

System Information and Method Statement Corporate Construction

Basement waterproofing with membranes

Scope:

Installation of

Sikaplan® WP 1100 – 15HL, -20HL, -30HL

(Sikaplan® - 9.6, -14.6, -24.6)

Sikaplan® WP 1100 - 15HL2, - 20HL2, 30HL2



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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.

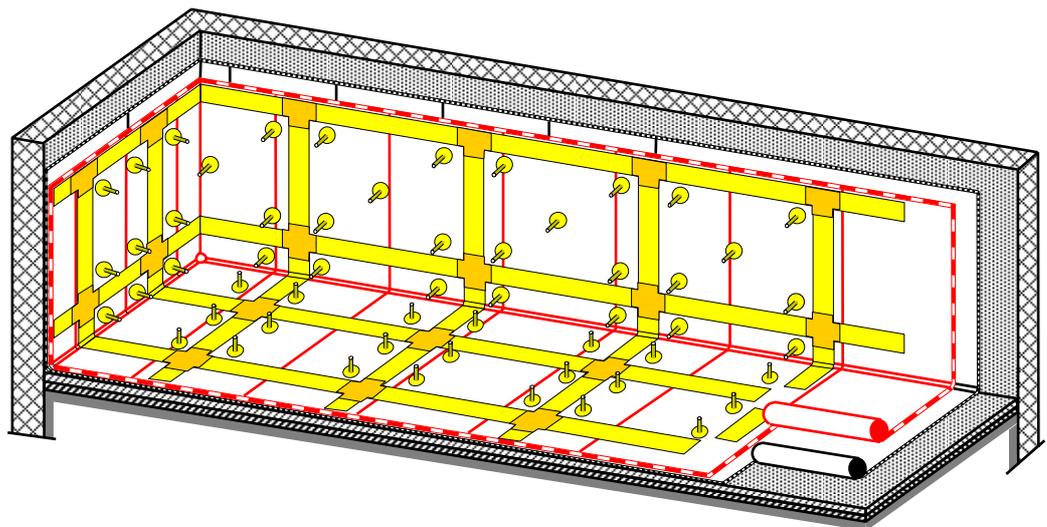
Highly flexible single layer, or if required double layer Sikaplan® WP waterproofing membranes can protect a structure against water from damp soil contact, percolating water and groundwater under hydrostatic pressure.

In situations with leaking waterproofing membranes caused by mechanical damage to the membranes, 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 membranes, combined with injectable hoses provides 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® WP waterproofing membranes based on plasticised PVC.



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® WP waterproofing membrane system 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® WP sheet membranes.

1.2 Construction requirements

The main criteria for the correct design and execution of the Sikaplan® WP 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 concrete shrinkage contraction etc.
- reinforcement bars in the concrete must be min. 30mm below surface
- 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 to avoid puncturing the membrane under the future influence of hydrostatic pressure

1.3 Waterproofing system

The installation procedure for waterproofing membranes depends on the:

- chosen excavation system i.e. open with free access to external walls, or internally with retaining walls
- project design
- 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 using with single layer membranes without compartment. This system is not resistant against water under hydrostatic 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).

The following installation instructions are divided into single operations, applicable according to each kind of project. The operational sequences must then be defined according to the project design and the specification requirements.

Membrane installation sequences:

Single layer or double layer membrane system	
Open with free access to external walls: <ul style="list-style-type: none"> • without retaining walls • with retaining walls (apart from the structure) 	Installation sequence of the membrane is in two phases: <ol style="list-style-type: none"> 1. lining below the basement slab <ul style="list-style-type: none"> • cast in place concrete structures (slab, walls, roof) 2. lining of walls and roof
Internally without access to external walls: <ul style="list-style-type: none"> • diaphragm walls • driven or cast pile walls 	Installation sequences of membrane in one, or two phases: <ul style="list-style-type: none"> • 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)	1.5 mm
Hydrostatic pressure 0m - 10m	1.5 mm
Hydrostatic pressure 10m - 20m	2.0 mm
Hydrostatic pressure exceeding 20m	3.0 mm

2. PRODUCTS

2.1 Product characteristics

Standard product (with signal layer 0.6 mm)	Sikaplan® WP 1100 -15HL (Sikaplan® 9.6)	Sikaplan® WP 1100 -20HL (Sikaplan® 14.6)	Sikaplan® WP 1100 -30HL (Sikaplan® 24.6)
Standard product (with signal layer 0.2 mm, available on inquiry)	Sikaplan® WP 1100 -15HL2	Sikaplan® WP 1100 -20HL2	Sikaplan® WP 1100 -30HL2
Colours	top layer: yellow / reverse layer: dark grey		
Specials (transparent acc. to French Standard, on request)	Sikaplan® WP 1100 -20H transparent (Trocal® T 2.00mm)		
Material	PVC-p membrane, homogeneous, not bitumen resistant		
Use	Waterproofing of all types of structures, situated below ground against groundwater ingress		
Membrane thickness and roll sizes	according to the respective product data sheets		
Suitable	<ul style="list-style-type: none"> • 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® WP laminated metal strip F 100

Colour of top layer	light grey
Size and thickness of strip	100mm x 2000mm
Use	linear fixing of Sikaplan® WP 1100 waterproofing sheets. Metal strip to be cut and preformed to profiles with suitable tools in metal workshops

Sikaplan® WP Disc 80/10mm

Colour	yellow, black
Size	80mm dia. x 10mm thickness
Use	spot fixing of Sikaplan® WP 1100 waterproofing sheets in vertical areas

Sika® Waterbar, type AR / DR / AR Inject

Colours	grey, yellow
Size	according to the product data sheet
Use	Compartments and linear fixings of Sikaplan® WP 1100 waterproofing sheets exposed to groundwater under hydrostatic pressure

Sika® Dilatec, type E / ER joint sealing strips

Colour	grey (white fleece edge strips)
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® WP 1100 waterproofing sheets exposed to groundwater under hydrostatic pressure

Sika® Control - and Injection Flange

	Sikaplan® WP Trumpet Flange	Sikaplan® WP Control Socket
Colour	black	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.	

Sikaplan® WP protection sheets

	Sikaplan® WP Protection sheet-20H	Sikaplan® WP Protection sheet-20HE
Material	PVC-p membrane, homogeneous, not bitumen resistant	
Use	Protection of installed waterproofing membranes against mechanical damage	
Colours	grey	grey, surface embossed
Sheet thickness and roll dimensions	according to the respective PDS	



Sikadur® - 31 EP adhesive, normal and rapid

	normal	rapid
Material	two part epoxy adhesive	
Use	at ambient temperature of + 10°C until + 30°C	at ambient temperature of + 5°C until + 15°C
Colour	grey	
Application	according to the respective PDS and MSDS	

Membrane Cleaner

	Sarna Cleaner	Sika-Trocal® Cleaner 2000
Material	solvent containing	solvent-free
Use	cleaning of contaminated membrane surfaces	
Colour	clear liquid	
Application	according to the respective PDS and MSDS	

3. INSTALLATION

3.1 General background information for installation

Installation of Sikaplan® WP waterproofing sheets must only be performed by skilled and experienced waterproofing contractors, trained in Sikaplan® WP membrane welding and installation.

In finalising their tender submissions the waterproofing contractor must have the possibility to inspect the site conditions beforehand.

Installation works can be performed in dry weather conditions and ambient temperature 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 membranes, unauthorised individuals must be prevented from having access to the installation site during and following the waterproofing works.

Waterproofing contractor's personnel must only wear suitable shoes with rubber soles, when walking on installed membranes. Smoking and open fires must not be permitted on site. Heat welding machine operators must be trained and instructed on the safety 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 under surveillance until their final covering with protective layers.



3.2 Substrate preparation

Substrates of blinding, or concrete surfaces 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 in the cementitious substrate must be removed by chiselling and grinding; nails and wires or loose stones must be removed. Any protective mortar layer thickness must be min. 5cm, if necessary with light reinforcement, to be covered min. 3cm. The maximum aggregate diameter of mortar screeds must not exceed 4mm. The whole surface must be thoroughly cleaned using high pressure water. Ponding water must be removed and the whole surface must be dried using compressed air.

Substrate surfaces for refurbished concrete structures:

Old linings, as well as any debonded rendering and screeds must be removed. Larger cracks and honeycombing must be broken out and reprofiled with repair mortars. Water infiltration must be sealed, either with waterproofing mortars, or by injection with acrylic resin, or micro-fine cement grout. New rendering and screeds must be applied on blast clean substrates, its maximum aggregate diameter must not exceed 4mm and its surface must be steel-trowel finished. Edges must be chamfered. The whole surface must be thoroughly cleaned using high pressure water. Ponding water must be removed and the whole surface dried using compressed air.

Substrate surfaces for new concrete structures:

The surface of the concrete must be smooth (steel trowel finish, resp. first class formwork quality) and edges must be chamfered. Reinforcement steel bars must be covered min. 3cm.

Any projections in the cementitious substrate must be removed by chiselling and grinding; nails and wires must be removed. Honeycombed concrete must be broken out and reprofiled with repair mortar. Water infiltration through cracks of concrete structures, or along steel elements must be sealed, either with waterproofing mortar or by injection of acrylic resin, or micro-fine cement grout. The maximum aggregate diameter of rendering and mortar screeds must not exceed 4mm. The whole surface must be thoroughly cleaned using high pressure water. Ponding water must be removed and the whole surface must be dried using compressed air. Substrate preparation procedure prior to application of Sikadur® -31 EP adhesives must be according to its product data sheet.



Substrate surfaces of shotcrete / gunite:

Unevenness of a shotcrete surface must not exceed the ratio of length to depth unevenness of 5 : 1 and its min. radius must be 20cm. The shotcrete surface must not contain broken aggregates. Local water infiltration, must be sealed either with waterproof plugging mortar, or drained with perforated hoses.

