WATERPROOFING
SIKA WHITE BOX CONCEPT

FOR WATERTIGHT CONCRETE STRUCTURES

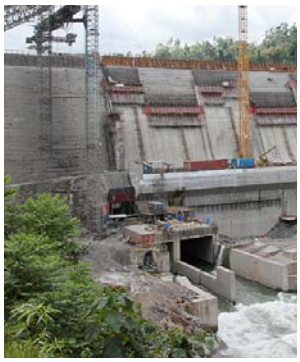
BUILDING TRUST

SIKA WHITE BOX CONCEPT – AN INTEGRAL WATERPROOFING SYSTEM

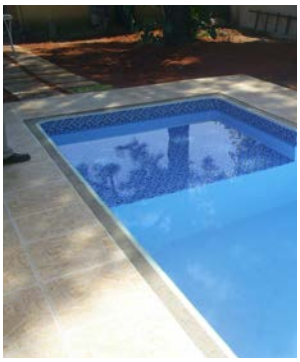
BASEMENTS AND OTHER BELOW GROUND STRUCTURES usually need to be watertight. The Sika White Box Concept is one of Sika`s waterproofing solutions to improve the internal living environment with increased comfort and options for use. It is a rigid and integral waterproofing system with a high durability of the entire life period of the project. The Sika White Box Concept consists of several different components including the overall design and a complete waterproof concrete mix design for integral watertight construction, plus appropriate joint waterproofing solutions. It also provides recommendations and guidance on the best methods to construct a watertight structure and to prevent the entry of water from the surrounding ground for the long-term. The concept also fully considers and evaluates the ground water, exposure stress and different environmental conditions.
To meet the requirements of the owners, architects, engineers and contractors on site, Sika has compiled the most complete and comprehensive range of products and systems for the use in the Sika White Box Concept.

TYPICAL APPLICATIONS

RESERVOIRS AND WATER TANKS



DAM CONSTRUCTIONS



SWIMMING POOLS

INDUSTRIAL FACILITIES

INFRASTRUCTURE PROJECTS

COMMERCIAL OFFICE BUILDINGS

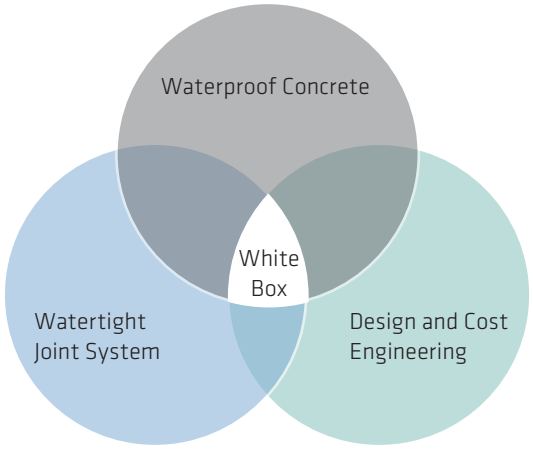
RESIDENTIAL BUILDINGS

UNDERGROUND PARKING AREAS

THE SIKA WHITE BOX CONCEPT

SIKA WHITE BOX CONCEPT

Engineered Waterproofing with the rigid and integral Sika White Box Concept defines a complete watertight concrete construction that includes a full range of concrete admixtures for the production of Waterproof concrete, a complete spectrum of products for Watertight Joints and detailed design details and crack limitation, as well as Cost Engineering for complex structures.



WATERPROOF CONCRETE

Waterproof Concrete describes only the concrete that is impermeable to water and is focused on the quality and performance of the concrete, which has been modified using concrete admixtures such as superplasticizers, pore blockers, capillary crystalline materials and others to achieve its integral watertightness.

WATERTIGHT JOINT SYSTEM

Building a below ground concrete basement will include various working steps that incorporate construction and movement joints as well penetrations. All joints and penetrations must have a joint sealing solution to be watertight.

DESIGN AND COST ENGINEERING

To ensure that the appropriate level of watertightness can be achieved, appropriate consideration and guidance for the concrete, the structural design, construction and the concreting works on site must be taken into account.

The Sika White Box Concept has the additional advantage of relatively simple and fast installation without additional protection of the waterproofing materials being required. This is therefore also an extremely cost efficient solution. The watertight joint systems are mainly installed parallel to the reinforcement and shuttering work. No additional time window for their installation is required. Therefore working procedures on site reduce and the building time and costs for the basement decrease.

Additionally, in the event of any damage or leaks, this is easy to locate and can be repaired by injection of limited areas. This includes the injection of cracks in the waterproof concrete and in all different kind of joints. A range of injection materials are available from Sika for these applications and requirements.

Performance Characteristics:

- Rigid waterproofing system
- Use for rising capillary, seepage and pressure water (As BS Grades 1–3)
- Watertight but not water vapour-tight
- Use for non-moving ground conditions where the groundwater is not aggressive to concrete (without additional surface protection),
- Very high durability
- Reduced working procedures
- No additional protection needed
- Limited chemical resistance – as concrete

Use:

- For non-moving structures and less aggressive environments (without additional concrete protection)

SIKA WHITE BOX CONCEPT: SYSTEM COMPONENTS

The Sika White Box Concept can be used for different methods of construction including open-cut construction, precast and construction with diaphragm walls.

