N°: 850 64 03
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Construction

System Information and Method Statement
Corporate Construction

Basement waterproofing with membranes

Scope:
Installation of
Sikaplan® WT 1200 - 16C, - 20C, - 30C
(Sarnafil® TG 68 -16, -20, -30)
Sikaplan® WT 1200 - 25CE, - 35CE
(Sarnafil® TG 68 - 25N, - 35N)

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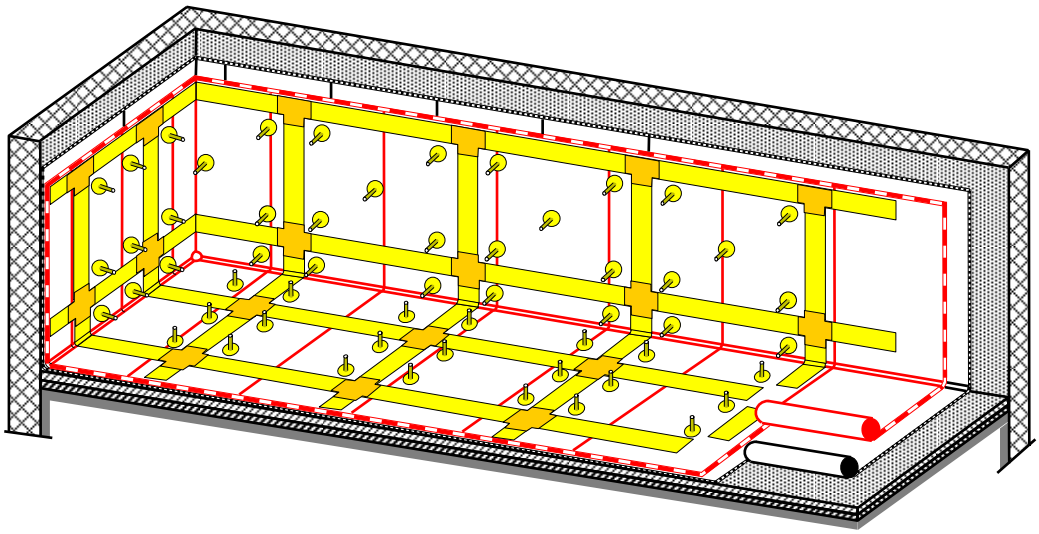
1. INTRODUCTION

1.1 General background information

Building structures with basements below ground usually need to be watertight. Waterproofing works dependant on the basement's structure are required to prevent leaks into the structure and to protect the structure against the harmful influences of aggressive ground- or seawater.
Highly flexible single layer, or if requested double layer Sikaplan® WT waterproofing membranes can protect a structure against water from damp soil contact, percolating water and groundwater under hydrostatic pressure.
In situations with leaking waterproofing membranes caused by mechanical damage to the membrane, whether a loose laid and single, or double layer systems, infiltrating water might underflow and spread uncontrolled between the installed membrane and the structure.
A compartment system with waterstops and specially welded single, or double layer membrane, combined with injectable hoses provide the possibility of control and repair by injection if required during service life.
Additional advantages are fast installation procedures, the high crack bridging ability of the installed membranes, plus minimal requirements for substrate preparation.
This Method Statement describes the installation procedure and details with the Sikaplan® WT waterproofing membranes based on flexible Polyolefin (FPO).



Limitations of membrane installations:
A successful waterproofing system requires detailed design and specification by the engineer prior to the membrane installation works being carried out on site.
The structure must be designed and built in such a way that the Sikaplan® WT waterproofing membranes can adequately fulfil its function during its long service life.
Installation procedures must only be performed by skilled and experienced membrane waterproofing contractors. The site personnel must be trained in correctly welding of the Sikaplan® WT sheet membranes.

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1.2 Construction requirements

The main criteria for the correct design and execution of the Sikaplan® WT flexible sheet membrane waterproofing system against groundwater ingress in underground structures are:

- type and purpose of structure
- waterproofing of structures in open cut excavation, or shafting between secant pile- or diaphragm walls
- circumference of the waterproofing (the level of waterproofing and its terminations)
- type and design of the retaining walls
- piled foundations and the pile cap location
- lowering of groundwater level during construction (sump pumping methods)
- condition of the substrate to be waterproofed
- thermal insulation details and requirements
- dimensions of the structure (length, width, depth)
- groundwater levels (max., min., average, immersion depth of structure)
- condition of groundwater (aggressive water, salt water, polluted water)
- expansion joint details and design
- construction phases construction/day work jointing of structure (construction schedule)
- requirements for single, or double-layer waterproofing system with vacuum control

All elements protruding from or through the waterproofing membrane and cast into the concrete, i.e. well shafts, service pipes, anchors, etc. must be made of corrosion-free steel quality (i.e. stainless V2A or V4A steel), or other non corroding materials. The elements must be designed with flanges in order to allow watertight sealing of the membranes around them.

In order to avoid any kind of damage to the installed waterproofing membrane and to ensure their performance the following requirements from the substrate must be met:

- the structure must be designed to minimise movement due to temperature, settlement and any concrete shrinkage and contraction, etc.
- reinforcement bars in the concrete must be min. 30mm below the surfaces
- all steel elements must be stainless, or anticorrosive materials (i.e. cast iron, V2A, V4A steel quality, aluminium)
- the surface of the substrate being waterproofed must be smooth and uniform to avoid puncturing the membrane under the future influence of any hydrostatic pressure

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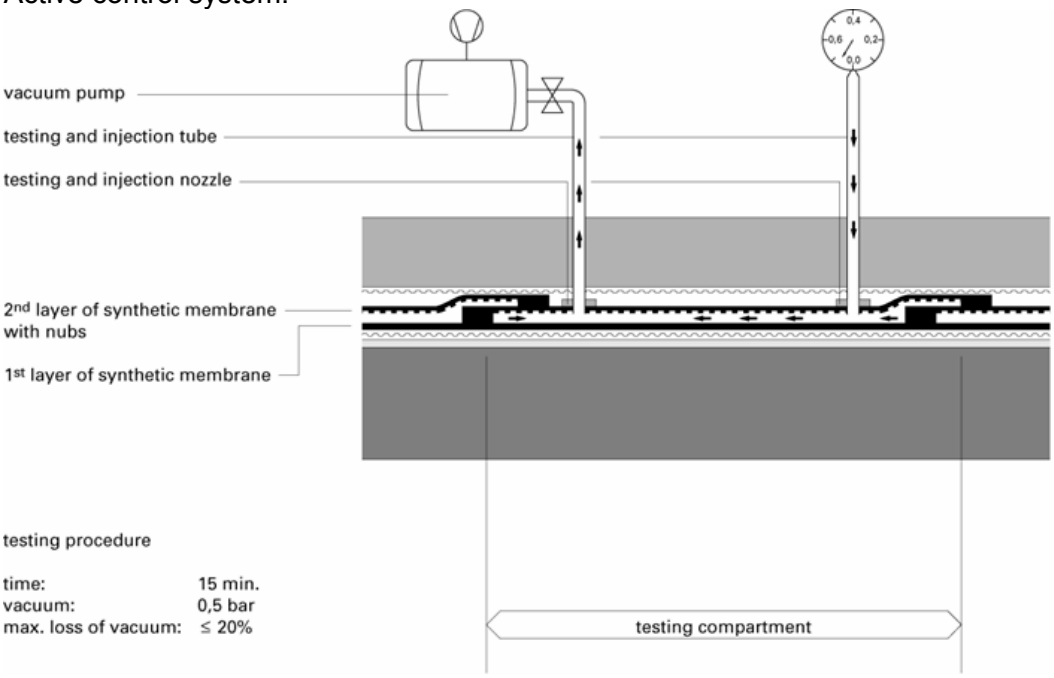
1.3 Waterproofing system

The installation procedure for waterproofing membranes depends on the:
- chosen excavation system i.e. open with free access to the external walls, or application to be internally with retaining walls
- specific project design details
- damp soil contact, percolating water or water under hydraulic pressure
- immersion depth below groundwater level
- chosen membrane type and its fixing methods
- chosen waterproofing system, i.e. drainage system, waterstop system, active control system

Drainage system	Waterproofing against damp soil contact and percolating water with single layer membranes without compartments. This system is not resistant against water under hydraulic pressure.
Waterstop system	Waterproofing against water under hydrostatic pressure, combining single layer membranes and waterstops – forming compartments (the most common standard waterproofing solution).
Active control system	Waterproofing against water under hydrostatic pressure, combined with double layer membranes and waterstops – compartments (allows highest security of water tightness – continual monitoring and vacuum testing).

Active control system:



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The following installation procedures are divided into the different operations that are applicable on each different kind of waterproofing project. The precise operational sequences must then be defined according to the project design and its specification requirements.

Membrane installation sequences:

Single layer or double layer membrane system	
Open with free access to external walls: • without retaining walls • with retaining walls (apart from the structure)	Installation sequence of the membrane is in two phases: 1. lining below the basement slab • cast in place concrete structures (slab, walls, roof) 2. lining of walls and roof
Internally without access to external walls: • diaphragm walls, secant pile walls • driven or cast pile walls	Installation sequences of membrane in one phase: • lining below basement and at retaining walls • cast in place basement, wall- and roof structure

Subject to other local requirements, the specification of the membrane thickness is according to estimated immersion depth and consequent potential water pressure.

	membrane thickness
Moisture and water ingress (to be combined with a drainage system)	1.6 mm
Hydrostatic pressure 0m - 10m	1.6 mm
Hydrostatic pressure 10m - 20m	2.0 mm
Hydrostatic pressure exceeding 20m	3.0 mm

2. PRODUCTS

2.1 Product characteristics

	Sikaplan® WT 1200 - 16C (Sarnafil® TG 68 - 16)	**Sikaplan® WT 1200 - 20C** (Sarnafil® TG 68 - 20)	**Sikaplan® WT 1200 - 30C** (Sarnafil® TG 68 - 30)	**Sikaplan® WT 1200 - 25CE** (Sarnafil® TG 68 - 25N)	**Sikaplan® WT 1200 - 35CE** (Sarnafil® TG 68 - 35N)
Surface	smooth			embossed	
Material	Flexible Polyolefin (FPO) membrane, stabilised with non woven fabric				
Use	waterproofing of all types of structures, situated below ground against groundwater ingress			waterproofing of all types of structures, situated below ground against groundwater ingress for double layer systems	
Colours	top layer: green / reverse layer: dark grey				
Membrane thickness and roll dimensions	according to the respective product data sheets				

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Treated	• against ageing or weathering during installation works • against aggressive influences occurring naturally in groundwater • against salt water • against accidental puncturing • against algae and micro-organisms • against hydrostatic pressure • to be resistant against root penetrations • to remain flexible at low temperatures

2.2 Ancillary products

Sikaplan® WT (FPO) laminated metal sheet

Colour of top layer	light green
Size and thickness of sheet	according to the product data sheet
Use	linear fixing of Sikaplan® WT 1200 waterproofing sheets. Metal sheets to be cut and preformed to profiles in metal workshop

Sikaplan® WT Disc PE

Colour	grey
Size	according to the product data sheet
Use	spot fixing of Sikaplan® WT 1200 waterproofing sheets in vertical areas

Waterstop FPO (PE), type MP AF / MP DF

Colour	grey
Size	according to the product data sheet
Use	compartments and linear fixings of Sikaplan® WT 1200 waterproofing sheets exposed to groundwater under hydrostatic pressure

Sikadur® - Combiflex joint sealing strips

Colour	grey
Size	according to the product data sheet
Use	joint sealing strips, bonded with Sikadur® -31 epoxy adhesive on concrete for compartments and linear fixings of Sikaplan® WT 1200 waterproofing sheets exposed to groundwater under hydrostatic pressure

Sikaplan® WT Control Socket PE

	Sikaplan® WT Control Socket PE
Colour	yellow
Size	according to the product data sheet
Use	access pipe for control of water-tightness and injection of compartment waterproofing system, incl. control-tubes, connecting pipes, etc.

