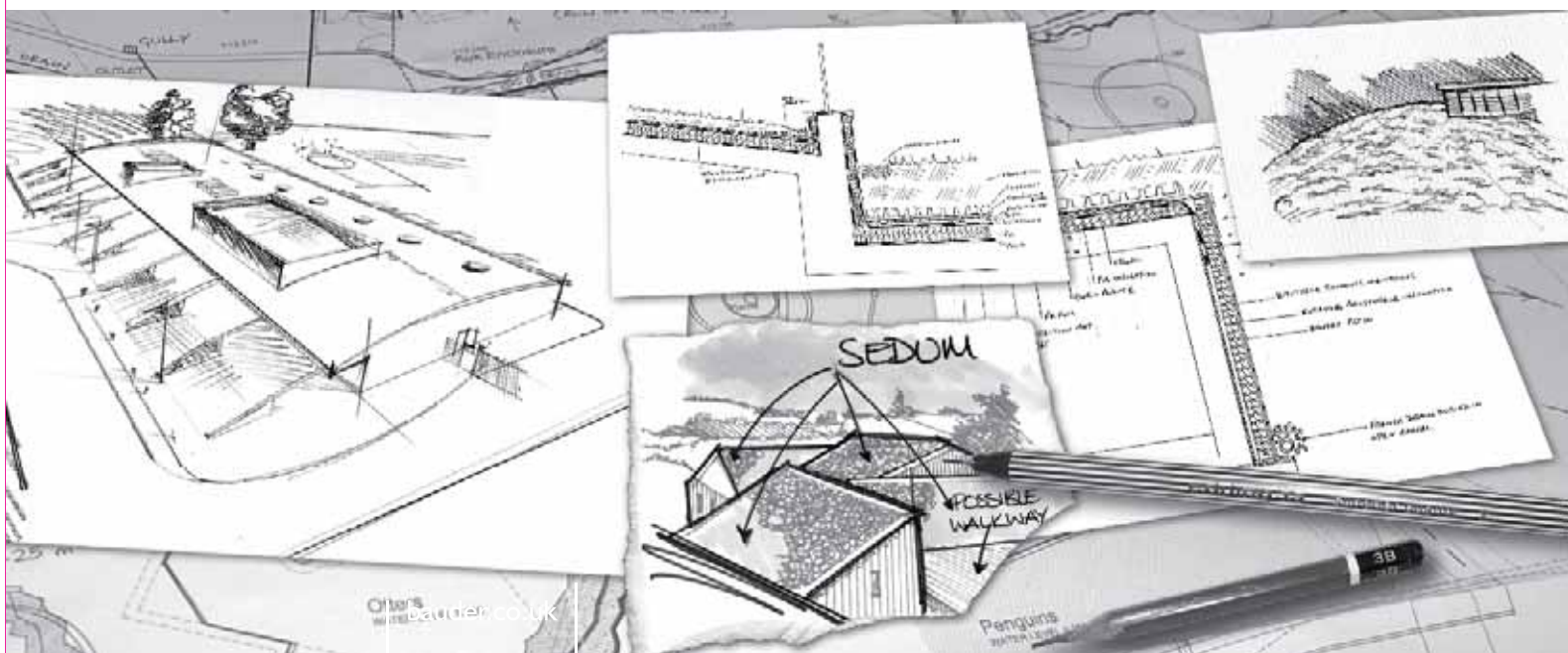




# TECHNICAL



# MANUAL

## Extensive Green Roofing

Environmental, Ecological and Biodiverse Systems

# Technical Guide

## Green Roof Systems

This technical guide is designed to assist specifiers to understand and design a Bauder Extensive Green Roof System. Bauder offers the complete package from superior quality waterproofing systems beneath, to the green roof systems above with their associated components, all from a single source manufacturer. Our unrivalled service will take you through specifying a green roof from initial concept to final delivery of the completed green roof.

Bauder was the first company to introduce lightweight extensive green roofing technology into the United Kingdom and Ireland as early as 1982. Since then we have continued to develop our range of extensive green roof systems, from our unique ultra lightweight sedum blanket system with its "instant greening", to the various lightweight multi-layer systems incorporating differing drainage layers and shallow growing substrate to suit the client's desired planting scheme for either hydroplanting or plug planting. In addition, we have a full range of accessories to complete the installation and ensure that the roof flourishes in the long term.

Our green roof technical team are trained to provide our clients with a comprehensive service. At the onset,

initial contact and guidance is with our Area Technical Managers, who have sound technical backgrounds with many years experience and are well qualified to offer the best advice on a roofing solution to meet a project's requirements. Our technical department and drawing office will compile a comprehensive specification with all the relevant loadings, roofing works and detailing. Our Site Technicians are available to help approved installers with practical solutions for complex or difficult projects. They work in tandem with the Area Technical Manager to monitor the correct installation of the green roof system.

Our green roof components and waterproofing systems are only installed by Bauder Approved Contractors whose teams have undergone training. In addition, Bauder Site Technicians inspect key stages of the work to ensure a successful green roof installation.

Our confidence in our systems is reflected in the comprehensive guarantee offered with every Bauder green roof, which provides additional comfort to our specifying clients by covering liability for all Bauder design and products.

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# Extensive Green Roofs - System Overview

## Extensive Green Roofs

Extensive green roof systems are designed to be lightweight and support a low maintenance vegetation landscape which is wind, frost and drought resistant. This type of green roof was created to fulfill a number of environmental or ecological requirements, such as aiding storm water management, environmental masking or providing a biodiverse landscape to encourage local wildlife.

There is a steady trend towards the specification of extensive green roofs because they are increasingly becoming a planning requirement, as well as being cost effective, lightweight and easy to maintain. These benefits make them ideal for refurbishment projects, where the existing roof structure loading is limited. With a view to sustainable design, many educational, residential and commercial buildings have adopted this form of green roof finish. Bauder provides a range of extensive green roof systems to suit the project and client's requirements.



## Xero Flor Sedum Blankets

Bauder's unique sedum blanket has been developed in partnership with Xero Flor and provides clients with a very lightweight 'instant' green roof. Initially developed in mainland Europe, Xero Flor has a proven history with nearly 3 million m<sup>2</sup> installed worldwide. Partners since 1997, we grow our own sedum blankets here in the United Kingdom, which allows us to use a blend of sedum varieties that are ideally suited to our local climate and we can therefore harvest and deliver our blankets to site within 24 hours. Our policy for continual development has enabled us to produce sedum blankets in rolls up to 10 metres in length that are ideal for large, pitched or barrel shaped roofs.

## Hydroplanting

Hydroplanting on to an extensive growing medium is a fast, economic and practical method for greening very large roof areas. A special coagulate mixture containing seeds, plant cuttings, mulch and fertiliser, is sprayed on to a lightweight substrate. Plant establishment and full coverage may take between 12 - 18 months to achieve depending on the time of year planting took place, the density of sedum cuttings spread, and of course the prevailing weather during the period of establishment. Hydroplanting gives the client the benefit of a diverse selection of plant varieties.

## Plug planting

Planting individual sedums (plugs) into a growing substrate on smaller roof areas gives the client both the choice of plant species and lay out design. Planting 15 - 20 plants per square metre is the average density recommended, however, if quicker coverage is required, this can be increased or alternatively, sedum cuttings can be spread in and around the plug plants.

## Our commitment

All of our extensive green roof systems are monitored immediately following installation and after the first full growing season, normally a period of between 12 - 18 months, before being signed over to the client. This is to ensure that the roof achieves full establishment as intended.

# Environmental and Ecological Benefits

## **Aiding Storm Water Management by Reducing Rainwater Run Off**

The spread of construction development and road building has rapidly reduced the amount of permeable ground in and around our towns and cities. This has increasingly resulted in local flash floods occurring during heavy rainfall as drainage systems fail to cope with the additional water flow. Green roof systems can play a significant role in helping to manage storm water run off. Even the thinnest extensive green roof system will absorb 40% of the average rainfall and equally importantly, the remaining 60% will drain off at a much slower rate compared to an exposed roof; significantly reducing the pressure on the drainage systems in our towns and cities. Intensive green roofs with their deeper soil levels can actually retain up to 90% of the average rainfall.

Many European countries are already aware of this problem and provide legislation for storm water management, but in return offer significant financial incentives to owners of commercial or industrial buildings who install green roof systems.

## **Reducing the 'Heat Island' Effect and Improving Air Quality**

Hard impervious construction materials absorb solar energy and the reflected heat can dramatically increase the local ambient air temperature within our towns and cities. By providing large additional areas of vegetation in the form of green roofing, the air is cooled by the natural process of evaporation, allowing an increase in humidity and consequently a reduction in ambient air temperatures. Plants will produce oxygen to improve air quality, and importantly reduce carbon dioxide levels, thought to be the main contributor towards global warming. Green roofs retain and therefore reduce airborne dust and pollutant particles, helping to filter and improve air quality by attracting these particles to the surfaces of damp vegetation and soil.

## **Biodiversity**

With continued urban expansion swallowing up the vital natural habitats of many of our indigenous plants, insect and bird species; landscaping our flat roofs offers an effective and practical alternative, helping to replace and sustain the lost natural habitats. Green roofs provide new living areas, by recreating the natural habitat for many of our endangered species of plants and insects and provide safe and undisturbed nesting sites for birds.

## **Improving Sound & Thermal Insulation**

Green roofs have been recorded as contributing towards a building's energy saving by up to 10%. They also provide significant acoustic benefits by reducing both internal and external noise levels.

## **Environmental Masking**

Green roofs offer the design potential for a building to blend in with its surrounding landscape, by delivering a practical and cost effective way of meeting stringent planning requirements where environmental masking is the main criteria.

## **Protection of the Waterproofing**

A green roof provides protection from climatic extremes, ultraviolet light and mechanical damage; at least doubling the usual life expectancy of the waterproofing system.



## Fire Testing

Bauder Xero Flor sedum blankets can play an important role in protecting roofs against the surface spread of fire. Bauder XF30I was the first sedum blanket in the UK to be awarded an EXT. FAA fire rating in November 2001 by the Building Research Establishment. Fire testing confirmed the effectiveness of our patented substrate in preventing fire penetration from reaching the waterproofing layers. Equally, no surface spread of flame took place.

Prior to testing, the sedum blankets were placed in dry storage for four weeks to reduce the moisture levels within the plants and allow the substrate to dry out completely, simulating conditions of drought so the effect of fire on the dry vegetation could be established. These tests were completely successful due to our substrate and the chosen vegetation, which reduces the amount of dead vegetation that occurs naturally after flowering.

The full system, including the waterproofing and insulation was tested, and so the EXT. FAA rating applies to the complete Bauder system and not just the sedum blanket covering.



## Evidence of Natural Air Purification

Bauder Xero Flor sedum blankets offer many environmental and ecological benefits, including helping to reduce pollution. Prof. Dr. H. J. Liesecke, the former chairman of the German FLL regulatory body, carried out tests at the University of Hanover to provide evidence of the natural air purifying effects of Xero Flor with its patented 'active carbon' substrate.

The test container housing the sedums and mosses was filled with the waste gas from petrol and diesel engines and after 48 hours the pollution levels were measured showing a reduction by 95% within the period. A second chamber was also set up without vegetation as a comparative control.

In conclusion, extensive green roof systems with moss species and succulents can effectively reduce car emissions. Granulated activated carbon can significantly improve the effect, but a good cover of vegetation is considered equally important.



## Water Retention in Extensive Green roofs

(Translated from the German FLL Green Roof Guidelines 2002, page 36)

Substrate depth (cm)	Vegetation varieties	Average Annual water retention (%)	Average Annual rainfall run off (%)
2 - 4	Moss, sedums <b>(Bauder Xero Flor XF30I)</b>	40	60
> 4 - 6	Sedums and Moss	45	55
> 6 - 10	Sedums, Moss and Herbs <b>(Bauder Plug or Hydroplanting)</b>	50	50
> 10 - 15	Sedums, Herbs and Grass	55	45
> 15 - 20	Grass and herbs	60	40

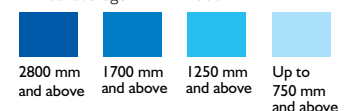
The above table indicates the percentage (%) of annual rainfall retention as a factor of the depth of substrate of the green roof system.

The figures for this table are based on 650 - 800 mm annual rainfall. This relates to most of England. However, in Cornwall, Devon, Somerset, the North West of England and Ireland, the annual rainfall figures can, in localised areas, be up to double the rest of England. Wales can expect 800 - 2,000 mm of annual rainfall and Scotland between 800 and up to 3,200 mm in the highlands.

In areas with higher annual rainfall than 800 mm, the percentage of water retention will obviously be lower. Likewise, a low annual rainfall will lead to a greater percentage of retained water. For detailed and specific information on rainfall, contact the Met Office. [www.metoffice.com](http://www.metoffice.com)



Illustration of Rainfall (mm)  
Annual average 1971 - 2000



The annual rainfall map above clearly shows that the west of the country has more rainfall. When using sedum blanket systems along the east coast of the UK or in exposed or steep south facing situations, provision for irrigation is recommended.



# Design Considerations for Planning a Green Roof

There are fundamental principals that apply to the design of all extensive green roof systems, regardless of the proposed landscaping, locality or climate.

## The Build Up of a Green Roof System

A successful green roof system must replicate nature within a lightweight compressed build-up. The Bauder system construction incorporates the following:

- 1 Structural deck constructed to a minimum roof fall of 1° (approx. 1:60)**
- 2 Waterproofing system with root resistance**
- 3 Water retention and drainage layers, the latter only incorporated, where the roof fall is below 2°**
- 4 Protection layer**
- 5 Filtration layer (where required)**
- 6 Bespoke lightweight growing medium**
- 7 Proprietary system accessories (outlet inspection chambers, edge trims, etc.)**
- 8 Suitable plant species.**

## Structural Loading

Most roof constructions are suitable as long as they can support the imposed load. The saturated weight of the system should be determined at an early stage. Our technical team can provide information and advice so relevant information can be passed to the client's structural engineer.

## Root Resistant Waterproofing System and Insulation

It is vital that the waterproofing is robust and proven to deliver long-term root resistance. Bauder waterproofing cap sheets have been tested and passed the German FLL 4 year root barrier test, which is widely accepted as the toughest trial currently available.

Bauder flat board and tapered insulation can be incorporated within our systems. We can calculate the thickness required to meet your required U-Value and produce condensation risk assessments upon request. The landscaping element of an extensive green roof system must not be taken into account when calculating the U-value, as the additional insulation gained will vary depending on the moisture content of the system at any one time.

## Falls and Drainage

Minimum falls of 1:60 and above are recommended (inc. cross-falls) for extensive green roof systems. However, on occasions, they can be applied to horizontal decks, provided the drainage layer is deeper than any residual standing water likely to occur. Extensive green roofs not only retain a good percentage of the average rainfall, but the excess drains off slowly. This can sometimes result in fewer outlets being required, giving the client a cost saving. When specifying internal outlets, we recommend a minimum of two units per roof area (regardless of roof size) or alternatively a single outlet and an overflow, as a precaution against blockage. All outlets should be protected by an inspection chamber and surrounded by a pebble vegetation barrier to prevent plant encroachment.

## Upstands and Perimeter Details

The minimum required upstand height for the waterproofing at abutments, parapets or pipe work penetrations etc. is 150 mm above the completed landscaped surface. With perimeter kerbs and linear drains, the height requirement can be reduced to 50 mm. Additional information can be found on page 12 and also on pages relating to general and drainage detailing.