A In-Situ Concrete

B Diaphragm Wall

C Precast elements

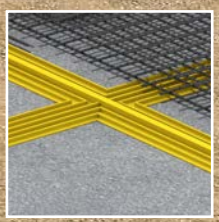
1

Waterproof concrete

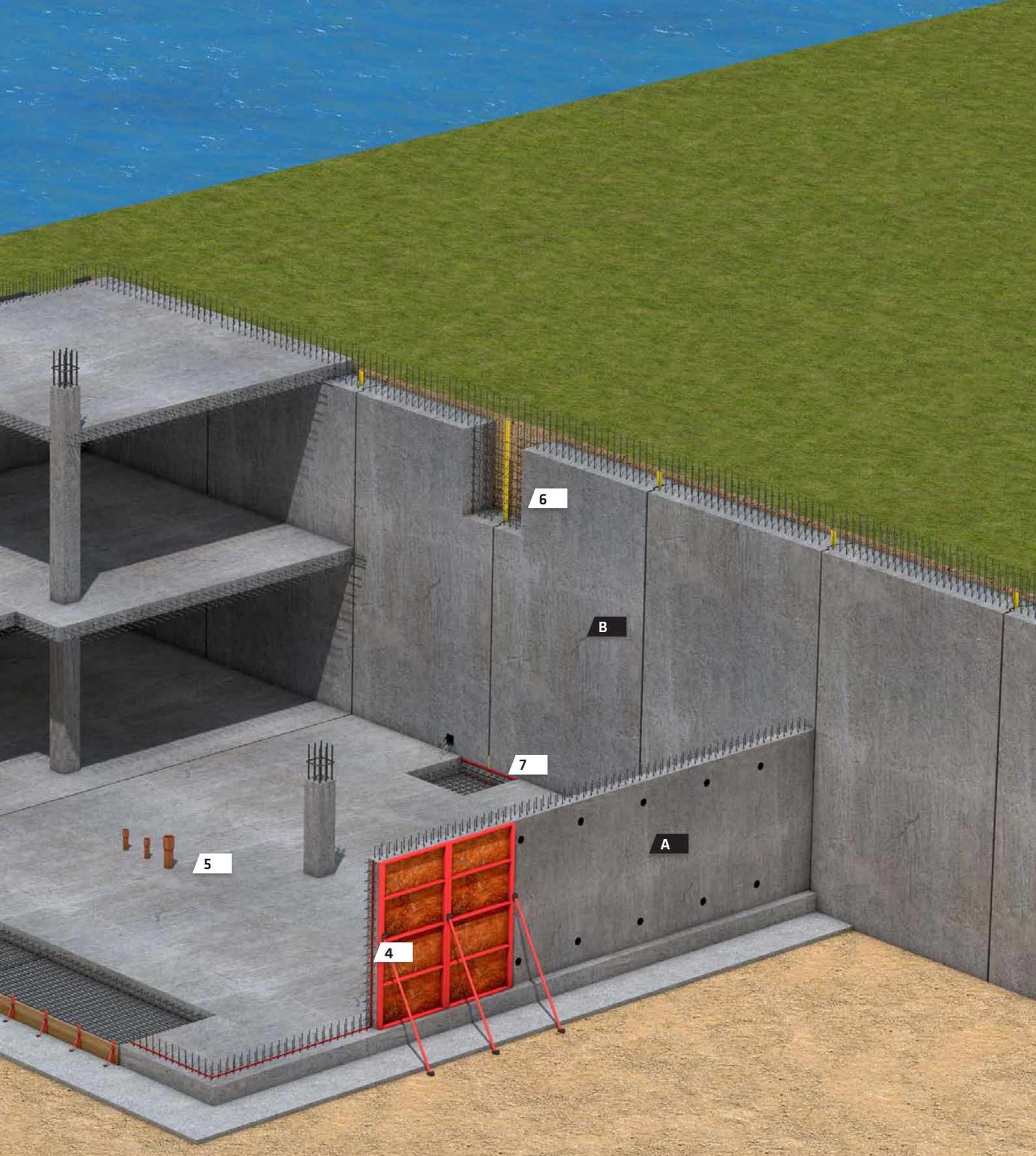
2

Connection joint between of precast elements

3



Movement and construction joint



4

Construction joint

5

Sealing of penetrations

6

Connection joint with aof diaphragm wall

7

Connection joint for of diaphragm wall to floor slabs

SIKA WHITE BOX CONCEPT: USE AND LIMITS

IT IS ESSENTIAL FOR THE SUCCESS of any watertight project to consider all of the requirements in service and the advantages and limitations of the whole waterproofing concept from the earliest point in the design process.

Dependent on the surrounding ground water conditions, the specific structure, its exposure and the construction process a full range of alternative materials and systems are available. These include the waterproof concrete which needs to meet our high quality standards, but also all details such as joints, connections and penetrations. A building is only as watertight as its weakest point.

The Sika White Box Concept can be used for limited exposure and only for non-moving and environments not aggressive to concrete.