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Sikaplan® WT protection sheets

	Sikaplan® WT Protection sheet - …H	Sikaplan® WT Protection sheet -…HE
Material	FPO membrane, homogeneous, not bitumen resistant	
Use	Protection of installed waterproofing membrane against mechanical damage	
Colours	grey	grey, surface embossed
Sheet thickness and roll dimensions	according to the respective product data sheets	

Cleaner

	Sarnafil T Clean	Sarnafil T Prep
Material	solvent	
Use	cleaning of dirt contaminated membrane surfaces	
Colours	clear liquid	
Application	according to the respective product data sheets and material safety data sheets	

3. INSTALLATION

3.1 General background information for installation

The installation of Sikaplan® WT waterproofing sheets must only be carried out by skilled and experienced waterproofing contractors that are trained in the installation and welding of Sikaplan WT membranes.

In finalising their proposals the waterproofing contractor and Sika® must have the opportunity to inspect the site conditions beforehand.

Installation works must be performed in dry weather conditions and the ambient temperature should be at least min +5°C.

Membrane rolls, geotextile rolls, etc. must be stored in horizontal positions in dry areas and protected against exposure to weathering on site.

In order to prevent damage of the installed waterproofing membrane, other trades and personnel must be prevented from having access to the installation area of the site both during and immediately following the waterproofing works.

Waterproofing contractors personnel should wear suitable shoes with rubber soles for walking on installed membranes. Smoking and open flames must not be permitted. Heat welding machine operators must be fully trained and instructed in the safe use of electrical equipment for site welding procedures.

In order to prevent mechanical damage by third parties, the installed membranes must be temporarily protected and/or must be kept closely monitored until their final protective covering is applied or the structure is cast in concrete.

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3.2 Substrate preparation

Substrate surfaces of below foundation slabs
The surface of the concrete or mortar must be smooth (steel trowel finish) and edges / corners must be rounded with min. radius 5cm. Any projections from the cementitious substrate should be removed by chiselling and grinding; any formwork nails, tie-wires or loose stones must be removed. Protective mortar layer thickness must be min. 5cm, with light reinforcement if necessary, that must be covered min. 3cm. The maximum aggregate diameter of mortar screeds should not exceed 4mm. All substrate surfaces must be thoroughly cleaned using high pressure water. Any ponding water must be removed and the whole surface dried using compressed air if necessary.

Substrate surfaces on refurbished concrete structures
Old linings, as well as debonded renders and screeds must be removed.
Larger cracks and honeycombing must be broken out and reprofiled with appropriate Sika repair mortar. Water infiltration to the surface must be sealed, either with waterproofing mortar, or by injection with Sika Injection acrylic resins or micro-fine cement grouts. New rendering and screeds should be applied on blast cleaned substrates, its maximum aggregate diameter should not exceed 4mm and its surface should be steel-trowel finished. Edges must be chamfered. The whole surface should be thoroughly cleaned using high pressure water.
Any ponding water must be removed and the whole surface should be dried using compressed air.

Substrate surfaces for new concrete structures
The surfaces of the concrete must be smooth (steel trowel finish, resp. first class formwork quality) and edges must be chamfered. Reinforcement steel bars should be covered min. 3cm. Any projections from the cementitious substrate should be removed by chiselling and grinding; any formwork nails, tie-wires or loose stones must be removed. Protective mortar layer thickness must be min. 5cm, with light reinforcement if necessary, that must be covered min. 3cm. The maximum aggregate diameter of mortar screeds should not exceed 4mm. All substrate surfaces must be thoroughly cleaned using high pressure water. Any ponding water must be removed and the whole surface dried using compressed air if necessary.
Substrate preparation procedure prior to application of Sikadur® -31 EP adhesives must be according to the relevant product data sheet.

Substrate surfaces of shotcrete / gunite
Unevenness of a shotcrete surface must not exceed the ratio of length to depth of 5 : 1 and its min. radius must be 20cm. The shotcrete surface must not contain broken aggregates. Local water infiltration, should be sealed either with waterproof plugging mortar, or drained with perforated hoses.
If the above requirements can not be fulfilled, it is recommended to apply a fine gunite layer on the shotcrete surfaces with a min. thickness of 5cm and an aggregate dia. not exceeding 4mm.
Steel elements (girders, purlins, reinforcement mesh, anchors etc.) must be covered min. 3cm. The surface of the shotcrete or gunite must be clean and free of loose debris (no loose stones, nails, wires, etc.).

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3.3 Protective layer

The waterproofing membranes being installed must be protected against hard substrates with a geotextile cushioning layer. The geotextile must be based on of Polypropylene non woven fabric, needle punched, or thermally cured (chemically cured geotextiles are not compatible with membranes and therefore should not be used). The geotextile must have min. unit weight of 500g/m^2 for use on smooth concrete substrate. Geotextiles must be loose laid and must be overlapped min. 100mm on horizontal areas and be free of loose materials. The physical properties of geotextile must fulfil the requirements of any relevant local standards for the protection of membrane waterproofing systems.

3.4 General membrane installation recommendations

The installation procedure for waterproofing membranes depends on the:

- excavation method (open cut / internal)
- project design
- chosen membrane type and its fixing methods
- chosen waterproofing system (single layer / double layer)

As an outline guide the following work sequences can be considered normal practise:

Open cut excavation system:
The structure is built in an excavated space with free access to the edges of slabs and external walls, or excavation is retained with driven steel piles with working space between external walls and the retaining walls. Membrane installation performed in two phases:

1. below basement slab, prior to concreting
2. to external walls

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1st phase (horizontal)

- installation of geotextile on prepared substrate
- installation of waterproofing membrane, incl. details
- installation of 2nd layer waterproofing membrane, incl. details (if specified)
- formation of compartments (if specified)
- preparation of membrane edges for overlapping and welding to waterproofing at walls - installation of protective layer on membrane

Construction of basement slab and walls; installation of waterstops (if specified)

2nd phase (vertical)

- installation of geotextile
- installation of membrane, incl. details and welding of membrane at prepared slab-wall junction
- installation of 2nd layer waterproofing membrane, incl. details (if specified)
- protective layer on installed membrane as specified

Diaphragm Walls/Shafts: internal working space only systems:

The structure is built in excavated space, retained with secant pile walls, or diaphragm walls.
Membrane installation performed in one phase: below the basement slab (horizontal), and onto the retaining walls (vertical), prior to the pouring of the concrete slab and wall structures.

horizontal

- installation of geotextile on prepared substrate
- installation of waterproofing membrane, incl. details
- installation of 2nd layer waterproofing membrane, incl. details (if specified)
- formation of compartments (if specified)
- preparation of membrane edges for overlapping and welding waterproofing at walls - installation of protective layer on membrane

vertical

- installation of geotextile
- installation of membrane, incl. details and welding of membrane at prepared slab-wall junctions
- installation of 2nd layer waterproofing membrane, incl. details (if specified)
- formation of compartments (if specified)

Construction of the basement slab and walls on to the completed waterproofing
The above mentioned guidelines are divided into different operations with various fixing options, applicable according to the design of each project. The operational sequences should always be precisely defined according to the individual project requirements.

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3.5 Waterproofing termination detail

Where not specified in the relevant standards, waterproofing must be terminated min. 1.00m above max. groundwater level and min. 0.15m above ground level. The vertical waterproofing should be linear fixed at terminations at the top of the loose hanging membranes if the height does not exceed 4.00m (exception: compartment systems with waterstops). Waterproofing, which exceeds 4.00m height, requires intermediate linear, or spot fixings at max. vertical distances of 2.00m.

With Sikaplan® WT (PE) laminated metal sheets
Unrolling and positioning of the geotextile protective layer, overlapped 100mm and fixed with Sikaplan® WT laminated metal sheet profiles and left loose hanging on the wall. Mounting of Sikaplan® WT laminated metal profiles (size 165mm x 2000mm, twice folded, mounting holes ø 5mm, at 150mm centres). The top level of the profile must be positioned min. 1.00m above the max. groundwater level and min 0.15m above ground level.
Between each profile there should be a gap of 5mm. The profiles must be fixed with countersunk screws (dia. 4.5mm/lenght 20mm, stainless steel) or dowels into the reinforced concrete. The gaps between profiles must be covered with 20mm - adhesive tapes. The profiles must not go across expansion joints.
The gap between the concrete surface and the profiles must be sealed with a permanently elastic polyurethane based sealant (i.e. Sikaflex® -11FC).
The optimum bonding of sealants requires the application of a suitable Sika® primer.
Once the membrane is fixed by the profiles the waterproofing must be protected against UV-light and mechanical damage.

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With Aluminium-sheet metal, folded to profiles (supplied by others):
Unrolling and positioning of geotextile protective layer, overlapped at edges with 100mm and temporarily fixed into the substrate (i.e. with nails).
Unrolling and positioning of the waterproofing membrane, min. 80mm overlapped heat-welded, and temporary fixed to the substrate (i.e. with adhesive tapes).
Mounting of Aluminium-profiles (size 1.5mm x 40mm x 4000mm, twice Folded, mounting holes ø 5mm, at 150mm centres). The top level of the profiles must be positioned min. 1.00m above max. groundwater level and min 0.15m above ground level. Between each profile should be a gap of 5mm. The profiles must be fixed with stainless steel screws (dia. 4.5mm/lenght 20mm) or dowels into reinforced concrete. The gaps between the profiles must be covered with 20mm-adhesive tapes. The profiles must not cross expansion joints. The gap between the concrete surface and the profiles must be sealed with a permanently elastic polyurethane based sealant (i.e. Sikaflex® -11FC). The optimum bonding of sealants requires the application of a suitable Sika primer. Once the membrane is fixed with the profiles, the waterproofing membranes must be protected against UV-light and mechanical damage.

Caution: due to the incompatibility of Aluminium metal with alkaline surfaces such as concrete, cement or mortar, the mounted profiles must not be in direct contact with any cementitious substrates.

With Sikaplan® W flat profile 30/4 V4A:
Unrolling and positioning of geotextile protective layer, overlapped at edges with 100mm and temporarily fixed into substrate (i.e. with nails).
Unrolling and positioning of the waterproofing membrane, min. 80mm overlapped heat-welded, and temporarily fixed on substrate (i.e. with adhesive tapes).
Mounting of Sikaplan® W flat profile 30/4 V4A (size 4mm x 30mm x 2000mm). The top level of the profile must be positioned min. 1.00m above max. groundwater level and min 0.15m above ground level.
Between each profile must be a gap of 5mm. The profiles must be fixed with countersunk screws (stainless steel) or dowels into reinforced concrete.
The mounted profiles must not cross expansion joints. The gap between the concrete surface and the profiles must be sealed with a permanently elastic polyurethane based sealant (i.e. Sikaflex® -11FC). The optimum bonding of the sealant on the substrate requires the application of a suitable Sika primer. Once the membrane is fixed with the profile, the waterproofing must be protected against UV-light and mechanical damage.

