premium products • proven solutions

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September 2010

Alumasc

ZinCo Green Roof Systems

alumasc
EXTERIOR BUILDING PRODUCTS

Contents

About Alumasc

Alumasc Exterior Building Products Ltd

Alumasc Exterior Building Products (Alumasc) is a leading supplier of premium products and systems for specification, generating an annual turnover in excess of £30 million. The Company has been a major force in the UK construction industry for over 35 years, during which time Alumasc products and systems have been used on some of Europe's most prestigious buildings.

The company is part of the Alumasc Group plc. The Group has over 800 employees, generating turnover in excess of £110 million. The aim is to focus on high quality, environmentally responsible building products within the construction arena in order to deliver first class customer service, long-term solutions and lasting relationships.

By pursuing sustainable building products, systems and manufacturing processes, Alumasc aims to offer specifiers a wide choice of design alternatives, with long-term peace of mind. Recognised brands such as Harmer, Apex, Derbigum, ZinCo, Hydrotech, Firestone and M.R., together with Alumasc's well-known architectural rainwater range have been independently certified, and in some cases have a lifespan in excess of 60 years or for the life of the building.

Alumasc brands are divided into distinct but interrelated groups:

- Rainwater
- Drainage
- Waterproofing
- Façades

Services and Support

Alumasc leads the way in the field of construction product and system manufacture and the delivery of proven solutions. This success is founded on four key areas:

Premium Products

A constantly evolving range of quality proven, world class products and systems, fully accredited to UK, European and North American Standards.

Technical Support

Comprehensive data for specification and use of all products and systems is available in published form, and on the company website. This is backed up by proactive project support, led by specialist area managers and using the latest CAD and calculation technology.

Approved Installers

Alumasc have a fully trained and monitored installation network for each specialist system to ensure correct application on site. This allows close control over all matters to ensure first class customer service.

Warranties

Alumasc products come with company backed assurance as to their quality, life expectancy and suitability for purpose, ensuring long-term peace of mind for specifiers and end users.

Quality and Sustainability

Quality: ISO 9001: 2008

Alumasc operates a quality management system which is independently audited to ISO 9001: 2008. The ISO 9001 framework governs the management of many aspects of Alumasc support services, manufacturing and transport operations. Alumasc extends quality management to its network of approved installers for single source accountability and peace of mind.

Environment: ISO 14001: 2004

Alumasc's manufacturing sites are audited to the ISO 14001:2004 Environmental Management Standard. Alumasc is committed to achieving improvements across all of its operating sites, not only as a good neighbour to the surroundings of manufacturing plants, but in the responsible sourcing of raw materials and monitoring of the impact on the environment as a whole.

BREEAM Standards

The BREEAM points system promotes the use of sustainable materials and allows designers to differentiate between products with true ecological credentials and those not achieving the benchmark.

ZinCo Green Roof systems are part of the range of high scoring Alumasc solutions. Promotion of these responsibly sourced materials brings clarity to the specification process thus achieving the desired effect of minimising the environmental impact of the construction process.

alumasc
EXTERIOR BUILDING PRODUCTS

CENTRE FOR ASSESSMENT LTD ISO 9001

BSI

Why have a Green Roof?

In the competitive world of construction every new idea or concept has to justify itself, not only environmentally but commercially.

Green Roofs are no exception and indeed offer the client a number of benefits, including contribution to BREEAM and other environmental assessment methods.

Minimises 'Heat Island' effect

Co-ordinated urban green roof development can reduce localised ambient temperatures significantly.

Improves climatic environment

Green roofs cool and humidify the surrounding air creating a microclimate which has beneficial effects within the immediate area.

Natural Biodiverse habitats for animals and plants

Green roofs encourage wildlife to remain within built up areas.

Improves life expectancy of roof

A green roof protects the waterproofing from climatic extremes, UV exposure and mechanical damage. This greatly increases the life expectancy of the waterproofing.

Recycling

Green roofs make extensive use of recycled and recyclable products, saving further valuable resources.

Reduced noise levels

Green roofs reduce reflective sound by up to 3dB and improve sound insulation by up to 8dB. This is most effective with buildings near airports, or noisy nightclubs and factories.

Reduces Carbon Emissions

The summer cooling effect of the green roof covering significantly reduces energy consumption of air-conditioning systems.

Pollution Reduction

Green roof vegetation helps to filter out dust and smog particles. Nitrates and other harmful materials are absorbed out of the air and rainfall and bound within the soil.

Use of space

Converting or designing normally unused roof areas into green roofs, particularly for recreational or sporting use not only makes use of expensive space, but saves the costs of purchasing additional land. Green roofs often assist in gaining planning consent.

Stormwater Management

Depending on the green roof design, the immediate water run-off can be reduced by up to 90%, greatly reducing drainage flow rates. This enables the rainwater management system to be reduced in capacity, thereby greatly reducing construction costs.

Replicating Nature on Roofs

When designing and installing a green roof it is important to provide a growing environment as close as possible to the plant's natural environment. The most important factor is to compensate for the lack of sub-soil.

ZinCo systems have the structure to retain the necessary quantities of water to support the plants, whilst draining off the excess. The required amount of water is determined by the plant type, geographical region and the roof itself.

Apart from creating the correct green roof system to support the plants, it is very important to protect the waterproofing from both mechanical damage and attack from plant roots.

ZinCo systems provide a number of solutions to these problems. ZinCo green roof systems have been designed to function naturally, even though there is no direct contact with the ground and the roof build-up is normally not very deep. Nevertheless, the plants receive a stable environment without adversely affecting the waterproofing.

The Answer is in the Technology

Alumasc ZinCo green roof systems embrace leading edge technologies in the four key elements that combine to ensure successful green roofs:

- Horticultural expertise
- Rainwater management
- Engineered drainage
- High performance waterproofing

Fig 1: Typical natural soil build-up

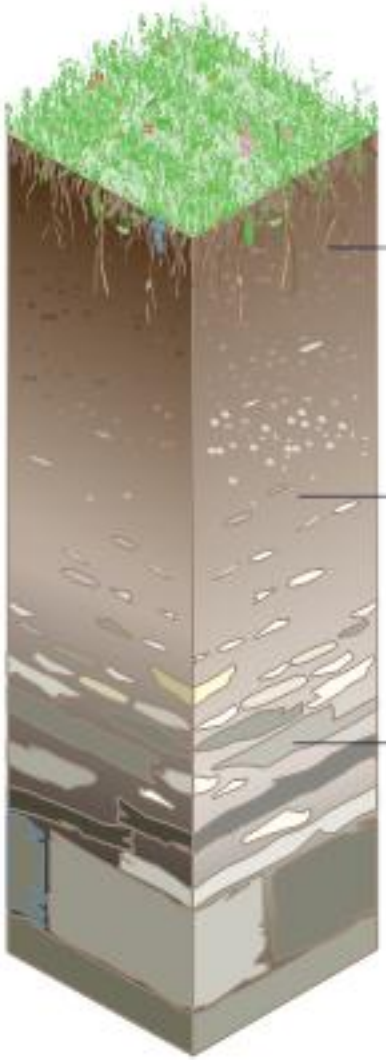
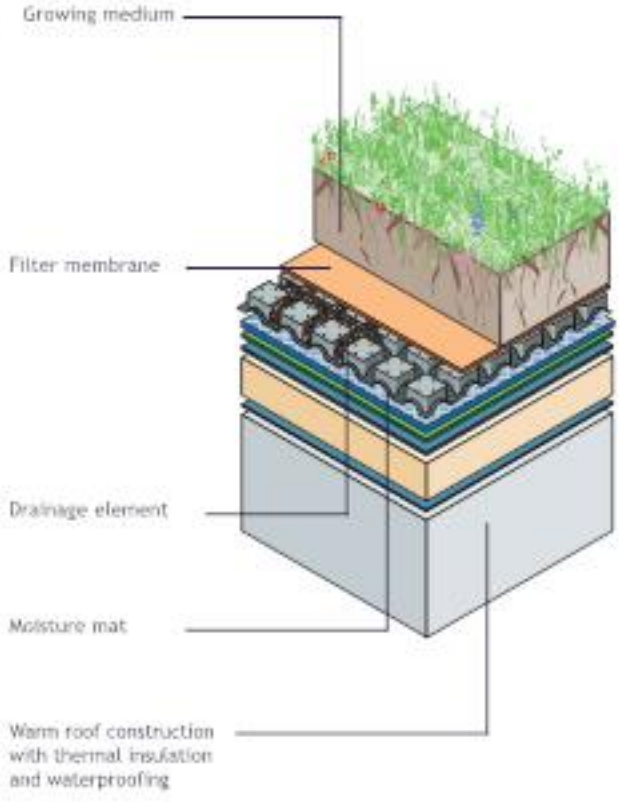


Fig 2: Alumasc green roof build-up



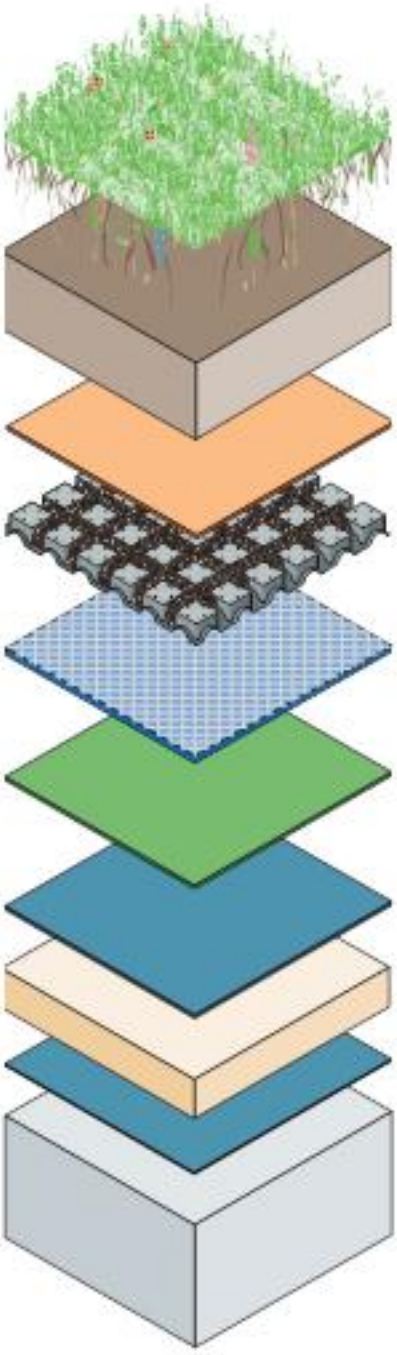
The Build-up of a Green Roof

The range of ZinCo systems ensures that the right build-up can be provided to meet the requirements of any landscape option, including:

- Extensive and intensive landscapes
- Sloping and flat roofs
- Ponds, paving and play areas
- Vehicle access onto the roof
- Landscaping with additional thermal insulation

At the heart of the ZinCo green roof system is one of the patented drainage elements (Floradrain®, Floratherm® or Floraset) with its systems of channels on the underside, ensuring drainage of water, even with dense root growth. The profiled troughs in the drainage elements retain water, even on a sloping roof, and have strategically placed holes to ensure the roots receive the necessary aeration and allow the water to diffuse.

Fig 3: Elements of a ZinCo Green Roof



Carefully selected plants - for extensive, low maintenance landscaping, suitable plants include mainly drought resistant, self-regenerating sedum and rockery varieties. Plants for intensive landscaping such as roof gardens can be supplied by garden centres and nurseries.

Growing medium - must have a well balanced structure and low weight. The pH values, nutrients, degree of porosity and vapour permeability must be suitable. The type and thickness of the substrate ultimately determine the plant growth as well as the structural load imposed on the roof structure. The growing medium should be independent of and in addition to any plant/sedum vegetation mats.

Filter membrane - to prevent fine particles being washed out of the substrate and therefore maintaining the efficiency of the drainage layer.

Drainage element - retains water in the profiled troughs, even on sloping roofs. Excess water drains away through the channels between the troughs. Strategically located holes provide the necessary aeration and ensure that moisture from the moisture mat diffuses up through the planting soil.

Moisture mat - made of non-rotting fibre to retain moisture and nutrients as well as providing mechanical protection to the root barrier and waterproof membrane. Not required in inverted roof assemblies.

Root barrier - prevents roots from affecting the waterproofing. The type, thickness and method of installation depend on the nature of the landscape planned and the shape and slope of the roof. Not required over root resistant membranes.

Waterproof membrane - Alumasc recommend the use of Derbigum or Hydrotech as the waterproofing membrane under green roofs due to their extreme durability and longevity.

Thermal insulation - situated below the waterproof membrane to form a warm roof construction. Inverted roof assemblies may also be accommodated, especially where Hydrotech is the waterproof membrane.

Vapour control - layer situated between the structural deck and insulation to prevent the formation of condensation.

Structural roof deck - must be designed to support the weight of the green roof and any live loads.

Types of Green Roof

There are two basic types of green roof, extensive and intensive, with a number of variations making four green roof types.


Extensive

Extensive Green Roofs

Lightweight with a relatively shallow substrate, providing a colourful carpet of planting comprising sedum and hardy plants. Requiring minimal maintenance and no irrigation, extensive green roofs provide a 'back to nature' look and offer strong ecological benefits. They are not normally designed to provide access for leisure use.

Biodiverse Green Roofs

These are a form of extensive green roof where the substrate is laid down and then planted with vegetation that is suitable for the local environment.


Biodiverse

Semi-intensive Green Roofs

Provide a more varied landscape that can include shrubs and woody plants - but still with a low build-up. Limited but scheduled maintenance and irrigation are required. With semi-intensive green roofs, ecological benefits are combined with access for recreational use.

Intensive Green Roofs

Offering the benefits of a small urban park, providing a rich habitat for wildlife as well as recreational access for people. Intensive green roofs have a deep substrate which can support a range of plants, trees and shrubs. Regular maintenance is required.


Semi-intensive


Intensive

Typical Green Roof Build-ups

Fig 4: Extensive - Metal deck warm roof

Extensive

With ZinCo green roof systems extensive roofs are versatile and economic. Only a shallow substrate depth is required, typically 50-150mm. Extensive roofs are suitable for large areas, are easy to install and lightweight. Some Floradrain systems weigh as little as 65kg/m², making it possible for inverted ballasted roofs to be brought to life by replacing all or part of the ballast with extensive landscaping. Extensive roofs support a self sustaining plant community, do not require irrigation and are low maintenance.

Ideal for: Lightweight roof decks, inaccessible roofs, flat or sloping roofs, and for reducing water run-off.

Planting: Mosses, sedums, herbs and grasses (see page 24 for suitable plants).

Fig 5: Biodiverse green roof

Biodiverse

ZinCo systems are also ideal for a form of extensive roof known as a biodiverse green roof. This requirement is most commonly met by a low-nutrition substrate and a vegetation mix suited to the area, selected to attract aphids and other invertebrates to encourage biodiversity (see page 24 for suitable plants). There is usually no requirement for irrigation and access is for maintenance only. As a form of extensive green roof, biodiverse roofs require only a shallow substrate depth.

The increasing use of extensive and biodiverse roofs in cities significantly reduces risk of flooding, as 50-90% of rainfall is retained in the green roof system, from which it evaporates slowly. This natural evaporation from the substrate cools the air and reduces dirt and smog levels.

Fig 6: Semi-intensive green roof

Semi-intensive

Semi-intensive roofs require a greater - though not substantial - substrate build-up than extensive roofs, sufficient to support a more varied range of plants and large shrubs. Build-up height is typically 100-200mm. A wide range of plants can be supported, requiring only periodic irrigation and maintenance. Semi-intensive roofs are suitable for recreational use and can include paving and patios.

Ideal for: Roofs that are visible and need all-year-round colour, accessible roofs, flat roofs, and for reducing water run-off.

Planting: Grasses, herbs, shrubs, woody plants, lawn/turf grass (see page 24 for suitable plants).

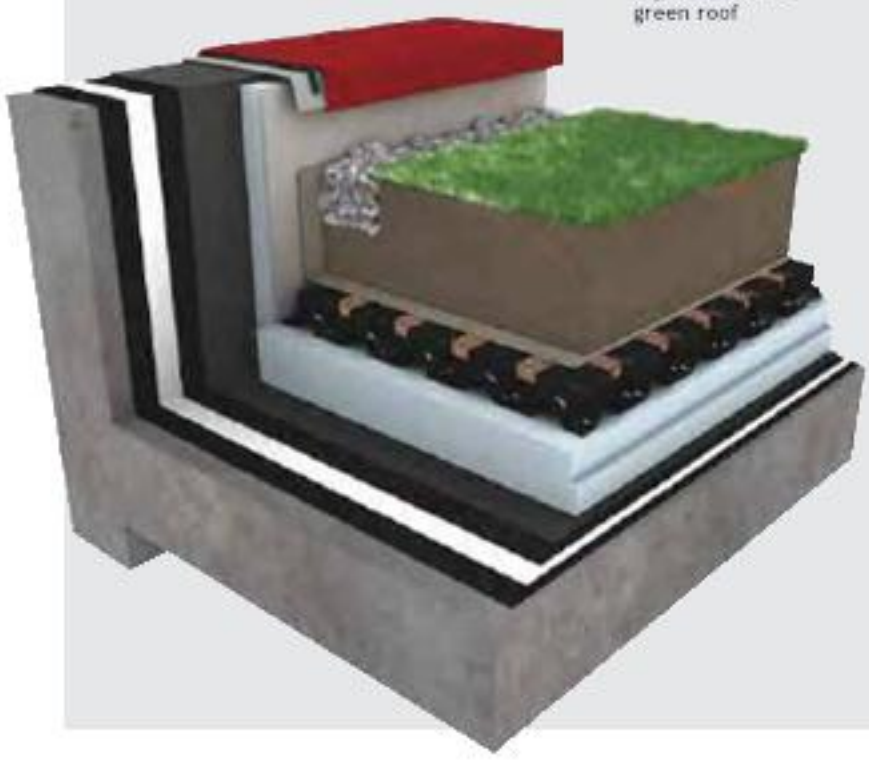


Fig 7: Intensive green roof

Intensive

Landscaping variety is virtually limitless with ZinCo intensive roofs. The substrate will contain a great deal more organic matter than its extensive counterpart to support a wide variety of plants and trees. Substrate depth can range from 150-1500mm. Intensive roofs are often indistinguishable from natural gardens, requiring regular irrigation and maintenance. They usually consist of a mixture of hard and soft landscaping, and the greater substrate depth provides particularly good insulation properties.

Ideal for: Natural gardens, recreational and sports use, growing food.

Planting: Lawn, shrubs, edible plants, perennials and grasses, small deciduous trees and conifers (see page 25 for suitable plants).

The Control of Water in a Green Roof

Water Storage

Providing moisture to the roots is essential to maintain good healthy plants on a green roof.

Much of the moisture is supplied by natural rainfall, which is collected and stored by the layers in a ZinCo green roof.

The drainage layer plays an essential part in storing rainwater that filters through the growing medium. Once the troughs in the drainage layer are full, excess water overflows, to be soaked up by the moisture mat. Only water that cannot be absorbed by the moisture mat drains from the roof down the roof outlets.

In dry periods, stored water gradually diffuses up into the growing medium for uptake by the plant's roots.

Rainwater Harvesting

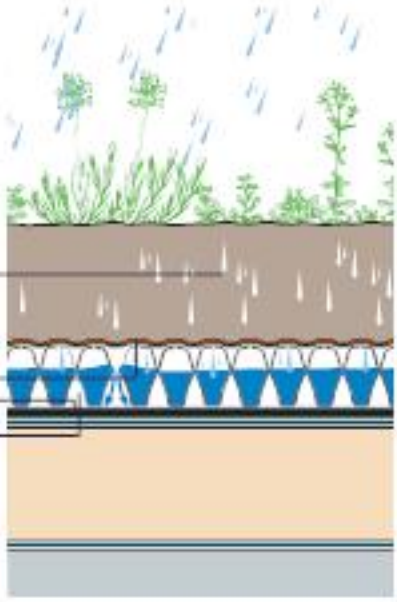
Excess rainwater run-off can be collected by rainwater diverters, and used for non-potable purposes such as lavatory flushing (which represents approximately 60% of total water consumption in a typical commercial office environment), and landscape irrigation.

Any water which is not collected is treated as surface water run-off.

Irrigation

There should always be easy access to a water point for irrigation purposes, especially for intensive roof gardens. An automatic system is the ideal solution as it provides a constant water supply. The ZinCo Sub Landscape Irrigation system is simple and reduces the water lost through evaporation which occurs during surface applied irrigation by up to 30%. See page 48 for further details.

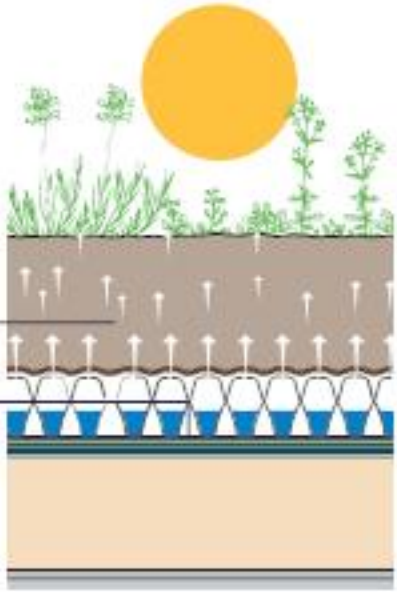
Fig 8: How a green roof stores water



1. The intensive/extensive substrate is highly porous, storing up to 3 litres/m² per 10mm depth of substrate.
2. Once the substrate is saturated, the excess water filters into the drainage layer and over into the moisture mat below.
3. The profiles of the drainage layer permits excess water to drain in any direction to the outlets.

Typically, green roofs will store between 50 and 90% of rainfall.

Fig 9: How a green roof releases moisture



1. As the substrate dries out through plant usage and evaporation the water stored in the drainage layer diffuses up into the substrate.
2. Once the drainage layer has run dry the moisture mat releases its moisture through diffusion up through holes in the top of the drainage layer.

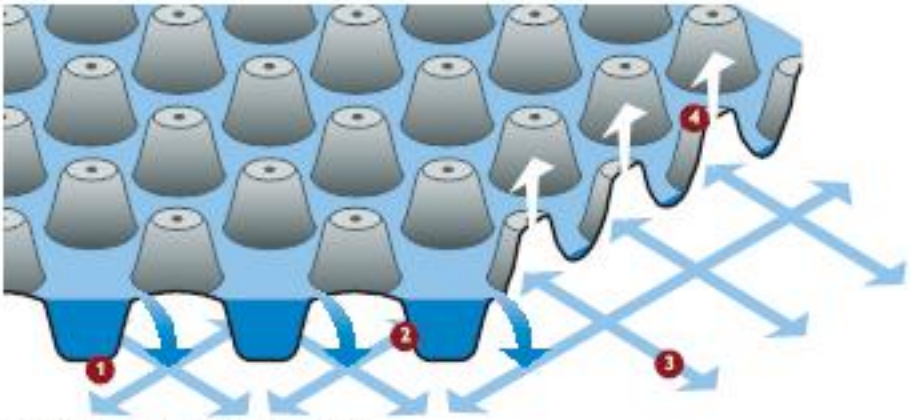


Fig 10: Floradrain® drainage element

1. A close up of a Floradrain® unit clearly shows how rainwater percolating through the growing medium is stored.
2. When the water level in the drainage tray is replenished, excess water flows over the edge of the trays.
3. The overflow water is absorbed by the moisture mat. Any unabsorbed water can flow easily to the roof outlets through the channels formed under the drainage layer.
4. The holes in the drainage layer allow water from the moisture mat below the layer to diffuse up into the growing medium, helping to keep it moist.

Jacobs Island, London

Gallie Craig Visitor Centre, Mull of Galloway

Alumasc ZinCo Green Roofs: A Proven Track Record

Alumasc has consolidated the very best in green roof technology through a combination of three tried and tested world class products:

ZinCo - the European market leader in green roof technology, with an international track record, ZinCo is closely associated with FLL (Forschungsgeselischaft Landschaftsentwicklung Landschaftsbau) the German-based Landscape Development Research Society, which is the recognised European voice for green roof standards. ZinCo and Alumasc are fully committed to these standards on all contracts, and also have links with the international green roof body, IGRA.

Hydrotech - monolithic waterproofing for concrete structures, BBA certified to perform for the lifetime of the building.

Derbigum - high performance waterproofing for general purpose use, recipient of the FRA (Flat Roofing Association) Product Excellence Award 2004 and BBA certified for a 30-year lifespan.

Premium Green Roof Systems

Premium IGRA award winning systems from Alumasc represent the ultimate green roof solution.

For the specifier

A fully integrated system - everything from choice of waterproofing to a complete range of options for planted landscape.

Moorgate Crofts, Rotherham

Mendip Green Primary School

Maths Faculty, Cambridge University

For the landscape gardener

Comprehensive technical support on all aspects of the green roof from initial choice of system to detailed plant and garden planning.

For the building client

The technical superiority of ZinCo ensures the best possible combination of direct benefits and environmental payback over the life of the building.

For the main contractor

A fully thought-out system, technically and logistically, which harmonises with the overall construction process.

For the quantity surveyor

Experience and knowledge in green roof projects ensures cost effective use of materials and fast installation time.

St Martins in the Field School, London

Bishop's Square, Bishopsgate, London

A track record that speaks for itself - reflected by the fact that international architects have consistently chosen premium green roof solutions from Alumasc above all others. The selection of prestige projects below is an eloquent testimony of the consistent long term performance of Alumasc green roofs.

