

Bitumen  
Waterproofing  
Association

**Environmental Declaration for  
Bitumen Roof Waterproofing Systems**



Incorporating the International  
Waterproofing Association

The Bitumen Waterproofing Association (BWA) was created to provide an authoritative voice for the Bitumen roofing and waterproofing membrane manufacturing industry across Europe.

The BWA is Europe's central source of advice and information on all Bitumen membrane roofing and waterproofing matters, both to the industry and to its user groups.

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Waterproofing, The Millau Viaduct, France



Green roof apartments, Tiel, Netherlands



Sustainable and environmental issues are, quite rightly, matters of great importance to us all in construction. A full understanding of ideas once rarely mentioned – like ‘global warming’, ‘waste recycling’ and ‘life-cycle analysis’ – is now core to maintaining our reputation as a responsible industry.

As the voice of the European Bitumen Waterproofing membrane industry, BWA represents manufacturers who are committed to ensuring their industry is sustainable and environmentally and socially responsible. It represents manufacturers who consider that this document – *Environmental Declaration for Bitumen Roof Waterproofing Systems* – is an important step in achieving that aim.

This declaration contains key information to help anyone involved in construction deal knowledgeably with the environmental impact of the building materials and systems they specify and use for bitumen waterproofing – be they architects, project developers, contractors, legislators, roofers or specifiers.

This commitment to environmental issues can also be seen in BWA’s involvement with several European platforms, like CEN TC<sup>1</sup> 350 ‘Sustainability of construction work’ and the publication of a Product Category Rules (PCR) document for Environmental Product Declarations of ‘bitumen waterproofing sheets’ as defined in the present ISO<sup>2</sup> and CEN<sup>1</sup> standards. This PCR was established in co-operation with Life Cycle Engineering (LCE) in Italy, an independent environmental consultancy, and is available on our website ([www.bwa-europe.com](http://www.bwa-europe.com)).

BWA has also developed, in close co-operation with LCE Italy, a Life Cycle Analysis (LCA) software tool for all BWA members, giving them the ability to continuously optimise the environmental performance of all their bitumen waterproofing products.

We are grateful to LCE Italy for peer-reviewing this document and ensuring its objectivity and neutrality.



Green roof, European Parliament, Strasbourg, France

# Bituminous waterproofing

## 1. Effective protection

The principal task of bituminous waterproofing is to protect buildings against water in its various forms e.g. rain, humidity, snow and hail. Beyond this, its waterproofing qualities preserve and sustain a building's capital value. In fact, its ability to protect thermal insulation from rainwater penetration ensures those thermal properties – the measure of **sustainable economy** – will remain effective.

Bituminous waterproofing can also make the roof **accessible** to pedestrians, even vehicles, and is the optimal, durable, solution to creating **vegetation systems** on the roof that can help keep a building healthy and support biodiversity.

## 2. Bitumen: a material with ideal qualities

**Water-repellent and flexible**, bitumen's mechanical properties make it ideal for waterproofing. Besides having excellent natural adhesion, bitumen will not absorb water and will withstand structural movements. Furthermore, it retains these properties over a long period and so significantly contributes to a structure's durability and longevity.

## 3. Exceptionally long service life

Ancient writings, in particular The Bible – which cites the Tower of Babel and Noah's ark, show that **bitumen in the form of natural asphalt has been used in construction since ancient times**.

Modern polymeric and elastomeric bitumen waterproofing however has been used for more than 30 years and in that time has been proven to be an excellent performer in many applications and under many conditions. Prof. N. Hendriks of BDA consultancy (Netherlands) was commissioned by the BWA to collect longevity experience with modified bitumen waterproofing and he reported:

*'The safe assumption for a general 'service life declaration' for (modified) bitumen roofing membranes can be taken as 25-30 years.'*

It follows that renovation or a new top layer could make service lifetimes of more than 90 years feasible.



Terrace waterproofing, Hotel Atrium, Prague, Czech Republic



#### **4. A natural by-product of oil**

Although bitumen does occur naturally at old oil fields, the current form used for manufacturing waterproofing membranes is produced by **industrially refining crude oil, separating out the heavier constituents when that oil is distilled** to produce fuel.