Welded at Waterstop WT (PE), type MP AF / MP DF:
Mounting of Waterstop FPO (PE), type MP AF / MP DF, with the flat side facing the formwork, seams (also for T- junctions- and expansion joints-elements) heat welded. The top level of the waterstop must be min. 1.00m above max. groundwater level and min. 0.15m above ground level. After concreting works, unrolling and positioning of the geotextiles, provisionally fixed (i.e. with adhesive tapes), resp. terminated under waterstops and loose hanging. The flat surface of the waterstops must be clean, free of dust, cement, mortar, oil or grease etc. Heat welding of waterproofing membranes onto the waterstops (membrane loosely hanging). Cleaning of surface of waterstop and membrane to be welded with Sarnafil® Cleaner prior to welding. Once the membranes are fixed to the waterstops, the waterproofing must be protected against UV-light and mechanical damage.

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Welded at bonded Sikadur® - Combiflex joint sealing strips:
Bonding of Sikadur® Combiflex joint sealing strips with Sikadur® -31 EP adhesive on prepared concrete substrates. Preparation of substrate according to product data sheet for Sikadur® -31 adhesive.
The top level of the bonded strip must be min. 1.00m above max. groundwater level, min. 0.15m above ground level. After the bonding works, unrolling and positioning of the geotextiles, provisionally fixed (i.e. with adhesive tapes), resp. terminated under bonded joint strips and loose hanging. The exposed surface of the bonded strips must be clean, free of dust, remains of cured EP adhesive,.oil or grease etc. The surfaces of Sikadur® Combiflex joint sealing strips and of Sikaplan® WT 1200 must be activated with Sarnafil Cleaner immediately prior to the heat welding. Heat welding of waterproofing membranes onto the exposed part of the bonded Combiflex joint strips (membrane loose hanging).
Once the membrane is welded to the Combiflex joint strips, the waterproofing must be protected against UV-light and mechanical damage.

3.6 Fixings on vertical areas

Intermediate fixings on walls:
Required for wall heights, exceeding 4.00m and for compartment systems

With Sikaplan® WT (PO) laminated metal sheets:
Mounting of Sikaplan® WT laminated metal sheets, cut to profiles. (size 100mm x 2000mm / mounting holes ø 5mm, at 150mm centres).
The profiles must be fixed in horizontally and at a vertical distance of max. 2.00m on the loose hanging geotextile. Between each profile must be a gap of 5mm. The profiles must be fixed with countersunk screws (dia. 4.5mm/length 20mm, stainless steel) or dowels into reinforced concrete.
The gaps between the profiles must be covered with 20mm-adhesive tapes.
The profiles must not cross expansion joints.
Heat welding of the waterproofing membrane onto the mounted Sikaplan® WT laminated metal profiles.

Onto Waterstop WT (PE), type MP AF / MP DF
Mounting of Waterstop FPO (PE), type MP AF (FPO / one sided ribbed) with the flat side fixed to the formwork, seams (also cross junctions and for expansion joints) heat welded. The positioning of the waterstops must be according to the engineers compartment design details. After concreting works, unrolling and positioning of the geotextiles, provisionally fixed (i.e. with adhesive tapes), resp. terminated under waterstops and loose hanging. The flat surface of the waterstops must be clean free of dust, cement,.oil or grease etc. Heat welding of the waterproofing membrane onto the waterstops (membrane loose hanging).

Onto bonded Sikadur® - Combiflex joint sealing strip:
Bonding of Sikadur® - Combiflex joint sealing strips with Sikadur® -31 EP adhesive on prepared concrete substrates. Preparation of substrates according to product data sheet for Sikadur® -31 adhesive.
The positioning of the bonded strips must be according to the engineers compartment design. After bonding works, unrolling and positioning of the geotextiles, provisionally fixed (i.e. with adhesive tapes), resp. terminated under bonded joint strip and loose hanging. The exposed surface of the bonded strips must be clean, free of dust, remains of cured EP adhesive, oil or grease etc.. The surfaces of Sikadur® Combiflex

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joint sealing strips and of Sikaplan® WT 1200 must be activated with Sarnafil® Cleaner immediately prior to the heat welding. Heat welding of waterproofing membrane onto the exposed part of bonded Sikadur® - Combiflex joint strip (membrane loose hanging).

Spot fixing with Sikaplan® WT Disc onto shotcrete / gunite
Fixing of Sikaplan® WT Disc discs (ø 90mm) on geotextile into shotcrete / gunite, or concrete The geotextile is also fixed with this operation.
The fixing of the discs is by nail guns into the shotcrete, or with dowels into predrilled holes in the concrete (i. e. Hilti DX nail gun system / Hilti type DX nail / washer and compatible cartridges). There should be min. two fixings for each membrane roll width horizontally and every 2.00m vertically. Heat welding of the waterproofing membranes onto the fixed discs.

Spot fixing with suspension straps made of Sikaplan® WT 1200 membrane:
Cut straps of Sikaplan® WT 1200 membrane from the roll (size approx. 50mm x 200mm). Fixing of Sikaplan® WT 1200 membrane straps on geotextile into shotcrete / gunite, or concrete. The geotextile is also fixed with this operation.
The membrane straps are fixed with nail guns into the shotcrete, or with dowels into predrilled holes in the concrete (i. e. Hilti DX nail gun system / Hilti type DX nail / washer and compatible cartridges). There should be min. two fixings for each membrane roll width horizontally and max. every 2.00m vertically. Heat welding of the waterproofing membrane onto the fixed straps.

Fixings on vertical corners

With Sikaplan® WT (PE) laminated metal strips:
Mounting of Sikaplan® WT laminated metal sheets, cut to strips (size 100mm x 2000mm, preformed to L-shapes 50mm x 50mm, mounting holes ø 5mm, at150mm centres in each section). Between each profile must be a gap of 5mm.
The profiles must be fixed with countersunk screws (dia. 4.5mm/lenght 20mm, stainless steel) or dowels over the geotextile into reinforced concrete.
The gaps between the profiles must be covered with 20mm-adhesive tapes.
Heat welding of the waterproofing membrane onto the mounted profiles.

With Aluminium-metal strips (supplied by others) in membrane overlaps:
Mounting of Aluminium-strip (size 4mm x 20mm x 4000mm, edges rounded, mounting holes ø 5mm, at 150mm centres) at the edge (seam overlaps) of each waterproofing membrane roll. Between each profile must be a gap of 5mm. The profiles must be fixed with countersunk screws (dia. 4.5mm/lenght 20mm, stainless steel) or dowels into reinforced concrete. Heat welding of the overlapping membranes over the fixings.

3.7 Waterproofing details on vertical area

Membrane junctions between horizontal and vertical areas (prayer seams):
Below foundation slabs (suitable for single layer waterproofing only):
Loose layout and heat welding of waterproofing membrane (horizontal) over the geotextile and the blinding below the foundation slab. The edge of the membrane must extend approx. 1.00m over the intersection line.
Loose layout of geotextile strip (width approx. 0.40m) at the intersection line on the installed membrane. The extended membrane part should be lapped over the

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geotextile strip as a provisional loop and heat welded on the previously installed waterproofing membrane. After the formation of the compartments, loose layout the geotextile on the prepared waterproofing membrane (incl. over the provisional loop), to be itself overlaid with PE foil 0.30mm. Its overlaps sealed with adhesive tapes, or alternatively with Sikaplan® WT protection sheets.
Application of protective mortar layer on the PE-foil (cement min. 300kg / m³, aggregate ≤ ø 4mm, thickness min. 5cm). Once the concreting works of both slab and walls are completed, the protective layers (mortar screed, geotextile) can be carefully removed. The provisional loop of membrane should be cut off and the geotextile strip removed. Heat welding of the vertical waterproofing membrane onto clean membrane from the horizontal waterproofing. The protective layers over this finished seam are then reformed as the base for the protective waterproofing layers for the walls.

At retaining walls, or on the formwork of the foundation slab:
Loose layout and heat welding of waterproofing membrane (horizontally) over the geotextile and the mortar screed below the foundation slab. The temporary edge of the membrane should extend vertically up 0.50m above the surface level of the foundation slab and be fixed temporarily on the retaining walls or on the formwork from the foundation slab. If a double layer waterproofing system is required, install second layer of waterproofing membrane.
After formation of compartments, loose layout the geotextile on the prepared waterproofing membrane, which is overlaid with PE foil 0.30mm, its overlaps sealed with adhesive tapes, or alternatively with Sikaplan® WT protection sheets.
Application of protective mortar layer (cement min. 300kg / m³, aggregate ≤ ø 4mm, thickness min. 5cm).

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Membrane penetrations:
Waterproofing details at penetrations (pipe-/anchor steel flanges, etc.) as supplied must be fixed by others prior to the membrane waterproofing works.
The surface of steel must be smooth, clean and free of oils and grease. Creation of sealing rings (min. one piece each penetration), made of waterproofing membrane. Cut to size according to the size of flange. Cut an opening in the waterproofing membrane, its size must be equal to the size of the penetration. Overlapping seams of membrane must be bypassed around penetrations by using separate membrane pieces. Do not allow membrane overlaps within flanges. Membranes must be welded outside of flanges, when double layer membrane systems have to be installed.
The prepared sealing ring must be heat welded on the waterproofing membranes within the flanges. Holes of equal diameter to the bolts must be punched through both, the membrane and the sealing ring, exactly at the locations of the bolts.
The prepared pieces of waterproofing membrane, incl. welded sealing rings must then be slipped over the base flange and be fixed to the pressure flanges (the membranes must not be loose or creased and the membrane sealing rings must not be 'fish-mouthed').

Bridging over expansion joints:
Mounting of support steel over expansion joints in walls and on roof slabs below ground (for waterproofing of structures without compartment systems only):
One sided mounting of stainless steel sheets (size 200mm x 2000mm,fixing-holes, dia. 5mm, at 150mm centres).
The one-sided fixings must be made with countersunk screws or dowels (dia. 4.5mm / 20mm length / stainless steel). Between the metal sheets should be a gap of 2 - 3mm, which must then be covered with 20mm adhesive tape.

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3.8 Installation of waterproofing membranes

Vertical waterproofing:
Check surfaces of geotextiles and mounted metal profiles etc. for loose debris or sharp projections prior to membrane installation.
Membranes must be unrolled and installed vertically on walls according to the selected fixing method:

- FPO - laminated metal strips / profiles: heat welding of waterproofing membrane on laminated metal strips
- Aluminium-profiles: acc. to separate description
- Aluminium-strips: acc. to separate description
- Sika® Discs (PE): acc. to separate description
- Surface waterstop: acc. to separate description
- Bonded joint sealing strips: acc. to separate description.

