Flexible Waterproofing of Basement Structures with Sikaplan® Membranes
Flexible Waterproofing of Basement St

Residential Apartments
Commercial Offices
Leisure Facilities
Retail Units and Storage Areas
Archives
Metro Stations
Parking Areas
Plant Rooms

- Drainage systems can be incorporated
- Can accommodate settlement and ground movement
- Will flexibly bridge cracks and joints in concrete
- Protects the structure from aggressive groundwater
Prevents reinforcement steel corrosion due to water ingress

Secure and homogeneous with welded seams tested on site

Protects and maintains thermal insulation values
The different Levels of Exposure and Requirements

The Ground Conditions

Basements are immersed in differing levels of groundwater, and aggressive influences including damp soil contact, percolating water, water under hydrostatic pressure plus aggressive chemicals in solution, different soil, gravel and rock, etc. These all require different and often specific waterproofing treatments to be applied to the structure. A part or partial waterproofing treatment can also be achieved with drainage or porous screeds that are laid to falls on horizontal surfaces to drain off any water.

Flexible Sikaplan® membrane waterproofing for damp soil contact, percolating water and water under hydrostatic pressure

Damp Soil Contact
Soil with low water permeability or high water retention.

Percolating Water
Water percolating by gravity through permeable soil.

Water under hydrostatic Pressure
Hydrostatic pressure develops with high water levels in permeable ground.
The Degree of Watertightness required
(Grades defined according to BS 8102)

Grade 1
**Basic Utility**
- Some seepage and damp patches tolerable (min. wall thickness: 150 mm)
  - Car parking areas
  - Plant rooms/workshops excluding any electrical equipment in the areas

Grade 2
**Better Utility**
- No water penetration but moisture vapour tolerable (min. wall thickness: 200 mm)
  - Retail storage areas
  - Plant rooms and workshops requiring drier environment with electrical equipment in the area

Grade 3
**Habitable**
- Dry environment — ventilated (min. wall thickness: 250 mm)
  - Residential areas, offices, restaurants
  - Leisure centres, gymnasiums

Grade 4
**Special Requirements**
- Totally dry environment — ventilated (min. wall thickness: 300 mm)
  - Archives and special equipment or storage areas
  - Controlled environment

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**Rigid Waterproofing (Grades 1 to 3)**
- Waterproof concrete/waterproof rendering and joint sealing systems

To seal structures against groundwater ingress, where some limited moisture presence or damp patches are tolerable.

**Note:** Can be used for Grades 3 and 4 with additional Sika jointing, waterproofing and other technologies.

**Flexible Waterproofing (Grades 2 to 4)**
- Loose laid and welded sheet membranes

To waterproof all types of structures in all different ground conditions against all types of groundwater ingress including high water levels with strong hydrostatic pressure even where the internal environment must be totally dry (i.e. Grade 4 in areas with a totally controlled environment or other special requirements).
# Selection Guide for different Waterproofing Systems

A Comparison between Flexible and Rigid Waterproofing Systems for new Watertight Basement Structures

<table>
<thead>
<tr>
<th>Rigid Waterproofing Systems</th>
<th>Flexible Waterproofing Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterproof mortar rendering</td>
<td>Loose laid Sikaplan® WP/WT</td>
</tr>
<tr>
<td>Watertight concrete</td>
<td>Hot applied “torch-on” bitu-</td>
</tr>
<tr>
<td></td>
<td>men membranes</td>
</tr>
<tr>
<td></td>
<td>Liquid applied polymer</td>
</tr>
<tr>
<td></td>
<td>membrane</td>
</tr>
<tr>
<td>Suitable against hydrostatic water pressure</td>
<td>✓</td>
</tr>
<tr>
<td>Specialized contractor required</td>
<td>x</td>
</tr>
<tr>
<td>No substrate preparation required</td>
<td>x</td>
</tr>
<tr>
<td>No priming of substrate required</td>
<td>x</td>
</tr>
<tr>
<td>Crack-bridging ability</td>
<td>✓</td>
</tr>
<tr>
<td>Prevents water underflow</td>
<td>✓</td>
</tr>
<tr>
<td>Requires no support</td>
<td>x</td>
</tr>
<tr>
<td>No need to be bonded to the surface</td>
<td>x</td>
</tr>
</tbody>
</table>
Waterproofing with Sikaplan® Flexible Sheet Membranes

