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

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.

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, gymnasiuums

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

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.

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

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.

<table>
<thead>
<tr>
<th>Rigid Waterproofing Systems</th>
<th>Flexible Waterproofing Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterproof mortar rendering</td>
<td>Waterproof concrete</td>
</tr>
<tr>
<td>Loose laid Sikaplan® WP/WT sheet membranes</td>
<td>Hot applied “torch-on” bitumen membranes</td>
</tr>
<tr>
<td>Suitable against hydrostatic water pressure</td>
<td>✓</td>
</tr>
<tr>
<td>Specialized contractor required</td>
<td>7</td>
</tr>
<tr>
<td>No substrate preparation required</td>
<td>7</td>
</tr>
<tr>
<td>No priming of substrate required</td>
<td>7</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>7</td>
</tr>
<tr>
<td>No need to be bonded to the surface</td>
<td>7</td>
</tr>
</tbody>
</table>

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) to prevent any build-up of water pressure
- Suitable products
  - Sikaplan® WP 1100
  - Sikaplan® WT 1200
  - Sika® Dilatec®, type E/ER sealing strips
  - Sikadur®-Combiflex® 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 1100
  - Sikaplan® WT 1200
  - Sika® Waterstops, PVC types
  - Sika® Waterstops, FPO types
  - Sika® Dilatec®, type E/ER strips
  - Sikadur®-Combiflex® System
  - Sika® Control® system and injection ports
  - Sika® Injection-305 resin

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 1100 H/HE
  - Sikaplan® WT 1200 C/CE
  - Sika® Waterstops, PVC types
  - Sika® Waterstops, FPO types
  - Sika® Dilatec®, type E/ER strips
  - Sikadur®-Combiflex® System
  - Sika® Control® system and injection ports
  - Sika® Injection-305 resin
## Construction Procedures

- Open trench excavation with sloping sides
- Open trench excavation with retaining walls
- Construction inside diaphragm walls

## The Sikaplan® Membranes

### Properties

<table>
<thead>
<tr>
<th>Properties</th>
<th>Sikaplan® WT 1200</th>
<th>Sikaplan® WP 1100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Former product names</td>
<td>Samafili TG 68...</td>
<td>Samafili TG 68...N</td>
</tr>
<tr>
<td>C: Fleece stabilized</td>
<td>-16 C</td>
<td>-15 CE</td>
</tr>
<tr>
<td>E: Embossed</td>
<td>-20 C</td>
<td>-20 HL2</td>
</tr>
<tr>
<td>H: Homogeneous</td>
<td>-30 C</td>
<td>-30 HL2</td>
</tr>
<tr>
<td>L: Laminated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z: Extruded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material base</td>
<td>FPO-PE with glass fleece restraint</td>
<td>PVC-P, homogeneous</td>
</tr>
<tr>
<td>Available thickness* (mm)</td>
<td>16, 20, 30</td>
<td>25, 35</td>
</tr>
<tr>
<td>Colour</td>
<td>Top layer: green</td>
<td>Top layer: yellow</td>
</tr>
<tr>
<td></td>
<td>Reverse layer: black</td>
<td>Reverse layer: black</td>
</tr>
<tr>
<td>Membrane surface appearance</td>
<td>Smooth</td>
<td>Top layer: smooth</td>
</tr>
<tr>
<td></td>
<td>Reverse: embossed</td>
<td>Smooth</td>
</tr>
<tr>
<td>Roll width (m)</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>CE conformity</td>
<td>According to EN 13967</td>
<td></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) or Sikaplan® WT (FPO-PE) Membranes

<table>
<thead>
<tr>
<th>Property</th>
<th>Sikaplan® WP (PVC-P)</th>
<th>Sikaplan® WT (FPO-PE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen resistance</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Resistance to salt water</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Resistance to chemically polluted</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>groundwater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance to water under hydrostatic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>pressure at 5 bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>suitability for installation during cold</td>
<td>Good</td>
<td>Needs experience</td>
</tr>
<tr>
<td>temperatures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site seam preparation</td>
<td>Not required</td>
<td>Activation and cleaning with solvent cleaner</td>
</tr>
<tr>
<td>Seam welding</td>
<td>With suitable heat welding machines</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 and TPO/PFO based types
- Sika® Waterbar type AR (PVC)
- Sika® Waterbar type DR (PVC)
- Sika® Waterstop type MP AF (TPO/PFO) for compartments on the base slabs and walls