It is recommended to spray a fine gunite layer on shotcrete surfaces with a min. thickness of 5cm and its aggregate dia. not exceeding 4mm (if the above mentioned shotcrete requirements can not be fulfilled). Steel elements (girders, reinforcement mesh, anchors etc.) must be covered min. 3cm.

The surface of shotcrete, resp. gunite must be clean and free of loose debris (no loose stones, nails, wires, etc.).



3.3 Protective layers

The waterproofing membrane to be installed must be protected against hard substrates with a geotextile cushion 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 must not be used).

The geotextile must have min. unit weight of 500g/m² for use on smooth concrete substrates. Geotextiles must be loose laid and must be overlapped min. 100mm on horizontal areas and be free of loose materials. The physical properties of geotextiles 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 guideline the following work sequences can be considered to be 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 the excavation is retained with driven steel piles with working space between external walls and these retaining walls. Membrane installation is performed in two phases:

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

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 junctions
- installation of 2nd layer waterproofing membrane, incl. details (if specified)
- protective layer on installed membrane as specified



Diaphragm wall / Shafts / Internal working space only system:

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 to the retaining walls (vertical), prior to the pouring of the concrete slab and wall structures.

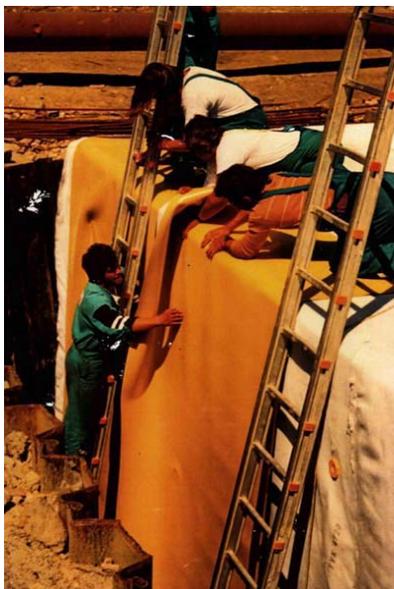
horizontal

- 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 to 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 in single operations with various fixing options, according to the design of each project. The operational-sequences must be precisely defined according to the individual requirements.



3.5 Waterproofing termination details

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 may be linear fixed at terminations at the top of loose hanging membranes if the height does not exceed 4.00m (exception: compartment systems with waterstops). Waterproofing, which exceeds 4.00m high, requires intermediate linear, or spot fixings at max. vertical distances of 2.00m.

With Sikaplan® WP laminated metal strips:

Unrolling and positioning of the geotextile protective layer, overlapped 100mm and fixed with Sikaplan® WP laminated metal strip, formed to profiles and left loose hanging on the wall. Mounting of Sikaplan® WP laminated metal – profiles (size 100mm x 2000mm, mounting holes \varnothing 5mm at 150mm centres). The top of the profiles must be positioned min. 1.00m above max. groundwater level and min. 0.15m above ground level.

Between each profile there must be a gap of 5mm. The profiles must be fixed with countersunk screws (dia. 4.5mm/length 20mm, stainless steel) and 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 profile must be sealed with a permanently elastic silicone based sealant (i.e. Sikasil® C).

The bonding of sealant on the substrate requires application of a suitable primer. Once the membrane is fixed by the profiles the waterproofing must be protected against UV-light and mechanical damage.

With Aluminium-sheet metal, formed in to profiles (by others):

Unrolling and positioning of geotextile protective layer, overlapped at edges 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, mounting holes \varnothing 5mm in distance of 150mm). 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 must be a gap of 5mm. The profiles must be fixed with stainless steel screws (dia. 4.5mm/length 20mm) and 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 profile must be sealed with a permanently elastic silicone sealant (i.e. Sikasil® C). The bonding of sealant on its substrate may require the application of a suitable 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 concrete, cement or mortar, the mounted profile must not be in direct contact with cementitious substrates.

With Sikaplan® W flat profile 30/4 V4A:

Unrolling and positioning of geotextile protective layer, overlapped at edges 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 profiles 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 0.15m above ground level.

Between each profile must be a gap of 5mm. The profiles must be fixed with countersunk screws (stainless steel) and dowels into reinforced concrete.

The mounted profile must not cross expansion joints. The gap between the concrete surface and the profile must be sealed with a permanently elastic silicone sealant (i.e. Sikasil® C). The bonding of the sealant on the substrate requires the application of a suitable primer. Once the membrane is fixed with the profile, the waterproofing must be protected against UV-light and mechanical damage on site.

Welded at Sika® Waterstops, type AR / DR:

Mounting of Sika® Waterstops, type AR, 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 etc. and free from oil or grease. Heat welding of waterproofing membrane onto the waterstops (membrane loose hanging). Once the membranes are fixed to the waterstops, the waterproofing must be protected against UV-light and mechanical damage.

Welded at bonded Sika® Dilatec, type ER joint sealing strips:

Bonding of Sika® Dilatec, type ER 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 glued strip must be min. 1.00m above max. groundwater level, and min. 0.15m above ground level. After 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, etc. and free from oil or grease. Heat welding of waterproofing membranes onto the exposed part of bonded joint strips (membrane loose hanging).

Once the membrane is welded to the joint tape, the waterproofing must be protected against UV-light and mechanical damage.



3.6 Fixings on vertical areas

Intermediate fixings on walls:

Required for wall height, exceeding 4.00m and for compartment systems

With Sikaplan® WP laminated metal strips:

Mounting of Sikaplan® WP laminated metal sheets strips.

(size 100mm x 2000mm / mounting holes \varnothing 5mm at 150mm centres).

The strips must be fixed in horizontally directions and at a vertical distance of max. 2.00m on the loose hanging geotextile. Between each strip must be a gap of 5mm. The strips must be fixed with countersunk screws (dia. 4.5mm/length 20mm, stainless steel) and 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® WP laminated metal strips.

On Sika® Waterstops, type AR / DR:

Mounting of waterstops (PVC / one side 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 concept. 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 (dust, cement, etc.) and free from oil or grease. Heat welding of the waterproofing membrane onto the waterstops (membrane loose hanging).

On glued Sika® Dilatec, type E joint sealing strip:

Gluing of Sika® Dilatec, type E joint sealing strip with Sikadur® -31 EP adhesive on prepared concrete substrate. Preparation of substrate according to product data sheet for Sikadur® -31 adhesive.

The positioning of the glued strip must be according to the design engineers compartment concept. After gluing works, unrolling and positioning of the geotextiles, provisionally fixed (i.e. with adhesive tapes), resp. terminated under glued joint strip and loose hanging. The exposed surface of the glued strip must be clean, free of dust, remains of cured EP adhesive, etc. and free from oil or grease. Heat welding of waterproofing membrane onto the exposed part of glued joint strip (membrane loose hanging).

Spot fixing with Sikaplan® WP Disc on shotcrete / gunité:

Fixing of Sikaplan® WP Disc discs (\varnothing 80mm) on geotextile into shotcrete / gunité, or concrete (the geotextile is fixed with this operation also).

The fixing of discs must be executed with the aid of 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). The grid distance must be min. two fixings each membrane roll width in the horizontal direction and 2.00m in the vertical direction. Heat welding of the waterproofing membrane onto the fixed discs.

Spot fixing with suspenders made of Sikaplan® WP 1100 membrane straps:

Cut straps of Sikaplan® WP 1100 membrane from roll (size approx. 50mm x 200mm)
 Fixing of Sikaplan® WP 1100 membrane straps on geotextile into shotcrete / gunite, or concrete (the geotextile is fixed with this operation also).

The fixing of membrane straps must be executed with the aid of 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). The grid distance must be min. two fixings each membrane roll width in the horizontal direction and max. 2.00m in the vertical direction. Heat welding of the waterproofing membrane onto the fixed straps.

Fixings on vertical corners

With Sikaplan® WP laminated metal strips:

Mounting of Sikaplan® WP laminated metal strips (size 100mm x 2000mm, once folded to L-shape 50mm x 50mm / mounting holes \varnothing 5mm in distance of 150mm 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) and dowels over 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 profile.

With Aluminium-metal strips (supplied by others) in membrane overlaps:

Mounting of Aluminium-strip (size 4mm x 20mm x 4000mm, edges rounded / mounting holes \varnothing 5mm in distance of 150mm) at edge (seam overlap) of 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) and dowels into reinforced concrete. Heat welding of the overlapping membrane roll over the fixing.

3.7 Waterproofing details on horizontal and vertical areas

Membrane intersection between horizontal - vertical areas (prayer seams):

Below foundation slab (suitable for single layer waterproofing only):

Loose layout and heat welding of waterproofing membrane (horizontal) over the geotextile and the mortar screed 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 must be lapped over the geotextile strip as provisional loop and heat welded on installed waterproofing membrane. After installation of compartment, loose layout the geotextile on the prepared waterproofing membrane (incl. over provisional loop), to be overlaid with PE foil 0.30mm (its overlaps sealed with adhesive tapes), or alternatively with Sikaplan® WP 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 slab and walls are completed, the protective layers (mortar screed, geotextile) must be careful removed. The provisional loop of membrane must be cut off and the geotextile strip removed. Heat welding of the vertical waterproofing on clean membrane of their horizontal waterproofing as a 'prayer' seam. The protective layers over finished 'prayer' seam must be reformed as a base for the protective layers for the walls.

At retaining walls, or at formwork of foundation slab:

Loose layout and heat welding of waterproofing membrane (horizontal) over the geotextile and the mortar screed below the foundation slab. The temporary edge of the membrane must extend to vertical wall up to 0.50m above surface level of foundation slab and fixed temporary at retaining wall, or at formwork of foundation slab.

If double layer waterproofing system is chosen, install second layer of waterproofing membrane.

After installation of compartment, loose layout the geotextile on the prepared waterproofing membrane, to be overlaid with PE foil 0.30mm (its overlaps sealed with adhesive tapes), or alternatively with Sikaplan® WP protection sheets.

Application of protective mortar layer (cement min. 300kg / m³, aggregate ≤ ø 4mm, thickness min. 5cm).