Operational sequences:

1. cut the membranes to the approx. size required
2. consider min. 80mm membrane overlaps
3. fix membranes with the selected fixing method at terminations and at intermediate fixing points on the wall
4. repeat 1. - 3. with next membrane roll
5. heat welding of vertical overlaps working from bottom to top
   welding of installed membrane at prepared details (i.e. penetrations)
6. repeat 1. – 5. for second layer, if a double layer membrane system is specified

Horizontal waterproofing:
Check surfaces of geotextiles and mounted metal profiles etc. for loose debris and sharp projections prior to membrane installation.
Irregular shapes of basement slabs need special consideration of the membrane laying direction on the bottom (i.e. to use the most optimised regarding cutting losses and membrane consumption)

Operational sequences:

1. cut the membranes to the approx. size required
2. consider min. 80mm membrane overlaps
3. unroll and position the membrane allowing for membrane laps at edges for intersection with the vertical waterproofing
4. temporary ballasting of positioned membrane (i.e. with sand bags)
5. repeat 1. - 4. with next sheet
   welding of membrane overlaps
   welding of installed membrane at prepared details (i.e. penetrations)
   welding of membrane laps with vertical waterproofing at edges of basement slabs
6. repeat 1. – 5. for second layer, if a double layer membrane system is specified

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3.9 Compartment waterproofing systems with Waterstop FPO (PE), type MP AF:

Waterstop FPO (PE), type MP AF for compartments, must be made of heat weldable FPO, compatible with the Sikaplan® WT FPO waterproofing membrane and profiled with ribs on one side, alternatively they can made from bonded joint strips based on FPO. Dependent on the type of structure the waterproofing membranes must either be heat welded on to the surface waterstops or bonded strips , alternatively the surface waterstops must be heat welded onto the waterproofing membranes:

	open excavation	**shafting / internally fined**
Basement slabs	waterstop on membrane	waterstop on membrane
Walls	membrane on waterstop	waterstop on membrane
Roof slabs	membrane on bonded tape (Sikadur® - Combiflex system)	membrane on bonded tape (Sikadur® -Combiflex system)

For single layer waterproofing system, each separate compartment area in the waterproofing should not exceed 150m².
As they are dependent on the type of structure and construction schedule, the layout and positioning of waterstops, resp. bonded joint sealing strips must be designed and detailed by the engineer Surface waterstops, to be prepared and fixed during concreting works, must be fixed firmly on the formwork. Cross- and T-junctions of waterstops should be prefabricated in factory workshops by skilled welding techniques.

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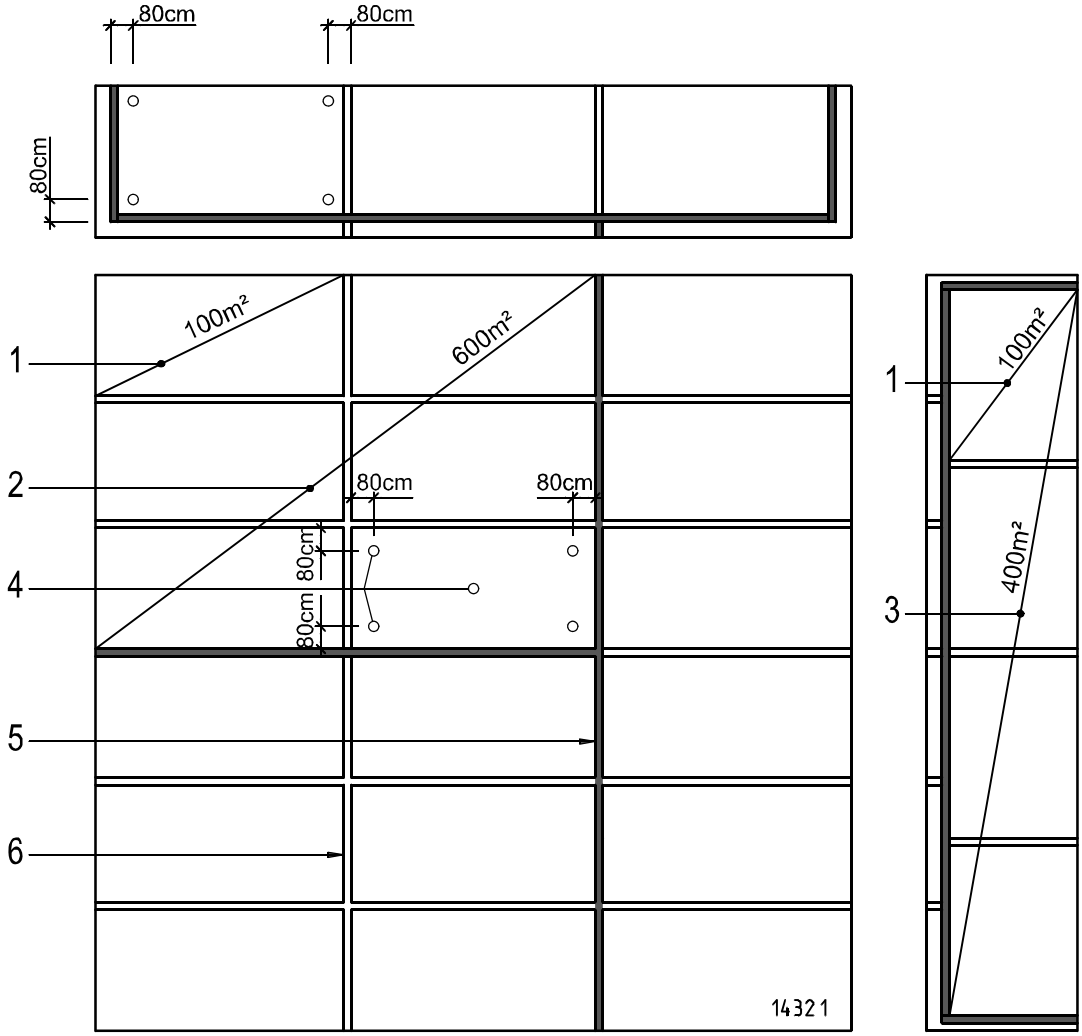
For double layer waterproofing systems, the compartments must be produced according to the following:
As they are dependent on the type of structure and the construction schedule, the layout and positioning of waterstops must be designed and detailed by the engineer

Surface waterstops, to be prepared and installed during the concreting works, must be fixed firmly on the formwork.

1. individual compartments between membrane layers: should not exceed an area of 100m^2
2. compartments with waterstops on the top layer of membrane: should not exceed an area of 600m^2
3. compartments with waterstops on top layer of membrane: should not exceed an area of 400m^2 on walls
4. positions of control and injection pipes
5. positions of weldings between membrane layers and waterstops
6. positions of weldings between membrane layers



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Heat welding of waterproofing membranes on flat surfaces of Waterstops, cast in concrete:

Install geotextile cushion layer on concrete substrate, provisionally fixed (i.e. with adhesive tapes), resp. terminated close to waterstop. The flat surface of waterstop must be clean (free of dust, cement, oil or grease etc). Projecting welding seams on waterstops must be trimmed with knives. The surfaces of Waterstop FPO (PE), type MP AF and of Sikaplan® WT 1200 must be activated with Sarnafil® Cleaner immediately prior to the heat welding. Heat welding of Sikaplan® WT waterproofing membranes on FPO waterstop. Strip heat welding of waterproofing membranes (with the membrane edges at both sides of the joint openings) on FPO waterstops, type MF DF for expansion joints. The remaining gap in the membrane over the joint openings must be covered a with a further membrane strip (width > 20cm) and welded on both membrane edges.

Heat welding of FPO Waterstops on installed waterproofing membranes:
The surfaces of installed membranes must be clean and free of oil and grease. The welded seams must be inspected for water tightness and the membrane edges must be chamfered (i.e. with peeling knives). Projecting welding seams on the flat reverse of the waterstops must also be trimmed with knives. The surfaces of Waterstop FPO (PE), type MP AF and of Sikaplan® WT 1200 must be activated with Sarnafil® Cleaner immediately prior to the heat welding. The FPO waterstops can be heat welded directly to membranes, if the side laps of the waterstop types used exceeds 50mm then this is by using of hand held welding tools. Direct welding of waterstops with side laps less than 50mm requires the use of semi automatic welding machines (type Leister Triac Drive).
Strips of Sikaplan® WT waterproofing membranes must be preliminary heat welded on the flat reverse of the FPO waterstops, if this welding equipment is not available and the widths of side laps are less than 50mm.
Operational steps as follows:
Heat welding of Sikaplan® WT waterproofing membrane strips (width 20cm: ≤ 10cm welding on waterstops / ≥ 10cm for subsequent welding on the waterproofing membrane) on both flat sides of the waterstop. The seams of membrane strips must be butt-jointed (no overlap seam), staggered to the waterstop joints. The prepared waterstops can then be heat welded with the remaining laps of the membrane strips.

Mounting of Sikaplan® WT Control Sockets Type PE
Allow 4 to 5 Control Sockets per 100m^{2}of area, to be positioned within each compartment for optimized control and injection procedures.
Cut holes with max. 30mm diameter into the second layer of the installed waterproofing membrane in the position of each sockets. The surface of the installed membrane must be clean and free of oil and grease. Membrane lap of Sikaplan® WT Control Socket PE must be heat welded completely around the hole. Fix the connecting pipes and control tubes to the mounted control sockets.

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Waterproofing terminations with Waterstop FPO (PE), type MP AF to pile caps:
Erect formwork around pile caps at the level of the basement slab. Mounting of Waterstop FPO (PE), type MP AF surface mounted, profiled with ribs on one side, to be fixed with the flat side on the inside of the formwork and butt joint welded.
The top level of the pile caps must not exceed the level of the waterstops. Fix reinforcement according to the engineers design. Pouring of grouting mortar (i.e. Sika® Grout), fill the space between the waterstop and concrete of pile cap. Cover top surface of pile cap with Sikadur® -42 EP mortar. After removal of formwork, the surface of waterstops must be cleaned (free from cement, oil and grease). Heat welding of waterproofing membranes onto the waterstops.