The industrial production of bitumen simply reproduces this **natural process**, by separating the various constituents of the oil. Bitumen therefore does not result from chemical transformation, but by the use of by-products that might otherwise be wasted. Because there is no chemical change **the material is exceptionally stable over time** and, as the distillation is short, **demands less energy and creates less waste** than many other waterproofing materials.

#### **5. Friendly to people and the environment**

Essentially, bitumen consists of **carbon** and **hydrogen**. As a hydrocarbon not intended for combustion but for use in construction materials, it is a useful trap for carbon and in itself generates no greenhouse gases. The remaining constituents of bituminous membranes (fillers, polymers, slate, sand, etc.) are either inert or have low propensity to chemical reaction. This means they present minimal hazard either to people or the natural world throughout their lifecycle – unlike tar, which is produced by distilling coal (coal-tar pitch) and is classified as a carcinogenic.

Bitumen is insoluble in water, non-biodegradable, and therefore the ideal material to collect and contain water (collection ponds, irrigation water, polluted water, etc.).





Green roof, Suffolk University, England





## 6. Performance

### 6.1 The starting point

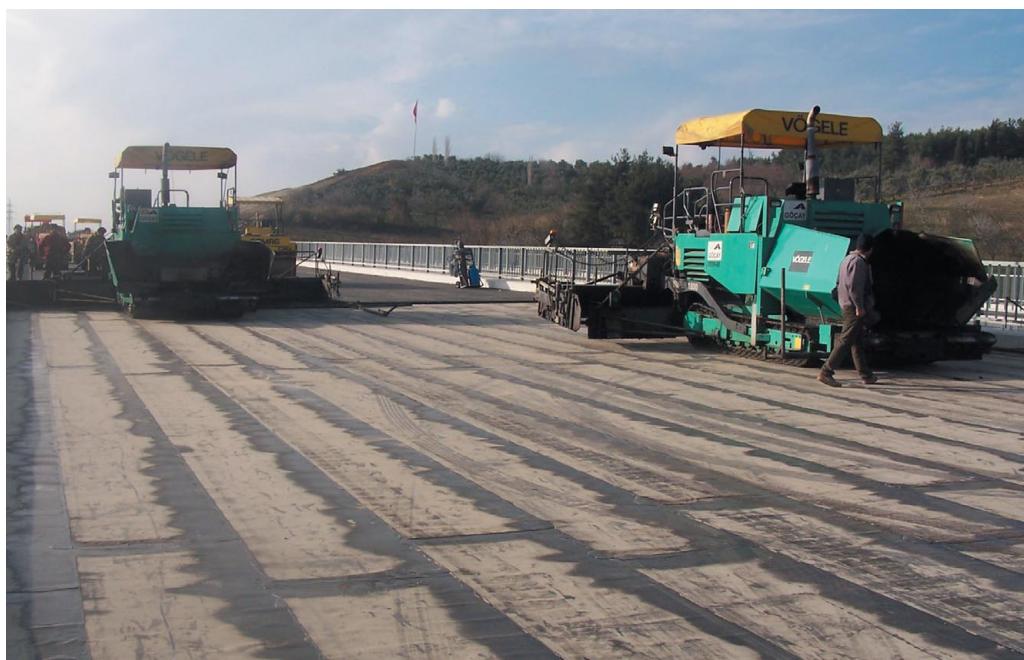
BWA, with the assistance of the independent reputable environmental specialists LCE decided to establish common European industry fact sheets for some commonly used waterproofing systems. The methodology used is in compliance with ISO<sup>1</sup> 14040 and 14044 standards and the publicly available BWA product category rules for bitumen waterproofing sheets ([www.bwa-europe.com](http://www.bwa-europe.com)).

BWA recommends to assess the environmental performance of a complete building, including the use phase (e.g. energy and water consumption) as the dominant contributors to the environmental impact, rather than to compare the performance of individual components. It is emphasised that in the case of a complete roof assessment, it is necessary to include the environmental impact of the entire structural deck, vapour barrier and thermal insulation.