DEGREE OF WATERTIGHTNESS REQUIRED (AS DESCRIBED IN BS 8102)

Can be achievedreached with the Sika White Box Concept

Can only be achievreached with barrier systems

Grade 1	Grade 2	Grade 3	Additional requirements
Basic utility Seepages and damp areas tolerable	**Better utility** No water penetration, damp areas tolerable	**Habitable** No water penetration acceptable, ventilation and dehumidification required	**As Grade 3 plus** ■ No water vapour penetration ■ Complete dry environment ■ Thermal insulation ■ Gas barrier ■ Protection against chemical attacks
			
■ Underground car parks ■ Plant rooms ■ Workshops	■ Storage areas ■ Plant rooms ■ Workshops	■ Residential areas ■ Underground car parks ■ Service Areas ■ Workshops	■ Strorage rooms ■ Archival rooms ■ Living rooms ■ Leisure centres

ADVANTAGES AND BENEFITS

OWNERS

ADVANTAGES FOR OWNERS

SIKA WHITE BOX CONCEPT:
- Long term experience
- Long service life
- No architectural effects

BENEFITS FOR OWNERS:

PERFORMANCE:
- Resistant to percolating water and water under pressure
- Time and material cost savings
- Delivers maximum footprint and useable space
- Long term durability

CONSULTANTS

ADVANTAGES FOR CONSULTANTS

SIKA WHITE BOX CONCEPT ALLOWS:
- Standard structural concrete and sealing functions
- Freedom of design
- High security with the possibility of back-up systems
- Tested and approved system for many years
- Different performance levels available for different requirements

BENEFITS FOR CONSULTANTS:

COST EFFECTIVE:
- Larger concreting steps
- No additional time for the waterproofing materials application
- Easy refurbishment if necessary
- Simplified structural design and construction methods

CONTRACTORS

ADVANTAGES FOR CONTRACTORS

SIKA WHITE BOX CONCEPT:
- Easy and fast installation of all components
- Easy to control and test the quality of application
- Easy to repair
- Easy detailing
- Different products available to meet different requirements

BENEFITS FOR CONTRACTORS:

QUALITY:
- Easy and reliable systems
- Easy to repair and maintain
- Time saving
- Eliminates additional materials and operations on site

WATERPROOF CONCRETE

THE IMPERMEABILITY OF CONCRETE AGAINST water penetration is determined by the impermeability of the binder matrix, i.e. the capillary porosity. The pores are the potential migratory paths for water through the concrete. Therefore normal concrete can be described as a porous material that allows the passage of water.

The impermeability of concrete can be improved by adding special components. Active components will form non-soluble materials throughout the pores and capillary structure of the concrete and effectively seal the concrete permanently against the penetration of water and other liquids.
In addition there are other special ingredients which can enhance the self-healing properties of concrete and which improve the concrete's ability to heal any cracks that form.
The water impermeability of a structure is defined by the limitation of water permeability through the concrete. The volume of water that penetrates into the concrete structure on one side has to be lower than the volume of water that can evaporate at the opposite side. The water conductivity test is a measurement of this performance.

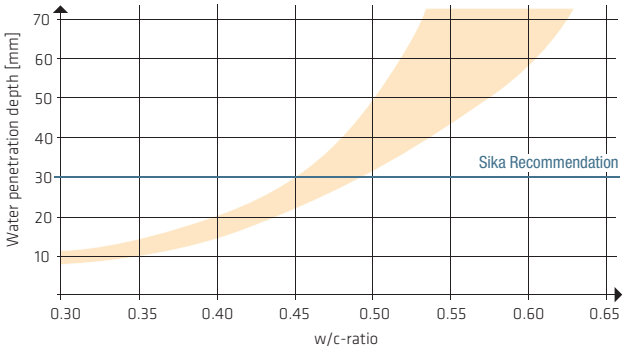
Different requirements regarding the limitation of water permeability through the concrete must be fulfilled to achieve a waterproof concrete.

The most important performance criteria of the concrete are:
- Water penetration depth <30 mm
- Water conductivity <6 g /m²/h
- Drying shrinkage <0.05%
- Water absorption
- Self healing properties

With the use of Sika products this performance can be positively enhanced.

WATER PENETRATION DEPTH

- Max. penetration depth has to be agreed by the involved parties (Sika recommendation <30 mm)
- Requirement: Good concrete quality and the right solutions for joint design and sealing!

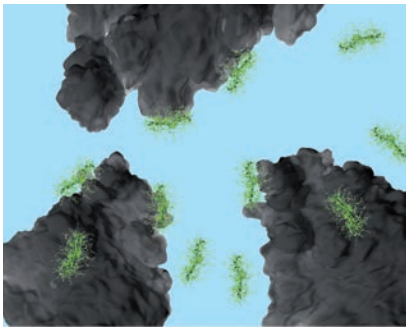


SIKA WATERPROOF CONCRETE MIX DESIGN AND PROPERTIES

Components	Description	Example formula	
Aggregates	Any quality aggregates possible	All aggregate sizes are possible	
Cement	Any cement meeting local standards	350 kg/m³	
Powder additives	SikaFume® (max. 40%)	Suficient fines content by adjustment of the binder content	
Water content	Fresh water and recycling water with requirements regarding fines content (max.40%)	Water/cement ratio according to standards with regard to exposition	<0.45
Concrete admixtures	Superplasticizer Type dependent on placement and workability method, requirements and time	Sika® ViscoCrete® or SikaPlast® or Sika Plastocrete® Sika® WT-200 P	0.60 – 1.50% 1.00 – 2.00%
Installation requirements	Curing compound	Subsequent curing to ensure high quality (compactness) of surfaces Sika® Antisol®	