Table 1: Completed Alumasc green roof projects include:

Projects	Date	Size (m^2)	Architect	Main Contractor
Rank Xerox Data Centre, Micheldene	1992	3500	HLM Architects, Twickenham	Wates Integra
Chaucer Street Car Park, Nottingham	1993	2500	James McArtney, Nottingham	Wimpey
Holmebridge Water Treatment Works	1994	6000	Jones Stock Partners, Leeds	Birse
No.1 Poultry, London	1996	900	Michael Wilford, London	Laing Construction
Museum of Scotland, Edinburgh	1996	4000	Benson & Forsyth, London	Laing Scotland & Bovis
Jacobs Island, London	1997	3500	Broadway Malyan	Berkeley Homes
Eden Project, St Austell	2000	450	Nicholas Grimshaw	Robert McAlpine
Polygon Hotel Development, Southampton	2000	1800	Morgan Cam Partnership	Barratt Homes
Golf Hotel, St. Andrew's	2000	6000	Parr Partnership	HBG
Merrill Lynch European HQ, London	2002	10000	Swanke Hayden Connel	MACE Ltd
New Providence Wharf, London	2002	8000	Skidmore, Owings & Merrill	Ballymore
Royal Artillery & Gunnery Quays, London	2002	8000	RMA Architects	Barratt Homes
BMW/Rolls Royce, Chichester	2002	40000	Nicholas Grimshaw	BMW
St Martins in the Field School, London	2004	1300	Lyle & Winter	William Verry Ltd
Genome Institute, Cambridge	2004	5000	NBBJ Architects	MACE Ltd
Moorgate Crofts, Rotherham	2005	800	Rotherham MBC	Hall Construction
Woolwich Arsenal, London	2005	5000	Broadway Malyan	Berkeley Homes
Bishop's Square, Bishopsgate, London	2005	3000	Foster and Partners	Sir Robert McAlpine
Oncology Unit, Belfast City Hospital	2005	4000	Ferguson McIlveen	Graham Martin Joint Venture
North Harringay Primary School, London	2005	500	London Community Herbalists	Tilbury Contracts Ltd
Ness Botanic Gardens, Wirral	2005	500	Cass Associates	John Turner & Sons
Royal Bank of Scotland HQ, Edinburgh	2006	1500	RHWL Partnership	MACE Ltd
Gallie Craig Visitor Centre, Mull of Galloway	2006	150	I B MacFadzean	Harvey & Angela Sloan
Scottish Natural Heritage HQ, Inverness	2006	1000	Keppie Design	Robertson Construction
Howlands Farm, University of Durham	2006	2000	Gotch Saunders & Surridge	Laing O'Rourke
City Council Offices, Edinburgh	2006	6000	BDP Glasgow	Miller Construction
The Heart, Walton-on-Thames, Surrey	2007	25000	EPR Architects	O&H Properties
Beacon South, Dublin	2007	11000	Trayner O'Toole	John Paul Hegarty
Plot 4100 Thorpe Park, Leeds	2007	800	Rio Architects	GMI Construction
Portstewart Strand Visitor Centre	2008	400	Donnelly O'Neill	David Patton & Sons
Rockliffe Park, Darlington	2009	1600	Browne Smith Baker	Shepherd Construction
River Quarter, Sunderland	2009	850	Napper Architects	Everlast Waterproofing
Bakers Court, Belfast	2009	2000	RPP Architects	Graham Construction
Midlands Co-op, Oakham	2010	3500	KPW Architects	The Tomlinson Group

International Projects	Date	Size (m^2)	Architect
United Bank of Switzerland, Basel	1990	1300	Buckhart & Partners
Potsdamer Platz, Berlin	1998	48000	Kruger & Mohrle
Siemens AG, Düsseldorf	1998	600	Gartenhof Küsters GmbH, Neuss
Greenwich Academy, Connecticut, USA	2003	1700	Skidmore, Owings & Merrill
Banco de Santander HQ, Spain	2003/5	100000	Foster & Partners
Subaru Hub, Singapore	2005	1300	Ong & Ong

Green Roof Gallery

Rockliffe Hall Clubhouse, Durham

Ness Botanic Gardens, Wirral

Bishop's Square, London

The Heart Development, Walton-on-Thames

Moorgate Crofts, Rotherham

No.1 Poultry, London

BMW/Rolls Royce, Chichester

Bakers Court, Belfast

Woolwich Arsenal, London

Council Offices, Edinburgh

New Providence Wharf, London

Howlands Farm, Durham University

The River Quarter, Sunderland

Total Green Roof Project Support

Alumasc provides a fully comprehensive package of advice and management backup - covering all stages of a project, site installation through to warranties and maintenance schedules. The Alumasc Green Roof Manager responsible for a specific project will lead and manage the support process.

Technical Support

At the start of a refurbishment project a fully detailed project report is prepared, to include:

- Evaluation of the general condition of a roof, based on visual field investigations and including, for example, core samples, pull-out tests, condensation analysis
- Budget costs via approved contractors

Alumasc's technical teams are fully briefed on the latest in roof technology, good practice, standards, regulations, etc. Available technical support is comprehensive and highly expert and covers:

- Thermal calculations
- Wind loading calculations
- Detailed written specification (to NBS format if required)
- Project specific CAD working drawings
- Material safety data sheets
- Health and safety guidance for maintenance and inspection of a green roof.

Specialist Installers

Alumasc provides a network of carefully approved selected installation specialists, all of whom have received instruction in the installation techniques for ZinCo green roof systems and whose project performance is rigorously monitored in respect of:

- Compliance with project specifications
- Compliance with project programmes
- General compliance with good working practice on site.

Project Monitoring

All Alumasc green roof projects are rigorously monitored throughout all stages:

- Regular site visits during the project to provide technical support
- A final inspection of work to ensure warranty compliance
- Ensuring that appropriate recommendations are made for a maintenance regime that fulfils the client's needs and to ensure the requirements of the warranty are fulfilled.

Alumasc Warranties

Alumasc offers a comprehensive choice of warranties covering both products and installation. Alumasc backed warranties are available for 10, 15 or 25 years, supported by public and product liability insurances with a total indemnity limit of £50 million on an annually renewable basis.

Alumasc Quality Assurance

Alumasc Exterior Building Products Ltd has a quality assurance management system which complies with BS EN ISO 9001:2000 and has also implemented an environmental management system to ISO 14001.

Alumasc Partnering

Alumasc's long established service ethic fits well with the company's commitment to partnering throughout the construction process. This teamwork approach ensures that all partners share in the rewards of improved efficiency and provides better value to the client. This brings considerable peace of mind to clients, particularly during long term contracts, and confidence in high levels of service and product quality.

Complementary Systems

Alumasc Green Roofs embody a range of complementary product and systems to bring faultless performance every time. Such complementary products and systems include Derbigum high performance sheet waterproofing, Hydrotech monolithic liquid-applied waterproofing and Armaseam metal roof systems.

Green Roof Design Considerations

Warm, Cold or Inverted Build-up

It is possible to design a green roof system to suit a warm, cold or inverted build-up. The green roof principles vary only slightly, dependant upon position of the insulation within the overall build-up.

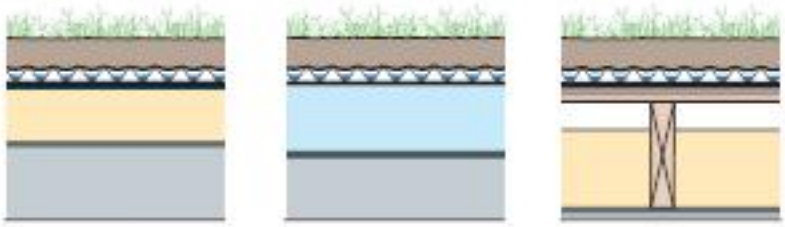
Membrane Selection

Alumasc recommend the use of either Derbigum or Hydrotech as the waterproofing membrane for a green roof. Both systems have a proven record of high performance and longevity.

Insulation

The substrate element of a green roof does have thermal insulation value, but as this varies with the moisture content it should not be taken into account when calculating the U-value requirement on the roof structure.

Fig 11: Roof types



Warm roof - waterproof membrane above insulation

Inverted roof - insulation above waterproof membrane

Cold roof - cross ventilation above insulation

However, the substrate will significantly help to insulate against sound, such as over flying aircraft.

Roof Falls/Pitch

As a rule, flat roofs should be laid to falls of at least 1:60.

With its shallow drainage layer and substrate this is particularly important when designing extensive green roofs (which must have a minimum 1:60 fall) as any deflection in the deck allowing water to pond above the drainage layer will be harmful to the plants.

However, green roofs can be installed on roof decks with zero degree falls, for instance when using Alumasc's unique ZinCo irrigation system, provided that the correct build-up is designed to avoid the danger of drowning the plants.

Designing a green roof for a sloping roof up to 25° is fairly simple, using the Floraset drainage system.

Slopes over 20° require special design to ensure the system remains stable on the roof.

Inverted Green Roof

The characteristic of an inverted roof is that the insulation is above the waterproofing. Extruded polystyrene insulation is used for inverted roofs because it is impervious to water.

However, the insulation is not impervious to water vapour. It is therefore essential to avoid forming a vapour barrier directly above it when installing a green roof.

The following must be taken into account when designing an inverted green roof:

- If a root barrier is required, it must be placed below the insulation
- The weight of the substrate must be adequate to prevent wind uplift and flotation
- It is not possible to use the roof dam irrigation system
- Water can be stored in the Floradrain® layer without affecting aeration or vapour pressure

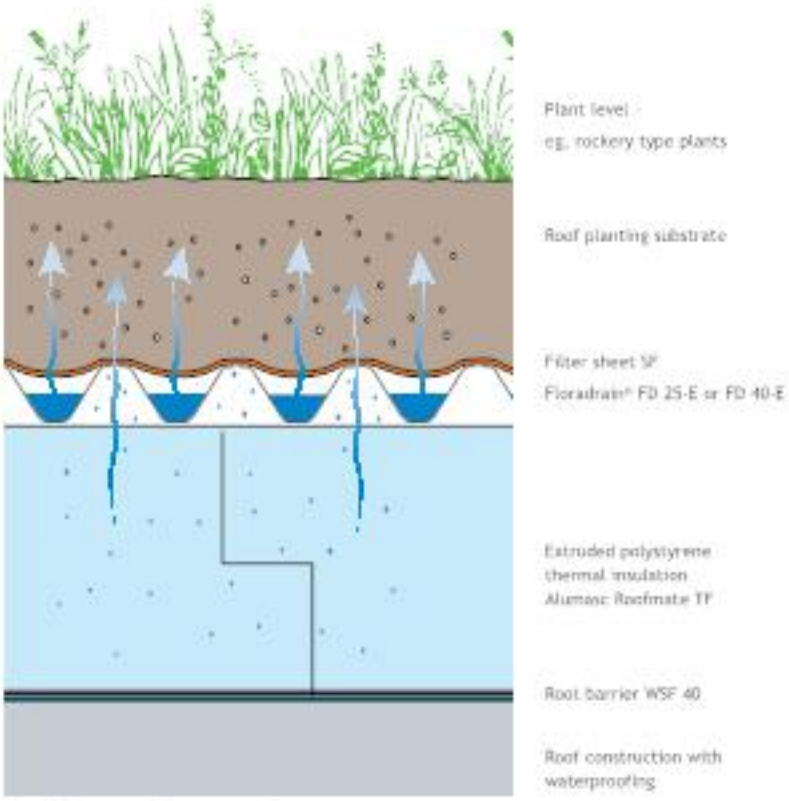


Fig 12: Inverted green roof

Roof Drainage

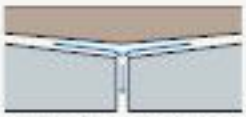
Landscaped roofs retain a high proportion of the rainwater that falls on the roof which therefore reduces the strain imposed on the surface water drainage systems.

However, there is always excess water that needs to be drained by means of:

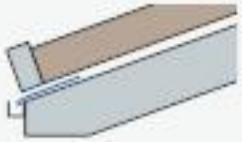
- roof outlets
- box or eaves gutters
- water spouts

As a safety precaution there should be at least two outlets, or one outlet and an overflow. The outlets must be kept clear of vegetation by installing inspection chambers over them. In the case of terraced areas, a terrace grill can be installed over the outlet.

Extensive roofs



Provide falls of 1:60 to 1:40



Slopes from 20° to 30° need extra sheer protection

Intensive roofs

Provide falls of 1:80 to 1:40

Roofs should be completely flat where a roof dam is being used

Fig 13: Roof types - drainage

Roof Penetrations

Roof penetrations for pipes, equipment, rooflights, etc. are best concentrated in one area whenever possible. This helps by simplifying waterproofing details and ensures unbroken areas for the plants.

Safety

Safety considerations are paramount and maintenance operations must be considered at the design stage. Appropriate access, anchorage points, safety rails and barriers must be provided, bearing in mind both the general use of the roof and anticipated maintenance operations.

The Alumasc Rainwater Design Service

Alumasc Technical Services can calculate the number and size of outlets needed to drain a green roof. Using dedicated software in conjunction with the requirements of BS EN 12056:2000, the software checks the capacity of downpipes used and suggests a minimum size.

The software takes into account:

- area of green roof and any other roofs discharging onto the green roof
- local rainfall intensity
- building life and safety factor
- frequency and size of outlets and downpipes

For information, the table below lists the run-off coefficient ψ which is the proportion of rainwater that drains from a green roof into the surface water drainage system for roofs with a pitch below 5%.

Table 2

System	Substrate depth	Plant type	Water retention (%)	Water run-off coefficient (ψ)
Extensive	20 - 40	Moss, sedum	40	0.60
	>40 - 60	Sedum, moss	45	0.55
	>60 - 100	Sedum, moss, herbs	50	0.50
	>100 - 150	Sedum, herbs, grasses	55	0.45
	>150 - 200	Grasses, herbs	60	0.40
Intensive	150 - 250	Lawn, perennials, woody plants	60	0.40
	>250 - 500	Lawn, shrubs, bushes	70	0.30
	>500	Lawn, shrubs, bushes, trees	>90	0.10

Upstand and Perimeter Details

The same waterproofing principles apply to green roofs as to conventional flat roofs. Waterproofing should be taken up a minimum 150mm above the finished surface. In the case of green roofs, this means the substrate, paving surface etc.

In front of doors the upstand height can be reduced to 50mm if a linear drainage grille is installed.

It is strongly recommended to provide vegetation barriers at all vulnerable points to prevent possible damage by plants. This includes the roof perimeter, all upstands, abutments and roof protrusions such as rooflights and inspection chambers. Strips of 16-32mm grade pebbles, 300 - 500mm wide are normally used for this purpose.

Protection Against Wind Uplift

Green roofs have to be designed to remain stable in high wind uplift conditions. Wind pressure varies over a roof area - from fairly low pressure in the centre, where even a thin layer of substrate is adequate ballast, to the perimeter and corners of the roof where wind uplift is such that coarse gravel or even concrete paving slabs may be needed to prevent wind uplift.

Green Roof Design Considerations

The higher the building, the greater the risk of wind uplift.

There is usually no problem if the waterproofing system is bonded or mechanically fixed. However, where the waterproof membrane is loose laid, or the insulation is placed above the waterproof membrane, as in an inverted roof, the green roof will be acting as the ballast.

In wind exposed locations and in the case of sloping roofs, it is essential to protect the substrate layer from erosion until there is close plant cover.

Fire Prevention

Intensive green roofs that are irrigated regularly and have relatively deep substrate are accepted as fire resistant to flying sparks and radiant heat.

Extensive green roofs, which are generally not irrigated are accepted as fire resistant provided that:

- The substrate is at least 30mm deep and contains no more than 20%, by weight, of organic material
- There are gravel or concrete fire breaks in the vegetation every 40m, with a minimum width of 1m or a height of 300mm
- There are gravel strips around all roof penetrations (eg rooflights) and in front of walls with openings
- In the course of annual maintenance the safety strips must be kept free of flammable vegetation

Structural Requirements

The following issues should be considered at the design stage:

- The height, size and maximum loadbearing capacity of the roof structure
- Type of roof structure, number and position of drainage outlets and any roof penetrations
- Location of building and access availability
- Transport and storage availability, water and electricity supplies

The superimposed loads resulting from a landscaped roof must be taken into account when calculating the structural load.

For roofs with an existing gravel or concrete paved surfaces, it is possible to install an extensive green roof system with the same or a smaller area load.

Experience has shown that on roofs with a limited loadbearing capacity there are areas where it is possible to have a deeper layer or a mound of substrate, such as above a structural column.

In such areas, it is possible to plant taller shrubs or small trees, thereby increasing the design possibilities. Any additional weight must, of course, be allowed for.

Substrate lement

In order to allow for natural settlement of the substrate over time, a settlement factor must be allowed when calculating the required volume, by adding the following percentages to the estimated cubic volume

Table 4: Settlement factors

Substrate Type	Add
Zincolit	8%
Sedum Carpet	12%
Rockery Type	20%
Heather with Lavender	25%
Roof Garden	30%
Cranberry Bog	30%

eg, for 1000m² of 70mm Sedum Carpet substrate, order 1000 x 0.07 + 12% = 78.6m³

Table 3: Design loads on a green roof

Layers		Build-up height mm	Weight per unit area dry kg/m²	Weight per unit area saturated kg/m²
Protection layer				
Root barrier with protection mat		10	1.0	5.0
Drainage layer				
Floradrain®	FD 25	25	1.5	4.5
	FD 40	40	2.0	6.0
	FD 60 filled with Zincolit	60	6.0	37.0
Floraset	FS 50	50	0.7	2.7
	FS 75	75	2.0	4.0
Elastodrain	EL 200/EL 202	20	14.0/18.0	14.0/18.0
Substrate layer (for every 10mm depth)				
Zincolit			12.5	14.0
Sedum Carpet Substrate			10.0	12.5
Rockery Type Substrate			10.0	13.5
Heather with Lavender Substrate			9.5	13.5
Roof Garden Substrate			9.5	14.0
Cranberry Bog Substrate			7.0	12.0
Plant level				
Sedum, small shrubs and lawn			approx. 5.0	
Shrubs and low bushes			approx. 10.0	
Shrubs and bushes up to approx. 1.5m high			approx. 20.0	
Bushes up to approx. 3.0m high			approx. 30.0	
Large bushes and trees cause a greater concentrated load due to the additional tipping movement under wind pressure.			individual values must be given	
Examples				
Gravel surface			approx. 90-150	
Paving slabs			approx. 160-220	
Vehicle surface			from approx. 500	
Extensive landscaping			approx. 60-150	
Intensive landscaping			approx. 200-500	

What kind of Vegetation?

'Ecological protection layer' or 'Garden roof'?

Basically there are three categories of green roof system:

Extensive/Biodiverse

- Minimal maintenance required
- No irrigation requirement
- Landscape of:
  - Moss + sedum
  - Sedum + moss + herbs
  - Sedum + grasses + herbs
  - Grasses + herbs
- Extensive substrate
- Build-up height 50-150mm

Semi-intensive

- Periodic maintenance
- Periodic irrigation
- Landscape of:
  - Grass + herbs
  - Shrubs + woody plants
  - Woody plants
- Semi-intensive substrate
- Build-up height 100-200mm

Intensive

- Regular maintenance
- Regular irrigation
- Landscape of:
  - Lawn
  - Hedges
  - Bushes
  - Large bushes
  - Trees
- Intensive substrate
- Build-up height 150-1500mm

Fig 14: Extensive/Biodiverse

Where access is not required an extensive green roof is ideal. It imposes minimum weight so can be installed on almost any roof deck. Extensive green roofs are ideal on large industrial structures where, apart from being attractive protection to the waterproofing, they also significantly reduce water run-off and thus lessen the risk of flooding.

Fig 15: Semi-intensive

Where the roof is visible and all year round colour is needed with minimum maintenance, then a semi-intensive green roof is the ideal solution. Compared with the extensive roof, the semi-intensive roof has greater water retention capacity and an increased depth of substrate which allows a wider range of plants to be chosen.

For access purposes, patios, paving and dwarf walls are often included in this type of design.

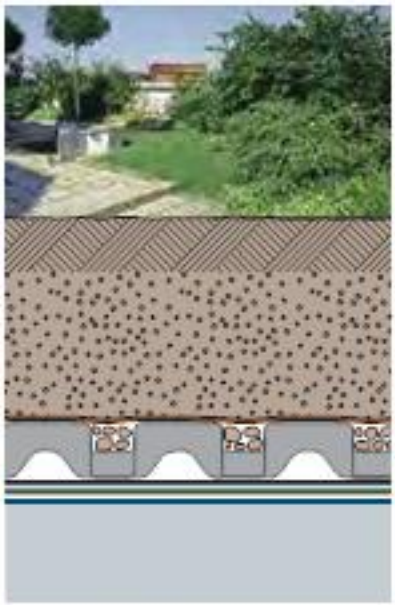


Fig 16: Intensive

Virtually any type of 'garden' landscape can be created using the ZinCo intensive green roof design. Lawns, water features, large shrubs and semi-mature trees are all possible.

The type of planting and its ultimate size will determine the depth of substrate that is needed and type of irrigation system necessary.

The maintenance regime will also depend on the species of plant installed.

Green Roof Substrates

The substrate is an integral part of a green roof system. The correct structure and mix of the substrate is vital to the long term health of the plants specified.

The substrate should provide:

- Good aeration to the plant roots even when saturated
- Compaction resistance to provide and retain good drainage within the substrate
- Good water retention
- Slow release of nutrients
- Good anchorage for the plants to resist wind and water erosion

In addition the substrate should be delivered free of weeds, diseases, pests and in the case of extensive substrate be fire retardant to DIN 4102. The mix and structure of the substrate will depend on the plants specified and their ratio requirement for water retention, aeration and nutrients.

Substrate Depth

The depth of substrate will generally control the plant type and growth. Alumasc are able to supply a system to support any proposed landscape. From a sedum carpet on a 50mm depth of substrate to one with more than a metre to support trees. The diagram below illustrates the Elastodrain system (as an example) beneath different landscapes.

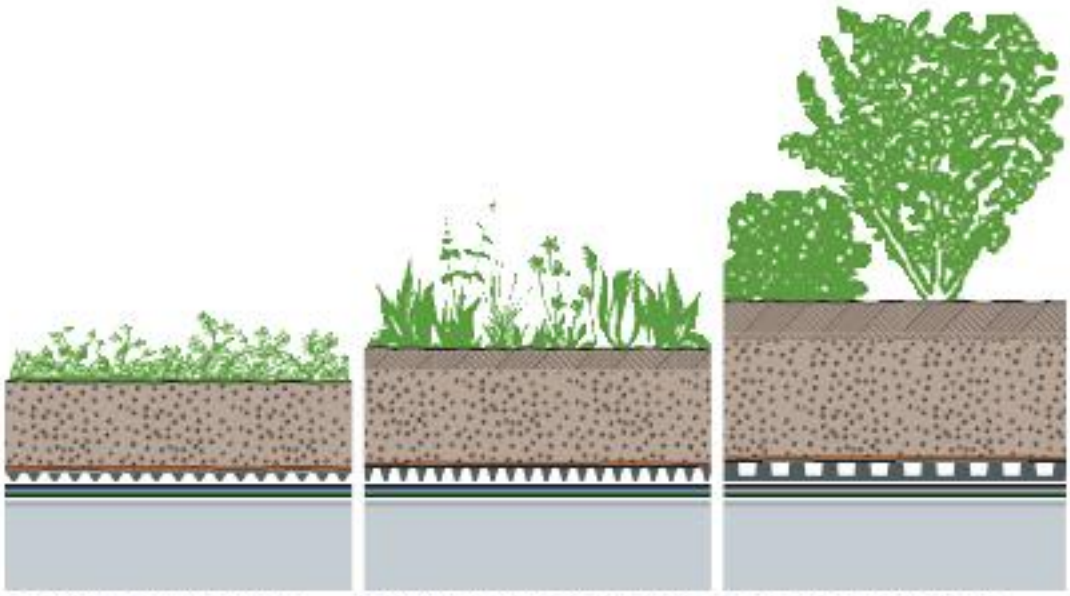


Fig 17: Extensive landscape

Fig 18: Semi-intensive landscape

Fig 19: Intensive landscape

Extensive/Biodiverse Landscape

- Low maintenance
- No irrigation
- Sedum

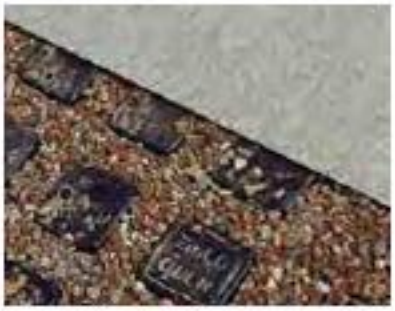
Semi-intensive Landscape

- Periodic maintenance
- Periodic irrigation
- Woody plants, lavenders, heathers

Intensive Landscape

- Regular maintenance
- Regular irrigation
- Trees, grass lawns, large bushes

Alumasc ZinCo Roof Planting Substrates



Alumasc Zincolit drainage substrate

Zincolit substrate is used to infill the Floradrain® FD 60 drainage layer in intensive roofs, to act as a bedding medium for permeable paving or setts, and to provide a drainage layer beneath deep applications of roof garden substrate.

Alumasc ZinCo 'Rockery Type' substrate (extensive)

Rockery Type substrate is formulated to support rockery and alpine plants which provide additional colour and variety, and also ZinCo's 'Meadow Scents', 'Country Colours' and 'Grassy Pasture' seed mixes.

