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Construction



Sika® Watertight Concrete Construction Technology and Concepts





PHOTOGRAPH ABOVE (Copyright FIFA)
 Project: FIFA Building
 Architect: Tilla Theus und Partner AG, Zürich
 Consulting Engineers (ARGE): Ribi & Blum AG and Romanshorn Andrin Urech & Partner, Zürich
 General Contractor: HRS (Hauser, Rutishauser, Suter AG), Zürich
 Construction organisation (ARGE): Zschokke Bau AG, Zürich, Marti AG, Zürich
 Underground car park using the Sika® Watertight Concrete System

Leading Innovation

Sika are a global company at the forefront of concrete admixture technology. Recognised as a market leader, innovator and a company with the highest quality standards, with an enviable reputation.

The **Sika® Watertight Concrete System** has constantly evolved, utilising the latest admixture technologies to provide continual improvement in performance and ease of use.

At the same time the popularity of the system has increased as clients, specifiers and contractors come to realise the benefits over more traditional methods of waterproofing a structure such as external tanking membranes.

Sika produce a full range of waterproofing solutions including renders, and cavity drainage systems. However, no matter how large or small the project, whether keeping water in or out, the benefits of the **Sika® Watertight Concrete System** are clear.

TIME SAVED at the design and construction stages as the need for external membranes with their inherent complex detailing and installation are eliminated.

COST EFFECTIVE in comparison to membranes and other systems. Delivers maximum usable area to the occupier.

QUALITY backed by Sika warranty, BBA certificate and a 50 year track record.

External membranes can be used to provide a watertight basement. However, such membranes are expensive and demand the highest quality workmanship to ensure their effectiveness. This principle is flawed as explained in *Design and Construction of Deep Basements* (Institution of Structural Engineers: 2004). This highlights that membranes prevent the natural autogenous healing of early age cracks in concrete and encourage drying shrinkage cracks. It is, therefore, better to avoid external membranes and rely on a properly reinforced concrete structure using the **Sika® Watertight Concrete System**.



Our Experience - Your Advantage

- Sika's 100 years experience in the waterproofing business
- The only full range system provider
- Complete solutions including design support and ancillary materials
- Full application training and on-site support
- Faster effective application with increased site productivity
- Proven products and application techniques
- All relevant international and national approvals and standards

FRONT COVER PHOTOGRAPH
 Project: River Crescent, Nottingham
 Architect: Franklin Ellis Architects
 Structural Engineer: BWB Consulting
 Main Contractor: Clegg Construction
 Underground car park for River Crescent - Nottingham Waterside Regeneration Project using the Sika® Watertight Concrete System





PHOTOGRAPH
 Project: Cliffs of Moher Visitor Centre
 Architect: Reddy O'Riordan Staehli Architects
 Structural Engineer: Arup
 Main Contractor: Rohcon
 Interpretive Centre buried below ground,
 constructed entirely using the Sika® Watertight
 Concrete System

Watertight Concrete Construction

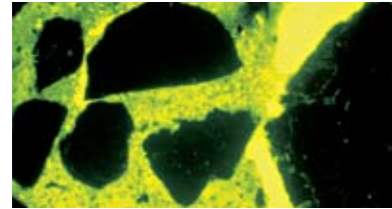
Table 2 Effects of Sika Watertight Concrete Powder on the hardened properties of concrete ⁽¹⁾			
Property	Control Concrete	Sika Watertight Concrete Powder	Test Reference
Water permeability (ms ⁻¹)	9.32 x 10 ⁻¹³	4.75 x 10 ⁻¹³	Taywood/Valenta
Capillary absorption (% by mass of control)			BS EN 480-5
7 day	100	48	
90 day	100	57	
Drying Shrinkage (%)	0.037	0.039	BS 1881-5
Wetting Expansion (%)	0.021	0.023	
Freeze/Thaw	No scaling	No scaling	DD CEN/TS 12390-9
Compressive Strength (Nmm ⁻²)			BS EN 12390-3
24 hours	17.5	28.2	
28 days	57.7	72.2	
Flexural strength (Nmm ⁻²)			BS EN 12390-5
24 hours	2.4	4.1	
28 days	5.7	6.7	
Modulus of elasticity (Nmm ⁻²)			BS 1881-121
28 days	36500	43000	
Water vapour permeability [gm (Ns) ⁻¹]	417 x 10 ⁻¹²	296 x 10 ⁻¹²	BS 3177
(1) The specific effect of the product on these properties, for a particular mix and site conditions should be evaluated through site trials prior to use			

Extract from BBA Certificate No 08/4606

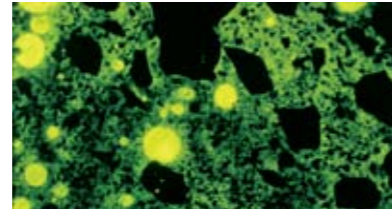
Concrete Technology

Utilising the latest admixture technology, the Sika® Watertight Concrete System is now even more robust in service and easier to produce giving increased confidence to all those involved in any project. A two step process is used to achieve a watertight concrete.