Sikadur® Combitex joint sealing system
- Sikadur®-Combitex® strip
- Sikadur®-31 CF (EP adhesive) for watertight compartments and terminations

Sika® Dilitec, type E/ER joint and edge sealing strips
- Sika® Dilitec®-E-220 for expansion joints
- Sika® Dilitec®-ER-350 for waterproofing terminations
- Sikadur®-31 CF (EP adhesive) for watertight compartments and terminations using PVC membranes

Sika® Control system and injection flanges

Sikaplan® WP/WT laminated metal sheets
Sikaplan® WP/WT protection sheets
Sikaplan® WP/WT disk fixing pieces

Detailing and Connections with Sikaplan® Membrane Systems

Sika® Waterbars 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 Sika® Dilitec® and Sikadur®-Combitex® 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.

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

Sika® Waterbars, AR/DR (PVC)
Sika® Waterbars AF (PE)
Sikaplan® WP/WT – Sikadur®-Combiflex® strip
Sikaplan® WP/WT – Sikadur®-Combiflex® tape
Sikaplan® WP/WT – Sika® Waterbars AR/DR
Sikaplan® WP/WT – Sika® Waterbars AF
Sikaplan® WP/WT – Sikalastic®-450/-80/-822 liquid membranes
Sikaplan® WP/WT – Sikagard®-186 (EP primer)
Sikaplan® WP/WT – Sikagard®-186 (EP primer)
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® Waterbars are heat welded with special heated blades.

- Manual welding with hand welding gun and pressure roller
- Automatic welding with self-propelled machine
- Heat welding of Sikaplan® membrane with heated blades

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

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

Butt joints between Sika Waterbars type AR/AF 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

Visual testing
Physical testing
Electric testing

Testing with blunt screw driver
Physical testing with a vacuum bell
Electric testing with a “holiday” detector

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 Service Life with Sikaplan® Flexible Membrane Systems

Repairing Leaks at any Time during the Construction Period and the Service Life of the Structure

A compartmental water-stopping system with Sika® Waterbars 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.

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.

Sika® Injection Pump PH-2C
The Sika® Injection Pump PH-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 Structures with Sikaplan® Membranes

Project
Central Aquarium, Moscow, Russia, 2007
Sika solution
Single-layer compartmentalized Sikaplan® TPO/FPO membrane with the Sika® Active Control System injection pipes and ports installed in the concrete.
Sikaplan® WP 1115-20 H translucent: 14,500 m²
Sikaplan® WT Waterbar type AR: 12,000 m

Details of the base slab compartments

Project
Sika solution
A large basement of 80,000 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: 90,000 m²
Sikaplan® WP Waterbar type AR: 27,000 m

Project
The National Bank HQ Building, Lisbon, Portugal, 1992
Sika solution
Pile cup 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

Details of the pile head

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: 14,500 m²
Sikaplan® WP Waterbar type AR: 12,000 m

Detail of the slab/wall intersection

Project
The National Bank HQ Building, Lisbon, Portugal, 1992
Sika solution
Pile cup 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

Details of the pile head

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Sikaplan® WP Waterbar type AR: 12,000 m

Details of the pile head

Sikaplan® WP 1100-20 HL: 25,000 m²
Sikaplan® WP Waterbar type AR: 12,000 m

Detail of the slab/wall intersection

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Sika solution
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Sikaplan® WP 1100-20 HL: 25,000 m²
Sikaplan® WP Waterbar type AR: 12,000 m

Details of the pile head

Sikaplan® WP 1100-20 HL: 25,000 m²
Sikaplan® WP Waterbar type AR: 12,000 m

Detail of the slab/wall intersection
Global Case Studies
Flexible Waterproofing of Basement Structures with Sikaplan® Membranes

Project
Wadi El Nile Street underpass, Cairo, Egypt, 1988

Sika solution
Sikaplan® flexible sheet membrane waterproofing, installed with automatic double-seam welding and air pressure testing, to confirm watertightness prior to backfilling over protective sheeting.