Alumasc ZinCo 'Roof Garden' substrate (intensive)

Roof Garden substrate supports lawns, perennials, climbing plants, shrubs and even trees, where sufficient depth is available, allowing complete design freedom.

Alumasc ZinCo 'Sedum Carpet' substrate (extensive)

Sedum Carpet substrate is designed to support sedum type plants which are wind, frost and drought resistant, and are sown as cuttings, plug planted, or supplied in pre-cultivated sedum mats.

Alumasc ZinCo 'Heather with Lavender' substrate (semi-intensive)

Designed to support low-maintenance communities of ground covering filler plants, combined with fragrant herbs such as thyme, oregano and lavender, and small shrubs.

General notes:

- Also available: Alumasc ZinCo 'Cranberry Bog' substrate (intensive). A special blend designed to support ericaceous plants such as rhododendrons, camellias and azaleas, which prefer a more acidic growing medium.
- The substrates are supplied in 1 cubic metre bags, or in bulk.
- ZinCo substrates are composed of recycled matter, and comply with the FLL guidelines.
- A list of plant varieties suitable for all types of green roofs is given on pages 24 and 25.
- Refer to table 4 on page 20 for substrate settlement factors to be taken into account when calculating volume requirements.
- Only specialist substrates specifically formulated for use on roofs should be used on green roofs.

Plant Selection

Table 5:
Extensive Green Roof: 'Sedum Carpet' (min depth of 70mm growing medium)

Botanical name	Height (cm)	Leaf colour	Flower colour	Months in bloom	Location
Sedum album (different varieties)	5-10	winter green	white	6-8	○
Sedum ewersii	10-15	summer green	blue grey	8-9	○
Sedum floriferum 'Weihenstephaner Gold'	5-10	winter green	dark green	6-8	○
Sedum hispanicum var. minus	5-7	summer green	grey green	6-7	○ ◐
Sedum hybridum 'Immergrünchen'	15-20	winter green	fresh green	7-8	○ ◐
Sedum reflexum	20-25	evergreen	blue green	7-8	○
Sedum sexangulare	5-9	winter green	green	7-8	○
Sedum spurium - pink	10-15	summer green	green	7-8	○ ◐
Sedum spurium - red	10-15	summer green	dark red	7-8	○ ◐
Sedum spurium - white	10-15	summer green	white	7-8	○ ◐

Extensive Green Roof: 'Rockery type plants' (min depth of 80mm growing medium)

Botanical name	Height (cm)	Leaf colour	Flower colour	Months in bloom	Location
Sedum album(different varieties)	5-10	winter green	white	6-8	○
Sedum floriferum 'Weihenstephaner Gold'	5-10	winter green	dark green	6-8	○
Sedum hybridum 'Immergrünchen'	15-20	winter green	fresh green	7-8	○ ◐
Sedum kamtschaticum	15-20	summer green	yellow	7-8	○ ◐
Sedum reflexum	20-25	evergreen	blue green	7-8	○
Sedum sexangulare	5-7	winter green	green	7-8	○
Sedum spurium - pink	10-15	summer green	green	7-8	○ ◐
Sedum spurium - red	10-15	summer green	dark red	7-8	○ ◐
Sedum spurium - white	10-15	summer green	white	7-8	○ ◐
Achillea tomentosa	5-20	winter green	yellow	6-7	○
Allium senescens ssp. montanum	20-70	summer green	pink	6-8	○
Dianthus carthusianorum	10-50	winter green	dark pink	6-9	○
Dianthus deltoids	5-15	winter green	dark pink	6-8	○
Dianthus plumarius	10-30	winter green	pink/white	6-7	○
Hieracium aurantiacum	10-30	winter green	orange	6-9	○
Hieracium pilosella	10-20	winter green	light yellow	6-8	○
Koeleria glauca	15-40	winter green	blue green	6-7	○
Petrorhagia saxifraga	15-25	summer green	white (pink)	6-9	○
Potentilla neumanniana	5-10	summer green	yellow	3-4	○
Saponaria ocymoides	10-20	summer green	deep pink	5-7	○
Saxifraga paniculata	5-25	evergreen	white	6-7	○ ◐
Sempervivum-Hybrids	5-15	evergreen	red/pink	7-8	○
Thymus serpyllum	3-7	evergreen	light pink	5-8	○

Semi-intensive Green Roof: 'Heather with Lavender' (100-150mm growing medium)

Botanical name	Height (cm)	Leaf colour	Flower colour	Months in bloom	Location
Sedum floriferum 'Weihenstephaner Gold'	5-10	winter green	dark green	6-8	○
Sedum hybridum 'Immergrünchen'	15-20	winter green	fresh green	7-8	○ ◐
Sedum reflexum	20-25	evergreen	blue green	7-8	○
Sedum sexangulare	5-7	winter green	green	7-8	○
Sedum spurium - pink	10-15	summer green	green	7-8	○ ◐
Sedum spurium - red	10-15	summer green	dark red	7-8	○ ◐
Sedum spurium - white	10-15	summer green	white	7-8	○ ◐
Allium tuberosum	30-60	white	white	8-9	○
Aster amellus	30-60	summer green	violet	7-9	○
Carex humilis	15-20	summer green	insignificant	-	○
Carex orrithopoda	15-25	summer green	insignificant	-	○ ◐
Dianthus carthusianorum	10-50	winter green	dark pink	6-9	○
Dianthus deltoids	5-15	winter green	dark pink	6-8	○
Dianthus gratianopolitanus	7-20	winter green	pink	5-6	○
Festuca amethystina	20-40	winter green	blue green	6-7	○
Helianthemum nummularium	5-10	winter green	yellow	5-6	○
Helicotrichon sempervirens	35-120	winter green	insignificant	-	○
Lavandula angustifolia	30-60	evergreen	violet	7-8	○
Melica ciliata	20-60	summer green	insignificant	-	○
Oenothera missouriensis	20-25	summer green	yellow	6-9	○
Origanum vulgare	30-50	winter green	violet	7-9	○
Pennisetum alopecuroides 'Compressum'	80-100	summer green	insignificant	-	○
Prunella grandiflora	10-20	summer green	deep violet	7-8	○ ◐
Saxifraga paniculata	5-25	evergreen	white	6-7	○ ◐
Sedum telephium 'Herbstfreude'	30-50	summer green	brown red	8-10	○
Teucrium chamaedrys	20-25	summer green	pink	7-8	○
Thymus vulgaris	15-20	evergreen	violet	7-9	○

Key ○ full sun ◐ half shade

Table 5:
Intensive Green Roof Plants

	Botanical name	Height (m)	Leaf colour	Flower colour	Months in bloom
Climbing plants	Akebia quinata	5-8	summer green	crimson	4-5
	Clematis montana 'rubens'	2-4	summer green	pink	5-6
	Clematis tangutica	3-4	summer green	yellow	6
	Hedera helix	10-20	evergreen	-	-
	Lonicera henryi	3-4	evergreen	yellow/red	6-7
	Parthenocissus quinquefolia	10	summer green with tendrils	green	6-8
	Parthenocissus tricuspidata	20	summer green	minimal	-
Perennials	Alyssum montanum	0.2	green	yellow	4-5
	Arabis procurrens	0.1	winter green	white	4-5
	Aster ammellus	0.6	dark green	purple/pink	7-9
	Aster dumosus	0.4	dark green	pink	8-9
	Aster linosyris	0.6	grey	yellow	8-9
	Centranthus ruber	0.6	blue/green	red	6-8
	Coreopsis verticillata	0.6	feathery foliage	yellow	6-8
	Doronicum caucasicum	0.4	green	yellow	4-5
	Erigeron hybridus 'adria'	0.7	spiky leaved	blue	6-7
	Geranium macrorrhizum	0.3	scented leaves	pink	6-8
	Inula magnifica	1-1.5	scented leaves	yellow	7-8
	Lavandula angustifolia	0.4-0.6	evergreen	violet	6-7
	Linum perenne	0.5	blue/green	blue	6-8
	Molinia caerulea	0.4-0.8	blue/green	green	8-9
	Oenothera missouriensis	0.25	light green	yellow	6-9
	Origanum vulgare	0.1-0.4	scented leaves	pink/red	7-9
	Phlox subulata	0.1	evergreen	pink	4-5
	Rudbeckia sullivantii	0.6	dark green	yellow	8-10
	Sedum telephium	0.6	fleshy leaved	rust/red	9-10
	Thymus serpyllum	0.05	evergreen	red	6-7
	Thymian vulgaris	0.3	dark green	bright pink	7-9
Grasses	Avena sempervirens	0.3-1	winter green	green	6-8
	Calamagrostis acutifolia	0.5-1	fresh green	grey/green	7-8
	Melica ciliata	0.4	grey green	silvery	5-6
	Pennisetum compressum	0.6	blue/green	brown/green	8-9
Leafy wood shrubs	Amelanchier canadensis	1-2	summer green	white	4-5
	Berberis verruculosa	1	evergreen	yellow	5-6
	Buddleja davidii	1-2	summer green	violet	7-8
	Buxus sempervirens	1-2	evergreen	insignificant	
	Calluna vulgaris 'j h hamilton'	0.25	evergreen	pink	8-9
	Calluna vulgaris 'county wicklow'	0.25	evergreen	red	8-9
	Caryopteris clandonensis	1	summer green	blue	8-9
	Cornus kousa	1-2	summer green	white	8-9
	Corylopsis pauciflora	1-1.5	summer green	yellow	6-7
	Cotoneaster adpressus	0.25	summer green	pink	3-4
	Cotoneaster dammeri	creeper	white	white	6
	Cytisus decumbens	creeper	summer green	yellow	6
	Cytisus kewensis	0.2	summer green	yellow	5
	Daphne cneorum	0.3	summer green	pink	5
	Deutzia gracilis	0.7	summer green	white	5-6
	Euonymus fortunei	creeper	evergreen	insignificant	
	Genista lydia	0.5	summer green	yellow	5-6
	Hypericum pat 'hidcote'	1.5	evergreen	yellow	7-10
	Jasminum nudiflorum	2-3	winter green	yellow	2-3
	Kolkwitzia amabilis	1-2	summer green	pink	5-6
	Ligustrum vulgare 'londense'	0.5	winter green	does not bloom	
	Pontentilla fructicosa 'goldfinger'	0.8-1	summer green	yellow	7-9
	Prunus tenella	1-2	summer green	pink	4-5
	Rosa nitida	0.5	summer green	pink	5-6
	Spiraea arguta	1-2	summer green	white	4-5
	Spiraea bumalda	1	summer green	red	7-8
	Spiraea japonica	0.4	summer green	pink	7-9
	Viburnum fragrans	1-2	summer green	pink	1-2
Evergreens	Juniperus chinensis	1-2	evergreen	insignificant/minimal colour	
	Juniperus communis 'hibernica'	1-1.5	evergreen	insignificant/minimal colour	
	Juniperus communis 'hornbrookii'	0.2-0.3	evergreen	insignificant/minimal colour	
	Juniperus horizontalis		evergreen	insignificant/minimal colour	
	Microbiota decussata	0.5	evergreen	insignificant/minimal colour	
	Pinus mugo mughus	0.5-1	evergreen	insignificant/minimal colour	
	Pinus mugo mops	0.2	evergreen	greenish	
	Taxus baccata	1.5-2	evergreen	red fruit	
	Taxus media	0.5-1	evergreen	poisonous	

Alumasc recommend expert advice is sought from a horticultural specialist when designing an intensive green roof

Solar Power

ZinCo SB 200 Solar-Basis support bracket systems for solar panels (water heaters) and photovoltaic panels (electricity generators) are readily available for incorporation into green roof systems. Photovoltaic panels benefit especially from the localised cooling effect of the green roof, as they are most efficient at 25°C.

The inclusion of solar power can be seen as a further valuable ecological benefit and will contribute towards compliance with various building regulations and environmental standards and assessments.

Prefabricated mill finished aluminium brackets are fixed to SB 200 Solar-Basis base panels and ballasted to resist local windloads.

Arrays of photovoltaic and solar panels can form an integral part of low carbon emission developments.

Surplus energy can be stored or fed directly into the electricity grid, by arrangement with the local electricity utility.

The cooling effect of localised vegetation maximises the efficiency of photovoltaic panels.

Roofs spaces can be utilised as valuable passive energy collection areas.

Further information on PV panels and Solar Panels, including advice on local suppliers and installers can be found at www.pv-uk.org.uk and www.solartradeassociation.org.uk

Safety on Roofs

Introduction

Any work on a roof is high risk and good safety standards are essential.

Risk assessment and method statements

A risk assessment should be carried out for all roof work. It is essential that all risks are identified before the work starts and that the necessary equipment, appropriate precautions and systems of work are provided and implemented.

Working on Flat Roofs

Regulations require that safety precautions are taken if work is being carried out on roofs with a low parapet. This could be in the form of scaffolding, railings or safety harnesses.

Unless the roof parapet provides adequate safety, temporary edge protection will be required during work on flat roofs. Both the roof edge and any openings in it need to be protected. Any protection should be:

- In place from start to finish of the work
- Strong enough to withstand people and materials falling against it

Accidents occur not only to those constructing roofs, but also to people maintaining, cleaning and inspecting them.

Maintenance and Inspection Work

Green roofs will inevitably involve regular maintenance and appropriate safety measures are essential. The Health and Safety Executive advise:

'It may not be reasonably practicable to provide edge protection during short-duration work. In such cases anyone working nearer than 2m to any unguarded edge should be using a safety harness. Where safety harnesses are used they need to be:

- Appropriate for the user and in good condition – full harnesses are essential, safety belts are not sufficient
- Securely attached to an anchorage point of sufficient strength
- Fitted with as short a lanyard as possible that enables wearers to do their work
- Actually used - tight management discipline is needed to ensure this'

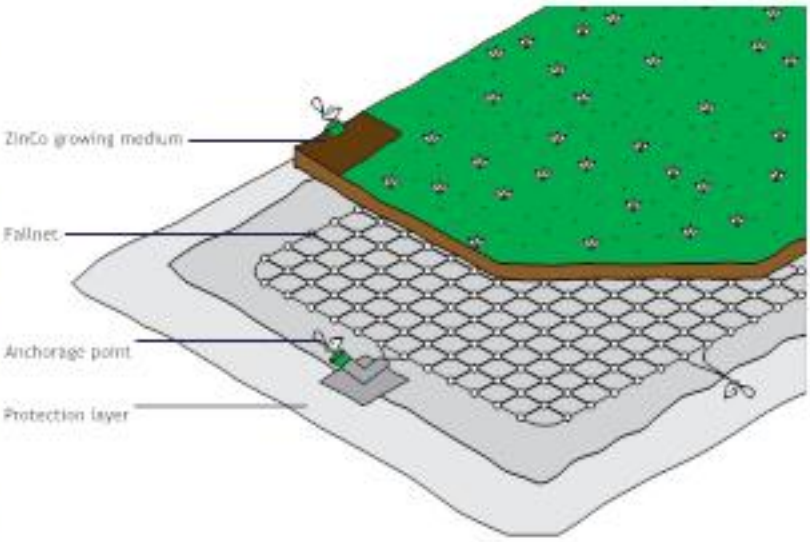


Fig 20: The Fallnet system

Fall Arrest and Fall Prevention Systems

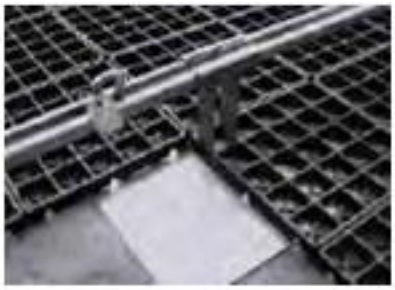
ZinCo Fallnets are non-membrane penetrating systems for providing anchorage points that have been specifically designed for use on green roofs with slopes of up to 5°. The systems comply with European Standard EN795 Class E. Each Fallnet is laid directly over the drainage layer, and is held securely in place by the weight of the substrate laid over it.

All Fallnet systems can be supplemented by wall-mounted brackets where appropriate.

Fallnet systems must be installed and maintained by competent operatives strictly in accordance with the installation/inspection manual supplied with each system.

Fallnet SR

Consists of interlocking polyethylene grid elements and a centralised fixing point made from stainless steel. The standard grid size is 2.67m x 2.0m (5.33m²) which is ballasted with either 80mm (100mm if between 2° and 5° slope) of ZinCo substrate or 50mm of gravel. Each fixing point can be used by one person only at any time.



Fallnet SR Rail

A linear fixing device which utilises the same underlying grid elements as the basic SR system above. The fixing rail is attached to the central fixing posts, and is installed parallel with the roof edge. A runner connects the user by lanyard to the rail. For use generally in restricted areas.

Fallnet SK

A reinforced plastic netting exclusively for ZinCo green roofs (minimum 5m x 5m) designed on a job by job basis, with a variable number of anchorage points, for multiple users. Requires a minimum ZinCo substrate depth of 80mm (100mm if between 2° and 5° slope).

Fallnet SE

Consists of a 4m x 4m stainless steel wire mesh embedded into a 5m x 5m polyester fleece, supplied with up to 4 anchorage points per unit. Each Fallnet SE can be used by a maximum of 2 people at any one time. Requires a minimum of 100mm of ZinCo substrate or 120kg/m² (dry weight) of any other bulk material.

Handrail Systems

A bespoke handrail system is available which comprises a ballasted drainage layer with integral baseplates to support a standard Alumasc ZinCo 40mm diameter stainless steel post and handrail arrangement, or the client's own proprietary system. This provides a permanent, non-membrane penetrating, edge restraint solution for green roof areas intended for frequent access or recreational use.

How ZinCo Green Roof Systems Work

ZinCo Green Roof systems have been designed to function naturally, even though there is no direct contact with the ground and the roof build-up is not deep. Nevertheless the plants enjoy a stable environment without adversely affecting the roof waterproofing.

Alumasc Provides the Complete ZinCo Green Roof Solution

The possibilities for ZinCo Green Roofs are so varied that the right build-up can be created to meet the requirements of any landscape - whether an intensive or extensive system, a flat or sloping roof, landscaping with additional thermal insulation, or terraces, paths, play areas and vehicular surfaces on roofs.

Intensive roof - Eden Project, Cornwall

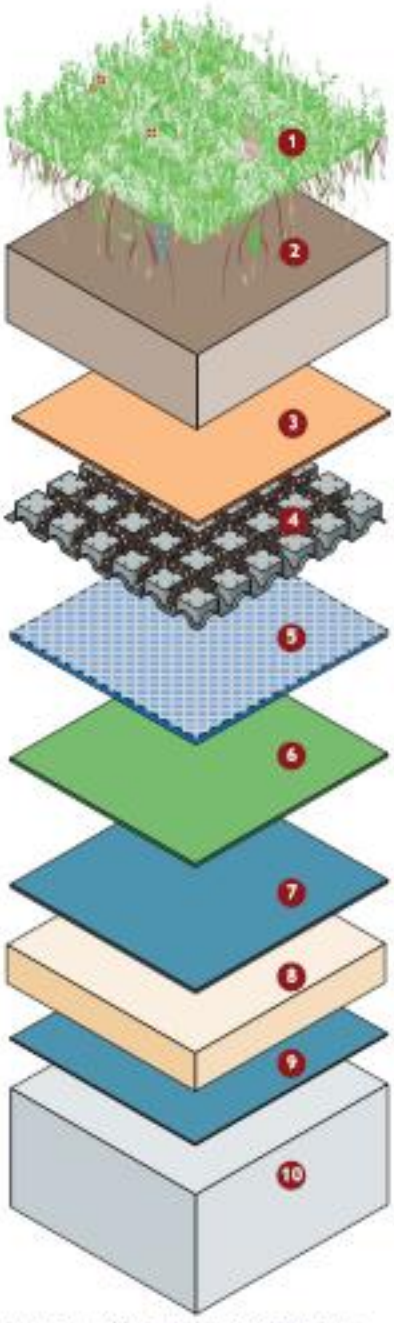


Fig 21: A ZinCo green roof build-up

Planting

Alumasc can supply a range of plants for extensive green roofs - for example, sedums and herbs - to suit design, maintenance and cost requirements. Plants for intensive landscaping, such as larger bushes and small trees, are normally supplied by garden centres.

Growing Medium

Alumasc offer a range of substrates for use on green roofs. When specifying a ZinCo Green Roof system, only approved ZinCo substrates from Alumasc should be used.

Substrates available from Alumasc include:

- Zincolit drainage substrate
- ZinCo sedum carpet substrate
- ZinCo rockery type substrate
- ZinCo heather with lavender substrate
- ZinCo roof garden substrate
- ZinCo cranberry bog substrate

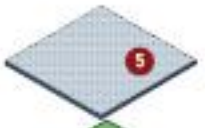
Filter Membrane

The filter membrane prevents fine particles from being washed out of the substrate and into the drainage layer. This ensures that the drainage layer does not become clogged and functions effectively.

Drainage Layer

The heart of a ZinCo Green Roof system is the drainage layer. A system of channels on the underside ensures drainage of water, even where there is dense root growth. The drainage layer also incorporates troughs for retaining water for plants (Floradrain® systems), even on sloping roofs, and holes that allow aeration to the roots and evaporation of water.

- Floradrain® FD 25-E is generally specified for use beneath shallow substrate (50-100mm) extensive green roofs. There must always be a fall of at least 1:60 in the roof deck.
- Floradrain® FD 40-E and FD 60 have a greater flow rate and water storage capacity, and are therefore ideal for intensive roof gardens. Floradrain® FD 60 is deep enough to enable water to be stored beneath it when used in conjunction with the ZinCo sub-landscape irrigation system.
- Floratherm® drainage layer is used to upgrade the insulation value of an existing roof when it is being converted to a green roof.
- Elastodrain EL 200 and EL 202 - for use on large areas such as car parks, podiums, plazas, etc - to provide exceptional protection for the waterproofing membrane against damage by heavy vehicular traffic during and after installation of the landscaping.
- Floraset FS 50 - for use on existing roofs with inadequate falls to overcome localised areas of ponding water.
- Floraset FS 75 - for use on sloping roofs up to 25°. Deep substrate retaining profile prevents slippage.



Moisture Mat

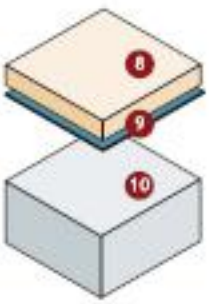
Releases moisture through diffusion up through holes in the top of the drainage layer. Moisture mats also retain moisture and nutrients. Not required in inverted roof assemblies.

Root Barrier

The root barrier is a membrane that prevents roots from affecting the waterproofing. The type, thickness and method of installation depend on the type of landscape planned and the shape of the roof. Not required over root resistant membranes.

Waterproofing membrane

For waterproofing under ZinCo Green Roof systems, Alumasc recommends Derbigum high performance waterproofing membrane or Hydrotech 6125 liquid applied structural waterproofing membrane system - both supplied by Alumasc.



Thermal Insulation and Vapour Control

The thermal insulation is situated beneath the waterproofing membrane to form a warm roof over a vapour control layer which prevents the formation of condensation.

Roof Structure

The structural roof deck must be designed to support the weight of the green roof and any live loads.

Step-by-step Installation

Pre-installation

Prior to commencement of operations the roof should be cleaned and the waterproof membrane checked, both visually and with a water test. Ensure any detected faults are corrected before installation of the green roof commences. It is advisable for the roof waterproofing system installer to be present during the initial stages of the installation while the protection layer is being laid.

Heavy loads should not be placed directly on light roofs. Shutter boards or other methods should be used to spread concentrated loads over a larger area.

Ensure that full safety precautions are in place before work starts. For roofs without permanent edge protection or with low parapets, temporary scaffolding, railings or safety harnesses may be necessary.

Roof outlets and expansion joints

Mark the position of roof outlets before installing the root barrier, so that they can be easily located and the root barrier and moisture mat cut out accordingly. During the entire installation of the system, care must be taken to ensure that the outlets do not become blocked with rubbish. Inspection chambers should be placed over outlets and fitted into the drainage layer.

Any expansion joints which are not extended up through the waterproofing should remain free of plants. They can be covered by gravel or paving slabs so that they can be easily located and accessible at any time.

Wind

As layers are completed they must be adequately restrained against wind suction. Matting and drainage elements may be watered as a temporary measure. If it is not possible to complete the spreading of soil on the same day, components must be secured overnight by means of wooden pallets, planks etc.

Step 1 - Root Barrier

New Build

In the Alumasc ZinCo green roof system the root barrier forms an integral part of the waterproofing system.

In the case of the Hydrotech 6125 system, a Hydrogard 40 protection sheet impregnated with the root resistant chemical Preventol B2 is fully bonded into the Hydrotech to form a root barrier.

When using the Derbigum system, the capsheet itself is manufactured with the root resistant chemical Preventol B2 impregnated, thus giving it excellent root resistance.

Existing waterproofing

ZinCo's WSF 40 root barrier is laid directly over the existing waterproofing. Manufactured from bitumen resistant polyethylene and electronically tested for pin holes, WSF 40 is laid loose and, as the laps are unsealed, they must be 1.5m wide to protect against lateral root growth.

General

All root barriers must be taken up all upstands to soil level.

Root Barrier being installed

Step 2 - Moisture Mat

The moisture mat is rolled out loose over the roof to lie directly beneath the drainage layer. The moisture mat performs two functions. First as a water retaining layer to aid the irrigation of the plants and secondly as a protection layer. When set out the laps should be a nominal 100mm.

