Flat Roof Design Guide

Best practice membrane waterproofing &
environmental design for
New Zealand roof conditions

NURALITE
THE FLAT ROOF EXPERTS

This guide is dedicated to the late Robert Groves.

Rob was a valued member of the Nuralite Waterproofing team for over 25 years. His contribution to our industry is an inspiration and his service for Nuralite will long be remembered.

EDITOR'S NOTE:

The 50 years of Nuralite's team knowledge and industry experience contained in this design guide has been collected, compiled and edited by one of our newest members, Joseph Nicholls – "There sure is a lot to consider with low pitch roof design, and numerous decisions to make in finding the optimum specification. Luckily, any specific conditions that are not covered in this guide can be used to test the Nuralite technical team who are, after all, The Flat Roof Experts".

Joseph has joined Nuralite from a career in Architecture and in teaching sustainable design. He is now based in Wellington as the Nuralite Architectural Consultant for the lower North Island.

Nuralite has achieved a significant milestone – 50 years as a trusted name for flat roofing in New Zealand. To mark this achievement, we have produced this design guide to help specifiers create the best outcomes for their clients.

In preparing this guide, we have drawn on Nuralite's long experience in the design, installation and maintenance of membrane roof systems. We hope you find this guide a valuable aid to achieve optimum design solutions.

In our experience, a robust waterproofing system will always deliver significant long-term benefits to clients. Many positive environmental aspects can be designed into a roof for little additional cost. We all have an obligation to "build better" and this guide is our contribution towards a smarter future in flat roofs.

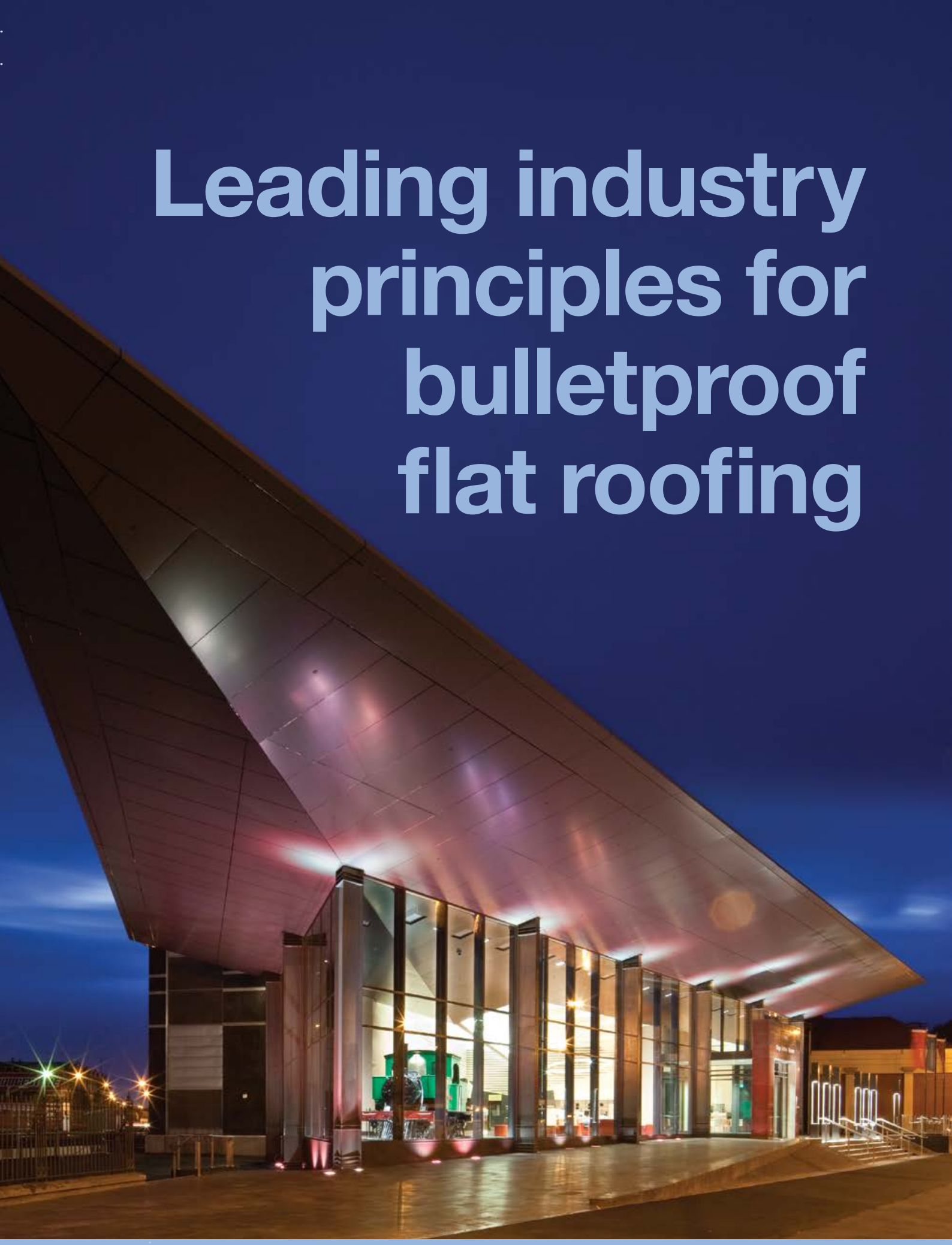
The specification and design process is critical to ensure long-term, good quality roof protection that meets the requirements of building regulations. A roof's performance is dependent upon material specification, correct design detailing and installation by fully trained operatives, followed up with regular inspection and maintenance.

Nuralite offers extensive consultation services regarding design, specification and material selection. Our services are delivered via a team of regional design specialists and our head office - technical centre.

We look forward to working with you on your next project.

John Simmons
MANAGING DIRECTOR

Leading industry principles for bulletproof flat roofing



» Toitū Otago Settlers Museum, Dunedin.

NURALITE
THE FLAT ROOF EXPERTS

FOREWORD

Philip E. Fry - Managing Director, Nuralite (1960-2006)

Over 50 years ago, New Zealand roof designers wanted to create smooth, waterproof, visually attractive, usable, near-flat and feature roofs. The age of terraces, barrel vaults, and hyperbolic paraboloids had arrived. Evolving from traditional hot bitumen screeds and multiple-layer hot tar roofing systems, Nuralite single layer sheet roof coverings were developed for the waterproof surface finish function.

Nuralite sheet systems had already been providing roof designers with excellent service and durability since around 1900. Originally produced in Great Britain, Nuralite had been used in a number of countries for over 50 years. It was an alternative to lead for waterproof roof trims, weatherings and flashings. Nuralite was credited with a number of Royal Warrants for waterproofing roofs on British crown properties. New Zealand was a logical extension for the Nuralite full roof waterproofing systems, then on to Australia, the Pacific, Asia and America.

In 1964, I helped to install the first Nuralite roofs in Auckland, on the Central Police Station designed by the then new Ministry of Works. Those roofs remain in place, waterproof, with no apparent degradation, after 52 years of service. My career with Nuralite systems then continued in New Zealand and internationally for over 40 years.

Correct design, detailing and specification of waterproof sheet membrane roofs and other surfaces has always been supremely important to ensure durable, low maintenance performance. Nuralite Waterproofing Ltd (which I am proud to have owned and operated up to 2006) has always provided the most current, technical detailing assistance for architects and designers.

In recommending this design and specification guide to designers, may I also commend to you an ancient adage from the traditional British roofing industry: “Look after the edges and the middle looks after itself!”

I am honoured to compose this short foreword for another fine quality Nuralite technical guide, which I am sure will serve roof designers very well indeed.

Sam Judd - Co-Founder & CEO, Sustainable Coastlines.

Warm roof solutions from Nuralite are an excellent option for a sustainable and effective way to create an environment that looks after people and the planet.

We are aiming to certify a 'Living Building' – which is the most rigorous sustainability framework for construction that exists on the planet.

A key part of this process is shifting towards regenerative design. The Nuraply 3PM Pure White product has become our most innovative example of regenerative design, because it is a solution that not only gives us a warm and waterproof roof, but also cleans nitrous and sulphur oxides from the air.

Greg Yeoman - Co-Founder & Director of Designer, StormWater360

From a green roof designer's perspective, flat roofs provide the most beneficial substrate for green roof performance and implementation. Flat roofs allow a safe working environment for installation of green roofs and the associated ongoing maintenance activities. Flat green roofs also provide for maximised uptake of water within the growing media and longer storage capability for plants to uptake, resulting in greater stormwater management properties and reduced irrigation requirements.

Sloped roofs can provide challenges for media containment and erosion prevention and may require interim lateral supports and edge restraint to be designed into the roof. Flat roofs on the contrary allow for gravity-supported green roof systems without the need to penetrate the waterproofing layer to anchor mechanical supports.

Bill Grayson - Founder & Director, Grayson Wagner

Flat roofs are increasingly popular, as they optimise the use of the site envelope. However, flat roof design still has to achieve the vital function of a traditional roof- runoff.

As roof slopes get closer and closer to 0°, an obvious trap is set, which most consider solved with better gutters, overflows, etc. But another insidious trap is also created which is much less obvious. Water heated by the sun is trapped behind imperfections in installation and roof levels, and is aggressive to roofing membranes. This leads to water absorption, which has translated to many millions of dollars worth of damage in recent years.

Flat roof membranes must be highly durable to satisfy the NZ Building Code and keep water out of buildings.
The multitude of membrane failures in the last 20 years show that membrane durability cannot be assumed.
Each membrane's performance over at least 15 years can be proven by subjecting it to International standard water absorption tests for a few weeks, which demonstrate performance/or not, in New Zealand's hot, wet conditions.

Ben Crawford - Winner of The Block NZ 2012

Why did we choose a flat roof for our home? The short answer is design and practicality. Our philosophy was always to work with the land, not against it. So when it came to the house's architecture, we wanted a home that complemented its surroundings by being as natural and as low-profile as possible.

A flat roof was the ideal solution. It provided clean, sharp and modern lines like the rest of the house and also enabled the bedroom pod to nestle perfectly under the bush canopy, an effect that wouldn't be possible with a steeply pitched roof.

After observing the sun's movements across the site, we identified the sunniest spot was where our living pod was. So we designed a roof top deck to maximise our sunlight hours.

This is again where flat roof designs excel. We have been able to create an additional 60 square meters of outdoor living space. Had we gone with a pitched roof we would have a smaller home and some pretty shady outdoor living spaces.

The Nuralite products and the Terracon install team were brilliant. From the customer service and specification process through to the Nuraply 3PM roof membrane and Nurajacks supporting our floating deck, we received a bulletproof, one-stop solution enabling us to realise our vision.

INTRODUCTION

Few elements of modern construction have such an effect on long-term environmental sustainability as the roofs over our heads. In addition to shielding building occupants from the elements and offering desired building aesthetics, a flat roof can provide a wide variety of functions critical to the sustainability of our urban and rural environments.

A carefully designed and specified modern flat roof can perform as well and last as long as any other roofing solution. Furthermore, this valuable surface area of our built environment can deliver significant benefits through flexibility of outdoor space, clean energy generation, water retention and collection, positive atmospheric contribution and with living roofs, habitat restoration.

This design guide covers the principles, challenges, risks, solutions, opportunities and considerations for best practice flat roofing in New Zealand. Designing and specifying in reference to this guide will ensure successful, robust and sustainable flat roof solutions.

ENVIRONMENTAL SUSTAINABILITY

In a time of increased environmental awareness and urgency, clients and designers hold real influence and opportunity in realising their projects. Globally, the construction industry accounts for and influences over 40% of all carbon emissions and 30% of all landfill waste.

This design guide encourages roof systems that maximise efficiency and longevity and minimise environmental impact. It also considers how roofs can go beyond sustaining a depleted environment and actually give a positive or restorative ecological contribution.

In each section of this guide, important environmental considerations are discussed as well as the dedicated chapter – **Innovative & Sustainable Design Opportunities**.

You will see **ENVIRONMENTALLY RELEVANT NOTES** indicated with this graphic:

HOW TO USE THIS GUIDE

This guide is structured to follow a typical design process. The chapters of this guide are grouped into these 6 main sections:

- New Zealand industry & design context
- Elements & principles from concept to detailed design
- Innovative & sustainable design opportunities
- Specifying products and systems
- Construction & flat roof application/installation
- Post design concerns

» **ALSO REFER TO:** Where one field relates to another, they are referenced like this.

Risk: Throughout this guide, flat roof design risks are identified in boxes like this.

Solution: These boxes offer best practice solutions, suggestions and considerations to help mitigate those specific risks. Any Nuralite specific solutions are then offered separately as shown below.

NURALITE SOLUTIONS

NURALITE SOLUTION:

When you see this box, it will contain the optimum Nuralite solution or design solution.

This design guide is an industry collaboration spearheaded by Nuralite Waterproofing Ltd. The principles and insight contained in this guide are based on 50 years of experience and expertise in New Zealand. We believe the knowledge and principles in this guide are applicable for all flat roof scenarios in New Zealand, regardless of which product brands are used. To make this clear we have kept our own product recommendations separate.

For more information on any Nuralite recommendations visit **www.nuralite.co.nz** or contact our regional experts.

INDUSTRY COLLABORATORS

Where flat roof design requires specialised additional systems, this guide recommends Nuralite's preferred industry collaborators and their expertise. This includes:

- **Stormwater 360** - Green Roof Systems
- **Harrisons** - Solar Energy
- **Marley** - Stormwater & Drainage
- **BAS** - Building & Span Expansion Joints
- **Allproof Industries** - Drainage Fittings
- **Monkey Toe Group** - Roof Access & Fixing

LIMITATIONS

RE-ROOFING & REFURBISHMENT: This design guide focuses on new roofs. For refurbishment of flat roofs contact Nuralite for their product recommendations. Also consider the chance to add a layer of insulation to enhance the thermal performance of the roof.

FULL TECHNICAL DETAILS: This design guide offers some important design principles and a range of typical scenarios. When the specific design configuration is ready for detailed technical precision, it is prudent to contact the selected supplier for review. Nuralite offers an expert review of roof designs and specification. This is to ensure code compliance, warranty and optimum product application.

DESIGNING: This guide is not for DIY design projects. For a successful flat roof project, engage a registered architect or suitably qualified architectural design professional.

APPLICATION: This is a design guide, not an application or construction guide.

Design Context

HISTORY OF ROOFS TODAY
NEW ZEALAND CONDITIONS
COMPLETE SYSTEMS VS HYBRID GROUPS OF PRODUCTS
THE VALUE OF MULTI-LAYER ENCLOSURES

Today's products & systems enable robust membrane waterproofing systems that can be designed with confidence

DESIGN CONTEXT

HISTORY & FLAT ROOFS TODAY

Last century, flat roof selection and design was simple. The product was black and a single layer would suffice. Substrates, insulation and condensation were often not considered important to the membrane's performance. Furthermore, once installed, flat roofs were often forgotten about with little or no maintenance.

For many consumers, membrane waterproofing and flat roofs developed a bad reputation. In hindsight, we can also see that this reputation grew from the use of inappropriate products and substandard installation.

Recently, flat roof systems and product technology have grown more complex. Flat roofs now have multiple elements and options. Consumers have far higher expectations of both the waterproofing integrity and the environmental performance of the system.

With careful selection and skilled application, today's products and systems enable robust membrane waterproofing that can be designed with confidence.

NEW ZEALAND CONDITIONS

New Zealand has a uniquely demanding climate with very high UV exposure, storm-force winds, geothermal activity and high humidity conditions that can shift numerous times in one day. New Zealand construction methods also offer a range of roof designs. New Zealand designers must consistently look for product/system performance that has proven success in New Zealand.

Some system applications have been inadequate in dealing with New Zealand conditions. Common examples are liquid membranes which age prematurely or membrane products that rely on adhesive bonded lap joints. Irrespective of the specific membrane system, poorly installed work on a New Zealand roof will not stand up to our conditions.

ALSO REFER TO: Types of Membrane (Page 23).

Risk: A product or system that is new to New Zealand and installed by inexperienced applicators carries a higher risk of failure than a proven product applied by an experienced installer. The quality of imported products is often unreliable and their claims of success may be founded in climates and industries quite different to New Zealand.

Solution: Choose a product/system that is proven over time in New Zealand conditions. Ensure it will be applied by an experienced local installer. Claims of success overseas should be researched before specifying.

COMPLETE SYSTEMS VS HYBRID GROUPS OF PRODUCTS

Product compatibility within any construction system is an important factor for design and specification. All flat roof products and accessories should come from the one supplier so that liability is clear if a problem arises. This includes membranes, adhesives, insulation, fixings, finishes and accessories such as outlets, vents, trim, expansion joints and deck supports.

ALSO REFER TO: Compatible Accessories (Page 51).

Risk: Components that are sourced from various international suppliers may not work together. Responsibility for system failures can be unclear and liabilities for remedial costs uncertain.

Solution: The entire system should be independently appraised – not just one or two components. A supplier who markets an entire system of compatible components should be selected. A system that is a hybrid of imported products should be avoided.

NURALITE SOLUTION:

Nuraply 3PM membrane systems and accessories are sourced from one European manufacturer. Nuralite custom-made scupper outlets are manufactured here in New Zealand. All Nuralite components are compatible and certified compliant to New Zealand Building Codes.

THE VALUE OF MULTI-LAYER ENCLOSURES

The New Zealand construction industry is becoming more aware that the building envelope needs careful attention.

Until recently, most wall cladding was a single line of direct-fix. Now, we have adopted the standard practice of cavity construction - an extra line of defense. Not long ago we used single glazed windows and reserved double glazing as an exclusive or premium option. Once the advantages were experienced and clear, the “2 layers of defense” became essential – or in other words, the “new norm”.

The quality and type of membrane systems that are available commercially in New Zealand is broad. There is still some perception that multi-layer products are exclusively for premium projects and that when a project budget is restrictive, a lesser system can be used. However, cautious and responsible specifiers are increasingly sticking to multi-layer systems on all their flat roofs.

Another term to explain the security of 2 layers is **Built-in Redundancy**. This a simple principle where any installation error or unforeseeable impact in one layer does not cause a problem because the additional layer is there as a back up. Single layer membrane options suit a simple design and require care and diligence to protect materials on the construction site.