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 penetration by using separate membrane piece. Do not allow membrane overlaps within flanges. Membrane must be welded outside of flange, when double layer membrane system have to be installed. The prepared sealing ring must be heat welded on waterproofing membrane within the flange. Holes in equal diameter than bolts must be punched through both, the membrane and the sealing ring, exactly at the locations of bolts. The prepared piece of waterproofing membrane, incl. welded sealing ring must then be slipped over the base flange and be fixed to the pressure flange (the membrane must not be loose or creased and the membrane sealing rings must not be fishmouthed').



Bridge over expansion joints:

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

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 chosen fixing method:

- PVC - laminated metal strips / profiles: heat welding of waterproofing membrane on laminated metals
- Aluminium-profiles: acc. to separate description
- Aluminium-strips: acc. to separate description
- Sika Discs: acc. to separate description
- Surface waterstop: acc. to separate description
- glued 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 termination and at intermediate fixing points on the wall
4. repeat 1. - 3. with next membrane roll
5. heat welding of vertical overlaps in direction from bottom to top
welding of installed membrane at prepared details (i.e. penetrations)
6. repeat 1. – 5. for second layer, if 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 consideration of the membrane laying direction on the bottom (i.e. the most optimised regarding cut loss 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 and consider membrane lap at edges for intersection to 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 lap with vertical waterproofing at edges of basement slabs
6. repeat 1. – 5. for second layer, if double layer membrane system is specified

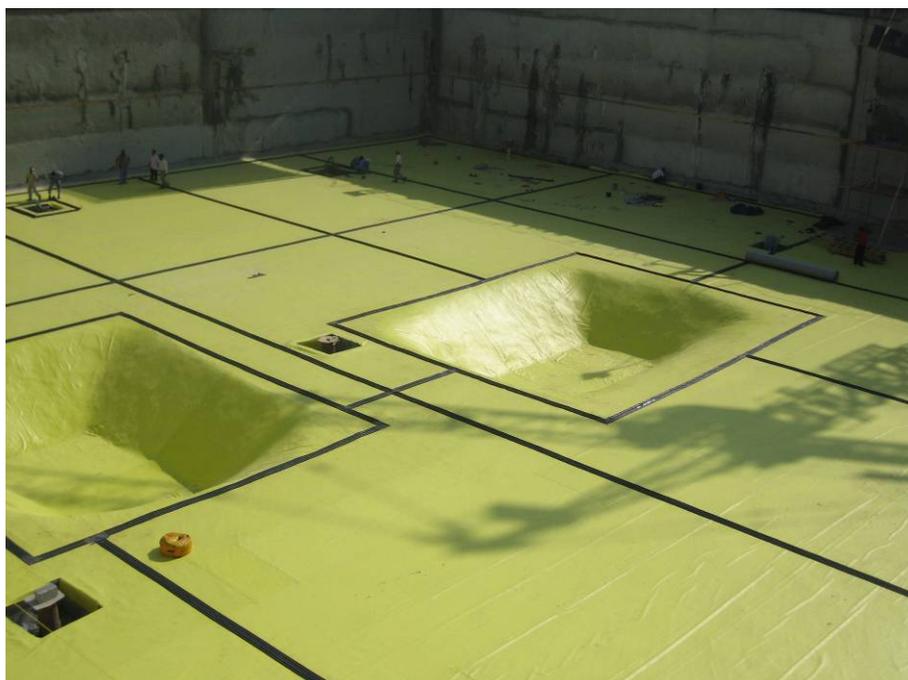
3.9 Compartment of waterproofing with surface waterstops:

Surface waterstops for compartments, must be made of heat weldable plasticised PVC, compatible to PVC waterproofing membrane and profiled with ribs on one side, or it must be made of glued joint strips on base of PVC. Dependent on the type of structures waterproofing membranes must either be heat welded on surface waterstops, resp. on glued strips, or surface waterstops must be heat welded on 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 glued tape (Sika® Dilatec system)	membrane on glued tape (Sika® Dilatec system)

For single layer waterproofing system, each compartment area of the waterproofing must not exceed 150m².

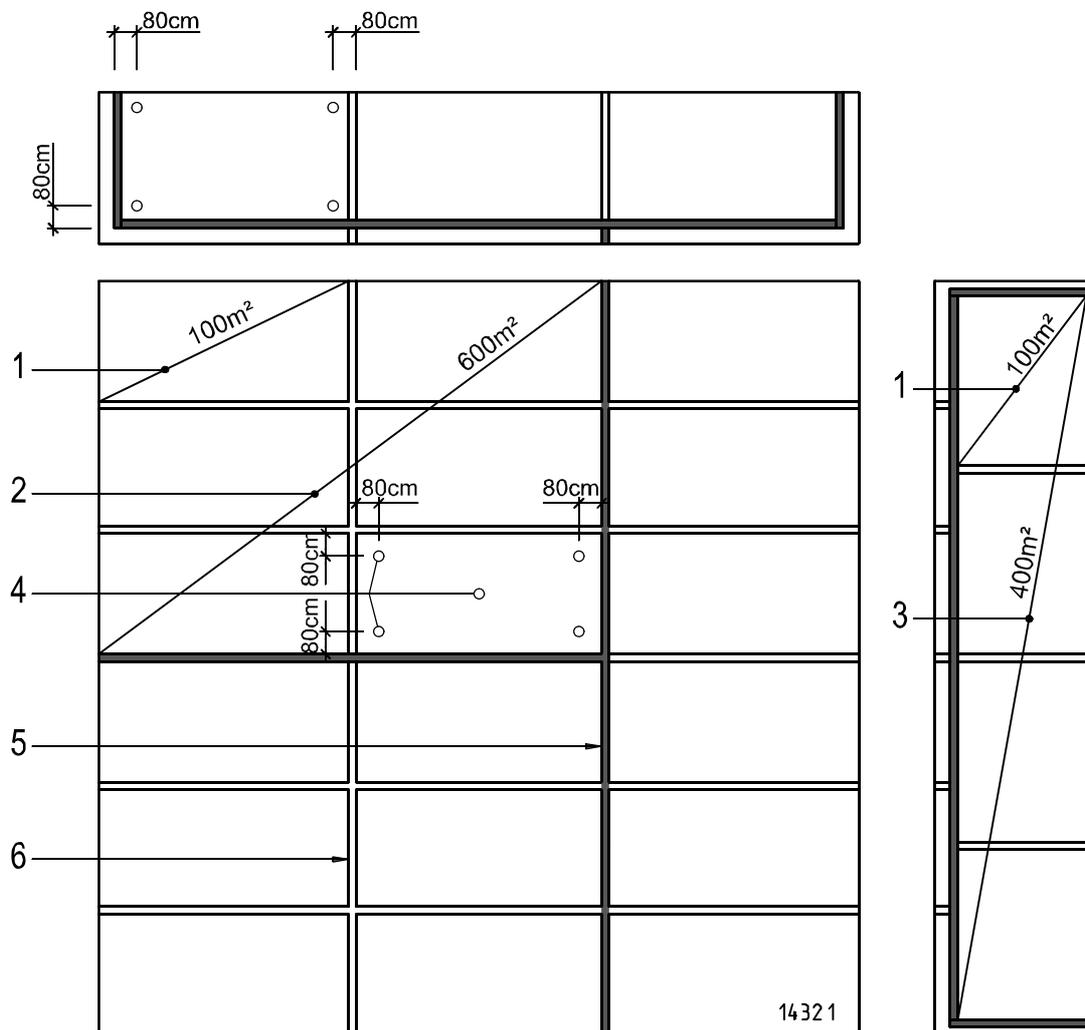
According to the type of structure and construction schedule, the layout and positioning of waterstops, resp. glued joint sealing strips must be planned with the consultant. Surface waterstops, to be prepared and fixed during concreting works, must be fixed firmly at the formwork. Cross- and T-junctions of waterstops must be factory welded, or prepared by skilled welding worker in local workshop.



For double layer waterproofing system, the compartment must be performed according to following specifications:

According to the type of structure and construction schedule, the layout and positioning of waterstops must be planned with the consultant. Surface waterstops, to be prepared and fixed during concreting works, must be fixed firmly at the formwork.

1. compartments within membrane layers: each field must not exceed 100m^2
2. compartments with waterstop on top layer of membrane: each field must not exceed 600m^2
3. compartments with waterstop on top layer of membrane: each field must not exceed 400m^2 in walls
4. positions of control and injection pipes
5. positions of weldings between membrane layers and waterstops
6. positions of weldings between membrane layers



Heat welding of waterproofing membranes on flat surface of Sika® Waterbar, 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 (dust, cement, etc.) and free from oil or grease. Projecting welding seams on waterstops must be peeled off with knives. Heat welding of Sikaplan® WP waterproofing membranes on Sika® Waterstop type AR / DR. Strip heat welding of waterproofing membrane (with the membrane edge at both sides of joint openings) on Sika® Waterstops, type DR in case of expansion joints. The remaining gap of membrane over joint opening must be covered with membrane strip (width > 20cm) to be welded on both membrane edges.

Heat welding of Sika® Waterbar on installed waterproofing membranes:

The surface of installed membrane must be clean and free of oil and grease. The welded seams must be inspected for water tightness and the membrane edge must be chamfered (i.e. with peeling knives). Projecting welding seams on waterstops must be peeled off with knives. Waterstops may be heat welded directly to membrane, if the side laps of used waterstop type exceeds 50mm by using of hand held manual welder. Direct welding of waterstops with side laps less than 50mm requests the use of semi automatic welding machine type Leister Triac Drive.

Strips of Sikaplan® WP waterproofing membranes must be preliminary heat welded on flat reverse of waterstop, if such welding tool is not available and the widths of side laps are less than 50mm.

Operational steps as follows:

Heat welding of Sikaplan® WP waterproofing membrane strips (width 20cm: ≤ 10cm welding on waterstop / ≥ 10cm for later welding on waterproofing membrane) on both flat sides of waterstop. The seams of membrane strips must be butt-jointed (no overlap seam), staggered to waterstop joints. The prepared waterstop must then be heat welded with the remaining laps of membrane strips.

