated debris. The SMARTFLO Guttering System was found to be intrinsically self-cleaning, drastically reducing maintenance requirements whilst extending the service-life of metal gutters. It was shown that The SMARTFLO Guttering System was capable of handling rainfall roof runoff in line with the design criteria (1/20 year storm event in Sydney) set out in Australian Standard AS 2180-1986 *Metal Rainwater Goods-Selection and Installation*. AS 2180-1986 sets out procedures for selection and installation of metal rainwater goods.

The SMARTFLO Guttering System was shown to be superior to conventional open gutter systems in terms of :

- **self cleaning** - requiring less maintenance, providing greater safety in bush-fire areas and reducing the ingress of dust and pollutants to water storage tanks.
- **corrosion resistant**- self cleaning leads to reduced corrosion thus extending service life.
- **robustness**- the closed design makes SMARTFLO guttering stiffer and stronger and thus safer when subjected to building maintenance loads eg. Ladders.
- **spacing of downpipes**- the water carrying capacity of SMARTFLO guttering was found to be greater than standard conventional designs, allowing greater spacing of downpipes.

In addition to these superior characteristics, the SMARTFLO gutter system was found to exhibit no deficiencies when compared to conventional gutter systems. It was found to:

- be capable of satisfying typical rainfall design criteria.
- be simple to install.

AIM 1. To assess the performance of The SMARTFLO Guttering System during simulated rainfall events.

2. To assess the benefits of the SMARTFLO Guttering over conventional gutter systems.

SCOPE

- The ability of the SMARTFLO Guttering System to effectively carry rainwater shed from a roof over a range of rainfall rates and roof pitches was assessed. Results are interpreted in terms of the ability to operate during significant storm events.

- The required spacing between downpipes when using the SMARTFLO Guttering System was calculated using the techniques given in Australian Standard AS 2180-1986 *Metal Rainwater Goods-Selection and Installation* and in Australian Standard AS 2179-1986 *Metal Rainwater Goods-Specification.* The spacing requirement was compared against two standard eves gutters that are commonly used in Sydney Australia.

- Maintenance and operational aspects of the guttering system were analysed in terms of:
  :The ability to shed leaves
  :The ability to operate effectively when leaves sit in the gutter
  :The materials of construction, corrosion resistance and service life
  :The ease of installation
  :The ability to support normal building maintenance activities

<u>Ability of the SMARTFLO Guttering System to cope with heavy rainfall.</u>

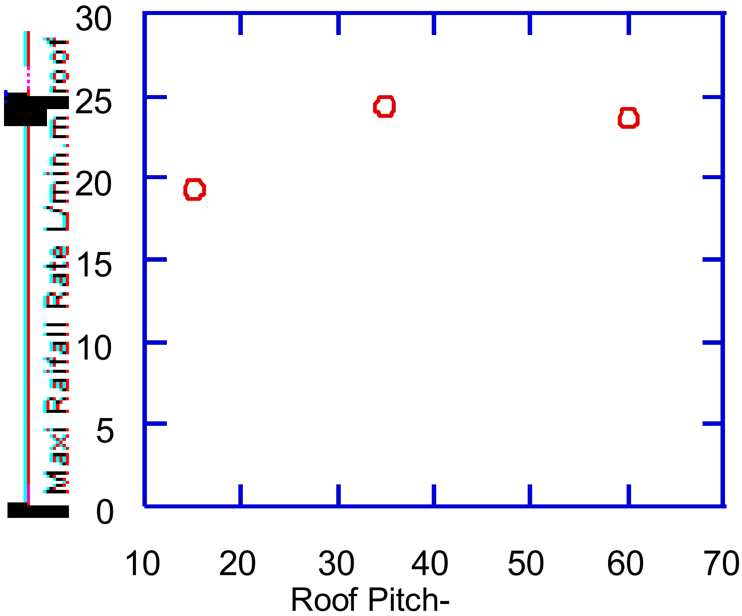
Methodology

A test-roof (custom-orb corrugated sheeting) was assembled in The Fluid Mechanics Laboratory at the University of Newcastle, Australia. Photographs of the rig are shown in Photos 1 and 2. The roof was square (1m x 1m) and was serviced by 1m of SMARTFLO gutter. The gutter had 2 filters spaced 500mm apart, and one 70mm downpipe at one end. The gutter was tilted at approximately 1^0 to the horizontal. The simulated rainfall flowrate to the test roof was adjustable and measurable using an Armfield Hydraulics Bench. The roof pitch was adjustable and was tested at pitches of 15^0, 35^0 and 60^0. The simulated rainfall was applied to the roof at a rate of 190mm/hr; equal to the 1 in 20 year storm design criteria (Sydney) set down in AS 2180-1986 *"Metal Rainwater Goods-Selection and installation".*

Photos 1 and 2: Experimental Set-up

The SMARTFLO Guttering System was found to easily cope with the 1 in 20 year storm design criteria (Sydney) for roof pitches of 15^0, 35^0 and 60^0.