Sikaplan® WP 1110-15 H: 6100 m²

Double-seam welding and pressure testing

Project
Pavan 2, Residential and commercial complex, Venice, Italy, 2004

Sika solution
Basement waterproofing with Sikaplan® flexible waterproofing installed on the formwork and then welded to the Sika® Waterbars in the joints to ensure a watertight structure.

Sikaplan® WP 1100-20 HL: 9500 m²
Sikaplan® WP Waterbar type AR: 3000 m

Lining for the basement slab formwork

Project
Hotel Moscow, Moscow, Russia, 2007

Sika solution
Waterproofing by installation of the Sikaplan® flexible sheet membrane system with work continuing on site even during temperatures as low as −15°C.

Sikaplan® WT 1200-20 C: 20000 m²

Membrane installation at extremely low temperatures

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: 128000 m²

Usage roof deck with integrated tree planting box-outs: watertightness testing by flooding the plant boxes
### The Sikaplan® Flexible Sheet Membrane Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sikaplan® WP 1100 HL2 yellow/black</td>
<td>Homogeneous waterproofing sheet membrane based on polyvinylchloride (PVC-P), available in thicknesses of 1.5 mm, 2 mm and 3 mm, not resistant to bitumen or permanent exposure to UV light.</td>
<td></td>
</tr>
<tr>
<td>Sikaplan® WP 1110 20 H transparent</td>
<td>Homogeneous waterproofing sheet membrane based on polyvinylchloride (PVC-P), thickness 2 mm and not resistant to permanent UV exposure, light absorption &lt;30%.</td>
<td></td>
</tr>
<tr>
<td>Sikaplan® WT 1200 C green/black</td>
<td>Reinforced waterproofing sheet membrane based on polyolefin (TPO/FPO) with non-woven polyethylene (PE) glass inlay for restraint, available in thicknesses of 1.6 mm, 2 mm and 3 mm. Resistant to bitumen and polystyrene, not resistant to permanent UV light exposure.</td>
<td></td>
</tr>
<tr>
<td>Sikaplan® WT 1200 CE green/black</td>
<td>Reinforced waterproofing sheet membrane based on polyolefin (TPO/FPO) with non-woven polyethylene (PE) glass inlay restraints available in thicknesses of 2.5 mm and 3.5 mm. Surface embossed with ribs to increase bond and watertightness. Resistant to bitumen and polystyrene, not resistant to permanent UV light exposure.</td>
<td></td>
</tr>
</tbody>
</table>

### The Sikaplan® Ancillary Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sikadur®-Combiflex® joint sealing system</td>
<td>Joint sealing strip, based on hypalon (TPO/FPO) for producing bonded compartments and terminations of TPO/FPO membranes.</td>
<td></td>
</tr>
<tr>
<td>Sika® Dilatec® tape joint sealing system</td>
<td>Joint sealing strips type E / ER, based on polyvinylchloride (PVC-P) for producing bonded compartments and terminations with PVC membranes.</td>
<td></td>
</tr>
<tr>
<td>Sika® WP/WT waterbars</td>
<td>Waterbar types AR and DR, based on polyvinylchloride (PVC). Waterbar types MP and AF based on polyolefin (TPO/FPO) cast in concrete for compartments and the base slabs, roof slabs and external walls of basements.</td>
<td></td>
</tr>
<tr>
<td>Sikadur®-31 CF (EP adhesive)</td>
<td>Normal and rapid (for low temperatures or accelerated curing) grades available based on epoxy resin (EP) for the bonding of Sikadur-Combiflex and Sika Dilatec joint sealing tapes.</td>
<td></td>
</tr>
</tbody>
</table>

### Also available from Sika

- **Waterproofing of Basement Structures with Sikaplan® Membranes**
- **Watertight Concrete Basements with Sikaplan® Membranes and Injection Technology**
- **Joint Sealing with Sikaplan® Membranes**
- **Flexible Waterproofing of Tunnels with Sikaplan® Membranes**
- **Sika® Injection Systems for Adverse Structures**

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