The peace of mind & long-term savings gained from selecting a more reliable membrane system is often underestimated

Risk: After only a short life, inappropriate membrane systems can result in:

- Leaking roofs and high costs of replacing the inappropriate membrane prematurely
- Moisture damage to the building structure
- Reduced thermal performance

Solution: Checking and comparing the actual costs of a robust multi-layer waterproofing system with the costs of a single layer system might show little difference between them. At the design stage, the peace of mind and long-term savings gained from selecting a more reliable membrane system is often underestimated. Clients must always be reminded of both the importance of their roof and also the risks of specifying inappropriate systems in the roofing of a building.

ALSO REFER TO: Types of Membrane (Page 23).

Replacing or repairing an inappropriate or incorrectly applied roof membrane after a short lifespan is an inefficient and wasteful use of material and energy. If something fails and is discarded, the embodied energy (including green house gas (GHG) emissions) in that system is also wasted. This typically includes impacts of: raw material extraction, manufacture, transportation, labour time to install. It is essential for the efficiency of our construction efforts to specify systems that are fit for purpose and last long-term.

ECO NOTE

Design Elements & Principles

ROOF STRUCTURE & SUBSTRATES
TYPES OF MEMBRANE
ROOF FALLS
ROOF DRAINAGE
EXTERNAL GUTTERS
INTERNAL OUTLETS & GUTTERS
OUTLETS, OVERFLOWS & SCUPPERS
DRAINAGE REQUIREMENTS
SYPHONIC DRAINAGE SYSTEMS
ROOF PENETRATIONS
DRAINAGE CRICKETS
THERMAL PERFORMANCE (R-VALUE)

COLD ROOF & WARM ROOF DESIGN
INVERTED & HYBRID ROOFS
INTERSTITIAL CONDENSATION
VAPOUR BARRIERS
DESIGN FOR DYNAMIC WIND LOADS
FIRE PERFORMANCE
ACOUSTIC PERFORMANCE
SEISMIC & CONTROL JOINTS
TRAFFICABLE AREAS & PROTECTION
ROOF ACCESS & MOUNTING SYSTEMS
ROOF SAFETY & FALL RESTRAINT SYSTEMS
COMPATIBLE ACCESSORIES
DETAILED DESIGN REVIEW

Getting the basics right

DESIGN ELEMENTS & PRINCIPLES

Typical Substrates. Concrete (or screed) / Plywood / Metal tray.

ROOF STRUCTURE & SUBSTRATES

The structural system and substrate of the flat roof will affect what type of membrane, drainage and outlet details are appropriate. The main issue to consider is the stability and rigidity of the completed structure. The more rigid, the better. This reduces stress on the membrane. The most common substrates are concrete, plywood and profiled steel (for warm roofs).

Each type of substrate will require specific preparation and/or priming in accordance with the chosen membrane system. The membrane should be compatible with the substrate and follow the supplier's specification.

Risks: The following are seen as main risks:

- Sagging or deflection in the substrate can lead to drainage and durability problems in the membrane.
- Sheet joints in the substrate can move and create localised stress on the membrane.
- Poor construction can lead to tolerance for movement in the roof and adjoining elements, which will see membranes stretched or compromised.

Solutions: The following are seen as solutions:

- The span of the substrate materials must be within the manufacturer's recommendations for material thickness and loadings.
- Plywood substrate sheet joints must be specified with secure fixing so that they can behave as a homogenous surface.
- Design must always suit construction movement joints and design membrane movement laps.

NURALITE SOLUTION:

In accordance with Nuralite's CodeMark certification, on a plywood substrate, **Nuraply 3PM** systems can be used with 600mm joist and nog spacing (this applies to 17mm plywood on roofs and 21mm plywood on decks). When compared to 400mm spacing, this offers up to a 1/3 reduction in material resource, labour energy and costs.

Choosing a substrate that lasts can also mean choosing natural materials treated with preservatives. A code-compliant timber flat roof requires a plywood substrate and support to be chemically treated. When a client wants a toxin-free construction, consider alternatives such as profiled steel substrate.

ECO NOTE

TYPES OF MEMBRANE

There are a variety of membrane products and systems available. All products can be proven to work well in laboratory testing. But in the real-world, problems in waterproofing membranes arise with both inappropriate product selection and/or inadequate product installation. The main system categories are liquid membranes, rubber, single layer and double layer. Within the system categories, there are also different products and adhesion methods to keep the membrane fixed to the substrate - mechanical, glued, peel 'n stick or torch-on.

TYPE	Thickness	Joints	Layers	Risk of Installation Issue
Liquid Membrane (Paint-on)	0.6 – 1.5mm	NA	One	Very High
Rubber (Butyl or EPDM)	≈ 1mm	Glued or Taped	One	High
Single Layer (PVC / TPO / TPE)	0.7 - 2mm	Welded	One	Moderate
Double Layer (Torch-on)	≈ 7mm	Welded	Two	Minimal

Table 01: **TYPES OF MEMBRANES**

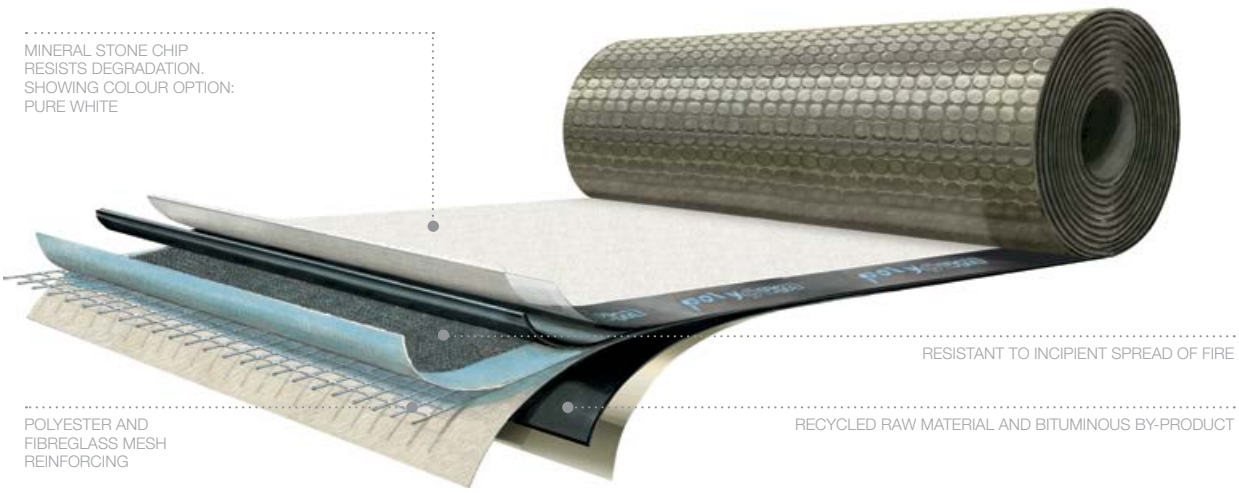


Figure 01: **MODERN MEMBRANES.** The quality of modern Nuraply 3PM torch-on is the result of a sophisticated manufacturing process (Showing colour option: Pure White).

MEMBRANE SYSTEM RISKS

The lap joints between sheets are a vital part of any membrane waterproofing system. Sheet membrane products are delivered in rolls which need to be lap jointed to form one continuous roof. For a durable lap joint, it is preferable that the entire joint is welded rather than contact glued or taped.

Close up of Nuraply 3PM mineral chip cap sheet (4mm) and base sheet (3mm). Showing colour option: Charcoal.

Other risks include:

- Liquid applied membranes often require regular re-coating to maintain their performance.
- Glued or taped joints have consistently struggled to last under New Zealand conditions.
- Lightweight products may be easily damaged by other on-site trades during construction.
- Recently developed products, or those recently introduced to New Zealand may not tolerate the New Zealand UV extremes.
- Single layer sheet materials have higher risk if jointed around complex gutter junctions or roof shapes. Single layer membrane options suit a simple design and require diligence on the construction site as well as absolute competence in application.

Risk: The following are seen as main risks:

- Leaking roofs and high costs of replacing the inappropriate membrane after a short life
- Moisture damage to the building structure
- Reduced thermal performance

Solution: The peace of mind and long-term savings that a reliable membrane system provides are often underestimated during the design stage. Remind clients of both the importance of their roof and the risks of making unsuitable specifications.

NURALITE SOLUTION:

For robust reliable and long-lasting membrane, a true 2 layer torch-on membrane is the optimum choice. The CodeMark certified **Nuraply 3PM** is a polymer enhanced bitumen based membrane with mineral chip cap-sheet. It forms a homogenous 7mm thick membrane that is both durable and flexible. The 3PM (and components) are manufactured in Belgium. A bitumen base ingredient is a by-product from the petroleum industry.

Replacing or repairing an inappropriate roof membrane after a short lifespan is an inefficient and wasteful use of material and energy.

ECO NOTE

ROOF FALLS

Under the Building Code, flat roofs must be designed to shed surface water. Falls are regulated depending on the type of roofing. Metal roofing profiles can be used to a minimum of 3 degrees. Beyond that, only membrane systems can be used and these are regarded as flat roofs.

The fall is most commonly expressed as a ratio, such as 1 in 80, or as an angle, although it is sometimes convenient to describe it in terms of a percentage slope where 1 in 100 is 1%. This is convenient for calculation as it expresses the fall in centimetres per metre run. The relationship between falls, angles and percentage slope is indicated in Table 02.

FALL RATIO	Slope angle	% Slopes	Rise in mm over 1m
1 : 120	0.5°	0.8%	8
1 : 100	0.6°	1.0%	10
1 : 80	0.7°	1.3%	13
1 : 60	1.0°	1.7%	17
1 : 40	1.4°	2.5%	25
1 : 38.2	1.5°	2.6%	26
1 : 28.6	2.0°	3.5%	35
1 : 19.1	3.0°	5.2%	52
1 : 14.3	4.0°	7.0%	70
1 : 11.4	5.0°	8.7%	87

Table 02: **ROOF FALLS**

To shed water under E2/AS1 the minimum fall in New Zealand has been 2 degrees (1:30 ratio) and 1:100 in the gutters. Recent membrane testing and technology allows some systems to work at lower falls. This can make a difference in design scenarios where the overall roof build-up has a height limitation. Gutter minimum remains at 1:100 fall.

NURALITE SOLUTION:

In accordance with Nuralite's CodeMark certification, a flat roof in the **Nuraply 3PM** range must have a minimum constructed fall of 1:80. For design purposes, a ecommended minimum 1:40 fall should be assumed for plywood and metal substrates or 1:60 for concrete. Gutter minimum is 1:100.

A slope closer to 1:80 may be accommodated following detailed analysis of the roof, including overall and local deflection, direction of falls and outlet design. In this case, the designer must be certain of achieving 1:80 falls on site. When working with another membrane system it is advised to keep the 2 degree minimum fall and consult on the independently certified details.

SUBSTRATE	Plywood	Concrete	Existing NURALITE	Concrete with Tapered Boards or Flat Enertherm	Plywood with Enertherm	NPM900 Metal tray with Enertherm
Recommended Design Fall (excluding gutters)	1:40	1:60	1:60 Confirm no ponding areas	1:60	1:40	1:40
Comments	Using 17mm (roofs) or 21mm (decks) plywood, rafters at 600 centers, nogs at 600 centers	Create required slope with a screed. Wait for concrete and screed to cure	Confirm substrate is sound	Nuralite to assist with tapered board layout	Create required slope in the plywood	Create required slope in the NPM900

Table 03: **FALLS CERTIFIED UNDER NURAPLY 3PM MEMBRANE**

ACHIEVING ROOF FALLS

STRUCTURAL FALLS

Falls may be formed in the roof structure or can be created within the roofing system above the substrate. Falls in the structure can be achieved by adjusting the height of supporting beams or purlins, by using tapered supports, or by the addition of firring pieces before the substrate is laid. The latter method is normally used with decks such as plywood, pre-cast concrete and metal decking. In the case of an in-situ cast concrete slab, falls are normally provided by using a separate screed.

FALLS IN THE INSULATION

Pre-formed tapered insulation products provide both thermal performance and drainage falls. They are of particular importance for re-roofing existing roofs, many of which do not have sufficient falls and often do not have sufficient insulation.

Pre-formed tapered insulation is also useful in situations where a horizontal substrate is needed for other reasons, such as on a horizontal internally exposed roof structure. Tapered insulation can provide falls in one direction to a gutter or level valley, or in two directions to form falls and cross falls. Any intersection in boards should be at 45° to avoid complex geometries during installation. The below example used falls from tapered insulation boards.

PIR products are appropriate in these situations. Non PIR products such as EPS have been used in the past but carry the risks of low performance around fire, compression, moisture absorbency and environmental factors.

ALSO REFER TO: High R-Value Roofs & PIR Product Options (Page 62).

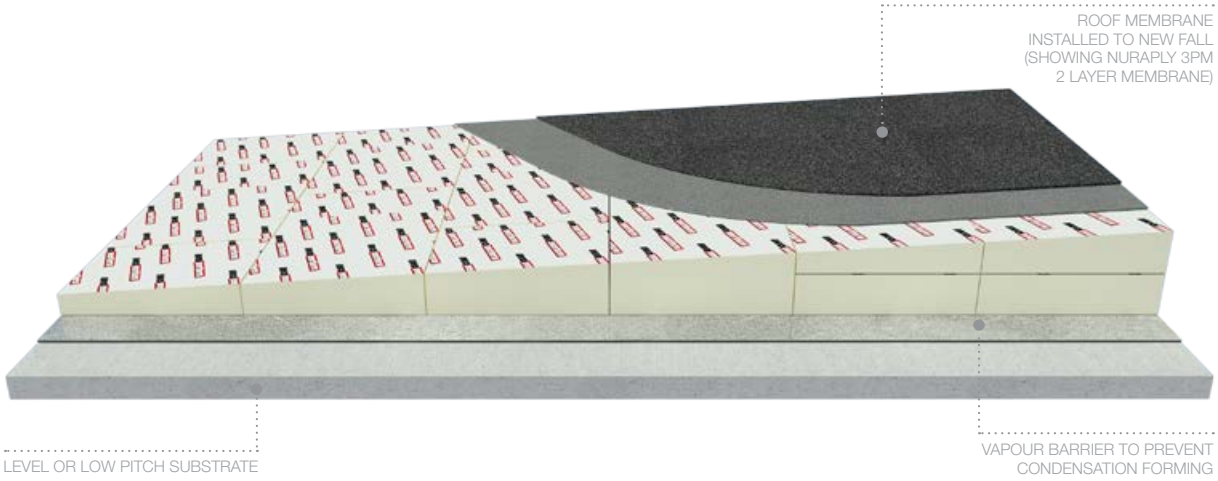


Figure 02: **TAPERED PIR LAYOUT.** Not to scale, slope exaggerated beyond 1 degree fall.

ROOF DRAINAGE

Flat roofs may be drained by two basic methods: towards the outer edges and into external gutters, or towards internal gutters or outlets within the main roof area. Straight falls to external gutters are desirable as drainage penetrations are outside of the enclosure. Internal drainage is achieved by straight falls to gutters or a pattern of falls and cross-falls to outlets.

Internal gutters should be laid to a minimum fall of 1:100. This can lead to a considerable depth of gutter at the low point. On a flat roof it is often better to omit the internal gutter in favour of sloping sections of roof between outlets.

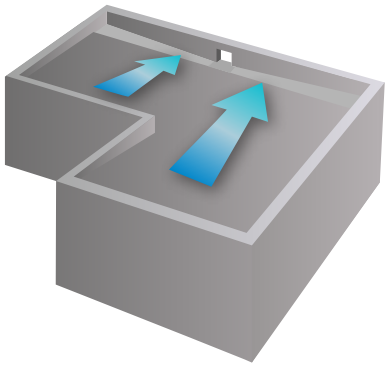
One of the advantages of flat roofs is the opportunity to avoid gutters and include a continuous wall-to-wall waterproof covering and insulation. As a general rule, a well-designed flat roof will contain a good number of outlets and limit internal gutters.

As a general rule, a well-designed flat roof will contain a good number of outlets & limit internal gutters

NURALITE SOLUTION:

The **Nuraply 3PM** CodeMark certified membrane allows for watertight outlet connections in a hip and valley design as well as an internal gutter.

A: Mono-slope to internal gutter and scupper.



B: Shorter hip & valley falls to internal outlets.

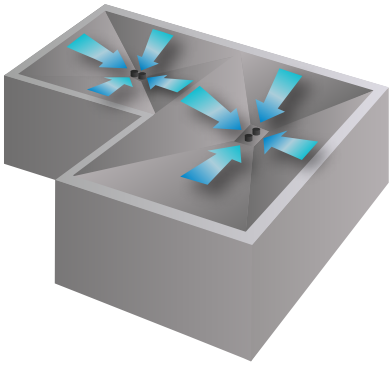


Figure 03: **DRAINAGE OPTIONS**. Drainage options where external gutters cannot be used.
A) Mono-slope to internal gutter.
B) Hip & valley to internal outlets.

EXTERNAL GUTTERS

A flat roof that drains to external gutters is the most risk adverse solution. Best practice ensures the detail of the termination of the membrane to a secure drip edge.

ALSO REFER TO: Rainwater Collection (Page 72).

Figure 04: **TYPICAL EXTERNAL GUTTER**. Detail shown on a warm roof design.

A flat roof that drains to external gutters is the most risk adverse solution

As a part of the drainage scheme, consider rainwater collection options to futureproof for water scarcity.

ECO NOTE

INTERNAL GUTTERS

If the design requires an internal gutter, it should be a minimum of 300mm wide to allow sufficient room for membrane applicators to complete installation. It should also be sized to suit the catchment and capacity of the roof. A minimum pitch of 1:100 is required for internal gutters.

Internal gutters are a vulnerable part of the roof and as such, design must include careful consideration of product sheet sizes, risks of blockage and location of overflows to prevent flooding or ponding. Inspecting internal gutters and outlets is an important part of the maintenance schedule.

ALSO REFER TO: Maintenance Schedules (Page 83).