## Vegetation Barriers

Vegetation barriers provide several important functions in a green roof:

- 1** Protection of the vegetation layer from water running down vertical upstand surfaces or from higher level rainwater down pipes
- 2** Provide rapid drainage during and after heavy rainfall
- 3** Reduce and ease routine maintenance
- 4** Protection of the waterproofing from mechanical damage
- 5** Fire break
- 6** Wind uplift resistance by increasing the superimposed load at roof perimeters.

Vegetation barriers are not suitable on roofs with a pitch greater than 9°, in this situation Bauder SS40 trim or concrete paving slabs can be used to confine the vegetation.

## Fire prevention

The potential fire risk that can occur during prolonged hot weather and particularly after flowering, when the vegetation is dry, is recognised by the FLL. Though these standards are not mandatory they have been adopted by Bauder. These standards recommend the use of pebble vegetation barriers as a firebreak, even though extensive roofs (normally not irrigated) are resistant to sparks and radiant heat provided that:

- 1 Substrate depth exceeds 30 mm and contains no more than 20% organic content by weight
- 2 Pebble or concrete paving fire breaks in the vegetation every 40 m, with a minimum width of 1 m or a height of 300 mm high fire wall
- 3 Vegetation barriers provided to all roof penetrations (rooflights etc.) and in front of walls with openings
- 4 Vegetation barriers kept clear of encroaching plants by routine maintenance.

Bauder Xero Flor XF30 I sedum blanket has been fire tested by the BRE achieving an EXT. FAA rating (BS746 Part 3 1958) and are currently the only blankets in the UK that have this fire rating for the complete system.

## Wind

Wind can lead to erosion problems, especially if plant establishment is in the early stages (plug or hydroplanted vegetation), or to premature drying out. The Bauder Xero Flor sedum blanket system has been independently tested as suitable on roofs up to a height of 20 metres without additional restraint or loading considerations.

## Planting and Visual Appearance

All planting schemes need basic requirements to sustain them; nutrients, a balance between moisture and drainage to suit the vegetation and aeration to the root systems. Annual routine maintenance to apply fertiliser and remove any persistent unwanted plant growth is all that is needed to keep these roofs in good condition. The aspect of the building, slope of the roof and exposure level of the site all have a bearing on the quality of the finished visual appearance of the roof and eventually dictates the species mix that will flourish in the long-term.

## Irrigation

Generally speaking, extensive sedum roofs require no additional watering following initial establishment. However, we recommend installing irrigation for sedum blankets where the following conditions apply:

- 1 South facing roof slopes exceeding 25° pitch
- 2 Very windy or exposed site locations
- 3 Inland sites where rainfall is less frequent.

Leaky pipe irrigation should only be activated during prolonged periods of hot dry weather, or if the sedum plants are showing signs of distress. Excessive watering will encourage unwanted plant species to germinate and so the maintenance advice should be followed.

## Maintenance and safe roof access

Provision should always be made for safe access to the roof for routine maintenance, which may include man-safe systems with harness attachment points, internal access hatches or an externally mounted bracket to secure a ladder. Bauder strongly advises the inclusion of cost for a two year post-installation maintenance program within the tender documents. This ensures that the green roof is handed over in a healthy and fully established condition.

Full maintenance information can be found on page 31.

# Waterproofing Options

Bauder provides a full range of waterproofing options to suit each individual project. Throughout Europe, the standards most widely recognised by the industry that specifically relate to green roofs are those of the independent German Forschungsgesellschaft

Landschaftsentwicklung Landschaftsbau (FLL) and Bauder has adopted these to ensure that all waterproofing membranes in our green roof systems exceed expectations.

## Bauder Total Green Roof System

This superior performance SBS modified elastomeric waterproofing system is based upon our renowned Bauder Total Roof System incorporating Bauder Plant-E cap sheet that is proven for long-term root resistance against the FLL's stringent testing. The VB4-Expal vapour barrier also provides temporary waterproofing, allowing internal works to continue within the building.

This system provides unrivalled reliability, performance and durability and is suitable for all types of extensive green roof construction.

### 1 Bauder Plant-E Cap Sheet

Superior performance, root resistant SBS elastomeric cap sheet to FLL standard.

### 2 Bauder G4E Underlayer

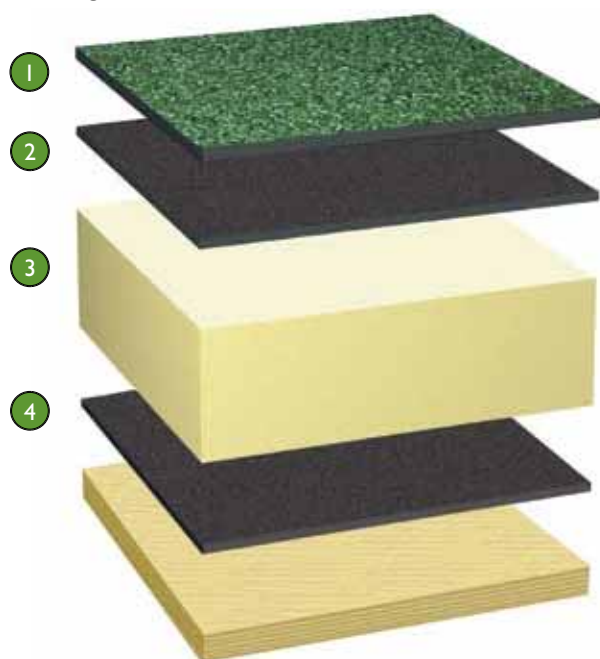
SBS elastomeric underlayer, reinforced with 200 g/m<sup>2</sup> woven glass.

### 3 BauderPIR Insulation

Highly efficient polyisocyanurate flatboard or tapered insulation for additional falls.

### 4 Bauder VB4-Expal Vapour Barrier

Vapour barrier reinforced with an expandable aluminium core and glass fibre fleece.



Plant - E

## Bauder Thermoplan T System

This high performance environmentally friendly single ply system, is a lightweight waterproofing option for the Bauder Xero Flor sedum blanket green roof. The recyclable waterproofing membrane with its environmentally friendly features and low embodied energy during production means that this system provides a sustainable waterproofing solution.

Fast and clean to install, it is fully compatible with the new generation of Bauder lightweight self-adhesive bitumen vapour barriers, that unlike mechanically fixed polythene barriers, can provide a temporary waterproofing under which internal works may continue.

Thermoplan T is suitable for roof slopes between 1 - 5°

### 1 Thermoplan T SV20

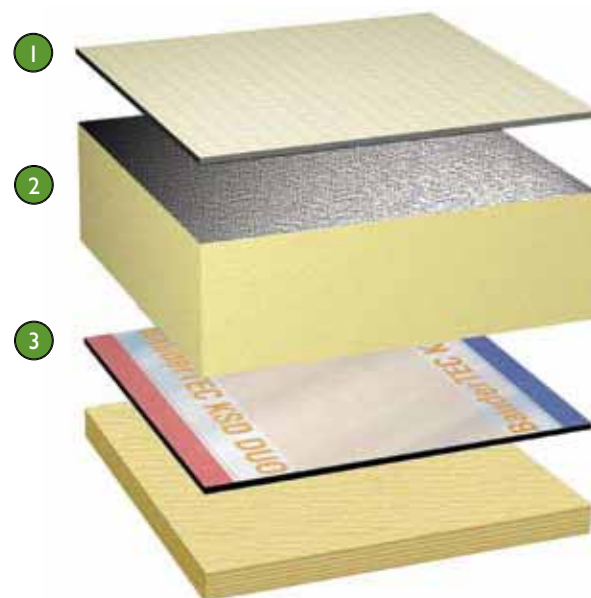
2.0 mm thick FPO single ply waterproofing membrane.

### 2 ThermotechPIR Insulation

Highly efficient polyisocyanurate flatboard or tapered insulation for additional falls.

### 3 Vapour Barrier

High performance vapour barrier isolating the waterproofing from the building.



Thermoplan T

Both systems are suitable for all types of roof construction, with specifications provided in industry recognised formats to suit. Please contact our technical team for assistance or advice on +44 (0)1473 257671.



The following table highlights the specific features and benefits of the various Bauder extensive green roof systems and may be of some assistance when determining the suitability for a particular project.

In addition, we have a team of experienced Technical Managers and office based technicians who are happy to offer more detailed advice.

	Bauder Sedum blanket	Bauder SDF mat	Bauder PLT10	Bauder PLT20	Bauder Reservoir Board	Bauder Mineral Drain
<b>Planting issues</b>						
Plug planting option	n/a	✓	✓	✓	✓	✓
Hydro-planting option	n/a	✓	✓	✓	✓	✓
Fully established when installed	✓					
Option of choosing plants	No	P	P	P	P	P
Est. establishment period 12 mths		P	P	P	P	P
Establishment period 12 - 18 mths		H	H	H	H	H
Fertilise annually	✓	✓	✓	✓	✓	✓
Irrigation required *	✓					
Fast installation	✓	H	H	H	H	H
<b>Specific system features</b>						
Suitable for paved walkways	✓	No	✓	✓	✓	✓
Very lightweight	✓				✓	
Additional water retention				✓	✓	
Ecological drainage layer alternative						✓
Integral protection/filtration layer	✓	✓	✓			
<b>Roof falls</b>						
Roof slopes between 0 - 10°				✓	✓	✓
Slopes between 2 - 10°			✓			
Slopes between 1 - 10°	✓	✓				
Slopes up to 25°	✓				✓	
Slopes up to 30°	✓					
Roof areas up to 1000 m <sup>2</sup>	✓	P	P	P	P	P
Roof areas 1000 - 3000 m <sup>2</sup>	✓	P or H	P or H	P or H	P or H	P or H
Roof areas 3000 m <sup>2</sup> +	✓	H	H	H	H	H

P = Plug planted

H = Hydroplanted

\* applicable only if specification circumstances dictate  
i.e. steep slopes, exposed locations and within 50 miles  
of the east coast of UK.



Xero Flor sedum blanket was first introduced in Germany over 20 years ago and is now the largest selling sedum blanket in Europe with millions of square metres installed not only in Europe, but also in the USA and Canada.

Bauder has been growing Xero Flor vegetation blankets in the United Kingdom since 1997; and currently cultivate approximately 120,000 m<sup>2</sup> annually to cater for the ever increasing demand for this living product.

Our unique patented lightweight carrier fleece and specially developed growing medium provides one of the few sedum blankets available that can be installed and retained on slopes as steep as 30°, using our special retention strips and drainage edge trims.

Approximately 11 species of sedum together with saxifrage, herbs and grasses ensures plant diversity regardless of location, all selected to suit our local climate and keep weight and maintenance to a minimum.



View looking along one of the banks of mature XF301 ready for harvesting.



Rolls being harvested and prepared for delivery.



Example of the many species found within our blankets.



Some examples of some of the plant species to be found within Bauder XF301 sedum vegetation blankets.



Long length rolls being craned into position and installed.

- Cultivated by the UK's leading specialists
- Proven range of green roof systems
- Wide existing portfolio of projects in the UK and Republic of Ireland
- Delivery to site within 24 hours of harvesting (not imported)
- Fully trained and approved installers
- Free monitoring and support through to final establishment
- Free from foreign insect or plant species

# Sedum Blanket on Bituminous Waterproofing Build Up

## Bauder XF30I Combination Sedum Blanket

Bauder Xero Flor XF30I is our highly successful sedum blanket system featuring up to 11 species of sedum together with some Saxifraga sub-species, herbs, moss and grasses specifically selected to flourish in our climate. The multifunctional sedum blanket combines the vegetation support layer with a moisture retention fleece to provide the perfect base for all roofing scenarios and a labour efficient installation.

The geo-textile carrier fleece with its ultraviolet resistant nylon loops provides a support base for the specially developed substrate growing medium and gives stability to the established vegetation whether on a low pitch flat roof or a 30° slope.

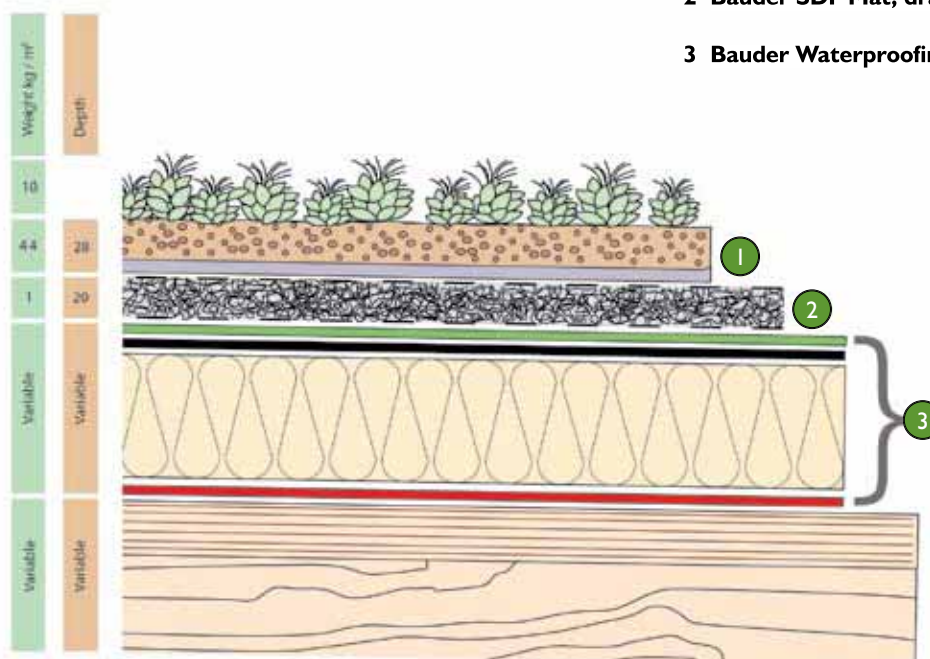
The pre-attached fleece is a unique feature of our sedum blankets, retaining moisture after rainfall thus allowing the plants time take up the water for future storage. The sedums are grown to maturity before being available for harvesting ensuring they acclimatise quickly to their new rooftop location.

## Roofs with minimal falls (> 1° and up to 2°)

Extensive green roofs should be designed with a minimum fall of 1:60, and even then, small areas of standing water may still occur. In these instances it is imperative to ensure that the plant roots do not become permanently immersed, otherwise they rot and the plants will die.

Bauder SDF Mat drainage layer is specified within the system to lift the blanket clear of any standing water, allowing it to disperse during periods of prolonged heavy rain. As the SDF Mat assists in free drainage, it ensures that the correct levels of moisture and air within the moisture retention fleece are maintained, providing the plant roots with the best conditions in which to develop.