Mounting of Sikaplan® WP Control Socket or Trumpet – Flange:

The control- and injection pipe PVC flange, connected with clamping rings to metal pipes or plastic hose. Its min. total length is equivalent to the thickness of the wall or slab. The purpose of the pipes are access for control of water tightness and if required, injection of grouts into each compartmentalised waterproofing area. The correct function of these pipes requires min. three pipes in each compartment, one on the lowest, one in the middle and one on the highest point. The position of pipe openings at the internal side of a structure must allow easy access for later use.

The pipes must be mounted on reinforcement bars. The PVC flange must be fixed to the formwork or spot welded on the installed waterproofing membrane. It must be secured during concreting works so that no cement slurry can penetrate into the pipe.

Waterproofing termination with waterstops to pile caps:

Erect formwork around pile caps at the level of the basement slab. Mounting of surface waterstop (in plasticised PVC, profiled with ribs to one side), to be fixed with the flat side at inside of formwork and its butt joint welded.

The top level of pile cap must not exceed the level of waterstop. Mounting of reinforcement according to the consultant. Pouring of grouting mortar (i.e. Sika® Grout), within space of waterstop and concrete of pile head. Cover top level of pile head with Sikadur® -42 EP mortar. After removal of formwork, the surface of waterstop must be cleaned (free from cement, oil and grease). Heat welding of waterproofing membrane at waterstop.

4. WELDING METHODS

Sikaplan® WP waterproofing membranes may be welded by using suitable heat welding machines:

- Seam overlaps of membranes must in all cases 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 dry, clean, and free of dust, oil and grease etc.
- Sikaplan® WP membrane surfaces must be cleaned preliminary to welding procedure in case of polluted surface with Sarna Cleaner or Sika-Trocal® Cleaner 2000
- prior to any heat welding work conduct a welding test with membrane specimen (mandatory in order to adjust welding temperature and speed of the machine)
- for continuous welding quality, it is recommended to run welding equipment connected with own circuit, or using its own generating set (automatic welding machine: 360V, hand held welding gun: 220V, resp. 110V according to regulations)
- welding machine operators must be trained and experienced in heat welding technology according to local regulations and to operate electrical devices in wet, or humid conditions

Recommended machines and tools

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)

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)



Leister X – 84 automatic



Leister Twinny S automatic



Leister Comet automatic



Leister Triac Drive semi-automatic

5. QUALITY CONTROL

Testing of welded seams:

All welded seams must be tested for water-tightness.

Testing methods depend on available testing equipment and/or clients specification.

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

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

- all double seams must be tested with compressed air testing kit, containing testing needle, reverse flow valve, manometer gauge and air pressure pump (manual, or electric)
- seal air channel with clamp at both ends of welded seam
- insert testing needle, connected with reverse flow valve and manometer at one membrane overlap end. Connect testing needle with hose of 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 clamp from membrane ends. Heat weld membrane patch over membrane penetration, caused by insertion of testing needle with hand held welding machine. Sign approved and tight seam with marking pen. Record the test in paper sheet form. Repeat this procedure at all double seams.
- if test of double seam welding fails, inflate double seam again and search for leaks. Once detected, repair with membrane patch to be heat welded with hand held welding machine over defective area.
- any voids or capillaries must be rectified with hand held welding gun and 20mm Silicone roller at welding temperature



Physical test with vacuum bell:

This test requires the following 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 leak)
- remove vacuum bell and clean seam with rag
- any leaks must be rectified with hand held welding gun and 20mm Silicone roller at welding temperature, or if required, closed with welded membrane patch

6. CLEANING AND INSPECTION OF COMPLETED WORK

The membrane surface must be cleaned and inspected before installation of waterstops, control and injection pipes and protection layers over membrane. This procedure can be performed when one section of the waterproofing is completed, or after completion of the whole area.

Representatives from the waterproofing contractor and from the client must inspect the completed works. The inspection must be recorded in a written report to be signed by both parties.

The waterproofing contractor must keep original labels (incl. batch No.) of delivered and installed membrane rolls, incl. inspection report in his files.

7. PROTECTION OF WATERPROOFING

Preparation works prior to installation of protection layers on completed waterproofing: The membrane surface 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 compartment system is specified) must be completed and welded seams approved.

Open cut excavation

Under 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 alternative, loose layout of Sikaplan® WP protection sheets min. 80mm overlapped.
Waterstops for compartments must 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.

At external walls:

- geotextile 500g/m², 100mm overlapped, suspended on top and free hanging
- as alternative, Sikaplan® WP protection sheets 80mm overlapped, suspended on top and free hanging
- erect brickwork firmly on the waterproofing
- alternatively guniting, thickness min. 50mm, with light reinforcement mesh, faced with glass fleece, to be suspended on top

On roof slabs below ground:

- loose layout of geotextile 500g/m², min. 100mm overlapped.
Use provisional ballast for geotextile with sandbags
- as alternative, Sikaplan® WP protection sheets, min. 80mm overlapped.
Use provisional ballast for protection sheet 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, if necessary use reinforced wire mesh).

Shafting / internally

Below basement slabs:

- loose layout of geotextile 500g/m², min. 100mm overlapped.
Waterstops for compartment must be kept unprotected.
Use provisional ballast for geotextile with sandbags
- as alternative, loose layout of Sikaplan® WP 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 compartment must be kept unprotected / exposed

At retaining walls:

- direct placing of concrete on the waterproofing membrane
- formwork for construction-/expansion joints require a soft medium on membrane surface (i.e. plastic hose, cut-off in longitudinal direction and capped over the formwork edge)
- Reinforcement bars must be held with spacers (material compatible to plasticised PVC) 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 glass fleece (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 alternative, loose layout of Sikaplan® WP 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).



8. PROPOSAL FOR BILLS OF QUANTITIES

PROJECT WATERPROOFING WORKS

Project:

Part /Lot:

Waterproofing system: Waterproofing of structures against hydrostatic pressure from outside
 Flexible waterproofing with Sikaplan® WP waterproofing membranes, loose laid and linear fixed with, or without 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 and drying with brooms 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%		m ²		
2.2	Vertical areas Vertical and sloped areas above 15%		m ²		
2.3	Drying of substrate Drying of substrate with warm air dryer or according to contractors recommendations		m ²		
2.4	Removal of ponding water, cleaning and drying of wet areas with wet-and dry vacuum cleaner		m ²		
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'		



Construction

pos.	scope of work	quantity	unit	unit rate	total
3.	<p>Protection layers Supply and apply of protective layers for the mechanical protection of waterproofing membrane.</p> <p>Sheet membranes, according to consultants specifications thicknessmm min. overlap 80mm material: PVC-p homogeneous brand name: Sikaplan® type: WP.....</p> <p>Geotextiles, according to consultants specifications unit weightg / m² unit weightg / m² min. overlap 100mm material: Polyester/Polypropylene non woven fabric, needle punched brand name..... type..... type.....</p>				
3.1	Horizontal and sloped areas less than 15%, loose laid		m ²		
3.2	Vertical and sloped areas above 15%, spotwise fixed as per manufacturers instruction		m ²		
3.3	Supply and apply of separation / slip layer, according to consultants specifications unit weightg / m ² Thicknessmm min. overlap 100mm to be sealed with adhesive tapes material:..... brand name:..... type.....		m ²		
3.4	Supply and apply of protective mortar layer for horizontal area (cement dosage > 300kg/m ³ , thickness 50mm, steel trowel finish		m ²		
3.4.1	Supply and apply of reinforcement mesh for protective mortar layer, ø...../.....mm		m ²		



pos.	scope of work	quantity	Unit	unit rate	total
4.	Waterproofing membranes Single layer waterproofing Supply and apply of single layer waterproofing membrane system on base of plasticised PVC, according to consultants specification, overlaps min. 80mm heat welded with electr. welding machine, incl. testing of welded seams as per suppliers recommendations, linear fixed at all terminations, edges and corners Materials: Membrane thickness:.....mm Membrane type: brand name: Sikaplan® type WP 1100 -..... Auxiliary products: Membrane cleaner: Sikaplan® WP Cleaner 2000 Fixing elements: Sikaplan® WP PVC-laminated metal strip Aluminium profile, size..... Metal strips, size..... Sikaplan® WP disc, dia..... Sika® Waterbar, type AR..... Sika® Dilatec PVC-p joint sealing strips, type.....				
4.11	Horizontal and sloped areas less than 15%, loose laid, overlaps heat welded, excl. fixings		m ²		
4.12	Vertical and sloped areas above 15%, installed as per suppliers recommendation, excl. fixings		m ²		
4.13	Waterproofing of sumps and channels in horizontal area: effective area until max. 10m ² , excl. fixings		m ²		
4.14	Waterproofing of returns and recesses in vertical areas: effective area up to max. 10m ² , excl. fixings		m ²		



pos.	scope of work	quantity	unit	unit rate	total
4.2	<p>Double layer waterproofing Supply and apply of double layer waterproofing membrane system on base of plasticised PVC, according to consultants specification, overlaps min. 80mm heat welded with, both layers heat welded to build compartmentalisation, incl. testing of welded seams as per suppliers recommendations, linear fixed at all terminations, edges and corners</p> <p>Materials: Membrane 1st layer thickness:.....mm Membrane 2nd layer thickness:.....mm</p> <p>Membrane type: Brand name: Sikaplan® type: WP 1100 - type: WP 1100 -</p> <p>Auxiliary products: Membrane cleaner: Sika® - Trocal Cleaner 2000 Fixing elements: Sikaplan® WP PVC-laminated metal strip Aluminium profile, size..... Metal strips, size..... Sikaplan® PVC-p disc, dia..... Sika® Waterbar, type AR..... Sika® Dilatec PVC-p joint sealing strips, type.....</p>				
4.21	Horizontal and sloped areas less than 15%, loose laid, overlaps heat welded, excl. fixings		m ²		
4.22	Vertical and sloped areas above 15%, installed as per suppliers recommendation, excl. fixings		m ²		
4.23	Waterproofing of sumps and channels in horizontal area: effective area until max. 10m ² , excl. fixings		m ²		