Dependent on the groundwater conditions, the type of structure and the degree of watertightness required, a full range of alternative Sikaplan® flexible membrane waterproofing solutions are available. These include systems in combination with drainage, plus systems in combination with Sika® Waterbars, for both single and double compartment waterproofing. For the most stringent requirements, the Sikaplan® Active Control System with additional vacuum dewatering capabilities is used.

1. Drainage System
Not suitable against hydrostatic pressure

- Loose laid, with lateral drainage, without compartments
  - For waterproofing against damp soil contact and percolating water
  - Requires drainage pipes at the base (sump drain) bottom to prevent any build-up of water pressure

Suitable products
- Sikaplan® WP 1120-HL
- Sikadur®-Combiflex® SG System

2. Waterstopping System
Suitable against hydrostatic pressure

- Loose laid, welded with compartments formed from additional waterbars
  - For waterproofing against water under hydrostatic pressure
  - Compartments are injectable in the event of any movements or damage causing leaks in the waterproofing membranes

Suitable products
- Sikaplan® WP 1120-HL
- Sikadur®-Combiflex® SG System
- Sika® Control® system and injection ports
- Sika® Injection

3. Active Control System
A waterstopping system with dewatering capabilities – suitable against hydrostatic pressure

- Loose laid, welded with compartments formed from additional waterbars
  - For waterproofing against water under hydrostatic pressure and incorporating the Sika Active Control System
  - High security for maintaining the watertightness with vacuum dewatering
  - Compartments are injectable in the event of any movement or damage causing leaks in the waterproofing membranes

Suitable products
- Sikaplan® WP 1120-HL
- Sika® Waterbar h
- Sikadur®-Combiflex® SG System
- Sika® Control® system and injection ports
- Sika® Injection
Sikaplan® Membrane Systems for all Types of Construction Procedures

Construction Procedures

- Open trench excavation with sloping sides
- Open trench excavation with retaining walls
- Construction inside diaphragm walls
The Sikaplan® Flexible Waterproofing Membranes

The Sikaplan® Membranes

<table>
<thead>
<tr>
<th>Properties</th>
<th>Sikaplan® WP 1120- HL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Former product names</td>
<td></td>
</tr>
<tr>
<td>H: Homogeneous</td>
<td>-15 HL</td>
</tr>
<tr>
<td>L: Laminated</td>
<td>-20 HL</td>
</tr>
<tr>
<td></td>
<td>-30 HL</td>
</tr>
<tr>
<td>Material base</td>
<td>PVC-P, homogeneous</td>
</tr>
<tr>
<td>Available thickness* (mm)</td>
<td>1.5 / 2.0 / 3.0</td>
</tr>
<tr>
<td>Colour</td>
<td>Top layer: yellow</td>
</tr>
<tr>
<td></td>
<td>Reverse layer: black</td>
</tr>
<tr>
<td>Membrane surface appearance</td>
<td>Smooth</td>
</tr>
<tr>
<td>Roll width (m)</td>
<td>2.00</td>
</tr>
</tbody>
</table>

* Thickness depending on project requirements and local standards.