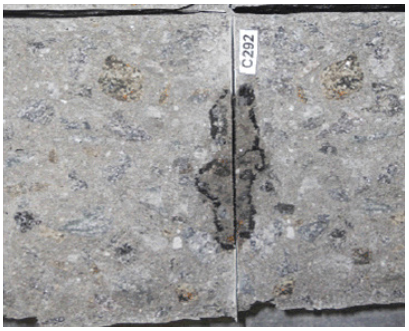
PRODUCTS USED IN MIX DESIGNS FOR SIKA WATERPROOF CONCRETE

SUPERPLASTICIZER



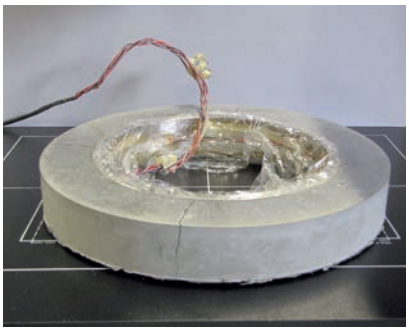
Sika® ViscoCrete®
- Substantial water reduction
- Increased strength and impermeability
- Reduction in capillary porosity

WATER RESISTANT ADMIXTURE



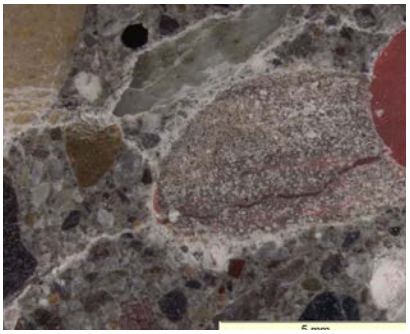
Sika®-1+
- Reduced water conductivity
- Improved water impermeability

SHRINKAGE REDUCING ADMIXTURE



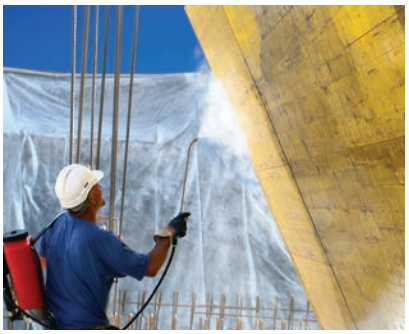
SikaControl®-40
- Reduced drying shrinkage and cracking
- Reducing permeability
- Increasing concrete durability

WATER RESISTING AND CRYSTALLINE ADMIXTURE



Sika® WT-200 P
- Reduced water conductivity
- Improved water impermeability
- Enhances the self-healing properties of the concrete

MOULD RELEASE AGENT



Sika® Formol
- Easier striking and cleaning
- No adverse effect on concrete surface
- Visually perfect surfaces

CURING AGENT

Sika® Antisol®
- Protection from premature drying
- Increasing concrete durability

JOINT SEALING – CONSTRUCTION JOINT

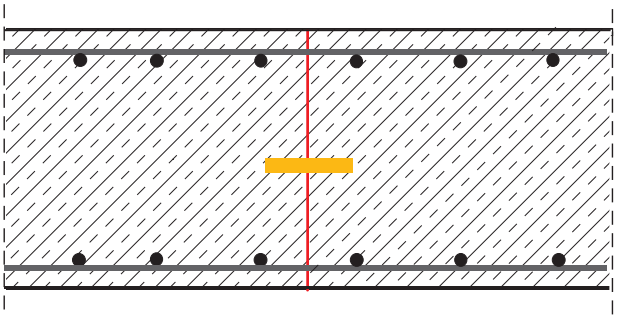
DUE TO THE NATURE OF CONCRETE AND REINFORCED CONCRETE, structures must always be built divided into sections by forming joints. construction joints are necessary-products used for the sealing of construction jointsbecause of these concreting steps (construction or day-work joints).

Waterstops should be used to stop the water transmission at joints and therefore must be installed in all joints to produce a closed joint sealing system.

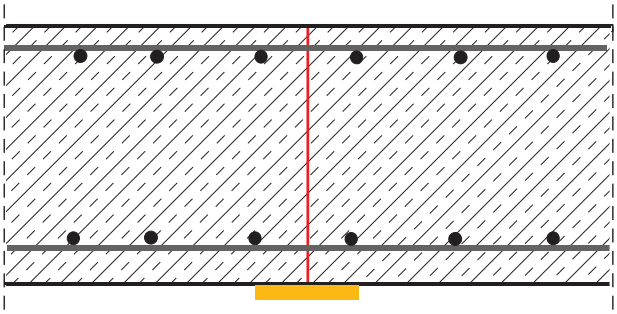
There are a range of waterstops for different requirements, tested and approved to meet local regulations and specifications.

- Hydrophilic Gaskets (profiles and sealants)
- Thermoplastic Waterbars
- Adhesive Tapes
- Injection Hose systems

CONSTRUCTION JOINT WATERSTOP, INTERNAL



CONSTRUCTION JOINT WATERSTOP, EXTERNAL



The positioning of the waterstop should be appropriate for the method of construction and the risk level.