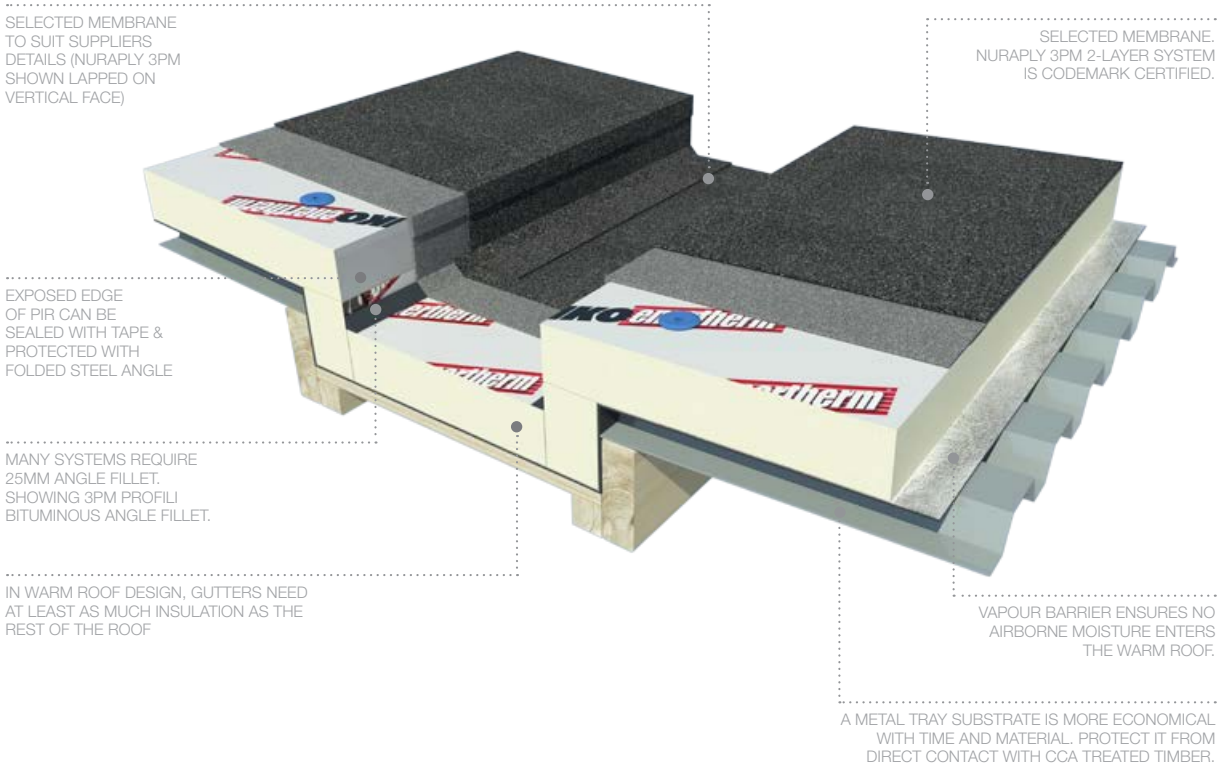


Figure 05: **TYPICAL INTERNAL GUTTER**. Detail shown on a warm roof design.

Internal gutters are a vulnerable part of the roof

ECO NOTE

How the internal gutters and outlets impact the thermal envelope is an important consideration. Best practice demands that internal gutters must be properly insulated.

OUTLETS, OVERFLOWS & SCUPPERS

Proprietary roof outlets need to be compatible with the type of roof membrane. They need to be sized to suit the drainage requirements. The outlet details need to be designed to connect suitably to the specific substrate. An outlet also needs to prevent large objects from entering and blocking the drain. It is the responsibility of the designer to ensure sufficient drainage capacity for the roof design. It may also be advisable to consult a drainage specialist.

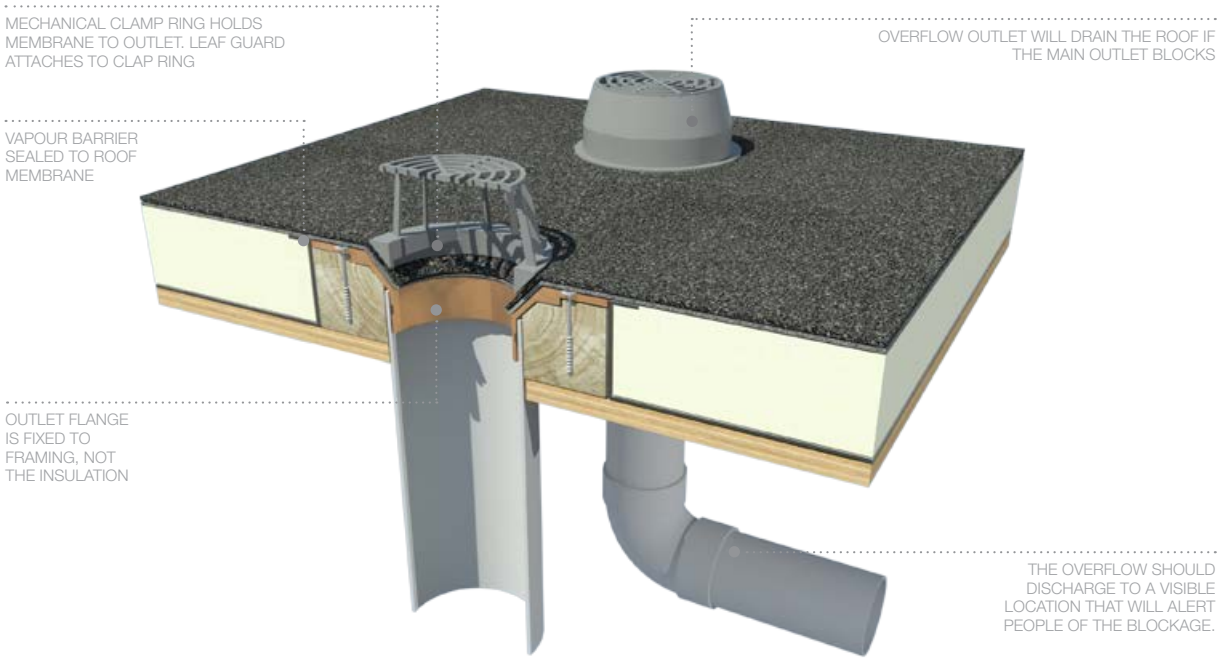


Figure 06: **TYPICAL INTERNAL OUTLET & OVERFLOW** at low point of membrane roof (detail shown on a warm roof design).

On an enclosed flat roof, it is important to have a backup plan in the form of an overflow. Blockage of the primary outlet is always a possibility. Overflows offer a temporary alternative method of draining the roof. The overflow must be located at a height that will work without significant ponding or flood damage and also at a location where the overflowing water will be easily seen by the building occupants.

Circular available in 80mm & 100mm diameter.

Square 100mm x 100mm.

Rectangular 200mm x 75mm.

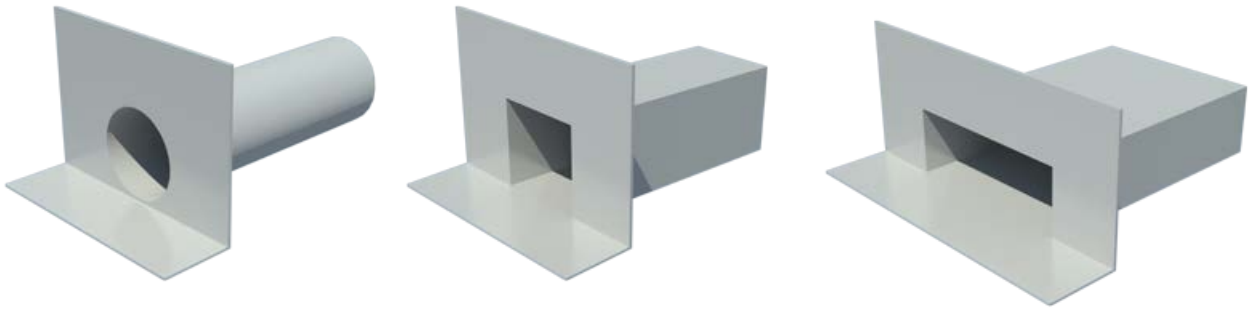


Figure 07: **STANDARD SCUPPER SIZES** in aluminium or stainless steel. Overflow scuppers are similar without the horizontal flange. Custom sizes can also be made.

DRAINAGE REQUIREMENTS

The size and location of the roof will determine the drainage design requirements. The size and slope of the roof area affects the required drainage capacity. Steeper pitches increase the speed with which the rainwater drains into the gutter and downpipe system. This may affect the size of gutters and the number and diameter of downpipes. Regions across New Zealand are subjected to varying levels of rainfall intensity which in turn affects the capacity required and the appropriate number of downpipes. The New Zealand Building Code requires that a rainwater system design can cope with the level of rainfall intensity that has a 10% chance of occurring once a year for 10 minutes. Exact rainfall intensities across NZ can be checked using the NIWA High Intensity Rainfall Design System – **www.hirds.niwa.co.nz**

While it is beyond the scope of this guide, it is recommended that a suitably qualified drainage expert is involved at the design stage.

NURALITE SOLUTION:

Nuralite collaborates with **ALLPROOF INDUSTRIES** for supply of drainage outlets, overflows, podium drains and rainwater heads.

Regions across New Zealand are subjected to varying levels of rainfall intensity

ALLPROOF INDUSTRIES

RAINWATER SYSTEMS

Allproof Industries offers fully integrated systems for managing rainwater outlets, drainage and overflows. Choose from a wide range of stock, custom designed fittings or architecturally styled components such as stainless steel rainwater heads, downpipes, cowels and soffit covers. Allproof Industries have solutions for all situations.

Bronze Roof Drains (FCR & DRCR): High quality premium roof drains for membrane situations.

The Allproof Sureflow Series provides a cost-effective PVC roof drain solution for heat applied membranes.

To view the full Allproof Industries range visit: www.allproof.co.nz or contact them at (09) 481 8020.
Read more about Allproof Industries at the Collaborators Section (Page 100).

Rainwater head & adjacent overflow.

SYPHONIC DRAINAGE SYSTEMS

A syphonic system on a membrane roof requires attention to the outlet details, particularly ensuring that the syphonic outlets are specified to suit the type of membrane. Consideration of the syphonic system is best early in the design process, otherwise other service related considerations may be affected.

NURALITE SOLUTION:

A technical review from Nuralite at the time syphonic outlets are being specified will ensure compatibility.

ROOF PENETRATIONS

The best strategy for flat roofs is to minimise penetrations. Where they are unavoidable, a penetration to a roof membrane can be detailed as a continuous part of an enclosure. Detail penetrations as per the suppliers recommended details.

Avoid locating roof penetration in gutters or close to walls, outlets or other features. Allow a minimum 300mm clearance so that membrane appliocators have space to create a continuous seal around the penetration. It can be smart to put roof penetrations on a raised plinth.

Risk: The penetration is a gap in the thermal performance of the roof. It is a physical break in the roof membrane and can increase the risk of leaks.

Solution: Avoid roof penetrations if possible. If unavoidable, detail a complete solution. A multi-layer membrane system ensures watertight connection to the penetrating element and gives the best results.

DRAINAGE CRICKETS

Drainage crickets (or saddles) may be used to prevent water ponding in an otherwise level valley. Crickets will displace standing water and provide a modest fallback to the main roof fall. In effect, crickets introduce a new valley with improved falls.

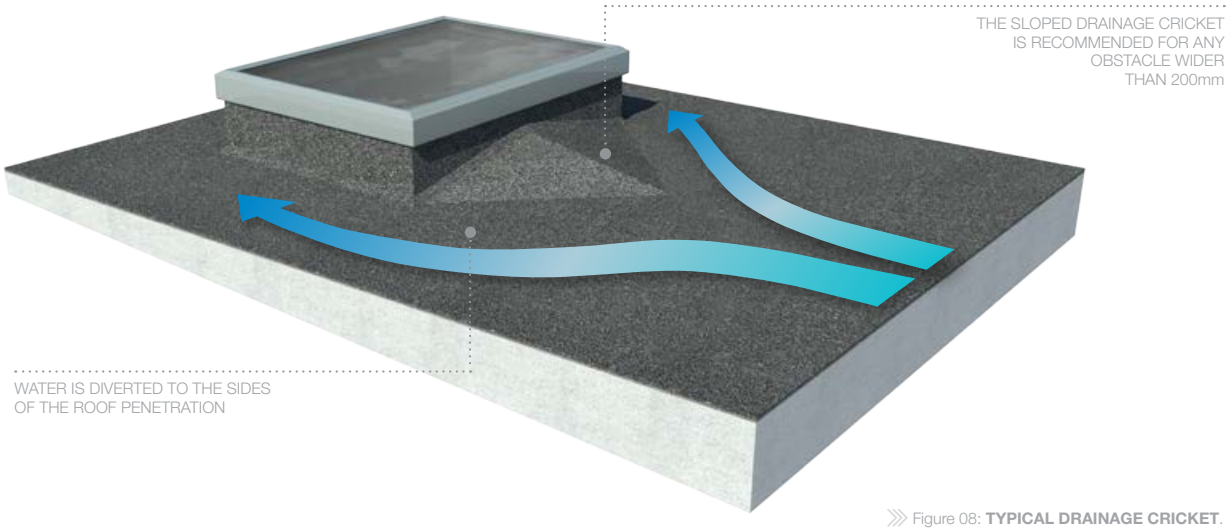


Figure 08: **TYPICAL DRAINAGE CRICKET**.

Risk: Poor drainage flow behind a roof object will result in the build-up of silt and debris that will require more maintenance or increase risk of membrane degradation.

Solution: A cricket must be designed for all roof objects that are wider than 200mm. Best practice is that the cricket is designed and formed as part of the substrate layer.

THERMAL PERFORMANCE (R-VALUE)

Thermal design is concerned with the flow and resistance of both heat energy and water vapour through the roof construction. Design awareness needs to register the impact of moisture vapour on the thermal performance of the insulation and on the components in the roofing system.

Any break in the insulation layer of the thermal envelope will allow heat energy to escape. Thermal bridges such as roof joists, recessed lights and roof penetrations should be minimised. The simpler the roof design, the better.

ALSO REFER TO: Cold Rooofs & Warm Roofs (Page 36).

Design awareness needs to register the impact of moisture vapour on the thermal performance of the insulation and on the components in the roofing system

Thermal performance is measured in R-Value. When specifying insulation the following should be considered:

- The New Zealand Standards are a minimum only.
- Internationally the New Zealand minimum is low. Other countries, including the United Kingdom and USA have significantly higher insulation targets.
- It is difficult and costly to retrofit insulation. The best time to fit insulation to the maximum is during the initial build.

	Zone 1	Zone 2	Zone 3
Minimum R-Value	2.9	2.9	3.3

Table 04: **SCHEDULE OF MINIMUM R-VALUES** (non-solid construction) for roofs as per the NZS4218/H1.

ALSO REFER TO: High R-Value Roofs (Page 62).

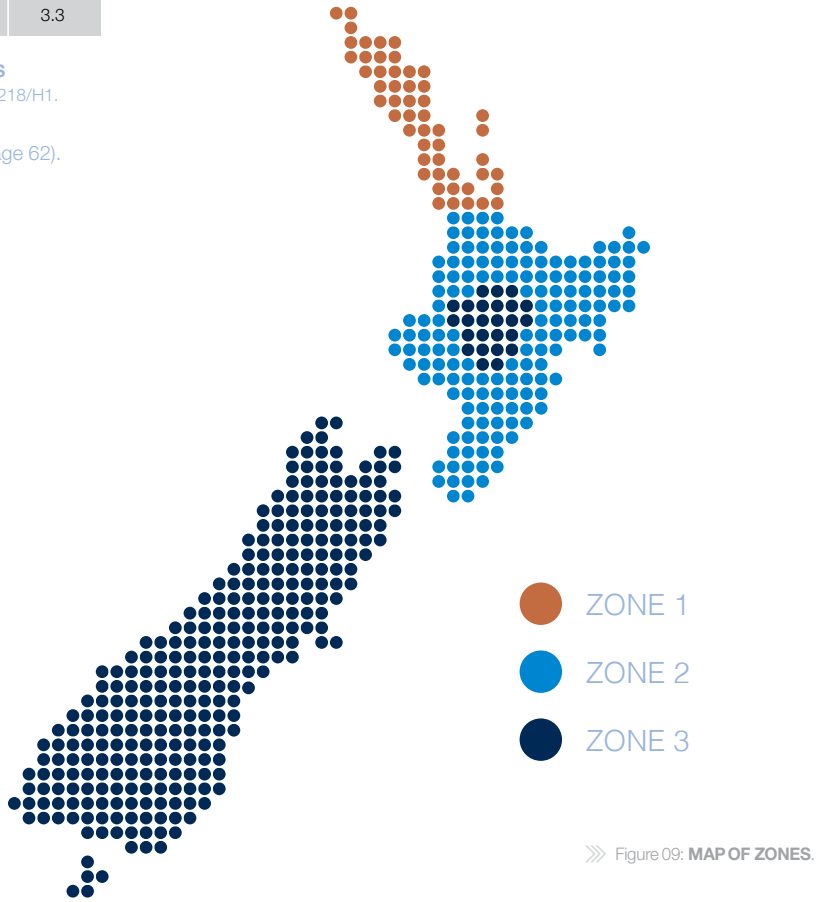


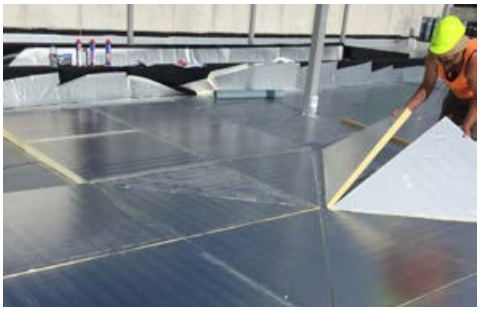
Figure 09: **MAP OF ZONES.**

Risk: Suppliers may quote international R-Values which are calculated differently, or they may use construction R-Values instead of product R-Values. The outcome can be a poorer actual performance once installed – perhaps not even meeting the New Zealand code compliance minimums.

Solution: Ensure the products specified have an R-Value testing and calculation method that is acceptable to New Zealand. Suppliers may quote international R-values which are calculated differently, or they may use construction R-Values instead of product R-Values.

NURALITE SOLUTION:

Nuralite provides the complete **Nuratherm** warm roof system that insulates using the Enertherm PIR boards. Refer to High R-Value Roofs (Page 62) for more on Enertherm.



TAPERED ENERTHERM - Enertherm PIR insulation before the membrane is installed.

Space heating and cooling places a huge demand on energy supply. With 30 – 35% of heat is lost through the roof of an uninsulated house. Well-insulated roofs and enclosures demand much less heating energy to stay warm. Over a building's lifespan, these energy savings or losses can amount to a much greater carbon footprint than was first emitted during the construction of the building. Designers and clients can choose minimum insulation requirements to save costs initially and allow occupants (and the planet) to continue paying for long-term energy use. An environmentally responsible approach is to design for high insulation rating during construction, so that the lifespan of the building uses less overall energy.