4. WELDING METHODS

Sikaplan® WT waterproofing membranes can be welded by using suitable heat welding machines:
- Seam overlaps of membranes must always be min. 80mm
- the width of the finished welded seam (single or double seam) must be at least > 30mm
- prior to welding procedure, membrane surfaces must be clean, dry and free of dust, oil and grease etc.
- The surfaces of Sikaplan® WT 1200 must always be cleaned with Sarnafil T Cleaner immediately prior to heat welding.
- prior to any heat welding work conduct a welding test on site with specific membrane specimens
  (always mandatory in order to adjust welding temperature and speed of the machine)
- for continuous welding quality, it is recommended to run welding equipment connected to its own power supply, or using its own generating set (automatic welding machine: 360V, hand held welding gun: 220V, resp. 110V according to local regulations)
- welding machine operators must be trained and experienced in heat welding technology according to local regulations and in operating electrical devices in potentially wet or humid conditions

Recommended machinery and equipment

Manual weldings:
- hand held welding gun type Leister Triac S, Triac PID, 220 V, resp. 110 V (*www.leister.com*)
- hand held welding gun type BAK Rion, 230 V (*www.bak-ag.com*)
- heat nozzles 40mm and 20mm, or 30mm all purpose-nozzle
- hand held pressure (Silicone) roller with ball bearing (available from same supplier as of welding machine), width 20mm and 40mm
- reserve heating element

Semi-automatic welding for horizontal and vertical waterproofing:
- hand held semi-automatic, self-propelled welding machine, type Leister Triac Drive, 220V, resp. 110V (adjustable temperature and speed)
  (*www.leister.com*)

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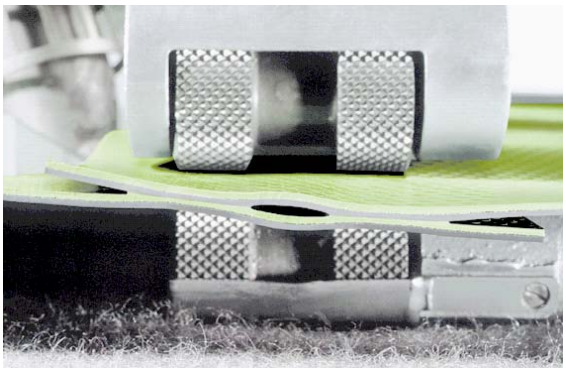
Automatic welding for horizontal and vertical waterproofing:
- automatic, self-propelled, types Leister Twinny S, Twinny T, Comet (adjustable temperature, speed and pressure), 220/380V (*www.leister.com*)
- automatic, self-propelled, types BAK Mion, Comon (adjustable temperature, speed and pressure), 230 V (*www.bak-ag.com*)



5. QUALITY CONTROL

Testing of welded seams:
All welded seams must be tested for water-tightness.
Testing methods depend on specifications and the clients requirements

Testing methods:

Visual test with screw driver:
- correctly heat welded single seams show continuous welding ‘rope’ at seam edge. Irregular, or interrupted rope can be the sign of voids or capillaries in the seam
- glide the head of screw driver (approx. size 2) with slight pressure along seam edge and check visually
- any voids or capillaries must be rectified with hand held welding gun and 20mm Silicone roller

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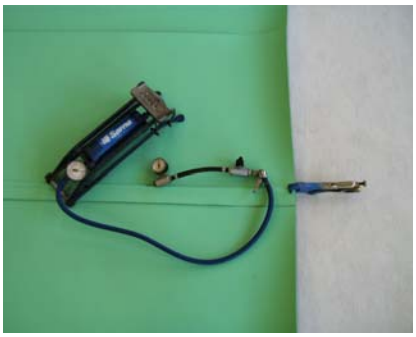
Physical testing with air pressure testing kit (for double seam weldings only):

- all double seams must be tested with the compressed air testing kit, containing testing needle, reverse flow valve, manometer gauge and air pressure pump (manual, or electric)
- close air channels with clamps at both ends of the welded seam
- insert testing needle, connected to the reverse flow valve and manometer at one membrane overlap end. Connect the testing needle to a manual, or electric compressed air pump.
- inflate air channel until pressure of 2.0 bar is achieved. Close reverse flow valve. Disconnect hose from testing needle. Check air pressure 20 minutes after inflation procedure.
- the welded seam can be regarded as tight, if the pressure decrease is less than 20%. Release clamps from membrane ends. Heat weld membrane patches over membrane penetrations, caused by insertion of testing needles, using hand held welding machine. Sign approved and tight seams with marking pen. Note the test details in site records. Repeat this procedure at all double seams.
- if testing of double seam welds fails, inflate the double seam again and search for leaks. Once detected, repair with membrane patches to be heat welded with hand held welding machines.
- any voids or capillaries must be rectified with hand held welding gun and 20mm Silicone roller at welding temperature



Physical test with air pressure
(*www.leister.com*)

Physical test with vacuum bell
(*www.herz-gmbh.com*)

This test requires the following from the testing kit :

- vacuum bell (Plexiglas, metal frame with rubber-pressure lips, reverse flow valve, manometer gauge, hose connection)
- vacuum pump
- soap solution
- marking pen (chalk pen only)

Test procedure:

- apply soap solution over seam edge within the range of vacuum bell
- press vacuum bell over area, treated with soap solution and build-up vacuum
- visual check of seam under vacuum (bubbling soap solution shows a leak)
- remove vacuum bell and clean seam with clean rags
- any leaks must be rectified with hand held welding guns and 20mm Silicone rollers at normal welding temperatures

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6. CLEANING AND INSPECTION OF COMPLETED WORK

The membrane surfaces must be cleaned and inspected before installation of The waterstops, control and injection pipes or protective layers over the membrane. This can be performed when one section of the waterproofing is completed, or after completion of the whole area.
The waterproofing contractor and the client's representatives must both inspect the completed works. The inspection should be recorded in a written report to be signed by both parties.
The waterproofing contractor should keep original labels (incl. batch No.) of delivered and installed membrane rolls, plus copies of these Joint site inspection records in his files.

7. PROTECTION OF WATERPROOFING

Preparatory works prior to installation of protection layers on completed waterproofing: The membrane surfaces for the protective measures must be clean (free from loose stones, sand, construction waste, etc.).

The installation of waterstops and control- and injection pipes (if a compartment system is specified) must also first be completed and the welded seams tested and approved.

Open cut excavation

Under basement slabs:
- loose layout of geotextile 500g/m², min. 100mm overlapped.
  Waterstops for compartments should be kept unprotected.
  Use provisional ballast for geotextile with sandbags
- as an alternative, loose layout of Sikaplan® WT protection sheets min. 80mm overlapped.
  Waterstops for compartments should be kept unprotected.
  Use provisional ballast on protection sheets with sandbags
- loose layout of Polyethylene foil 0.30mm as separation-/slip layer on geotextile, overlap 100mm to be sealed with adhesive tapes
- application of protective mortar layer (cement min. 300kg/m³, thickness min. 50mm, reinforced with wire mesh if required). The waterstops of compartments must be left unprotected/exposed.

On the external walls:
- geotextile 500g/m², 100mm overlapped, suspended from the top and free hanging
- as an alternative, Sikaplan® WT protection sheets 80mm overlapped, suspended on top and free hanging
- bed and erect brickwork carefully but firmly on the waterproofing
- alternatively use gunite, thickness min. 50mm, with light reinforcement mesh, faced with glassfleece suspended from the top

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On roof slabs below ground:
- loose layout of geotextile 500g/m², min. 100mm overlapped. Use provisional ballast for geotextile with sandbags
- as an alternative, Sikaplan® WT protection sheets, min. 80mm overlapped. Use provisional ballast for protection sheet with sandbags
- loose layout of PE foil 0.30mm as separation-/slip layer on geotextile, overlap 100mm to be sealed with adhesive tapes
- application of protective mortar layer (cement min. 300kg/m³, thickness min. 50mm, if necessary use reinforced wire mesh).

Diaphragm Walls / Shafts / Internally

Below basement slabs:
- loose layout of geotextile 500g/m², min. 100mm overlapped. Waterstops for compartments must be kept unprotected. Use provisional ballast for geotextile with sandbags
- as an alternative, loose layout of Sikaplan® WT protection sheets min. 80mm overlapped. Waterstops for compartments must be kept unprotected. Use provisional ballast for protection sheets with sandbags
- loose layout of Polyethylene foil 0.30mm as separation-/slip layer on geotextile, overlap 100mm to be sealed with adhesive tapes
- application of protective mortar layer (cement min. 300kg/m³, thickness min. 50mm, use reinforced wire mesh if required). The waterstops of compartments must be kept unprotected / exposed

On retaining walls:
- direct placing of concrete on the waterproofing membrane
- formwork for construction-/expansion joints requires a soft medium at the membrane surface (i.e. plastic hose, cut length ways and capped over the formwork edges)
- Reinforcement bars must be held with spacers min. 50mm from the membrane surface
- Provisional layout of non-combustible mineral wool insulation boards to protect the membrane against sparks from steel welding works
- for special cases or on request, gunite protective layer, thickness min. 50mm, reinforced with suspended light mesh and glassfleece (waterstops for compartments must be kept free).

On roof slabs below ground:
- loose layout of geotextile 500g/m², min. 100mm overlapped Use provisional ballast for geotextile with sandbags
- as an alternative, loose layout of Sikaplan® WT protection sheets min. 80mm overlapped. Use provisional ballast for protection sheets with sandbags
- loose layout of Polyethylene foil 0.30mm as separation-/slip layer on geotextile, overlap 100mm to be sealed with adhesive tapes
- application of protective mortar layer (cement dosage min. 300kg/m³, thickness min. 50mm, use reinforced wire mesh if required).

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8. PROPOSALS FOR BILLS OF QUANTITIES

PROJECT WATERPROOFING WORKS
Project: .....
Part /Lot: .....
Waterproofing system: Waterproofing of structures against external hydrostatic pressure from outside
Flexible waterproofing with Sikaplan® WT waterproofing membranes, loose laid and linear fixed with, or without a compartment system.

Specialist waterproofing contractor:
.....

pos.	scope of work	quantity	unit	unit rate	total
1.	**Installation** Supply and erecting of all scaffoldings, machinery's and equipment, required for waterproofing works, incl, demounting and removal afterwards		lump sum		
1.1.	Provision of scaffoldings		lump sum		
1.2	Provision of dewatering pumps		lump sum		
2.	**Preparation of substrates** Cleaning from dust and drying with brushes or compressed air from dust (compressed air supplied from main contractor) incl, inspection of substrate)				
2.1	Horizontal areas Horizontal and sloped areas less than 15%		m²		
2.2	Vertical areas Vertical and sloped areas above 15%		m²		
2.3	Drying of substrate Drying of substrate with warm air dryer or according to waterproofing contractor's recommendations		m²		
2.4	Removal of ponding water, cleaning and drying of wet areas with wet-and dry vacuum cleaner		m²		
2.5	Removal of cement laitance in width of 30cm by blast, cleaning or abrasive mechanical method, incl. cleaning and drying as preparation for bonding works		m'		

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pos.	scope of work	quantity	unit	unit rate	total
3.	**Protective layers** Supply and application of protective layers for the mechanical protection of Sikaplan® WT waterproofing membrane. Sikaplan® WT sheet membranes, according to engineers specifications thickness .....mm min. overlap 80mm material basis: FPO reinforced or homogenous membrane brand name:…….. type:…… Geotextiles, according to Engineers specifications unit weight .....g / m² unit weight .....g / m² min. overlap 100mm material: Polyester/Polypropylene non woven fabric, needle punched brand name…… type..... type.....				
3.1	Horizontal and sloped areas less than 15%, loose laid		m²		
3.2	Vertical and sloped areas above 15%, spotwise fixed as per manufacturers instruction		m²		
3.3	Supply and apply of separation / slip layer, according to engineers specifications unit weight .....g / m² Thickness .....mm min. overlap 100mm to be sealed with adhesive tapes material:…….. brand name:..... type.....		m²		
3.4	Supply and apply of protective mortar screed for horizontal area (cement dosage > 300kg/m³, thickness 50mm, steel trowel finish		m²		
3.4.1	Supply and apply of reinforcement mesh for protective mortar layer, ø...../.....mm		m²		