Technical data	
Total build up height (assuming 100 mm thick insulation)	161 mm
Weight of waterproofing system (exc. deck)	19.1 kg / m <sup>2</sup>
Saturated weight of landscaping	45 kg / m <sup>2</sup>
<b>Total system weight (exc. deck)</b>	<b>64.1 kg / m<sup>2</sup></b>



1 Bauder XF 30I Sedum Blanket

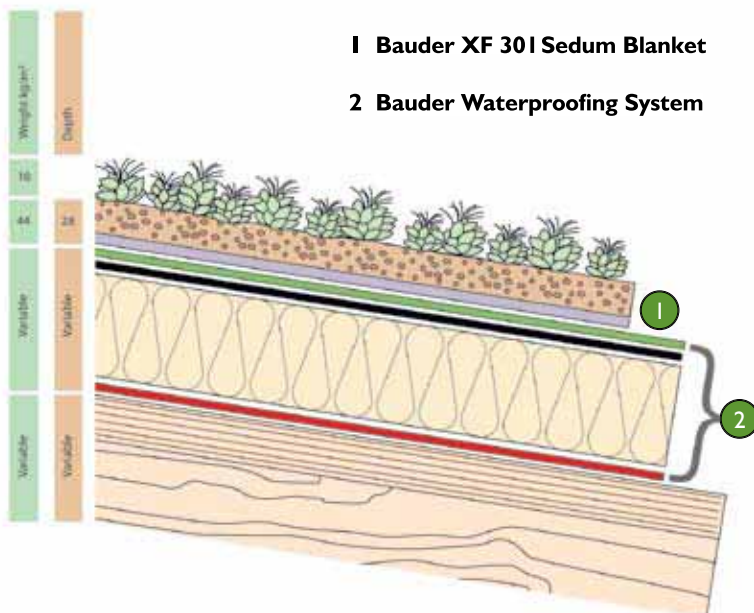
2 Bauder SDF Mat, drainage layer

3 Bauder Waterproofing System



## Roof slopes >2° and up to 9°

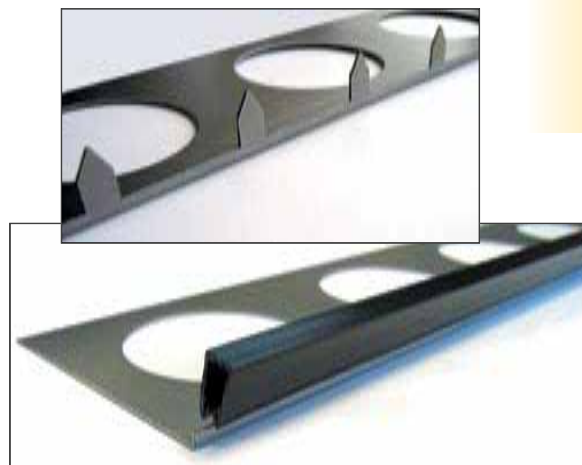
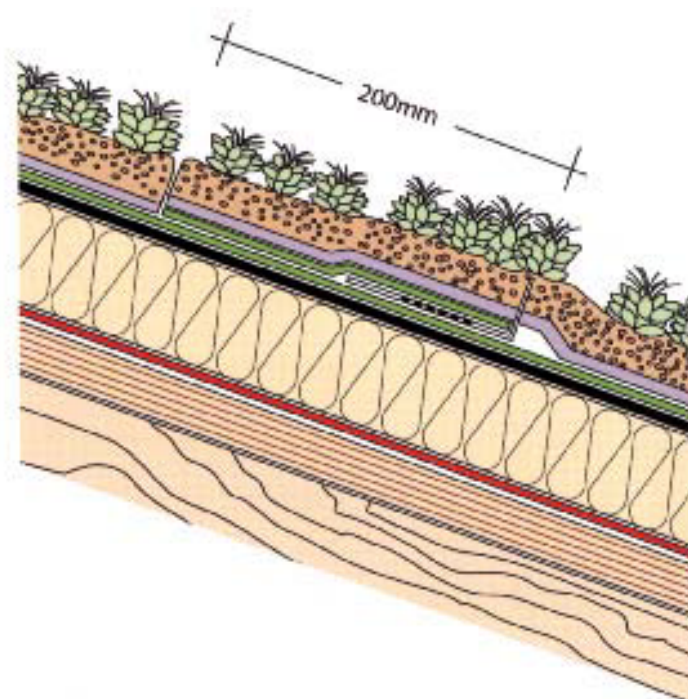
For roof slopes exceeding 2° standing water should not be an issue, allowing the SDF Mat drainage layer to be eliminated and the Bauder XF30I combination blanket to be installed directly over the waterproofing.



## Roof slopes >9° and up to 30°

Long rolls are recommended for roof slopes exceeding 9°. They are available in lengths up to 10 m and cut to the nearest full metre. A crane which is capable of reaching all areas of the roof is imperative.

When installed over either a 'barrel vault' or 'dual -pitched' roof, the long length blankets may be applied over the ridge without additional mechanical



retention, as the forces imposed are counterbalanced. For all other situations, Bauder Sedum Blanket Retention Strip should be used.

In some instances it is not possible to use the long length roll, i.e. if there are numerous rooflights or interruptions or if crane access is impossible. In these situations the standard 2 x 1 m lengths may be used in conjunction with the sedum blanket retention strips to mechanically prevent slippage of the blanket.

The Bauder Sedum Blanket Retention Strip is a simple stainless steel device for securing the blankets without impeding drainage or creating visual surface undulations once installed. Each retention strip is set in a staggered pattern 200 mm below the position of the leading edge of the blanket. The strip is secured with a 200 mm wide flashing of waterproof cap sheet membrane which bonds through the holes in the base plate of the strip to the surface of the Bauder waterproofing. The teeth of the retention strip penetrate the blanket and ensure that no post-installation slippage can occur. A protective plastic cover strip is provided and remains in place until the blankets are ready to be installed.

Technical data	
Total build up height (assuming 100 mm thick insulation)	141 mm
Weight of waterproofing system (exc. deck)	19.1 kg / m <sup>2</sup>
Saturated weight of landscaping	44 kg / m <sup>2</sup>
<b>Total system weight (exc. deck)</b>	<b>63.1 kg / m<sup>2</sup></b>



# Sedum Blanket on Bituminous Waterproofing Build Up

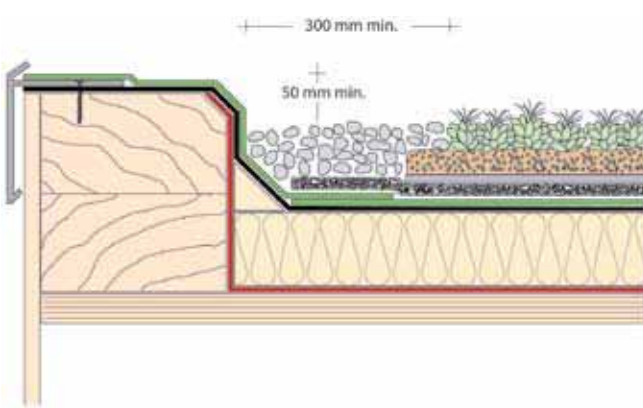
## General Detailing

The British and European standards and industry codes of practice for traditional flat roof waterproofing apply equally to all forms of green roof construction. For the landscaping element, the widely respected and independent German FLL standards are the most widely recognised and have been fully adopted by Bauder.

The minimum required upstand height is 150 mm. This must be observed at all times and taken from the finished landscape surface and not that of the waterproofing. Perimeter kerbs featuring mechanically fixed capping must also be treated as upstands and given a minimum height of 150 mm.

The only exceptions to this are perimeter kerbs, where the waterproofing terminates in a traditional welted drip or a GRP trim or beneath door thresholds, where a lineal drainage channel is incorporated. In these situations, a minimum 50 mm upstand is required.

Round washed pebbles, graded 20 - 40 mm, or other Bauder approved aggregate, should be used at all borders to a recommended width of 300 - 500 mm, to provide vegetation free edging around all upstand abutments, roof lights, rainwater outlets and all other penetration points.

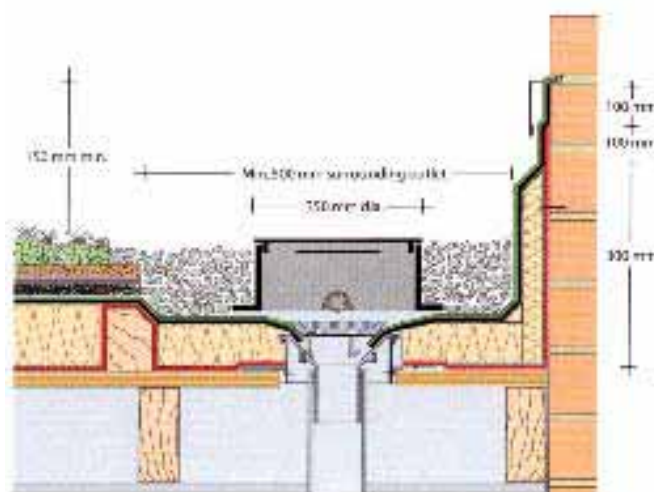
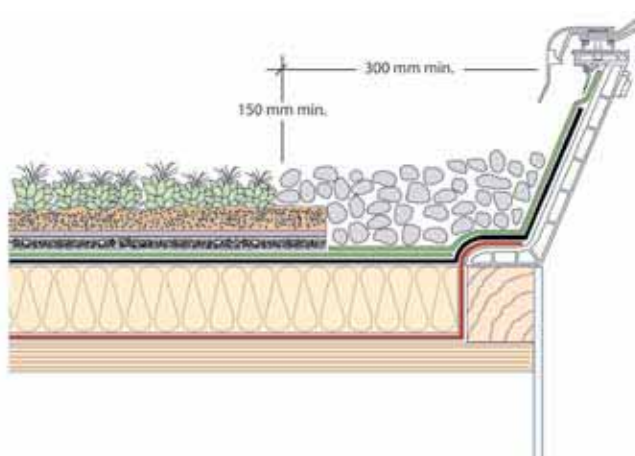


To conform to current Health and Safety legislation, either a handrail or fall arrest system should be incorporated within the design. If a portable ladder is to be the main means of access then a wall mounted fixing point for securing the ladder must be included.

## Vegetation Barriers

Vegetation barriers provide several important functions for extensive green roofs:

- Protection of the vegetation layer from water running down vertical upstands
- Rapid drainage during and after heavy rainfall
- Ease removal of encroaching vegetation during routine maintenance
- Protection of the waterproofing from mechanical damage
- Provision of a fire break
- Resistance to wind uplift by increasing the imposed loading at roof perimeters.



### Bauder Inspection Chambers

These should be installed above all internal rainwater outlets to provide access for inspection and cleaning. The chamber lid has finger holes for easy removal with a blanking plate beneath, preventing sunlight from allowing any washed through seeds to germinate within the outlet and obstruct drainage. The unit also features perforated piping that allows excess water to reach the outlet quickly during heavy rainfall.

Bauder inspection chambers are available as either a full size unit for internal outlets and a semi-circular alternative for outlets positioned close to abutment walls or kerbs. If required, the height of the chambers can be raised in 50 mm increments by use of height adapter rings.

### Bauder SS40 Drainage and Edge Trim

Bauder SS40 is a perforated stainless steel trim used to retain the sedum blanket at open perimeters with external gutters and is suitable for both bitumen and single ply scenarios. It is automatically used on specifications where the roof slope exceeds 9°.

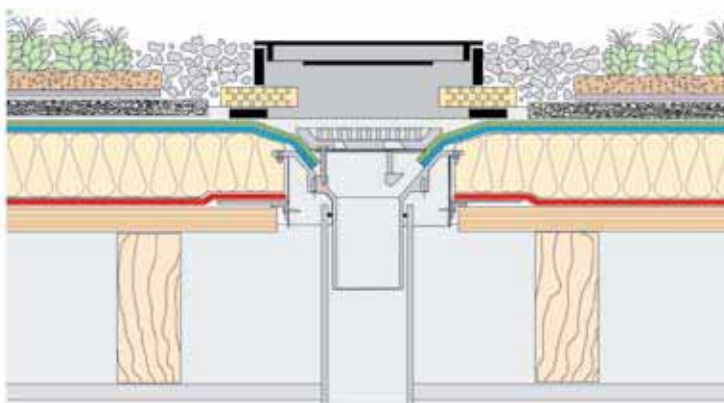
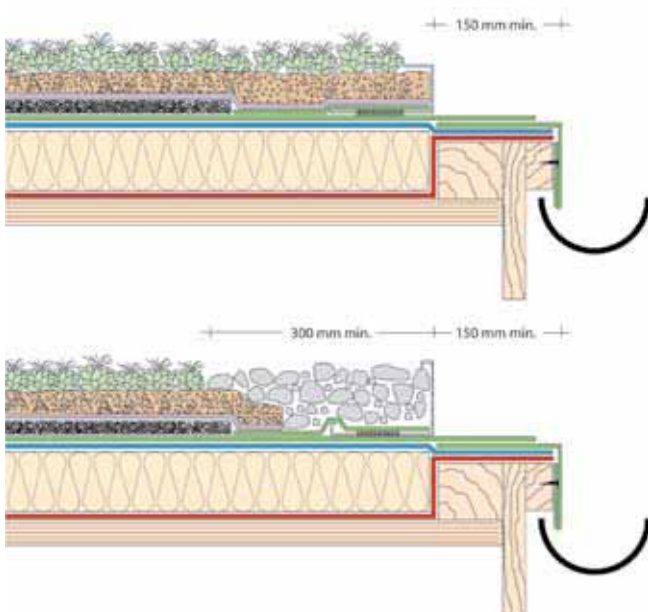
Bauder SS40 prevents substrate erosion at the exposed edges of the blanket and, due to the excellent wind uplift and fire characteristics of the Bauder sedum blanket, may be used where the pebble vegetation barrier is impractical. The trim should be set back from the drip edge by 150 mm to prevent vegetation overhanging the gutter and impeding drainage.

### Bauder AL80/100 Drainage Trim

Bauder AL80/100 is a perforated aluminium trim that retains pebble vegetation barriers at open perimeters. The product is suitable for use with both bitumen and single ply waterproofing systems.



Bauder inspection chamber with surrounding pebble vegetation barrier.





# Thermoplan T Single Ply Waterproofing

## Bauder Thermoplan T Waterproofing System

Thermoplan T is used only with our Xero Flor XF30I sedum blanket system on roof constructions with falls between 1 - 5°. It is recommended that all extensive green roofs are designed with a minimum fall of 1°. Even on flat roofs designed with these minimal falls, small areas of standing water can sometimes occur and it is important that the plant roots do not become permanently immersed, otherwise they will rot and the plants will die.

### Roofs with minimal falls (> 1° and up to 2°)

Bauder SDF Mat drainage layer is incorporated into the system where the falls are between 1 - 2° to lift the blanket clear of any standing water and allow it to quickly disperse during periods of prolonged heavy rain. Not only does SDF Mat assist free drainage, but it also ensures that the roots develop properly within the moisture retention fleece where the correct levels of moisture and air are provided.