ECO NOTE

COLD ROOFS & WARM ROOFS

Flat roof construction can normally be categorised as either cold roofs or warm roofs, depending on the position of the principal thermal insulation layer. In a warm roof the structure and substrate stays warm, below a rigid board insulation. With a cold roof, the substrate and structure is above the insulation and will become cold (or hot) to match the external temperature.

Warm roof design has been mandatory in European flat roof practice, while New Zealand has traditionally accepted the cold roof solution. This is rapidly changing as New Zealand industry realises the benefits of warm roof design.

NURALITE SOLUTION:

Wherever possible, new flat roofs should be specified as warm roof systems. If re-roofing an existing flat roof, it should be insulated so that it becomes a warm roof.

NOTE: FOR WARM OR COLD ROOFS, 600mm WIDE STRUCTURAL SPACING CAN BE USED WITH PLYWOOD SUBSTRATES UNDER NURAPLY 3PM CODEMARK CERTIFICATION

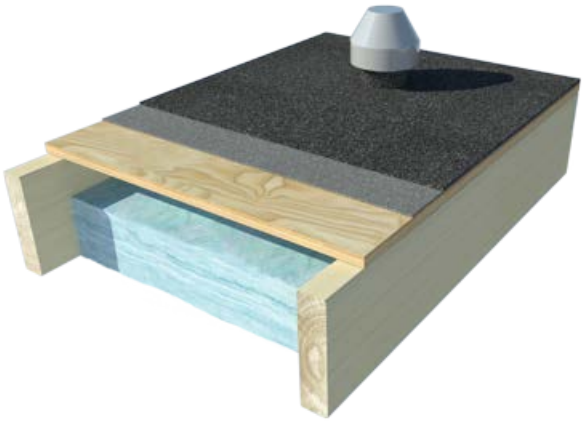


Figure 10a: **TYPICAL COLD ROOF** showing cold-bridging & a ventilation dome.

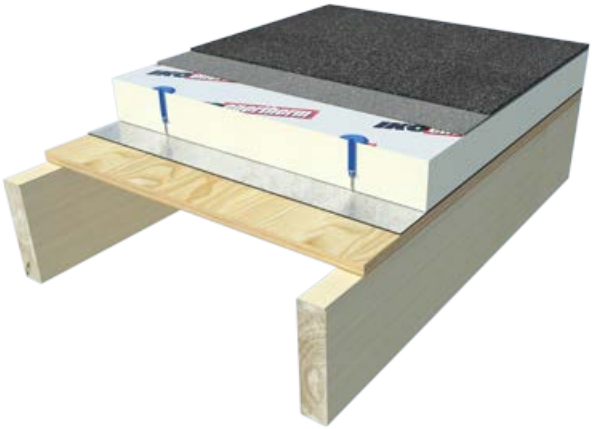


Figure 10b: **TYPICAL WARM ROOF** with continuous insulation.

The warm roof system provides a continuous insulation layer while the cold roof is often bridged by the structural elements. Cold roofs provide a cold surface which risks interstitial condensation forming. A cold roof is therefore required to be ventilated. In many flat roof designs this is achieved with ventilation domes. Furthermore, the R-Value in a warm roof design is likely to retain its thermal value, whereas the insulation in a cold roof can be degraded by the invisible impacts of interstitial condensation and moisture to the insulation material. Most insulation products have reduced performance when wet or damp.

ECO NOTE

Existing cold roofs can be upgraded to warm roofs when a roof system is being upgraded. Lock in future energy savings by specifying more than the minimum insulation thickness.

Installing the same R-Value insulation product into a warm or cold roof will result in very different construction R-Values. The inferiority of a cold roof system is clearly demonstrated when comparing the two methods in Design Navigator. Refer to **www.designnavigator.co.nz**

	Nuraply Cold Roof	Nuratherm Warm Roof
Insulation R-Value	3.2	3.14
Construction R-Value	2.67	3.53

Table 05: **R-VALUE** warm vs cold roof

ALSO REFER TO: Interstitial Condensation (Page 41).

ECO NOTE

Compromising insulation at the design stage imposes an unnecessary energy cost burden on the property owner for the life of the building. Insufficient cold roof ventilation can reduce the lifespan of the roof.

COLD ROOF DESIGN & VENTILATION

A cold roof design can be advantageous to reduce building height by placing insulation thickness within the structural depth, but it is not a desirable thermal option. The insulation is placed within a ventilated void space below the roof deck and above the internal ceiling.

Proper ventilation of the roof space and an effective vapour control layer at ceiling level is difficult to achieve. This method also compromises the insulation with multiple thermal bridges from rafters, downlights, stereo speakers or other ceiling fixtures.

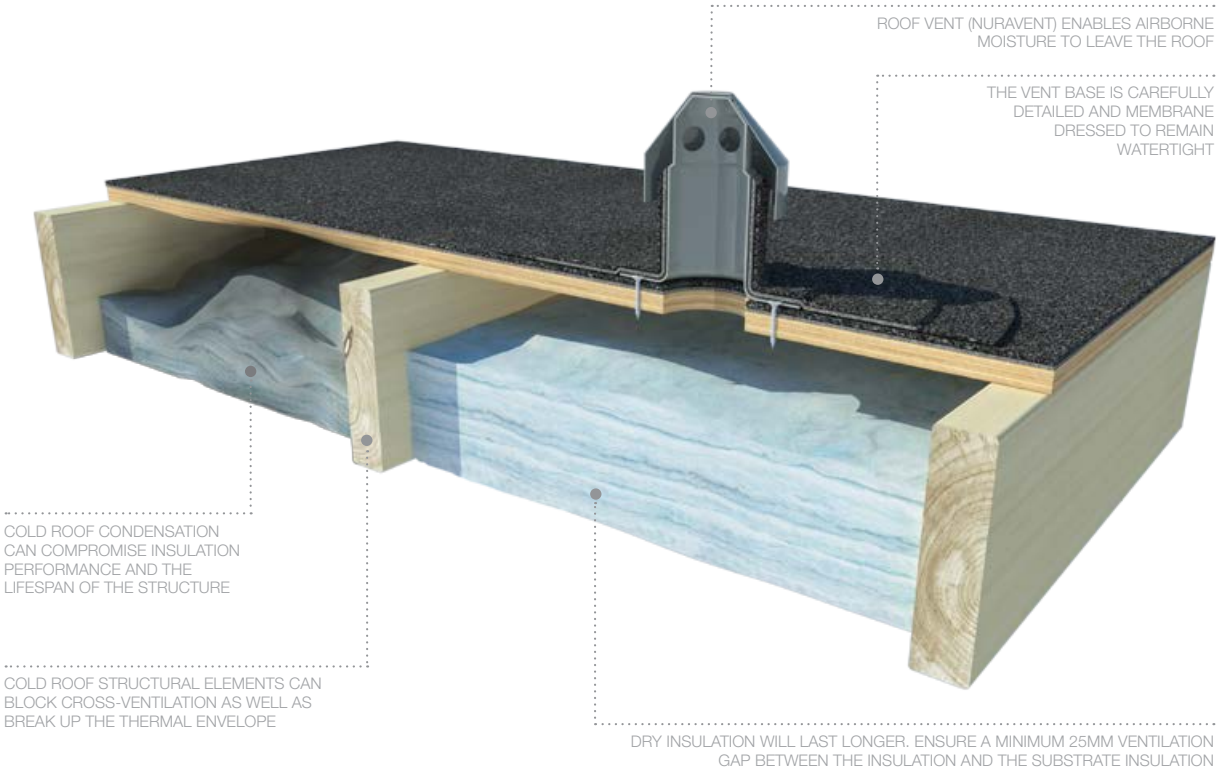


Figure 11: **COLD ROOF DESIGN RISKS.** Risks that are unpredictable and concealed in a cold roof design.

Flat roofs that are cold roofs require ventilation cowls to penetrate the roof itself. This is to allow moist air to escape with the hope that it does escape rather than condensate. However, the ventilation is not well proven or regulated. How moisture performs in a closed space is not predictable. The vents through the roof are less than ideal and in some cases can also allow cold damp air to be drawn inside the structure.

NOTE: A cold roof is not the same as a Cool Roof. Refer to Cool Roof Design (Page 60).

NURALITE SOLUTION:

We suggest a ventilation dome for every 20m^2 of unventilated cold roof. Consider how damp air can move across the roof to reach the vents.

WARM ROOF DESIGN

Warm roof construction has the principal thermal insulation layer placed above the structural deck and immediately below the waterproofing membrane. Locating the insulation above the structural deck is desirable, as the insulation is a continuous plane and the R-Value of the insulation product is therefore achieved. The structure and substrate is protected from thermal extremes so it will remain stable and last longer.

In a warm roof configuration, a vapour barrier layer is recommended to achieve the highest performance standards. Because the insulation is kept dry between the membrane and the vapour barrier, it will retain the R-Value performance. In contrast, cold roof insulation products often degrade over time.

Normally insulation finishes at the top of a wall. With a warm roof the designer must ensure that the wall insulation is specified to extend to the base of the roof substrate. This is illustrated in Figure 14 (Page 44).

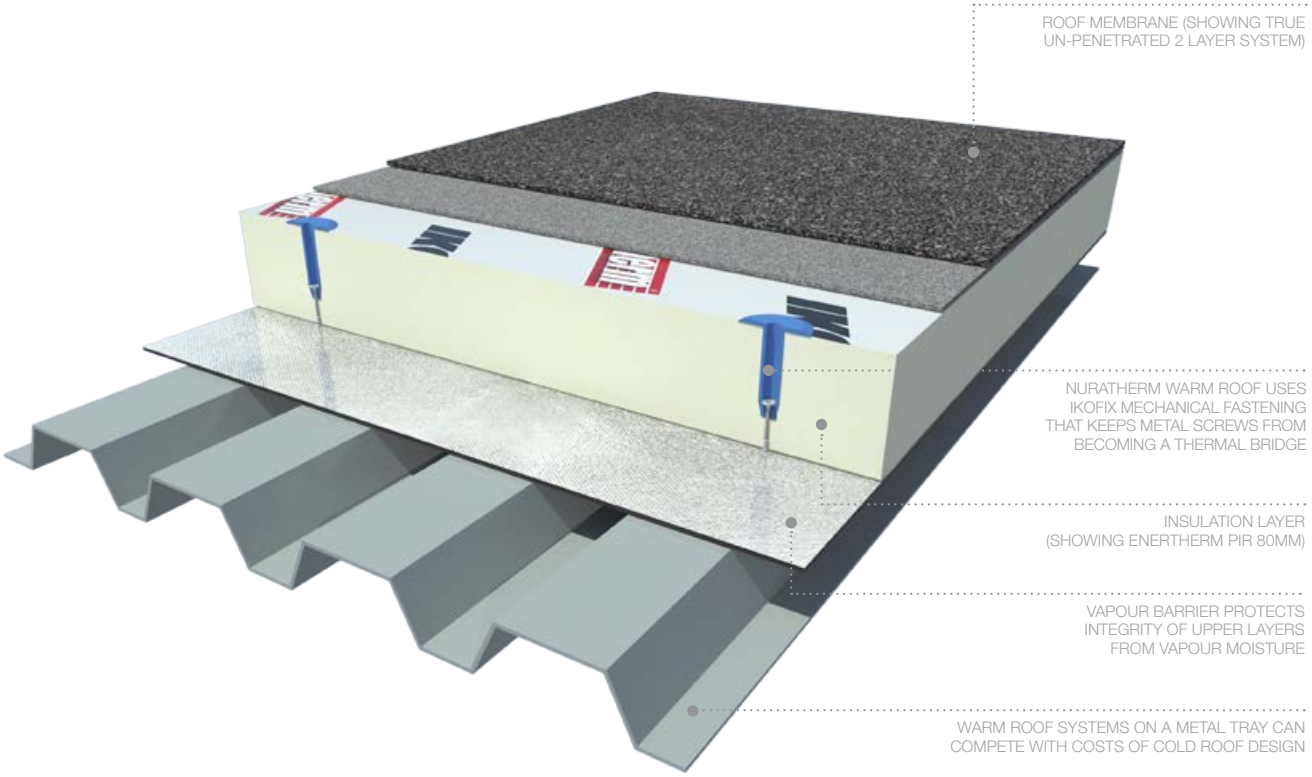


Figure 12: **WARM ROOF DESIGN.** Diagram showing continuous insulation of warm roof design.

NURALITE SOLUTION:

- The **Nuratherm** warm roof system provides the best possible flat roof insulation method. It includes Enertherm PIR insulation boards. Refer to Figure 12 (Page 39).
- For warm roofs, **Enertherm** PIR insulation has the highest energy efficiency per m^2. Compared to other insulation materials (such as EPS, XPS and Rockwool), a higher insulation value is achieved with a thinner board.
- Installing two layers of a thinner board is optimum so that greater thicknesses and R-Value can easily be achieved. 100mm (R 4.5) of Enertherm for Zone 1 and 2 and more for Zone 3 should be considered.
- PIR insulation has very high compressive strength. Combining this with the excellent R-Values of the aluminium faced Enertherm PIR boards makes for the ultimate flat roof insulation.
- Enertherm boards are lightweight and easy to handle on site. The boards can be installed over plywood, concrete or metal substrates, on new or existing buildings and on flat roofs regardless of their slope.
- Utilising NPM900 metal tray as the substrate is recommended as it is cost effective – it can be installed for less than a traditional cold roof system.
- Specifying more than the minimum insulation thickness locks in energy savings for years ahead.

ALSO REFER TO: High R-Value roofs and PIR Product Options (Page 62).

Over a building's lifespan, the energy losses due to poor insulation performance can amount to a much greater carbon footprint than emissions from the original construction. In contrast, a warm roof with quality PIR will retain its R-Value for decades.

ECO NOTE

INVERTED & HYBRID ROOFS

There are less common approaches to flat roof insulation, such as Inverted Roofs (insulation above the waterproofing) or Hybrid Roofs (mix of warm and cold roofs). These require specific design. Consulting with Nuralite will make sure that condensation, insulation and waterproofing details have all been considered.

INTERSTITIAL CONDENSATION

Moisture-producing activities take place in most buildings. Some manufacturing processes clearly release a large amount of water vapour into the internal air. Bathrooms, kitchens, laundries and swimming pools are also sources of high indoor humidity.

Air has a limited capacity for carrying water vapour. At full capacity, it is said to be fully saturated. The moisture vapour in air exerts a pressure known as the vapour pressure.

The temperature at which the air becomes fully saturated with moisture, ie 100% Relative Humidity, is called the dew point. When warm moist air meets a cold surface it is cooled, and if its temperature drops below the dew point it will give up moisture in the form of surface condensation.

Air inside a building normally contains more water vapour than the external air and therefore has a higher vapour pressure. A vapour drive moves from the areas of high pressure to areas of low pressure and therefore the water vapour will try to escape by all available routes to the low pressure conditions outside the building.

When designing a roof, the potential for condensation must always be considered. The flow of water vapour through the roof takes place slowly and continuous periods of condensation are necessary before interstitial condensation becomes a problem.

Condensation forming on cold surfaces.

The water vapour will try to escape by all available routes to the low pressure conditions outside the building

Risk: Dampness due to condensation can lead to fungal growth, decay in structural timbers and the accelerated corrosion of metal components and fixings. There is also the risk that insulation boards containing organic fibres will decay from the growth of fungus, lose their strength and suffer a reduction in their insulating efficiency. These effects may be taking place within the structure but with no visible indication of problems. In extreme cases it may appear that the roof is leaking, when in fact the issue is interstitial condensation.

Solution: Suitable thermal insulation should be included within the system. This layer must have sufficient insulation value for its underside to remain above the temperature at which condensation can start, even in the coldest design conditions.

To future-proof a warm roof design, it is desirable to specify a proper vapour barrier

Risk: The provision of insulation alone is not sufficient to prevent condensation. If the insulation is permeable to water vapour, the vapour will pass upwards through it and condense on the underside of the waterproof membrane.

Solution: To prevent this from occurring, a vapour control layer should be provided directly below the insulating layer.

NURALITE SOLUTION:

To future-proof a warm roof design, it is desirable to specify a proper vapour barrier. Any future shifts in the building-use will not create hidden internal moisture problems in the roof. Nuratherm ALU vapour barrier is a robust option that has excellent tear resistance, tensile strength and a leading vapour diffusion resistance of 5000ud.

ALSO REFER TO: Vapour Barriers (Page 43).

Designing ventilated cold roofs or airtight warm roofs without careful attention to risks of condensation can compromise the whole building fabric and integrity. The performance of a building over time can seem less relevant when the budget and schedule are immediate. Design and specification with attention to condensation and airtightness can help extend the building's lifespan.

ECO NOTE

VAPOUR BARRIERS

It is crucial in a warm roof to keep insulation dry from internal moisture with a vapour barrier/blocker. The vapour control layer prevents warm moist air from reaching the dew point where it will form condensation. It also acts as an air barrier by preventing air leakage through the roof system.

Professional energy auditors use blower door tests to help determine a home's airtightness. An airtightness test result (n50) of ≤ 0.6 air changes/hour is a requirement for Passive House certification. Incorporating Passive House principles makes common sense even if the property is not being built to fully meet these standards.

The vapour barrier to the roof membrane must be properly sealed at roof penetrations and at the roof perimeter. If not, there will be an opportunity for moisture to be drawn into the insulation envelope. If moisture does enter the insulation, it can create vapour expansion and compromise the membrane. Condensation underneath the membrane will cause water damage to both the insulation and to the roof. If this happens it is no longer a true warm roof.

ECO NOTE

Even well-insulated homes can be difficult to heat if draughts constantly replace hot air with cold air. Airtight building and controllable ventilation lets occupants manage air replacement for a warmer, healthier, more comfortable home.

NURALITE SOLUTION:

A **Nuratherm** warm roof system installed with an IKO ALU vapour barrier/blocker is optimum. This Nuralite vapour barrier provides temporary waterproofing during construction and a 3rd layer of defence for the already bulletproof Nuraply membrane.

DESIGN FOR DYNAMIC WIND LOADS

Protection against wind forces should be one of the fundamental principles behind good membrane roofing design. Distribution of air pressure over the roof is far from uniform, even for the simple box-type structure illustrated. Wind does not normally strike square to the face of a building. When it strikes at an oblique angle, the air deflected up and over the roof is at the same time moving along the face of the building, creating vortices along the roof edges.

