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	27.2	N6

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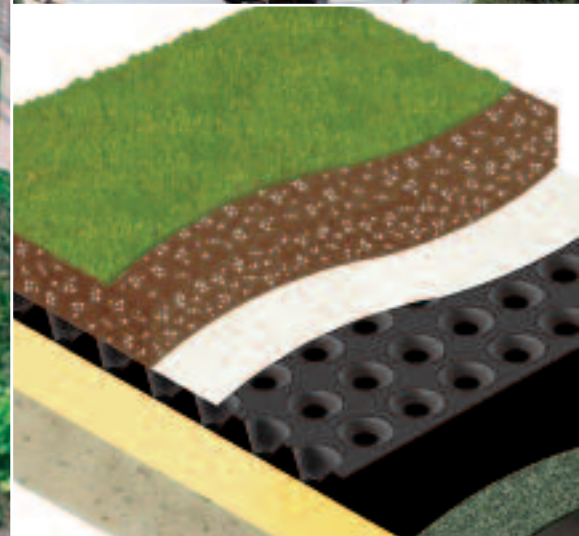
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Fytocell™ is manufactured by
Greenscape UK Ltd.

Every effort has been taken in the preparation of this brochure to ensure the accuracy of representations contained herein. Recommendations as to the use of materials, construction details and methods of installation are given in good faith and relate to typical situations. However, every site has different characteristics and reliance should not be placed upon the foregoing recommendations. Advice can be given as to specific applications of the products, upon request.

Design Ref: ICO0582



Lightweight Green Roof Systems

Elevated Deck Waterproofing



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WORLD LEADER IN CONSTRUCTION MEMBRANES

Icopal Lightweight Systems: The Way Forward for Green Roof Technology



Fytocell™ is a proven solution installed in over 1.6 million m² of roof gardens

**ICOPAL:
A WORLD CLASS RESOURCE,
AVAILABLE LOCALLY**

Icopal is the world leader in building protection from roof right down to basement. From our UK headquarters in Manchester we offer you the UK's most complete range of construction membranes, support services and insurance-backed guarantees.

A Green Roof is created when a planting scheme is established on a roof structure. The roof can be located anywhere from ground level, usually with an underground car park beneath, to a residential or commercial roof many storeys high. The technique is well established in continental Europe and is now growing fast in the UK, popular with planning authorities, architects and developers alike. Icopal have now further refined the concept of Green Roof Design in three important ways.

The Icopal Difference

The Icopal Green Roof provides three key benefits over other systems:

1. Minimum Roof Loading

At the heart of the Icopal landscaping system is a specialist growing substrate called Fytocell™. Unique in the UK, this material offers performance proven over 35 years of use and has been installed in over 1.6 million m² of roof gardens. This substrate is typically one-third of the weight of top soil, allowing a Green Roof to be established successfully on a lower load bearing structure, reducing build costs.

2. Guaranteed Waterproofing Integrity

At Icopal we believe that the waterproofing of adjacent elements such as podium decks, DPCs or tanking should not be treated as separate projects but as part of one integrated waterproofing plan. In a number of projects there have been compatibility issues when different companies have been considering separate elements of the building waterproofing in isolation.

Icopal can provide a total solution giving complete compatibility between all elements of waterproofing within the building, e.g. tanking, roof deck, podium deck, DPC and green roof waterproofing, thereby guaranteeing all elements from failure.

3. The Reassurance of Single Source Supply

Our unique holistic approach helps to eliminate fragmentation, compromised waterproofing performance and divided responsibility that has affected some Green Roof projects. It also allows us to provide a single waterproofing guarantee for the entire installation, giving complete peace of mind to architects and building owners alike.



Icopal Green Roof Systems: The Benefits

- **Lightweight systems** - reduce build costs.
- **Single source supply** - removes the uncertainty of using different suppliers.
- **Seen positively by planners** - in both urban and rural situations, helping to secure successful applications.
- **Longer roof life** - as the waterproofing is protected from extreme weather and UV radiation.
- **Aesthetically pleasing** - satisfies a basic human desire to be near plants.
- **Recreation areas** - can be developed around residential properties.
- **Improved urban air quality** - green areas help to remove atmospheric pollutants and increase oxygenation of the air.
- **Quieter buildings** - as a Green Roof can reduce dB levels by up to 60%.
- **Cooler cities** - as plants use heat energy to evaporate moisture. This helps to reduce the Urban Heat Island Effect - the difference in temperature between a city and its surrounding countryside.
- **Better urban humidity** - as green areas retain rainfall which is then given up through evaporation, helping to control over-dry city 'desert climates' in summer.
- **Lower pressure on drains and sewers** - as Green Roofs retain or delay stormwater runoff.
- **Wildlife habitats** - are introduced into the city, particularly for birds and insects.

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Green Roofs: The Unique Icopal Approach



A successful Green Roof design relies on a complete understanding of the system mechanics, performance characteristics and the relationship between the various integrated elements. The Icopal team will help you achieve this from the outset with a complete support programme:

Design Advice

By identifying the critical issues and design requirements early in the project's life, we can help ensure that performance criteria, contract programs and cost budgets are achieved. Icopal's Technical staff work closely with designers and architects, providing assistance on specification, design, loading and thermal calculations.

The Unique Lightweight Fytocell™ Growing Substrate

Unique in the UK, Fytocell™ forms the heart of the landscaping within an Icopal Green Roof, both as a substrate and flaked soil enhancer. Proven over 35 years' use, this product combines high water retention with lightweight, reducing structural loads and pressure on build costs. The use of Fytocell™ can reduce the irrigation requirement by up to 30% compared to systems without Fytocell™. Therefore there is a cost saving incurred by minimising both, total water consumption and the use of electricity needed to run the irrigation equipment.



Roof Waterproofing System

Every Icopal Green Roof is guaranteed to go beyond providing the specified aesthetic appeal and usage. Underlying the landscaping is a high quality roof waterproofing and insulation system capable of long term in-use performance, meeting all the following criteria:

- **Resistance to root penetration**
- **Very high resistance to mechanical and chemical damage**
- **High load bearing capacity**
- **Resistance to imposed stresses**
- **Resistance to ageing**
- **Flexibility and workability**
- **Provides a homogenous and continuous waterproof layer under hard or soft landscaping**

Guaranteed Waterproofing Integrity

In an Icopal Green Roof all adjacent elements of waterproofing such as podium decks, DPCs, cavity trays or tanking are treated as part of one seamlessly integrated plan covered by a single waterproofing guarantee. This unique approach gives extra peace of mind to architects and building owners.

Quality Installation

The installation of the Icopal Green Roof Waterproofing and Thermal Insulation System, is carried out exclusively by a network of trained and approved contractors, who can demonstrate excellence in all areas of working practice. In addition, these contractors are able to offer the installation of landscaping materials up to planting levels if required. Planting and landscaping can be provided by specialist Icopal partner landscape contractors, who can provide further advice on plant choice and design if required.

Electronic Leak Detection

As part of the Icopal warranty requirements, a specialist electronic leak detection test is made on all waterproofing and interfaces with adjacent elements before landscaping begins.

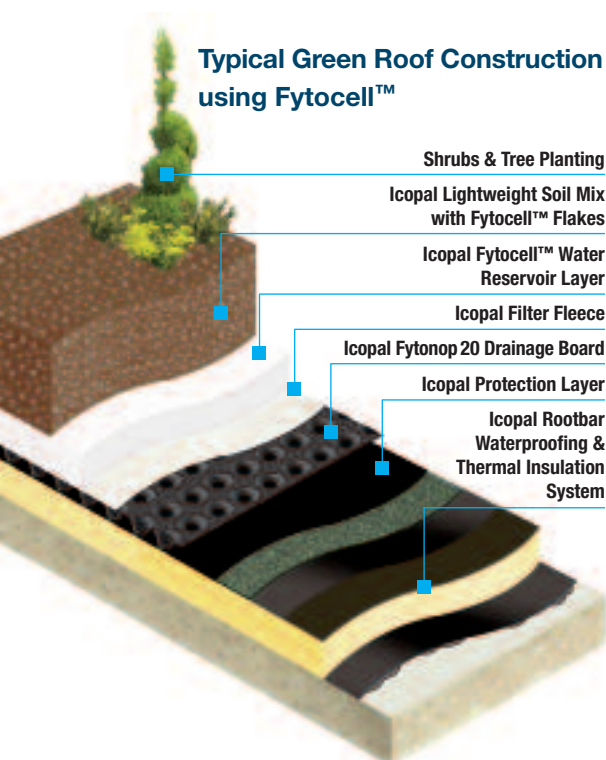


Waterproofing Guaranteed up to 20 years

To complete the Icopal quality chain and give complete peace of mind, the waterproofing element of every system is supported by a comprehensive range of insurance backed guarantees. These guarantees cover failure of the waterproofing due to defective product or workmanship, contractor insolvency, consequential loss and design liability for periods up to twenty years.

Fytocell™: Key to Icopal's Superior Landscaping Performance

The Icopal Green Roof system is the only one of its kind in the UK to feature the exclusive benefits of Fytocell™. A hard foam produced from an aminoplast resin, Fytocell™ is typically one-third of the weight of top soil, bringing cost reductions both in materials handling and also in construction of the roof structure, which can be designed to carry a correspondingly lighter loading. As a growing medium Fytocell™ promotes greater root mass, increasing root surface area for more effective absorption of water and nutrients.