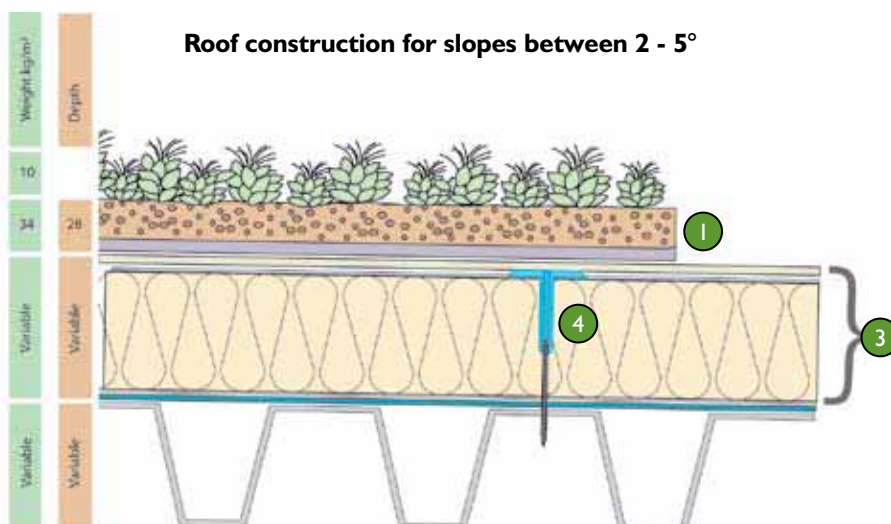
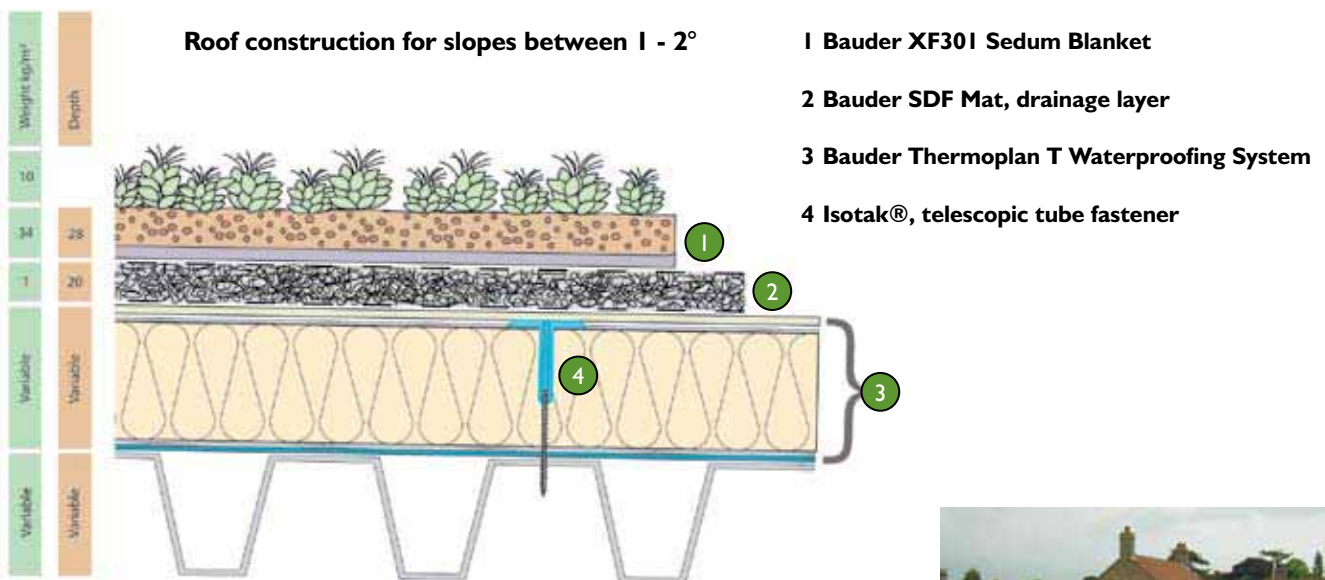
### Roof slopes >2° and up to 5°

Although it is technically possible to install Thermoplan T on roof slopes above 5° and we are prepared to discuss all project proposals, there are technical and safety implications and generally we recommend bitumen based systems in these situations. Thermoplan T waterproofing systems for green roofs come with our comprehensive 20 year guarantee.

For more information regarding options for waterproofing construction in Thermoplan T, please see the Thermoplan Literature and visit our web site [www.bauder.co.uk](http://www.bauder.co.uk)

#### Technical data

Total build up height (assuming 100 mm thick insulation)	150 mm
Weight of waterproofing system (exc. deck)	6.5 kg / m <sup>2</sup>
Saturated weight of landscaping	44 kg / m <sup>2</sup>
<b>Total system weight (exc. deck)</b>	<b>50.5 kg / m<sup>2</sup></b>



# Substrate Based Extensive Green Roof Options

With extensive green roofs, circumstances dictate that it is not always possible to use the same system construction. The drainage requirements are often a deciding factor when selecting the most appropriate

solution for the build up. Once the appropriate drainage layer has been specified, it is used in conjunction with Bauder extensive substrate to deliver a successful green roof.

## **SDF MAT - The Multifunctional Cost Effective Solution**

When minimal drainage demands are placed on the roof, the Bauder SDF Mat combines protection, drainage and filtration in one product layer making it very cost effective. This product is the standard system build-up where there is no regular foot traffic, other than for routine maintenance.



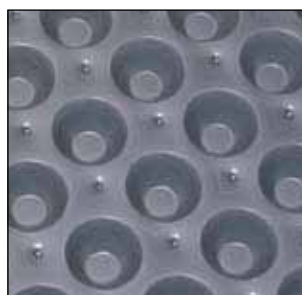
## **Bauder PLT10 - 10 mm Multifunctional Layer to Support Hard Landscaping**

On roofs with some hard landscaping it is necessary to provide support for the walkways or equipment plinths without compromising the drainage ability of the green roof system. Bauder PLT10 does not compress under loading and is the ideal continual drainage layer beneath both vegetation and hard landscaping where falls to the roof exceed 2°. Bauder PLT10 is a multi functional layer providing filtration, drainage and protection.



## **Bauder PLT20 - 20 mm Drainage Layer to Support Hard Landscaping**

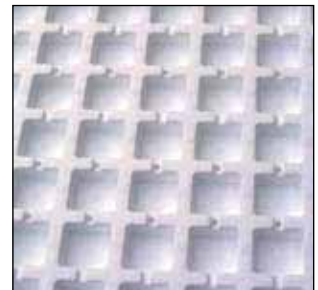
Bauder PLT20 provides support for walkways and equipment plinths in the same way as PLT10, but the increased board depth makes it suitable for roofs with falls below 2°; it is also suitable if the deck is flat providing that any standing water is unlikely to exceed 15 mm. Bauder PLT20 has additional water storage capacity and is specified in conjunction with Bauder Filter Fleece, to prevent substrate fines from the growing medium washing through, and Bauder Eco-mat to protect the waterproofing system.



## **Bauder Reservoir Board - Lightweight Water Storage and Drainage Layer**

Bauder Reservoir Board is used for schemes where the chosen plants require more water than the usual drought tolerant vegetation. The closed chamber and canal system provides additional water storage and is used in conjunction with Bauder Filter Fleece to prevent substrate fines from the growing medium washing through and Bauder Eco-mat to protect the waterproofing system.

Bauder reservoir board is the ideal product for sloped roofs, specifically those exceeding 10°, where the channel profile helps to retain the growing medium and provide additional water storage.



## **Bauder Mineral Drain - Ecological Alternative**

This is a substrate produced from recycled crushed brick to give an ecological alternative to our other drainage components. The Bauder Mineral Drain has some inherent water storage, though this is limited. This is specified with Bauder Extensive Substrate growing medium together with Bauder Eco-mat to protect the underlying waterproofing.









# Hydroplanting Plant List

## Botanical name - Herb species

- *Achillea millefolium*
- *Allium schoenoprasum*
- *Anthemis tinctoria*
- *Anthyllis vulneraria*
- *Armeria maritima*
- *Aster amellus*
- *Campanula rapunculoides*
- *Centaurea cyanus*
- *Daucus carota*
- *Dianthus carthusianorum*
- *Dianthus deltoids*
- *Hieracium aurantiacum*
- *Hieracium pilosella*
- *Inula conyzatiacum*
- *Leucanthemum vulgare*
- *Linaria vulgaris*
- *Linum perenne*
- *Lychnis viscaria*
- *Lotus corniculatus*
- *Malva moschata*
- *Matricaria inodora*
- *Origanum vulgare*
- *Papaver rhoeas*
- *Petrorhagia saxifrage*
- *Pimpinella saxifrage*
- *Potentilla argentea*
- *Ranunculus bulbosus*
- *Sanguisorba minor*
- *Scabiosa columbaria*
- *Silene dioica*
- *Thymus pulegoides*
- *Thymus serpyllum*
- *Trifolium arvense*
- *Verbascum lychnitis*
- *Verbascum phlomoides*
- *Veronica teucrium*



## Botanical name - Sedum species

- *Sedum album* 'Murale'
- *Sedum album* 'Coral carpet'
- *Sedum caucicolum*
- *Sedum floriferum* 'Weihenstephaner Gold'
- *Sedum hybridum*
- *Sedum kamtschaticum*
- *Sedum reflexum*
- *Sedum sexangulare*
- *Sedum spurium* 'album superbum'
- *Sedum spurium* 'Fuldaglut'

Above, a list of herb and sedum species, typically used in the Bauder hydro-planting spray mix.

# Planting Options

## Hydroplanting

Bauder Hydroplanting is a proven technique for spray applying vegetation cuttings and seeds to large roof areas with Bauder Extensive Substrate used as the growing medium. The depth and quality of the Bauder substrate meets all requirements of the current FLL standards.

The Hydroplanting process involves taking seeds, plant seedlings and cuttings, together with necessary fertilisers and mulch, and combining them with a 100% biodegradable coagulate binding agent which is then sprayed onto the prepared roof to distribute the vegetation. The binding agent ensures adhesion to the substrate and promotes fast establishment by aiding moisture retention and providing resistance against wind and rain erosion. Growth of the vegetation then begins and is generally fully established after 12 - 18 months.



Applying the special spray mix to the substrate growing medium.



Seeds and plant cuttings spray applied to recently prepared substrate growing medium.



After one day



After one week



After two months



12 - 18 months

## Plug planting

Where the client wishes to choose the particular type and species of vegetation, Bauder can supply plug plants as an alternative to the pre-selected random mix associated with the hydroplanting system. The 'plugs' are then planted by

hand to a density specified by the client. The more plants per square metre the faster the vegetation will establish to cover the roof entirely.

Below, the various stages of plant development in a Bauder hydro-planted extensive green roof system.



Pre-cultivated plug plants are also available as an alternative option to hydroplanting.



Measuring the correct depth of growing medium.



Individual plug planting by hand.

Many native species of plants, birds, insects and other wildlife are in decline due to years of urban development that has claimed increasing areas of their natural habitat. Environmentalists, ecologists and local government planners now recognise the potential offered by roof landscaping as a method of replicating this lost natural habitat and there is now a growing interest in landscaping roofs designed specifically to meet local biodiversity needs.

This interest has developed from conservation work carried out in London on the rare Black Redstart. As a protected species of bird its future has become a planning consideration when building proposals are put forward for the development of brown-field sites, its natural habitat.

This type of green roof finish now forms part of a biodiversity action plan for many local authorities as a solution to planning issues for developers and can often be a prerequisite for planning consent.

Flat roofs are ideal for developing into biodiversity landscapes. The Bauder Total Green Roof is the recommended system build up, with choices available for differing drainage layers dependent upon any weight limitations and the roof falls.

The substrate and vegetation should be suitable to replicate the natural habitat of the differing species the roof is designed to attract. The ideal solution is to be able to re use site material produced from the building demolition such as crushing the brick and concrete to form a suitable substrate. However this is not always

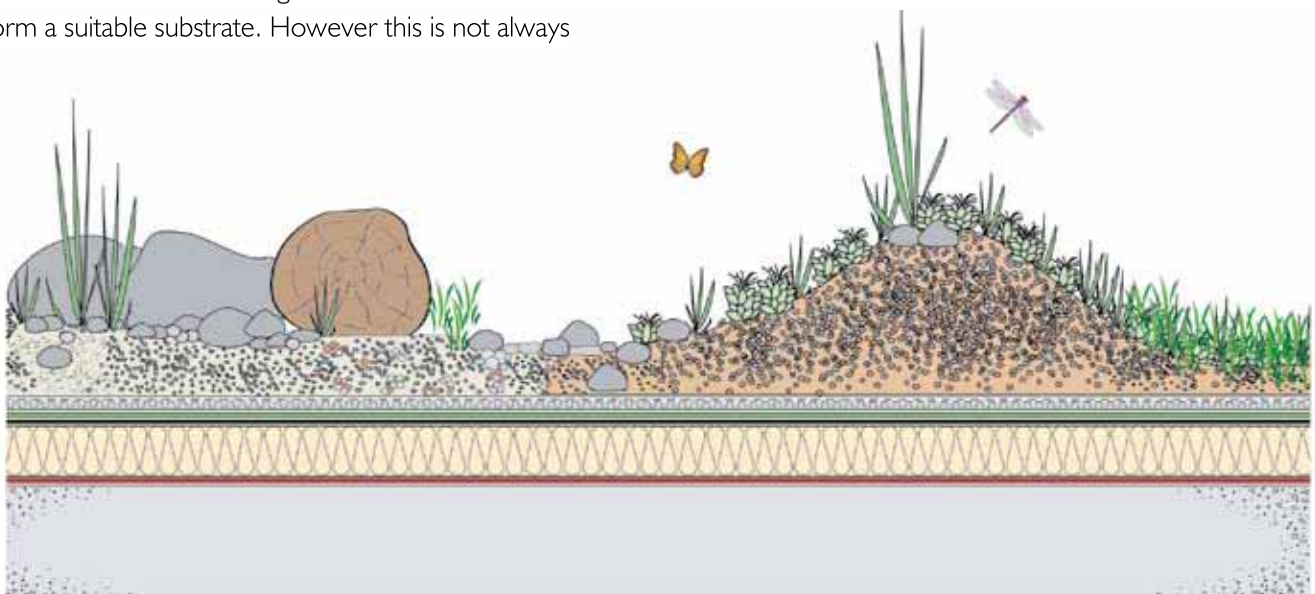
possible due to contamination of these materials during their previous “life”. In this case, there are other sources of recycled brick and concrete available to mix and form a suitable substrate.

Natural colonisation of the substrate by local plant species is the ideal solution. A helping hand may be given to nature by hand-seeding a chosen mix of grasses and flowers. To give the biodiversity landscape an element of “design”, tree branches, small piles of stones, a heap of coiled rope, etc. can all be incorporated into the landscaping. These types of items also provide micro-habitats for the differing wildlife.

Bauder can supply advice on all waterproofing and drainage related issues. Specific advice on the biodiversity aspects can be obtained from two leading independent organisations; the London Biodiversity Partnership, **[www.lbp.org.uk](http://www.lbp.org.uk)**, and English Nature, **[www.english-nature.org.uk](http://www.english-nature.org.uk)**



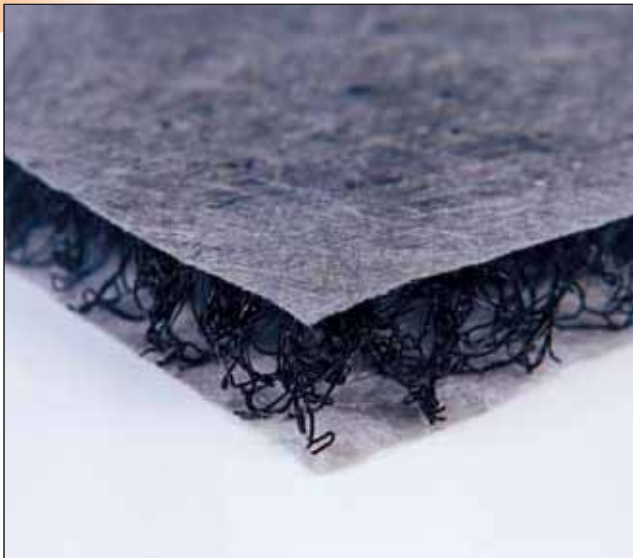
Photograph taken by Craig Churchill





# Bauder SDF Mat

## The cost effective solution for large areas



Material	Geo-textile facings with UV resistant woven nylon loops	
Roll size	1 m x 20 m <sup>2</sup>	1 m x 50 m <sup>2</sup>
Thickness	20 mm	20 mm
Coverage	20 m <sup>2</sup>	50 m <sup>2</sup>
Weight	ca. 600 g/m <sup>2</sup>	
Pressure resistance	ca. 20 kN/m <sup>2</sup>	

Bauder SDF Mat is manufactured from ultraviolet resistant nylon woven loops which are thermally bonded to geo-textile filter fleece facings. The nylon loops create an open mesh through which the rainwater drains, whilst the filter fleece prevents substrate fines from washing away.