The greatest wind pressures are experienced at the windward corners and edges of the roof, where the negative pressure can be several times the pressure of central areas.

Figure 13: **WIND FLOW.** Perspective diagram of wind forces from an oblique angle.

The negative pressures that develop over the roof will often be quite small in area and may traverse the roof or parts of the roof as eddies. Lightweight, flexible waterproofing only requires a small flow of air to the underside of the waterproofing to allow air to collect locally under an eddy formation. From there it will form a wave which will follow the eddy as it passes over the roof surface.

ALSO REFER TO: Nurajack Windproof (Page 71).

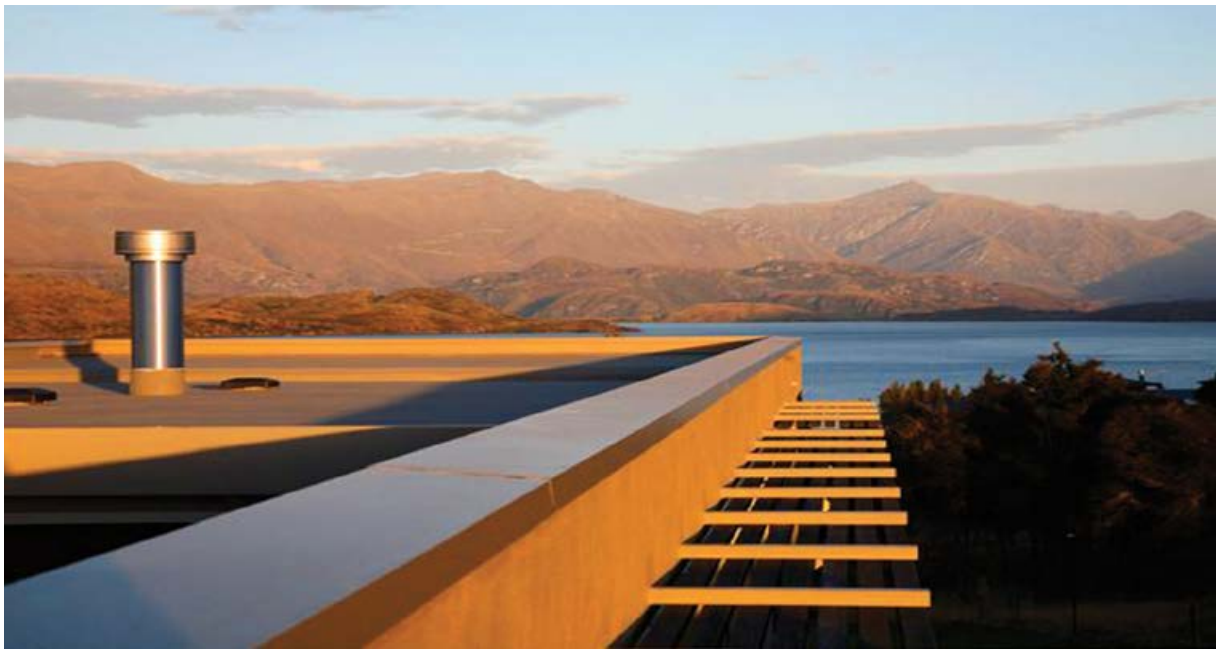
Figure 14: **EXAMPLE OF NURATRIM** mechanically fixed edging system for resisting dynamic wind forces, shown with a Nuratherm warm roof.

Risk: Extreme wind forces can break down a mechanically attached or poorly adhered waterproofing system. If a wave form develops, the amount of air under the waterproof covering can sometimes increase rapidly and failure can occur by simple lift-off. It is also possible for the waterproofing to be lifted up and down or dragged out of position until air can find an entry at an edge and cause further damage. Oversails, fascias, cappings, trims and drips/edges take the brunt of the wind force, so these details are usually the first components to fail.

Solution: All details should be designed to reduce the free entry of air beneath the membrane. If the waterproofing is fully bonded to a good, stable surface, the wind forces involved will not be sufficient to break down the bond and will not allow a wave to form. For roofs with very high wind exposure, the membrane supplier should recommend any additional design and specification measures (such as extra mechanical fixings).

NURALITE SOLUTION:

- The robust **Nuratrim** extruded aluminium edge flashing neatly contains a wind-resistant and watertight roof edge. (See Figure 14). It offers a clean straight edge to the roof and façade. It meets 70mm E2 vertical measure and is designed to form watertight edge with the **Nuraply 3PM** two layer torch-on membrane.
- As a rough guide, all metal cappings and trims should be fixed at 300mm centres, with extra fixings added under conditions of extreme exposure. The grounds to which the details are secured must themselves be firmly attached to the structure.
- Always seek input from the Nuralite technical team in Extra High (or above) wind zones. Special details and fixings may be used to ensure project success.



FIRE PERFORMANCE

Fire can have a catastrophic impact on a property and those within it. Building materials have an important role to play in minimising the consequences of a fire event.

Objectives of Clause C1 of the Building Code are to:

- Safeguard people from an unacceptable risk of injury or illness caused by fire
- Protect other property from damage caused by fire
- Facilitate firefighting and rescue operations

In a flat roof situation, it is therefore critical to consider the fire performance of the materials. Selecting materials that resist the spread of fire from other buildings (low combustibility and self-extinguishing) will assist the roof design to meet the Code requirements.

Attention must be paid when detailing near heat sources such as chimneys or flues. The membrane and insulation should be separated from the heat source to ensure long-term performance.

NURALITE SOLUTION:

- The **Nuratherm** system is a complete system that consists of self-extinguishing Enertherm PIR insulation (meets AU/NZS4020) and the flame retardant **Nuraply 3PM**.
- The Nuraply 3PM membrane has an expandable graphite powder coating to the membrane carrier. In the heat of a fire this will expand to 250 times its original volume, which works as a flame retardant and inhibitor. There are no toxic effects in the event of fire and the graphite layer also acts as a smoke suppressant.

ACOUSTIC PERFORMANCE

Some projects require the roof to have specific acoustic performance. A roof may be designed to reduce external noise levels or prevent internal noise escaping. Impact noise of rainfall is often considered as well. Often a flat roof build-up will be considered acoustically in conjunction with an acoustic ceiling system. Reputable flat roof systems will have tested STC ratings that an acoustic engineer can apply to design calculations.

NURALITE SOLUTION:

The Nuratherm warm roof system on Dimond NPM steel profile substrate has been independently tested in an acoustic lab. The 7mm thickness of relatively dense modified bitumen on 80mm PIR offers the STC loss of 50dB. Additional layers of acoustic products can easily be included beneath the Nuraply 3PM membrane if desired.

SEISMIC & CONTROL JOINTS

Large roof elements will experience movement due to thermal expansion and wind/earthquake forces. A flat roof design needs to allow for such movement, especially where adjacent building elements are designed to move. The purpose of a dedicated movement joint in a membrane roof is to allow the waterproofing integrity to endure the likely stresses that a building moves under.

Risk: If a design does not allow for movement or seismic joints and the roof substrate moves or fails in unexpected places, the membrane will also be subject to that movement with high risk of failure. Any repair of the membrane may result in high risk of repeated failure as the building elements continue to move.

Solution: A structural engineer will set parameters for seismic movement and then select seismic jointing solutions that are purpose-designed to withstand these events. Awareness of the substrate structure and roofs that span different conditions or geometries is essential.

NURALITE SOLUTION:

Nuralite recommends considering the reliable systems on offer with our collaborators **BAS - BUILDING AND SPAN EXPANSION JOINTS.**

BAS
BUILDING AND SPAN EXPANSION JOINTS

BAS - BUILDING AND SPAN EXPANSION JOINTS

A key feature of the range offered by BAS is that their expansion joints are all 'seismic joints'.

Read more about BAS at the Collaborators section (Page 102).

BAS seismic joint on Nuraply 3PM membrane roof.

TRAFFICABLE AREAS & PROTECTION

Flat roofs are often used for access to facilities such as plant or aerials. Lightweight products with as little as 1mm thick waterproofing can be damaged by tradesmen and serious damage can result if not addressed quickly.

⋙ **ALSO REFER TO:** Functional Roof Space and Floating Deck Systems (Page 68).

Some suppliers will insist on a 10mm or 12mm protective board layer on top of warm roof insulation. The material and cost demand of an additional layer is not required when a quality insulation board is specified.

ECO NOTE

NURALITE SOLUTION:

- On larger sites where the roof has frequent maintenance foot-traffic, installation of an additional layer of walkway membrane in an alternative colour is beneficial. This membrane marks both the safe walkway and acts as a "sacrificial" extra membrane.
- To reduce costs, a protective cover board is not required when the Enertherm PIR with 175Kpa compressive strength is specified.

ROOF ACCESS & MOUNTING SYSTEMS

It is important to consider safe maintenance access to flat roofs. This should be integrated at design stage rather than risking a penetration of the membrane during a retro-install of heavy or structural elements.

NURALITE SOLUTION:

Systems on offer from **MONKEY TOE GROUP** can provide a great solution.

MONKEYTOEGROUP®
TRUST IT WITH YOUR LIFE

Monkey Toe Group products include roof walkways, hand rails, steps and stairs, ladders, plant platforms and condenser mounts along with modular balustrades and railing systems. They are manufactured in New Zealand and all of their products are fully compliant with AS/NZS industry standards.

All mounting clips, extrusions and fixings are designed to comply with the 'dissimilar metals' standards while also maintaining strength and ability to withstand extreme weather conditions in New Zealand.

Read more about Monkey Toe Group at the Collaborators section (Page 101).

Roof access and mounting systems by Monkey Toe Group.

ROOF SAFETY & FALL RESTRAINT SYSTEMS

The roof is a dangerous environment. Under Health & Safety regulations, all parties, from roofers to building owners, have a responsibility to ensure people access roofs safely. Permanent edge protection is desirable – preferably with a system that does not require penetrating the membrane deck as illustrated on below.

Fall restraint systems are a means of safety which should be the minimum protection installed on a flat roof. They should be considered during the design stage to ensure they are ideally positioned and have good watertight details for the fixing points.

Drawbacks of fall restraint systems include: the necessity to have trained users, they can be a trip hazard for other movement on the roof and they must be set up first in order to prevent the user from falling.

NURALITE SOLUTION:

- A walkway clear of the restraint system should be delineated by installing an extra “sacrificial” layer of Nuraply 3PM in a contrasting colour to the main roof colour. This provides additional protection for maintenance foot traffic and clearly shows where workers may safely walk.
- Use a suitable, reputable and engineered restraint system. If it affects the membrane, Nuralite can be consulted for a review on securing fall restraint anchors through the membrane.

COMPATIBLE ACCESSORIES (COMPLETE SYSTEM ASSURANCE)

Product compatibility within any construction system is an important factor for design and specification. All flat roof products and accessories should come from the one supplier so that liability is clear if a problem arises.

Below are some of the flat roofing accessories that can be specified with a membrane system:

- Insulation layers
- Substrate options
- Floating deck systems in timber or tile
- Drainage outlets
- Pre-formed scuppers
- Rainwater heads
- Diverters
- Contact bond adhesives
- Edge flashings
- Ventilation cowls
- Adhesives & tapes
- Corner fillet
- Termination bars
- Sealants
- Primers and seal coats

ALSO REFER TO: Complete Systems (Page 18).

Risk: Components that are sourced from various international suppliers may not work together. Responsibility for system failures can be unclear and liabilities for remedial costs uncertain.

Solution: Avoid specifying a branded system that is actually a hybrid of imported products. Select a supplier who markets an entire system of compatible components. Be sure the entire system has been independently appraised – not just one or two components.

NURALITE SOLUTION:

- Nuraply 3PM membrane systems and accessories are sourced from one European manufacturer: Iko, Belgium. Nuralite custom made scupper outlets are manufactured here in New Zealand.
- Nuralite systems and accessories are tested and are proven to be compatible. Have confidence that the one name confidently offers product warranties.

Avoid specifying a branded system that is actually a hybrid of imported products

DETAILED DESIGN REVIEW

For every chosen flat roof membrane it is important to get an expert review of all design details and specifications. This will help to ensure the design has the optimum conditions for a watertight and long-lasting solution. Make sure the chosen supplier is available to offer this level of support. If the supplier does not provide expert support, be diligent and careful in specifying their system.

ALSO REFER TO: For a summary of things to consider, try the Flat Roof Design Checklist at the back of the guide.

NURALITE SOLUTION:

Nuralite treats each flat roof project as unique and provides architects and specifiers a complete expert technical review, including CAD details and customised specification documents. Nuralite ensures that our systems are used appropriately, resulting in quality roofs that last.

Innovative & Sustainable Design Opportunities

GREEN ROOFS, HABITAT & STORMWATER RETENTION
BALLAST ROOFS / BROWN ROOFS
COOL ROOF DESIGN & ENVIRONMENTALLY RESTORATIVE SYSTEMS
HIGH R-VALUE ROOFS & PIR PRODUCT OPTIONS
ROOFTOP SOLAR ENERGY SYSTEMS
RECYCLING, RE-USE & DESIGN FOR DECONSTRUCTION
FUNCTIONAL ROOF: FLOATING DECK SYSTEMS
RAINWATER COLLECTION & WATER USE REDUCTION
ROOF LIGHTS & DAYLIGHTING

Simple design options that make a flat roof come to life

INNOVATIVE & SUSTAINABLE DESIGN OPPORTUNITIES

While membrane systems are steadily evolving to meet the demands of greater waterproofing integrity, flat roofs also present innovative opportunities for enhancing the environmental sustainability of our built environment.

Each generation of construction and design needs to challenge the standard and go further to assist with rebalancing our impact on the environment. This section offers some simple design options that can make a flat roof come to life and give a positive or restorative ecological contribution.

GREEN ROOFS, HABITAT & STORMWATER RETENTION

Green roofs or living roofs are an obvious, visible and celebrated device in sustainable design. They offer both ecological advantages and some design challenges.

Living roofs can provide aesthetic green space that visually softens the built environment. In addition, designing greenery into human environments is also proven to help the mental and physical health of people. Green roofs are a successful component in sustainable management of stormwater systems, as covered in the next section.

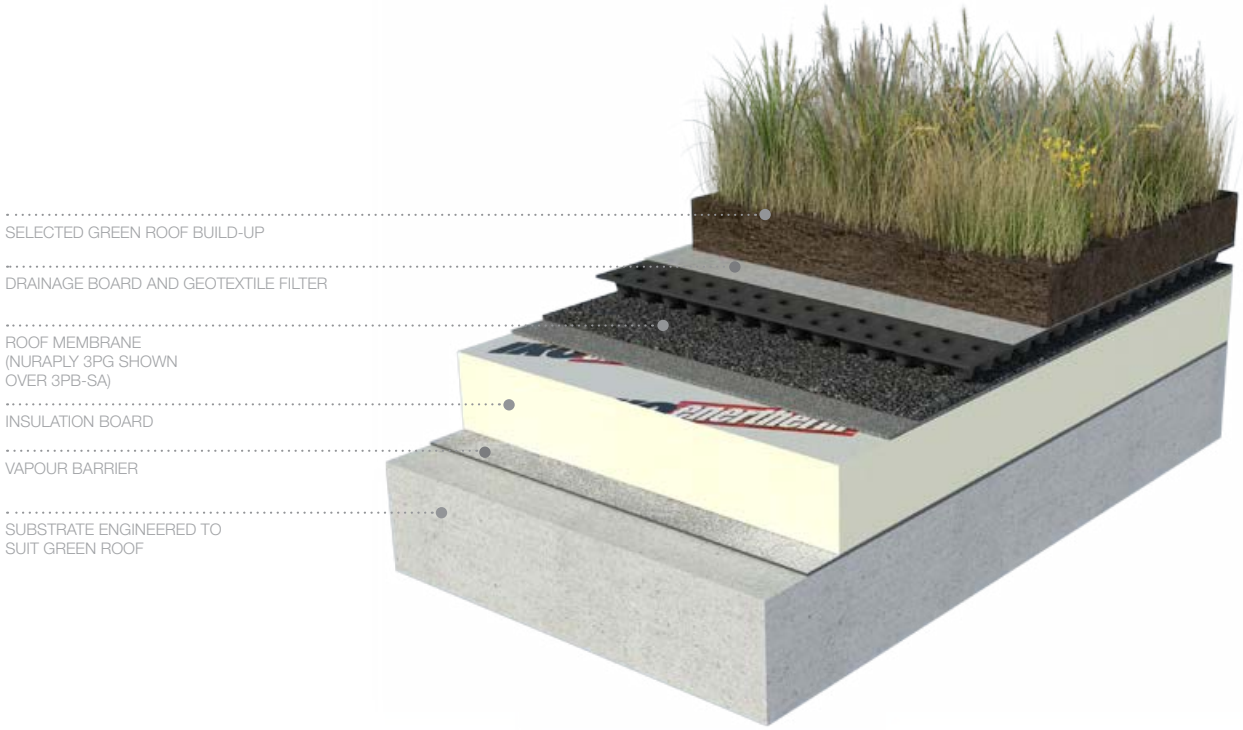


Figure 15: **GREEN ROOF SYSTEM.** Typical build-up of semi-intensive green roof over Nuraply 3PG membrane and Nuratherm warm roof.

Living roofs can provide pockets of habitat & conditions for ecosystems to extend back into the urban setting

ECO NOTE

Ecosystems and layers of biodiversity are displaced when buildings and roads are built. This particularly impacts ecology in towns and cities. Living roofs can provide pockets of habitat and conditions for ecosystems to extend back into the urban setting.

It is useful to explain the above long-term benefits to clients so that the green roof is prioritised & remains specified through the entire design & estimation process

Green roofs are also beneficial to a building's performance as they insulate to keep a steady temperature at the roof level. A green roof can absorb thermal energy and reduce fluctuation of temperture due to solar gain. The green roof layer also protects the roof membrane beneath from the extremes of the elements.

Green roofs can affect structural engineering, construction budget and maintenance needs. They also might require an irrigation system to stay alive through dry spells.

It is useful to explain the above long-term benefits to clients so that the green roof is prioritised and remains specified through the entire design and estimation process.

TYPES OF GREEN ROOFS

Intensive Living Roofs

Intensive living roofs are essentially roof gardens. They are most often designed for public access and high visual and recreational amenity. The vegetation options can be designed to allow shrubs and trees, however the cost of these roofs is high.