High Performance in Two Key Layers

By increasing water & nutrient retention and improving drainage, Fytocell™ supports healthy plants, helping to increase their tolerance to drought:

■ A 100mm Fytocell™ Water Reservoir Layer

can be applied as a substrate. This layer has a very high compressive strength and is ideal for use beneath high density planting. Fytocell™ Water Reservoir Layer is supplied either as prefabricated slabs or can be foamed in-situ.

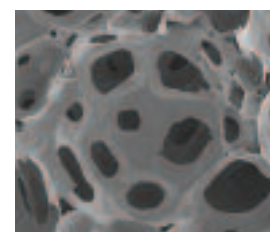
■ Fytocell™ Flakes are used as an integral part of the Icopal Green Roof Lightweight Soil Mixes to reduce weight, increase water and nutrient retention and improve drainage and aeration.

Unbeatable Water Management

Fytocell™ is able to retain water to between 60% and 70% of its volume. The material never becomes saturated, always retaining 30% - 40% of its volume as air. This water / air ratio together with high nutrient retention provides an ideal medium for healthy root and plant growth. Fytocell™ also makes more efficient use of natural rainfall and irrigation by maintaining a reservoir for plants in times of low rainfall or high temperatures.

Proven in the Toughest Conditions

In addition to Green Roof applications Fytocell™ material is widely used by professional turf growers and the sports pitch industry. It is currently used at football clubs including Arsenal, Tottenham Hotspur, Leicester City, West Ham and Reading.



Electronmicrograph of the cell structure of Fytocell™



Without Fytocell™

With Fytocell™

Designing The Right Green Roof System

When designing a Green Roof System, it is vitally important to understand the characteristics of each element within the system, and in particular the impact on the structural and waterproofing elements of the roof construction.

Structural Roof Decks

An Icopal Green Roof System can be designed for almost any roof deck, providing that it is structurally capable of carrying the additional imposed loads of the build up chosen. For more information on loading please refer to page 15.

The designer must carefully assess the overall load intensity to the roof due to:

- Access & egress points ■ Usage & foot traffic ■ Maintenance ■ Vehicles
- Roof features such as trees, planters, safety barriers and water features
- Roof mounted equipment ■ Later additional buildings

On all projects penetrations to the deck should be avoided if possible, but Icopal can provide waterproof details for items such as seating, lamp posts, flagpoles, cable ducts, hand rails and security equipment etc. If an existing roof is being refurbished it is important to have the loading capability of the structure checked by a qualified structural engineer.

Types of Roof Design

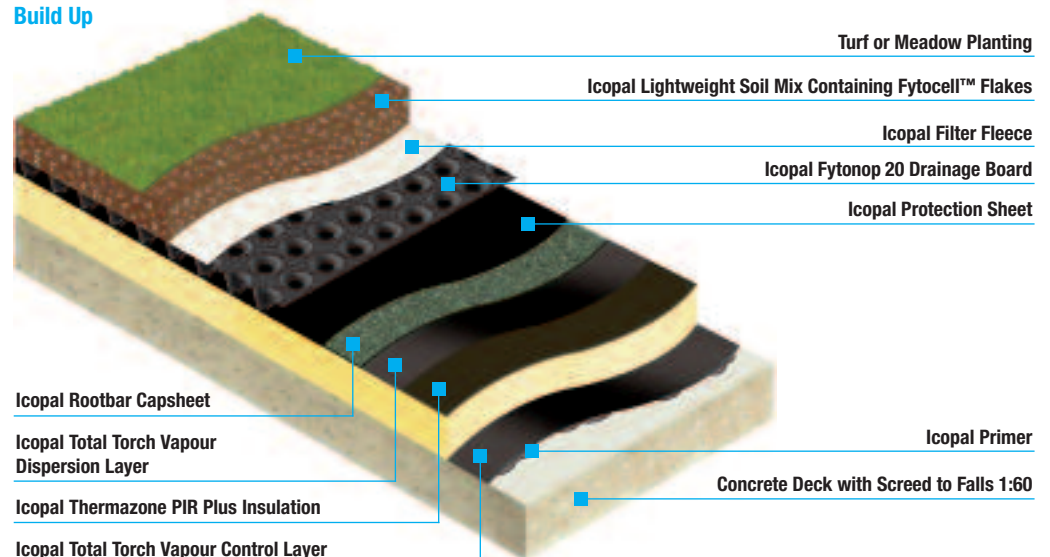
Installing an Icopal Green Roof System does not mean sacrificing any aspect of the roofs waterproofing or thermal performance. Most flat roofs are capable of supporting a Green Roof system.

Warm Roof

The warm roof design encapsulates the thermal insulation within the waterproofing layers. This requires the use of a high quality vapour control layer and calculation of the dew point to ensure that there is no condensation risk within the roof build up.

In a warm roof system the waterproofing layers incorporating root inhibitors are positioned above the insulation layer. Care must therefore be taken during maintenance of the Green Roof to prevent damage.

Typical Warm Roof Build Up



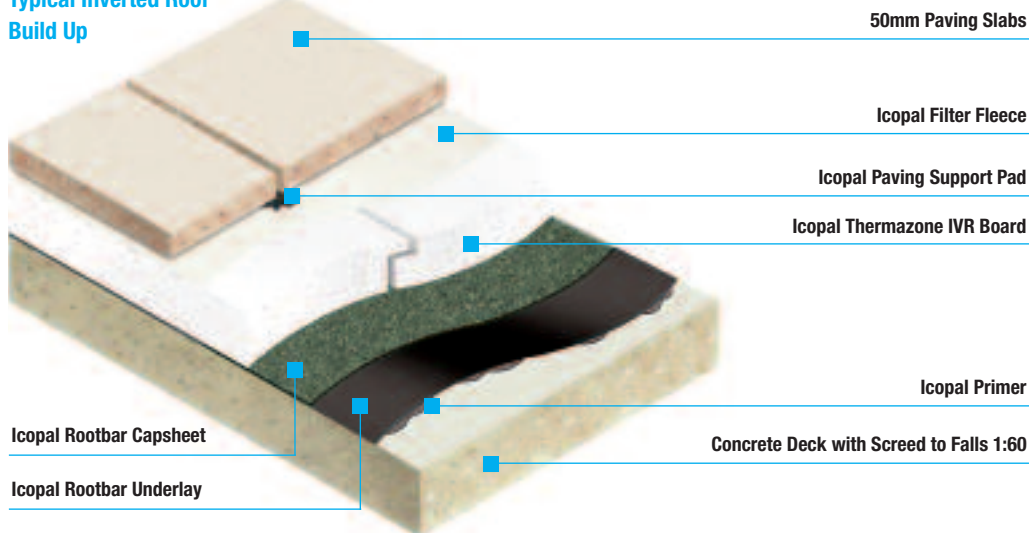
Inverted Roof

This design positions the waterproofing layers directly above the structural deck and below the impervious high density extruded polystyrene thermal insulation layer. An inverted roof system can withstand very high loading and is the preferred option for trafficked and hard landscaped areas.

Design Considerations:

- 1 With an Inverted Roof the design must allow for a loss of efficiency in the thermal insulation, as rainwater drains directly over and through the the insulation layer. Refer to table on page 22
- 2 Insulation Boards are loose laid and must be adequately restrained against wind uplift or flotation.

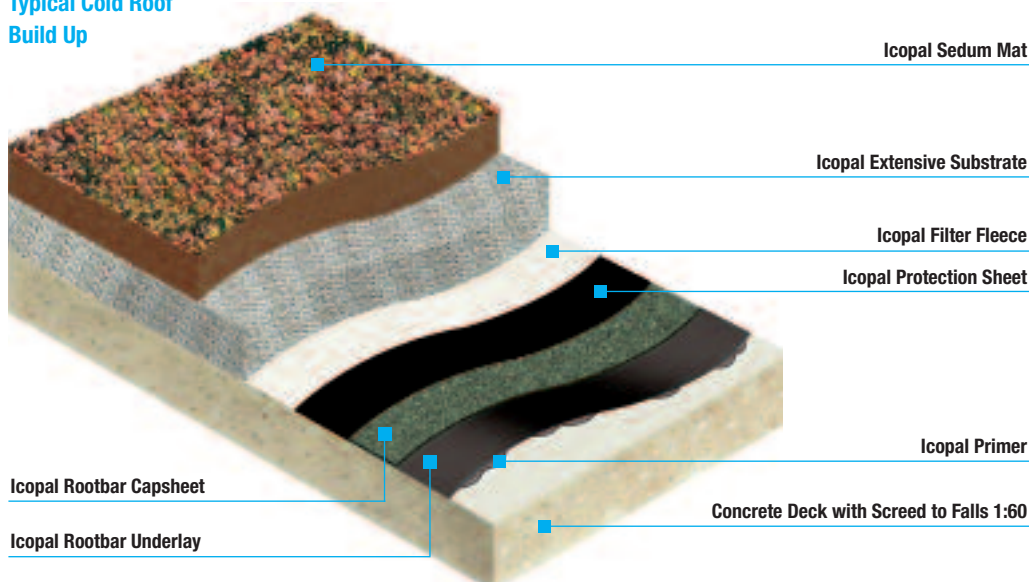
Typical Inverted Roof Build Up



Cold Roof

The cold roof system incorporates a thermal insulation layer below the structural roof deck i.e. at ceiling level. It relies solely on ventilation within the roof space to remove moisture vapour - so it is important in this construction to ensure that this ventilation is not obstructed. Cold roof systems are also used where no insulation is required, for example above well ventilated underground car parks.