Bauder SDF Mat is a multifunctional single layer that provides filtration, drainage and protection of the waterproofing system. Bauder SDF Mat is the most cost effective extensive roof construction, ideally suited to lightly trafficked roof areas.

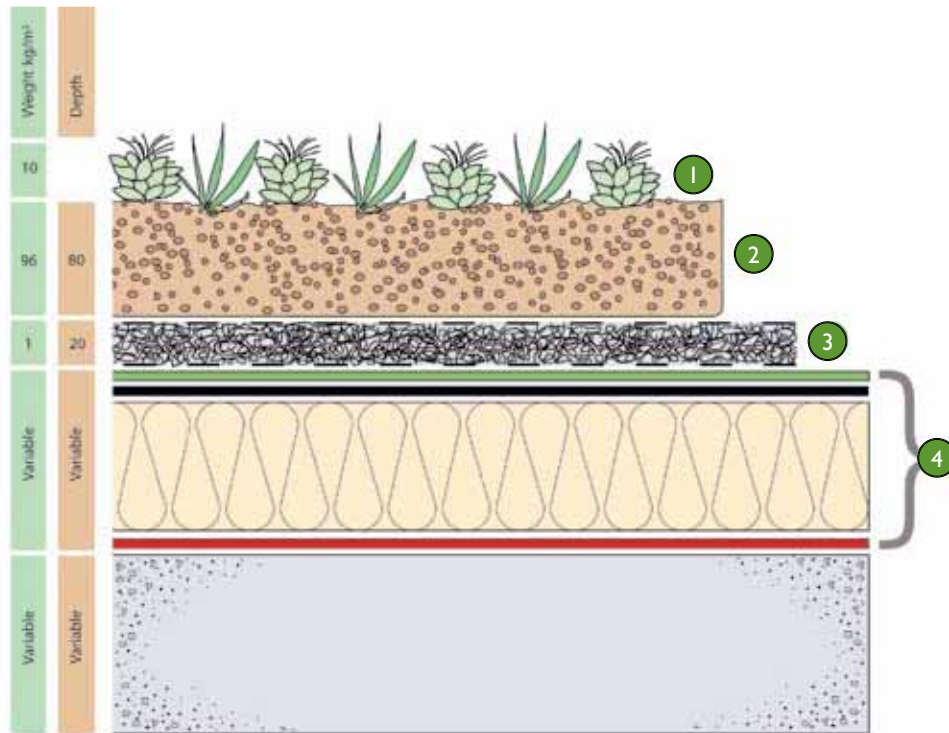
On roofs where paved walkways or platform mounted equipment are required, Bauder SDF Mat is not suitable because of its compressive nature. In this situation, Bauder PLT20 should be used either throughout or adopted in the specific areas where additional support is required; in this circumstance, a separate filter fleece layer is used to lap onto any adjoining Bauder SDF mat.

Planting options are: hydroplanting where a mixture of pre-selected plants are incorporated, or plug-planting, where specific plants may be chosen.



## Roof slope > 1° and up to 10°

(0 - 1° only if less than 15 mm of standing water present)



### 1 Plug Planting or Hydroplanting

Selected species to suit the project and site location.

### 2 Bauder Extensive Substrate

Lightweight growing medium, depth 80 mm. Manufactured and used in accordance with FLL guidelines.

### 3 Bauder SDF Mat

Multi-functional drainage, filtration and protection layer, 20 mm thick.

### 4 Bauder Waterproofing System

High performance waterproofing membranes suitable for green roof systems.

#### Technical data

Build up height	100 mm
Total water storage capacity of system	38 litres/m <sup>2</sup>
Total weight (exc. waterproofing)	107.0 kg/m <sup>2</sup>
<b>Weight of waterproofing system (assuming 100 mm PIR insulation)</b>	<b>19.1 kg / m<sup>2</sup></b>

#### MAIN FEATURES:

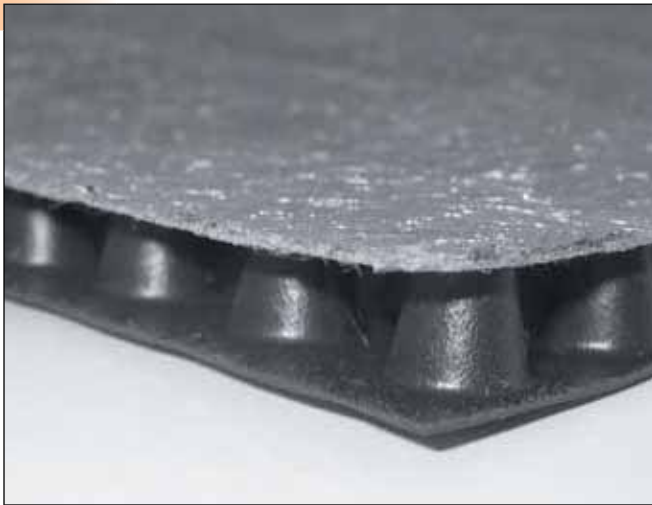
- Utilised on roofs with 1 - 10° slope
- Suitable only for lightly trafficked areas
- Drainage, filtration and protection from a single product
- Cost effective construction
- Excellent drainage





# Bauder PLT10

## For roofs with some hard landscaping



Material	High density polyethylene and geo-textile fleece
Board size	2 m x 12.5 m
Thickness	10 mm
Coverage	25 m <sup>2</sup>
Weight	ca. 750 g/m <sup>2</sup>
Lateral drainage rate under a load 30 kN/m <sup>2</sup>	2% fall ca. 0.55 litres/sec/m 3% fall ca. 0.67 litres/sec/m
Drainage rate when used vertically	ca. 4.8 litres/sec/m
Compressive strength	ca. 400 kN/m <sup>2</sup>

Bauder PLT10 is manufactured from high density polyethylene (HDPE) with a geo-textile fleece bonded to the crowns of the 10 mm high studs. The profile of the HDPE creates the channels through which the rainwater drains, whilst the filter fleece prevents substrate fines from washing through the system.

Bauder PLT10 is similar to SDF Mat in that it provides filtration, drainage and protection of the waterproofing. However, it has the additional benefit of being highly pressure resistant and therefore does not compress under loading. Bauder PLT10 provides a stable base to support

walkways or platform mounted equipment without compromising the capacity for drainage beneath.

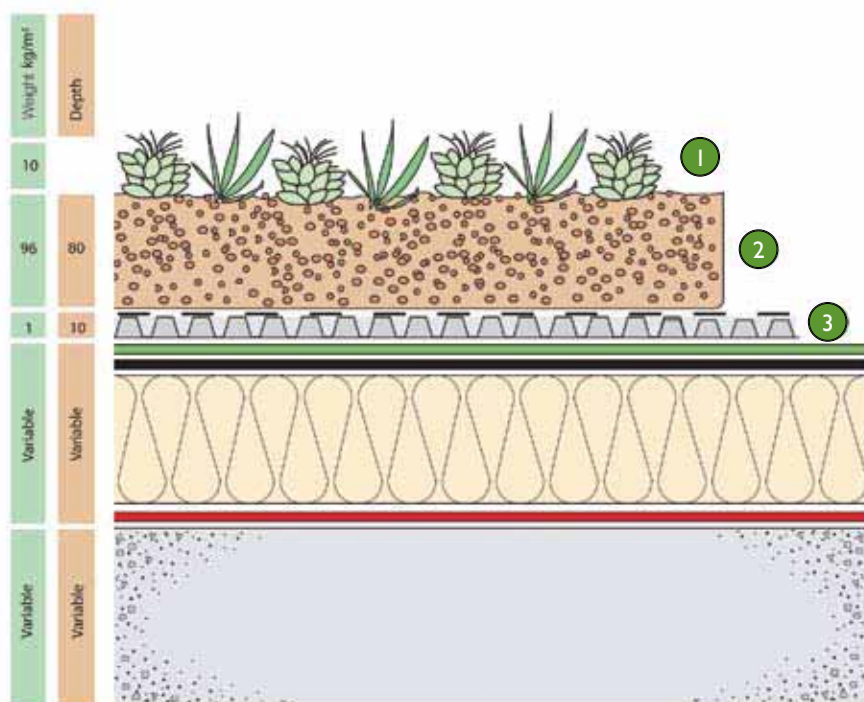
Bauder PLT10, due to its shallow depth, is designed for use on a deck with a minimum fall of 1:40 where the risk of standing water is minimal.

Planting options are: hydroplanting where a wide variety of pre-selected plants are incorporated, or plug-planting, where specific plants may be chosen.





## Roof slopes > 2 and up to 10°



### 1 Plug Planting or Hydroplanting

Selected species to suit the project and site location.

### 2 Bauder Extensive Substrate

Lightweight growing medium, depth ca. 80 mm. Manufactured and used in accordance with FLL guidelines.

### 3 Bauder PLT10

10 mm thick multifunctional drainage layer.

### 4 Bauder Waterproofing System

High performance waterproofing membranes suitable for green roof systems.

Technical data	
Build up height	90 mm
Total water storage capacity of the system	38 litres/m <sup>2</sup>
Total weight (exc. waterproofing)	107.2 kg/m <sup>2</sup>
<b>Weight of waterproofing system (assuming 100 mm PIR insulation)</b>	<b>19.1 kg/m<sup>2</sup></b>

## MAIN FEATURES:

- Suitable for roofs from 2 - 10° slope
- Provides a stable base where walkways or plant equipment are incorporated
- Compression resistant
- Protection, filtration and drainage from a single product



# Bauder PLT20

## For extensive roofs with associated hard landscaping



Material	High density polyethylene
Board size	1.2 m x 2.5 m
Thickness	20 mm
Weight	ca. 1.0 kg/m <sup>2</sup>
Lateral drainage rate	ca. 7 litres/sec/m
Vertical drainage rate	ca. 10 litres/sec/m
Rate of drainage through board perforations	ca. 0.07 litres/sec/m
Water storage capacity	ca. 5.5 litres/m <sup>2</sup>
Compressive strength	ca. 150 kN/m <sup>2</sup>

Bauder PLT20 is manufactured from high density polyethylene (HDPE) where the cupped profile provides water storage whilst allowing the water to drain through the channels on the underside. The design features of Bauder PLT20 means that it requires additional filtration, protection and separation layers within the specification.

Bauder PLT20 is similar to Bauder PLT10 in that it provides a pressure resistant stable base for paved walkways or support for roof mounted equipment without compression of the drainage layer.

The increased board depth of Bauder PLT20 provides better drainage and water storage capacity and is suitable for roofs with a minimum fall of 1° or flat roof projects where standing water does not exceed 15 mm.

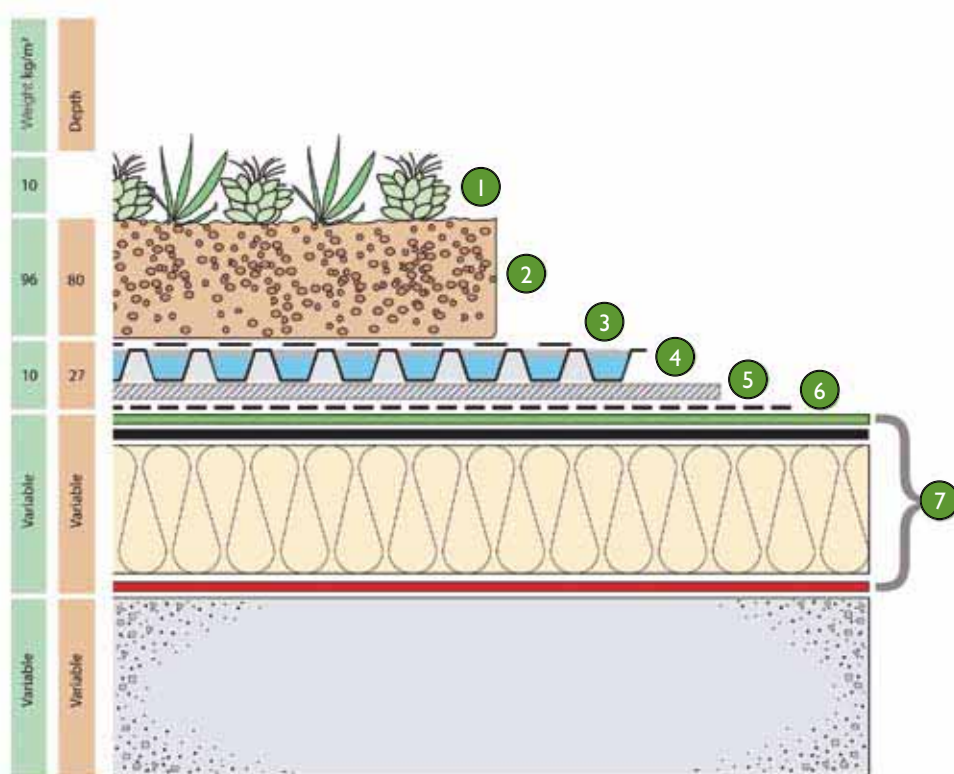
Planting options are: hydroplanting where a wide variety of pre-selected plants are incorporated, or plug planting, where specific plants may be chosen.





## Roof Slopes > 1° and up to 10°

0 - 2° only if less than 15 mm of standing water present



### 1 Plug Planting or Hydroplanting

Selected species to suit the project and site locality.

### 2 Bauder Extensive Substrate

Lightweight growing medium, depth 80 mm. Manufactured and used in accordance with FLL guidelines.

### 3 Bauder Filter Fleece

Filtration layer prevents substrate fines from washing into the drainage layer.

### 4 Bauder PLT20

Water storage and drainage, 20 mm thick.

### 5 Bauder Eco-Mat

A 6 mm thick protection layer.

### 6 Bauder PE Foil

A polyethylene foil separation and slip layer manufactured from recycled granules. (Not used if the roof fall is over 3°)

### 7 Bauder Waterproofing System

High performance waterproofing membranes suitable for green roof systems.