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pos.	scope of work	quantity	unit	unit rate	total
4.	**Waterproofing membranes** Single layer waterproofing Supply and application of Sikaplan® WT single layer waterproofing membrane system on based on FPO stabilized with glass fleece, according to engineers specification, overlaps min. 80mm heat welded with electr. welding machine, incl. testing of welded seams as per Sika recommendations, linear fixed at all terminations, edges and corners Materials: Sikaplan® WT Membrane thickness:.....mm Membrane type: brand name:…… type:……..... Ancillary products: Sarnafil® Cleaner Fixing elements: Sikaplan® WT FPO-laminated metal strip Aluminium profile, size…….. Sikaplan® WT Metal strips, size…… Sikaplan® WT FPO disc, dia..... Waterstops, type AF…… Sikadur® Combiflex joint sealing strips, thickness:……..mm				
4.1.1	Horizontal and sloped areas less than 15%, loose laid, overlaps heat welded, excl. fixings		m²		
4.1.2	Vertical and sloped areas above 15%, installed as per Sika's recommendation, excl. fixings		m²		
4.1.3	Waterproofing of sumps and channels in horizontal area: effective area until max. 10m², excl. fixings		m²		

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pos.	scope of work	quantity	unit	unit rate	total
4.1.4	Waterproofing of returns and recesses in vertical areas: effective area up to max. 10m², excl. fixings		m²		
4.2	Double layer waterproofing Supply and application of Sikaplan® WT double layer waterproofing membrane system on based on FPO, stabilized with glass fleece according to engineers specification, overlaps min. 80mm heat welded then, both layers heat welded to build compartments, incl. testing of welded seams as per Sika® recommendations, linear fixed at all terminations, edges and corners Materials: Sikaplan® WT Membrane 1st layer thickness:.....mm Sikaplan® WT Membrane 2nd layer thickness:.....mm Sikaplan® WT Membrane type: type:……..... type:……..... Ancillary products: Sarnafil® Cleaner Fixing elements: Sikaplan® WT FPO-laminated metal strip Aluminium profile, size…….. Metal strips, size…… Sikaplan® WT FPO disc, dia..... Waterstops, type AF…….. Sikadur®-Combiflex joint sealing strips, thickness…..mm				
4.2.1	Horizontal and sloped areas less than 15%, loose laid, overlaps heat welded, excl. fixings		m²		
4.2.2	Vertical and sloped areas above 15%, installed as per suppliers recommendation, excl. fixings		m²		

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pos.	scope of work	quantity	unit	unit rate	total
4.2.3	Waterproofing of sumps and channels in horizontal area: effective area until max. 10m², excl. fixings		m²		
4.2.4	Waterproofing of returns and recesses in vertical areas: effective area up to max. 10m², excl. fixings		m²		
5.	**Fixing of waterproofing**				
5.1	Supply and mounting of fixing sections for waterproofing terminations, to be fixed with stainless steel screws and dowels (150mm centres) into reinforced concrete min. 1000mm above max. groundwater level, incl. sealing with permanently elastic sealants on top, or with FPO strips, bonded with Sikadur® EP-adhesive, suitable for jointing to FPO waterproofing membranes				
5.1.1	Aluminium formed profiles, size 1.5mm x 40mm, (max. length 4000mm per element), fixed with screws, ø 4.5mm x 20mm		m'		
5.1.2	FPO-laminated metal strips, size 100mm x 2000mm to be cut and formed as per required for installation on site, fixed with countersunk screws ø 4.5mm x 20mm, incl. heat welding of waterproofing membrane on Sikaplan WT FPO-laminated metal profile		m'		
5.1.3	Metal strip stainless, size 4mm x 30mm (length 2000mm each), fixed with countersunk screws, incl, overlapping with waterproofing membrane and heat welding		m'		

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pos.	scope of work	quantity	unit	unit rate	total
5.1.4	Supply and apply Sikadur® - Combiflex strips, suitable to bond with Sikadur EP-adhesive on concrete at walls, incl. bonding on prepared substrate Sikadur® -Combiflex strip, type…… size……. type of Sikadur EP adhesive ……..		m’		
5.2	Supply and mounting of fixing elements for fixings for Sikaplan® WT waterproofing membrane on vertical areas, to be fixed with stainless steel screws and dowels (centres 200mm) into reinforced concrete.				
5.2.1	Sikaplan® WT FPO-laminated metal strips, size 100mm x 2000mm, fixed with countersunk screws, ø 4.5mm x 20mm, incl. heat welding of waterproofing membrane		m'		
5.2.2	Metal strip, size 4mm x 30mm (length 2000mm each), fixed with countersunk screws, incl. overlapping of waterproofing membrane and heat welding		m'		
5.3.	Supply and mounting of fixings for the waterproofing membrane at vertical corners and edges, to be fixed with stainless steel screws and dowels (centres 200mm) into reinforced concrete				
5.3.1	Sikaplan® WT FPO-laminated metal strips, size 100mm x 2000mm, formed to angle size 50mm x 50mm, both shanks fixed with countersunk screws, ø 4.5mm x 20mm , incl. heat welding of waterproofing membrane		m'		

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pos.	scope of work	quantity	unit	unit rate	total
5.3.2	Metal strip, size 4mm x 30mm (length 2000mm each), fixed with countersunk screws, incl. overlapping of waterproofing membrane and heat welding		m'		
5.4	Supply and mounting of fixing elements for fixings of waterproofing membranes on horizontal corners and edges, to be fixed with stainless steel screws and dowels (centres 200mm) into reinforced concrete				
5.4.1	Sikaplan® WT FPO-laminated metal strip, size 100mm x 2000mm, folded to angle size 50mm x 50mm, both shanks fixed with countersunk screws, ø 4.5mm x 20mm , incl. heat welding of waterproofing membrane		m'		
5.4.2	Metal strip, size 4mm x 30mm (length 2000mm each), fixed with countersunk screws, incl. overlapping of waterproofing membrane and heat welding		m'		
5.5	Supply and mounting of fixing elements for spotwise fixings of waterproofing membrane on vertical areas, plasticised FPO –PE Discs, to be nailed with suitable nailing techniques into shotcrete, or dowels into predrilled holes into reinforced concrete (horizontal distance with 2pcs./membrane roll width, vertical spacing 2.00m)				
5.5.1	Sikaplan® WT FPO – PE Discs, ø 80mm, fixed with nail gun, incl. compatible nail and washer		pcs		

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pos.	scope of work	quantity	unit	unit rate	total
6.	**Expansion joint (without compartment system)**				
6.1	Supply and mounting of support for waterproofing membrane as bridge over joint openings with stainless steel sheet, size 1.5mm x 200mm, fixed one-side with countersunk stainless steel screws and dowels into substrate, loose layout of waterproofing membrane over sheets Type of metal sheets:.....				
6.1.1	In vertical and sloped areas above 15%		m'		
6.1.2	In horizontal and sloped areas below 15%		m'		
7.	**Compartment system**				
7.1	Supply and mounting of FPO profile as surface waterstops for construction joints, one side with flat surface, to be fixed on formwork, resp. heat welded on installed Sikaplan® WT waterproofing membrane, incl. heat welding of seams				
7.1.1	Waterbar type:..... width:.....mm		m'		
7.1.2	Cross junction pieces: type:..... prefabricated size: .....mm x .....mm		pcs		
7.1.3	T-junction: type:…… prefabricated size: .....mm x .....mm		pcs		
7.1.4	Inner corner junction, horizontal: type:..... prefabricated size: .....mm x .....mm		pcs		
7.1.5	Inner corner junction, vertical: type:..... prefabricated size: .....mm x .....mm		pcs		

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pos.	scope of work	quantity	unit	unit rate	total
7.1.6	Supply and heat welding of strips (width 20cm) of Sikaplan® WT waterproofing membrane on both reverse sides of the Waterbars (if direct welding of the waterbars on membranes not possible)		m'		
7.2	Supply and mounting of FPO profiles as surface waterstops for expansion joints, one side with flat surface, to be fixed on formwork, resp. heat welded on installed Sikaplan® WT waterproofing membrane, incl. heat welding of seams				
7.2.1	Waterstop type:..... width:.....mm		m'		
7.2.2	Cross junction: type:..... prefabricated size: .....mm x .....mm		pcs		
7.2.3	T-junction: type:..... prefabricated size: .....mm x .....mm		pcs		
7.2.4	Inner corner junction, horizontal: type:..... prefabricated size: .....mm x .....mm		pcs		
7.2.5	Inner corner junction, vertical: type:..... prefabricated size: .....mm x .....mm		pcs		
7.2.6	Welding of Sikaplan® WT waterproofing membrane strips, type:..... width 20cm on flat surface of Sika® Waterbars, prior to mounting of surface waterbars (if direct welding of Sika® Waterbars on membranes not possible)		m'		
7.3	Supply and apply of Sikadur® - Combiflex strips, bonded with EP-adhesive on horizontal areas, where Waterbar installation is not possible, strips suitable for welding onto Sikaplan® WT FPO waterproofing membranes				

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pos.	scope of work	quantity	unit	unit rate	total
7.3.1	Sikadur®-Combiflex strips, suitable to bond with EP-adhesive on concrete at walls, incl. bonding on prepared substrate and waterproofing junction with Sika® WT Waterbars AF at wall-roof junctions Sikadur®-Combiflex strip, thickness…… width……. type of Sikadur® EP adhesive ……..		m’		
7.4	Supply and mounting of Sikaplan® WT control and injection flanges, type: Sikaplan® Control Socket, according to engineers specifications, incl. mounting of control tubes and connecting pipes		pcs		
8.	**Penetrations**				
8.1	Waterproofing of penetrations, cast in structure with stainless steel fixed and pressure flanges on base of stainless steel materials, incl. production of sealing rings to size made from Sikaplan® WT waterproofing membrane, steel type:..... thickness:.....mm				
8.1.1	Well shafts ø:…….....mm ø:…….....mm		pcs pcs		
8.1.2	Pipe penetrations ø:…….....mm ø:.....mm		pcs pcs		
8.1.3	Anchor bolts ø:…….....mm ø:.....mm		pcs pcs		
8.1.4	Foundation pile caps ø…….....mm ø…….....mm		pcs pcs		

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pos.	scope of work	quantity	unit	unit rate	total
8.2	Supply and mounting of FPO profiles as surface waterstops for waterproofing of penetrations of pile caps, one side with flat surface, to be fixed on pile caps - formwork incl. butt welding then heat welding of Sikaplan WT waterproofing membrane afterwards, according to detailed specifications				
8.2.1	Waterbars type:..... width:.....mm effective length		m'		
8.2.2	Sealing of foundation pile caps with grouting mortar for the sealing between concrete and waterbar, incl. sealing of pile cap with Sikadur® EP – layer, type…… ø…….....mm ø…….....mm		pcs. pcs.		
9.	**Cleaning and inspection of installed waterproofing**				
9.1	Cleaning of installed Sikaplan® waterproofing with brushes and vacuum cleaner				
9.1.1	Horizontal and sloped areas less than 15%		m²		
9.1.2	Vertical and sloped areas above 15%		m²		
9.2	Inspection of installed waterproofing and welded seams to check watertightness, incl. repair of detected leaks by welding on Sikaplan® WT membrane patches				
9.2.1	Horizontal and sloped areas less than 15%		m²		
9.2.2	Vertical and sloped areas above 15%		m²		