### 6.2 The participants

Since the **environmental impact** for the same system is comparable from one manufacturer and from one factory, to another, BWA decided to establish a common industry fact sheet that states the average impact generated by systems that use bitumen waterproofing sheets produced by BWA members.

26 manufacturers, from Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden and Turkey, participated in this scheme.



Bridge waterproofing, Bursa, Turkey

### **6.3 The bitumen waterproofing systems**

**Bituminous waterproofing** is always carried out by a combination of relevant products at the construction site. These products can include: bituminous primer, bitumen membranes, mechanical fastenings, flashings, protection (gravel, small stones, etc.) and one or two waterproofing sheets that consist of reinforced bitumen (elastomeric or plastomeric modified) and mineral finishing.

In accepting that waterproofing practices change from one European country to another, BWA decided to define six systems for its environmental declaration as follows:

#### **System 1**

Single layer fully torched system with a 4mm polyester reinforced modified bitumen sheet, and a self-protecting mineral finish.

#### **System 2**

Single layer mechanically fastened system with a 4mm polyester reinforced modified bitumen sheet, a self-protecting mineral finish and five mechanical fastenings per m<sup>2</sup>.

#### **System 3**

Single layer loose-laid system with a 4mm polyester modified bitumen sheet and 65kg/m<sup>2</sup> dry gravel ballast.

#### **System 4**

Multi layer fully torched system, consisting of:

- A fully torched 4mm polyester reinforced modified bitumen sheet top layer.
- A fully torched 3mm glass fleece reinforced bitumen sheet base layer.

#### **System 5**

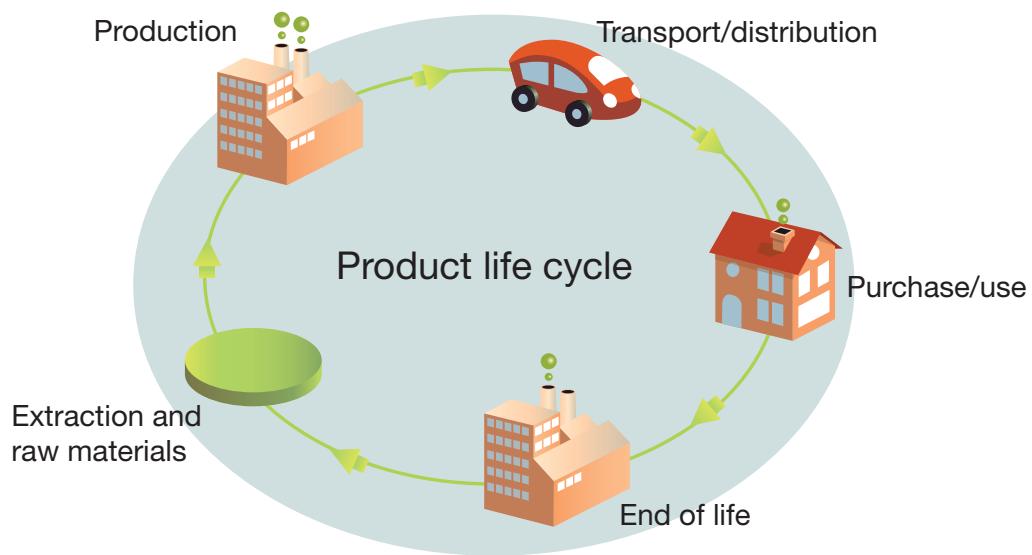
Multilayer mechanical fastened system consisting of:

- A fully torched 4mm polyester reinforced modified bitumen sheet with self-protecting mineral finish as a top layer.
- A mechanically fastened 3mm polyester reinforced bitumen sheet mechanically fastened with five mechanical fasteners per m<sup>2</sup>.

#### **System 6**

Multilayer loose laid system consisting of:

- A fully torched 4mm polyester reinforced modified bitumen sheet as a top layer.
- A loose laid 3mm glass fleece reinforced bitumen sheet base layer and
- 65 kg/m<sup>2</sup> dry gravel ballast.