Intensive green roofs require more soil depth and, when saturated can get very heavy. In some cases, structural loading costs can be prohibitive. Maintenance of these roofs requires careful consideration and planning. Irrigation of intensive green roofs is often required.

Semi-intensive

Semi-intensive green roofs can have varying depths of substrate and generally have elements of both intensive and extensive roof design. Vegetation can include shrubs, grasses, sedums or mosses.

Extensive

Extensive green roofs have a shallow substrate and are generally cheapest to install. They have the lightest weight and as such are generally the most favoured option for retrofitting a living roof onto an existing building.

Extensive green roofs are commonly planted with sedums, mosses and grasses that are able to thrive in a shallow substrate and require minimal maintenance and irrigation.

FACTOR	Intensive Living Roofs	Semi-intensive	Extensive
Substrate	150mm-1500mm	150mm-500mm	20mm-150mm
Vegetation	trees, shrubs, grasses	shrubs, grasses	grasses, succulents, mosses
Cost	high	moderate	low
Structural Loading	high	moderate	light, generally suitable for retrofit
Maintenance	high	moderate	low
Saturated Weight	high	moderate	low

Table 06: **GREEN ROOF FACTORS.**

Whichever system is selected, it is important to have specific engineering design for the structure and to employ green roof specialists for the installation of the soil substrates, plants and irrigation.

NURALITE SOLUTION:

- **Nuraply 3PG** membrane is manufactured to perform as the waterproofing layer in any green roof design. It will not be compromised by tree roots. It is compatible with the rest of Nuralite systems and can be used in collaboration with various living roof build-ups.
- Nuralite recommends considering the clever live-roof systems on offer from **STORMWATER 360**.

The LiveRoof® modular green roof system uses Stormwater360's compliant green roof soil media and has numerous New Zealand native or sedum/succulent planting options.

As a LiveRoof® system is delivered around 95% vegetated, with the plant's roots matured and extending to the bottom of the soil at the time of installation, there is minimal time, cost or risk associated with rooftop establishment.

» **Read more about Stormwater 360** at the Collaborators section (Page 98).

GREEN ROOFS & STORMWATER RETENTION

Effective stormwater management is a concern in our cities. Many existing urban drainage systems were designed long ago and are operating at or beyond their ideal capacity. Green roofs are a useful component of a sustainable drainage system.

An intensive green roof will soak up 70% of water from a typical New Zealand rainstorm before it is released back into the environment by evaporation. The water that is not caught in the green roof is delayed on its path into the stormwater system, typically some time after the initial and peak deluge.

If a sustainable drainage or low impact design approach is taken as part of a development, it ensures the site is not increasing surface water flood risk or polluting the environment.

An intensive green roof will soak up 70% of water from a typical New Zealand rainstorm before it is released back into the environment

In projects with landscape design elements, stormwater from the roof can be integrated into site-wide surface water treatment and wetland design.

ECO NOTE

BALLAST ROOFS / BROWN ROOFS

A ballast roof or brown roof is when the roof membrane has a layer of gravel, pebbles, rubble or similar metal that will not be affected by wind. As it is not as absorbent as soil, a ballast roof does not hold as much water or grow as much greenery. A ballast roof can introduce landscaping textures to the roof-scape and a brown roof can offer micro-habitat for lichen and insects which can, in turn, provide a desirable terrain for birdlife in the city.

A ballast roof requires 3 key additions to the roof design:

- A suitable membrane
- A geotextile layer to allow free drainage between the ballast and the membrane
- A barrier detail to keep the ballast out of the gutters

NURALITE SOLUTION:

Future-proofing a ballast roof can be done by specifying **Nuraply 3PG** membrane. It will then have the flexibility to also become a green roof (structural engineering must also be considered in this case).

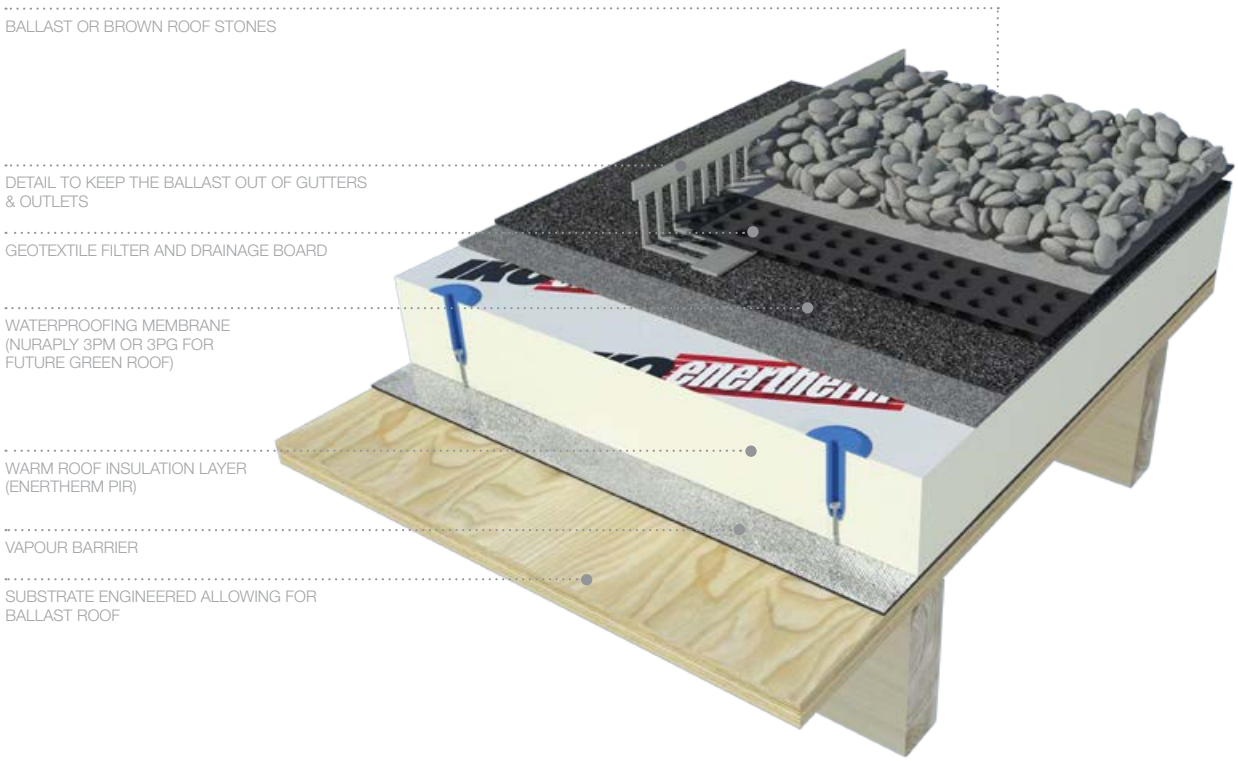


Figure 16: **BALLAST ROOF** (shown over Nuratherm warm roof).

ECO NOTE

A ballast roof, like a green roof, will protect the membrane from the elements and increase its lifespan. A ballast roof also creates micro-shading which enables passive cooling based on the principle that parts of each stone are always in shade.

COOL ROOF DESIGN & ENVIRONMENTALLY RESTORATIVE SYSTEMS

A basic cool roof is one that uses a lighter colour or sheen to deflect thermal solar radiation. A darker colour will absorb the radiant energy and generate a warmer roof surface temperature. In areas with warm summer temperatures, a cool roof will stay cooler and prevent over-heating.

The most obvious advantage of cool roofs is lower energy use due to smaller peak air-conditioning load. Potentially, the HVAC system may be downsized and power bills reduced. The bright white or reflective surface of a cool roof may not however, be suited to roofs overlooked by occupants or neighbours. Glare from a white roof should be designed with consideration to building orientation and sun angles.

Cool roofs also increase the life of the membrane as a result of decreased thermal stress on the roof materials. A cool roof is expected to add at least 5 years to the roof-life and a buried green roof membrane will last even longer as it is protected from UV exposure.

A cool roof is achieved by one of three primary methods:

- Installing a membrane system with a highly reflective and emissive surface (this is measured in LRV or Light. Reflectance Value) that can remain cooler than traditional materials especially during peak summer weather.
- Installing an overburden, such as ballast (stones) or a green roof which will remain cooler during peak summer periods.
- Installation of a raised deck surface on pedestals. Refer to Functional Roofs (Page 68).

» **NOTE:** A **cool roof** is a different principle from a **cold roof**. A cool roof can also be either warm or cold. Refer to Cold Roof Design (Page 38).

On a community-wide level, cool roofs are useful to provide:

- Diminished peak demand effects on the power grid
- Reduced urban heat island effect, which in turn helps minimize the formation of greenhouse gases and smog

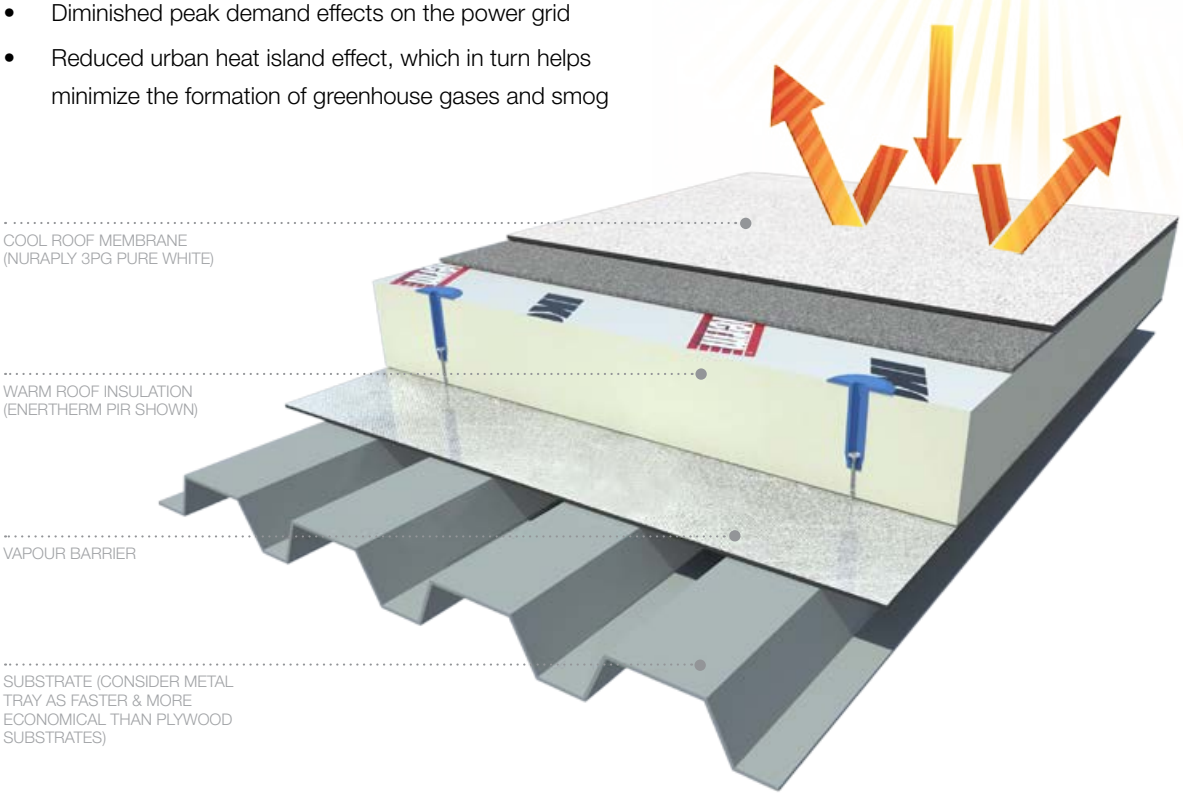


Figure 17: **COOL ROOF** is very similar to a warm roof build-up. Solar radiation is deflected in the the top layer only.

ECO NOTE

Recently, restorative membrane products have been developed to actively clean and neutralise atmospheric pollution. A layer of Titanium Dioxoide (TiO_2) converts nitrogen oxide and sulphur oxide (NOx and SOx) into environmentally neutral substances when exposed to UV. These are then washed away by rainfall. Pollution is catalysed into a harmless salt. Solar panels are notably more effective when placed over cool roofs.

Restorative (air-care) membrane products have been developed to actively clean & neutralise atmospheric pollution

NURALITE SOLUTION:

- **Nuraply 3PM Pure White** is coated with titanium dioxide, which converts air pollution into a salt that is harmlessly washed away. Regenerative building materials such as this help to address the harm caused by human activities.
- Nuraply 3PM Pure White is particularly appropriate for large commercial projects as it reduces the surface temperature by 30 degrees compared to alternative waterproofing solutions.

HIGH R-VALUE ROOFS & PIR PRODUCT OPTIONS

When a design strives to be eco, passive or green, a fundamental feature (and easy solution) is to allow for higher insulation performance in the roof. This requires design to R-Values that are above and beyond the Building Code minimum.

The advantage of a high R-Value roof is that it seriously limits the escape of thermal energy during winter and solar thermal gain during summer. This means less heating and cooling energy is required to maintain the desired temperature. A high R-Value enclosure will deliver energy savings for years to come.

A high R-Value roof seriously limits the escape of thermal energy

It is likely that our buildings will continue be designed to higher and higher standards. Designing for mere compliance with the current minimum requirements could be seen as imposing an unnecessary energy burden for the life of the building.

With high R-Value roofs, design effort needs to also reduce all cold bridges and penetrations that can defeat the value of the additional insulation.

»» **ALSO REFER TO:** Warm and Cold Roof Design (Page 39).

»» PIR insulation products during installation, several layers thick.

Well-insulated roofs and enclosures demand much less heating energy to stay warm. Over a building's lifespan, the energy losses in a building with minimum insulation can amount to a much greater carbon footprint than was first emitted during the construction of the building. An environmentally responsible approach is to design for a high insulation rating so that, during its lifespan, the building uses less overall energy.

ECO NOTE

PIR PRODUCT OPTIONS

A high R-Value flat roof in New Zealand is currently best achieved using a warm roof with rigid board insulation. Of the rigid board insulation products available, PIR is widespread. PIR refers to Polyisocyanurate, which is a thermoset plastic foam. There are a range of products available.

Comparing the compressive strength on the insulation product is recommended. A strong product provides a solid foundation for the waterproofing and anything that sits upon it.

Enertherm boards are lightweight and easy to handle. The boards can be installed over plywood, concrete or metal substrates, on new or existing buildings and on flat roofs regardless of their slope.

Design for a high insulation rating so that, during its lifespan, the building uses less overall energy

NURALITE SOLUTION:

- The **Nuratherm** warm roof system provides the best possible flat roof insulation method. It includes Enertherm PIR insulation boards. Refer to Figure 12 (Page 39).
- **Enertherm** PIR insulation has the highest efficiency per m^2. When compared to other insulation materials (such as EPS, XPS and Rockwool), PIR achieves a higher insulation value with a thinner board.
- Greater thicknesses and R-Value can easily be achieved by installing two layers of a thinner board. 100mm (R 4.5) of Enertherm for Zone 1 and 2, and 120mm (R 5.45) for Zone 3 is better practice than meeting Building Code minimums.
- Enertherm PIR insulation has very high compressive strength (10% deformation≥175kPa). Combining this with the excellent R-Values of the aluminium faced Enertherm, PIR boards achieve the optimum flat roof insulation.
- Using NPM900 Metal Tray as the substrate for Nuratherm is a cost effective solution (it may even be installed for less than a traditional cold roof system).

Enertherm PIR (mm)	40mm	50mm	60mm	70mm	80mm	100mm	110mm	120mm	140mm	160mm
R-VALUE	1.80	2.25	2.7	3.15	3.6	4.5	5	5.45	6.35	7.25

Table 07: **ENERTHERM PIR R-VALUES**

ROOFTOP SOLAR ENERGY SYSTEMS

Rooftop Solar Energy generation is a sensible and cost efficient way to produce renewable energy. Flat roofs are the ideal platform for solar energy generation because they are readily accessible, are relatively safe to walk on and are level so panels can be optimally directed over the entire area if desired.

Rooftop solar energy is regarded as an environmentally stable power source. Benefits are:

- Zero greenhouse gas emissions
- Silent operation
- Requires little maintenance
- Efficiency (the electricity it produces is used where it is needed: on-site or by the grid, which meets an immediate electricity need)
- Solar irradiation is relatively predictable
- Photovoltaic technology is proven in performance and growing in availability

NURALITE SOLUTION:

- Studies show that solar PV panels are more efficient when installed near a cooler roof surface. A Nuraply 3PM Pure White surface is demonstrably cooler than a dark membrane. Alternatively, a green roof may be installed below the panels to provide a cooler surface.
- Nuralite details are available for rooftop solar installation without compromising the waterproofing membrane.

  The technology and service of **HARRISONS ENERGY SOLUTIONS** is recommended.

Harrisons are known for specifying world-leading products. Harrisons specifies products such as LG's Mono X2 and Multi-X modules because of their proven performance and durability in New Zealand's demanding weather conditions. Harrisons solar products are rigorously tested beyond industry standards.

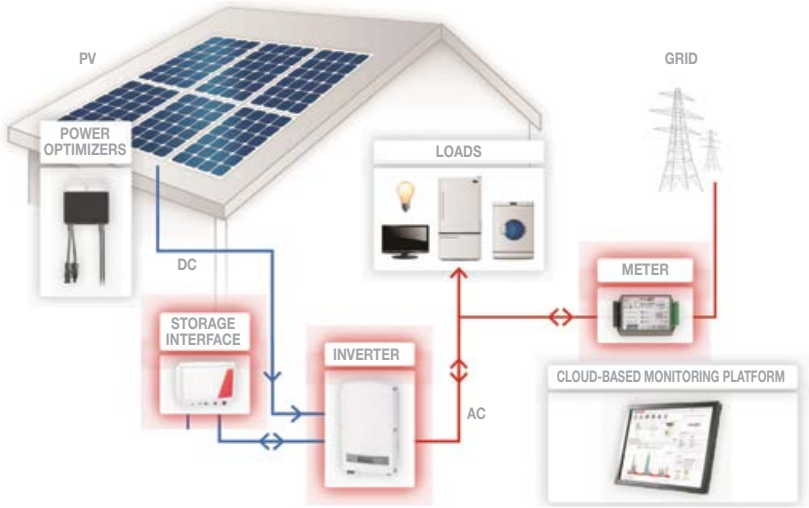


Figure 18: **HARRISONS ENERGY SYSTEM.**

Read more about Harrisons Energy Solutions at the Collaborators section (Page 99).