Typical Cold Roof Build Up



Designing The Right Green Roof System cont

Roof Falls

The falls under an Icopal Green Roof System should be designed in the same way as a normal roof construction, providing adequate drainage to remove excess water from the roof in accordance with code of practice BS6229. Roof falls can be achieved either by sloping the structural deck, or providing Icopal Thermazone tapered thermal insulation, or Icopal FireSmart® IRS sloping screed system. Please refer to sections on Extensive and Intensive Green Roof Systems for required roof falls.

Sloping Roofs

It is possible to create Extensive Green roofs sloping up to approx 30 degrees by the introduction of intermediate shear battens and edge restraints.

Roof Drains

Icopal Specialist Roof Outlets are used which are protected from blockage by vegetation or soil, and allow easy access for cleaning/rodding. In an Inverted Roof design or hard landscaped area where the flow of rainwater is restricted, it is necessary to drain both at the surface level and at the waterproofing level. If the Hard landscape has vehicular access it may be necessary to provide silt traps or mud gullies.



Icopal Specialist Roof Outlets.

Wind Action

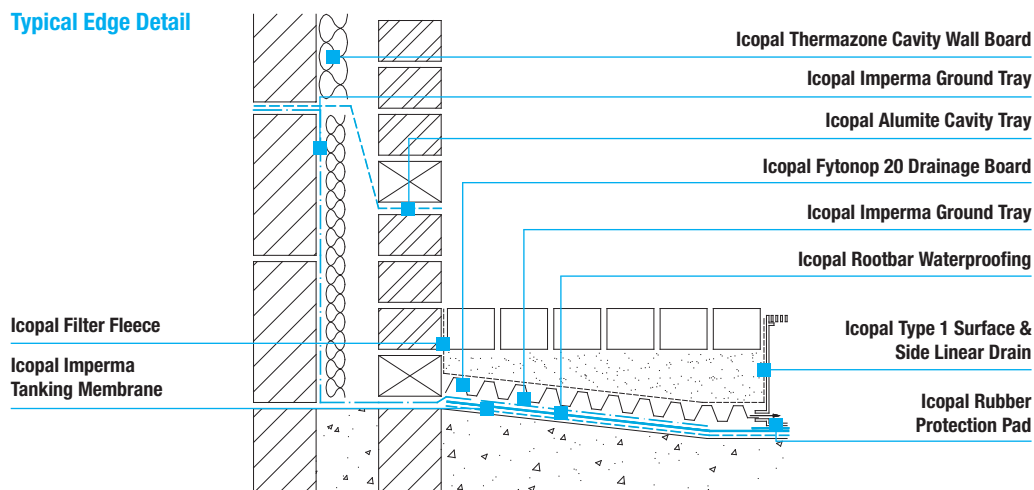
Landscaped roofs provide additional dead weight to the roof structure. This mass must be adequate to resist the action of the wind, which will vary over the whole roof area. Normally the wind uplift pressures are less towards the centre of the roof and more excessive around the perimeters and corners, where additional ballast such as paving slabs or pebbles can be used.

In exposed locations the action of wind scour can cause movement of soil or ballast and can lead to the redistribution of loading. The roof area should be checked regularly and the ballast size increased if necessary. It may also be necessary to protect soil from wind action in exposed locations and on sloping roofs until planting is established.

Detailing

Icopal recommend that all waterproofing details should be fully bonded in two layers, and upstands should extend to a minimum height of 150mm above the surface of the landscaped element. Protection of all details from vegetation growth should be provided by the incorporation of Icopal Stainless Steel Protection Kerbs or 300mm gravel borders. It is essential, when designing the roof details, that all adjacent elements of waterproofing are considered, including tanking, cavity trays, ground trays, DPCs and elevated deck waterproofing. Icopal Technical Services will be pleased to prepare full project details.

Typical Edge Detail



Roof Safety and Awareness

When a Green Roof has access for either recreation or for maintenance, it is imperative that safety measures are addressed during the design stage and adequate protection is provided in the following areas;

- **Safe access**
- **Fire escape**
- **Edge protection**
- **Designated walkway areas**
- **Anchorage points for maintenance**

Compliance with Health & Safety Legislation is paramount and a risk assessment should be carried out ahead of the commencement of any works. Scaffolding or temporary edge protection must be provided against open edges, low parapets and around openings in the roof area during the construction phase.

Persons accessing the roof to carry out maintenance and who will be working on an open edge roof, or a roof with edge detail below minimum Health & Safety guidelines, must wear safety harnesses attached to a fall arrest system. Icopal are able to supply these systems, and to design permanent fixing points into any Green Roof design, to accommodate this. (See section on Health & Safety page 19).

Fire Resistance

The Icopal Rootbar Waterproofing System has been designated a fire rating FAA when tested in accordance with BS476:Part 3:1958. The additional finishes of stone chippings, round washed ballast and concrete paving slabs also provide a FAA fire rating. The addition of an irrigated soil based Green Roof is generally considered fire resistant, although additional methods of reducing fire risks, may be considered, such as:

- **The introduction of fire breaks**
- **Strips of gravel around all roof penetrations, for example roof lights & roof outlets etc.**
- **Ensure all gravel areas kept free of vegetation by regular maintenance**

Irrigation

It is essential that a water supply is provided at roof level and close to the planting. This will enable the necessary watering required during the formative stages of the Green Roof to establish strong and healthy plant growth. The water supply will also aid on-going maintenance and irrigation in excessively dry periods. Icopal can advise on the various types of irrigation systems available.



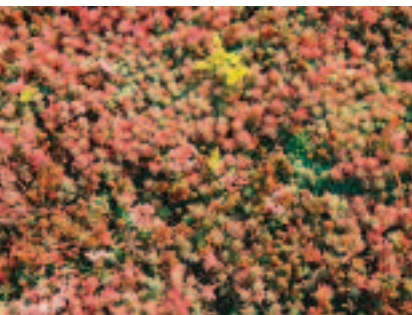
Icopal Fall Arrest Systems

Icopal Extensive Green Roof Systems

For technical information on Icopal Green Roof landscaping components see pages 26/27.

ROOF FALLS

Roof falls must be included to provide adequate drainage to remove excess water from the roof in accordance with code of practice BS6229. For Extensive Roofs, the design roof falls are 1:60. Roof falls can be formed within the roof structure or by the use of Icopal Thermazone Tapered Insulation Systems or Icopal FireSmart® IRS Sloping Screed System.



Icopal Sedum Mat

Extensive Green Roof Systems are generally intended to be viewed from another location as a decorative/ecological feature. They are not normally used as a recreational space to be walked through or sat in and often have limited access for maintenance only. Extensive systems generally have a shallow profile (approx 100 - 200mm deep) and are much lighter in weight than intensive systems.

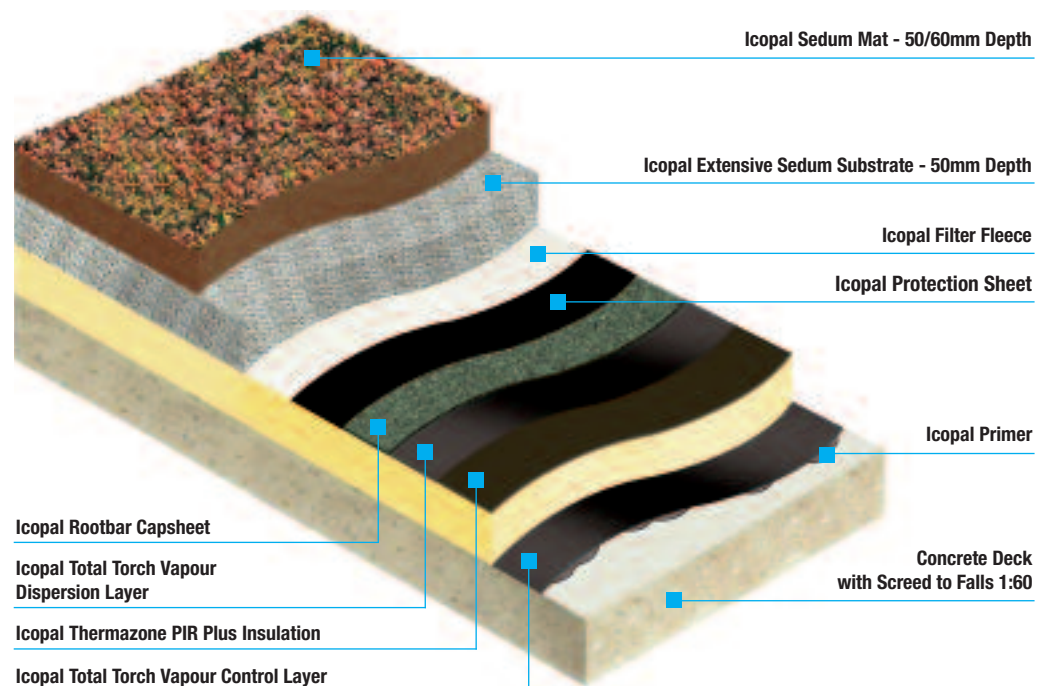
Planting an Extensive Roof

There are a number of options including turf, wildflower & grass meadows, lavender and chamomile. One of the most widespread Extensive roof planting species however is sedum which is available in many different varieties.