The moisture mat being installed over the root barrier and secured at the roof perimeter

Step 3 - Drainage layer

The specified drainage layer should be installed to form a continuous layer over the roof deck. To achieve this could mean overlapping, clipping together or butt jointing the drainage boards/sheets, depending on the type being installed.

The drainage layer should be cut to fit closely around all protrusions and to form suitably sized and shaped holes to serve the outlets and to enable inspection chambers to be correctly installed

Note that the reservoir 'cups' in the Floradrain® FD 60, require infilling with Zincolit prior to installing the filter sheet.

Floradrain® FD 60 installed over the moisture mat

Step 4 - Filter Sheet

The filter sheet is used to prevent the substrate being washed away and as such must be carefully installed to prevent 'leakage', particularly at outlets and roof edges.

During installation and before the substrate is installed, the filter sheet can be temporarily held in place with strips of industrial tape.

Note that the type of filter sheet required will depend on the drainage layer being installed. On pitched roofs over 10° a filter sheet is not recommended on the main roof area as it will act as a slip layer. However a strip of filter sheet should be installed at all perimeter upstands, up to soil level.

The filter sheet rolled out over the drainage layer

Step 5 - Hard Landscaping

Once the filter sheet is in place, any hard landscaping should be installed directly into and onto the drainage layer. Pebbles or paving acting as vegetation barriers should also be installed.

If specified, the ZinCo automatic irrigation system should be positioned prior to the application of the soil.

Irrigation unit in place

Hard landscaping constructed before substrate layer installed

Step 6 - Substrate Layer

Alumasc ZinCo substrates can be supplied in a variety of ways, including Mini Bag (25kg), 'Big Bags' or in bulk.

Delivery onto the roof can be by lift, crane or, for the extensive substrates only, pumping. Each method has its advantages and disadvantages. The principal criteria will be the size of the project, substrate type and depth in specific areas, accessibility of the roof as well as its load-bearing capacity and resistance to point loads. Site storage and the location of access roads also need to be taken into consideration.

Substrate being pumped in position on a large roof

Step 7 - Planting

The final step is installing the plants and/or seeds. The method of installation will depend upon whether the vegetation is intensive or extensive in nature.

Two photographs showing initial planting (top) and established planting scheme (bottom)

Planting Options

Extensive Green Roofs

Methods of Planting

Green roof systems can be installed at almost any time of year. Planting takes place at specific times of year, depending on the method of planting and types of plants being used.

Plug planting

Individual plants used for extensive landscapes are cultivated in special flat-bottomed trays which minimises damage during transport. The roots need to be shallow for planting into the extensive substrate.

The advantage of hand-planting is that the plant layout can be designed to best effect rather than randomly. Ground coverage is achieved much more quickly than when planting by cuttings or seed. Alumasc recommend planting 15-20 plants per square metre, which takes about 5-6 minutes. Planting should take place between spring and autumn, the months of May and June being the best time.

Sedum cuttings

Sedum cuttings are produced by cutting off the shoot tips of various types of sedum. They are usually 30-50mm in length, depending on the type and variety. It is only possible to take these cuttings during the non-flowering or dormant period ie, in spring and autumn, as flowering shoots do not easily grow roots.

Sedum cuttings are living organisms and can therefore only be stored for a limited period of time. If it is not possible to sow them immediately, they must be spread out in a cool, dark and dry place.

The best method of sowing cuttings is to scatter them evenly onto a layer of Zincolit, covered with a layer of Zincohum and watered. If the Zincohum is spread beforehand, the cuttings are then pressed or rolled in to ensure good contact with the substrate. It is recommended to sow 50 g of cuttings per square metre. If faster ground cover is desired, the quantity must be increased accordingly. The planting time is 3-4 minutes per square metre. The best sowing times are spring (April/June) and autumn (September/October). Good ground cover is achieved within 2 - 3 years. The use of cuttings is cheaper than planting with plug plants.

Table 6: Substrate type and minimum depth for basic plant selection

	Extensive roof planting ◄			► Roof garden	
Substrate type	Sedum & other ground cover	Sedum & leafy perennials	Herbs, wild flowers & grasses	Perennials, grass, lawns & shrubs	Perennials, large shrubs & small trees
Extensive	50-70mm	80mm	100mm	-	-
Semi-intensive	-	-	100mm	150-200mm	-
Intensive	-	-	-	150-200mm	from 250mm

Seed sowing

Herb and grass seeds are very small depending on the plant variety and the required amount is approx. 1-3 g/m². To achieve an even distribution the seeds are mixed with grain-substrate. It is recommended to sow 25 g/m² of the grain seed-mixture which is sown onto the layer of Zincohum (organic material) and then either covered with a thin layer of substrate or rolled in and watered. Seed-sowing can be compared with cutting-sowing in respect of labour and material costs, sowing time and achieved ground cover.

Precultivated vegetation mats

Vegetation mats are similar to turf for lawns, but are composed of sedum and similar plants.

Planting with precultivated vegetation mats is significantly more expensive than planting with plug plants, though the maintenance is comparable. For this reason, extensive precultivated vegetation mats are used only for special green roof applications, such as those with a steep slope. They are also recommended for installation at the roof perimeter as an initial protection against wind suction in extreme locations. Vegetation mats should be laid onto a ZinCo extensive substrate, rolling the mats into the substrate to ensure good contact.

Planting and Maintenance

Plug plants can be planted throughout the growing season, provided they are sufficiently watered.

The sowing of sedum cuttings and/or seeds, for extensive green roof, is restricted to spring and autumn.

Once planting has been completed, a period of maintenance begins. This covers a set period of time at the end of which the ground cover should be 60-70%. After the final inspection it is advisable to ensure regular maintenance of the green roof by negotiating a maintenance agreement.

Note that the substrate must be kept moist for the initial four weeks, whatever the method of planting chosen, to enable the plants/seeds to establish root growth.

Intensive Green Roofs

When intensive vegetation is specified, the planting regime will normally be provided by a landscape consultant. The consultant should provide the sub-contractor with a clear plan showing the depth of substrate, which species and the density of planting required in any given location.

Particular attention should be given to the sourcing of turf for lawned areas and advice should be sought from the supplier regarding any additional top dressing to be applied to the Roof Garden substrate prior to installation of the turf.

The consultant should provide a programme of maintenance to be carried out after installation, to ensure the effective establishment of the vegetation. We strongly recommend that establishment maintenance is included as part of the contractual responsibilities of the contractor carrying out the installation of the vegetation and is set for a period of time of not less than 6 months.

Maintenance Regimes

Extensive Green Roofs

The health and longevity of any green roof will depend on it being given the correct maintenance. Any area of vegetation that is neglected will simply return to nature. Dominant species will take over, self sown species will invade and vulnerable areas of the roof will become overgrown.

Designing to reduce future maintenance:

- **The correct choice of substrate** will reduce the chances of unwanted wind blown seeds from germinating
- **The correct level of moisture retention** will help the less dominant species survive
- **Correct detailing** will reduce the chance of plants damaging vulnerable details on the roof

Remember, low maintenance does not mean no maintenance!

Roof perimeter and outlets

The roof perimeter, upstands and roof penetrations must be kept weed free. This is normally achieved by separating them from the vegetation areas using a 300mm wide barrier of large rounded pebbles, 16mm to 32mm grade, paving slabs, decorative bricks etc.

Outlets must have inspection chambers over them and must be inspected to ensure they are clear of debris.

Consider detailing at lawn edges to make mowing easier

Remove unwanted plants

Seeds of unwanted plants can be brought by the wind and birds. Unwanted plants must be removed with roots, complete. Their seedlings are harmful and should be pulled up and not dug or cut as this might damage the waterproofing. The more ground cover is achieved with the desired plants the less chance of alien plants invading.

Mowing, trimming, pruning

Grass and herb type landscapes have to be cut when the seeds are mature. This helps to avoid moss growth. All mown or trimmed material should be removed in the same way as maintaining a natural garden.

Additional material

It is possible after initial planting that some plants fail or do not spread as quickly as required. Then additional planting will be necessary. This type of maintenance is usually built into the landscape contractor's contract.

Irrigation

It is necessary to irrigate after initial planting to establish plant growth. Later in the life of extensive green roofs there should be no need for additional irrigation. Intensive green roofs will need irrigating regularly, the frequency depending on the plant type.

Fertilising

Extensive green roofs do not require fertilising. However, there may be occasions such as trying to speed up ground cover or, if the plants are showing signs of stress (sedums turning red from green despite good weather) when the addition of fertiliser in the spring will be beneficial.

Intensive Green Roofs

The extent of the maintenance required on an intensive green roof will be determined by the type of substrate used, the nature of the vegetation selected and the client expectation regarding the visual appearance. In all installations, the regular six monthly inspections of roof outlets to check for debris and root growth that might affect the flow of rainwater from off the waterproofing surface is essential. It is strongly suggested that the landscape consultant responsible for the specification of the vegetation and substrate should be contractually obliged to prepare an ongoing maintenance programme at tender stage, to be put into effect after the initial establishment period. This should be subject to review with both the client and installing contractor at the end of the establishment period.

Lightweight Extensive/Biodiverse Installation

Low Pitched Roofs

Floradrain® FD 25-E

Floradrain® FD 25-E is the most suitable drainage layer for extensive and low maintenance green roofs. Manufactured from recycled polyethylene, it has a high compressive strength and is suitable for use under paving.

Rainfall collects in the storage cells. Roots are supplied with both air and water through capillary action. Water is also held in moisture mats that protect the waterproof membrane whilst retaining moisture and nutrients. Excess water drains away beneath the drainage layer.

ZinCo extensive green roof solutions from Alumasc include special substrates and a selected range of hardy plants. They have an attractive 'back-to-nature' appearance, and require very little maintenance. Substrate and plant types (eg. stone crop and sedums) must be drought, wind and frost-resistant. Extensive roofs do not require great substrate depth - as little as 50mm - making them lightweight and economical.

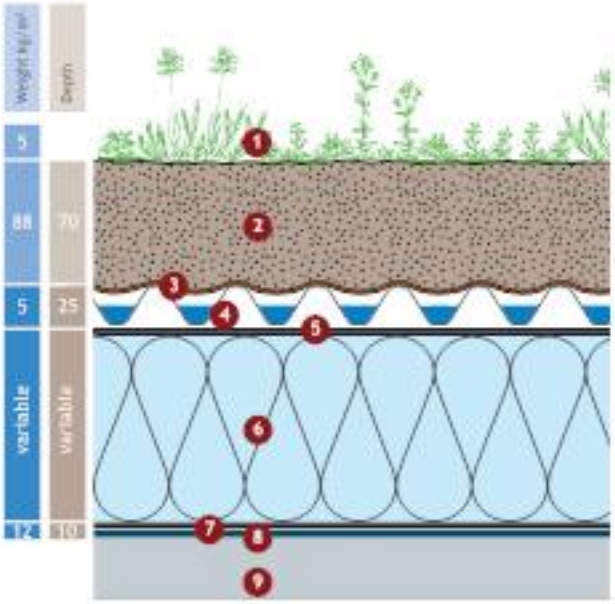
Floradrain® FD 25-E gives specifiers considerable freedom - for example, to transform barren and featureless inverted roofs by replacing all or part of the paving with extensive landscaping.

The increasing use of extensive roofs in cities significantly reduces the risk of flooding, because 50-90% of rainfall is retained in the substrate, to evaporate slowly. The natural evaporation from the substrate cools the air and reduces dirt and smog levels.

Table 7: Technical data

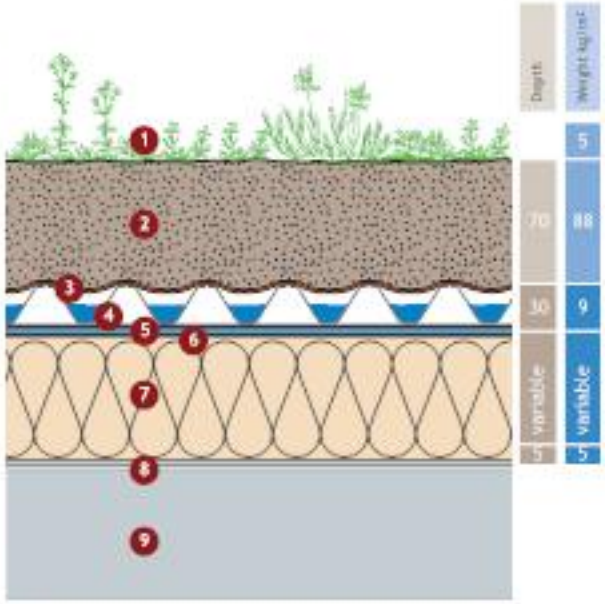
Material	High density polyethylene (HDPE)
Height	25mm
Weight	1.7kg/m² dry, 4.7kg/m² wet
Dimensions	1m x 2m sheets or rolls 1m wide, with or without filter sheet
Water retaining capacity	3l/m²
Maximum pressure load (empty)	270kN/m²

Fig 22: Inverted Roof Solution



1. Sedums
2. Alumasc ZinCo sedum carpet substrate
3. Filter Sheet SF
4. Floradrain® FD 25-E drainage layer
5. Alumasc MK Separator
6. Alumasc Roofmate TF/A insulation, thickness to suit U-value required
7. Hydrogard 40 root barrier
8. Hydrotech MM6125 waterproofing
9. Roof construction

Fig 23: Warm Roof Solution



1. Sedums
2. Alumasc ZinCo sedum carpet substrate
3. Filter Sheet SF
4. Floradrain® FD 25-E drainage layer
5. Moisture Mat SSM 45
6. Derbigum Anti Root waterproofing system
7. Derbifoam polyurethane insulation, thickness to suit U-value
8. Vapour barrier
9. Roof construction

Table 8: Systems summary

Build-up height	approx 100mm
Wet weight (including plants)	approx 108kg/m²
Water retention capacity	approx 23l/m²

Features - Floradrain® FD 25-E green roof

- Ideal for extensive green roofs with a variety of hardy, drought-resistant planting - the ecologically sound alternative to gravel coverings.
- Suitable for roofs with a slope up to 10°.
- Requires minimum care and attention.
- Offers various design possibilities with hardy planting and can include footpaths and terraces.
- The construction is resistant to flying sparks and is a 'hard roof' in accordance with German Building Standard DIN 4102 dealing with fire resistance.
- The drainage layer meets the requirements of German Building Standard DIN 4095.

Lightweight Extensive/Biodiverse Installation

Zero Falls Roofs

Floraset FS50

Floraset FS50 is a lightweight drainage board specifically for use on roofs with little or no drainage falls. Made of partly recycled CFC free polystyrene, the board provides water retention and allows drainage, whilst minimising the possibility of any potential standing water from interfering adversely with the essential airspace beneath the board.

The board collects water in its storage cells, whilst a multi-directional channel system on the underside allows positive drainage of any excess. Ventilation and provision for evaporation is by means of perforations through the board. Normal levels of foot traffic can be accommodated by the product.

The use of the TSM32 separation and protection mat beneath the product ensures efficient and even dispersion of any ponding water, allowing maximum uptake by the vegetation.

A typical system utilising 70mm of Rockery Type substrate can retain up to 33 litres of water per square metre.

Table 8a: Technical data

Material	Recycled expanded polystyrene
Height	50mm
Weight	0.7kg/m² dry, 2.7kg/m² wet
Dimensions	1m x 1m
Water retaining capacity	2l/m²

Fig 24: Extensive/Biodiverse Green Roof with Floraset FS50

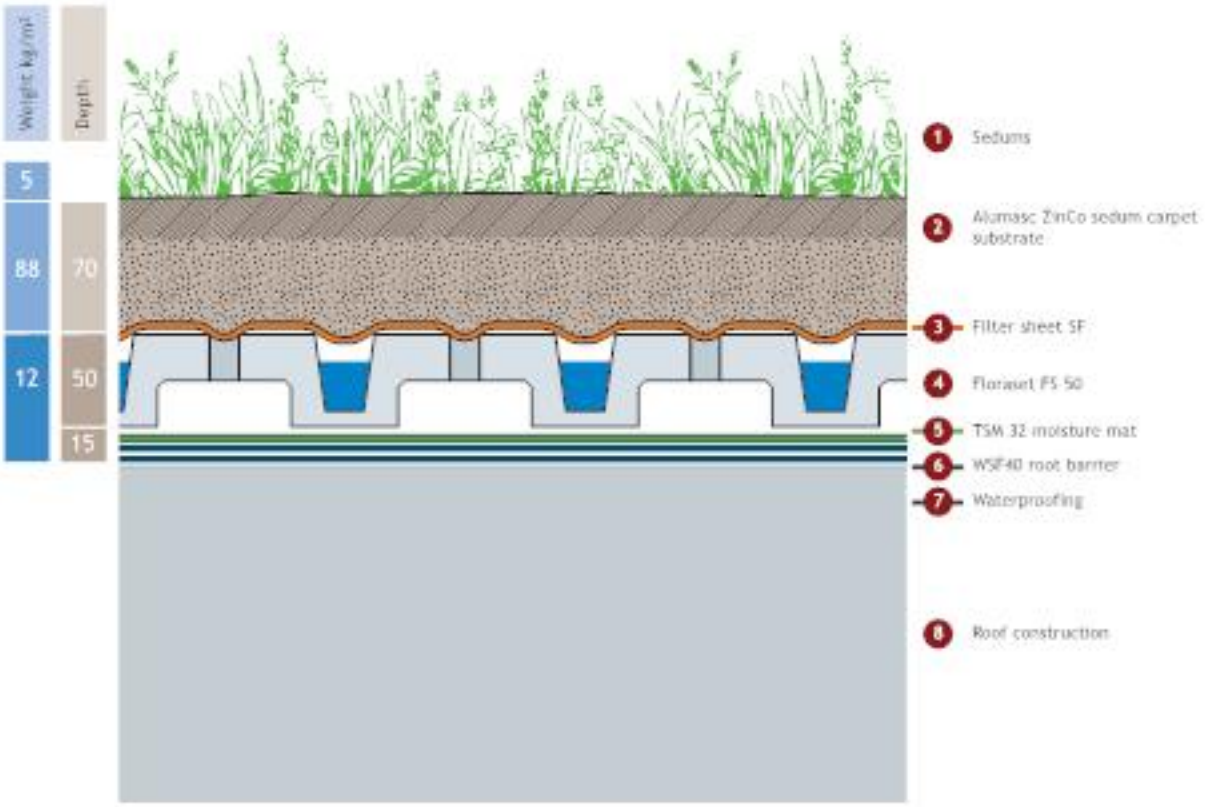


Table 9: System summary

Build up height	approx 135mm
Wet weight (including plants)	approx 105kg/m²
Water retention capacity	23l/m²

Features - Floraset FS 50 green roof

- Provides a low maintenance green roof landscape on roofs with little or zero falls
- Floraset FS 50 contains recycled material and is blown with a CFC free agent
- Requires minimum care and attention
- The construction is resistant to flying sparks and is a 'hard roof' in accordance with German Building Standard DIN 4102 dealing with fire resistance
- The drainage layer meets the requirements of German Building Standard DIN 4095

Lightweight Extensive or Biodiverse Installation

8-25° Sloped Roofs

Floraset FS 75

Floraset FS 75 is a drainage board manufactured from recycled CFC-free expanded polystyrene. It is used principally on inclined roofs over 10° and up to 25° in pitch. Boards are laid loose and overlapped. Floraset FS 75 can also be used on flat roofs, but it is important to lay the product right side up, depending on the type of application. On pitched roofs the deeper profile should always be laid upwards for better retention of substrate. Floraset FS 75 is suitable for both extensive and intensive green roof installations.

Floraset FS 75 - the green roof solution for inclined roofs.

Table 10: Technical data

Material	Recycled expanded polystyrene
Depth	75mm
Weight	1.5kg/m²
Dimensions	1x1m

Fig 25: Extensive or Biodiverse Sloping Green Roof with Floraset FS 75

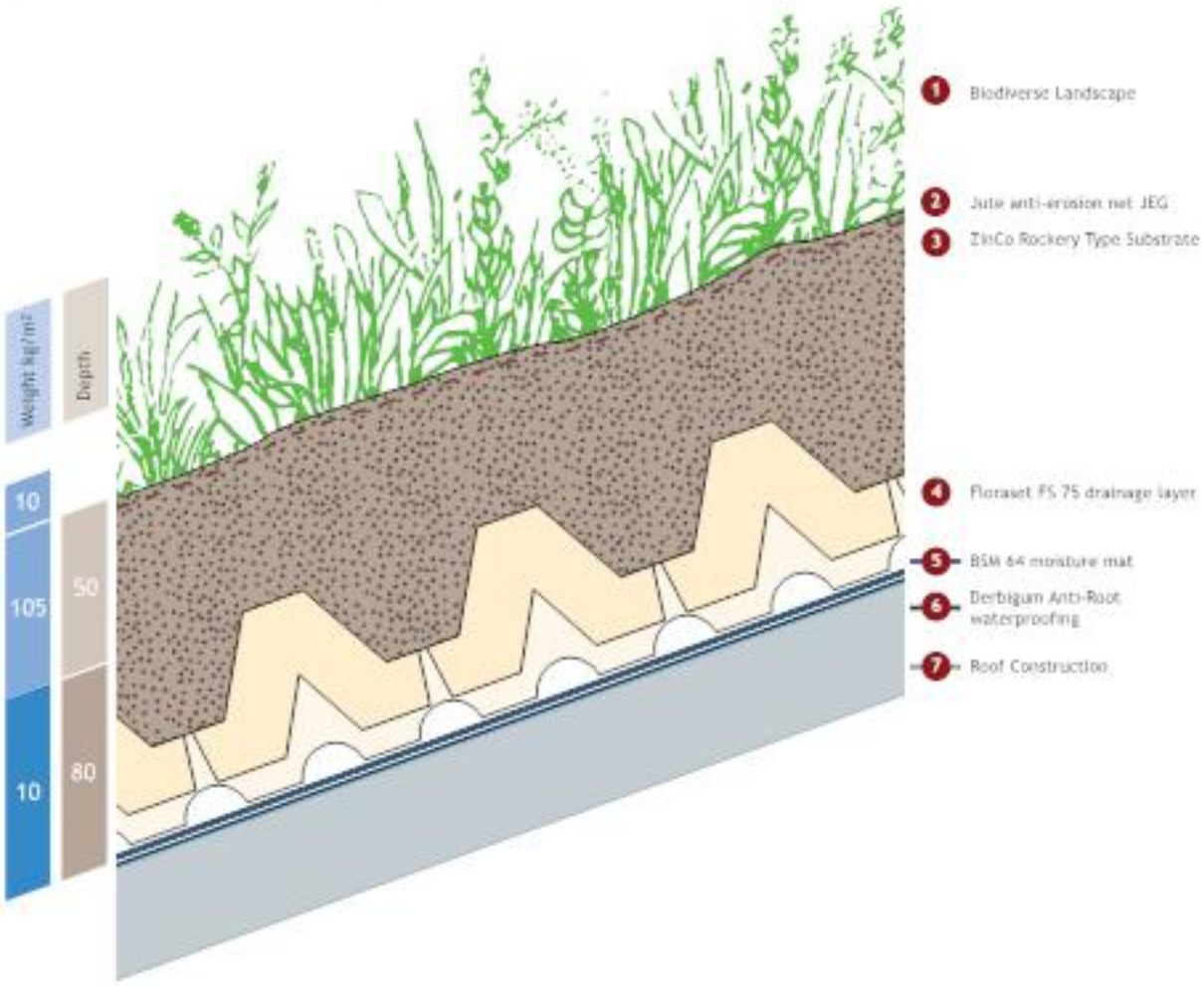


Table 11: System summary

Build-up height	approx 130mm
Wet weight (including plants)	approx 100kg/m²
Water retention capacity	approx 30l/m²

Features - Floraset FS 75 green roof

- Provides a low maintenance extensive green roof landscape on inclined roofs.
- Floraset FS 75 is 100 per cent recycled polystyrene, blown with CFC-free agents.
- Deep profiles secure the substrate and prevent slippage. The interlocked Floraset FS 75 drainage boards provide excellent resistance to shear forces and safeguards against the threat to eaves stability.
- Designed for roof pitches up to 20° without additional cross battening. Above 20° cross battens are required to counteract shear forces. Maximum roof pitch is 30°.
- Roofs steeper than 15°, or sites subject to strong wind uplift, require the incorporation of a jute anti-erosion net to prevent substrate depletion.
- The construction is resistant to flying sparks and is a 'hard roof' in accordance with German Building Standard DIN 4102 dealing with fire resistance.

Lightweight Extensive/Biodiverse Installation

Standing Seam Roofing Systems

Floradrain® FD 25-E or FD 40-E Strip

The Armaseam® standing seam roof System is the ultimate metal substrate for green roofs. The material properties of aluminium, the penetrative-free fixing method, and the absence of any lap joints offer an excellent long term solution.

The flexibility of standing seam roofs - curvature (from 6m upwards) and pitches (down to 1.5°) enhance green roof design possibilities.

At steeper pitches, baffle plates can be used to restrain the growing medium without penetrating the metal roofing substrate.

Floradrain drainage layers are supplied pre-cut to suit the standing seam module. The filter sheet, installed above, ensures that fines do not block the drainage holes. Alumasc ZinCo growing medium (50 to 70mm) is then installed before planting (eg, sedums, rockery plants, herbs).