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pos.	scope of work	quantity	unit	unit rate	total
10.	**Additional works (Day work rates)**				
10.1	Waterproofing contractor's personnel				
10.1.1	Resident Project Engineer / Contracts Manager		h		
10.1.2	Skilled waterproofing Installer		h		
10.1.3	Labourer		h		
10.2	Material				
10.2.1	Sikaplan® WT Waterproofing membrane type: ……		m²		
10.2.2	Sikaplan® WT Protection layer type:		m²		
10.2.3	Fixings: Sikaplan® WT laminated metal strip, type……		m'		
10.2.4	Fixings: stainless steel strip, type/size……		m'		
10.2.5	Fixings: Sikaplan® WT disc, dia……../ type……		pcs		
10.2.6	Waterstops, type ……		m'		
10.2.7	Control- and injection flanges, type:…….		pcs		
10.2.8	Sarnafil Cleaner		lt		
10.3	Hire of equipment / tools				
10.3.1	Hire of el. heat welding gun (hand welder and pressure roller)		h		
10.3.2	Hire of el. heat welder (automatic)		h		
10.4.1	Hire of el. submersible pump .....l/min.		h		
10.4.2	Hire of compressor.....l/min.		h		
10.4.3	Hire of el. generating set.....V		h		
10.4.4	Hire of el. switch box		h		
10.4.5	Hire of movable scaffolding/staging		h		

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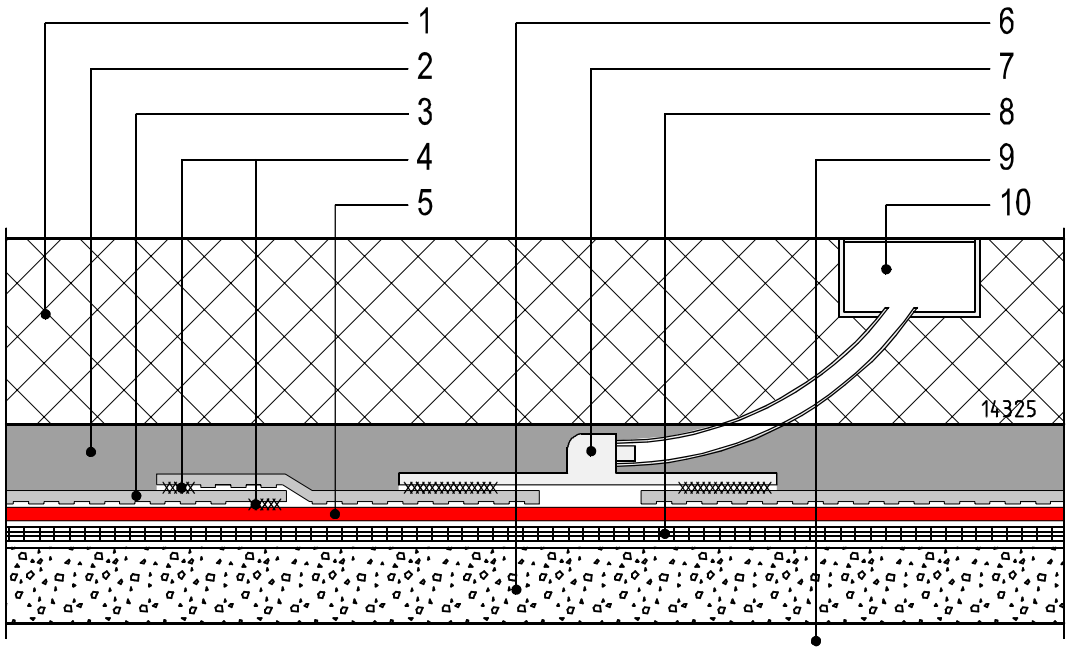
Construction

9. Standard details

Basement Slab assembly with Sika Control Socket:



1 Reinforced concrete
2 Protective mortar screed
3 Protective layer: geotextile PP 500 to 1000 g/m^2 and separation- / slip layer PE film, thickness > 0.20mm,
or alternatively Sikaplan® WT protection sheet –HE
4 Heat welding Sikaplan® WT protection sheet (embossed surface)
5 Waterproofing: Sikaplan® WT 1200 waterproofing membranes
6 Substrate: blinding concrete
7 Sikaplan® WT Control socket PE
8 Protective layer: geotextile PP 500 to 1000 g/m^2
9 Consolidated ground
10 Control box

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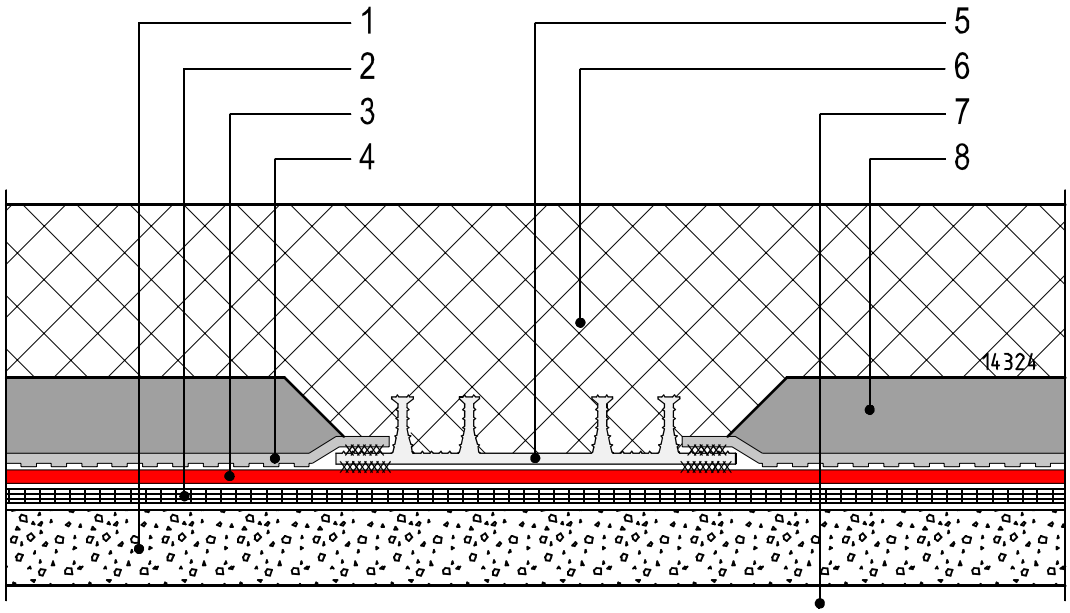
Construction

Waterstop detail for compartments below basement slab



1 Substrate: blinding concrete
2 Protective layer: geotextile PP 500 to 1000 g/m^2
3 Waterproofing: Sikaplan® WT 1200 waterproofing membranes
4 Protective layer: geotextile PP 500 to 1000 g/m^2 and separation- / slip layer PE film, thickness > 0.20mm,
or alternatively Sikaplan® WT protection sheet -HE
5 Compartment with FPO waterstop: Waterstop FPO (PE), type MP AF
6 Reinforced concrete
7 Consolidated ground
8 Protective mortar screed

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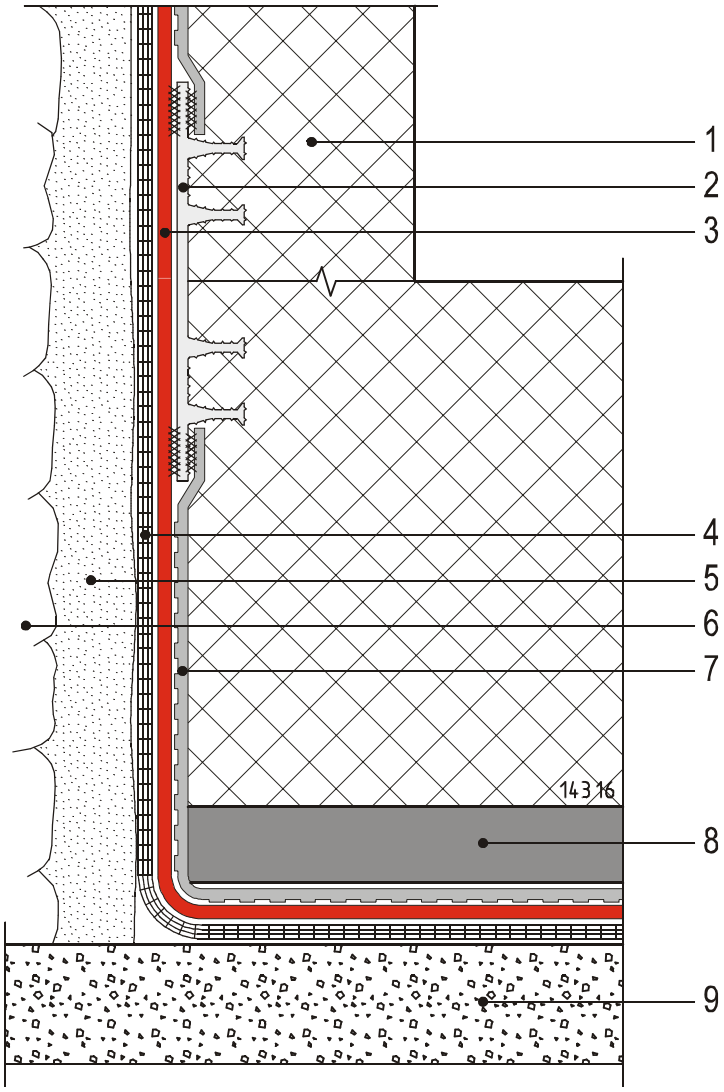
Construction

Build-up of layers below basement slab to wall junction



1 Reinforced concrete
2 Compartment with FPO waterstop: Waterstop FPO (PE), type MP AF
3 Waterproofing: Sikaplan® WT 1200 waterproofing membranes
4 Protective layer: geotextile PP 500 to 1000 g/m^2
5 Wall - substrate: shotcrete, or formworked concrete
6 Diaphragm wall: reinforced concrete
7 Protective layer: geotextile PP 500 to 1000 g/m^2 and separation- / slip layer PE film, thickness > 0.20mm,
or alternatively Sikaplan® WT protection sheet -HE
8 Protective mortar screed
9 Substrate: blinding concrete