pos.	scope of work	quantity	unit	unit rate	total
4.24	Waterproofing of returns and recesses in vertical areas: effective area up to max. 10m ² , excl. fixings		m ²		
5.	Fixing of waterproofing				
5.1	Supply and mounting of fixing elements for waterproofing termination, to be fixed with stainless steel screws and dowels (distance 150mm) into reinforced concrete min. 1000mm above max. groundwater level, incl. sealing with permanent elastic sealants on top, or with PVC-p strips, glued with EP-adhesive, suitable for on-welding of PVC-p waterproofing membranes				
5.1.1	Aluminiumprofile, size 1.5mm x 40mm, twice folded (max. length 4000mm/element), fixed with screws, ø 4.5mm x 20mm		m'		
5.1.2	Sikaplan [®] WP PVC-laminated metal strip, size 100mm x 2000mm to be cut and twice folded as per suppliers instruction on site, fixed with countersunk screws ø 4.5mm x 20mm, incl. heat welding of waterproofing membrane on PVC-laminated metal profile		m'		
5.1.3	Metal strip stainless, size 4mm x 30mm (length 2000mm/element), fixed with countersunk screws, incl, overlapping with waterproofing membrane and heat welding		m'		



pos.	scope of work	quantity	unit	unit rate	total
5.1.4	Supply and apply PVC-p joint sealing strips, suitable to glue with EP-adhesive on concrete at walls, incl. gluing on prepared substrate PVC-p strip, Brand name: Sika® Dilatec type..... size..... type of EP adhesive		m'		
5.2	Supply and mounting of fixing elements for fixing of waterproofing membrane at vertical areas, to be fixed with stainless steel screws and dowels (distance 200mm) into reinforced concrete.				
5.2.1	Sikaplan® WP PVC-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 /element), fixed with countersunk screws, incl. overlapping of waterproofing membrane and heat welding		m'		
5.3.	Supply and mounting of fixing elements for fixings of waterproofing membrane at vertical corners and edges, to be fixed with stainless steel screws and dowels (distance 200mm) into reinforced concrete				
5.3.1	Sikaplan® WP PVC-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'		



Construction

pos.	scope of work	quantity	unit	unit rate	total
5.3.2	Metal strip, size 4mm x 30mm (length 2000mm /element), 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 membrane at horizontal corners and edges, to be fixed with stainless steel screws and dowels (distance 200mm) into reinforced concrete				
5.4.1	Sikaplan® WP PVC-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 /element), 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 at vertical areas, plasticised PVC Discs, to be nailed with suitable nailing technique into shotcrete, or spike into predrilled hole into reinforced concrete (horizontal distance 2pcs./membrane roll width, vertical distance 2.00m)				
5.5.1	Sikaplan® WP PVC-p Discs, ø 80mm, fixed with nail gun, incl. compatible nail and washer		pcs		



Construction

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-sided 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 plasticised PVC-profile as surface waterstops for construction joints, one side with flat surface, to be fixed at formwork, resp. heat welded on installed waterproofing membrane, incl. heat welding of seams				
7.1.1	Sika® Waterbar type: width:.....mm		m'		
7.1.2	Sika® Waterbar Cross junction: type: prefabricated size:mm xmm		pcs		
7.1.3	Sika® Waterbar T-junction: type:.....prefabricated size:mm xmm		pcs		
7.1.4	Sika® Waterbar Inner corner junction, horizontal: type:..... prefabricated size:mm xmm		pcs		
7.1.5	Sika® Waterbar Inner corner junction, vertical: type:..... prefabricated size:mm xmm		pcs		



Construction

pos.	scope of work	quantity	unit	unit rate	total
7.1.6	Supply and heat welding of strip (width 20cm) of waterproofing membrane on both reverse sides of waterstop (if direct welding of waterstop on membrane not possible)		m'		
7.2	Supply and mounting of plasticised PVC-profile as surface waterstops for expansion joints, one side with flat surface, to be fixed at formwork, resp. heat welded on installed waterproofing membrane, incl. heat welding of seams				
7.2.1	Sika® Waterbar type:..... width:.....mm		m'		
7.2.2	Sika® Waterbar Cross junction: type:.....prefabricated size:mm xmm		pcs		
7.2.3	Sika® Waterbar T-junction: type:..... prefabricated size:mm xmm		pcs		
7.2.4	Sika® Waterbar Inner corner junction, horizontal: type:..... prefabricated size:mm xmm		pcs		
7.2.5	Sika® Waterbar Inner corner junction, vertical: type:..... prefabricated size:mm xmm		pcs		
7.2.6	Welding of waterproofing membrane strip, type:..... width 20cm on flat surface of waterstop, prior to mounting of surface waterstop (if direct welding of waterstop on membrane not possible)		m'		



pos.	scope of work	quantity	unit	unit rate	total
7.3	Supply and apply of PVC-p joint sealing strips, glued with EP-adhesive on horizontal areas, where waterstop installation is not possible, strip suitable for on-welding of PVC-p waterproofing membranes				
7.3.1	PVC-p joint sealing strips, suitable to glue with EP-adhesive on concrete at walls, incl. gluing on prepared substrate and waterproof intersection to waterstops at wall-roof junctions PVC-p strip, Type Sika® Dilatec type..... type of EP adhesive, type: Sikadur® -31		m'		
7.4	Supply and mounting of control and injection flange, type: Sikaplan Trumpet Flange, according to membrane suppliers, or waterproofing contractors instruction at formworks, resp. at reinforcement, incl. measurements after mounting		pcs		
7.5	Supply and mounting of control and injection flange, type: Sikaplan WP Control Socket, according to membrane suppliers, or waterproofing contractors instruction, incl. mounting of control tubes and connecting pipes		pcs		



pos.	scope of work	quantity	unit	unit rate	total
8.	Penetrations				
8.1	Waterproofing of penetrations, cast in structure with fixed and pressure flange on base of stainless steel materials, incl, on site creation of sealing rings made of waterproofing membrane, steel type:..... thickness:.....mm				
8.1.1	Well shafts \emptyset :.....mm \emptyset :.....mm		pcs pcs		
8.1.2	Pipe penetrations \emptyset :.....mm \emptyset :.....mm		pcs pcs		
8.1.3	Anchor bolts \emptyset :.....mm \emptyset :.....mm		pcs pcs		
8.1.4	Foundation pile heads \emptyset :.....mm \emptyset :.....mm		pcs pcs		
8.2	Supplier and mounting of plasticised PVC-profile as surface waterstops for waterproofing of penetrations of pile heads, one side with flat surface, to be fixed at pile head - formwork incl. butt welding and heat welding of waterproofing membrane afterwards, according to specification				
8.2.1	Sika [®] Waterbar type: AR..... width:.....mm effective length		m'		
8.2.2	Sealing of foundation pile head with grouting mortar for the sealing between concrete and waterbar, incl. coating of pile head with EP - layer, type Sikadur [®] -42 \emptyset :.....mm \emptyset :.....mm		pcs. pcs.		



pos.	scope of work	quantity	unit	unit rate	total
9.	Cleaning and inspection of installed waterproofing				
9.1	Cleaning of installed waterproofing with brooms, vacuum cleaner				
9.1.1	Horizontal and sloped areas less than 15%		m ²		
9.1.2	Vertical and sloped areas above 15%		m ²		
9.2	Inspection of installed waterproofing and welded seams to check watertightness, incl. repair of detected leaks by onwelding of membrane patches				
9.2.1	Horizontal and sloped areas less than 15%		m ²		
9.2.2	Vertical and sloped areas above 15%		m ²		
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	Waterproofing membrane type: Sikaplan® WP.....		m ²		
10.2.2	Protective layer type:		m ²		
10.2.3	Fixings: PVC laminated metal strip type Sikaplan® WP		m'		
10.2.4	Fixings: stainless steel strip, type/size.....		m'		
10.2.5	Fixings: Sikaplan® WP PVC-p disc		pcs		
10.2.6	Sika® Waterbar, type		m'		
10.2.7	Control- and injection flanges, type:.....		pcs		
10.2.8	Cleaner, Sikaplan® WP Cleaner 2000		lt		

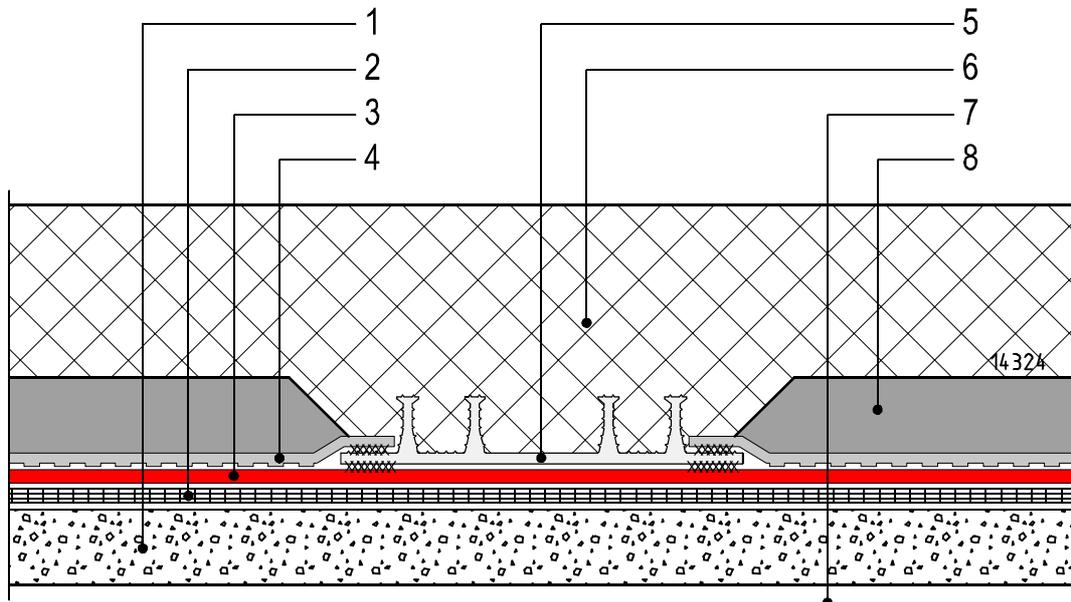


pos.	scope of work	quantity	unit	unit rate	total
10.3	Equipment / tools				
10.3.1	Hire of el. heat welding gun (hand welder and pressure roller)		h		
10.3.2	Hire of el. heat welder (automatic)		h		
10.4.1	Hire of el. submersible pumpl/min.		h		
10.4.2	Hire of compressor.....l/min.		h		
10.4.3	Hire of el. generating set.....V		h		
10.4.4	Hire of el. switch box		h		
10.4.5	Hire of movable scaffolding / staging		h		