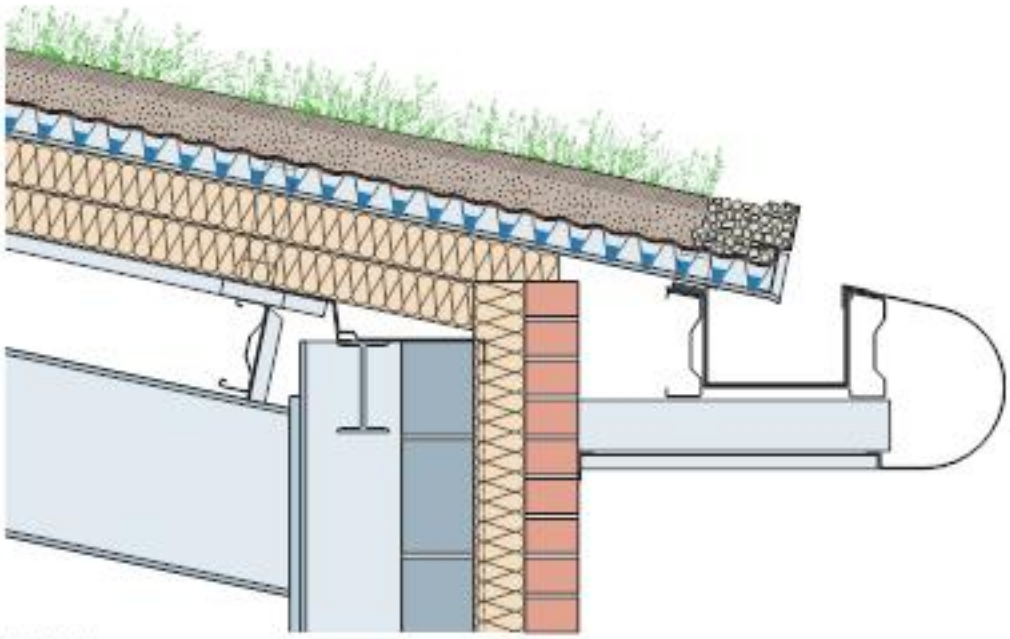


Fig 26: Eaves

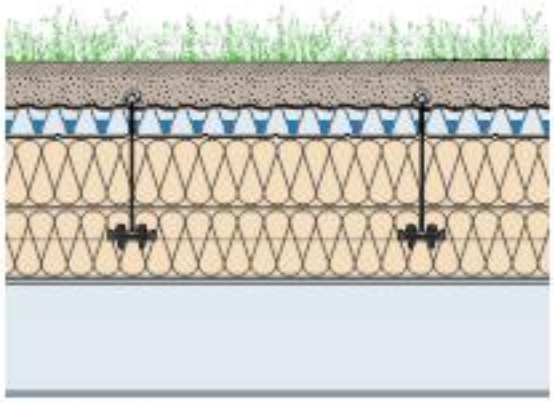


Fig 27: Section

Table 12: Technical data

Green Roof Depth	Approx. 100mm
Green Roof Weight (wet)	Approx 110kg/m²
Armaseam Sheet Weight	3.55kg/m²

Weight and depth of overall construction is subject to structure and U-value.

Features - Extensive Green Roof on Standing Seam

- Aluminium offers a long, corrosion-free life - requiring little or no maintenance - after which it is 100% recyclable.
- Secret-fix roof system - no holes, no leaks - suitable for low pitched and curved roofs.
- Lightweight aluminium weatherproofing, reducing loads to structure.
- Insulated standing seam construction, achieving an 'A' rating in the Green Guide to Specification (3rd Edition).
- Suitable for retro-fitted green roofs.

Lightweight Semi-Intensive and Intensive Installation

Low Pitched Flat Roofs

Floradrain® FD 40-E

Floradrain® FD 40-E is identical to Floradrain® FD 25-E, but with an increased depth of 40mm. This gives sufficient increased water storage capacity to support both extensive and intensive green roofs.

Rainfall collects in the storage cells. Roots are supplied with both air and water through capillary action. Water is also held in moisture mats that protect the waterproof membrane whilst retaining moisture and nutrients. Excess water drains away beneath the drainage layer.

ZinCo extensive green roof solutions from Alumasc include special substrates for both extensive and intensive green roofs. Hardy, drought and frost-resistant plants are required for low maintenance extensive roofs, whilst a Floradrain® FD 40-E roof with greater substrate depth can support more intensive planting with small shrubs.

With Floradrain® FD 40-E design possibilities are wide ranging and can include pedestrian areas such as footpaths and terraces.

Table 13: Technical data

Material	High density polyethylene (HDPE)
Height	40mm
Weight	2.2kg/m² dry, 6.2kg/m² wet
Dimensions	2m x 1m or rolls 10m x 1m
Water retaining capacity	4l/m²
Maximum pressure load (empty)	170kN/m²
Maximum pressure load (infilled)	250kN/m² approx

Examples of semi-intensive green roofs

Fig 28: Semi-Intensive/Intensive Green Roof on Inverted Roof with Floradrain® FD 40-E

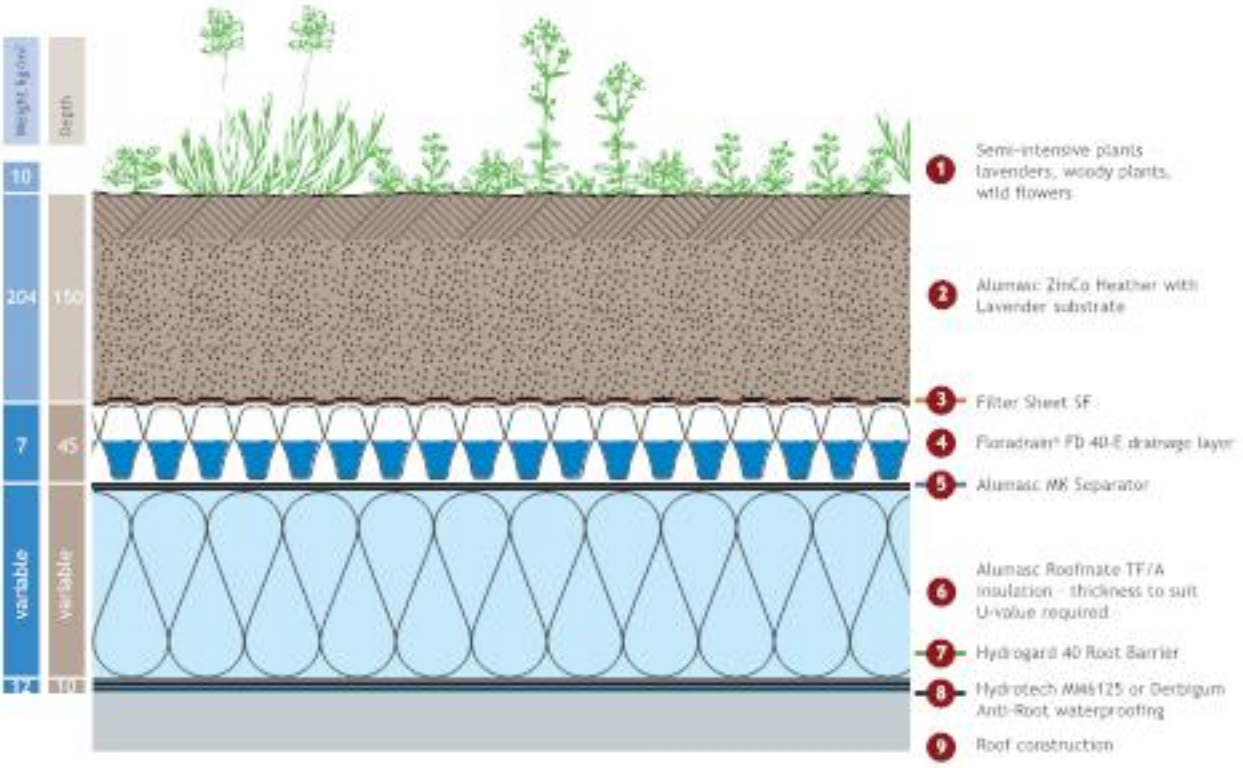


Table 14: System summary

Build-up height	approx 195mm
Wet weight (including plants)	approx 220kg/m²
Water retention capacity	approx 80l/m²

Features - Floradrain® FD 40-E green roof

- Ideal for extensive green roofs with a variety of hardy, drought-resistant planting - the ecologically sound alternative to gravel coverings. Increased depth provides sufficient water storage capacity to make Floradrain® FD 40-E also suitable for intensive green roofs.
- Suitable for flat roofs and roofs with a slope up to 10°.
- Suitable for flat roofs with no falls in cases where residual ponding is less than 40mm, thereby keeping the substrate clear of the water beneath.
- Offers various design possibilities with a variety of planting, and can be used for areas of pedestrian traffic such as footpaths and terraces.
- The construction is resistant to flying sparks and is a 'hard roof' in accordance with German Building Standard DIN 4102 dealing with fire resistance.
- The drainage layer meets the requirements of German Building Standard DIN 4095.

Intensive Installation

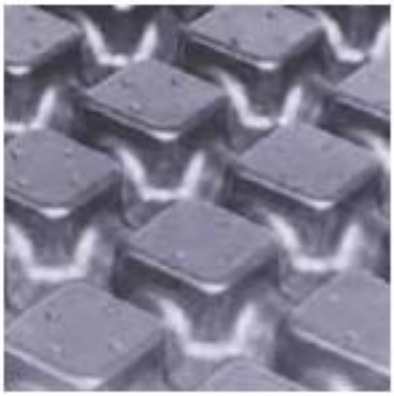
Low Pitched and Zero Falls Flat Roofs

Floradrain® FD 60

Floradrain® FD 60 has a greater depth than either Floradrain® FD 25-E or FD 40-E. It is ideal for virtually any type of intensive green roof landscape, including roof gardens, terraces, play areas, water features, roadways and car parks.

Rainfall collects in the storage cells, which have significantly more water transfer capacity than FD 25-E and FD 40-E. Roots are supplied with both air and water through capillary action. Water is also held in moisture mats that protect the waterproof membrane whilst retaining moisture and nutrients. Excess water drains away beneath the drainage layer.

Floradrain® FD 60 is so strong it can be used as shuttering for concrete, forming the base for roadways.



Lawned intensive green roof with Floradrain® FD 60 drainage layer

Table 15: Technical data

Material	ABS-Plastic
Height	60mm
Weight (Dry)	2.3kg/m²
Weight (Wet with infill)	43kg/m²
Dimensions	1m x 2m
Water retaining capacity (filled with Zincolit)	5l/m²
Maximum pressure load (empty)	19kN/m²
Maximum pressure load (infilled)	75kN/m²

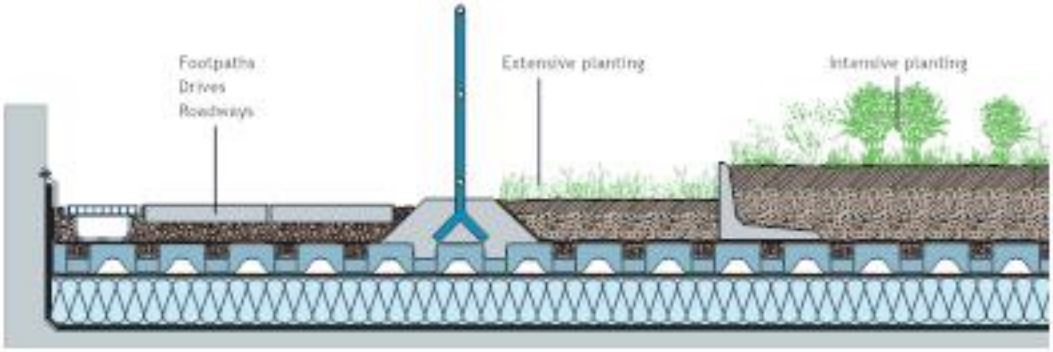


Fig 29:

Fig 30: Intensive Green Roof on Inverted Roof with Floradrain® FD 60

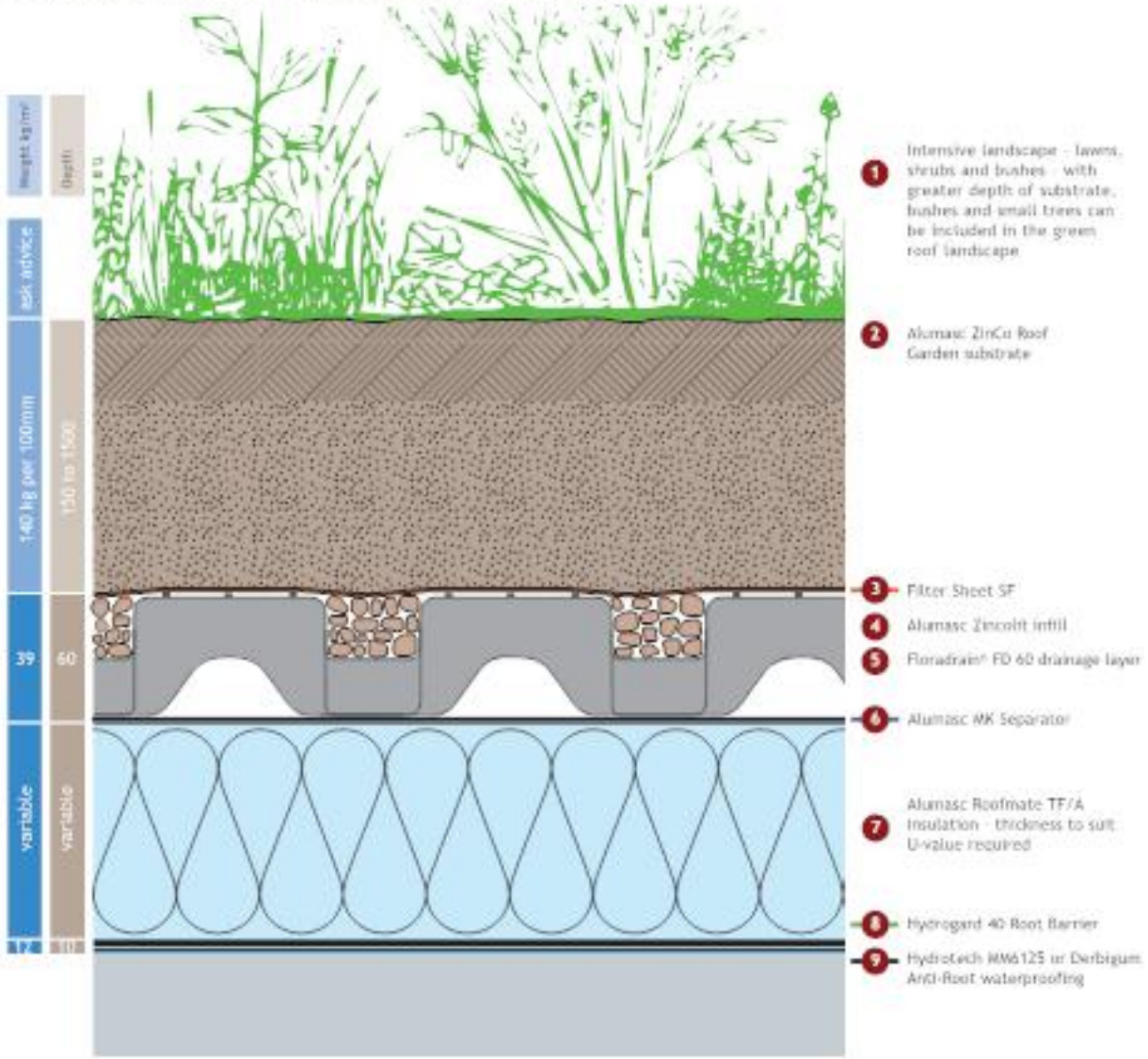


Table 16: System summary

Build-up height	from approx 220mm, plus insulation
Wet weight (including plants)	from approx 270kg/m²
Water retention capacity	starts at 90l/m²

Features - Floradrain® FD 60 green roof

- A highly versatile, multi-functional system for intensive green roofs that is capable of supporting virtually any form of green roof landscaping.
- Suitable for walkways, paths, terraces, play areas, water features, and vehicular areas such as drives, roadways and car parks.
- Can be used as shuttering for concrete in the construction of roads and foundations without impeding drainage over the waterproofing membrane.
- On roofs with no falls, FD 60 can be used with the ZinCo Roof Dam water storage system, and also with the Alumasc ZinCo automatic irrigation control system, or the ZinCo HydroSolar system with solar powered irrigation control - see pages 48 - 49.
- The construction is resistant to flying sparks and is a 'hard roof' in accordance with German Building Standard DIN 4102 dealing with fire resistance.
- The drainage layer meets the requirements of German Building Standard DIN 4095.

Intensive Installation

Zero Falls Roofs with Reservoir Irrigation

Floradrain® FD 60

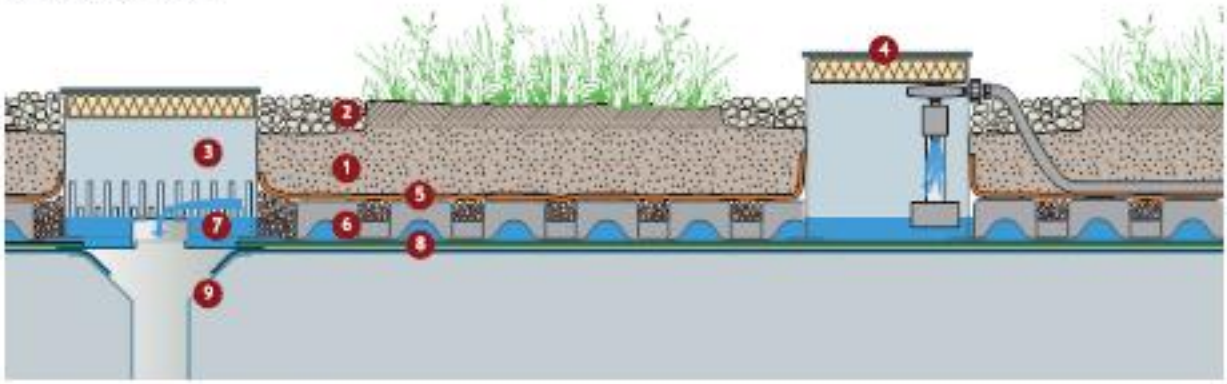


Fig 31: ZinCo Irrigation System

By making use of the 60mm depth of the FD60 profile, the drainage board is used to create a 40mm deep reservoir underneath the green roof substrate when installed on a dead flat structure. By the process of evaporation, the water in the reservoir will expirate into the substrate above, maintaining the correct level of moisture within the substrate and thus ensuring healthy vegetation.

The reservoir is kept topped up by the use of cistern-type irrigation units, which can either draw additional water from the mains or, if a harvesting system is used to gather excess rainwater, by use of a photovoltaic powered pump which can draw water from the harvest system storage.

The significant reduction in potable water usage of this system over traditional sprinkler irrigation installations, due to there being only minimal loss to evaporation, makes this system particularly well suited to developments where water supply is metered.

1. Alumasc ZinCo Roof Garden Substrate
2. 20-40mm round pebble >vegetation barrier
3. ZinCo inspection chamber
4. ZinCo irrigation unit
5. Filter sheet SF
6. Floradrain® FD 60 drainage layer with Alumasc Zincolit infill
7. ZinCo Roof Dam damming piece
8. Hydrotech 6125 waterproofing with Hydrogard 40 root barrier
9. Harmer outlet with flat grate

Fig 32: Irrigated intensive green roof on inverted roof to zero falls with Floradrain® FD 60

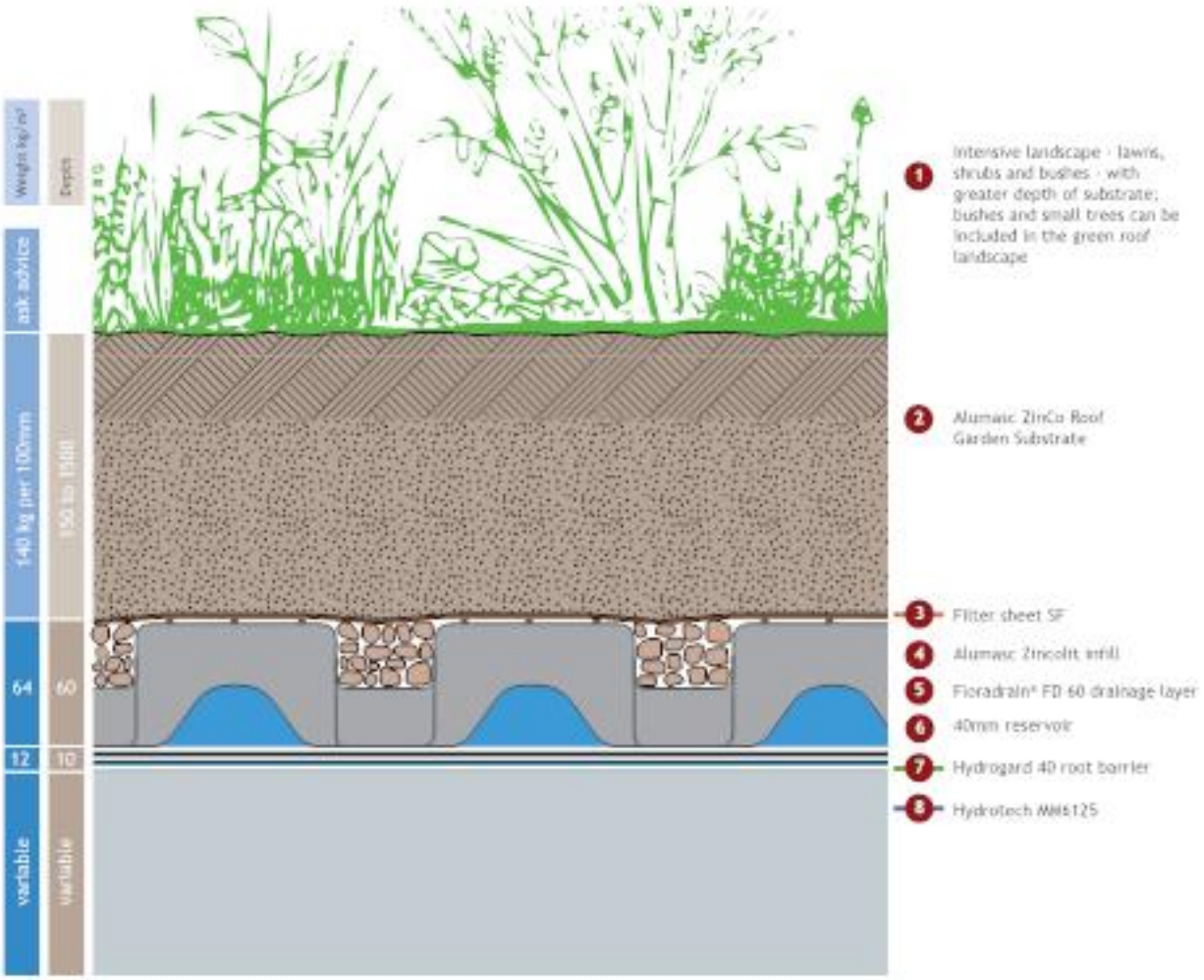


Table 17: System summary

Build-up height	from approx 220mm
Wet weight (including plants)	from approx 290kg/m²
Water retention capacity	starts at 90l/m²

Features - Irrigated Floradrain® FD 60 green roof to zero falls

- A highly versatile, multi-functional system for intensive green roofs that is capable of supporting virtually any form of green roofing.
- Automatic irrigation system maintains a 40mm water reservoir during the growing season.
- The construction is resistant to flying sparks and is a 'hard roof' in accordance with German Building Standard DIN 4102 dealing with fire resistance.
- The drainage layer meets the requirements of German Building Standard DIN 4095.

Intensive Installation - Predominantly Hard Landscape

Elastodrain EL 200 and EL 202

Elastodrain EL 200/202 are heavy duty protection and drainage mats of solid rubber, designed for use on recreational intensive green roofs and landscaped underground car parks. Elastodrain is also suitable for pathways, terraces, play areas, and is strong enough for vehicular traffic.

Elastodrain EL 200 has a 6mm base with 14mm projections to support the landscape above. An especially stiff filter sheet (Filter sheet TG) is required.

Elastodrain EL 202 has twice the number of projections and has exceptional resistance to compression. It is suitable for roads bearing heavy vehicles, and can withstand traffic from site plant during installation.

Elastodrain EL 200/202 is ideal for recreational green roofs which need to withstand heavy traffic.