PRODUCTS USED FOR THE SEALING OF CONSTRUCTION JOINTS

HYDROPHILIC GASKET INTERNAL

SikaSwell®
- Highly economical
- No influence on formwork or reinforcement
- Can be used as a back-up system
- Tested and approved system
- Alternative profiles available for different requirements

ADHESIVE TAPE EXTERNAL

Sikadur-Combiflex® SG
- Approved for the use in contact with drinking water
- Easy adaptable to the construction method
- Excellent adhesion to different substrates

THERMOPLASTIC WATERBAR INTERNAL/EXTERNAL

Sika® Waterbar
- Easy design of closed systems for construction and expansion joints
- Easy connections by welding
- Pre-fabricated waterstop systems are possible
- Internal and external waterstops available

INJECTION HOSE SYSTEM INTERNAL

SikaFuko®
- Suitable for high requirements
- No influence on formwork or reinforcement
- Stand alone or back up-systems
- A good injection fills the complete joint and prevents any entry of water
- Re-injectable systems

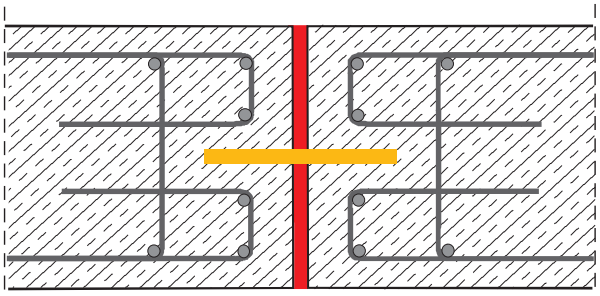
JOINT SEALING – MOVEMENT JOINT

SPECIAL ATTENTION SHOULD BE given to the use of waterstops at movement joints. Movement joints are necessary because of movement in the structure as a result of settlement, traffic loads, shrinkage or other causes.

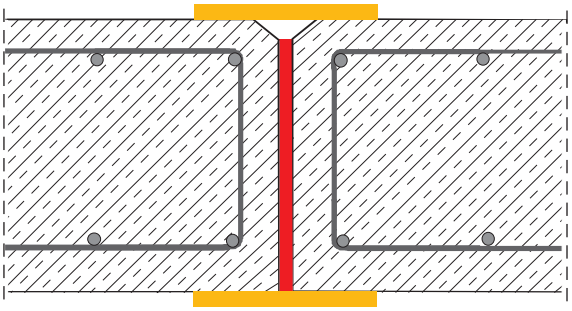
In addition to the function of the waterstops to act as a waterproofing seal in the joint, the waterstop should allow the sections to move independently of each other – without restriction (free from tension).

Construction and movement (expansion) waterstops must create a closed waterproofing system. For sealing and waterproofing of the concrete structure, waterstops are installed in all of these types of joints.

EXPANSION JOINT WATERSTOP, INTERNAL



EXPANSION JOINT WATERSTOP, EXTERNAL



Where internal waterstops are used, correct fixing is essential to keep the waterstops in place during the concreting operations. Good compaction of the concrete around the waterstops is also necessary to avoid paths for water ingress.

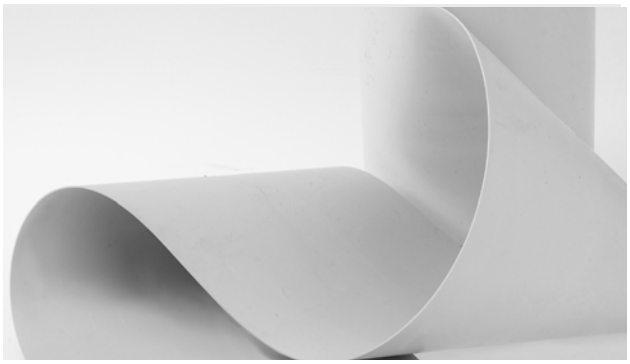
PRODUCTS USED FOR THE SEALING OF MOVEMENT JOINTS

THERMOPLASTIC WATERBARS INTERNAL/EXTERNAL

Sika® Waterbars

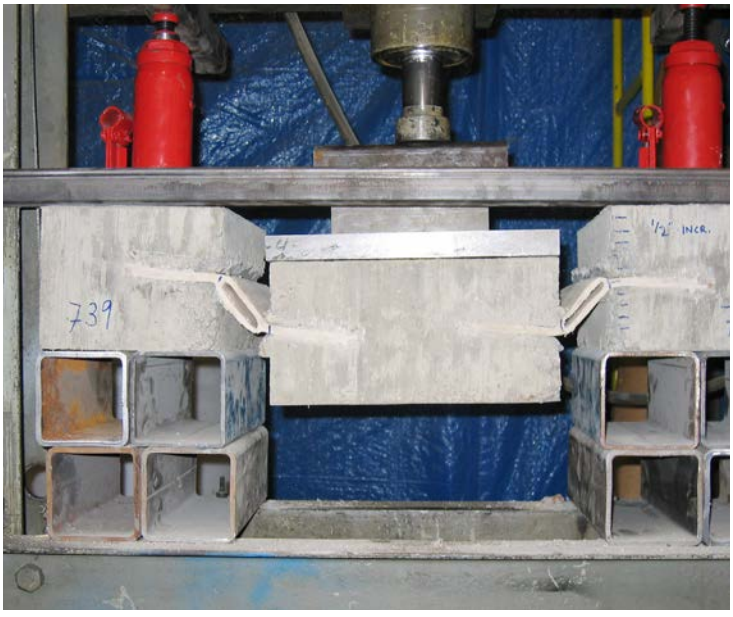
- Easy design of closed systems for construction and expansion joints
- Different products, shapes and sizes for diverse requirements (load and exposure)
- Customized sealing system solutions for different technical, practical and economic requirements
- Resistant to many aggressive media
- Pre-fabrication of waterstop system possible
- Long term experience
- Long service life