#### Technical data

Build up height	107 mm
Water storage capacity of entire system	45 litres/m <sup>2</sup>
Total weight (exc. Waterproofing)	117.3 kg/m <sup>2</sup>
<b>Weight of waterproofing system (assuming 100 mm PIR insulation)</b>	<b>19.1 kg/m<sup>2</sup></b>

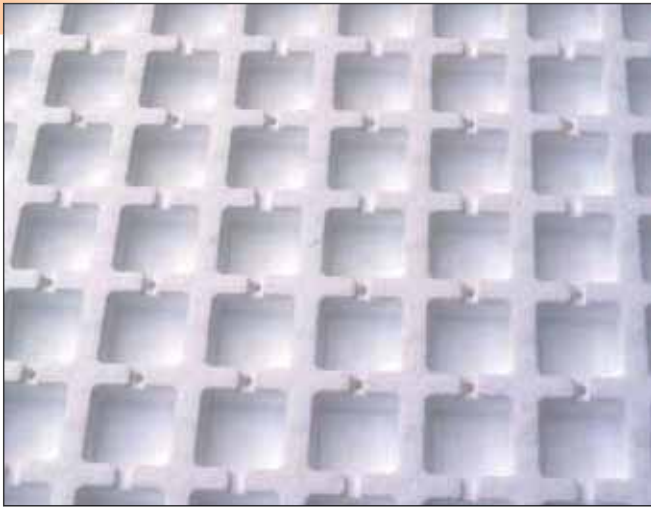
#### MAIN FEATURES:

- Suitable for roofs from 1 - 10° slope, or 0° if less than 15 mm standing water
- Provides a stable base where plant or pathways are incorporated
- Compression resistant
- 5.5 litres/m<sup>2</sup> water storage



# Bauder Reservoir Board

## The lightweight solution



Material	Expanded polystyrene	
Board size	0.780 m x 1.283 m	
Thickness	50 mm	75 mm
Water storage capacity	10.1 litres/m <sup>2</sup>	21.5 litres/m <sup>2</sup>
Weight	ca. 0.65 kg/m <sup>2</sup>	ca. 0.95 kg/m <sup>2</sup>
Pressure resistance	35 kN/m <sup>2</sup>	

Bauder Reservoir Board is manufactured from expanded polystyrene with a profile that provides water retention and multidirectional drainage. The 50 mm reservoir board is generally used for roof slopes between 0 - 5°, but can be used up to a maximum of 10° if planting is predominately drought tolerant. The 75 mm board is used for sloped roofs over 5° where extra water storage capacity and substrate retention is required. The boards are finished with rebated edges.

Bauder Reservoir Board provides an effective method of retaining low system weight, whilst at the same time increasing inherent water retention. If the chosen planting is predominantly sedum, it is possible to reduce the substrate depth on roof slopes between 0 - 10° down to

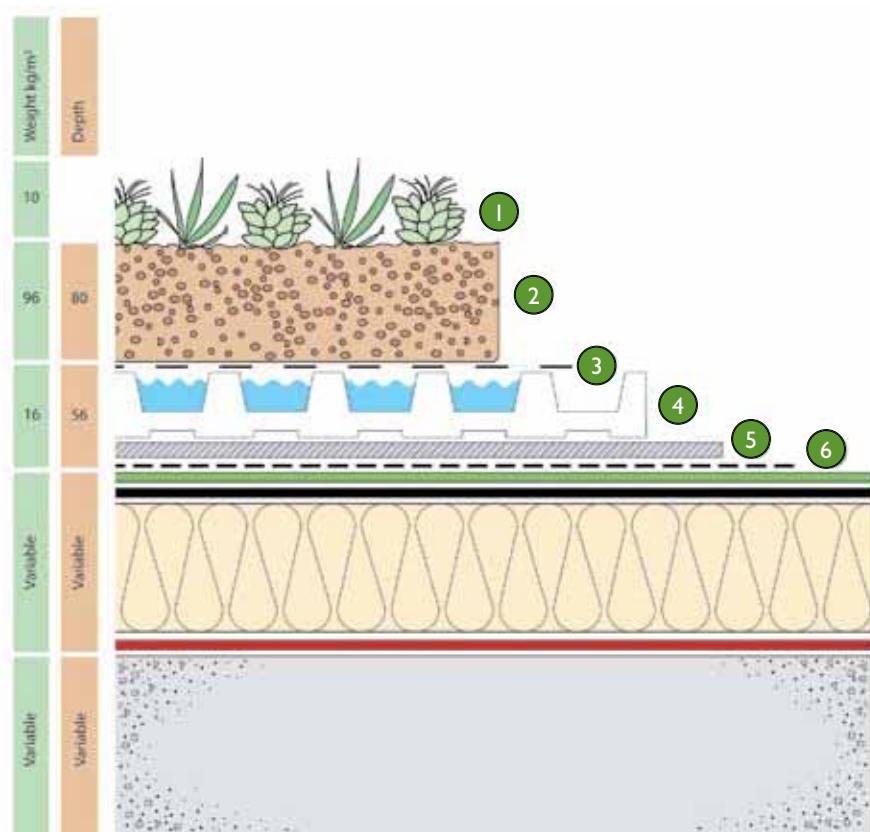
60 mm to reduce the overall system weight by a further 24 kg/m<sup>2</sup>. Alternatively, the 75 mm board can be used to increase the volume of water stored within the system, thus keeping the diverse plant mix.

Reservoir board construction is ideal for projects where within the overall system water retention is an important factor or where the extensive planting schedule is to be more diverse and to include species such as herbs and grasses that require more water than typical drought tolerant plants such as sedums.

Planting options are: hydroplanting where a wide variety of pre-selected plants are incorporated, or plug planting, where specific plants may be chosen.







### 1 Plug Planting or Hydroplanting

Selected species to suit the project and site locality.

### 2 Bauder Extensive Substrate

Lightweight growing medium, depth 80 mm. Manufactured and used in accordance with FLL guidelines.

### 3 Bauder Filter Fleece

Filtration layer prevents substrate fines from washing into the drainage layer.

### 4 Bauder Reservoir Board

Water storage and drainage, 50 mm or 75 mm thick.

### 5 Bauder Eco-Mat

A 6 mm thick protection layer.

### 6 Bauder PE Foil

A polyethylene foil separation and slip layer manufactured from recycled granules. (Not used if the roof fall is over 3°)

### 7 Bauder Waterproofing System

High performance waterproofing membranes suitable for green roof systems.

#### Technical data

Build up height (50mm Bauder Reservoir board)	136 mm
Water storage capacity of entire system	50 litres/m <sup>2</sup>
Total weight (exc. Waterproofing)	122.4 kg/m <sup>2</sup>
<b>Weight of waterproofing system (assuming 100 mm PIR insulation)</b>	<b>19.1 kg/m<sup>2</sup></b>

#### Water retention on steep slopes

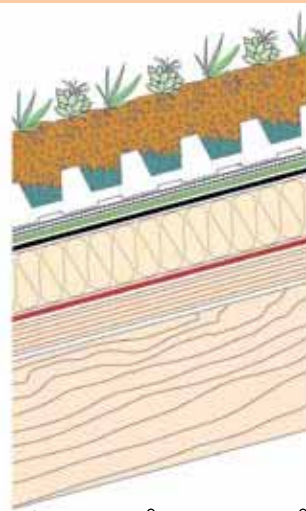
Of all the substrate based Bauder extensive green roof systems, only our 75 mm Reservoir Board has the water storage capacity to be used on slopes that exceed 10°.

For roof slopes between 5 - 15°, Bauder extensive substrate can be applied directly to the profiled surface of the Reservoir Board. No Filter Fleece or PE Foil separation layer are used. The special board profile helps to retain the growing medium, which is further stabilised once the plants have fully rooted into the substrate.

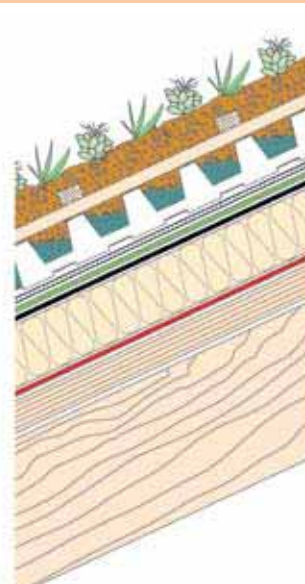
For slopes between 15 - 25°, an untreated timber trellis is used to help retain the substrate until the plant roots have established, after which time the trellis is superfluous and will rot away.

#### MAIN FEATURES:

- Suitable for roofs from 0 - 10° slope
- Lightweight
- Extra water storage capacity
- Excellent multidirectional drainage
- Wider range of plant options
- Additional protection to the waterproofing
- Rot resistant and root tolerant



Slopes > 5° and up to 15°



Slopes > 15° and up to 25°

# Bauder Mineral Drain

## The ecological alternative



Mineral component	Crushed brick (graded)
Organic content	None
Water storage capacity	ca. 15% Vol.
Vol. - weight delivered	ca. 1000 kg/m <sup>2</sup>
Vol. - water saturated	ca. 1150 kg/m <sup>2</sup>
Settlement in transit	ca. 10%
Supply form	Silo, tipper, big bags or sacks

Bauder Mineral Drain is made from brick production waste providing an ecological drainage method for a green roof system. Bauder Mineral Drain provides excellent aeration and drainage qualities, together with some inherent water retention. It is this water retention ability that allows for the depth of Bauder extensive growing medium substrate to be reduced from 80 mm to 50 mm, which helps to offset the additional weight.

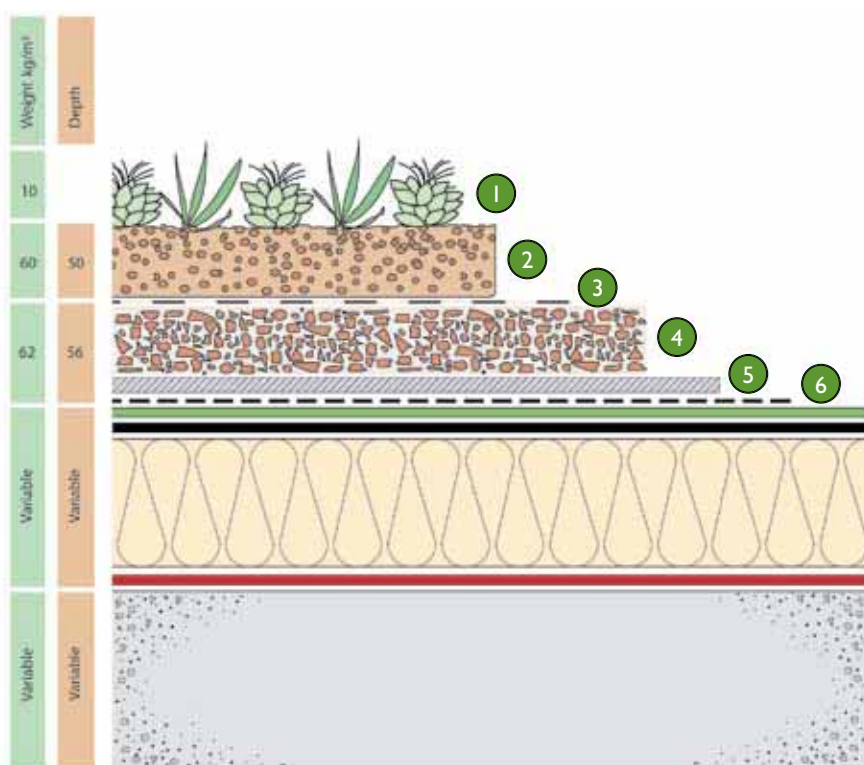
Mineral drain is normally delivered to site by Silo lorry and pumped on to the roof. Alternatively, it may be delivered in one ton bags that are craned to the roof

and suspended approximately one metre above the surface; the contents can then be discharged accordingly. These methods also apply to the delivery of Bauder Extensive Substrate growing medium. A filter fleece is incorporated between the Bauder Extensive Substrate and Mineral Drain to prevent any fines washing through the system.

Planting options are: hydroplanting where a wide variety of pre-selected plants are incorporated, or plug planting, where specific plants may be chosen.







### 1 Plug Planting or Hydroplanting

Selected species to suit the project and site locality.

### 2 Bauder Extensive Substrate

Lightweight growing medium, depth 50 mm. Manufactured and used in accordance with FLL guidelines.

### 3 Bauder Filter Fleece

Filtration layer prevents substrate fines from washing into the drainage layer.

### 4 Bauder Mineral Drain

Recycled crushed brick drainage, layer 50 mm in depth.

### 5 Bauder Eco-Mat

A 6 mm thick protection layer.

### 6 Bauder PE Foil

A polyethylene foil separation and slip layer manufactured from recycled granules. (Not used if the roof fall is over 3°)

### 7 Bauder Waterproofing System

High performance waterproofing membranes suitable for green roof systems.

#### Technical data

Build up height	106 mm
Water storage capacity of entire system	33 litres/m <sup>2</sup>
Total weight (exc. Waterproofing)	132.3 kg/m <sup>2</sup>
<b>Weight of waterproofing system (assuming 100 mm PIR insulation)</b>	<b>19.1 kg/m<sup>2</sup></b>

#### MAIN FEATURES:

- Suitable for roofs from 0 - 10° slope
- Ecological use of recycled waste brick
- Excellent drainage
- Extra water storage
- Fast application and wind resistant



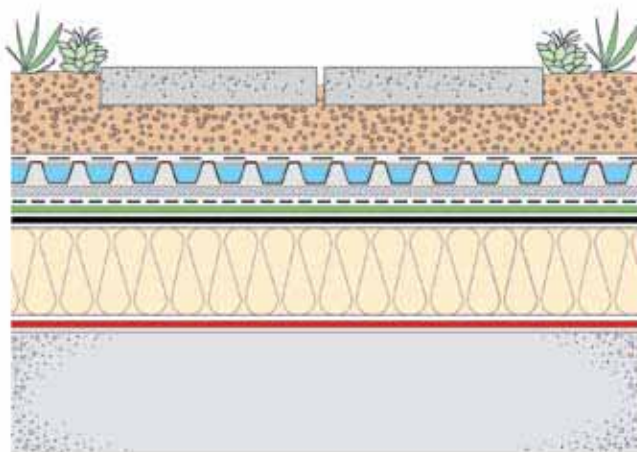


# General Detailing

## Pathways and Roof Mounted Plant

Extensive green roofs on commercial or industrial buildings often require defined access to service roof mounted plant and equipment. Paving can be laid directly on to extensive substrate or in a 2 - 5 mm angular crushed bedding gravel laid directly beneath the slabs, but it is important that the drainage layer is very stable. We recommend Bauder PLT10 or PLT20 for these situations.

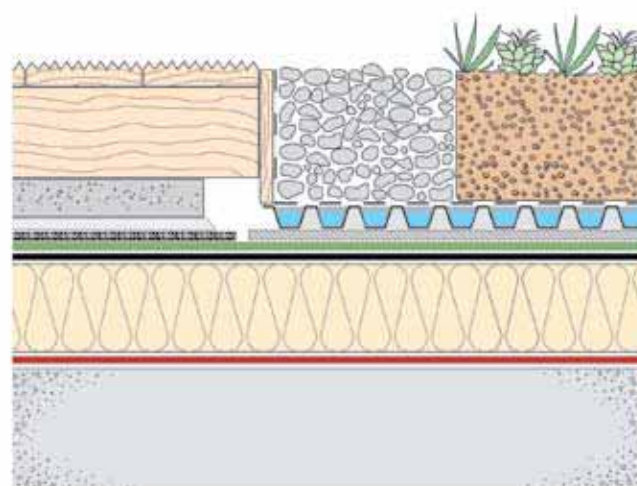
For regularly trafficked pathways or for permanently sited items of plant, such as air conditioning units, another option is to lay mortar or a no fines concrete bedding layer directly over PLT20 and then install the paving slabs. This prevents them from moving or becoming dislodged.



## Timber Decking

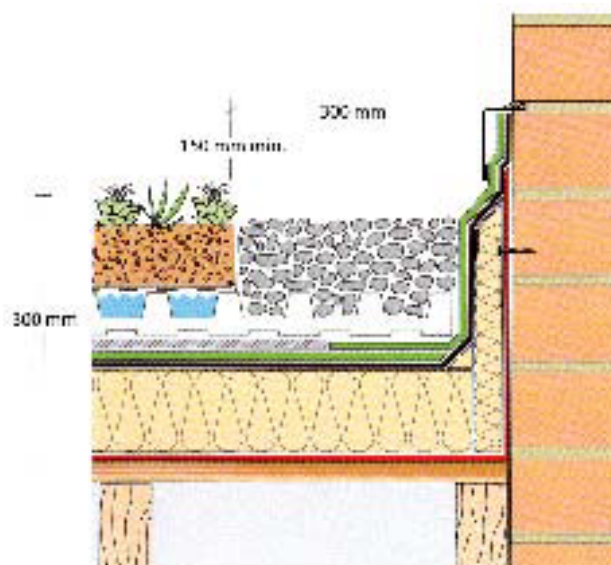
Timber decking should be constructed with a slight fall to disperse rainwater. The timber framework should be raised off the roof surface so that water can flow freely to rainwater outlets and prevent the bearers from eventually rotting.