Advantages of Icopal Sedum Mat

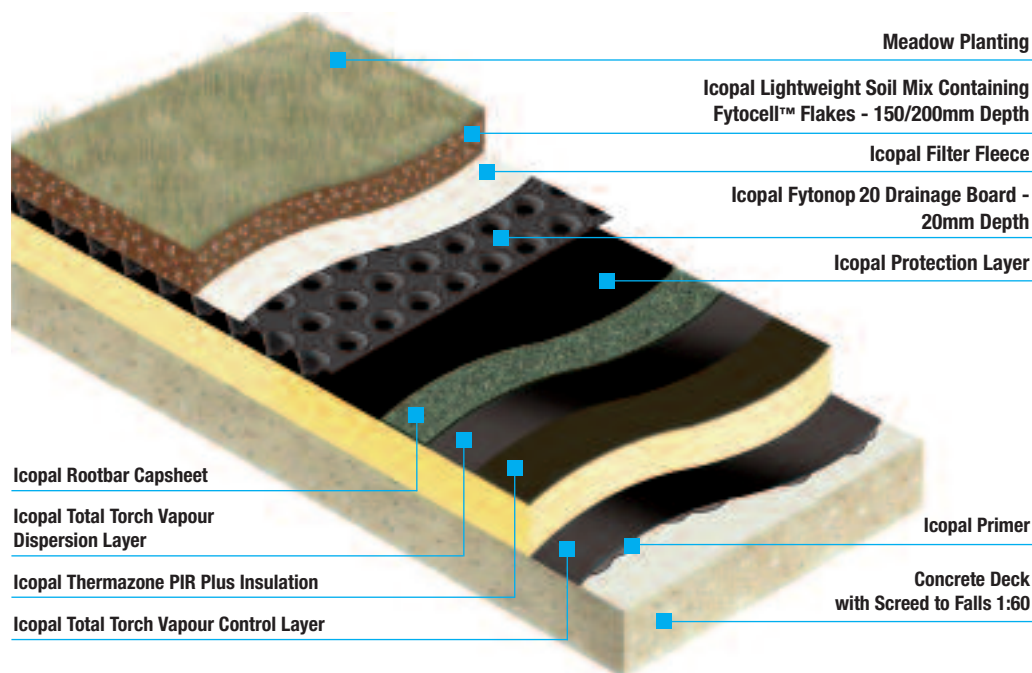
- These plants are very drought tolerant and therefore, once established, natural rainfall should be sufficient to sustain them with little need for a dedicated irrigation system.
- Sedums change colour with the seasons, both through flower and foliage, adding further interest to the roof aesthetics.

Typical Icopal Extensive Sedum System



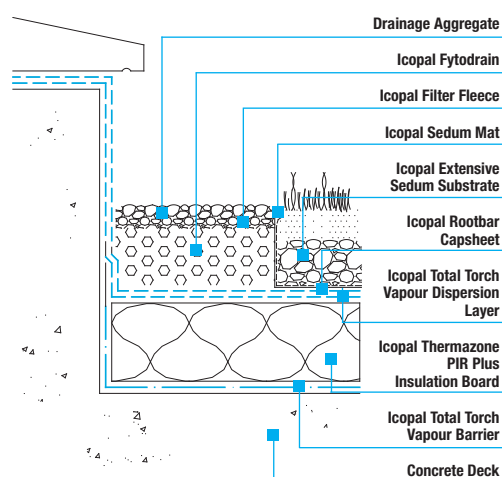
Note: The Icopal Extensive Sedum Substrate retains some water to sustain the sedum growth, but it also acts as a drainage layer to move excess water quickly and efficiently to the roof drains. During the early stages of a newly planted sedum roof, it may be necessary to irrigate until the plants become established. This is especially important in the warmer, dryer summer months.

Typical Icopal Extensive Meadow System



Use of Gravel Borders

We recommend that Extensive systems have a gravel border to keep the planting away from any waterproofed upstands. This keeps the edging tidy but also reduces the incidence of mechanical damage to waterproofed upstands when cutting or trimming. Alternatively, Icopal proprietary protective upstands can be used in vulnerable areas.



Icopal Stainless Steel Pitched Roof Edge Restraint

Typical Icopal Extensive Sedum System on Pitched Roof

Systems can be placed on roof pitches up to approximately 30 degrees by the introduction of roof battens and edge restraints to resist shear forces, and keep the green roof components in place. Please contact our Technical Department for more information, and design details.

Icopal Intensive Green Roof Systems

For technical information on Icopal Green Roof landscaping components see pages 26/27.

ROOF FALLS

These must provide adequate drainage to remove excess water from the roof in accordance with code of practice BS6229. For Intensive Roofs, the design roof falls are 1:60. Falls can be provided in the structure or by the use of Icopal Thermazone Tapered Insulation or copal FireSmart® IRS Sloping Screed System.

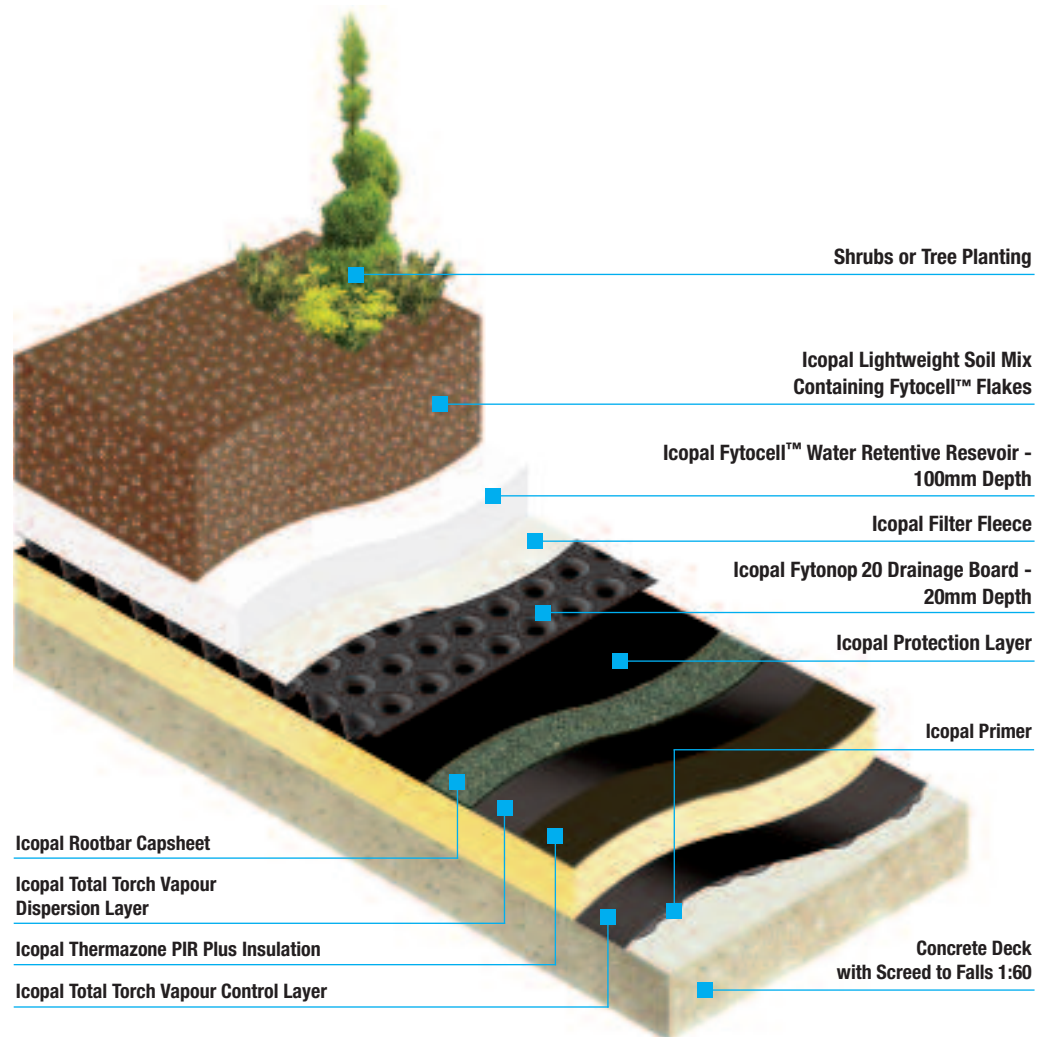
Intensive systems are designed to be used as recreational spaces and often involve features similar to traditional gardens including paving, water features, lawns, shrubs and trees. Icopal will supply a complete waterproofing / garden roof solution including hard landscaping, planting and turf.

Roof Loading

Although the use of Fytocell™ technology brings down the overall weight of all Icopal Intensive Green Roof Systems, these systems are much deeper than Extensive systems (generally around 200 - 1000mm) and so create a greater loading on the roof deck. The structural engineer involved in the project must therefore confirm that the roof can withstand the weight of the saturated system, the planting scheme and any foot or vehicular traffic which can access the roof deck.