BONDED TAPES – EXTERNAL (POSITIVE SIDE)



Sikadur-Combiflex® SG

- Approved use in contact with drinking water
- Easy adaptable to the construction program
- Excellent adhesion to different substrates
- Highly flexible
- Easily maintained



JOINT SEALING – CONNECTION JOINT

BESIDE THE STANDARD APPLICATION of sealing products in construction and movement joints the sealing of any other connections and joints is also necessary, such as connections between precast concrete elements, different materials and different parts of diaphragm walls and the connections between diaphragm walls and floor slabs.

PRECAST ELEMENTS

These are supplied directly to site and the joints between them need to be sealed after installation. Post applied systems such as Bonded Tape systems can ensure their watertightness.

DIAPHRAGM WALL (DW)

Diaphragm walls are made in many single segments in different building methods and systems. The connections between these components need to be sealed to keep the excavation dry and to then use the wall as part of the watertight building envelope. Technologies used to seal DW are thermoplastic waterbars and injection hose systems.

CONNECTIONS BETWEEN DIAPHRAGM WALLS AND THE BASE / FLOOR SLABS

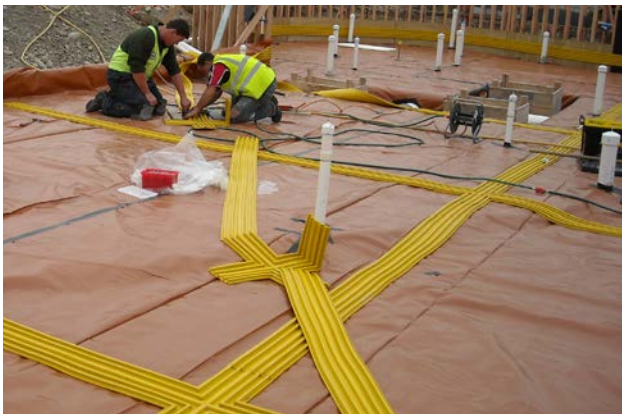
To create a whole watertight structure and system, the joint between the sealed diaphragm wall and the base / floor slabs also needs to be sealed. This can be achieved by using a combination of technologies (e.g. hydrophilic gaskets plus injection hose systems).

PRODUCTS USED FOR THE SEALING OF CONNECTION JOINTS

BONDED TAPES

Sikadur-Combiflex® SG

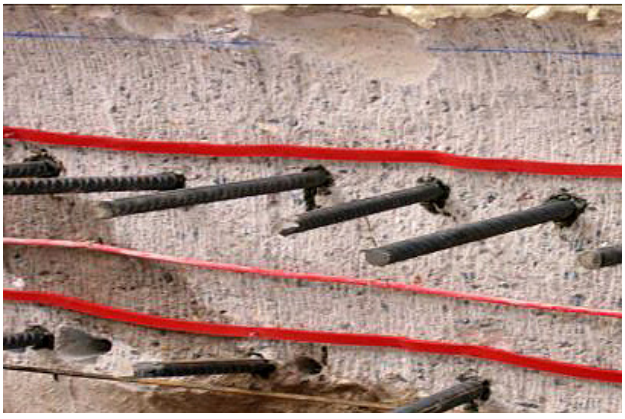
- Sikadur-Combiflex® SG
- Flexible post-applied sealing system
- Excellent adhesion to different substrates
- Highly flexible
- Easily maintained



THERMOPLASTIC WATERBAR

Special Sika® Waterbars

- Different products designed to fit mostly formwork systems
- Durable sealing of the connections between segments
- Systems can be adapted to meet site requirements



INJECTION HOSES AND HYDROPHILIC GASKETS

Combination of different products to reach best results:

SikaFuko®

- SikaFuko® injection hose systems to seal all remaining gaps between the different sealing layers

SikaSwell®

- Double function of SikaSwell® as a sealing system and to control the limits of the injection

WATERPROOFING DETAILS – PENETRATIONS, ISOLATION JOINTS, FORM SPACERS

ENGINEERED WATERPROOFING is all about the details. Therefore, details such as sealing around formwork spacers, service entries, isolation joints between different material and pipe penetrations also have to be considered.

Very effective solutions to seal such details are SikaSwell® swellable profiles and sealants. The SikaSwell® products develop an expansive swelling pressure between the expanding SikaSwell® and the surrounding concrete structure. This blocks the penetration of water through the joint and provides a durable waterproofing solution.

SikaSwell® PRODUCTS USED FOR WATERPROOFING DETAILS

ISOLATION JOINTS

SikaSwell® can seal the isolation joints between different materials very easily. It can be applied or bonded to many different substrates as well as concrete, including stone, metals and many plastics.