The suggested method is to place the decking framework onto concrete paving slabs, using a mortar bedding to create slight falls where required. The paving/mortar bedding should be installed on square pads of protection mat, polyethylene sheet or surplus Bauder Plant-E cap sheet to isolate it from the surface of the waterproofing.



## Abutment Wall Detail

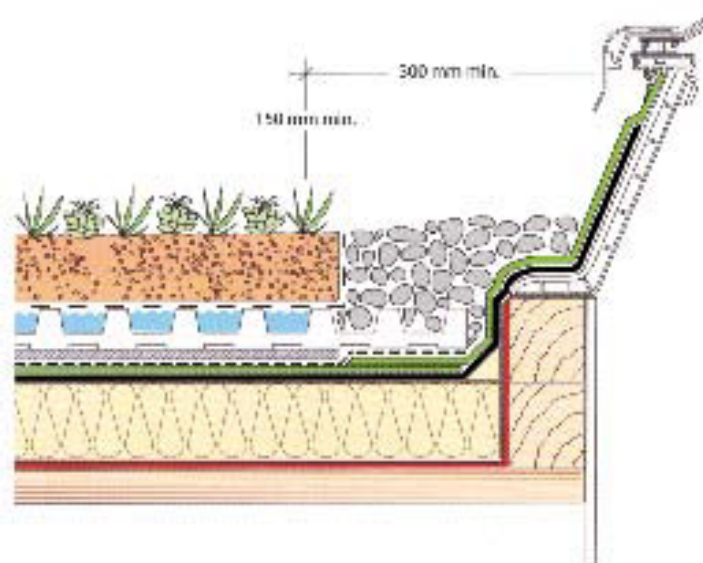
To conform to current 'Part L' requirements, it may be necessary to insulate the upstand at abutment walls, to compensate for unavoidable cold bridging created within the construction. This requirement can be achieved using the appropriate thickness of BauderPIR insulation encapsulated within the upstand waterproofing that is at least 300 mm in height from the base of the structural deck. We have developed a special metal wall mounted bracket to secure the top of the insulation and protect the exposed leading edge, so it can be waterproofed. This bracket ensures that visual appearance of the finished upstand is neat and regular.



### Construction of Rooflight Upstands

Due to the combined depth of the waterproofing system and soft landscaping, the proprietary kerbs supplied with most standard rooflights may be insufficient in height. In these situations the problem can be overcome by using timber to raise the kerb height and then fixing the proprietary kerb. A lining board can be used to conceal the exposed timber frame.

The finished upstand height should be a minimum of 150 mm above the surface of the landscaping. A minimum 300 mm wide vegetation barrier should be created around the base of the rooflight upstand.

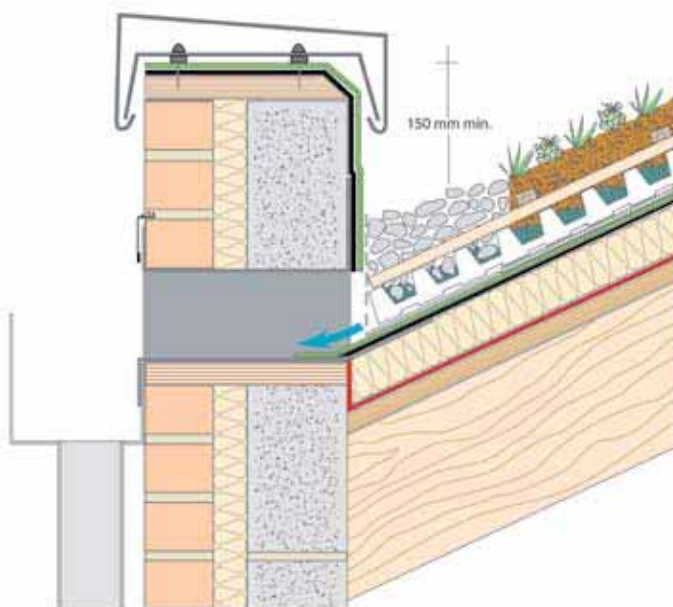


### Base Support for Sloped Roof Systems

Where Bauder Reservoir Board system is specified to provide substrate retention and a degree of water storage on slopes exceeding 5°, it is important that the first board is supported by a kerb or parapet wall at the base of the slope. This base support helps to prevent the load being transferred to the surface of the waterproofing that would otherwise result in slippage.

This support is equally important where an untreated timber retention trellis is incorporated to provide initial support for planting and protection against substrate erosion (applicable for all slopes between 15 - 25°).

The detail opposite shows a typical parapet wall with a lead box chute outlet. Note the perforated stainless steel grille over the chute opening.

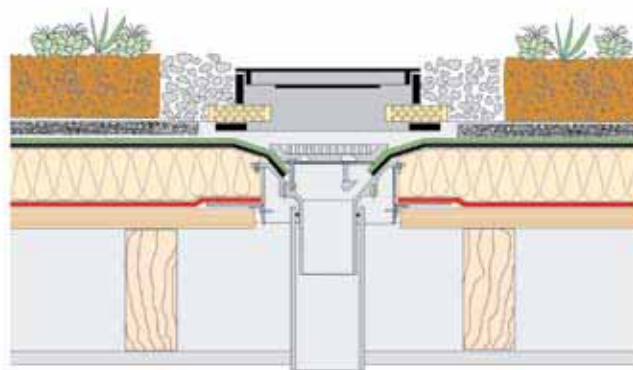


# Drainage Detailing

## Inspection Chambers

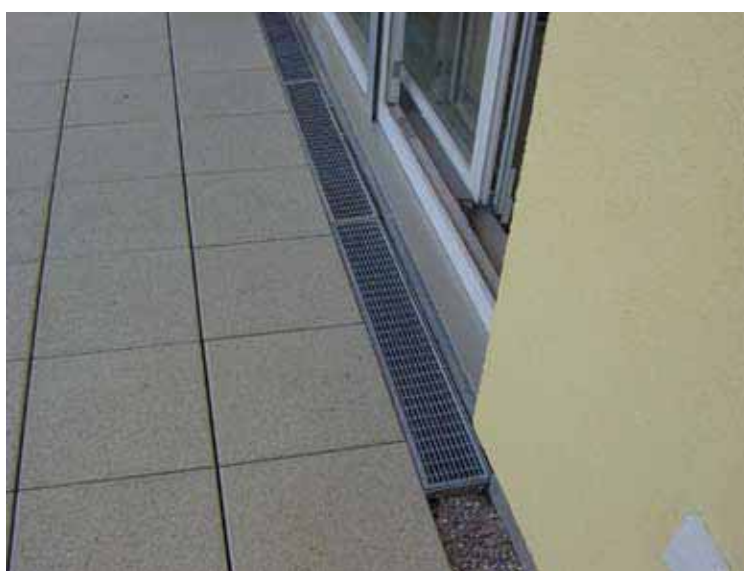
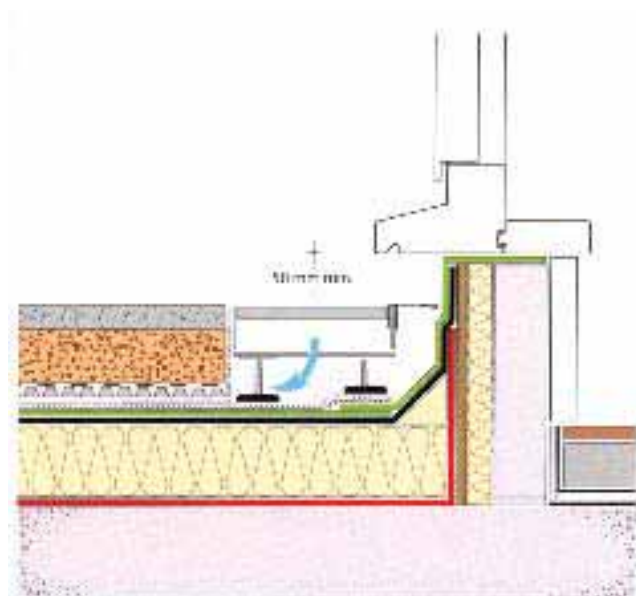
Bauder inspection chambers restrain the pebble vegetation barrier and provide ease of access to inspect and maintain rainwater outlets and drainage down pipes. Two sizes are available, the full standard circular unit and a half circular unit for outlets positioned close to abutments (page 37). A perforated pipe provides additional flow to the outlet during periods of heavy rainfall.

The width of the chamber and vegetation barrier should be taken in to account when calculating the design width of internal box gutters or gullies. A centrally located chamber requires a gutter width of 500 mm. If the outlet is located 'in-field', allow one square metre to accommodate both chamber and vegetation barrier.



## Bauder Linear Drainage System

For drainage close to walls or beneath door thresholds, linear drains can be used to collect surface water and discharge it directly into the drainage layer. The channel sections are perforated to allow water to seep through, and in the event of heavy rain, can direct water to outlets or drainage channels. The upstand height beneath door thresholds can be reduced to a minimum of 50 mm. The channel can be supplied separately for bedding on Bauder Mineral Drain (landscape depths exceeding 90 mm) or with adjustable support legs with an adjustment between 60 - 90 mm. A stainless steel closer is also available for this version if required, to bridge the space above the angle fillet. For more information, please see the technical data on page 39.





Annual maintenance is normally carried out each spring. It is important to ensure that safe access can be gained to the roof and that relevant health and safety procedures are followed. Safety harness attachment points or man safe systems should be provided in the construction where appropriate.

## Fertilising

A granular fertiliser, either organic or slow release, should be applied during spring, but no later than the beginning of May. It is an essential part of the maintenance routine, providing the plants with nutrients allowing them to become hardy enough to resist extreme cold, heat and drought. On small roof areas, fertiliser can be scattered by gloved hand from a bucket or a hand held spreader. For roofs over 100 m<sup>2</sup>, we recommend using a trolley applicator for a faster distribution that provides accurate coverage.

Information regarding suitable fertilisers can be found on our web site **[www.bauder.co.uk](http://www.bauder.co.uk)** or through our technical department who will be pleased to offer advice concerning maintenance issues.

## Debris

All debris and leaves should be removed from the roof surface, rainwater outlets, chutes and gutters. Roofs in the vicinity of deciduous trees will require a further visit at the end of the autumn to remove any leaves that are covering underlying plants.

## Plant Encroachment

Any plants that have encroached into areas surrounding rainwater outlets, walkways, pebble vegetation barriers, gutters, etc. must be removed in order to prevent blockage or impeded drainage.

## Weeding

Any unwanted vegetation such as weeds, grass or saplings can be removed either by hand or by using a 'weed wipe'. Large areas of weeds most often occur after a wet and warm summer and do not cause any damage to the waterproofing or roof structure.

## Repairing Bare Patches

Any bare patches that remain after the removal of large weeds or grass will eventually be covered over by sedum plants. This coverage process may be accelerated by taking cuttings or small clumps of sedum and placing them on the affected area and then covered with substrate, fine sandy soil, or compost and then watered. After 3 - 4 weeks, the cuttings will become fully rooted. Works to bare patches should be undertaken during spring or late autumn, as the cuttings will not establish in extreme climatic conditions such as frost or hot sun.

## Monitoring Colour and Growth

The sedums will naturally change colour depending on the seasons and weather conditions. For example Sedum album 'coral carpet', one of the more prominent species, means that visually the plants vary in appearance from green during spring, to blushing red in the summer months.

The colour and rate of growth should be examined to determine the condition of the plants. If the plants are shrunk back and dark crimson in colour, this may indicate a lack of water or inadequate nutrition. A simple application of water and fertiliser should resolve this problem. If severe degradation has occurred, Bauder Limited should be contacted to advise on the appropriate course of action.

## Vegetation Barrier

If settlement of the vegetation barrier has occurred, then additional washed pebbles, grade 20/40 mm must be added.

## Promenade Tiles or Paving Slabs

Where promenade tiles or paving slabs have been incorporated it is important to ensure that they are still secure in their original position and are in good condition.

## Rainwater Outlets

All rainwater outlets must be free of blockage to enable water to flow freely through them. Any protective metal flashings or termination bars should still be securely fixed into place. The mastic sealant should be examined for signs of degradation and renewed where appropriate.

**For clarification on any maintenance issues please contact our Green Roof Technical Department for advice, T: +44 (0)1473 257671**

**Any alterations to the system without consultation with Bauder may invalidate the guarantee. Bauder should be advised of any amendments that need to be made to the roof so that we can provide the correct procedure for their installment, thus ensuring the guarantee will not be affected.**

# Technical Services and Approved Contractors

## Technical Services

At Bauder we pride ourselves on our complete “no obligation” service package. From our national team of Technical Managers and highly trained office based technicians, we can provide all your likely requirements, from initial design advice on waterproofing or landscaping related issues through to a detailed and comprehensive specification package, supplied in National Building Specification format (NBS). The package will include drawings and, where appropriate, thermal and condensation risk calculations that are specific to your project and dispatched with a high level of quality and efficiency, which is unrivalled within our industry.

## Approved Contractors

Bauder has always operated a policy of selecting professional roofing contractors and then training their operatives in the correct application of our systems. Site inspection of workmanship by Bauder Site Technicians ensures that high standards are both achieved and maintained.

With careful selection, we have created a network of green roof contracting companies who possess the technical expertise to install our systems and the organisational skills necessary when working on major new build construction sites. These contractors often get involved with all the landscape elements on extensive roof projects. However it is normal on intensive projects, which are more complex and specialised, for our approved installers to work in conjunction with the appointed specialist landscaping contractor to ensure correct installation sequencing.

## On-site Monitoring

In addition, inspections are carried out at key stages of the contract by our Site Technicians to satisfy the requirements of our insurance backed company guarantee.

## Specifying the Bauder Green Roof System

Specifying Bauder materials for your project could not be easier. Simply contact your local Technical Manager or our Technical Department with details of your project and leave the rest to us.

- 1 Design advice on waterproofing, planting and landscaping
- 2 Information on saturated loadings
- 3 Advice on drainage related issues
- 4 Thermal calculations
- 5 Condensation risk analysis
- 6 Detailed CAD drawings
- 7 Comprehensive project specifications.

NBSPlus



## IMPORTANT

Our specifications are written exclusively to meet the needs of each individual project. If you would like to produce your own specification it is important to note that you must gain our direct approval to ensure complete eligibility for guarantee. This includes any documentation using NBS software.

## The Bauder Green Roof Guarantee

Before we issue a guarantee, we have to be certain that the installed waterproofing and green roof build up meets our strict quality control standards. That is why we always ensure that our Approved Contractors are subject to stringent monitoring procedures throughout the installation by our Area Technical Managers and Bauder Site Technicians.

Our one-off single certificate, insurance backed company guarantee is issued as standard on all installations for up to 20 years depending on the waterproofing system specified and is not reliant on roof size or contract value. Our guarantee commits Bauder to replacing or repairing faulty waterproofing systems where water ingress is due to the failure of the waterproofing system through faulty manufacture of Bauder products or their installation through poor workmanship.