Typical Icopal Intensive Tree/Shrub System

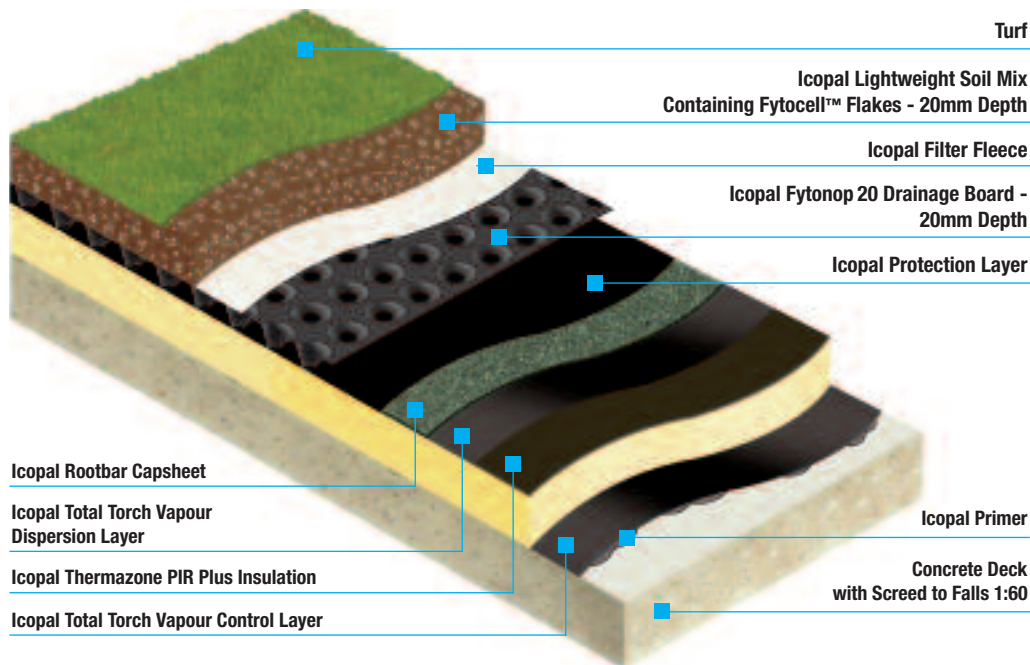
This Intensive roof garden system is very adaptable and can be used with general shrub and tree plantings. The Icopal lightweight soil depth will vary from around 200mm for small shrubs up to 1,000mm for small trees. A typical system make-up would comprise:





Typical Icopal Intensive Lawn System

A typical system build up for an intensive roof garden system designed to grow turf would comprise:

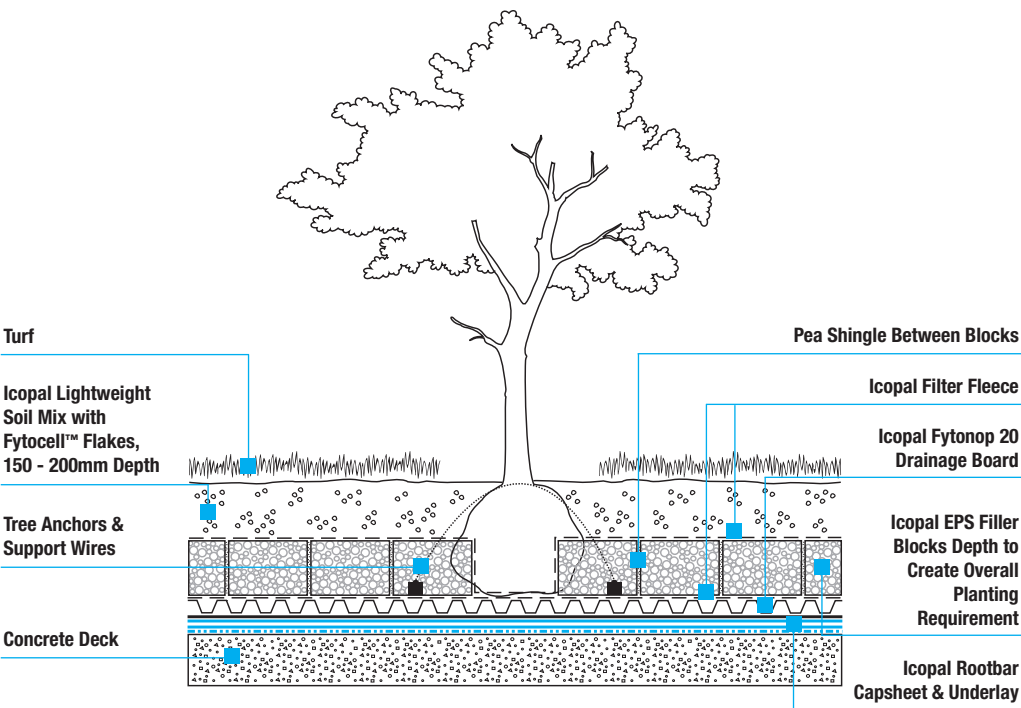


Icopal Intensive Green Roof Systems cont



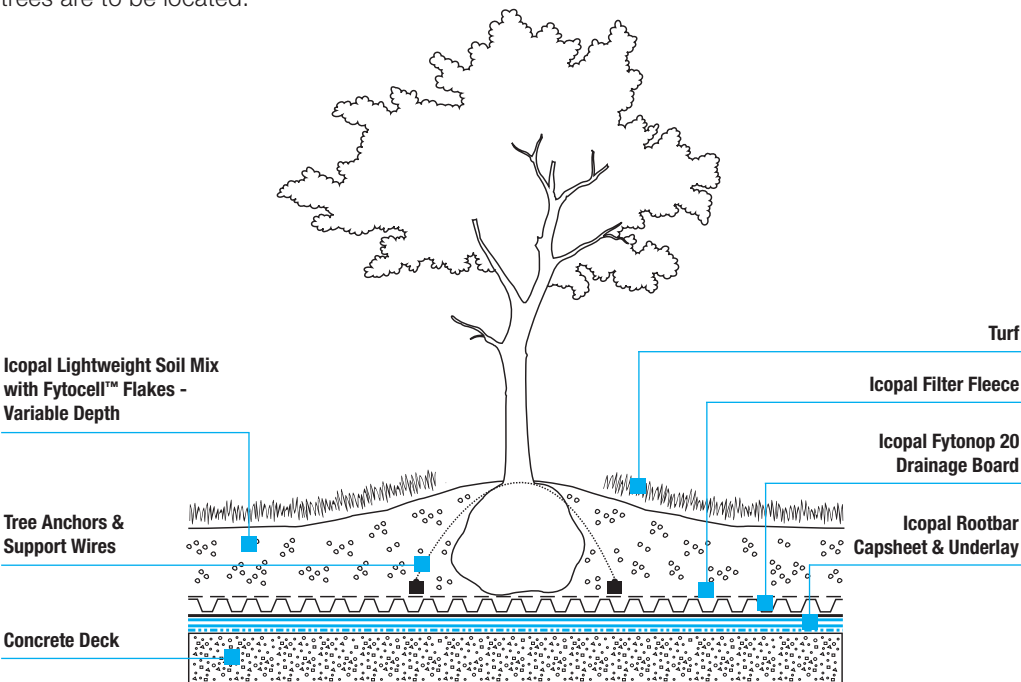
Typical Tree Pits with Turf and Icopal EPS Filler Blocks

In this example a tree, which requires greater soil depth, is planted within a shallower system of turf and shrubs using Icopal EPS Filler Blocks to bring the soil surface to the same level. This saves weight as the Icopal EPS Filler Blocks are lighter than the soil mix and is also a generally more cost effective solution under both planted areas and paving.



Typical Mounded Tree Pit with Turf

It is possible to landscape the Icopal Lightweight Soil Mix so that it is mounded in areas where trees are to be located:



Tree Anchors

These are used to support larger trees and consist of eyebolts and guy lines securely fixed into independent kerbs which are placed onto the drainage board. Guy lines can be secured around paving kerbs positioned on the roof deck surface and buried within the soil.

Icopal Lightweight Soil Mixes

It is important that the soil mixes used for a green roof are free draining, but also water retentive. This is so that excess water does not build up within the profile and create water logging and excess weight loading. Although it must be free draining, the soil mix needs to retain sufficient water for healthy plant growth. The Icopal soil mixes contain 40% Fytocell™ Flakes, which create drainage channels for excess water, but also retain 60% of their volume to store water and hold it freely available for the plant roots to take up. The Icopal 30/50/40 mix consists 30% sandy loam, 30% peat free compost and 40% Fytocell™ Flakes. This mix is a very lightweight, cost effective soil mix. The Icopal 60/40 consists 60% sandy loam and 40% Fytocell™ Flakes. This is a slightly heavier, more durable mix. Both mixes are very suited to all types of planting, although the 60/40 is especially suited to turf growing applications.

Icopal Intensive Green Roofs: Typical Planting Depths / Weight Guidelines

60% /40% FYTOCELL SOIL MIX	TURF	SHRUBS	BUSHES	TREES small with flat root systems	TREES large to 12 metres
Layer 5	200 mm of Icopal soil mix 130 Kg psm	200mm of Icopal soil mix 260 Kg psm	300mm of Icopal soil mix 390 Kg psm	500mm of Icopal soil mix 650 Kg psm	800mm of Icopal soil mix 1040 Kg psm
Layer 4		Fytocell™ Water Reservoir Layer - 100mm. 84 Kg psm wet (80 Kg of water and 4 Kg of hardfoam).			
Layer 3	Icopal Filter Fleece - c2mm. Negligible weight psm.				
Layer 2	Icopal Fytonop Drainage Layer - 20mm. 20kg psm.				
Layer 1	Icopal Protection Layer - to be laid beneath the drainage layer and on top of a structurally sound, waterproof roof. c2mm. Negligible weight psm.				
Total Depth	224mm	324mm	424mm	624mm	924mm
Total Weight	235 Kg psm	365 Kg psm	495 Kg psm	755 Kg psm	1,145 Kg psm