PENETRATIONS

Waterproofing details are required at all types of penetrations. The SikaSwell® system using sealants and different shaped profiles can meet many different requirements.

There are different materials, products and methods used to seal the waterproofing details. Besides the swellable products the post-applied bonded tape Sikadur-Combiflex® SG system is a reliable and easy to apply sealing solution for such details and creates a closed waterproof ing system. The Sikadur-Combiflex® SG system is adjustable to different detailing, and highly flexible; therefore it can be used here as well as for sealing construction and movement joints, especially, for waterproofing details such as penetrations and connection joints between precast concrete elements. This system is also useful for the repair of damage to concrete arrises and surfaces, plus their subsequent sealing during maintenance.

Sikadur Combiflex® SG SYSTEM USED FOR WATERPROOFING DETAILS

PENETRATIONS

All penetrations such as service entries or pipe pentrations must be sealed to create a closed sealing system. Sikadur-Combiflex® SG can be used as post applied system to secure such areas and seal them durably.

CONNECTION JOINTS

Connection joints between precast concrete elements need to be sealed after installation of the individual segments. In addition all transitions / connections to in-situ concrete must be sealed – typically using the Sikadur-Combiflex® SG System.

DESIGN AND COST OPTIMIZATION

GENERAL REQUIREMENTS

An optimized design of a basement with a simple shape and few or no offsets and inside corners reduces the stress within the structure. Additional measures to reduce stress in the structure e.g. additional reinforcement and joints can be reduced or eliminated and the construction sequences will be easier and more efficient.

- Simplify design and construction methods
- Buildings have to be designed and built free of excess water and separation cracks
- Any necessary joints have to be sealed in every situation
- The structure, the shuttering system and the reinforcement have to allow good and easy concrete placing
- Consider any aggressive water and the ground conditions

Relevant Standards:

- EU Standard: EN 1992, Eurocode 2 – Design of concrete structures
- UK: National Structural Concrete Specification for Building Construction
- German Standard: DAfStb-Richtlinie – Watertight Concrete Structures

REQUIREMENTS FOR WATERPROOF CONCRETES

An optimized granulometry and w/c ratio; the selection of appropriate type of cement, an improved rheology and the use of admixtures such as shrinkage reducers, pore blockers, superplasticizers, etc. result in limited crack formation within the concrete. A homogenous concrete, without any changes of thickness reduces or eliminates any local stress points.

- Restrained shrinkage and thermal movement to maximum of 0.2 mm (Local specification/standards take precedence if lower than 0.2 mm)
- Aspect ratio should not exceed 3 :1
- Minimum section thickness 200 mm for ground water and percolating water, 240 mm for ground water and percolating water (Minimum cover to joint protection systems can also dictate increases in section thickness)
- Low concrete drop height
- Good flow without segregation and an even distribution
- Good vibration
- Concrete free of voids
- Maximum dimension in horizontal areas of 400 m², in vertical areas the size needs to be adapted according to the height and thickness of the concrete structure.

Relevant Standards:

- EU Standard: EN 1992, Eurocode 2 – Design of concrete structures
- EU Standard: EN 206
- EU Standard: EN 12390-8
- German Standard: DAfStb-Richtlinie - Watertight concrete Structures

REQUIREMENTS FOR JOINT SEALING SYSTEMS

The selection and definition of construction and movement joints has to be carried out according to the exposures and site conditions. Joints should be positioned in order to split the base slab into regular square areas to reduce stress.

- Design, creation and installation of a closed waterproofing system within the reinforced concrete structure in all joints
- Stay within one system and material quality to simplify connections and details
- Stay internal or external with the selected waterstop system to avoid special transitions and effects on the reinforcement
- Waterstops should be installed in their specified position symmetrical to the joint axis, and be fixed so their position can not change or move during concreting works
- Waterstops must be fully enclosed in concrete and the concrete must be free from voids
- Internal Waterstop systems must be designed with the proper clearance between the profile and the adjacent rebar

Relevant Standards:

- German Standard: DIN 18197 – Sealing of joints in concrete with waterstops
- German Standard: DIN 18541 – Thermoplastic sealing strips for sealing joints in in-situ concrete
- German Standard: DIN 7865 – Elastomeric joint sealing strip for sealing joints in concrete
- USA Standard: U.S. Army Corps of Engineers CRD-C-572-74 - Specifications for PVC Waterstop
- USA Standard: U.S. Army Corps of Engineers Engineering Manual EM 1110-2-2102, Waterstops and Other Preformed Joint Materials for Civil Works Structures

REQUIREMENTS FOR REINFORCEMENT

This is the key design element to limit crack formation. The amount of steel reinforcement normally is significantly higher than that needed for the structural integrity only. Calculation of the minimum steel grade and distribution should be carried out by a structural engineer who is familiar with the local standards.

- The selection of structure dimensions and grade of steel reinforcement, maximum diameters and spacing, which allow systematic installation of joint sealing and concrete (including vibration of the fresh concrete for good compaction)
- The amount of steel reinforcement ensures limitation of any cracks in the waterproof concrete to a maximum of 0.2 mm.