The Bauder guarantee has been designed to provide complete confidence and meet the needs of our clients. Since Bauder was founded in 1857 we have always worked in the best interests of our customers, and with this exceptional guarantee we are proud to be maintaining our reputation for excellence.

## Guarantee Criteria

**To safeguard the specifier, the installer and end client, the following criteria must be adhered to if the installation is to be covered by the guarantee. Full terms and conditions available on request.**

1. The specification for each roof to be covered must be given to the specifier, client or approved contractor in writing by Bauder Ltd.
2. Specifications and drawings prepared and issued directly by the specifier are also permitted subject to written approval from Bauder Ltd.
3. A Bauder Approved Contractor using certified operatives, who have undergone additional training particular to the relevant system, must carry out the waterproofing installation. All such operatives will be issued with Bauder ID badges and the specifier has the right to reject work carried out by any other operatives. The approved installing contractor must abide by the specification and report any anomalies or uncertain issues to Bauder Ltd, so that they can be clarified and approved. Any work not carried out in accordance with the written specification will not be covered by the guarantee.
4. Bauder Technical Staff monitoring the installation at all key stages must be granted access both during the installation and upon completion. It is only upon successful completion and approval that the guarantee will be issued.





# Bauder Waterproof Membranes

## BAUDER PLANT-E ROOT RESISTANT CAPPING SHEET



Material	Chemically treated elastomeric bitumen root barrier	
Surface	<b>Top</b> - Green slate	<b>Bottom</b> - Foil
Roll size	1 m x 5 m	
Thickness (nominal)	ca. 5 mm	
Weight (nominal)	ca. 6 kg/m <sup>2</sup>	
Reinforcement	250 g/m <sup>2</sup> spunbond polyester fleece	
Tensile Strength (EN 12311-1)	> 1000 N/50 mm	
Elongation at break (EN 12311-1)	> 40%	
Cold bending test (EN 1109)	- 36°C	
Heat stability (EN 1110)	+ 120°C	

## BAUDER G4E UNDERLAYER



Material	Elastomeric bitumen underlayer	
Surface	<b>Top</b> - Mica	<b>Bottom</b> - Foil
Roll size	1 m x 7.5 m	
Thickness (nominal)	ca. 4 mm	
Weight (nominal)	ca. 5 kg/m <sup>2</sup>	
Reinforcement	200 g/m <sup>2</sup> woven glass fleece	
Tensile Strength (EN 12311-1)	> 1200 N/50mm	
Elongation at break (EN 12311-1)	> 2%	
Cold bending test (EN 1109)	- 30°C	
Heat stability (EN 1110)	+ 110°C	

## BAUDER VB4-EXPAL VAPOUR BARRIER



Material	Elastomeric bitumen aluminium lined vapour barrier	
Surface	<b>Top</b> - Mica	<b>Bottom</b> - Foil
Roll size	1 m x 7.5 m	
Thickness (nominal)	ca. 3.5 mm	
Weight (nominal)	ca. 4.5 kg/m <sup>2</sup>	
Reinforcement	Expanding aluminium core and glass fleece	
Tensile Strength (EN 12311-1)	<b>Width</b> > 300 N/50 mm	<b>Length</b> > 400 N/50 mm
Elongation at break (EN 12311-1)	> 2%	
Cold bending test (EN 1109)	- 25°C	
Heat stability (EN 1110)	+ 70°C	

## BAUDER THERMOPLAN SV20



Material	Single ply FPO (flexible polyolefin) membrane	
Surface	<b>Top</b> - FPO (pearl white)	<b>Bottom</b> - FPO (black)
Roll size	1.5 m x 20 m	
Thickness (nominal)	ca. 2.0 mm	
Weight (nominal)	ca. 2.0 kg/m <sup>2</sup>	
Reinforcement	Pre-coated polyester fleece	
Tensile Strength (EN 12311-1)	> 1200 N/50 mm	
Elongation at break (EN 12311-1)	> 23%	
Cold bending test (EN 1109)	- 45°C	
Heat stability (EN 1110)	+ 120°C	

Please refer to the ThermoPlan Technical Manual for further information regarding specific product and construction options for this system.

# Bauder Insulation, Substrate and Sedum Blanket

## BAUDERPIR FLATBOARD INSULATION



Thicker insulation will be available once the implications of the 2005 version of Part L of the Building Regulations have become known.

Material	Laminated foam polyisocyanurate (PIR)
Board size	1200 mm x 600 mm
Standard thickness	30, 40, 50, 60, 80, 90, 100, 120 mm
Facing material	Mineralised glass fibre fleece
Density	Minimum 30 kg/m <sup>3</sup>
Lambda value (EN13165)	0.026 - 0.029 W/(mK) - dependent upon thickness
Compressive strength	min 0.10 N/mm <sup>2</sup>
Water absorption	2% Vol.
Vapour resistance	< 15 MN.s/g
Fire classification	B2 self extinguishing - DIN 4102
Hot bitumen resistance	+ 250°C

## BAUDERPIR TAPERED INSULATION



Material	Block foam polyisocyanurate (PIR)
Board size	1200 mm x 800 mm
Standard falls	1:100 1:67 1:60 1:50 1:40 1:33
Facing material	Un-faced
Density	Minimum 30 kg/m <sup>3</sup>
Lambda value (EN13165)	0.027 - 0.030 W/(mK) - dependent upon thickness
Compressive strength	min 0.10 N/mm <sup>2</sup>
Water absorption	2% Vol.
Vapour resistance	< 15 MN.s/g
Fire classification	B2 self extinguishing - DIN 4102
Hot bitumen resistance	+ 250°C

## BAUDER EXTENSIVE SUBSTRATE



Product use	Growing medium for plug planting or hydroplanting
Mineral component	Recycled crushed brick and expanded clay shale (graded)
Organic content	10% composted pine bark
Water storage	ca. 35% Vol.
Saturated weight	ca. 1200 kg/m <sup>3</sup>
pH value	6.5 - 7
Supply form	Silo, tipper, big bags or sacks

## BAUDER XERO FLOR XF301 SEDUM BLANKET



Product	Pre-cultivated vegetation blanket on a patented nylon loop and geo-textile base carrier with special substrate. The product has an integral 8 mm moisture retention fleece pre-attached to the underside.
Thickness	ca. 28 mm (excluding vegetation)
Weight	ca. 44 kg/m <sup>2</sup> (saturated condition)
Standard roll size	2 m x 1 m
Non-standard lengths	up to 10 m (cut only in increments of 1 m)
Fire classification	EXT.FAA (BS746: part 3: 1958) for complete system



# Bauder Protection, Filtration and Isolation Layers

## BAUDER FSMI 100 PROTECTION MAT



Material	Polyester and polypropylene fibre mix	
Roll size	2 m x 15 m	
Thickness (nominal)	ca. 8 mm	
Coverage	30 m <sup>2</sup>	
Weight (nominal)	ca. 1.1 kg/m <sup>2</sup>	

## BAUDER ECO-MAT PROTECTION FLEECE



Material	Recycled fleece from PES and PP regeneration	
Roll size	2 m x 30 m	
Thickness (nominal)	ca. 6 mm	
Coverage	60 m <sup>2</sup>	
Weight (nominal)	ca. 600 g/m <sup>2</sup>	
Saturated weight	ca. 4.4 kg/m <sup>2</sup>	

## BAUDER XEROFLOR XF154 MOISTURE RETENTION FLEECE



Material	Recycled fibres - 80% man-made, 20% organic	
Roll size	2 m x 25 m	
Thickness (nominal)	ca. 8 mm	
Coverage	50 m <sup>2</sup>	
Weight (nominal)	ca. 800 g/m <sup>2</sup>	
Saturated weight	5.8 kg/m <sup>2</sup>	
Water storage capacity (horizontal)	ca. 5 litres/m <sup>2</sup>	

## BAUDER FILTER FLEECE



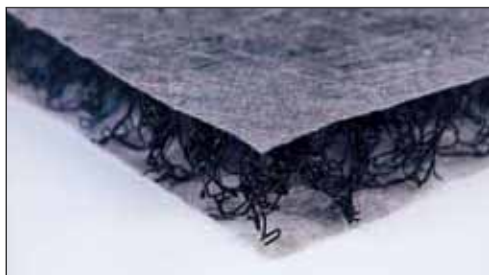
Material	Polypropylene fleece	
Roll size	1 m x 100 m	2 m x 100 m
Thickness (nominal)	ca. 1 mm	ca. 1 mm
Coverage	100 m <sup>2</sup>	200 m <sup>2</sup>
Weight (nominal)	ca. 105 g/m <sup>2</sup>	
Pore size (maximum)	ca. 0.13 mm	

## BAUDER PE FOIL SEPARATION LAYER



Material	Polyethylene foil manufactured from recycled granules	
Roll size	4 m x 50 m (folded to a 1 m width)	
Thickness (nominal)	ca. 0.2 mm	
Coverage	200 m <sup>2</sup>	
Weight (nominal)	ca. 190 g/m <sup>2</sup>	

## BAUDER SDF MAT



Material	Geo-textile facings with UV resistant woven nylon loops	
Roll size	1 m x 20 m	1 m x 50 m
Depth	20 mm	20 mm
Coverage	20 m <sup>2</sup>	50 m <sup>2</sup>
Weight	ca. 600 g/m <sup>2</sup>	
Pressure resistance	ca. 20 kN/m <sup>2</sup>	

## BAUDER PLT10



Material	High density polyethylene with geo-textile fleece	
Board size	2 m x 12.5 m	
Depth	10 mm	
Coverage	25 m <sup>2</sup>	
Weight	ca. 750 g/m <sup>2</sup>	
Lateral drainage rate under a load 30kN/m <sup>2</sup>	2% fall ca. 0.55 litres/sec/m 3% fall ca. 0.67 litres/sec/m	
Drainage rate when used vertically	ca. 4.8 litres/sec/m	
Compressive strength	ca. 400 kN/m <sup>2</sup>	

## BAUDER PLT 20



Material	High density polyethylene	
Board size	1.2 m x 2.5 m	
Depth	20 mm	
Weight	ca. 1 kg/m <sup>2</sup>	
Lateral drainage rate	ca. 10 litres/sec/m	
Vertical drainage rate	ca. 4.8 litres/sec/m	
Rate of drainage through board perforations	ca. 0.07 litres/sec/m	
Water storage capacity	ca. 5.5 litres/m <sup>2</sup>	
Compressive strength	ca. 150 kN/m <sup>2</sup>	

## BAUDER RESERVOIR BOARD



Material	Expanded polystyrene	
Board size	0.780 m x 1.283 m	
Depth	50 mm	75 mm
Weight	ca. 0.65 kg/m <sup>2</sup>	ca. 0.95 kg/m <sup>2</sup>
Water storage capacity	ca. 10 litres/m <sup>2</sup>	ca. 21.5 litres/m <sup>2</sup>
Compressive strength	ca. 35 kN/m <sup>2</sup>	

## BAUDER MINERAL DRAIN



Mineral component	Crushed brick (graded)	
Organic content	None	
Water storage capacity	ca. 15% Vol.	
Saturated weight	ca. 1150 kg/m <sup>3</sup>	
Supply form	Silo, tipper, big bags or sacks	

## BAUDER EXTENSIVE INSPECTION CHAMBER



Material	High density polyethylene
Diameter	350 mm
Height	120 mm
Weight	2.5 kg
Colour	Black

## BAUDER INSPECTION CHAMBER FOR USE AGAINST ABUTMENTS



Material	High density polyethylene
Diameter	350 mm (half round)
Height	120 mm
Weight	2 kg
Colour	Black

## BAUDER INSPECTION CHAMBER HEIGHT ADAPTER RINGS



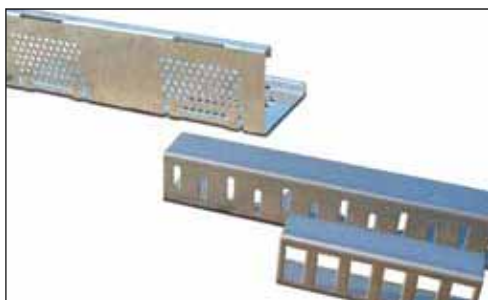
Material	High density polyethylene	
Diameter	350 mm	
Height	50 mm	100 mm
Weight	1 kg	1.5 kg
Colour	Black	

## BAUDER SEDUM BLANKET RETENTION STRIP



Description	Mechanical retention strip supplied with protective plastic cover
Material	1.2 mm stainless steel
Dimensions	H 22 mm x W 100 mm x L 800 mm
Supply form	24 per box

## BAUDER EDGE/DRAINAGE TRIMS



Type - SS40	Perforated edge/drainage trim for use with Bauder sedum blankets
Material	1.2 mm stainless steel
Dimensions	H 40 mm x W 100 mm x L 2000 mm
Supply form	10 lengths per box including connection pieces

Type AL80/100	Perforated edge/drainage trim for use with sedum blankets or substrate based extensive green roof systems
Material	1.5 mm aluminium
Dimensions	H 80 mm x W 100 mm x L 2500 mm
Supply form	Individual lengths ordered as required



# Bauder Linear Drainage System

## BAUDER KH50 (DRAIN CHANNEL AND GRILLE PLATE ONLY)



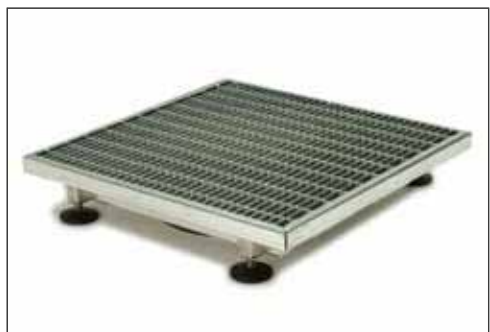
Product	Dimensions	Material
	Height x Width x Length	
Bauder KH50 channel sections supplied with grille plate	50 mm x 150 mm x 1000 mm	Channel and grille plate made from galvanised steel

## BAUDER KH60 - 90 COMPLETE UNIT WITH HEIGHT ADJUSTABLE SUPPORT LEGS



Product	Dimensions	Material
	Height x Width x Length	
Bauder KH60 - 90 channel section supplied with grille plate and height adjustable support legs	60 - 90 mm x 150 mm x 1000 mm	Channel and grille plate made from galvanised steel
Adjustment range 60 - 90 mm		Adjustable supports made from stainless steel with polyamide base

## BAUDER RAINWATER OUTLET ACCESS COVERS



Product	Dimensions	Material
	Height x Width x Length	
Bauder GA250 rainwater outlet access cover	60 - 90 mm x 250 mm x 250 mm	Channel and grille plate made from galvanised steel
Bauder GA400 rainwater access cover	60 - 90 mm x 400 mm x 400 mm	
All units supplied complete with removable grille plate and height adjustable support legs. Adjustment range 60 - 90 mm		Adjustable supports made from stainless steel with polyamide base

## BAUDER LINEAR DRAIN CHANNEL CONNECTION CLIPS



Product	Thickness	Material
Bauder channel connection clips	1 mm	Stainless steel

## BAUDER LINEAR DRAIN CHANNEL STOP END



Product	Thickness	Material
Bauder channel stop end	1 mm	Stainless steel



Bauder reserve the right to amend information and product specifications without prior notice. All reasonable care has been taken to ensure that all information is current at the time of print, however, because Bauder pursue a policy of constant development we recommend ensuring that your copy of the literature is current by contacting our Marketing Department.

Recommendations for use should be verified as to the suitability and compliance with actual requirements, specifications and any applicable laws and regulations.

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