Physical properties according to Product Data Sheets

The correct Selection of Sikaplan® WP (PVC-P) Membranes

<table>
<thead>
<tr>
<th></th>
<th>Sikaplan® WP (PVC-P)</th>
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<tbody>
<tr>
<td>Bitumen resistance</td>
<td>No</td>
</tr>
<tr>
<td>Resistance to salt water</td>
<td>Yes</td>
</tr>
<tr>
<td>Resistance to chemically polluted groundwater</td>
<td>No</td>
</tr>
<tr>
<td>Resistance to water under hydrostatic pressure at 5 bar</td>
<td>Yes</td>
</tr>
<tr>
<td>Suitability for installation during cold temperatures</td>
<td>Good</td>
</tr>
<tr>
<td>Site seam preparation</td>
<td>Not required</td>
</tr>
<tr>
<td>Seam welding</td>
<td>With suitable heat welding machines</td>
</tr>
</tbody>
</table>


Ancillary Products for Sikaplan® Membrane Systems

The compatibility of materials and the professional sealing of details will decide on the successful waterproofing of basement structures.

Sika® Waterbars, PVC based types
- Sika® Waterbar h for compartments on the base slabs and walls

Sikadur®-Combiflex® SG Joint sealing system
- Sikadur®-Combiflex® SG strip
- Sikadur®-31 C for watertight compartments and terminations

Sika® Control system and injection fanges

Sikaplan® WP laminated metal sheets
Sikaplan® WP protection sheets
Sikaplan® WP disk fixing pieces
Sika® Waterbar h are used to form watertight compartments with the sikaplan® sheet membrane waterproofing systems below base slabs, above roof slabs and behind external walls. These compartments above underground roof slabs must be produced using Sikadur®-Combiflex® SG System waterproofing tapes. The waterproofing terminations on external walls and at intersections are made using liquid applied Sikalastic® products, to ensure that completely watertight basements are achieved.

Sikaplan® WP-Sika® Waterbar h AR/DR

Waterproofing terminations of Sikaplan® sheet membranes at walls

Compartments over construction joints on roof slabs

Compartments over expansion joints on roof slabs
Heat Welding of Sikaplan® Membranes

The seam overlaps of the membranes are securely and homogeneously welded with electric heat welding machines; this can be done manually with hand welding guns, or automatically with self-propelled machines. The butt joints of the Sika® Waterbar h are heat welded with special heated blades.

**Manual welding with hand welding gun and pressure roller**

Single seams (width >30 mm) are produced with hand welding guns and pressure rollers or with automatic welding machines.

**Automatic welding with self-propelled machine**

Double seams (widths: 15 mm each plus 10 mm air testing channel) only with automatic welding machines.

**Heat welding of Sika® Waterbar h onto the installed Sikaplan® membrane with heated blades**

Butt joints between Sika® Waterbar h type AR are made with hot copper blades whilst the waterbar’s ends are fixed into special clamps.
Quality Control of welded Seams on Site

The welded seams of Sikaplan® flexible membranes are always thoroughly quality control tested on site to confirm their watertightness. This is done by both visual and physical testing methods, electrical testing for voids is also straightforward. Quality control of the completed membrane installation on the structure prior to the concreting works is therefore particularly easy and extremely important. It therefore gives the Sikaplan® flexible sheet membrane systems another real advantage in ensuring the prevention of any future leaks in important basement structures that are specifically designed to be watertight.

Visual testing

Physical testing

Electric testing

Testing with blunt screw driver

Physical testing with a vacuum bell

Electric testing with a “holiday” detector

Physical testing of double welded seams and central void with compressed air

Inadequate workmanship or incorrect installation of membrane waterproofing could mean that the structure is not watertight, thus allowing future water ingress. Sika trained professional contractors and quality control on site are always recommended to prevent such defects.

Non-professional welding

Incorrect welding

Ignoring substrate requirements and omitting protective backing materials
Watertight Security and Extending Security with Sikaplan® Flexible Membrane System

Repairing Leaks at any Time during the Construction

A compartmental water-stopping system with Sika® Waterbar® and welded double layer Sikaplan® sheet membranes is combined with Sika® injectable pipes and ports cast into the concrete structure, to provide the security of complete watertightness control, allowing fast location, then fast and easy repairs using Sika® injection resins, if this is ever required at any time during the construction period or during the entire service life of the structure.