Relevant Standards:

- EU Standard: EN 1992, Eurocode 2 – Design of concrete structures
- German Standard: DIN 1045 -1

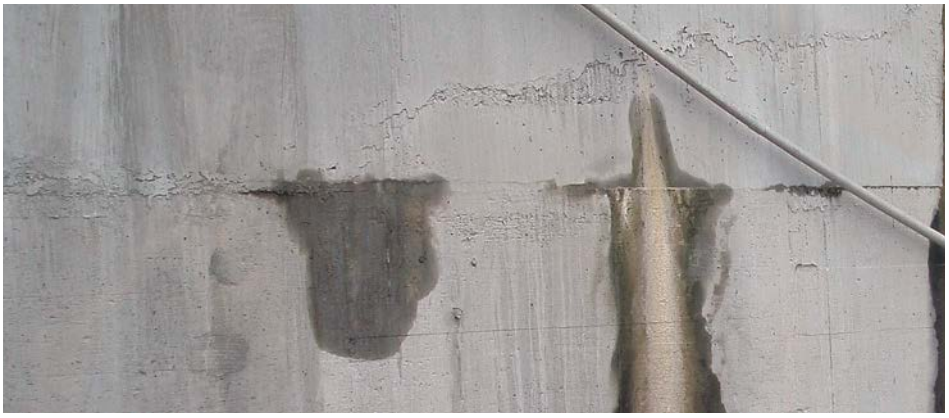
POST – REPAIR SOLUTIONS INJECTION SYSTEMS

SIKA INJECTION SYSTEMS are necessary as post – repair solutions to seal concrete structures. If any leaks occur the Sika injection systems will reliably seal leaking structures so they are subsequently watertight. Due to the possibility of direct detection of any leaks the repair work is focused on the specific area and is therefore highly effective.

TYPICAL PROBLEMS IN WATERTIGHT CONCRETE STRUCTURES

CRACKS IN WATERPROOF CONCRETE

Water bearing cracks in waterproof concrete, as a result of high shrinkage or additional uncalculated external loads e.g. poor concrete quality or loads which cause movement in the structure, such as heavy traffic and high settlement. Packer injection can be used to fill and bridge these cracks durably and to restore structural strength if required.



JOINTS

Movements and construction joints if the joint sealing system is defective, damaged or not properly installed. Construction joints can be sealed using an injection hose system or packer injection in the joint area. Movement joints can also be repaired using packer injection.

AREAS OF WATERPROOF CONCRETE

Leaking areas in waterproof concrete are because of inadequate concrete quality e.g. honeycombing, voids and pores due to poor installation and vibration, or the wrong mix design. Remedial surface sealing by curtain injection of the defects seals the leaks.

SIKA INJECTION TECNOLOGIES USED AS POST REPAIR SYSTEMS

PACKER INJECTION:

Separation cracks and damaged joints can lead to direct and heavy water ingress. This water ingress must be stopped immediately with a fast reacting and expansive material before proceeding with the final repair.

Typical material:
- Sika® Injection-101 RC (Polyurethane)

After the material which was used to stop the water ingress, the leak must be re-injected to seal the structure durably. For wet areas without heavy water ingress the flexible material can be injected directly into the crack or joint area.

Typical materials:
- Sika® Injection-201 CE (Polyurethan)
- Sika® Injection-306 (Acrylate)

Injection can be used not only to seal a structure but also to improve or restore the structural integrity of the concrete structure. Non-moving cracks and non-homogeneous areas can be bonded, filled and sealed with a rigid material.

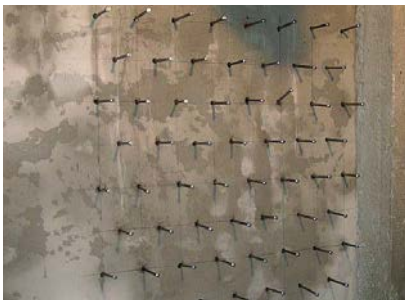
Typical materials:
- Sikadur®-52 (Epoxy)

INJECTION HOSE SYSTEMS:

SikaFuko® injection hose systems are installed before concreting and are ready for use after hardening of the concrete. In the event of any leaks the system allows direct and fast access into most areas of a watertight concrete structure.

Typical materials:
- Sika® Injection-306 (Acrylate)
- Sika® Injection-201 CE (Polyurethane)

CURTAIN INJECTION:



Packers are placed in a grid in or all over the concrete structure to inject the material and create a new water- tight sealing layer.

Typical material:
- Sika® Injection-306 (Acrylate)

SIKA WHITE BOX CONCEPT – WHY SIKA?

Sika provides a full and complete range of products and systems based on all available modern technologies for waterproof concrete and joint sealing systems to meet the specific requirements of each project and structure.

Sika provides technical and practical support not only during the design and specification phase to ensure selection of the right materials and technologies, but also with additional training for engineers and contractors.

GLOBAL BUT LOCAL PARTNERSHIP

FOR MORE WATERPROOFING INFORMATION:

Our most current General Sales Conditions shall apply.
Please consult the Data Sheet prior to any use and processing.

since 1986

since 1997

USGBC

Sika (NZ) Ltd / Sika White Box Concept / 0820

SIKA (NZ) LTD
85 Patiki Road, Avondale
Auckland 1026.
New Zealand

Contact
Phone 0800 745 269

www.sika.co.nz

BUILDING TRUST