30% / 30% / 40% FYTOCELL SOIL MIX	TURF	SHRUBS	BUSHES	TREES small with flat root systems	TREES large to 12 metres
Layer 5	200 mm of Icopal soil mix 101 Kg psm	200mm of Icopal soil mix 202 Kg psm	300mm of Icopal soil mix 303 Kg psm	500mm of Icopal soil mix 504 Kg psm	800mm of Icopal soil mix 808 Kg psm
Layer 4		Fytocell™ Water Reservoir Layer - 100mm. 84 Kg psm wet (80 Kg of water and 4 Kg of hardfoam).			
Layer 3	Icopal Filter Fleece - c2mm. Negligible weight psm.				
Layer 2	Icopal Fytonop 20 Drainage Layer - 20mm. 20kg psm.				
Layer 1	Icopal Protection Layer - to be laid beneath the drainage layer and on top of a structurally sound, waterproof roof. c2mm. Negligible weight psm.				
Total Depth	224mm	324mm	424mm	624mm	924mm
Total Weight	210 Kg psm	310 Kg psm	410 Kg psm	615 Kg psm	915 Kg psm

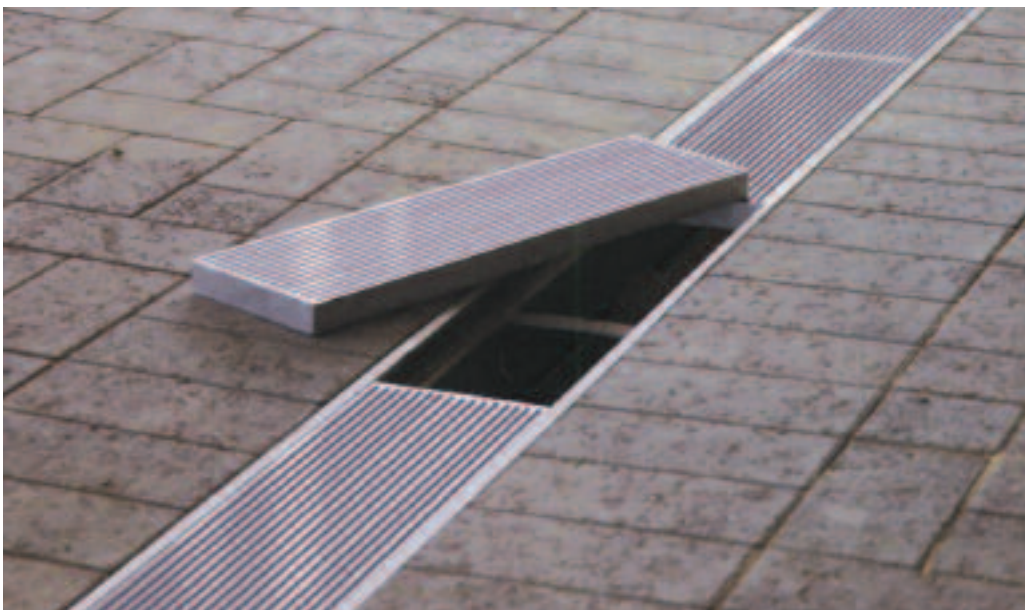
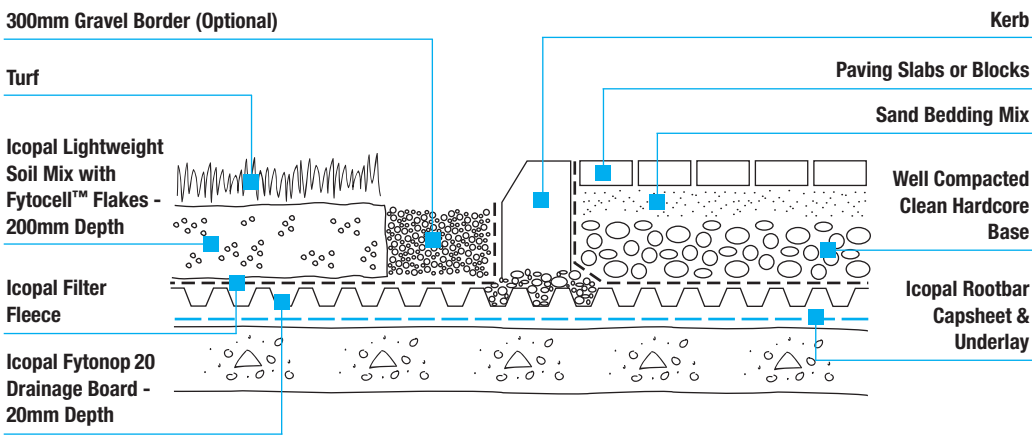
Icopal Green Roof Car Park and Hard Landscaping Systems

For technical information on Icopal Green Roof landscaping components see pages 26/27.

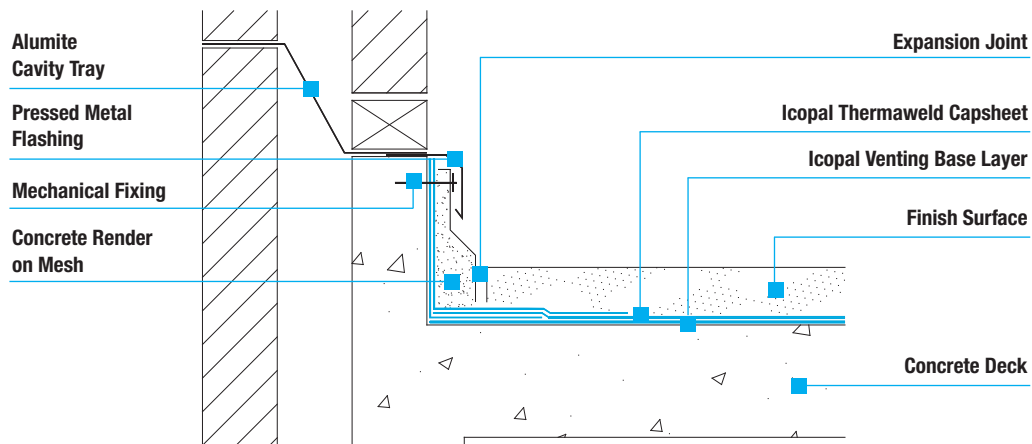


Icopal will supply deck waterproofing and drainage systems. Hard landscaping and any associated planting is supplied by an approved landscape contractor.

Typical Icopal Green Roof Paved Area with Adjoining Turf



Typical Icopal Green Roof with Car Park Surface



Typical Icopal Green Roof Water Feature with Containment Lining

Icopal's unique integrated waterproofing approach will give you the confidence to indulge your imagination to create true landmark water features within your Icopal Green Roof.



Icopal Green Roof Systems: Guidelines for Maintenance after Installation

Extensive Green Roofs, when planted according to Icopal guidelines, require relative little maintenance once established. Intensive Green Roofs on the other hand are soil based multi layered 'roof gardens' that require similar levels of maintenance to a conventional garden. Icopal will be pleased to provide a list of suitable contractors who can carry out on-going maintenance, on a contract basis if required.



Contractor Awareness

Any landscapers or other contractors working on the Icopal Green Roof system should be made aware of its layered construction to avoid damage to any of the system components.

Use of Garden Tools

Any tools used such as forks, hoes and trowels must not reach a depth where they are likely to puncture or damage the waterproofing. They should not penetrate any layer beneath the lightweight soil mix, as this could damage the structure of the system.

Irrigation

Icopal Green Roofs should be irrigated when needed to reduce water deprivation in the planting. This is especially important in periods of low rainfall and warm temperatures. Prolonged periods of wind may also have a drying effect on a roof garden. Irrigation of a roof garden is easier and less time consuming when a suitable system is installed during construction. For advice please contact Icopal Technical Services.

Weed Control

The Green Roof must be kept weed free to reduce competition and help the planting to become established and subsequently grow unhindered. Sedums in particular are not very competitive plants, therefore they do need a regular maintenance programme.

Avoid Inappropriate Planting

Do not replace any of the designated plants for ones which may grow larger. This could increase the roof loading which may be greater than the recommended guidelines. The new plant may also need a greater soil depth to grow sufficiently well. Plants which have aggressive root systems should also be avoided to protect the integrity of the waterproof membrane. Icopal landscape partner contractors are able to advise on the correct plant choice.

Avoid Inappropriate Materials

Do not add any other material to the roof. This could increase the roof loading, and carry it over the recommended weight guidelines.

Monitor Drainage

All Icopal Green Roof systems incorporate a filter layer to minimise the risk of debris blocking water outlets. Drainage points should however be checked on a regular basis to avoid any blockages and potential ponding or flooding.

Practice Good Plant Care

Plants need to be kept pest and disease free, with regular feeding to enable them to remain healthy and grow to their expected potential. Turf will need cutting on a regular basis.



Observe Good Roof Safety on Extensive Systems

On open edge design roofs, anyone working closer than 2m to the roof edge during maintenance must wear a safety harness attached to lanyards fixed to the points provided, or be protected by the erection of an appropriate safety rail system.

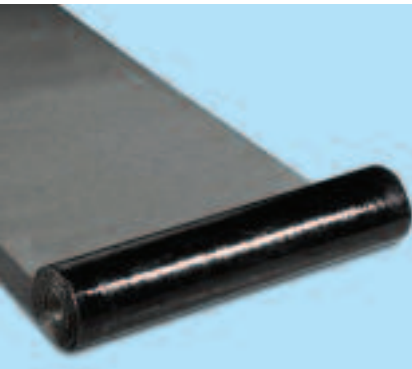
For safety reasons it should be considered mandatory to provide as safe a system as possible. These measures, if added during construction, can be far less obtrusive.