#### 6.4 Reliable third party involvement

Given the complexity of the task, BWA has commissioned LCE, who co-operated with Boustead Consulting Ltd. in the UK, to carry out the following activities:

**Updating** the BWA specific LCA<sup>1</sup> software

**Collating data** from external sources with regard to impact on the environment

**Training operators in the use of the BWA specific LCA<sup>1</sup> software**

**Collecting data from the individual participants**

**Calculating the BWA average environmental profiles and LCA<sup>1</sup> report**

**Providing guidance to BWA throughout the process of creating these fact sheets.**

#### 6.5 Life-Cycle Analysis

This fact sheet **takes into account environmental impact at every point in the lifecycle of the systems studied** – from extraction of raw materials, through manufacturing and installation, to decommissioning and end of life treatment. In this LCA<sup>1</sup>, the end of life treatment scenario is based on two-thirds incineration with energy recovery, and one-third landfill, notwithstanding the fact that, in several countries, recycling operations are already available.



Green roof, The Odney Club, Maidenhead, England

### 6.6 The Functional Unit (FU)

The functional unit is defined in line with the BWA product category rules as **the installation of 1m<sup>2</sup> bitumen roof waterproofing, with a service lifetime of 90 years, including maintenance and renovation.** This functional unit incorporates the ancillary components (flashing, rainwater entry points, protection etc.) that are directly associated with the installation of waterproof roof coverings.

### 6.7 Typical Service Life

The service life of a roof waterproofing system varies according to its exposure to:

- Local weather conditions
- Workmanship and installation conditions
- Stability of the substrate
- Use
- Maintenance

Moreover, the service life of a system is not the same as that of the roof itself. Indeed, experience throughout Europe shows that it is possible to apply a second and third layer during the service life of a waterproofing system without the need to remove the previous layers. Based on a proven service life of 25-30 years, as stated by BDA<sup>1</sup>, for the initial system this can increase overall life to as much as 90 years.



### 6.8 The environmental impacts

The BWA has drawn up a specific 'common industry fact sheet' for each of the six beforementioned systems. The environmental impact of the these systems are expressed in the tables 1 and 2 which, in particular, report energy and environmental indicators for **the entire life-cycle of the systems (from cradle to grave)**.



Green parking garage, Tiel, Netherlands

**Table 1 Energy results for the entire life-cycle of the systems analysed.**  
(Rounded) data refers to 1m<sup>2</sup> of membrane per year (durability 30 years, service life 90 years).

Environmental resources	System 1 fully torched	System 2 mechanically fastened	System 3 with ballast
With energy content (data in MJ)	Renewable	< 0,1	< 0,1
	Non-renewable	7,6	7,2
	Gross energy requirement (GER)	7,6	7,2
Without energy content (data in kg)	Total renewable	< 0,1	< 0,1
	Total non-renewable	0,01	0,01
	Water	0,2	0,2

Environmental resources	System 4 multilayer fully torched	System 5 multilayer mechanically fastened		System 6 multilayer with ballast
		A	B	
With energy content (data in MJ)	Renewable	< 0,1	0,1	< 0,1
	Non-renewable	9,2	13,4	9,6
	Gross energy requirement (GER)	9,2	13,5	9,6
Without energy content (data in kg)	Total renewable	< 0,1	< 0,1	< 0,1
	Total non-renewable	< 0,1	< 0,1	< 1,0
	Water	0,2	0,3	0,2



Green roof, Gunpowder Park, London, England



Green roof, Gunpowder Park, London, England

**Table 2 Environmental indicators for the entire life-cycle of the systems analysed.**  
**(Rounded) data refers to 1m<sup>2</sup> of membrane per year (durability 30 years, service life 90 years).**  
*Environmental indicators are calculated according to the European Product Declaration (EPD) System, see [www.environdec.com](http://www.environdec.com).*