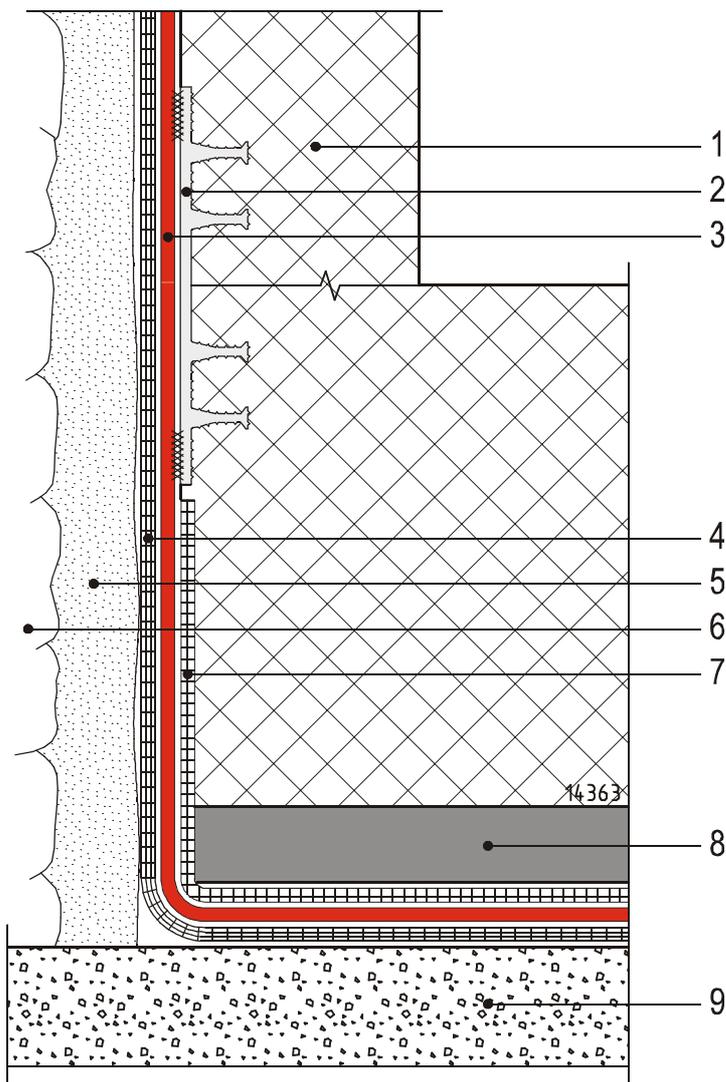
9. STANDARD DETAILS

Floor assembly with waterbar:



1	Substrate: blinding concrete
2	Protection layer: geotextile PP 500 to 1000 g/m ²
3	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
4	Protection layer: geotextile PP 500 to 1000 g/m ² and separation- / slip layer PE film, thickness > 0.20mm, or alternatively Sikaplan® WP protection sheet -HE
5	Compartment with PVC-p waterstop: Sika® Waterbar type AR
6	Reinforced concrete
7	Consolidated ground
8	Protective mortar screed

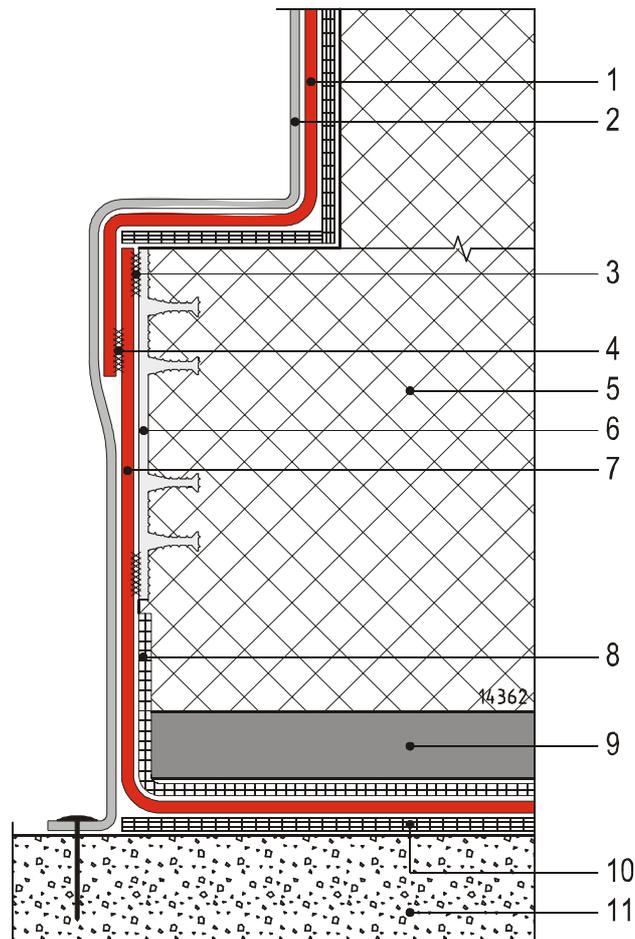
Floor to wall intersection joint, with waterbar



1	Reinforced concrete
2	Compartment with PVC-p waterstop: Sika® Waterbar type AR
3	Waterproofing: Sikaplan® WP 1100 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® WP protection sheet -HE
8	Protective mortar screed
9	Substrate: blinding concrete

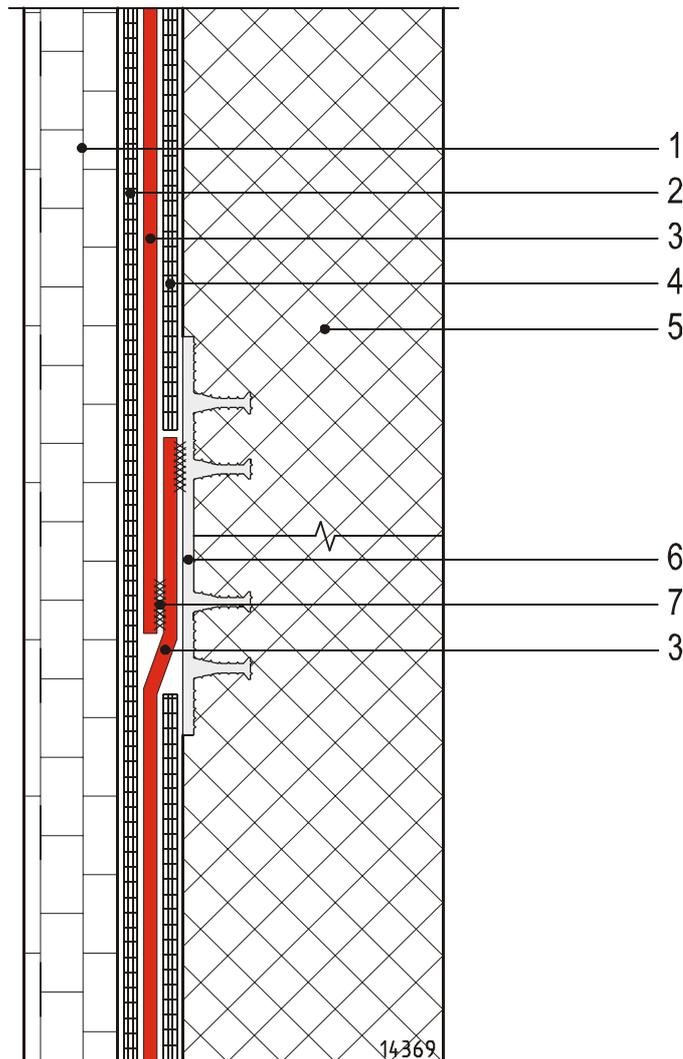


**Floor to wall intersection joint with flat joint
 (wall sealing in second phase from external side)**



1	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
2	Protective layer: geotextile PP 500 to 1000 g/m ² , or alternatively Sikaplan® WP protection sheet -HE
3	Heat welding of Sika® Waterbar type AR to Sikaplan® WP 1100 waterproofing membranes
4	Heat welding of Sikaplan® WP 1100 waterproofing membranes
5	Reinforced concrete
6	Compartment with PVC-p waterstop: Sika® Waterbar type AR
7	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
8	Protective layer: geotextile PP 500 to 1000 g/m ² and separation- / slip layer PE film, thickness > 0.20mm, or alternatively Sikaplan® WP protection sheet -HE
9	Protective mortar screed
10	Protective layer: geotextile PP 500 to 1000 g/m ²
11	Substrate: blinding concrete