Icopal Green Roof System Membranes

Icopal Specialist Green Roof Waterproofing Products

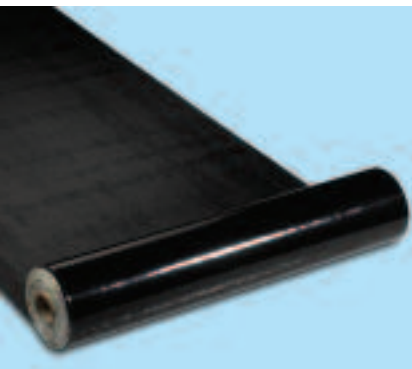
The following products have been specially developed by Icopal to suit the unique requirements of Green Roof Systems. When installed as specified, the waterproofing performance of the resulting systems can be guaranteed for up to 20 years.



Icopal Rootbar Cap Sheet

The top layer in the two-layer Icopal Green Roof waterproofing system, this high performance membrane combines:

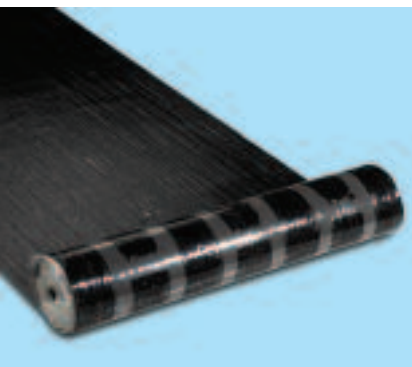
- The elastomeric properties of SBS modified bitumen with specially formulated root inhibitors
- High quality polyester reinforcement for puncture resistance and dimensional stability.



Icopal Rootbar Underlay - Fully Bonded System

Used as the underlayer in a fully bonded Icopal two-layer Green Roof waterproofing system:

- SBS modified bitumen and polyester reinforcements provide a secondary layer of performance waterproofing and resistance to root penetration.
- The membrane is fully bonded to the substrate, preventing water tracking beneath in the event of damage. This avoids the possible cost of landscaping removal to carry out repairs.



Icopal Total Torch Vapour Dispersion Underlay - Partially Bonded System

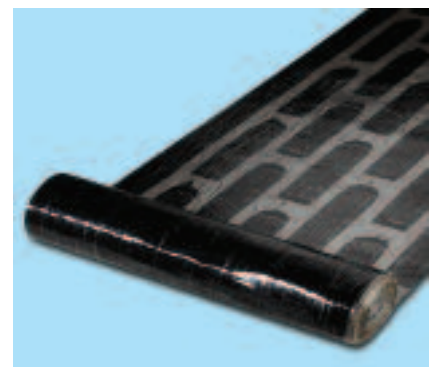
Used as the underlayer in the two-layer Icopal Green Roof waterproofing system incorporating PIR Plus Thermal Insulation:

- SBS modified bitumen and polyester reinforcements provide a secondary layer of performance waterproofing and resistance to root penetration.
- The membrane is specially designed for direct bonding to Thermazone PIR Plus Thermal Insulation.

ICOPAL Total Torch Vapour Control Layer

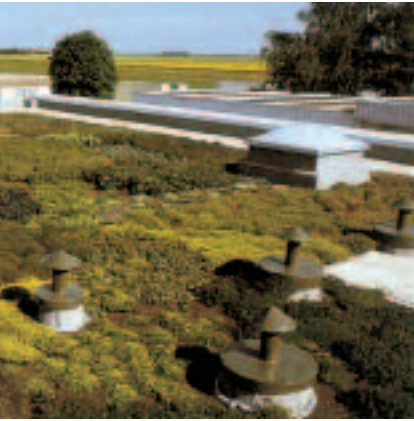
These heavy duty reinforced vapour barriers are specifically designed for use under highly efficient thermal insulation.

- **SBS modified bitumen with a high strength core ensures that the VCL can resist mechanical and physical damage.**
- **The integral PET core also provides absolute vapour protection for the insulation.**
- **Lozenges to the upper surface allow direct application of thermal insulation**



NAME MEMBRANE TYPE	ICOPAL ROOTBAR CAPSHEET	ICOPAL THERMAWELD CAPSHEET	ICOPAL ROOTBAR UNDERLAY	ICOPAL TOTAL TORCH VAPOUR DISPERSION UNDERLAY	ICOPAL TOTAL TORCH VAPOUR CONTROL LAYER
Surface Treatment	Mineral Slate	Mineral Slate	Film	Fine Sand	SBS/ Resin Lozenges
Bitumen Type	SBS modified + Root Inhibitor	SBS modified	SBS modified	SBS Modified	SBS Modified
Reinforcement	180 gsm Non Woven Polyester	250 gsm Non Woven Polyester	120 gsm Non Woven Polyester	80g reinforced glass mat	100g reinforced glass mat + PET Core
Tensile Strength Longitudinal (N/50mm)	<900	<1100	<600	500	500
Tensile Strength Transverse (N/50mm)	<700	<1400	<350	350	450
Elongation at Break (LxT)	50 x 50%	26 x 41%	50 x 50%	2 x 2%	2 x 2%
Cold Bend Flexibility	< - 20 Deg C	< - 20 Deg C	< - 20 Deg C	< -6 Deg C	< -6 Deg C
Thickness (Nominal)	4mm	4.3mm	3mm	3.5mm	3.5mm
Weight (Nominal)	4.9 Kg	4.75 Kg	3.75 Kg	4.0 Kg	3.75 Kg
Roll Size	8m x 1m	8m x 1m	10m x 1m	7.5m x 1m	8m x 1m
Roll Weight (Nominal)	39.5 Kg	38.0 Kg	37.5 Kg	30.0 Kg	30.0 Kg
Quantity per pallet	24 Rolls	24 Rolls	25 Rolls	30 Rolls	30 Rolls

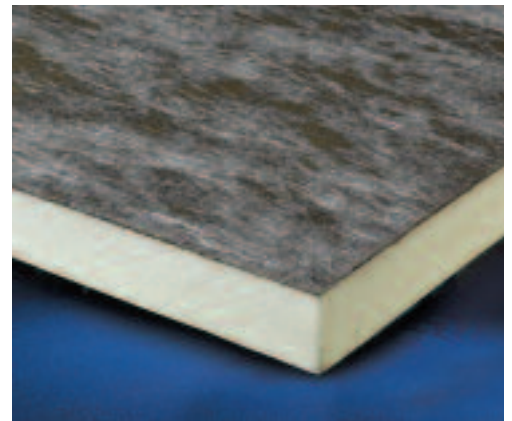
Icopal Green Roof System Thermal Insulation



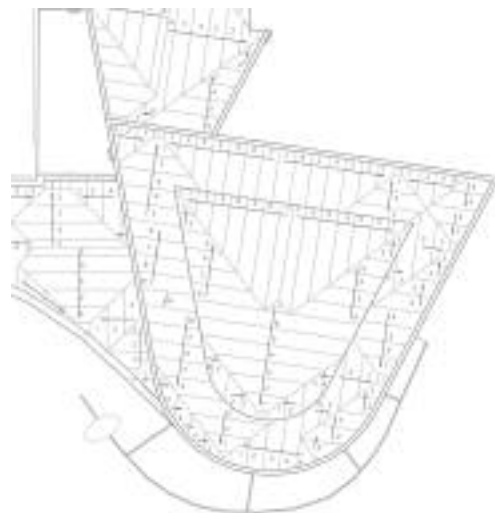
Icopal Thermal Insulation

Icopal's range of Thermazone thermal insulation has been designed to meet all current U-Value standards and offers a high quality, environmentally friendly solution to all insulation requirements:

- **Excellent thermal performance**
- **Dimensional stability**
- **Compressive strength**
- **Resistance to mould and microbial growth**
- **Easy to handle and install**
- **CFC and HCFC free**



INSULATION BOARDS	THICKNESS	BOARD SIZE	LAMBDA VALUE W/m²K	HCFC FREE	U-VALUE 0.25 W/m²K
Icopal Thermazone PIR Plus Torch-on	50mm, 60mm, 70mm, 80mm,	600mm x 600mm	0.025	yes	90mm
	90mm, 100mm	600mm x 600mm	0.024	yes	90mm
Icopal Thermazone Inverted Roof (IVR)	30mm, 60mm,	1250mm x 600mm	0.034	yes	160mm
	60mm, 120mm	1250mm x 600mm	0.037	yes	160mm