Environmental indicators		System 1 fully torched	System 2 mechanically fastened	System 3 with ballast
Global warming potential (GWP100)	[kg CO <sub>2</sub> ]	0,6	0,6	0,5
Stratospheric ozone depletion (ODP)	[kg CFC <sub>11</sub> ]	–	–	–
Acidification (AP)	[kg SO <sub>2</sub> ]	0,002	0,003	0,002
Photochemical ozone creation (POCP)	[kg C <sub>2</sub> H <sub>4</sub> ]	< 0,001	< 0,001	< 0,001
Eutrophication (EP)	[kg PO <sub>4</sub> <sup>3-</sup> ]	< 0,001	< 0,001	< 0,001

Environmental indicators		System 4 multilayer fully torched	System 5 multilayer mechanically fastened		System 6 multilayer with ballast
			A	B	
Global warming potential (GWP100)	[kg CO <sub>2</sub> ]	0,7	1,0	0,8	0,7
Stratospheric ozone depletion (ODP)	[kg CFC <sub>11</sub> ]	–	–	–	–
Acidification (AP)	[kg SO <sub>2</sub> ]	0,003	0,004	0,004	0,003
Photochemical ozone creation (POCP)	[kg C <sub>2</sub> H <sub>4</sub> ]	< 0,001	< 0,001	< 0,001	< 0,001
Eutrophication (EP)	[kg PO <sub>4</sub> <sup>3-</sup> ]	< 0,001	< 0,001	< 0,001	< 0,001



## 7. Low impact on water resources / Water management

The water used in the production of the components of bituminous waterproofing systems is essentially for cooling purposes. **Once used, this water is returned to the environment with little notable impact**, other than a slight increase in temperature.

Flat roofs (slope < 5%) generally have a significant water retention capacity compared with sloped roofs – making urban drainage systems simpler.

**Added vegetation cover** (roof garden or an extensive green roof) over the waterproofing gives greater water-retention capacity. Here, some 50% to 80% of the annual volume of rainfall in a continental climate will be prevented from reaching the urban drainage system, as it is restored to the atmosphere through the transpiration action of plants (*FLL German Landscaping Research Institute, rules relating to green roofs, 2002 edition*).

**Waterproofing systems with gravel protection** also retain rainwater, reducing the risk of overloading urban drainage systems in the event of violent storms.

### No pollution of surface water by leaching.

Water outlets of roofs with bitumen waterproofing can feed directly to surface water without the need for expensive drainage systems.

Extensive leaching/emission studies by Dak & Milieu (Netherlands) on all commonly used oxidized and modified bitumen sheets have proven that leaching levels are extremely low. These tests have shown that leaching of substances according NEN<sup>1</sup> 7375 are, for all regulated substances, significantly below the Dutch Quality Soil Decree regulatory limits.

Table 3 shows a summary of the leaching results according NEN<sup>1</sup> 7375.

**Table 3 Leaching inorganic substances according NEN 7375**

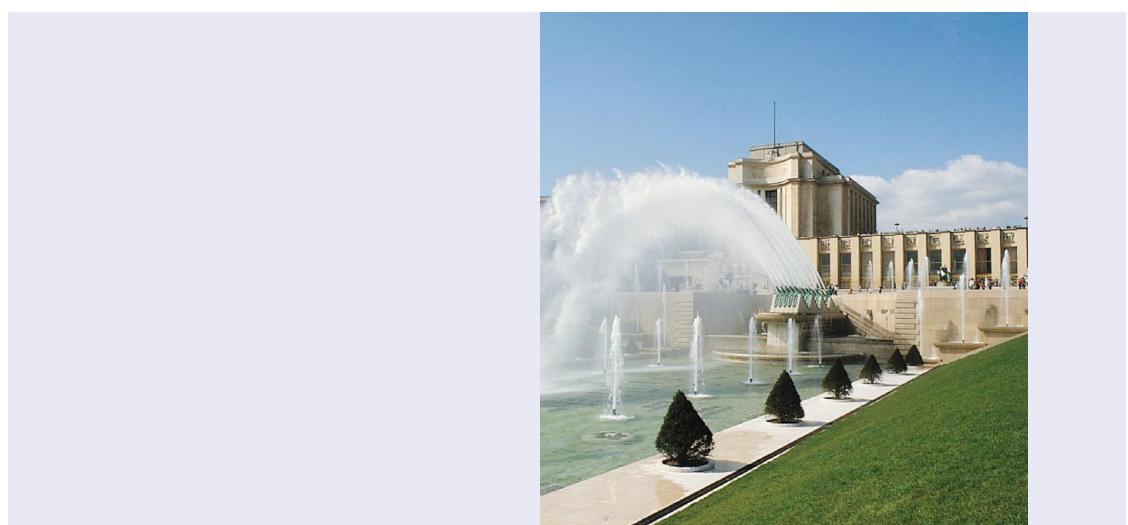
Substance	Dutch Limits (mg/m <sup>2</sup> )	Average Bitumen Sheets (mg/m <sup>2</sup> )*
Antimony	8,7	< 2
Arsenic	260	< 10
Barium	1500	< 4
Cadmium	3,8	< 0,2
Chromium	120	< 2
Cobalt	60	< 2
Copper	98	< 2
Mercury	1,4	< 0,06
Lead	400	< 4
Molybdenum	144	< 1
Nickel	81	< 2
Selenium	4,8	< 1
Tin	50	< 3
Vanadium	320	< 4
Zinc	800	< 10
Fluoride	2500	< 40
Chloride	101000	< 260