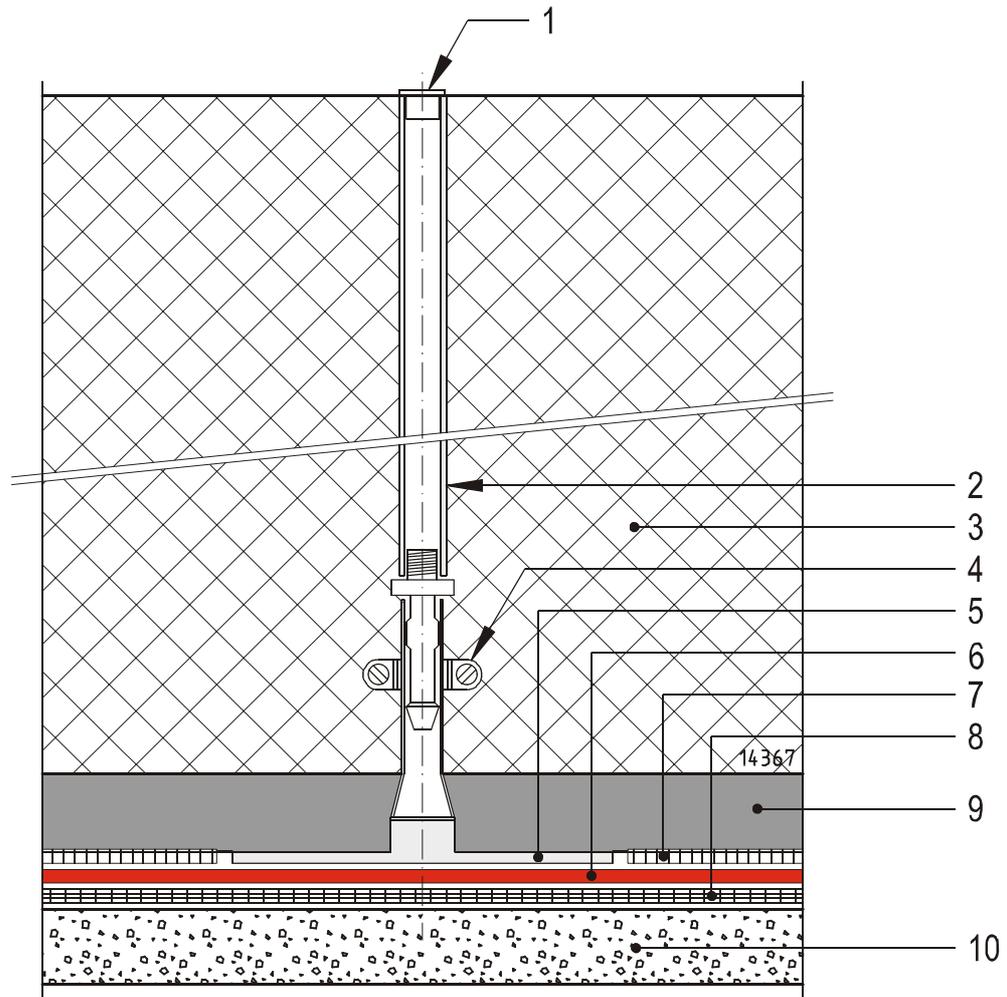
Wall compartment joint with Sika Waterbar; Sikaplan waterproofing membrane hot welded onto it (plan view)



1	Protection with brickwork or reinforced concrete layer
2	Protective layer: geotextile PP 500 to 1000 g/m ²
3	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
4	Protective layer: geotextile PP 500 to 1000 g/m ²
5	Reinforced concrete
6	Compartment with PVC-p waterstop: Sika® Waterbar type AR
7	Heat welding

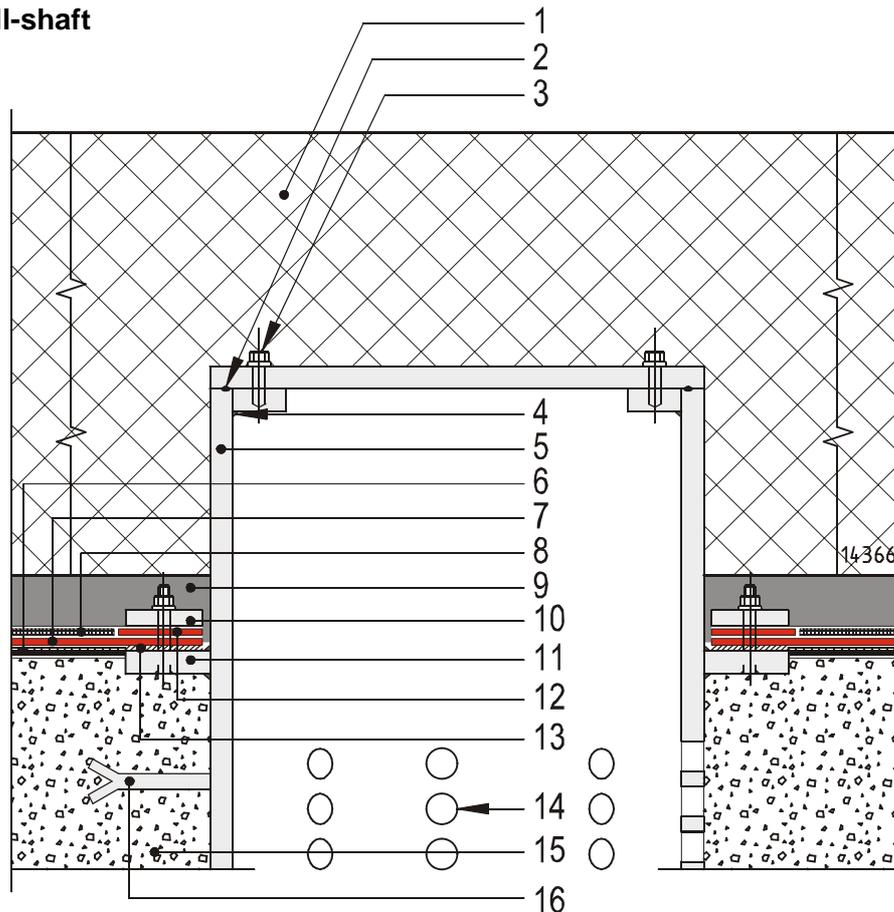


Detail of control-/ injection pipe for compartment system with trumpet-flange



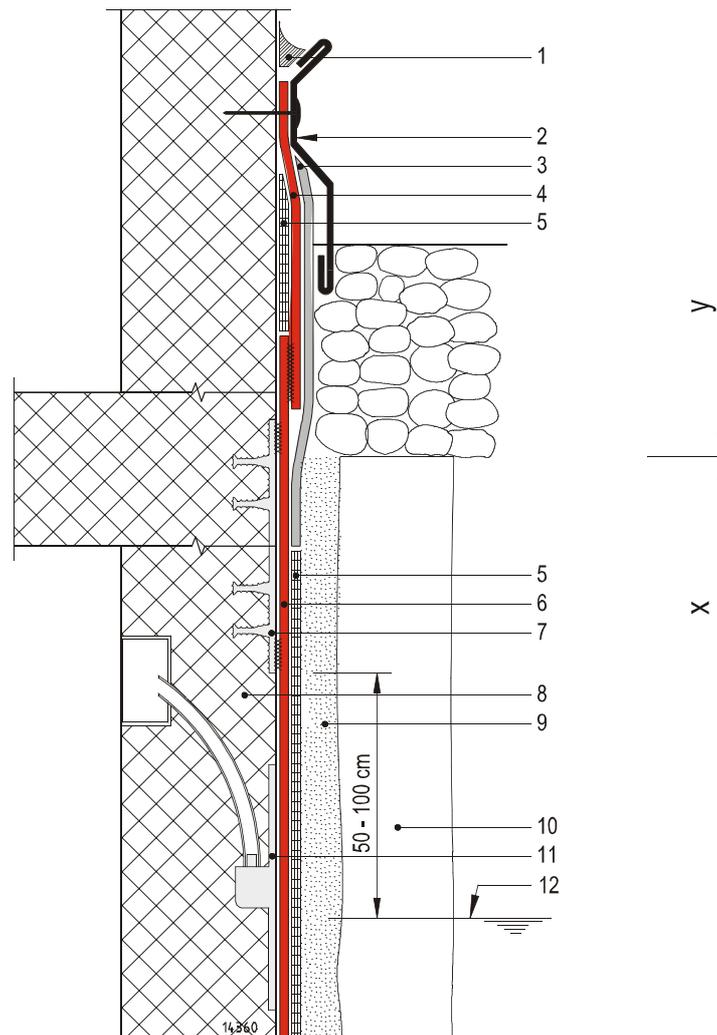
1	Cover nut, supplied by others
2	Steel pipe with internal threaded hole (approx. 1/4") supplied by others, length according to wall/slab thickness, temporary fixed with wires at reinforcement bars
3	Reinforced concrete
4	Clamping rings, hose nipple Ø 18 mm with external threaded hole (approx. 1/4") supplied by others
5	Sikaplan® WP trumpet flange, pipe Ø 18 mm, length 168 mm, flange Ø 200 mm, spotwise hot air welded at the waterproofing membrane
6	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
7	Protective layer: geotextile PP 500 to 1000 g/m ² and separation- / slip layer PE film, thickness > 0.20mm, or alternatively Sikaplan® WP protection sheet -HE
8	Protective layer: geotextile PP 500 to 1000 g/m ²
9	Protective mortar screed
10	Waterproofing substrate according to specification