Sika® Control® and injection ports

Watertight compartments cast under the floor slabs
Leaks through damaged membrane are easily detected as water appears in the Sika® Control pipes and injection ports.

Possible Reasons for Membrane Waterproofing System Leaks

- Membrane perforated during construction works
- Welded seam overlaps not professionally welded and tested to be watertight
- Torn membrane after excessive settlement or other structural movement

Sika® Injection-305

A flexible, very low-viscous and fast-reacting polyacrylate injection gel for the permanent watertight sealing of damaged membrane waterproofing installations (both single and double layer systems). The material reacts to form a waterproof, flexible but solid gel with good adhesion to both dry and wet substrates.

Repairing the waterproofing by the injection of Sika® Injection-305 resin through the Sika® Control pipe and injection port.

Two-Component Sika® Injection Pump for Polyacrylate Gels

The Sika® Injection Pump PN-2C is specially designed for full curtain injection watertight sealing. A two-component pump is required, for the fast-reacting polyacrylate gels to the individual components are introduced separately and mixed at the gun. The actual mixing takes place in a static mixer in the head. Suitable injection packers are inserted into the Sika® Control system injection ports.
Global Case Studies
Flexible Waterproofing of Basement Stru

Project
The National Bank HQ Building, Lisbon, Portugal, 1992

Sika solution
Pile cap waterproofing details with preformed double-flanged sections of Sikaplan® sheet membranes.
Sikaplan® WP 1100-20 HL: 25 000 m²
Sikaplan® WP Waterbar type AR: 12 000 m

Project
Turkish Commercial Centre, Moscow, Russia, 2001

Sika solution
Waterproofing details with Sikaplan® membrane for the floating slab design, to accommodate the anticipated settlement movement and building load both during and after construction.
Sikaplan® WP 1115-20 H translucent: 14 500 m²

Details of the pile head

Detail of the slab/wall intersection
Project:
Basement waterproofing of supply channel at Palm Jumeirah, Dubai

Sika solution:
Compartmentalized waterproofing system with Sikaplan® membrane system.
Sikaplan® 1100-15 HL: 10000 m²
Sika® Waterbar h (Type AR 20) approx 200 m

Project

Sika solution
A large basement of 80000 m² made watertight with Sikaplan® flexible waterproofing, including preformed detailing sections for more than 1500 pile caps installed in combination with Sikadur®-42 epoxy grout.
Sikaplan® WP 1100-20 HL: 90000 m²
Sikaplan® WP Waterbar type AR: 27000 m

Detail of the pile cap waterproofing
Global Case Studies
Flexible Waterproofing of Basement Structures

Project:
Cast Iron Wheel Manufacturing Unit, Chapra, Bihar

Sika solution:
Waterproofing system with Sikaplan® membrane system.
Sikaplan® 1120-20 HL 35000 m²

Project:

Sika solution:
Compartmentalized waterproofing system with Sikaplan® membrane system. Sikaplan® 1120-20 HL 7000 m²
Sika® Waterbar h (Type AR) approx 2000 m
Structures with Sikaplan® Membranes

Project:
Sky Office, Zagreb, Croatia

Sika solution:
Compartmentalized waterproofing system with Sikaplan® membrane system.
Sikaplan® 1100-20 HL 28000 m²
Sika® Waterbar h (Type AR 20)

Project:
Vorobyovi Gori condominium, garage and basement roof deck, Moscow, Russia, 2007

Sika solution:
Underground car parking and storage areas with the roof slab waterproofed with Sikaplan® flexible sheet membranes, also providing watertight tree planting box-outs and bases for children’s play areas.
Sikaplan® WP 1100-15 HL/-20 HL/-30 HL: 128 000 m²

Garage roof deck with integrated tree planting box-outs; watertightness testing by flooding the plant boxes.
Sika – global knowledge with a local presence

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