\* = Cumulative emission in 64 days. Most results are below detection limits.



Waterproofing, Niffer Canal, Mulhouse, France

Waterproofing, Trocadero, Paris, France





Waterproofing, The Millau Viaduct, France



In addition to the Dutch legislation, results of leaching tests on organic substances were published in the Dutch magazine ‘Land+water’ 2-2002 ‘Branch calls for fairer tests on building materials’ by Intron B.V. and Stichting Dak & Milieu (Netherlands). Table 4 shows test results which prove that leaching of organic substances is also a negligible issue for bitumen waterproofing.

**Table 4 Leaching organic substances**

Substance	Test result * (mg/m <sup>2</sup> )
Ethylbenzene	No leaching
EOX	No leaching
Toluene	0,4
Xylene	0,4
Mineral oil	No leaching
PAH	No leaching

\* = Cumulative emission in 64 days.

Bitumen waterproofing has proved that it easily meets the leaching requirements of The Netherlands, the country with the most severe leaching legislation in Europe. As a result water can be confidently returned to the environment without further treatment for use in non-potable applications (irrigation, toilet flushing, etc.).

Furthermore, besides its use in buildings, **bituminous waterproofing is used in applications intended to protect structures** such as channels and reservoirs – either for temporary storage or for later treatment.

In other circumstances, bituminous membranes are also used for roads, storm spillways, reservoirs and for storing contaminated liquids, so helping to **protect ground water and soil from the risk of contamination with dangerous substances**.



Green roof, The Odney Club, Maidenhead, England



## **8. Inert and recyclable waste / Waste management**

Within the industry the use of secondary materials such as polyester and other polymers is widespread, and recycling of production waste has become an increasingly common practice. Because of its composition, the waste created by dismantling a bituminous waterproofing system is considered to be inert with no impact on the environment.

It is also possible to recover the energy potential of bitumen (feedstock) by using it as fuel or to produce electricity.

**Waterproofing membranes are also recyclable.** Due to the thermoplastic properties of their principle components (bitumen, polyester reinforcements, polymers, fusible plastic film), bitumen waterproofing sheets can be converted into mass bitumen products like road asphalt – significantly reducing the demand for virgin bitumen. Indeed in the case of high quality waste, bitumen roofing can be recycled to become bitumen sheets once again.

When reused to cover roads, bituminous waterproofing sheets thus form a viable and sustainable stockpile of oil constituents.