The relative ability of the various configurations to cope with even heavier rainfall rates was examined. The relative results are shown in Figure 1, where the maximum water flow rate corresponds to the condition where water just began to overflow the front edge of the gutter. It was found that for roof pitches between 15^0 and 60^0, the maximum rainfall carrying capacity of the gutter system only varied by 18%. The relative insensitivity of the gutter system to changes in roof pitch is probably due to the ponding effect caused by the filters. Ponding of water in the top of the channel occurs for all but the lightest of downpours. This ponding means that water coming off the roof is hitting water which acts like a brake and inhibits the skating effect thereby retaining water within the top channel.



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It was also observed during testing that the rear of the SMARTFLO Gutter was higher than the front which allowed excess rainfall (over and above the design limits) to spill over the front, away from the building thus eliminating possible water damage to the building.

Figure 1: Relative affect of roof pitch on the maximum rainwater carrying capacity of the gutter system.

The data shown in Figure 1 can be used to calculate the roof catchment area per filter, allowing effective design of rooves. This data is given in Table 1.

Table 1: Design criteria for 1/20 yr storm (Sydney Australia)

Roof Pitch	Max. Rainfall rate (L/min)/ filter	Max. (m^2roof) /(filter) 1/20yr storm (190mm/hr)
15^0	9.7	3.1
35^0	12.2	3.9
60^0	11.8	3.8

Table 1 shows the maximum roof area that can feed water to each filter (spaced 500mm apart) during a 1/20 year storm event in Sydney Australia. This information can be used to calculate the length of roof sheets that can be used when designing for this rainfall condition. Using the data in Table 1 and the knowledge that the filters are spaced 500mm apart, the maximum length of roof sheets that can be used, when designing for a 1/20 year storm event, is shown in Table 2.

Table 2: Maximum roof sheet lengths for 1/20 yr storm (Sydney Australia)

Roof Pitch	Max. (m^2roof) /(filter) 1/20yr storm (190mm/hr)	Max. length of roof sheets (m)
15^0	3.1	6.2
35^0	3.9	7.8
60^0	3.8	7.6

In reference to the data in Table 2, it should be recalled that the SMARTFLO Gutter System is designed to expel any excess water away from the building, so that rainfall rates in excess of the 1/20 year storm design rainfall rate, or roof catchment areas greater than the design values given above create no significant operational problems.