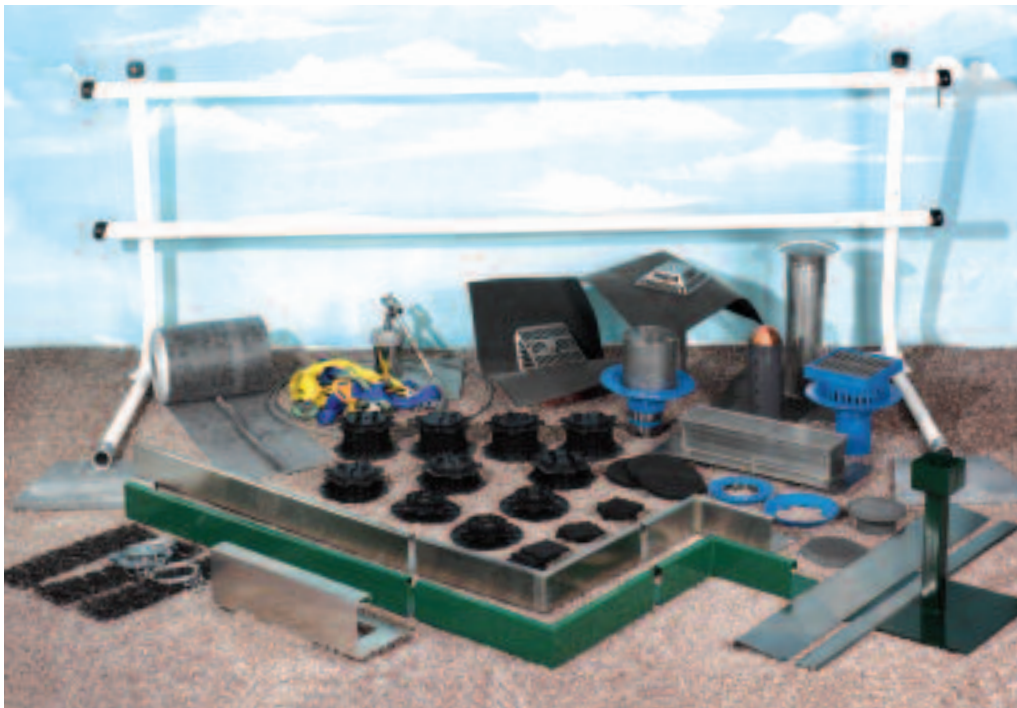


Insulation Cut to Falls

One of the major benefits in roof drainage design is the combined effect of thermal insulation and positive roof falls in one installation. Using the latest CAD technology our design team can produce the most efficient and cost-effective layouts and quotations for any project. Calculations for 'U' Value and condensation risk are carried out, with maximum depths of insulation shown on drawings to aid detailing. Schemes can be submitted electronically or as hard copy for approval before working drawings are issued.

Icopal Green Roof Accessories

Icopal has developed a dedicated range of accessories for use in Green Roof. Each item is specifically designed to perform under roof garden conditions, able to resist the long-term activity of powerful tree and shrub roots. The Icopal Technical Department will be pleased to advise on the use of these accessories.



- Kerbs
- Outlets
- Upstands
- Edging Details
- Gullies
- Protection Sheets
- Anchoring Equipment
- Paving Supports



Icopal Protection Mats



Icopal Stainless Steel Pitched Roof Edge Restraint

Installation of Icopal Green Roof Systems

Icopal's broad expertise in both waterproofing and roof garden design gives you the major advantage of dealing with a single source for the entire project, including installation of hard landscaping and planting. This ensures that all elements are designed and installed as one seamless system with the waterproofing integrity assured.



Guaranteed for up to 20 Years

Provided an Icopal Green Roof system is built to our recommended specification and installed by approved Icopal Green Roof Contractors then the waterproofing performance will be covered by insurance-backed guarantees for up to 20 years.



Approved Icopal Green Roof Contractors

Icopal maintains a register of approved contractors to carry out the waterproofing and landscaping elements of any Green Roof installation. We only approve expert contractors who can demonstrate excellence in working practice. This tight control ensures that the quality chain is maintained from initial roof specification, through materials and workmanship to the finished contract - and beyond if necessary. Icopal Green Roof contractors are easily identified on site by their identity badges.

Icopal can also provide a list of suitable landscape contractors to carry out irrigation and installation work and on-going roof garden maintenance.



Technical Support

At Icopal we are committed to helping professionals get the best possible performance from our Green Roof Systems.

Our advisory service for specifiers and contractors is free of charge. Members of our technical team are available at any time during working hours to answer queries on any aspect of Green Roof waterproofing design or best practice.

Our service also includes detailed Green Roof specifications itemising waterproofing, landscaping and planting requirements, incorporating CAD drawings where necessary.

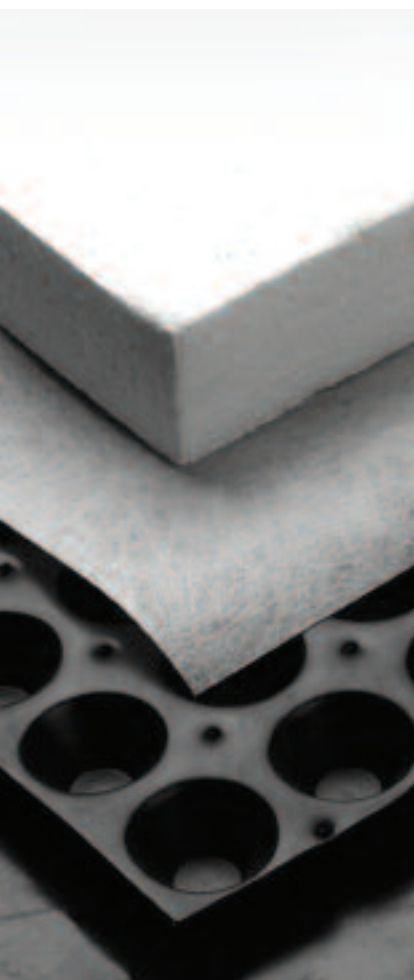
For our Technical Services Team please call 0161 865 4444

or email technical@icopal.co.uk

A wide range of technical information including drawings is also available at www.icopal.co.uk



Icopal Green Roof Garden Components: Technical Specifications



Icopal Protection Layer

Product	Low density polyethylene sheet
Thickness	0.02mm
Roll Size	4m x 25m (100 sq m)
Use	To protect the waterproof membrane from foot traffic when installing the system, and also as a partial root barrier once the system is planted.

Icopal Fytodrain Drainage Board

Product	Thermo-sealed large beaded expanded polystyrene boards.
Board Depth	65 mm
Board Size	1m x 1m (1 sq m)
Drainage Capacity	vertical: 0.10 to 0.07 litres water/m ² / second (DIN 4095).
Density	10 - 15 Kg /m ³
Compressive Strength	1,500 kg/m ² (at 65mm thickness)
Use	To move excess water quickly out of the system to drainage outlets.

Icopal Fytonop 20 Drainage Board

Product	High Density Polyethylene 'egg-cup' type drainage board
Colour	Black
HDPE Material Thickness	Approx 1.0mm
Single Sheet Dimensions	2.5 x 1.2m (3 sq metres)
Dry Weight	1 Kg /sq metre
Sheet Depth	20 mm
Number of "nops"	approx 400 /sq metre
Compressive Strength	150 kN /sq metre (15,000 Kg /sq metre)
Temperature Resistance	-40°C to +80°C
Use	To move excess water quickly out of the system to drainage outlets.

Icopal Filter Fleece

Product	Non-woven heat and pressure bonded polyester sheet.
Use	To limit the amount of particles reaching the drainage layer and outlets, therefore reducing the likelihood of blockages. Also as a partial root barrier.
Roll Sizes	100m x 4.5m (450 sq m) 100m x 2.00m (200 sq m) 50m x 2.00m (100 sq m)

Icopal Fytocell™ Water Reservoir

Product	Foamed Aminoplast Resin; dry material content 30kg/m ³ .
Saturated Weight	84 Kg /m ² at a depth of 100mm
Thickness	100 mm
Board Dimensions	1m x 0.5m (0.5 sq m)
Water Absorption	80% volume water - 20% volume drains out
Pressure Resistance	1,500 kg/m ² after 2 days. After curing and tested to ISO 844: final pressure resistance 23,000 Kg/m ²
Product Life	More than 150 years according TNO test report. Applied in roof garden with root activity: maximum 25 years without maintenance.
Use	Acts as a water reservoir where roots will grow directly into, and tap out the available water and nutrients held there.

Icopal EPS Filler Blocks

Product	Expanded Polystyrene.
Colour	White.
Dry Weight	approx 15 Kg /cubic metre.
Block Size	Standard - 2,440 x 1,220 x 610mm. But can be cut to other sizes.
Compressive Stress at 1%	20 kPa (2,000 Kg /sq metre to create 1% compression).
Cross Break Strength	140 kPa.
Use	Lightweight void filler for roof garden designs.
Notes	Can be supplied in different grades for greater load bearing. The filler blocks should be protected from hydrocarbon (oil based) products by a membrane, which could otherwise damage (melt) the material.



Icopal Fytocell™ Flakes

Product	Foamed Aminoplast Resin.
Form	Flakes.
Dry Weight	18 Kg /m³.
Saturated Weight	618 Kg /m³ (RG18).
Water Absorption	60% volume water - 40% volume drains out.
Use	Added to soils to increase water/nutrient holding capacity, aeration and drainage. It also makes the soil mix considerably lighter in weight.



Icopal Lightweight Soil Mixes

Icopal 60 / 40 Mix

Product	60% Sandy Loam 40% Fytocell™ Flakes
Estimated Saturated Weight	Approximately 1,200 - 1,400 Kg /m³
Bag Sizes	Loose Bulk Tippers 1.0 cubic metre bags 30 litre bags

Icopal 30 / 30 / 40 Mix

Product	30% Sandy Loam 30% Peat Free Compost 40% Fytocell™ Flakes
Estimated Saturated Weight	Approximately 1,000 - 1,200 Kg /m³
Bag Sizes	Loose Bulk Tippers 1.5 cubic metre bags 1.0 cubic metre bags 40 litre bags



Icopal Extensive Substrate

Product	Pumice gravel - complex natural silicate consisting mainly of amorphous silica(SiO ₂) but also containing minor quantities of various metallic oxides.
Colour	Grey
Damp Weight	700 (+/- 7%) Kg/m³
Melting Point	1,500°C
Use	To retain sufficient moisture for growth and to move excess water quickly out of the system to drainage outlets.
Bag Sizes	Loose Bulk Tippers 1 cubic metre bulk bags