Table 18: Technical data

	EL 200	EL 202
Material	Recycled rubber	Rubber
Thickness	20mm	19mm
Weight	14kg/m²	18kg/m²
Studs	600/m²	1200/m²
Dimensions	1m x 1m	1m x 1m

Fig 33: Intensive Green Roof on Warm Roof with Elastodrain EL 200 or EL 202

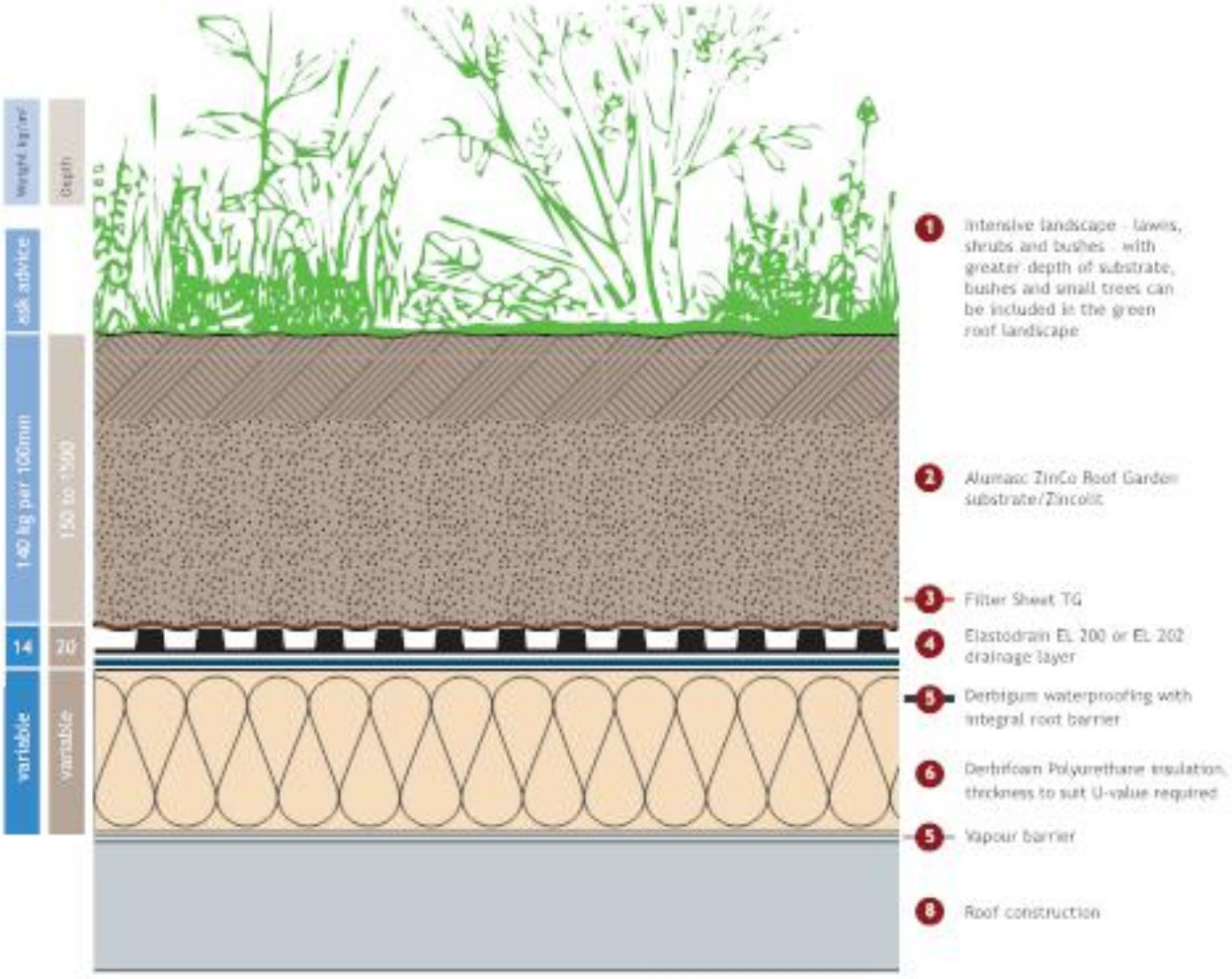


Table 19: System summary

Build-up height	approx 220mm
Wet weight (including plants)	approx 320kg/m²
Water retention capacity	approx 74l/m²

Features - Elastodrain EL 200/EL 202 green roof

- A heavy duty system for use on recreational intensive green roofs and underground car parks.
- Can withstand high mechanical loading and is spade resistant.
- Precast concrete planters can be installed with Elastodrain as the base.
- Complies with German National Standards DIN 18 195 and 4095.
- Resistant to oil and bitumen.
- Reduces transmission of noise and vibration.
- Easy and quick to install - simply butt-jointed.

Floradrain® FD 25-E Application Details

Abutment Detail

At upstands the waterproofing must be taken up 150mm above the finished surface of the roof - 100mm if the pitch is above 5%.

The waterproofing should be mechanically fixed back with a termination bar, preferably with a counter flashing. The counter flashing should also protect the root barrier, moisture retention mat and filter sheet from UV.

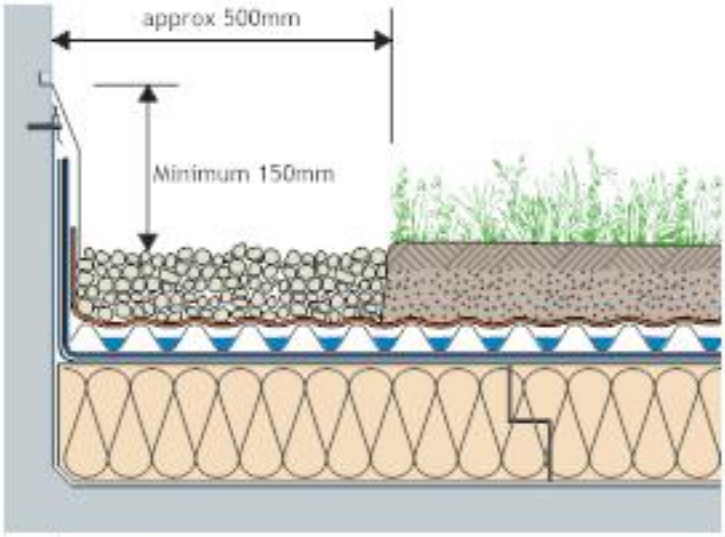


Fig 34:

Roof Perimeter

There should be a minimum 100mm upstand at roof edges - approx 50mm if the slope is 5° or more. The roof edging should have a coping with the slope to the inside of the roof. The root barrier, moisture retention mat and filter sheet should be taken above the water bearing level and be protected from UV, for example by an angle as shown.

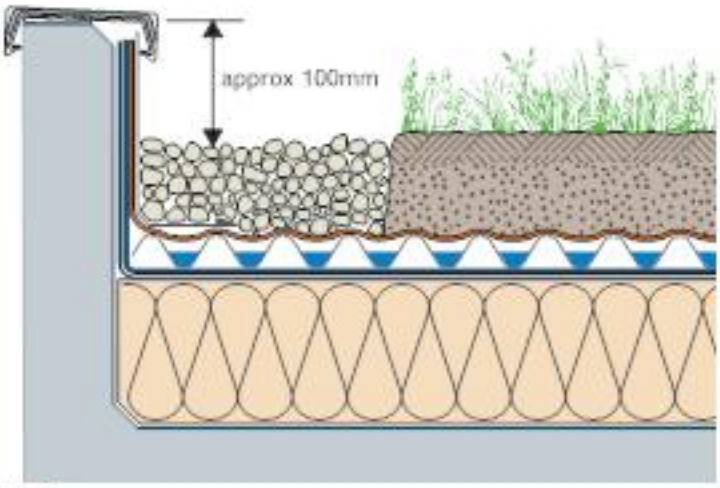


Fig 35:

Facade Drainage

At the base of facades, more water drains down than is often realised and a linear grille is recommended.

The use of the terrace linear grille, FR-HK, enables the use of a fillet to angle the roof waterproofing in the normal way.

The height of the grating can be adjusted from 65 to 115mm. The base units incorporate slots to allow the water to drain through the drainage layer.

Below paving, the Floradrain® is infilled with Zincolit to increase the compression resistance of the drainage layer.

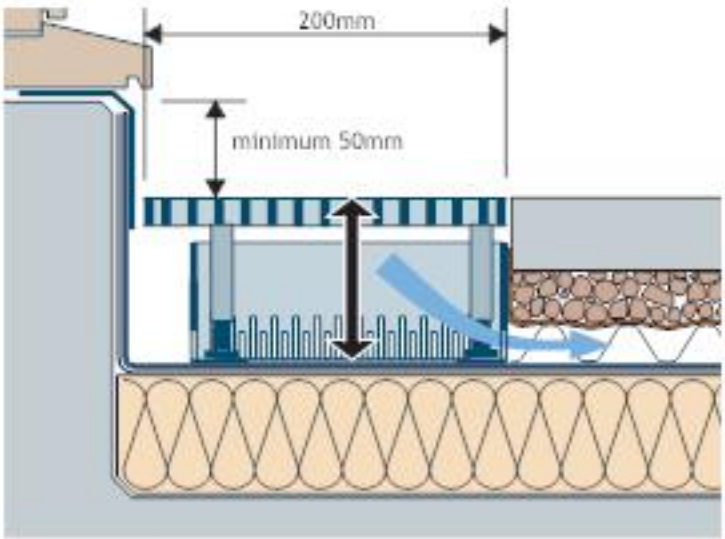


Fig 36:

Eaves Details

The use of retaining trims helps to solve a number of problems that occur at the eaves.

Slots in the vertical face of the trim allow water from the drainage layer of the green roof to drain into the eaves gutter. The base section of the trim has a series of holes. It is secured in place by bonding a strip of waterproofing material through the holes to the main roof waterproofing below.

The vertical arm of the trim is designed to hold concrete edging blocks in place, providing a neat and secure edge to the roof.

The trim is also designed to hold pebbles in place. The filter sheet should be carried under the pebbles and turned up at the edge trim to prevent a build-up of silt in the drainage layer.

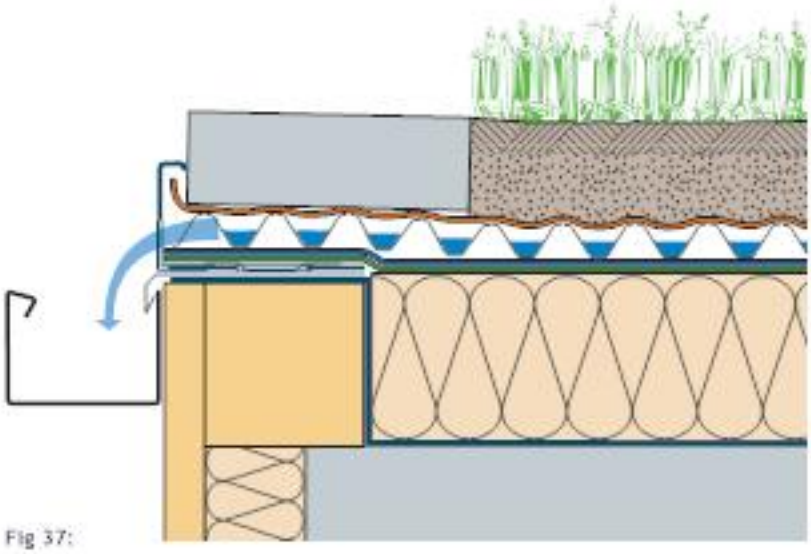


Fig 37:

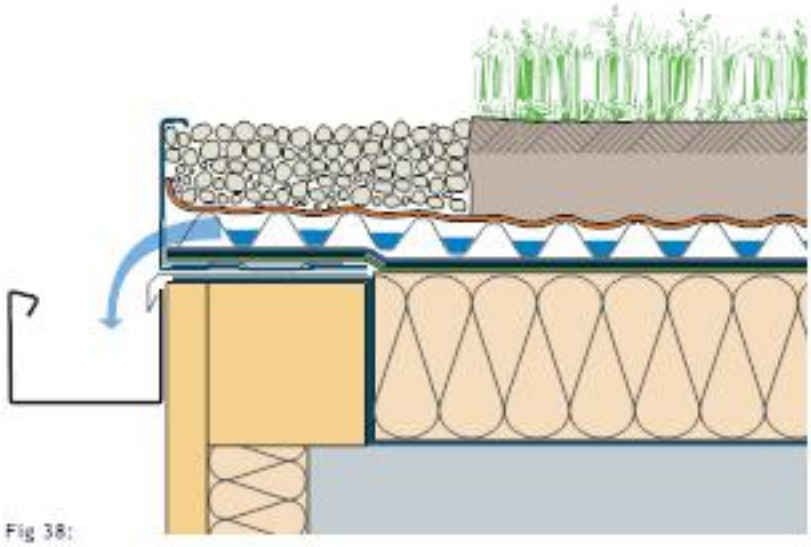


Fig 38:

Inspection Chamber

When roof outlets are located in planted areas it is necessary to provide an inspection chamber to allow access to the roof drain outlet for inspection and cleaning. Alumasc supplies inspection chambers in various depths to suit the depth of the build-up.

The inspection chamber is surrounded by at least a 300mm wide strip of washed gravel to prevent strong plant growth in this area and enable any surface water to drain off.

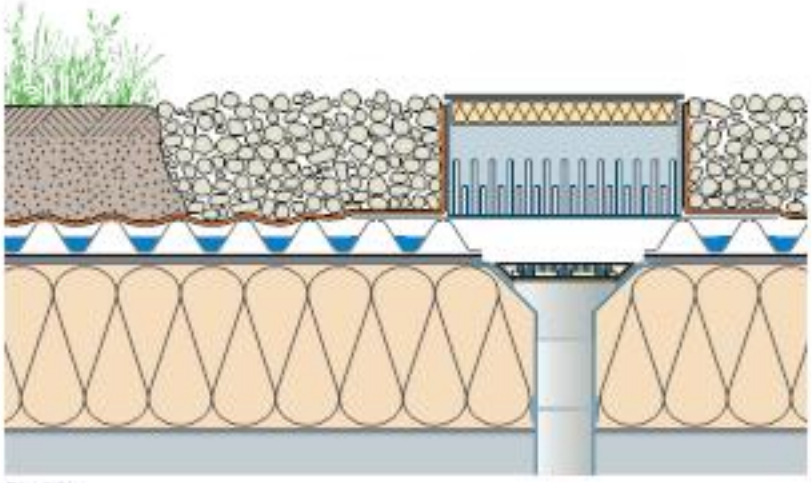


Fig 39:

Floraset FS 50 Application Details

Abutment Detail

At upstands the waterproofing must be taken up 150mm above the finished surface of the roof - 100mm if the pitch is above 5%.

The waterproofing should be mechanically fixed back with a termination bar, preferably with a counter flashing. The counter flashing should also protect the root barrier, moisture retention mat and filter sheet from UV.

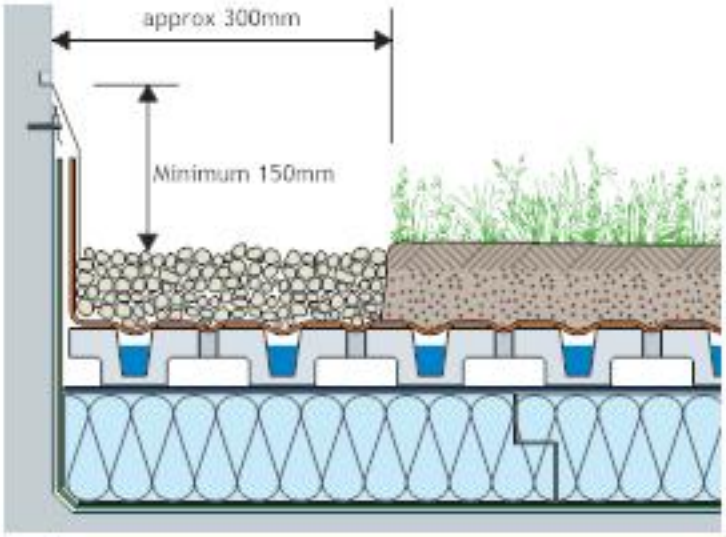


Fig 40:

Roof Perimeter

There should be a minimum 100mm upstand at roof edges - approx 50mm if the slope is 5° or more. The roof edging should have a coping with the slope to the inside of the roof. The root barrier, moisture retention mat and filter sheet should be taken above the water bearing level and be protected from UV, for example by an angle as shown.

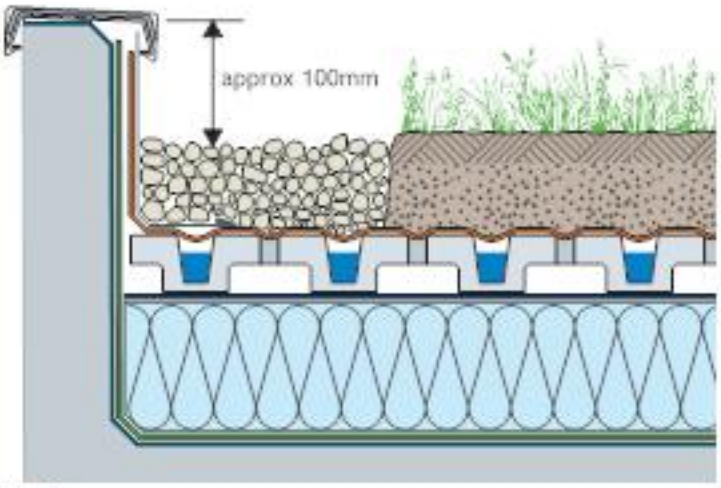


Fig 41:

Facade Drainage

At the base of facades, more water drains down than is often realised and a linear grille is recommended.

The use of the terrace linear grille, FR-HK, enables the use of a fillet to angle the roof waterproofing in the normal way.

The height of the grating can be adjusted from 65 to 115mm. The base units incorporate slots to allow the water to drain through the drainage layer.

Below paving, the Floraset is infilled with Zincolit to increase the compression resistance of the drainage layer.

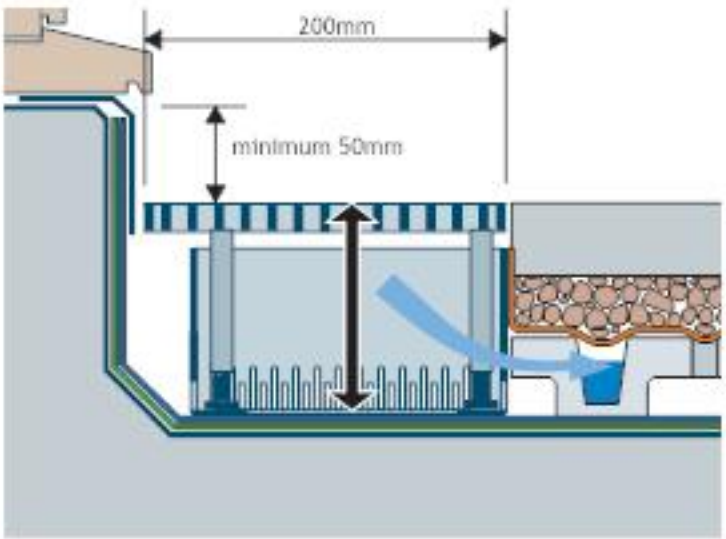


Fig 42:

Eaves Details

The use of retaining trims helps to solve a number of problems that occur at the eaves.

Slots in the vertical face of the trim allow water from the drainage layer of the green roof to drain into the eaves gutter. The base section of the trim has a series of holes. It is secured in place by bonding a strip of waterproofing material through the holes to the main roof waterproofing below.

The vertical arm of the trim is designed to hold concrete edging blocks in place, providing a neat and secure edge to the roof.

The trim is also designed to hold pebbles in place. The filter sheet should be carried under the pebbles and turned up at the edge trim to prevent a build-up of silt in the drainage layer.

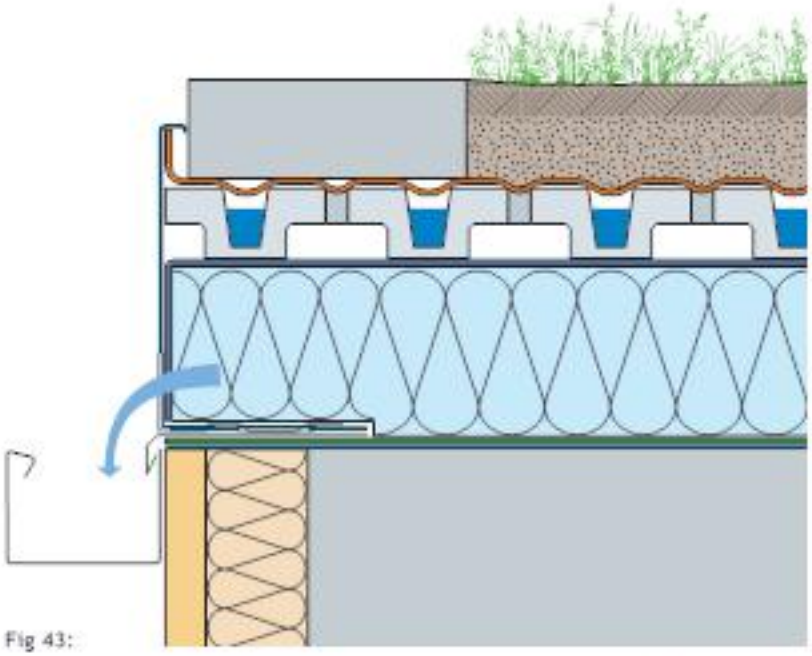


Fig 43:

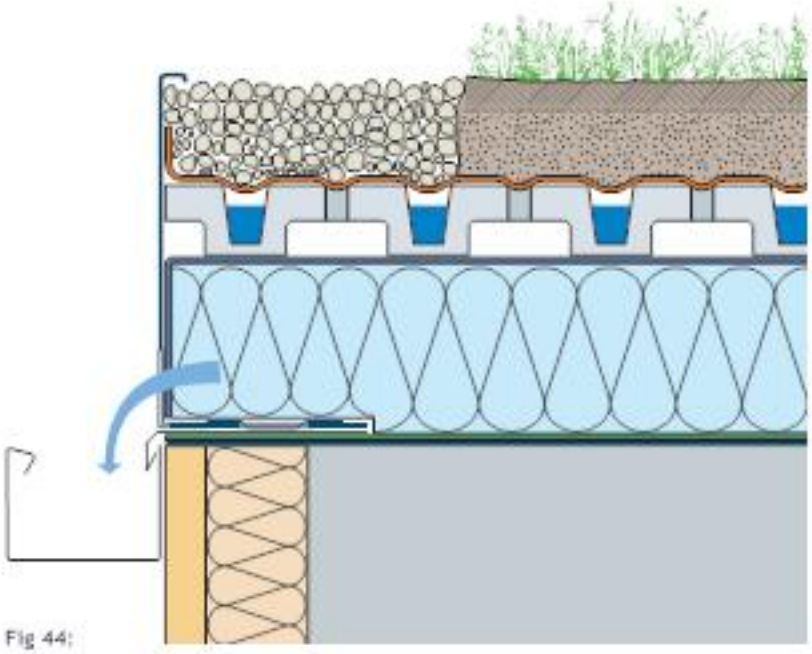


Fig 44:

Inspection Chamber

When roof outlets are located in planted areas it is necessary to provide an inspection chamber to allow access to the roof drain outlet for inspection and cleaning. Alumasc supplies inspection chambers in various depths to suit the depth of the build-up.

The inspection chamber is surrounded by at least a 300mm wide strip of washed gravel to prevent strong plant growth in this area and enable any surface water to drain off.

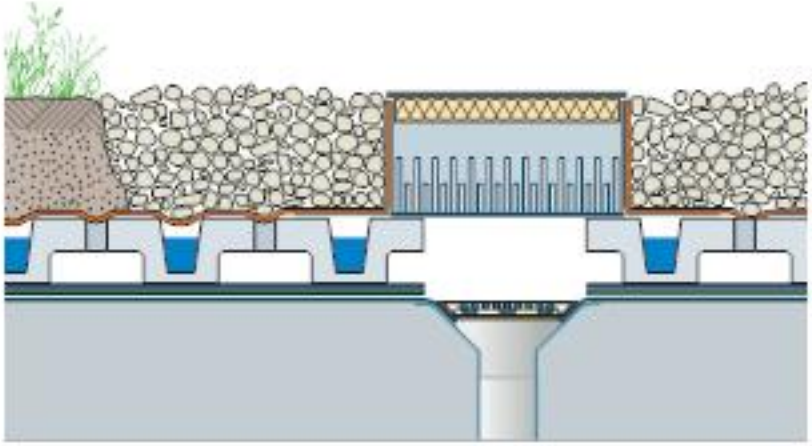


Fig 45:

Sloping Roofs Application Details

Eaves Detail

The stop rail is raised above the level of the waterproofing membrane, by brackets, to allow water to run off the roof and into the gutter. The stop rail prevents the Floraset units from sliding down the roof.

A filter sheet is fixed to the back of the stop rail and below the washed gravel to prevent fines from being washed down and blocking the drainage slot.

The planting and substrate is stopped short of the eaves and replace by washed gravel or Zincolit to prevent strong plant growth in this area.

Fig 46:

Verge Detail

The waterproofing membrane and the moisture mat are both turned up at the verge and protected by a capping trim.

The planting and substrate is stopped short of the verge and replace by washed gravel or Zincolit to prevent strong plant growth in this area.

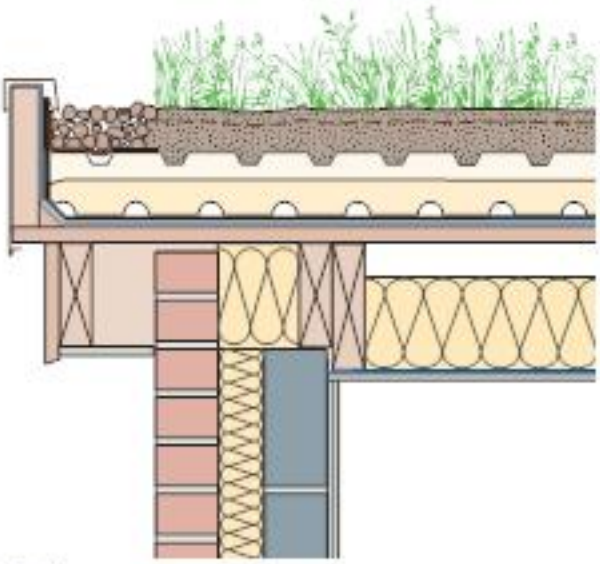


Fig 47:

Slopes over 20°

Where the roof slope is 20° or more, shearing protection is necessary. This is achieved by introducing intermediate cross battens, as shown, to deal with the shear forces.