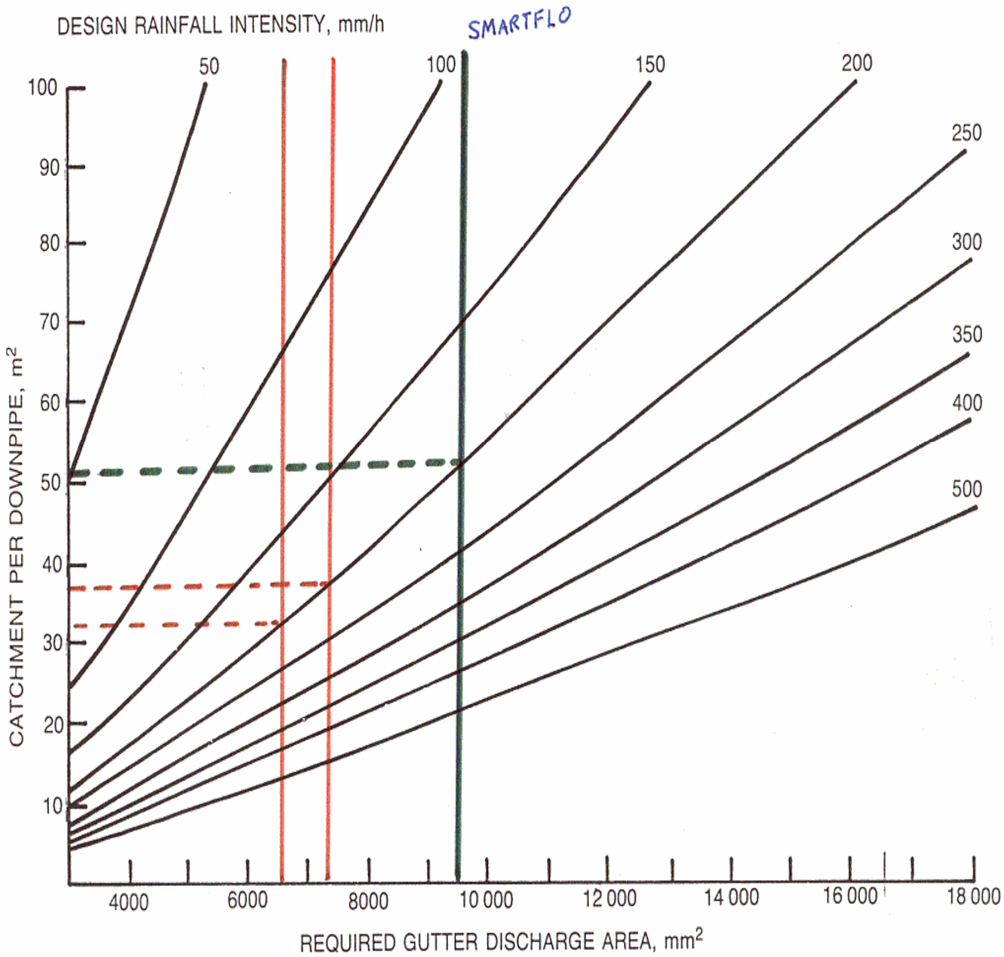
Spacing of Downpipes

One significant consideration when installing eaves gutters is the spacing of downpipes. The greater the allowable spacing, the easier it is to design the location of the downpipes to complement the design of the building, and the less downpipes required the lower the materials and installation costs.

Australian Standard AS 2179-1986 *Metal Rainwater Goods-Specification* was used to calculate the effective cross sectional area A_c of the SMARTFLO Guttering System, and of two commonly used open gutter profiles. Diagrams showing the cross sectional sections of the these gutter systems are shown in Appendix A.

Australian Standard AS 2180-1986 *Metal Rainwater Goods-Selection and Installation* was then used to calculate the roof catchment area per downpipe of the SMARTFLO Guttering System, and of two commonly used open gutter profiles for a variety of rainfall rates. A comparison of the gutter systems for a rainfall intensity of 200 mm/hr is shown in Figure 2 (taken from AS2180-1986).. The data shown in Figure 2 reveals that of the SMARTFLO Guttering System has a significantly higher roof catchment area per downpipe than commonly used standard eves gutter systems. In Figure 2, the green vertical line (the right-most) corresponds to the SMARTFLO Guttering System, and the two remaining vertical orange lines correspond to the common profiles shown in Appendix A.

At a nominal rainfall intensity rate of 200mm/hr (exceeding the normal design criteria of 190mm/hr), the SMARTFLO Guttering System is shown to accommodate a roof catchment area per downpipe of over $50m^2$. The larger of the two standard gutter systems analysed is shown to accommodate less than 40 m^2 per downpipe. This analysis has shown that the SMARTFLO Guttering System outperforms conventional standard gutter systems in its ability to minimise the number of downpipes required per square metre of roof.



NOTE: This graph is based on the formula in Appendix A of CSIRO Technical Paper No 1. It relates to an eaves gutter that is sloping, within 2 m of the outlet, and has the outlet at the end of the run of gutter. Gutters with no bends and with central outlets have higher discharge capacities; if such improved design features are to be taken into account, reference should be made to CSIRO Technical Paper No 1.

Figure 2: Calculation of roof catchment area for the SMARTFLO Guttering System compared with conventional gutters. Green- SMARTFLO; Orange- standard gutters.(Original graph from AS2180-1986).

Maintenance and operational aspects of the guttering system

:The ability to shed leaves
:The ability to operate effectively when leaves sit in the gutter
:The materials of construction, corrosion resistance and service life
:The ease of installation
:The ability to support normal building maintenance activities

<u>The ability to shed leaves</u>

The test-roof was placed outside and was covered with a sufficient wet leaves and twigs to cover two-thirds of the roof surface. The test-roof was left for 5 days, which were dry with moderate winds. Details of the weather conditions are given in Appendix B. It was found that most of the debris had drifted down the roof into the gutter, and had subsequently been shed to the ground. It appears that the SMARTFLO Guttering System allows leaves and twigs to dry out and be blown from the gutter under the natural affects of the wind.