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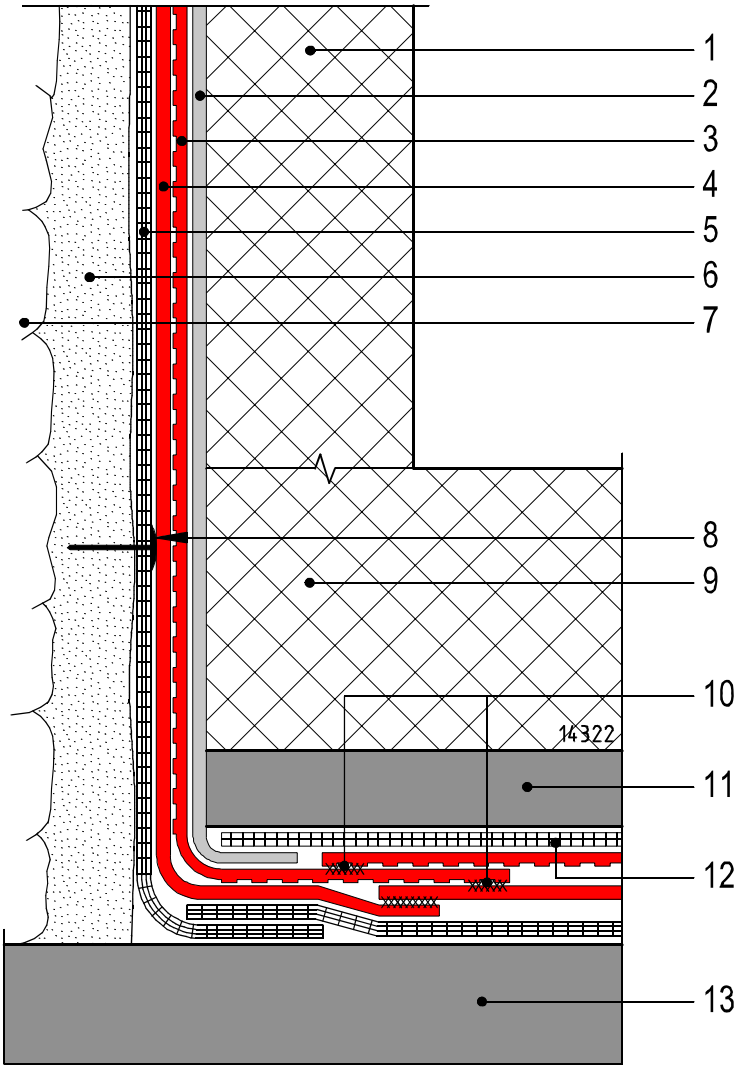
Construction

Build-up of layers below basement slab to wall junction with double layer membranes



1 Reinforced concrete
2 Protective layer: Sikaplan® WT protection sheet
3 Waterproofing: Sikaplan® WT 1200 – CE waterproofing membranes
4 Waterproofing: Sikaplan® WT 1200 waterproofing membranes
5 Protective layer: geotextile PP 500 to 1000 g/m^2
6 Wall - substrate: shotcrete, or formworked concrete
7 Diaphragm wall: reinforced concrete
8 Spot-wise fixing of waterproofing: Sikaplan® WT-PE disc
9 Reinforced concrete
10 Heat weldings
11 Protection mortar screed
12 Protective layer: geotextile PP 500 to 1000 g/m^2 and separation- / slip layer PE film, thickness > 0.20mm,
or alternatively Sikaplan® WT protection sheet -HE
13 Substrate: blinding concrete

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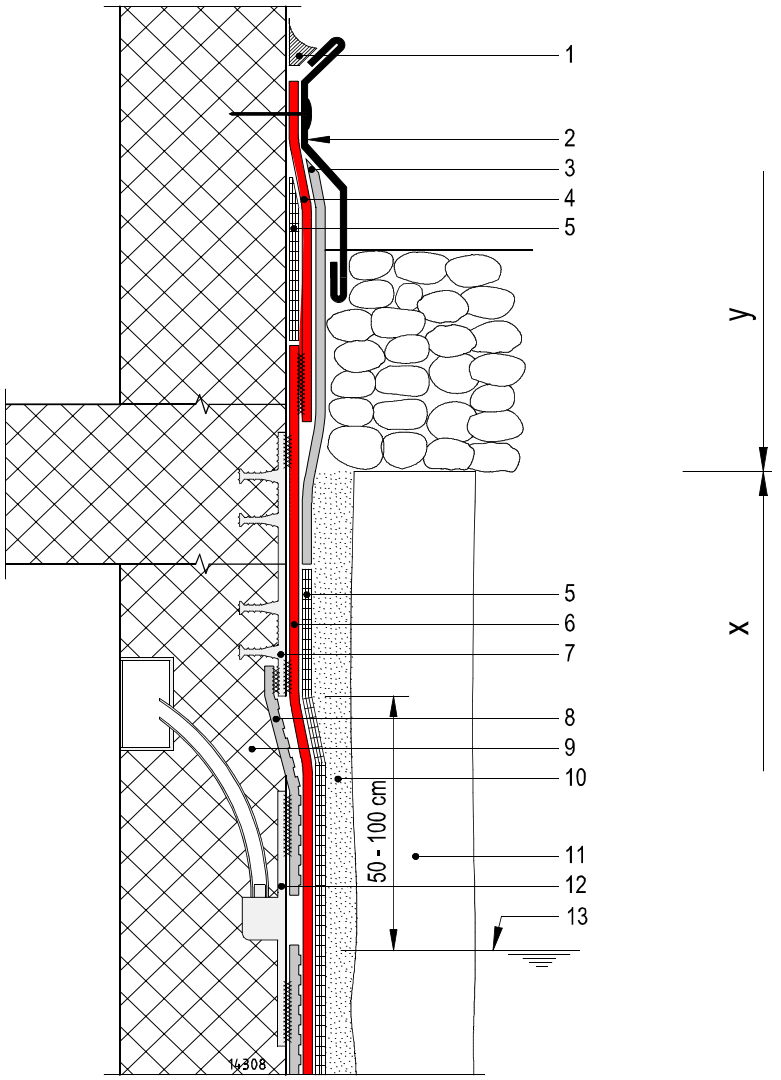
Construction

Build-up of layers at wall / detail of waterproofing termination



1	Sealant: Sikaflex® 11FC incl. primer for metal and concrete substrate
2	Metal flashing
3	Sikaplan® WT protection sheet
4	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
5	Protective layer: geotextile PP 500 to 1000 g/m^2
6	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
7	Compartment with FPO waterstop: Waterstop FPO (PE), type MP AF
8	Protective layer: Sikaplan® WT protection sheet -HE
9	Reinforced concrete
10	Wall - substrate: shotcrete, or formworked concrete
11	Diaphragm wall: reinforced concrete
12	Sikaplan® WT Control socket PE
13	Max. groundwater level
Y	Area positive waterproofing application
X	Area negative waterproofing application

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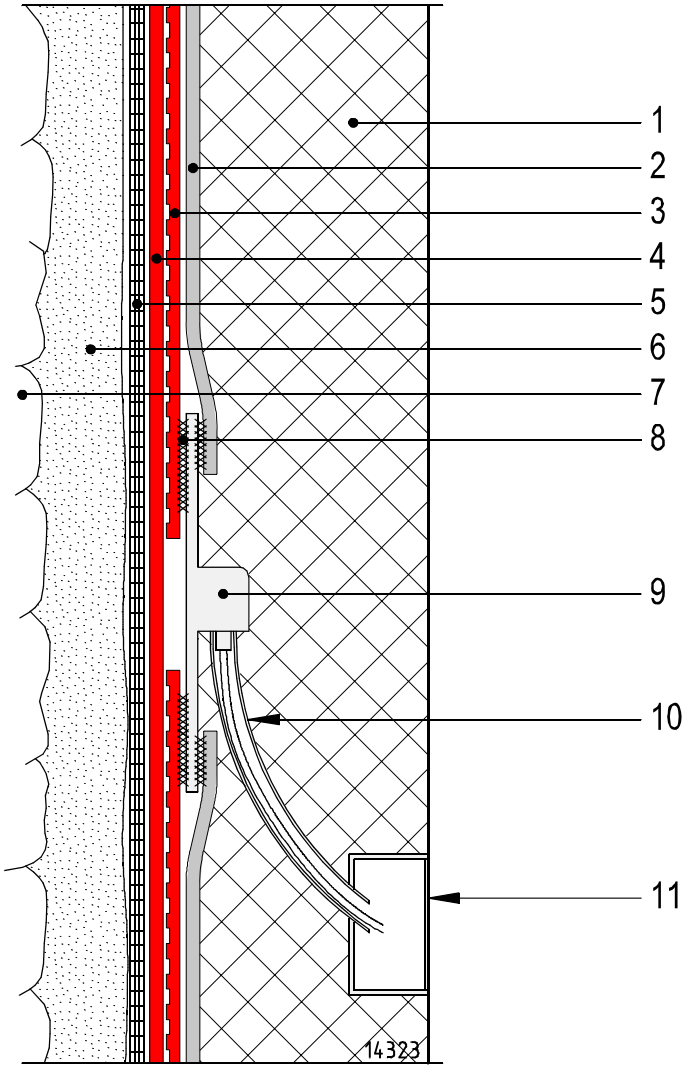
Construction

Build-up of layers at wall with double layer membrane



1 Reinforced concrete
2 Protective layer: Sikaplan® WT protection sheet
3 Waterproofing: Sikaplan® WT 1200 – CE waterproofing membranes
4 Waterproofing: Sikaplan® WT 1200 waterproofing membranes
5 Protective layer: geotextile PP 500 to 1000 g/m^2
6 Wall - substrate: shotcrete, or formworked concrete
7 Diaphragm wall: reinforced concrete
8 Heat welding
9 Sikaplan® WT Control socket PE
10 Sikaplan® W PU-control tube in Sikaplan® W flexible PP protection pipe
11 Sikaplan Control box

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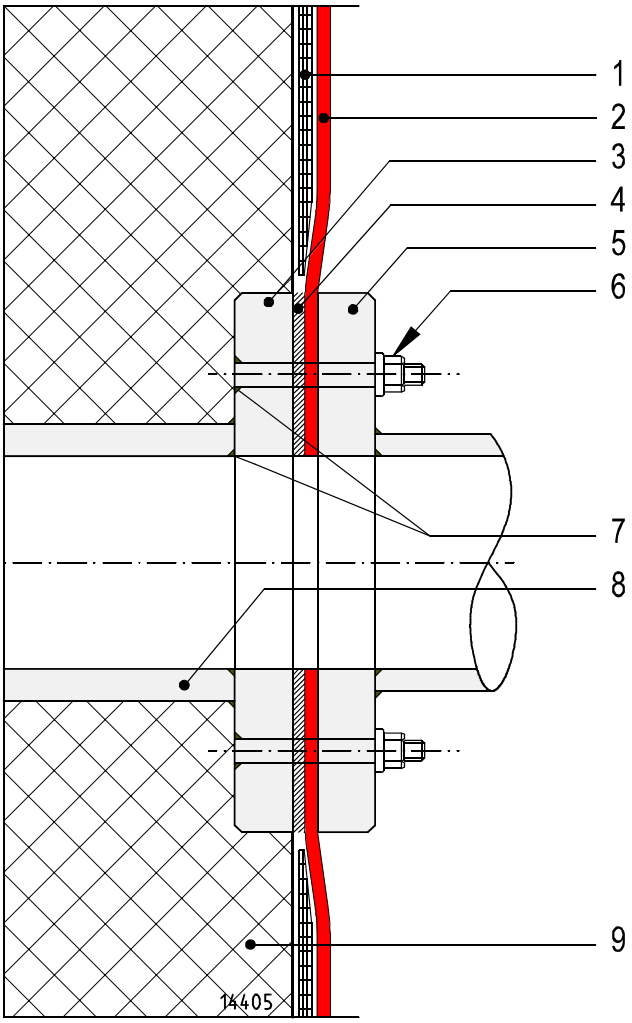
Construction

Detail penetration of service pipes



1 Protective layer: geotextile PP 500 to 1000 g/m^2
2 Waterproofing: Sikaplan® WT 1200 waterproofing membranes
3 Fixed clamp flange, stainless steel
4 Appropriate flat gasket
5 Loose clamp ring, stainless steel
6 Bolt with locking nut and tapered washer, stainless steel
7 Watertight weld
8 Pipe, stainless steel
9 Reinforced concrete

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