RECYCLING, RE-USE & DESIGN FOR DECONSTRUCTION

In New Zealand, construction and demolition waste accounts for over 20% of the total landfill waste. A key objective of waste minimisation is to reduce the amount and proportion of once-useful material that ends up in landfill.

Some principles to guide the design are:

- Designing for deconstruction, dismantling or disassembly is one smart way to future-proof our building stock from dead-end material use.
- Putting systems in place to re-use or recycle excess from the installation process or at the end of its life.
- Specify systems and products that use renewable materials or contain recycled content and that are safely able to be re-used, re-purposed or recycled.

With construction waste we used to simply 'throw it away', but ecosystem awareness shows us there is no such place as 'away'. Landfills are a potential ecological hazard for centuries to come. For the optimum life-cycle of any material or resource, landfills need to be a last resort. An environmentally responsible approach is to design for high insulation rating, so that, during its lifespan the building uses less overall energy.

ECO NOTE

Nuralite mechanical warm roof fixing (IKO-Fix); allows for the disassembly and reuse of insulation.

Risks:

- If decommissioned, a construction material resource that cannot be easily re-used or recycled will end up locked into landfill.
- Due to degradation, most sheet membrane products that have failed in one use are no longer suitable for a second application. If not actively re-purposed/recycled, they will end up in landfill.
- Fleece and fibreglass insulation products are often significantly degraded after one use. In many applications their performance does not last. After disassembly these products are seldomly re-used.

Solution:

- Unlike rubbers or thermoplastic membranes, old bitumen membranes are usually left in place. A new layer of material is typically welded directly on to the old product to provide added waterproofing to the new system. The original layer becomes usefully engaged and homogenous with the restored system. Bitumen membranes seldom make it to landfill.
- Rigid board insulation can hold its integrity and performance for decades. If mechanically fastened it can be cleanly dismantled and re-used.
- Systems that are permanent in their integrity or easily dismantled for re-use, re-purpose or recycling should be specified.
- If possible, avoid composite materials that cannot be separated for re-use. Also avoid construction adhesives which can make clean dismantling impossible.

NURALITE SOLUTION:

Nuraply 3PM is composed mainly of by-product materials. It can be recycled if required or it can be safely left in place and upgraded without an intensive salvage procedure or contributing to landfill.

- A warm roof designed using Enertherm insulation will keep its insulation integrity.
- Specifying the **IKO-Fix** fastening system for Enertherm PIR board means that it can be easily unfixed with a screwdriver.
- Nuralite operates a waste reclaim system. Excess bituminous material is returned to Nuralite, bagged and returned to the manufacturing plant to be recycled into new waterproofing product.

Nuraply 3PM is composed mainly of by-product materials. It can be recycled if required or it can be safely left in place and upgraded without an intensive salvage procedure or contributing to landfill

FUNCTIONAL ROOFS: FLOATING DECK SYSTEMS

A flat roof can be decked over, have hot tubs installed on it, be turned into green spaces or be used for growing edible plants. It can become a valuable and functional space for building users.

In these circumstances, the membrane should be protected from damage so that it can continue to provide its primary purpose of waterproofing the structure. The floating deck system both protects the membrane and creates a usable outdoor area.

The floating deck system both protects the membrane & creates a usable outdoor area

Tiled floating deck showing 12mm gap to surrounding elements.

There are a number of deck pedestal systems available in New Zealand. They consist of an array of pedestals or "jacks" that support the floating tile or timber. A few factors to consider are:

- **Base size** – A wide footprint will ensure that the deck load is distributed over a wide base, giving stability and an integrity that does not compress or damage the membrane.
- **Self-levelling heads** – A jack with a self-levelling head provides a level deck surface, even with variations in the roof pitch. With fixed heads, tilers or builders must resort to placing ad-hoc shims under the base of the jacks – a time consuming practice that has the potential to damage the waterproofing membrane through point loading.
- **Height adjustment** – The pedestals should be available in various sizes and be adjustable so the finished surface remains level. Being able to fine-tune the height after the tiles are installed is a significant time saver on site.
- **Waterproofing compatibility** – Some membrane suppliers' warranties may be voided by the use of non-approved systems. Liquid membrane systems should be avoided as they require future re-coating and maintenance to maintain their integrity. The best protection is to purchase the membrane and deck support from a single supplier.
- **Structural tiles** – If a tile surface is required, structural tiles or pavers must be used. Before purchasing a tile or paver, ensure it is strong enough to carry the expected load when supported by deck pedestals.
- **Timber decks** – Utilising a timber or aluminium joist, timber decking or composite decking can act as a deck surface.
- **Lateral bracing** – The system must braced against the surrounding cladding systems using a tile cladding spacer.

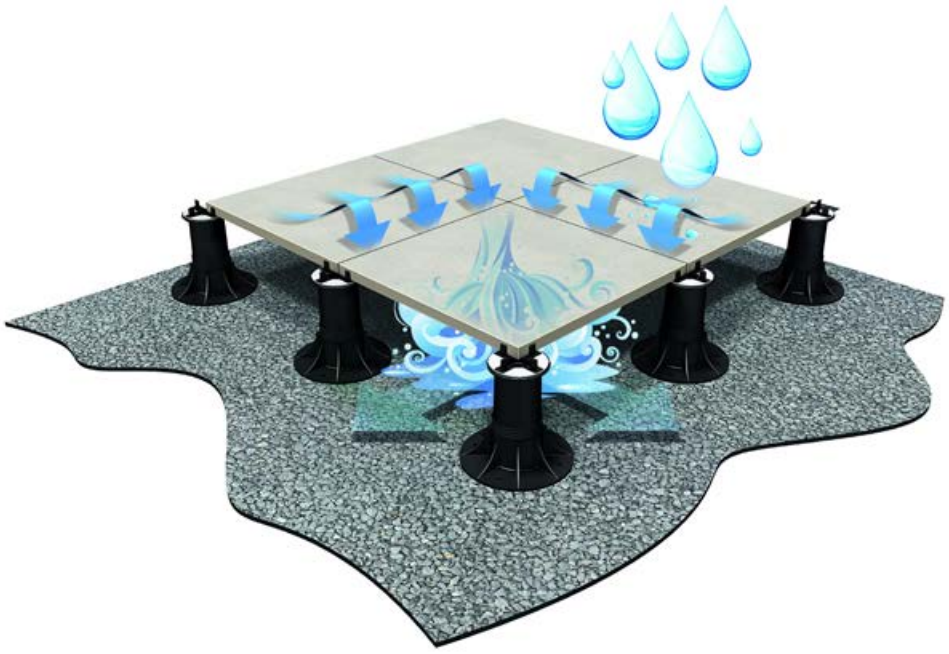


Figure 19: **WATER SHEDDING PRINCIPLE OF FLOATING DECKS.**

ECO NOTE

- The sustainable merit of functional roofs is that they add another usable area without demanding any additional land area. This enriches the density and quality of experience of the same building footprint.
- Under a floating deck, the membrane is protected from UV and weather extremes and therefore should last considerably longer than regular roof installations.

NURALITE SOLUTION:

Nuralite provide the Nurajack adjustable pedestal system. Nurajack have self-leveling heads and a range of accessories including Nurapads. Nuralite recommends working with our in-house Nurajack experts to find all you need to know. Also see the Nurajack website **www.nurajack.co.nz**

NURAJACK
DECKING MADE EASY

Laying a deck with Nurajacks is straightforward, whether it is with tiles, pavers or timber decking. The Nurajacks rest on top of the waterproofing membrane and the tiles or joists sit on the self-levelling head of the Nurajack. The void between the decking and the membrane can be used to accommodate pipes and other services. Adding an acoustic shim is a cost effective way to further enhance the acoustic reduction properties of the system.

CONSIDERATIONS WHEN USING NURAJACKS IN EXTREME CONDITIONS

In some extreme situations, tiles may need to be affixed to a Nurajack. The Nurajack SE Windproof is a pedestal especially designed for areas in direct exposure to high winds. When balustrade or parapets do not provide enough protection, the Nurajack SE Windproof provides the solution.

Nurajack SE Windproof.

Also Refer to: Design for Dynamic Wind Loads (Page 44).

RAINWATER COLLECTION & WATER USE REDUCTION

If a property is not connected to a mains water supply, rainwater may be the only viable water source. If a property is connected to the mains water supply, by storing and using rainwater, the demand for mains water supply is reduced. In turn, this may reduce water use charges.

Water is becoming an increasingly valuable resource, and flat roofs are a logical catchment for rainwater collection. If a suitable membrane is used, the water collected can be free from any contamination.

Designing for the collection of rainwater is an obvious & achievable means of applying sustainable design principles

ECO NOTE

Designing for the collection of rainwater is an obvious and achievable means of applying sustainable design principles. If more of our new and existing roofs can collect rainwater for re-use, the demand on infrastructure is reduced, and resilience of our communities will be increased.

NURALITE SOLUTION:

- **Nuraply 3PM** membrane with its natural mineral chip finish is tested as safe for collection of potable water.
- Consider the extensive range of water collection and storage systems available from **MARLEY**.
- Specify **Nuraglaze** on top of Nuraply 3PM to keep the surface even more clean.

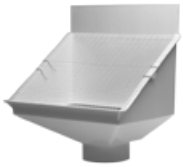
MARLEY

Marley is one of New Zealand's largest manufacturers in the plastics industry. Involved with extruded and injection moulded products, Marley manufactures using PVC, Polyethylene and Polybutylene.

Marley manufacture and/or supply a wide range of accessories designed to help prevent debris from blocking drains, direct rainwater into storage for re-use and improve the quality of water collected when being used for drinking purposes. The Marley First Flush Diverter reduces the pollution of tank water by diverting the first load of contaminated water away from the storage tank. Other products include:

Leafslide

Leaf Beater



Leaf Eater

Leaf Catcher

Outlet Strainer

First Flush

Downpipe Diverter

Tank Accessories

Read more about Marley at the Collaborators section (Page 102).

PREVENTING CONTAMINATION

1. **Debris Diverter** - Prevents leaves and debris from entering the downpipe.
2. **First Flush Diverter** - Improves water quality, reduces tank maintenance and protects pump by preventing the first flush of rain (contaminated from roof debris) from entering the tank.
3. **Calmed Inlet** - Discharge oxygenated water from the lower part of the tank without disturbing the sediment layer at the bottom.
4. **Floating Out-take** - Ensures the section of water is just below the surface where the cleanest water is found.
5. **Tank Vacuum** - Automatically vacuums the sediment from the bottom of the tank around the out-take pipe every time the tank overflows.
6. **Vent Cowl** - Provides air circulation through the tank.
7. **Tank Gauge** - Easily monitors the water level in the tank.

Figure 20: **TYPICAL DOMESTIC ROOF WATER & TANK COLLECTION**.

To ensure water collected is suitable for drinking:

- A roof membrane tested and approved for potable water catchment should be used.
- A 'first flush diverter' is also recommended. This is a simple, inexpensive device that fits to the tank inlet. It prevents the initial flow of contaminant-laden water from the roof entering the tank when it rains. Contaminants drain off to a suitably planted part of the garden or soakage area.
- The tank must be tightly covered – this also prevents evaporation.
- A screen over the tank's inlet pipe is necessary to keep out insects, birds and animals.
- A leaf filter will help keep the rainwater tank free from contamination.
- Rainwater-collecting gutters should be covered to prevent debris from entering the water tank.

Regular maintenance is vital, especially if rainwater is collected for household consumption. Maintenance should include:

- Clear overhanging vegetation from roof areas to prevent leaves and debris falling onto the catchment as well as preventing rodents, cats and possums from accessing the roof.
- Check and clear the roof and guttering of any debris.
- Ensure the roof remains clean, especially from bird droppings.
- Regularly check and maintain screens and filters.
- Wash out the first flush diverter every six months or so, depending on the rainfall.
- Check the condition of the tank's pipes, fittings and structural supports and inspect the tank for cracks and leaks, particularly before it gets dry over summer.
- Service any sterilisation equipment (as recommended by the supplier).
- Drain and clean the tank on average every five years – how often depends on what gets into the tank and on how often sludge and sediment is removed during that time.

ROOF LIGHTS & DAYLIGHTING

Flat roofs are ideal for installing skylight systems because the skylight can reach the full hemisphere of the sky. Skylights bring natural illumination indoors and` give occupants connection to the day outside. Roof lights will be energy effective if they are sized correctly and if appropriate controls are set out.

Natural daylight provides optimum quality of light and gives people a link to the day outside. Spaces with natural light are proven to foster greater health and reduce stress

ECO NOTE

One measure of sustainable design is the well-being of building occupants. Natural daylight provides optimum quality of light and gives people a link to the day outside. Spaces with natural light are proven to foster greater health and reduce stress.

Risk: An undersized skylighting system may not attain the pleasing visual aspect of a well-lit space. Similarly, an oversized skylighting system provides too much solar-gain into the space and allows heat to escape on cold winter nights.

Solution: A lighting designer or skylight expert will optimise roof lights and calculate the optimal solution. Large, widely-spaced skylights are the most economical to install, but may produce bright conditions under the skylights and relatively dark conditions in between each skylight.
On the other hand, small closely-spaced skylights will provide more uniform lighting conditions and greater energy savings, but will cost more to install.

NURALITE SOLUTION:

- The roof light will not compromise the waterproofing of a flat roof when detailed with Nuraply 3PM and Nuralite certified applicators are used for installation.
- Have skylight detail drawings reviewed by a Nuralite technician.

Product/ System Specification

CHOOSING A DURABLE MEMBRANE SYSTEM
COST COMPARISONS
PRODUCT / SYSTEM CERTIFICATION (CODEMARK & BRANZ)
SPECIFYING FOR NON-TOXIC & LOW-VOC MATERIALS
WARRANTIES & MAINTENANCE SCHEDULES

Considerations for a confident specification

PRODUCT / SYSTEM SPECIFICATION

A flat roof design needs a clear and comprehensive specification that covers the relevant substrate, membrane system and accessories. Whether using an automated specification writing system or a custom-written specifications, the specification should be checked to cover specific selections, execution and warranty information. A smart specification will also offer guidance for achieving quality control during install and a detailed maintenance programme. If any aspects of the specification are unclear, seek support from your supplier, whose best interest should also be to secure an accurate project specification.

NURALITE SOLUTION:

- Nuralite regional support teams are available to provide a custom edited specification document for specific projects.
- As a quality assurance process, all Nuralite specifications include a detailed roof Substrate Readiness Check-sheet that must be inspected, signed and recorded.
- Nuralite specified projects will only go to our trained and approved applicators who are experienced in ensuring application is in accordance with our system parameters and CodeMark certificates.
- All Nuralite specifications also boost longevity by providing a maintenance program to be followed by the original applicator.

CHOOSING A DURABLE MEMBRANE SYSTEM

Selecting a durable, low-maintenance system is a critical decision. The more durable a system proves to be, the longer it will remain in use and the smaller its environmental footprint will be.

ALSO REFER TO: For a guide to durable membrane systems, see Types of Membrane (Page 23).

Risk: Choosing an inappropriate membrane system may result in leaking roofs, short life, moisture damage, reduced thermal performance and high costs of repair.

Solution: A reliable and reputable membrane system will provide peace of mind and long-term savings. Consider all the relevant aspects of this design guide before selection the desired membrane.

NURALITE SOLUTION:

- **Nuraply 3PM** is a two-layer torch-on waterproofing system with built in redundancy, that is proven in New Zealand conditions; total thickness of 7mm, with two layers of reinforcing and mineral chip surface for protection from UV damage.
- The **Nuratherm** warm roof system will ensure that the thermal performance is not only better but lasts longer.

Replacing or repairing an inappropriate roof membrane after a short lifespan is an inefficient and wasteful use of material and energy. If something fails and is discarded, the embodied energy in that system is also wasted. This typically includes impacts of raw material extraction, manufacture, transportation, labour time in installation and removal. It is essential for the efficiency of our construction efforts to specify systems that are fit for purpose and last.

ECO NOTE

COST COMPARISONS

Selecting a durable, low-maintenance system is a critical decision. The more durable a system proves to be, the longer it will remain in use and the smaller its environmental footprint will be.

There is still some perception that multi-layer products are exclusively for premium projects. However, cautious and responsible specifiers are increasingly sticking to multi-layer systems on all their flat roofs.

The cost of remedying roofing failure can outweigh the initial savings that a budget system may have. Maintenance and/or replacement costs can be expensive to do properly.

The actual costs of a robust multi-layer waterproofing system should always be checked and compared with other systems. The peace of mind and long-term savings with a reliable membrane system has more value than is often appreciated. Reminding clients of the importance of their roof is recommended.

SYSTEM	INSTALLED COST
Liquid Membrane (Paint-on)	$
Rubber (Butyl or EPDM)	$$
Single Layer (PVC / TPO / TPE)	$$$
Double Layer (Torch-on)	$$$

Table 08: **COST GUIDE TO TYPES OF MEMBRANES**

A reliable membrane system has more value than is often appreciated

PRODUCT / SYSTEM CERTIFICATION (CODEMARK & BRANZ)

A serious supplier to the New Zealand construction industry will ensure that CodeMark certificates and independent appraisals are provided for the complete system that they are promoting. If not, there will be no guarantee that the system will work.

A CodeMark is desirable because the system will have demonstrated a higher standard of compliance and will be accepted by Councils if designed within its certified scope. CodeMark is the best way to ensure a hassle-free path to compliance.