The spacing of the battens depends on the roof slope:

20° slope, battens at 10m centres

25° slope, battens at 8m centres

30° slope, battens at 5m centres.

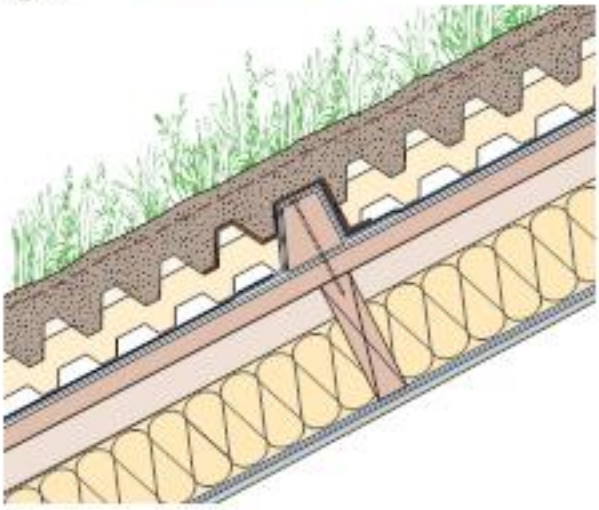


Fig 48:

Metal Roof Application Details

Typical Section Detail

Floradrain drainage layers are supplied pre-cut to suit the standing seam module. The filter sheet, installed above, ensures that fines do not block the drainage holes. ZinCo growing medium (50 to 70mm) is then installed before planting (eg, sedum, herb).

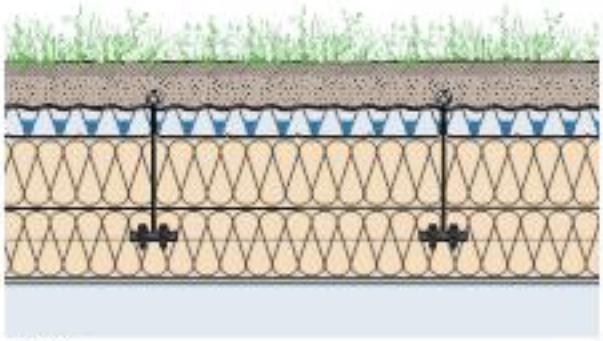


Fig 49:

Verge Detail

Form the verge detail using standard Armaseam® components - verge channel, verge clip and verge tolerance section. A neoprene membrane can be installed for additional weatherproofing before fixing the verge fascia.

The planting and ZinCo growing medium is stopped short of the verge and is replaced by washed gravel to prevent strong plant growth in this area.

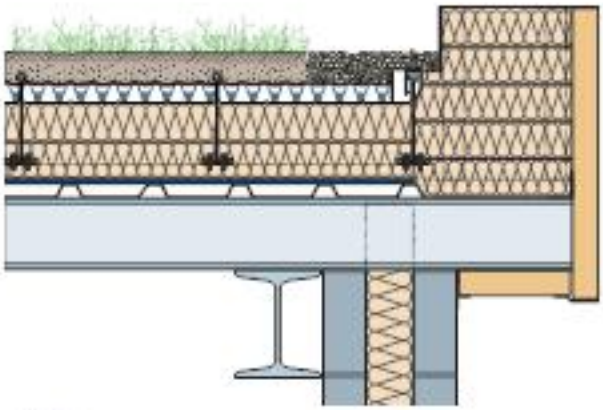


Fig 50:

Ridge Detail

For pitched roofs, turn up the sheet ends and install Armaseam® ridge foam fillers, dams and zed supports, before securing the ridge flashing.

The planting and ZinCo growing medium is stopped short of the apex and is replaced by washed gravel to prevent strong plant growth in this area.

The fixed point arrangement must accommodate all in-plane forces. Consult AEBP Ltd Technical Department for further assistance.

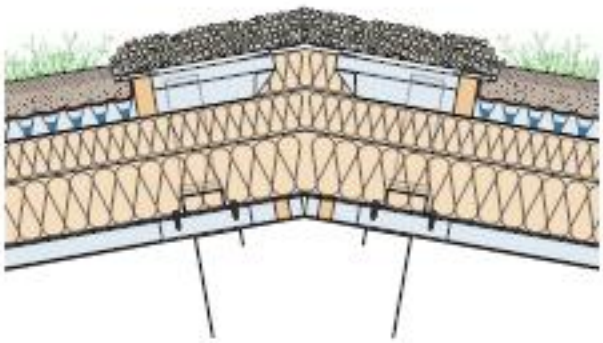


Fig 51:

Eaves Detail

Turn down Armaseam® sheet and fix the eaves drip angle.

The planting and ZinCo growing medium is stopped short of the eaves and is replaced by washed gravel. Secure the eaves retaining angle to the Armaseam® seam clip, preventing gravel from entering the gutter, yet permitting the drainage of any rainwater.

Choose from the extensive Alumasc gutter and rainwater pipe ranges for the drainage of excess rainwater and from the Alumasc Skyline range of fascia and soffit for aesthetic appeal.

Floradrain drainage layers are supplied pre-cut to suit the standing seam module. The filter sheet, installed above, ensures that fines do not block the drainage holes. ZinCo growing medium (50 to 70mm) is then installed before planting (eg, sedum, herb).

Fig 52:

Floradrain® FD 40-E Application Details

Paving Edge Detail

Paved areas can easily be combined with planted areas.

Built on the continuous base and drainage layers, the paving can be bedded onto Zincolit, crushed gravel or sand. Kerbs of treated timber, precast concrete or brick pavers provide a simple border between the hard and soft landscaping.

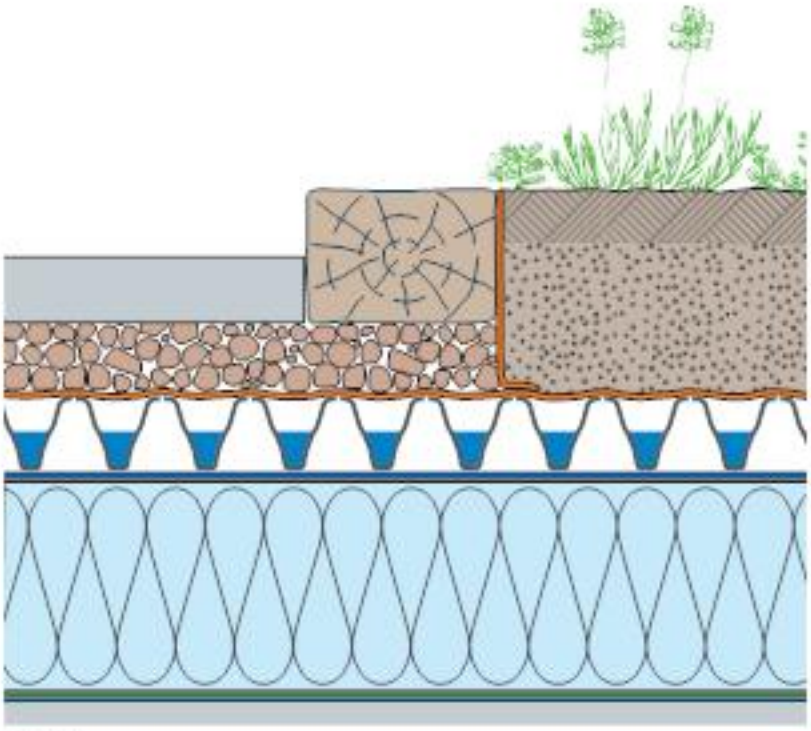


Fig 53:

Threshold Detail

Providing a 150mm upstand beneath door thresholds is often difficult to achieve. The installation of a ZinCo drainage channel can solve the problem and permits an upstand of only 50mm. The channel collects the water run off and directs it into the drainage layer.

Below paving, the Floradrain® is infilled with Zincolit to increase the compression resistance of the drainage layer.

At the junction of the paving and planting, a kerb is haunched up with mortar laid directly on the Floradrain®. The Floradrain® allows water to drain below it. The filter sheet SF in the planting area should be turned up at the kerb to prevent grit from washing down and obstructing the drainage below.

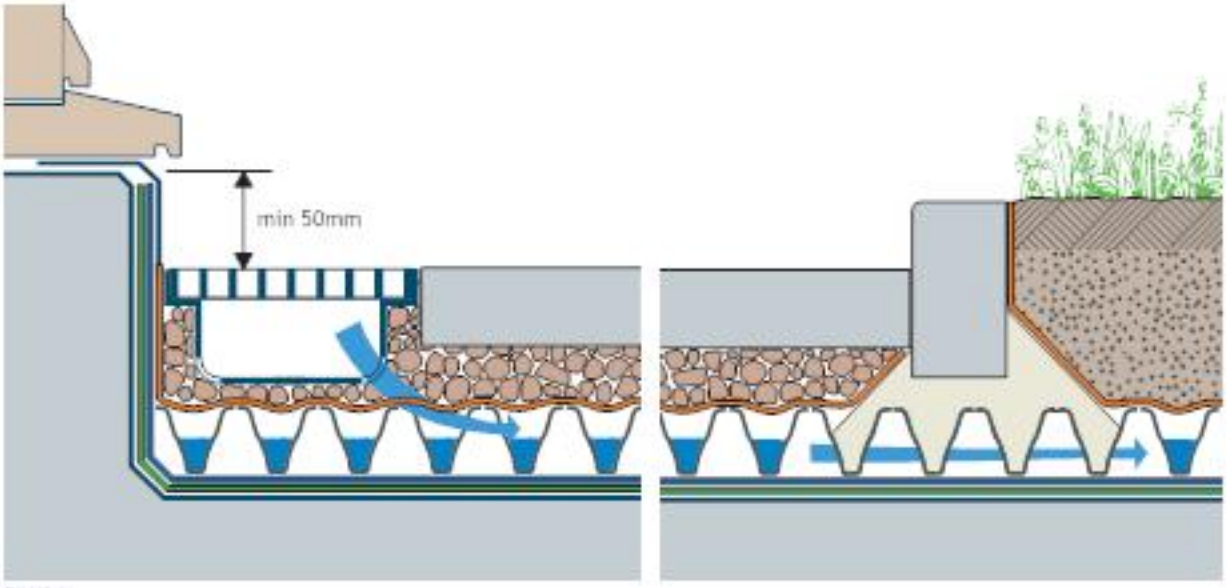


Fig 54:

Terrace Drainage

When roof outlets are located in paved areas, a terrace grating is available that allows access to the roof drain outlet. The dimensions correspond to those of terrace slabs: 200 x 400mm, 400 x 400mm, 500 x 500mm.

This ensures excellent drainage from the surface as well as through the drainage layer.

The grating is height adjustable from 60 to 90mm high. The height adjustment is easily carried out with a screwdriver.

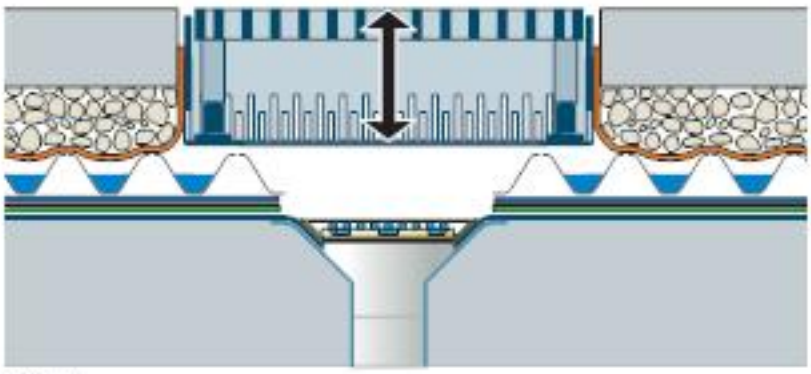


Fig 55:

Rooflight Junction

A 500mm wide safety area is recommended around rooflights to enable inspection and provide a fire break.

The detail shows the green roof built over a warm roof construction.

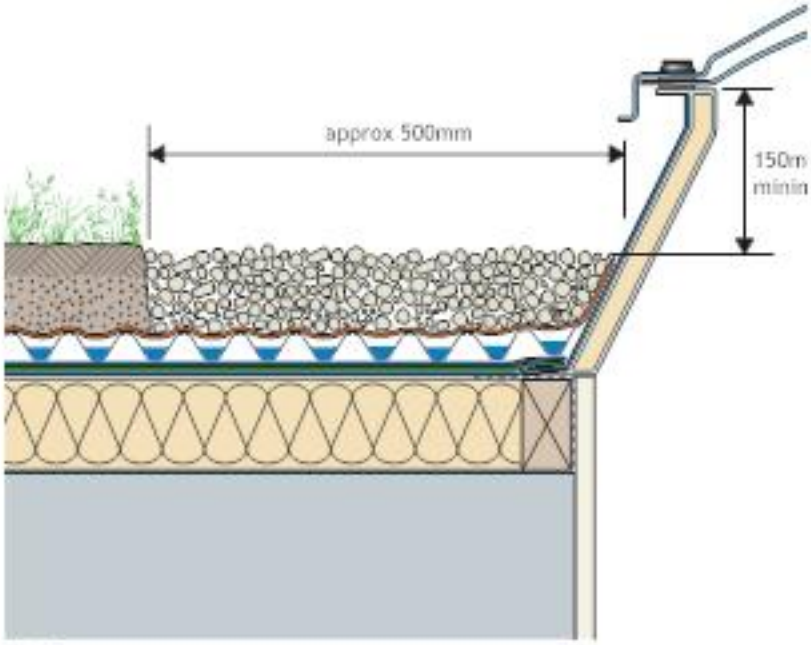


Fig 56:

Floradrain® FD 60 Application Details

Roof Dam

With intensive planting it is necessary to conserve as much rainwater as possible for plant use, thereby keeping additional watering to a minimum.

The channel system on the underside of the Floradrain® FD 60 is capable of retaining 40mm of water. This can be used by installing roof dams over the roof outlets. Inspection chambers allow access for cleaning purposes and enable the roof dam coverings to be removed in winter.

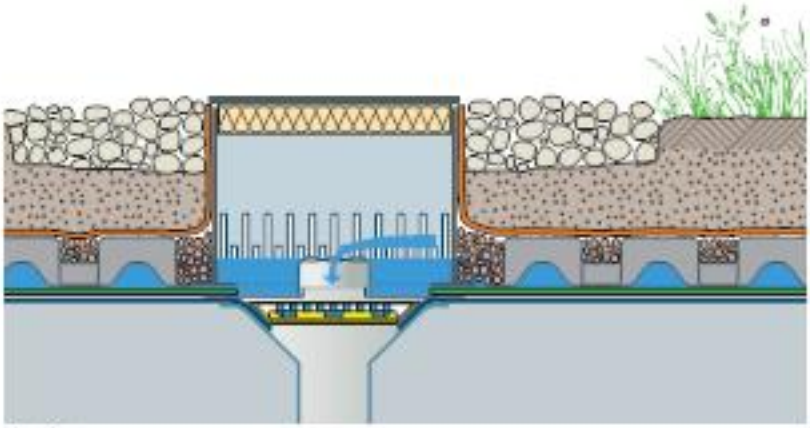


Fig 57:

Tree Anchorage

All trees on roofs should be anchored down to prevent wind damage. Tree anchorage fixings through the waterproofing layer are to be avoided.

A solution is to use a galvanised reinforcing mat below the tree root ball. This spreads the forces from strong winds over a wide area, minimising the risk of uprooting the tree.

An alternative is to place paving slabs with eye bolt fixings laid directly over the drainage layer.

Trees prone to wind damage should not be used on roofs.

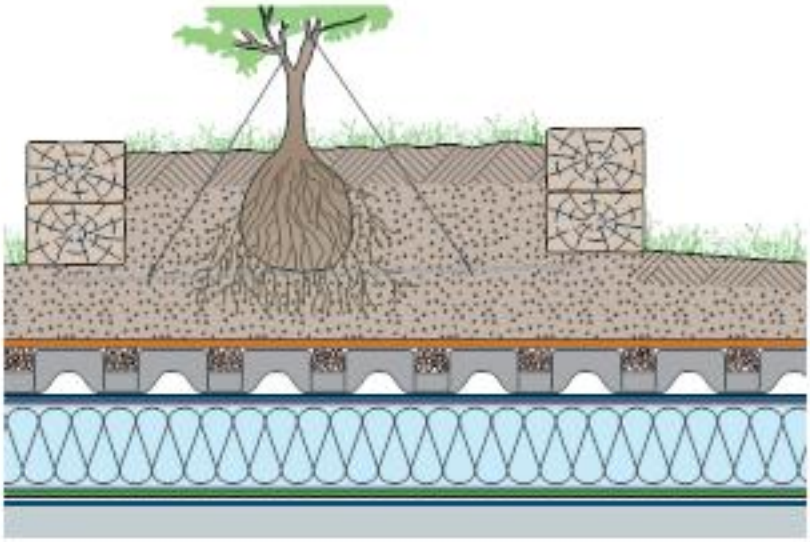


Fig 58:

Landscape Options

Floradrain® FD 60 can support the loading of the most intensive landscaped roof garden. Bushes and small trees are possible with a deeper layer of substrate.

Floradrain® FD 60 is also suitable for hard landscaped areas, including pathways, terraces, play areas and even vehicle access.

Where firm foundations are required for dwarf walls and balustrades, for example, concrete can be placed directly on top of the drainage layer without interrupting the flow of drainage water below.

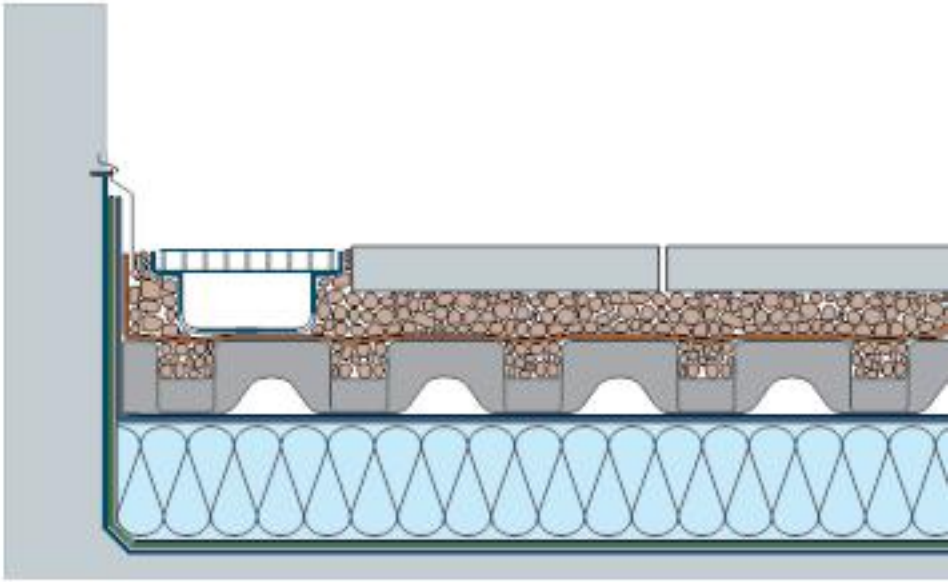


Fig 59:

Road Surface Bordered by Planted Area

The Floradrain® FD 60 units can be used as permanent shuttering and still allow drainage water to flow through the voids formed under them.

This enables concrete sub-bases for road constructions, and foundations for constructions such as balustrading, pergolas etc, without damaging the roof covering.

There are numerous possibilities. The example shows a road formed of block paving.

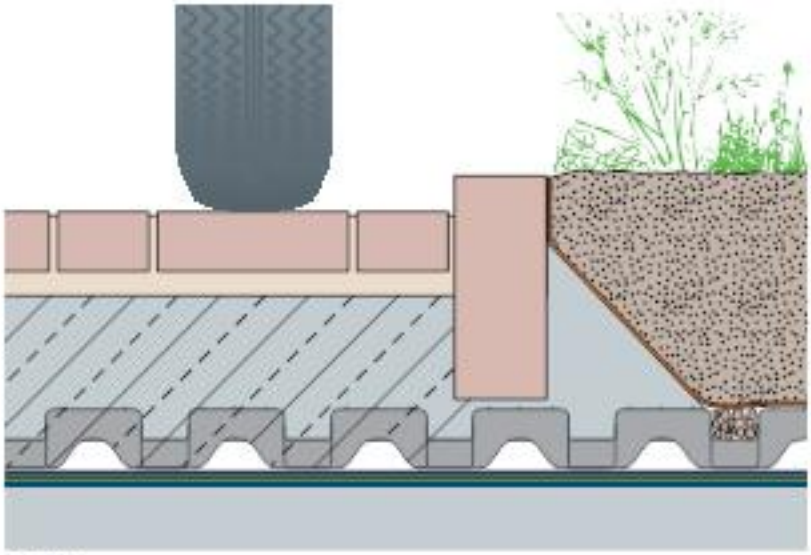
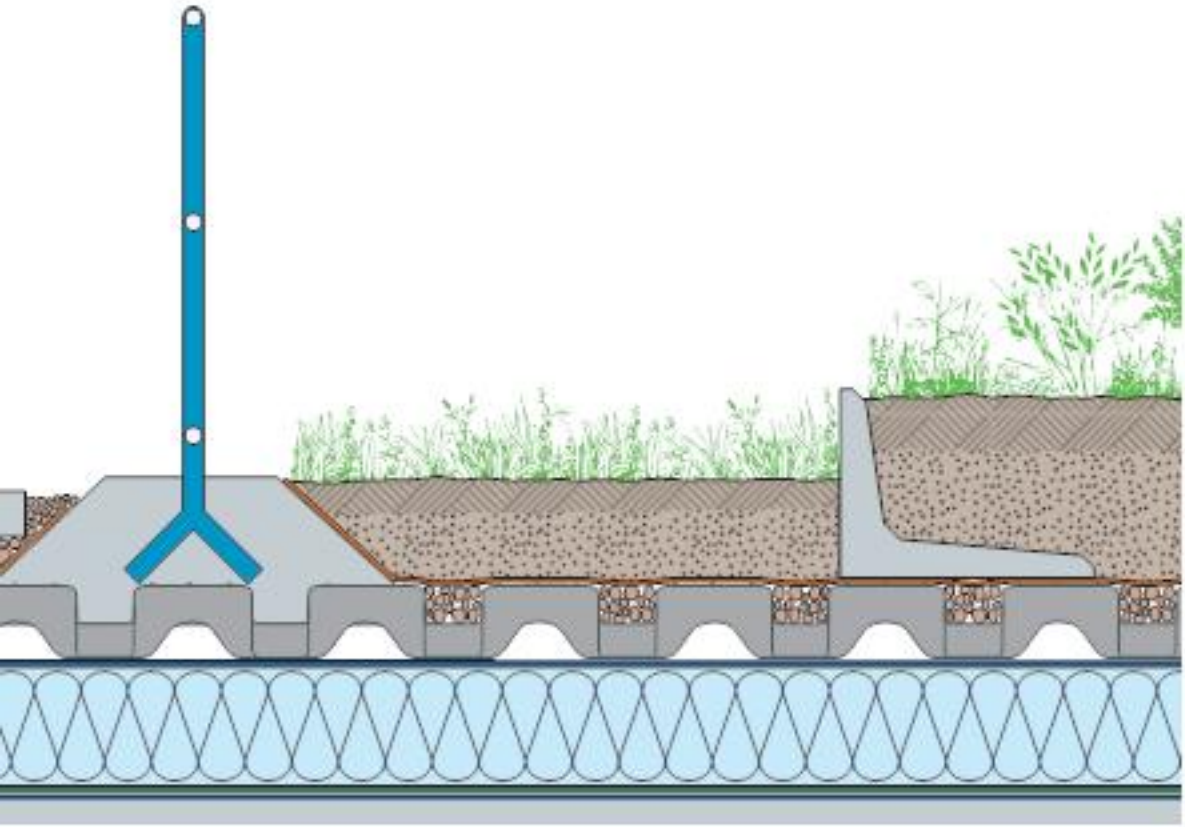


Fig 60:

Table 20:
Concrete thickness for various loadings

Imposed load (tons)	Concrete cover (mm)	Reinforcement 500/550 (bottom layer)
HGV 60	70	Q257
HGV 45	70	Q221
HGV 30	70 60	Q221 Q257
Lorry 16	70 60	Q221 Q257
Lorry 9	60	Q221
Lorry 6	60 50	Q221 Q257
Lorry 3	50	Q131



Elastodrain EL 200 and EL 202

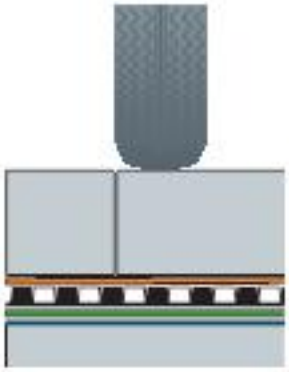


Fig 61:

Directly Laid Vehicular Paving

Elastodrain EL 202 is excellent at withstanding heavy loads and dynamic forces, making it suitable for use under roadways.

Elastodrain mats have a high positional stability after installation.

Fig 62:

Build-up for Heavy Trucks

An alternative build-up where block paving is used for the road finish.

The mats have rebated joints, ensuring excellent protection at the mat edges.

Fig 63:

Access Road for Supply Vehicles

The concrete slab may be replaced by compacted gravel, where less heavy vehicles are expected.

Infiltration water passes through the roadway build-up and is drained away through the Elastodrain layer.