This ability is of course one of the primary attractions of this form of guttering, whereby leaves are shed by the action of wind between rainfall events, eliminating cleaning maintenance and premature rusting. Though only visual examinations were made, it was clear from the current testwork that small pieces of debris that pass through the filters are readily carried away in the water flow inside the sealed section of the gutter. This means that leaf debris is not permitted to settle in any part of the guttering system, greatly enhancing the expected service life of the guttering system and eliminating the need to clean the inner section of the gutter.

Apart from the obvious reductions in maintenance requirements, there are two other very important benefits gained by reducing the build-up of leaves in eaves gutters:

- SMARTFLO gutter fire prevention ability
- SMARTFLO gutter ability to reduce dust and pollution ingress into water storage tanks

Buildings situated in bush fire areas are at risk of severe fire damage due to the build-up of leaves in standard gutters. The leaves, often the only combustible material on the outside of a house, catch fire that spreads up the roof rafters igniting fires in the roof space. The SMARTFLO gutter system prevents the build-up of leaves in the gutter drastically reducing the risk to life and property in bush fire areas.

During dry periods various pollutants such as particles of dust, rubber and lead dust from motor vehicles, industrial pollutants etc. are found in the atmosphere. These pollutants deposit onto rooftops and eventually get trapped in conventional gutters. When it rains, these pollutants which have concentrated in the gutters are washed into water storage tanks.

The SMARTFLO gutter design prevents the pollutants from being trapped in the gutter by the smooth upper catchment section that allows the majority of pollutants to be blown off by the wind. This action reduces the levels of pollutants in water storage tanks by up to an estimated 94%.

The ability to operate effectively when leaves sit in the gutter

The test rig was run at a rainfall rate of 190mm/hr with the gutter partly filled with gum leaves and twigs. It was shown that for all roof pitches examined that the SMARTFLO Guttering System was still capable of carrying this significant rainfall roof run-off .

The materials of construction, corrosion resistance and service life

The SMARTFLO Guttering System is made from Colorbond Steel (0.55mm thick), which has been found to be well suited to the varied weather conditions found across Australia. Colorbond steel roofing products have extremely long service lives if they remain dry between rainfall events. The problem with open-gutter systems is that leaves and debris collect in the gutters, trap water, and if not removed regularly will lead to premature corrosion, drastically reducing the service life of the gutter. The SMARTFLO Guttering System eliminates these service problems by preventing leaf build-up in the gutters. Furthermore, filters prevent leaves from entering the downpipes, serving to extend the service life of both gutters and downpipes.

The ease of installation

The methods of fitting and installation of this new form of guttering is equivalent to those used for conventional open-gutter systems.

The ability to support normal building maintenance activities

The guttering system was subjected to a normal vertical load of 30kg (294N), to assess the rigidity of the guttering system under normal maintenance activities. The load was applied for 5 minutes and a deflection of less than 1 mm was observed. On removal of the weight, the gutter showed no residual deflection. Furthermore, by virtue of the cross-sectional shape of the SMARTFLO Guttering System, it can be readily assumed that the rigidity will be significantly greater than for conventional open-gutter systems.

Conclusions

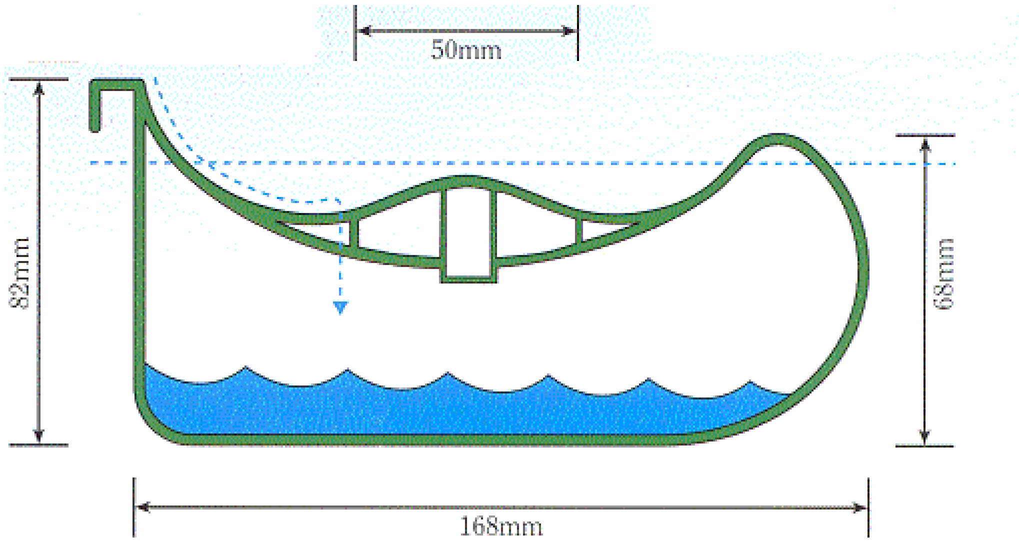
In tests performed in The Fluid Mechanics Laboratory at the University of Newcastle, Australia by the Universities Research Division TUNRA, the SMARTFLO Guttering System was found to handle severe stormwater run-off from a roof and to significantly outperform conventional guttering systems in a number of important areas including:

- The ability the shed leaves by the action of moderate winds between rainfall events
- The ability to operate effectively when leaves sit in the gutter, partly blocking the outlets during rainfall events
- The ability to shed leaves drastically increasing the service life of the gutter system
- The added strength gained by the closed profile reduces the risk of damage and deformity under normal building maintenance activities

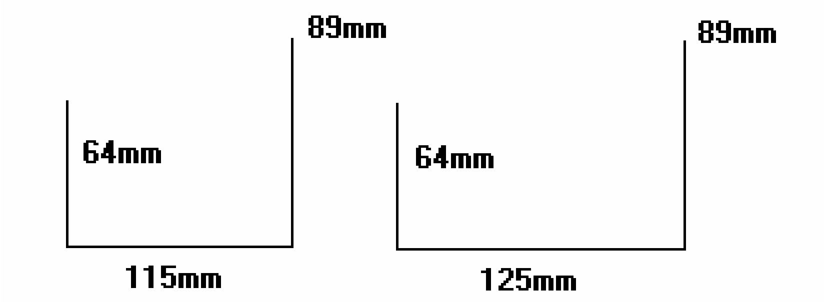
The SMARTFLO Guttering System was found to be superior to conventional systems, offering vastly improved operational characteristics. The ability to shed leaves in light to moderate winds eliminates the need for regular cleaning and drastically slows the rate of corrosion and extends the service life. Even when small amounts of debris remain on the gutter between storms, the gutter can still cope with rainfall run-off equivalent to that occurring during a 1/20 year storm.

Appendix A: Dimensions of gutter systems

SMARTFLO Guttering System



Standard gutter profiles



Appendix B: Weather conditions on the 5 day outdoors trial

Day/date	wind	Max daily T	Rainfall
Sat 18-9-99	Mod S/E	19 ^{0}C	nil
Sun 19-9-99	Light S/E	18 ^{0}C	nil
Mon 20-9-99	Light N/E	19 ^{0}C	nil
Tue 21-9-99	Light N/E	19 ^{0}C	nil

Wed 22-9-99	Mod S/E	21 ^{0}C	nil

TABLE 1: RESULTS OF SIMULATED RAINFALL EVENTS

Roof Pitch R	Filter Hole Size	Max. Rainfall rate (L/min)/ m^2 roof	Max. (m^2roof) /(metre of gutter) 1/20yr storm
15^0	**Standard**	**19.35**	**7.7**
15^0	**Large**	**17.48**	**7.0**
15^0	**No filter**	**15.65**	**6.3**
35^0	**Standard**	**24.32**	**9.7**
35^0	**Large**	**29.51**	**11.8**
35^0	**No filter**	**35.29**	**14.1**
60^0	**Standard**	**23.68**	**9.4**
60^0	**Large**	**25.00**	**10.0**
60^0	**No filter**	**25.00**	**10.0**

1/20yr yr @ 190mm/hr = 0.19m^3/hr=3.17L/min per m^2 roof

Table 1 shows the continuing work data.

- Standard holes: 796.5mm^2/filter
- Large holes: 986mm^2/filter
- Standard filter total free area ≈ 796.5mm^2
- Large filter total free area ≈ 796.5mm^2
- No filter total free area ≈ 1963mm^2
- Downpipe:90mm = 63617mm^2
- Test roof : custom-orb profile, 1m x 1m with 0.1m barge capping on each edge
- Roof pitches studied : 15^0, 35^0 and 60^0.
- Gutter length 1m