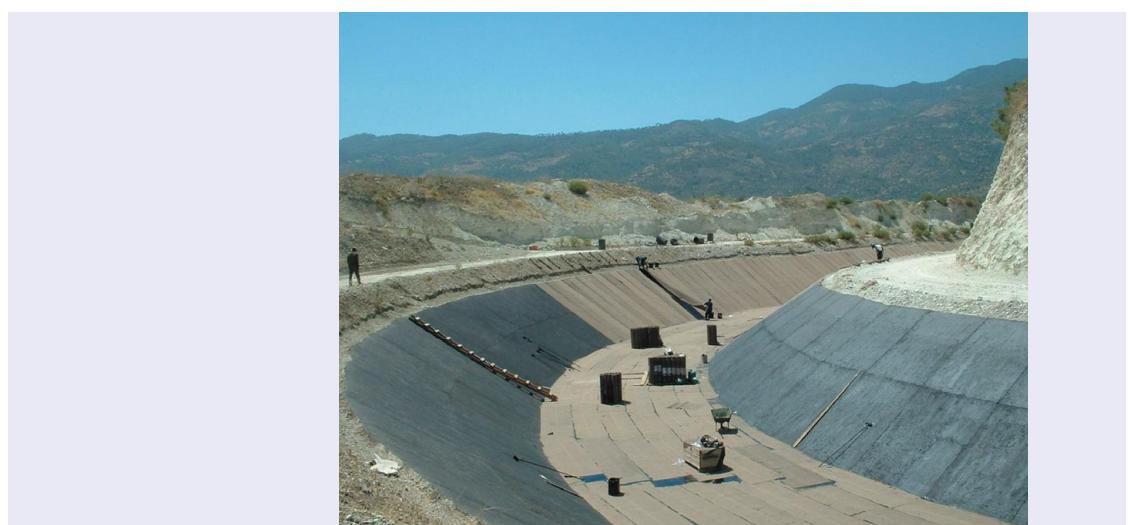


Green roof, Art Academy Arnhem, Netherlands



Green cladding and roofs, Sportplaza Mercator, Amsterdam

Water Channel, Aydin, Turkey





## **9. Bituminous waterproofing the solution for green roofing**

Fully bonded waterproofing systems have proven to be the most durable solution for green, parking and terrace roofs. Bitumen membranes, with their high puncture resistance and root resistant qualities are ideal materials for this application.

BWA supports all initiatives to stimulate green roofing as a **protective plant cover** over fully bonded bitumen waterproofing systems. This has a number of tangible benefits:

- Any green space destroyed in erecting the building is reinstated on the roof
- Green roofing contributes to biodiversity by attracting insects, which in turn attract birds
- A wide variety of colours and shapes can be achieved by judicious selection of plants
- The local climate is improved through absorption of dust, reduction in temperature and humidified air.



Green roof, INRIA, Grenoble, France



Roof waterproofing, Suzanne Lenglen Sports Complex, Paris, France



Green parking garage, Tiel, Netherlands

## **10. Bitumen waterproofing – the flexible, economic and durable solution**

The cost of maintaining and renewing bituminous waterproofing systems is low due to their typically long service life (estimated at 25-30 years).

When implemented as two layers, bituminous waterproofing makes on-site working more efficient with the first layer providing temporary protection whilst other trades carry out their tasks. The final layer need only be applied in the final stages when there is minimal danger of accidental damage.

In many cases, **renovating** bituminous waterproofing can be achieved by adding a new bituminous membrane to the existing surface – easily prolonging the system's life and the effectiveness of the insulation it protects.





## **11. Service and maintenance management**

A simple preventative and diagnostic maintenance inspection once a year is all that is necessary to **ensure** the bitumen waterproofing system gives long and faultless service.

In **renovation**, it is often a simple matter of adding to the existing waterproofing, with no need to dismantle the old. This can be done twice during the building's lifetime, extending the service life to approximately 90 years and so eliminating a major source of waste.

**Given a change in function of the building, or new installations within the building,** bitumen roof coverings can easily be adapted to the changed circumstances with no need to dismantle the existing roof covering.

## **12. Acoustic comfort**

Acoustic longevity is vital to the users of a building. Due to the mass and elasto-plastic properties of bituminous waterproofing systems they dampen the impact noise of rain and hail and help make buildings a pleasant environment in which to work and live.

Bitumen waterproofing systems under heavy protection of gravel, screed, roof gardens, or plant cover can also significantly add to acoustic comfort by both filtering the noise of impact, and by attenuating a high degree of ambient noise.





Downloadable files

[www.bwa-europe.com](http://www.bwa-europe.com)