CODEMARK™
BCS - 151216 - CMNZ

BRANZ Appraised
Appraisal No. 732 [2012]

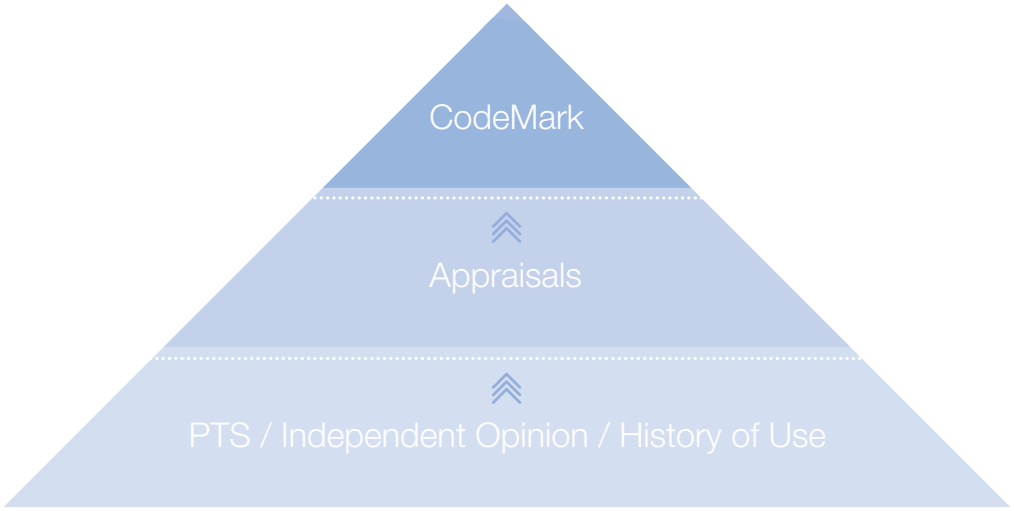


Figure 21: **HIERARCHY OF PRODUCT / SYSTEM CERTIFICATION.**

For example, Auckland Council have provided the following guidance in Practice Note AC2210:

- **New Zealand CodeMark** is a product certification system administered by the Ministry of Business Innovation and Employment (MBIE) which must be accepted by Councils so long as the product or system is designed and used within the scope of the CodeMark certificate.
- **Product Appraisals** are an independent assessment of compliance by a recognised New Zealand Body e.g. BRANZ Appraisals. The assessment body must be independent of the product manufacturer or supplier and the use of the product or system specified must fit within the scope of approval.
- **Product Technical Statement (PTS)** is a statement from the manufacturer or supplier of a product or system stating that the product will, if installed in accordance with the technical data, plans, specifications, and advice prescribed by the manufacturer, comply with the relevant provisions of the Code.

NURALITE SOLUTION:

The Nuraply 3PM, 3PG and 3PT range carry **CodeMark** certificates. This ensures acceptance by Councils but also allows the roof to be designed at lower slopes than those who rely solely on E2/AS1. Refer to Achieving Falls (Page 26).

As well as Building Code compliance and lower slopes, Nuralite CodeMark certificates enable flat roofs on plywood to have roof joists and nogs set at 600mm centers. This offers solutions with less material and labour than the 400mm maximum of E2/AS1 as well as the benefit of enhanced thermal performance with cold roof scenarios.

1° GUARANTEE

New Zealand's lowest slopes - guaranteed.

CodeMark ensures acceptance by Councils & with lower slopes creates greater design flexibility

SPECIFYING FOR NON-TOXIC & LOW-VOC MATERIALS

Volatile organic compounds (VOCs) are numerous, varied and ubiquitous. They include both man-made and naturally occurring chemical compounds. Some VOCs are dangerous to human health or cause harm to the environment. Harmful VOCs are not usually toxic, but have compounding long-term health effects.

In the construction industry, VOCs are often found in liquid substances (glues or coatings). During the curing process a large number of molecules evaporate from the liquid and enter the surrounding air.

Removing VOCs is desirable, but unfortunately VOCs are helpful to speed up curing of products, especially in difficult weather conditions. Low-VOC materials may produce an inferior result if not carefully installed (for example, if moisture is trapped within a system using a water-based adhesive).

Care must be taken to ensure that the Low-VOC material will perform well.

NURALITE SOLUTION:

Nuralite 3PM range with Enertherm insulation can be installed without VOCs from adhesives. The Enertherm boards are mechanically fastened to the substrate and the other products are installed without the use of glues.

A healthy approach is to use systems that do not require any VOCs. An example would be using screw fixings instead of glues.

ECO NOTE

WARRANTIES & MAINTENANCE SCHEDULES

A warranty should always be provided with the products that are supplied – but few specifiers ever read them. Legislation provides general protection to consumers but, if selecting a supplier based on the warranty they offer, remember the truism that the most generous warranties are often offered by those with the least to lose!

Risk: The chosen membrane supplier or applicator may appear to carry fair liability with clear warranty, but in reality they may not.

Solution: Read all warranty and guarantee documents carefully. Ensure the warranty registration is with the company providing the products. Follow stipulated maintenance programmes. Choose a reputable and experienced supplier and applicator who will stand by their products, systems and work. How long has the company been trading? How much scale does the company have?

NURALITE SOLUTION:

For a trouble-free experience, it is best not to take chances and rely solely on warranties. In our experience, is it is preferable to choose a reputable supplier and the most suitable product for the job.


LIBRARY

Installation

ON-SITE MANAGEMENT & QUALITY ASSURANCE
WEATHER CONDITIONS ON-SITE
FLOOD TESTING & ELECTRONIC LEAK DETECTION

The highest risk of failure in any waterproofing system is during installation

INSTALLATION

Successfully installing a flat roof membrane is a skill that can take substantial experience to get right. The highest risk of failure in any waterproofing system is during installation. The applicator not only has to be competent in using the specific waterproofing system in a range of conditions, but they need to be well organised to manage and sequence the work on-site.

Look for a roof membrane supplier with a strong network of experienced applicators. There must be enough applicators so that there is pricing tension, but too many applicators indicates that the supplier has not focused on the quality of their network.

Risk: During construction many trades work on-site, often with little interest in protecting the newly installed waterproofing membranes. Installation damage is possible with any membrane system.

Solution: The built-in redundancy of a multi-layered system ensures that a single installation oversight does not lead to a leak at a later stage. The risk of waterproofing failure is dramatically reduced by the installation of a second waterproofing layer.

The double layer systems may be installed at two distinct times. The first stage installs the base sheet which provides initial waterproofing during construction. If there are any delays or site damage, the base layer can be repaired and tested before installing a pristine second layer of cap sheet.

NURALITE SOLUTION:

Nuraply 3PM – a two-layer torch-on waterproofing system with built in redundancy, that is proven in New Zealand conditions. Total thickness of 7mm, with two layers of reinforcing and mineral chip surface for protection from UV damage. Refer to Choosing a Durable Membrane System (Page 78).

ALSO REFER TO: On-site Management (Page 87).

Installation damage is possible with any membrane system

Expert membrane applicator.

ON-SITE MANAGEMENT & QUALITY ASSURANCE

To mitigate the risk of poor installation, it is recommended to hold a pre-job meeting of all parties involved to identify any areas of concern. A successful initial meeting must clarify any issues or project requirements, the work programme, issues with other trades, the project documentation, product storage and site health and safety matters.

Before commencing work, the applicator must determine:

- That all the building consents have been issued and the specifications and detailed drawings are workable and suitable for the project.
- That there is nothing that will compromise the applicator's required responsibility under the New Zealand Building Code.
- That no existing conditions at the site prevent the applicator from performing in a professional and safe manner.
- That the product to be installed is as per the official consent documents.
- That a Substrate Readiness Check-sheet has been completed by the head contractor.

It is strongly recommended that photos are regularly taken during the installation project. On large jobs there should be documented points where work must be checked before proceeding.

Upon completion of the work, the head contractor and applicator should do a thorough inspection of the work, perform flood testing of vulnerable areas where possible and then complete a project sign-off checklist. A thorough process of documentation and checks is the best method of ensuring the job is performed to the highest possible standards.

Nuralite torch-on re-roof solution for Scotts Hut, Antarctica.

WEATHER CONDITIONS ON-SITE

It is essential to keep a membrane roof-build dry during installation, especially where dampness can be absorbed in the substrate or insulation. Some products involving liquids or adhesives will simply not perform in low temperatures. Yet, often it is not possible to schedule a roof installation to align with mild times of year.

Risk: Cold conditions can prevent some membrane products from curing properly, causing blisters and lack of adhesion to the substrate. This may then have an impact on the construction timelines – or worse yet, the product is installed incorrectly. Rain or dew can leave unacceptable moisture content in the system.

Solution: In cold conditions, the heat of a torch-on membrane will temporarily overcome the climate conditions to enable a desired bond. Liquid membranes and sheet membranes using contact adhesives must be installed in fair weather conditions. For all membrane jobs in progress, ensure that applicators protect the work-site and products from rain, dew and frost.

FLOOD TESTING & ELECTRONIC LEAK DETECTION

FLOOD TESTING

During construction phase, vulnerable areas in a membrane roof can be flood tested to ensure that they are watertight. This involves blocking the outlets and filling the enclosed parts of the roof with water. The pressure of this water body will find any defects and allow water through. It does have some limitations due to the delay that can occur in seeing the evidence of a small leak. Do not attempt to flood test an entire roof without planning this at design stage and consulting a structural engineer.

ELECTRONIC LEAK DETECTION TECHNOLOGY

Leak detection systems can give the client additional peace of mind for accurate and fast leak repairs if needed. In the event of a leak, it can be difficult to see exactly where water is getting in. Electronic leak detection processes determine specifically where the leak is situated. Electronic leak detection works by creating an electrical difference between a non-conductive membrane and an earthed conductive substrate.

The limitations of leak detection are dependent on the substrate. To successfully use it on a plywood substrate, a stainless steel grid needs to be installed during construction.

Vulnerable areas of a membrane roof can be flood tested to ensure they are watertight

NURALITE SOLUTION:

If the client/designer wishes to include an electronic leak detection system, it is compatible with the Nuraply membrane system. Electronic leak detection is not a requirement for the Nuraply system nor is it required to obtain the full Nuralite system warranty.

Electronic leak detection systems may add a level of reassurance in a covered roof scenario such as a green roof. In an exposed roof situation, maintenance access is typically available to find and repair membrane leaks.

Post Design

ROOF MAINTENANCE PROGRAMME
REPAIR WORK

Maintenance of our buildings has often been neglected in New Zealand

POST DESIGN

ROOF MAINTENANCE PROGRAMME

Maintenance of our buildings is often neglected in New Zealand, or seen as an avoidable expense. It is important that all roof elements are checked and maintained to maximise their life. For a flat roof membrane, factors such as UV exposure, dirt retention and ponding water can all have an impact on a system.

All systems will age and degrade over time, some more than others, and some will require more maintenance than others. Be aware that higher maintenance requirements may not affect the design outcomes initially, but can be an accumulative burden to the building owners.

ROUTINE MAINTENANCE

As with all roofing systems, proper maintenance is essential in order to obtain maximum performance and ensure the longest life expectancy for the system. It is also an integral part of all manufacturers' guarantees. Any deficiencies should be reported immediately to the installer.

All personnel given permission to access the roof must be fully advised of the health and safety procedures required by the site or that of the individual roof concerned. The client or building owner is responsible for providing safe access to and from the roof and for suitable edge protection or fall arrest systems.

ROUTINE INSPECTIONS

All flat roofs should be inspected at least annually and after extremes of weather events. Inspections should be carried out with particular attention to the following items:

- Check that roof outlets are functioning and gratings are not blocked. Remove debris from the roof (without flushing silt or dead leaves down outlets). In areas where taller trees are adjacent to the roof, inspections may be required more frequently.
- Note the general condition of the membrane finish and immediately address any signs of creasing/blistering, de-bonded laps or damaged areas.
- Check perimeter details and upstands to ensure that metal cappings, flashings, edge trims and mortar pointing to chase details are secure.
- Check waterproofing to rooflight kerbs.
- Check rooflight domes for signs of damage or deflection.
- Check flashings to expansion joints and that cappings are secure.
- Check upstand flashings to plant support legs/upstands.
- Check upstands and flashings to pipe penetrations.
- Examine all mastic seals and repair/replace as necessary.
- Check walkways and around access points to ensure damage/displacement has not occurred to walkway or concrete paving.

ECO NOTE

Sensible, regular maintenance will increase the lifespan and value of a roof system. While some industries and business models invite us to frequently discard and upgrade, the responsible approach is to take care of the things we already have.

Sensible, regular maintenance will increase the lifespan & value of a roof system

NURALITE SOLUTION:

Nuraply 3PM membrane is long-lasting and has a simple maintenance plan. When it eventually is time for refurbishment, easily apply a compatible overlay.

REPAIR WORK

Ideally, the client or building owner will be provided with a user manual for smart maintenance and energy efficient building use. This manual should include company names for products and applicators to ensure compatible repair procedures.

Risk: Repair work commissioned by an applicator who is not familiar with the specific roof system will not be compatible with the original construction.
If the repair work itself fails, the original warranty may become void due to the repair attempts.

Solution: Roofs which are under warranty should only be repaired by the installing contractor.

Repair work on bituminous membrane.

A successful repair is often less resource-intensive than a full replacement. Note that there can be an economic incentive behind advice to replace the entire roof. Sometimes a more honest and environmentally responsible solution will be to extend the lifespan of the existing roof by repairing localised degradation. Investing in leak detection may also assist with this approach.

ECO NOTE

Summary

NURALITE OVERVIEW

The design and specification process is critical to achieving a watertight and smart flat roof. Selecting the optimum waterproofing system will always deliver significant long-term benefits to the client and, in turn, the sustainability of our building stock. The more durable a system proves to be, the longer it will remain in use and the smaller its environmental footprint will be.

The main considerations contained in this guide are listed as bullet points in the Design Guide Checklist (Page 108).

Many positive environmental options can be included in a flat roof design and wasteful decisions and practices can be avoided. A roof's performance over time is also dependent upon competent design detailing and installation by fully trained operatives, followed up with regular inspection and maintenance.

Nuralite recommends that CodeMark certified membrane systems should be specified, in particular our Nuraply 3PM – a robust two-layer torch-on waterproofing solution with built-in redundancy.

Nuralite also offers leading solutions for basement tanking systems. The roof, deck and ground conditions can be waterproofed with a warranty under one brand.

Keep in mind that Nuralite also offers an extensive consultation service regarding design, specification and material selection. Our services are delivered via a team of regional design specialists and our head office technical centre.

We look forward to working with you on your next project.

Shane Clarke
GENERAL MANAGER

NURALITE
THE FLAT ROOF EXPERTS

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We are proud work alongside companies who are recognised as leaders in their fields

COLLABORATORS

Nuralite acknowledges the ongoing support and expertise of our related flat roof industries. Our collaborators have provided invaluable input to this guide. Here is more information about Nuralite's chief collaborators:

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We are passionate about the environment and proud to be working towards cleaner water and a sustainable future.

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Allproof prides itself on being able to solve problems that can delay a project and because of this new products are being developed all the time. Allproof Industries NZ LTD has a research and development programme in place to create suitable products for the Plumbing and Drainage industry and more specifically to the Australia/New Zealand standard AS/NZ 3500.2.2.

A large percentage of Allproof Industries products are manufactured by Allproof and supported by local New Zealand manufacturers. Because of this Allproof Industries is able to maintain control of quality and price stability, which makes Allproof an attractive alternative to costly imported products, produced outside New Zealand.

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MONKEYTOEGROUP®
TRUST IT WITH YOUR LIFE

Monkey Toe is a total solution safety-access company, covering both height and ground level products across all industries and buildings – and it's guaranteed for life. Our quality products are engineered for safety and include roof walkways, handrails, steps and stairs, ladders, plant platforms and condenser mounts along with modular balustrades and railing systems.

Conceived in the heart of Taranaki, this New Zealand owned and operated company has grown into a nationwide presence and an international business. Fully manufactured in New Zealand, this high quality and fully engineered system is made to withstand local climate and weather conditions and the ground-breaking products and fixing methods won't compromise the structural integrity of a roof - or the user's safety.

Innovative designs have pioneered changes in the way access systems are fixed to roofs and Monkey Toe are market leaders in the industry. All products are fully compliant with AS/NZS industry standards.

Monkey Toe Group stands for rigid compliance to relevant safety codes. We are proudly 100% New Zealand owned and operated.

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Marley New Zealand is part of the Aliaxis group, a privately owned business based in Belgium and active around the world. Aliaxis group employs 15,700 people across 40 countries and is made up of more than 100 companies worldwide. Each of these companies manufactures and/or markets plastic products for construction, industrial and public utilities. Marley New Zealand is the largest division of Aliaxis in Australasia and the largest manufacturer of uPVC pipes and fittings in New Zealand.

uPVC is an environmentally smart choice because it takes a small amount of energy to make, lasts a long time and at end of life can be 100% recycled. The European Council of Vinyl Manufacturers (ECVM) commissioned an independent study and found uPVC to be either the best environmental option or equivalent to the best alternative in terms of environmental lifecycle assessment.

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For more than 50 years, Watson Bowman Acme has developed and manufactured expansion joints for some of the worlds most unique and complex projects. BAS Expansion Joints Ltd has partnered with WBA to provide specifiers with the definitive range of expansion joints for the New Zealand market.

A key feature of the range offered is that many of the expansion joints are also ‘seismic joints’. We think that in New Zealand buildings should be built to withstand our seismic conditions.

T: 027 295 4457
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LISTS OF FIGURES, TABLES & CHECKLIST

LIST OF FIGURES

LIST OF TABLES

CHECKLIST:

- Proposed substrate is rigid and suitable for selected membrane
- Durable and suitable membrane is selected
- Understand the benefits of CodeMark as means of compliance
- Adequate fall/slope is achievable
- Drainage design avoids internal gutters and penetrations if possible
- Drainage includes overflows as required
- Drainage design meets required capacity
- Raised platforms in the roof have drainage crickets
- Have considered exceeding thermal code minimums for R-Value
- Have considered the benefits of warm roof design
- Roof design includes ventilation (cold roof design only)
- Designed with understanding of interstitial condensation
- Roof system meets acoustic requirements
- Roof system meets fire requirements
- Have detailed edges to meet dynamic wind conditions
- Designed with control and seismic joints as required
- Safety from falling has been considered
- Design includes means of roof maintenance access

- Compatible accessories are selected
- Detail designs are technically reviewed by supplier before consented
- Roof is provided/reviewed by system suppliers
- Have considered the benefits of a green or ballast roof
- Have considered a functional rooftop space (floating deck systems)
- Provided for future solar energy generation equipment
- Have designed for rainwater storage and re-use
- Have considered the benefits of skylights on a flat roof
- Have specified a system with understanding of adhesives and VOCs
- Have considered design for disassembly and re-use
- Have considered lifecycle of materials and options for reducing waste to landfill
- Have educated client on the value of durable long-lasting roof membranes
- Have educated client on the importance of maintenance programmes
- Have inspected suppliers warranty details
- Have prepared owners manual and maintenance schedule
- Have proposed that contractor and applicator have a pre-job site meeting
- Have scheduled a roof shout!

Proud to be setting the standard for flat roofs in New Zealand

NURALITE
THE FLAT ROOF EXPERTS

Flat Roof Design Guide

NURALITE
THE FLAT ROOF EXPERTS

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