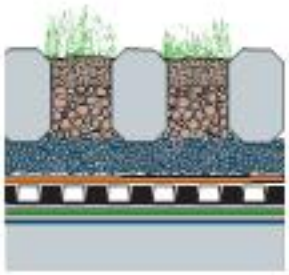


Fig 64:

Car Parking

Proprietary concrete block may be used to enable planting to grow through the spaces between the concrete.

Paving Details

Elastodrain EL 202 enables all hard landscaping ideas to be realised. Send your project ideas to Alumasc Technical Services and we will provide a green roof solution for you.

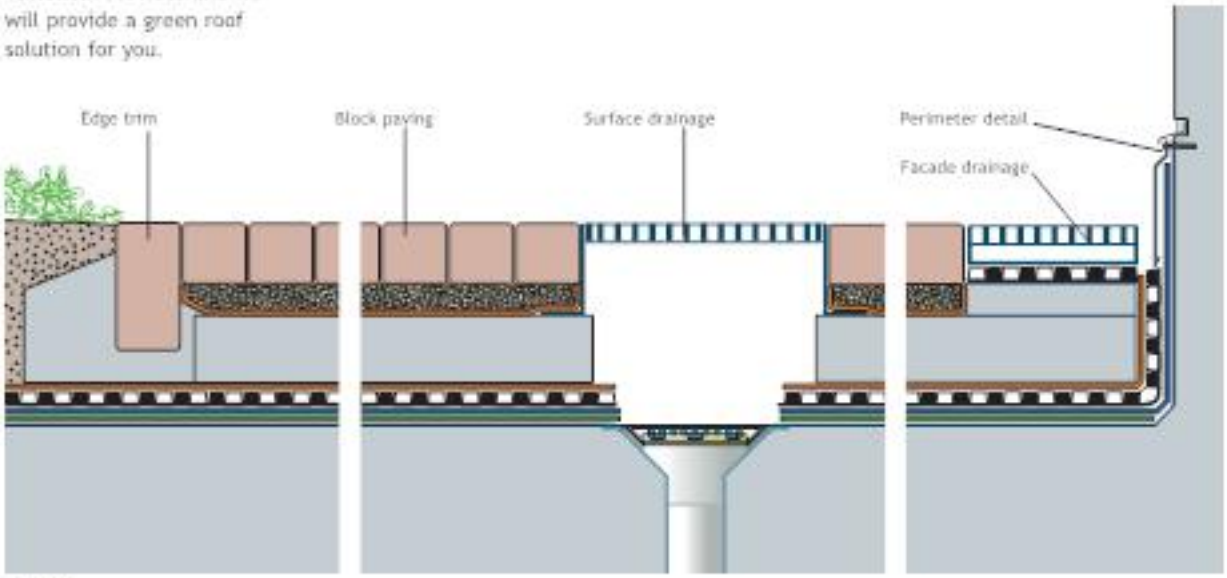


Fig 65:

Wall Abutment

The flexible Elastodrain mat can be extended up the sides of the perimeter wall and sealed with a suitable wall flashing. The top of the flashing should be 150mm above the surface of the paving slab.

The paving slabs may be laid on a strip of washed gravel, ensuring any heavy rainfall onto the wall above will quickly run into the drainage layer. The paved area also makes inspection access easier.

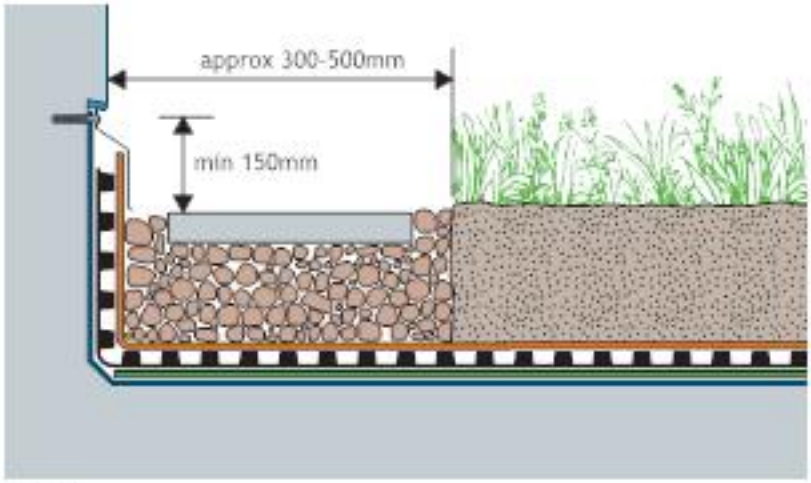


Fig 66:

Edge of Underground Car Park

A deep layer of substrate can be built up at the edge of a loadbearing underground car park deck as shown. Substrate soils can be spread by means of wheel-loaders.

This design is also suitable for pathways, terraced areas, play areas and even vehicle surfaces such as a fire station entrance.

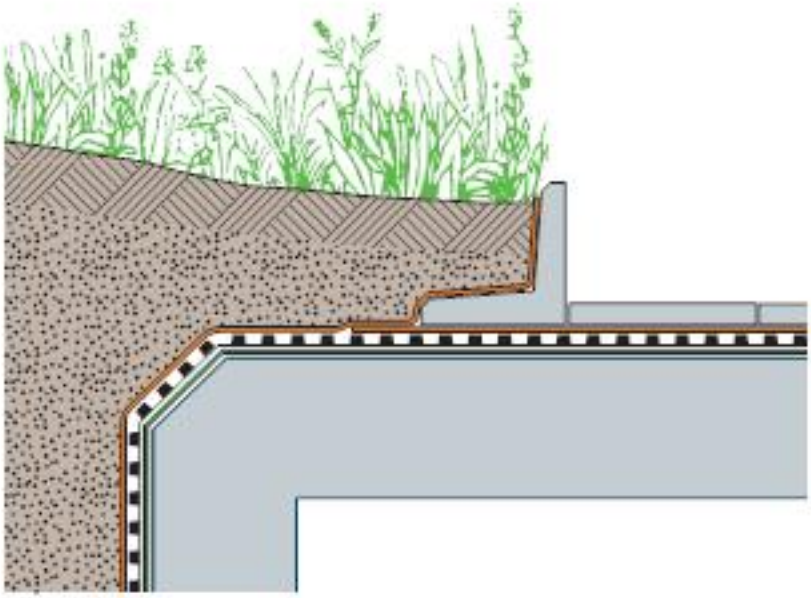


Fig 67:

Ponds and Pools

With the correct design, pools and ponds can be installed on roof decks. The pool lining should be installed on a sand bed over the Elastodrain.

Should the pool ever leak, the water can safely drain away, via the Elastodrain. It is recommended to have at least 300mm depth of water to compensate for the higher evaporation rate on high and exposed buildings.

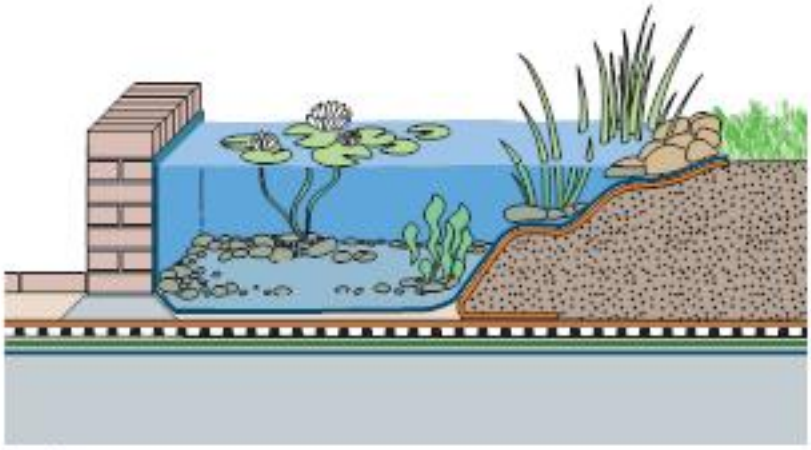


Fig 68:

Product Data

Substrates

Zincolit recycled crushed brick

Supply	1m³ or 25 litre bag
Weight when wet	1400kg/m³
Weight when dry	1250kg/m³
Particle size	4-15mm
Settlement factor	+8%
Typical pH value	8.9

Sedum Carpet substrate - extensive

Supply	1m³ or 25 litre bag
Weight when wet	1250kg/m³
Weight when dry	1000kg/m³
Settlement factor	+12%
Typical pH value	7.9

Rockery Type substrate - extensive

Supply	1m³ or 25 litre bag
Weight when wet	1350kg/m³
Weight when dry	1000kg/m³
Settlement factor	+20%
Typical pH value	7.8

Heather with Lavender substrate - semi-intensive

Supply	1m³ or 25 litre bag
Weight when wet	1350kg/m³
Weight when dry	950kg/m³
Settlement factor	+25%
Typical pH value	7.8

Roof Garden substrate - intensive

Supply	1m³ or 25 litre bag
Weight when wet	1400kg/m³
Weight when dry	950kg/m³
Settlement factor	+20%
Typical pH value	7.8

Cranberry Bog substrate - intensive

Supply	1m³ or 25 litre bag
Weight when wet	1200kg/m³
Weight when dry	700kg/m³
Settlement factor	+30%
Typical pH value	4.4

Notes:

Add settlement factor to calculated volume.

All wet and dry weights are approximate and after settlement.

Substrates other than those supplied by Alumasc must be approved for use in a green roof application.

Filter Sheets

Filter Sheet SF

A standard filter sheet for use with Floradrain® elements.

Material	Polypropylene
Mass	0.1kg/m²
Roll size	2m x 100m
Installation	Loose laid over the drainage layer with 150mm laps

Filter Sheet TG

A filter sheet specifically for use over Elastodrain EL 200/EL 202 when laid nipple up.

Material	Polypropylene and polyethylene
Mass	0.19kg/m²
Roll size 2.25m x 100m	1.12m x 100m
Installation	Loose laid with 150mm laps

Filter Sheet PV

An extra heavy duty filter sheet for use over Elastodrain EL202 on driveways etc.

Material	Polypropylene polyethylene
Mass	0.35kg/m²
Roll Size	2.25m x 50m
Installation	Loose laid with 150mm laps

Drainage Layers

Floradrain® forms a continuous drainage layer under any type of landscape, allows water to drain in any direction and retains water for plant use.

Floradrain® FD 25-E

For shallow 50-100mm soil depths on extensive roofs to falls of at least 1:60.

Material	Recycled polyethylene
Thickness	25mm
Size	1m x 2m sheets and in 1m x 15m rolls with or without a filter lining
Mass (empty) Mass (full)	1.7kg/m² 4.7kg/m²
Capacity	3 litres/m²
Installation	Loose laid and butt jointed

Fixodrain XD20

Economic combined drainage, water retention and protection mat.

Material	polypropylene
Thickness	20mm
Size	1m x 20m
Mass (empty) Mass (full)	1.0kg/m² 4.0kg/m²
Capacity	3 litres/m²
Installation	interlocking long edges

Floradrain® FD 40-E

For roofs with falls of at least 1:60 and complex extensive or semi-intensive landscaping.

Material	Recycled toughened polyethylene
Thickness	40mm
Size	1m x 2m sheets and 1m x 15m rolls with intergral filter
Mass	2.2kg/m² empty 6.2kg/m² full
Capacity	4 litres/m²
Installation	Loose laid and butt jointed

Floradrain® FD 60

For roofs with or without falls which may incorporate high loads and dwarf walls. Can be used as permanent shuttering for further constructions or vehicle surfaces.

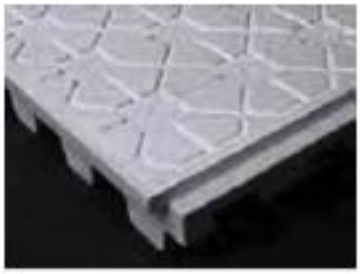
Material	Recycled toughened polyethylene
Thickness	60mm
Board size	2m x 1m
Mass	2.3kg/m² empty 40.7kg/m² full & infilled with Zincolit
Capacity	5 litres/m²
Installation	Loose laid and butt joints and stapled

Floraset FS 50 and FS 75

Floraset FS 50 is for use on existing roofs with inadequate falls to overcome localised areas of ponding water.

Floraset FS 75 is for use on sloping roofs up to 25°. Deep substrate retaining profile prevents slippage.

Material	Recycled expanded polystyrene
Board size	1m x 1m x 50/75mm high
Mass	1.5kg/m²
Capacity	2/3 litres/m²
Installation	Loose laid and interlocked boards must be laid correct side up - this varies depending on whether the roof is flat or pitched, the deeper profile is always upwards on pitched roofs



Floratherm® WD 65-H, WD 120-H and WD 180-H

For increased thermal insulation, profiled to store water. Generally used on existing roofs.

Material		Recycled polystyrene	
Board size		1m x 1m	
Type	Thickness (mm)	Mass (kg/m²)	'R' value (m²K/W)
WD 65-H	65	1.1	1.0
WD 120-H	120	2.1	2.4
WD 180-H	180	2.1	1.7

Elastodrain EL 200/EL 202

Rubber drainage mats with large studs on one side. For use directly under vehicular and pedestrian paving and on large intensive roofs where irrigation is to be provided. Loose laid over slip membrane, studded side up.

	EL 200	EL 202
Material	Recycled rubber	Rubber
Thickness	20mm	19mm
Weight	14kg/m²	18kg/m²
Studs	600/m²	1200/m²
Compressive strength	>1000kN/m²	>1000kN/m²
Size	1m x 1m	1m x 1m
Installation	laid loose butt jointed	laid loose butt jointed

Stabilodrain SD30

Extremely stable drainage element for use over underground car park decks under vegetation, walkways and driveways.

Material	Rigid thermoformed polystyrene
Thickness	32mm
Board Size	2000 x 940mm
Mass	3kg/m² dry 10.5kg/m² full
Capacity	7.5 litres/m²
Installation	Loose laid and butt jointed

Product Data

Root Barriers, Protection Layers, Moisture Mats and Slip Sheets

WSF40 Root Barrier for extensive green roofs

Material	Electronically tested polyethylene
Thickness	0.4mm
Roll size	2m x 50m 6.25m x 20m 3m x 33.3m 2m x 50m
Mass	3.8kg/m²
Installation	Loose laid with 1.5m laps to prevent penetration by lateral roots

WSB80-PO Root Barrier for intensive green roofs

Material	Flexible polyolefin
Thickness	1mm
Roll size	2m x 20m
Mass (dry)	1.2kg/m²
Installation	Loose laid with 100mm hot air welded laps

BSM 64 Moisture Retention and Protection Mat

Material	Recycled polypropylene rot proof fibres fixed to needle punched carrier
Water retention capacity	7 litres/m²
Thickness	7mm
Roll size	2m x 25m
Mass (dry) Mass (wet)	0.68kg/m² 7.68kg/m²
Installation	Loose laid with 100mm laps

SSM 45 Moisture Retention and Protection Mat

Material	Fibre mat with polypropylene carrier
Water retention capacity	5 litres/m²
Thickness	5mm
Roll size	2m x 50m
Mass (dry) Mass (wet)	0.47kg/m² 5.47kg/m²
Installation	Loose laid with 100mm laps

TSM 32 Moisture Retention and Protection Mat

Material	Non rotting synthetic polyester fibre, for use under hard landscapes and extensive soils
Water retention capacity	3 litres/m²
Thickness	3mm
Roll size	2m x 50m
Mass (dry) Mass (wet)	0.32kg/m² 3.32kg/m²
Installation	Loose laid with 100mm laps

ISM 50 Moisture Retention and Protection Mat

Material	Fibre mat with polypropylene and rubber, reinforced for spade resistance
Water retention capacity	4 litres/m²
Thickness	6mm
Roll size	2m x 25m
Mass (dry) Mass (wet)	0.85kg/m² 4.85kg/m²
Installation	Loose laid with 100mm laps

WSM150 Moisture Retention and Protection mat

Material	Needled fleece of recycled synthetic fibres for water retention on pitched roofs
Water retention capacity	12 litres/m²
Thickness	20mm
Roll size	1m x 15m
Mass (dry)	1.5kg/m²
Mass (wet)	13.5kg/m²
Installation	Loose laid and butt jointed

TGF20 Separating and Slip layer

Material	Polyethylene
Thickness	0.2mm
Roll size	8m x 25m 3m x 33.5m
Mass	1.9kg/m²
Installation	Loose laid with 200mm laps

TGV21 Air permeable separating and slip layer

Material	Polypropylene
Thickness	0.55mm
Roll size	1.6m x 50m 1.6m x 250m
Mass	0.8kg/m²
Installation	Loose laid with 100m overlaps

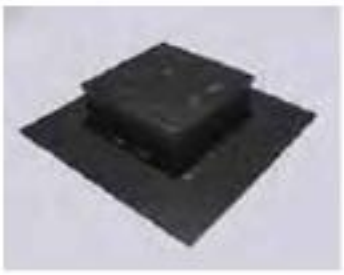
JEG Anti Erosion Net

Material	Heavy, wide mesh jute fibre for binding new substrate surface on sloping areas - 100% bio-degradable
Roll size	1.22m x 70m
Mass	43kg per roll
Installation	Secure with wooden pegs on slopes ≥10° overlap by 200mm

Inspection Chambers, Terrace Gratings and Roof Dams

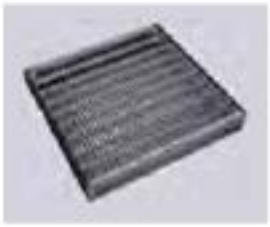
Inspection chambers

For access to roof outlets. Chambers have varying heights to suit different substrate depths.



Type	For substrate depth	Material	Size
KS5	50mm	Black plastic coated steel	250 x 250 x 50mm high with 500 x 500mm flange attached for stability and to lap filter sheet
KS8	80mm	Black plastic coated steel	250 x 250 x 80mm high with 500 x 500mm flange attached for stability and to lap filter sheet
KS12	120mm	Black plastic coated steel	250 x 250 x 120mm high with 500 x 500mm flange attached for stability and to lap filter sheet
KS15	150mm	Aluminium	250 x 250mm on 320 x 320 x 150mm polystyrene support base
KS25	250mm	Aluminium	250 x 250mm on 320 x 320 x 150mm polystyrene support base
KS30 PE	300mm	Recycled polyethylene	300 x 300 x 300mm high
KS30 E	300mm	Stainless steel	300 x 300 x 300mm high
KS52	500mm	Recycled polyethylene	400 x 500 x 520mm high

Note: extension pieces for all inspection chambers available to order.



Terrace Grill-TR-H

Adjustable height square grill units of different sizes for use in paving systems.

Material	Steel
Height	65-95mm or 95-125mm
Unit size	200 x 400mm 400 x 400mm and 500 x 500mm
Installation	Placed over Floradrain® layer and adjusted to level of paving

Terrace Linear Grating

Adjustable height linear units for use against facade abutments in paving.

Roof Dam

For fixing over roof outlets to retain water on roofs.

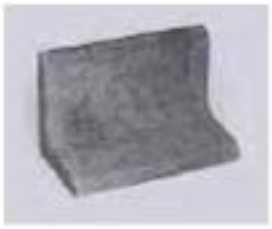
Material	Copper to suit built-up roofing materials or PVC to suit single-ply PVC membranes
Size	90mm x 40mm high with 400mm dia connecting membrane

Drainage Channel

A two piece unit which is not height adjustable, for use in proximity to facades. Drainage channels comprise a removable grill set in a U-frame casing perforated along its base length.

Material	Galvanised steel or stainless steel
Lengths	Stainless steel 1m Galvanised steel, 500mm, 1m, 2m, and 3m
Accessories	Internal and external corners

Product Data



Kerbs

Concrete kerbs for retaining soil at junctions with paved areas and changes in level or material.

Kerb size	500mm long x 300mm x 250mm
Installation	Laid on a sub-base of Zincolit laid over Floradrain®, installed either way around for kerb height of 250mm or 300mm
Accessories	Internal and (480 x 480mm) and external (230 x 230mm) corner junctions available in both 250mm and 300mm heights

Ballast Retaining Trims

A range of aluminium upstands, perforated to allow drainage, available in a variety of heights to suit variable substrate depth. Polyester powder coated colour finishes or stainless steel versions available to order.

Material	Aluminium or stainless steel
Height	55mm, 80mm, 120mm, 140mm (other sizes to order).
Length	3m

Automatic Irrigation Units

Automated water top up mechanisms for maintaining predetermined water levels, for use on roofs without falls. Used in conjunction with outlets fitted with roof dams.

Type B 32

Can be situated at any position on the roof. Must not be situated directly over outlets.

Base	300 x 300mm
Height	300mm
Weight	7kg

Type B 52

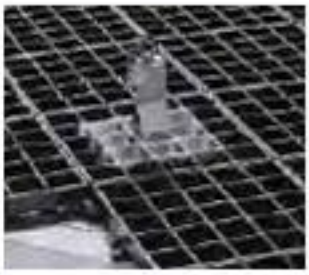
Can be situated at any position on the roof, directly over outlets if desired.

Base	400 x 500mm
Height	500mm
Weight	18kg

Note: these units must be connected to a water supply in accordance with current water by-laws.

Fall Prevention /Arrest Systems

Non-membrane penetrating anchor system for green roof maintenance access.



Fallnet SR

Interlocking grid with centralised stainless steel anchor point.

For use by one person.

Fallnet SR Rail

Linear device employing a runner attachment, for use generally in restricted areas.

For use by one person per length.

Fallnet SK

Reinforced plastic netting for use with ZinCo green roofs only)

Variable in shape and size, for multiple users.

Fallnet SE

4m x 4m Stainless steel wire mesh with integral polyester fleece.

For use by a maximum of two people.

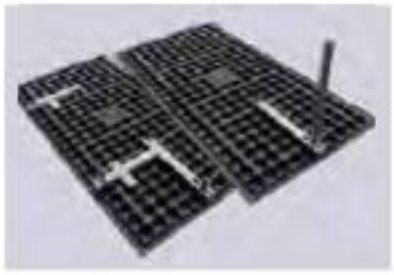
Fallnet Harness

Personal harness with adjustable lanyard, for use with any Fallnet system.

Handrail System

Handrail baseplates

Bespoke handrail system, with integral baseplates for green roofs intended for frequent access.



For use with proprietary handrail systems of client's choosing.

Solar Panel SB200 support system

Combined baseplate/support systems for solar panels and photovoltaic panels

Plug Plants

Floratop FT50

A variety of 110cm³ rootball plug plants specifically selected for either extensive or semi-intensive green roofs, supplied in trays of 50 plants each.

Floratop FT 4 x 15

A variety of 75cm³ rootball plug plants specifically selected for either extensive or semi-intensive green roofs, supplied in packs of 4 trays of 15 plants each.

Floratop FT100

A variety of 50cm³ rootball plug plants specifically selected for extensive green roofs, supplied in trays of 100 plants each.

Product Data

Sedum Mats

Precultivated sedum mats for extensive green roof applications, containing between 4 and 8 varieties, supplied in 2m² mats for instant 100% coverage.

Must be installed and watered thoroughly immediately upon delivery.

Weight	25-30kg/m²
Thickness	30-40mm

Sedum Cuttings

Sedum Shoot Mix

A mixture of a minimum of 4 varieties of sedum species for application at 60-80 gm/m² (approx 100 cuttings), supplied in 2kg bags. Also available in 2kg bags of selected individual species.

Semi-intensive Seed Mixes

'Country Colours'

A mixture of over 25 species, supplied in bags of 0.5, 1.0, 2.0 and 5.0kg, and applied at a rate of 25gm/m².

'Meadow Scent'

A blend of 8 grass species supplied pre-mixed at a ratio of 60:40 with the 'Country Colours' seed mix (see above), applied at a rate of 25 gm/m².

Fertilisers

Plantfit® 4M

Slow release fertiliser for extensive green roofs, for application once per year at 25 gm/m², ideally between March and June, supplied in 2.5, 10 and 25kg bags.

Alumasc Premium Products - All Brands

Alumasc provides an unrivalled range of premium products for building exteriors and drainage, along with high levels of technical expertise and project support. Our wealth of experience combined with networks of approved installers, merchant stockists and a choice of warranty options ensures we provide appropriate product and system solutions for all types of buildings.

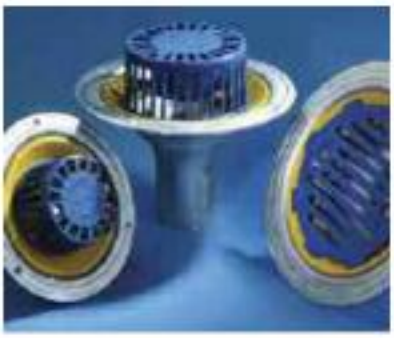
Alumasc is the UK's leading manufacturer of aluminium rainwater systems and offers a complete range of gutters, downpipes and fascia/soffits for both contemporary and traditional architecture.

Alumasc's cast iron rainwater system is for historic and restoration sites, with bespoke designs available to match or replace existing installations.

Rainwater

- Aluminium Rainwater Systems
- Aluminium Fascias, Soffits and Copings
- Cast Iron Rainwater Systems

www.alumascrainwater.co.uk



Alumasc's Harmer brand provides market leading solutions for rainwater handling and building drainage.

Aluminium roof, floor and shower drains are complemented by specialist drainage ranges in plastic. A choice of cast iron pipework systems is available for internal and rainwater drainage. Specialist rainwater management systems and paving and deck supports are also available.

Drainage

- Roof, Floor and Shower Drains
- Cast Iron Soil & Waste Systems
- Rainwater Management Systems
- Paving and Decking Supports

www.alumascdrainage.co.uk

Alumasc is a specialist provider of world class waterproofing and green roof systems.

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