Well-shaft



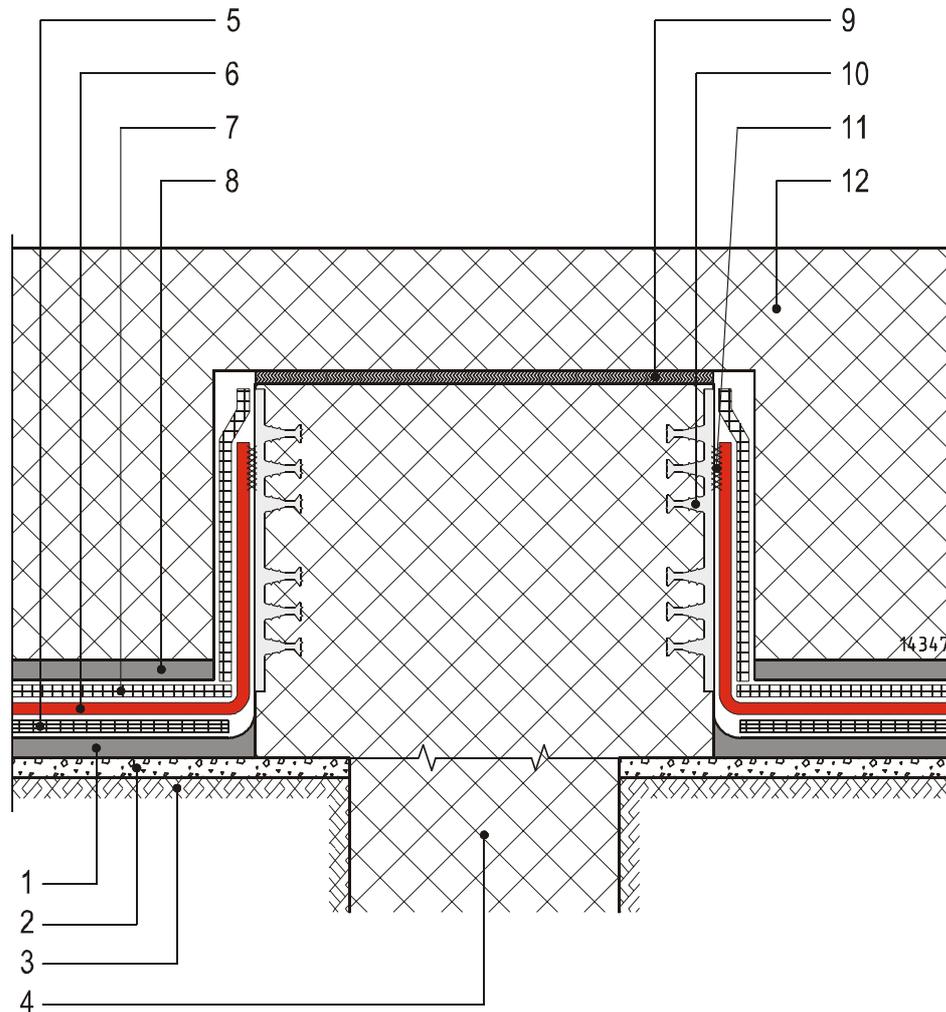
1	Reinforced concrete
2	Rubber sealing ring
3	Cover bolts in blind holes
4	Fix clamp flange for closing cover, welding watertight
5	Steel pipe
6	Protective layer: geotextile PP 500 to 1000 g/m ²
7	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
8	Protective layer: geotextile PP 500 to 1000 g/m ² and separation- / slip layer PE film, thickness > 0.20mm, or alternatively Sikaplan® WP protection sheet -HE
9	Protective mortar screed
10	Pressure flange ring
11	Clamp flange ring with threaded bolts, ring tight welded to steel pipe
12	Additional membrane layer for clamp sealing in pressure flange
13	Appropriate flat gasket
14	Drain holes
15	Drainage layer
16	Steel anchor

Wall flashing; change from pressure to non pressure water



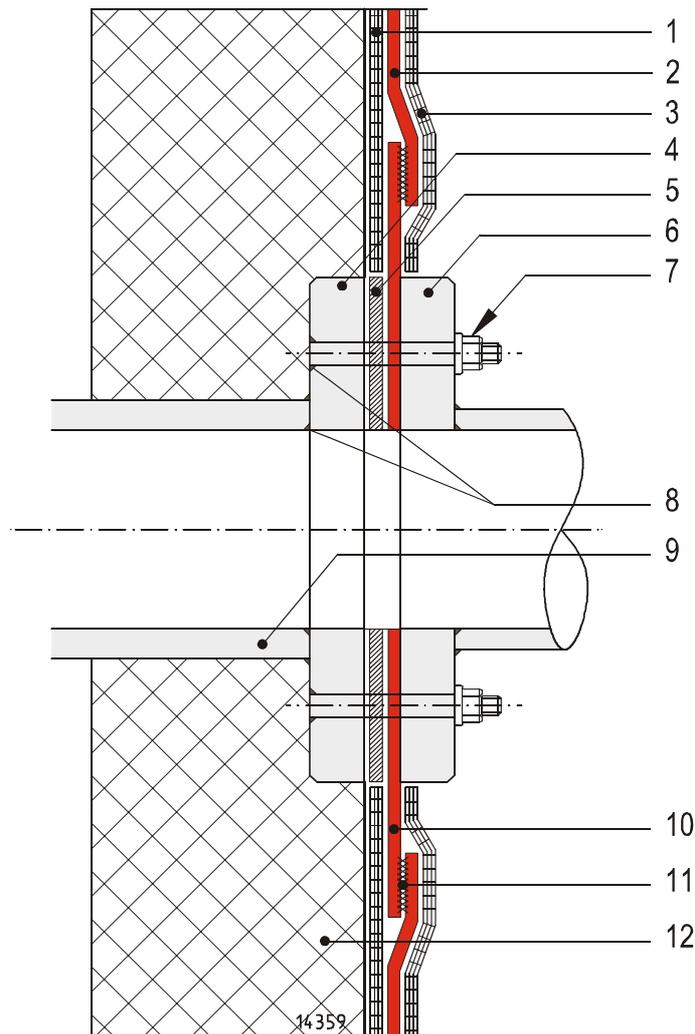
1	Sealant: Sikaflex® 11FC incl. primer for metal and concrete substrate
2	Metal flashing
3	Sikaplan® WP protection sheet-15H/-20H
4	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
5	Protective layer: geotextile PP 500 to 1000 g/m ²
6	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
7	Compartment with PVC-p waterstop: Sika® Waterbar type AR
8	Reinforced concrete
9	Wall - substrate: shotcrete, or formworked concrete
10	Diaphragm wall: reinforced concrete
11	Sikaplan® WP control and injection socket 14 mm PVC only spot welded onto membrane, alternatively Sikaplan® WP trumpet flange, pipe Ø 18 mm, length 168 mm, flange Ø 200 mm, spotwise hot air welded at the waterproofing membrane with steel pipe
12	Groundwater level
Y	Area positive waterproofing application
X	Area negative waterproofing application

Typical flashing detail at pile heads



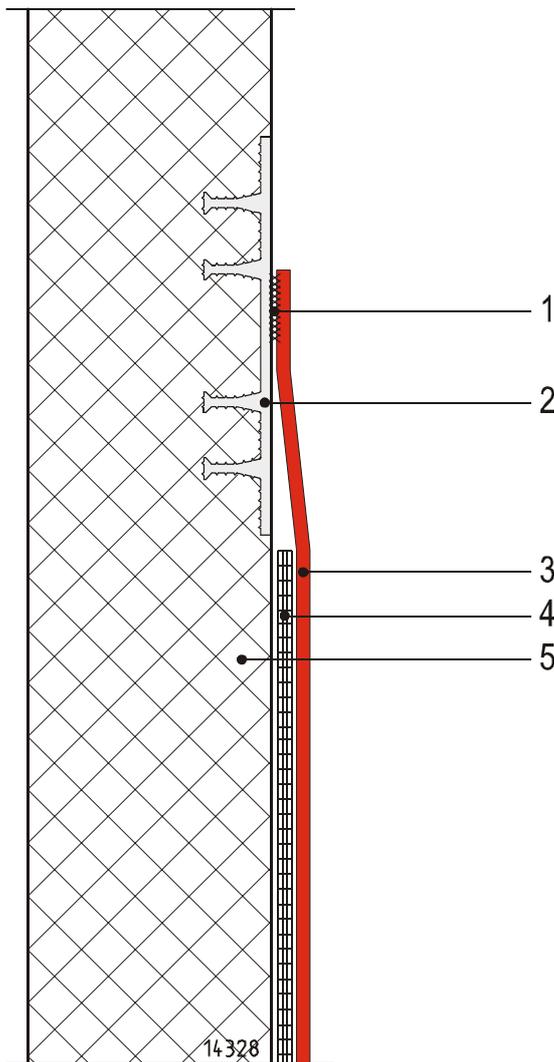
1	Protective mortar screed
2	Substrate: blinding concrete
3	Consolidated ground
4	Foundation pile: reinforced concrete
5	Protective layer: geotextile PP 500 to 1000 g/m ²
6	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
7	Protective layer: geotextile PP 500 to 1000 g/m ² and separation- / slip layer PE film, thickness > 0.20mm, or alternatively Sikaplan® WP protection sheet -HE
8	Protective mortar screed
9	Rigid waterproofing layer with Sikadur® – 42 EP-resin
10	Waterproofing intersection with PVC-p waterstop: Sika® Waterbar type AR around pile head
11	Heat welding of Sikaplan® WP 1100 waterproofing membranes on Sika® waterbar
12	Reinforced concrete

**Pipe penetrations
 With double clamped flange (for area positive waterproofing application)**



1	Protective layer: geotextile PP 500 to 1000 g/m ²
2	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
3	Ev. protective layer: geotextile PP 500 to 1000 g/m ² and separation- / slip layer PE film, thickness > 0.20mm, or alternatively Sikaplan® WP protection sheet -HE
4	Fixed clamp flange, stainless steel
5	Appropriate flat gasket
6	Loose clamp ring, stainless steel
7	Bolt with locking nut and tapered washer, stainless steel
8	Watertight weld
9	Pipe, stainless steel
10	Prepared piece of waterproofing membrane Sikaplan® WP with press cut hole for bolt
11	Heat welding
12	Reinforced concrete

Watertight wall joint to Sika waterbar



1	Heat welding
2	Compartment with PVC-p waterstop: Sika® Waterbar type AR
3	Waterproofing: Sikaplan® WP 1100 waterproofing membranes
4	Protective layer: geotextile PP 500 to 1000 g/m ²
5	Reinforced concrete
-	Protective, drainage and slide layer according to project requirements
-	Protection layer adapted to backfill material (earth, gravel etc.). Backfill material placed and compacted in layers