Reducing capillary pores and voids by water reduction



Capillarity with a high w/c ratio: >0.6
 Large pore network and voids due to the high water cement ratio.



Capillarity with a low w/c ratio: 0.45
 Very dense cement matrix, ideal for watertight concrete.

Even good quality concrete will allow the passage of water through it as a function of capillarity, when there is water on one side of the structure and air on the other. The volume of capillary pores in the concrete matrix is proportional to the water/cement ratio.

STEP 1 - reduce the water cement ratio whilst producing a highly workable concrete to aid placement and compaction.

State of the art Sika® ViscoCrete® superplasticisers are used to achieve this.

STEP 2 - block the remaining capillary pores. Sika pore blocking admixture achieves this by producing a hydrophobic layer within the capillary pores.



The Sika® Watertight Concrete System has traditionally used and still does use liquid admixtures.

Through listening to our readymixed concrete customers, Sika have developed the alternative Sika® Watertight Concrete Powder to help make production simpler, particularly for the smaller projects. A powdered version of the Sika® ViscoCrete® superplasticiser and Sika® pore blocker are supplied in a soluble bag and dosed at one bag per m³ of concrete.

The system underwent rigorous testing during its development, has attained a BBA certificate (08/4606) and has proved very popular in the marketplace. Another example of Sika's innovation and product development.

Due to its greatly reduced permeability, the Sika® Watertight Concrete System provides reduced transport of aggressive ions in solution leading to increased durability.

Concrete must be obtained from a supplier with a recognised third party accreditation such as BSI or QSRMC.

Central to the Sika® Watertight Concrete System is the provision of good quality concrete. Sika's minimum requirements for the concrete mix design are:

- Minimum cementitious content: 350kg/m³ (blended cements permitted)
- Maximum water/cement ratio: 0.45

- Admixtures: Sika pore blocker and Sika® ViscoCrete® superplasticiser or Sika® Watertight Concrete Powder
- For sections >500mm Sika suggest CEMIII/B be used to reduce heat of hydration



Watertight Concrete Construction

Joints and Detailing

As well as the concrete technology, it is important to consider how to deal with construction joint protection and any other details that may arise on a project.

Construction Joints

Where to position joints will depend on several factors:

- Pour sequencing
- Aspect ratio of pours. Sika recommend a maximum aspect ratio of 3:1 for example a maximum wall length of 9m to be cast given a wall height of 3m
- The shape of the structure. What is practical?

The type of joint protection chosen will depend on factors such as:-

- Movement or non movement joint
- End use of the basement (defined by BS 8102 Grades 1-4 see page 8/9)
- Site conditions
- Method of construction

Non Movement Joints

SikaSwell® Benefits

- Swells on contact with water
- Easily installed
- Permanently water resistant
- Resistance to most contaminants in surrounding ground
- Protective coating on **SikaSwell® Profiles** prevents premature swelling



SikaSwell® S
Hydrophilic adhesive/sealant

Use to adhere **SikaSwell® Profiles** and **Sika® Injectoflex®** to the substrate as well as sealing around service entries or awkward details



SikaSwell® Profile
Hydrophilic joint profile

Use in construction/day joints.

Available in two sizes

- 20mm x 10mm (2010)
- 20mm x 3mm (2003)

Sika® Injectoflex® Benefits

- Two lines of protection
- Easy to install
- Can be injected or reinjected at any time in the future to seal the joint - due to movement, damage or excessive loading



Sika® Injectoflex® can be adhered to the substrate using **SikaSwell® S** or mechanically fixed

NB SikaSwell® and Sika® Injectoflex® are not suitable for movement joints.



PHOTOGRAPH
Project: Millennium Centre, Cardiff
Architect: Percy Thomas Partnership
Consulting Engineers: Arup
Main Contractor: Sir Robert McAlpine
Basement within this iconic theatre and arts centre constructed using the Sika® Watertight Concrete System

Movement Joints

Sikadur® Combiflex is a high performance joint sealing system consisting of a hypalon sealing strip and **Sikadur®** epoxy adhesive.

Benefits

- Can be installed at any time after the concrete is cast
- Easy to adjust to complicated details
- Easy to control the installation because it is visible
- Easy to repair if needed

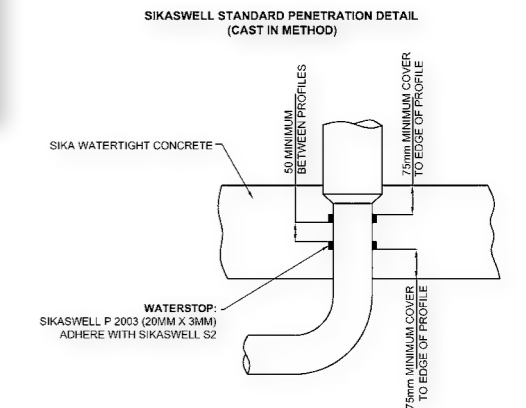
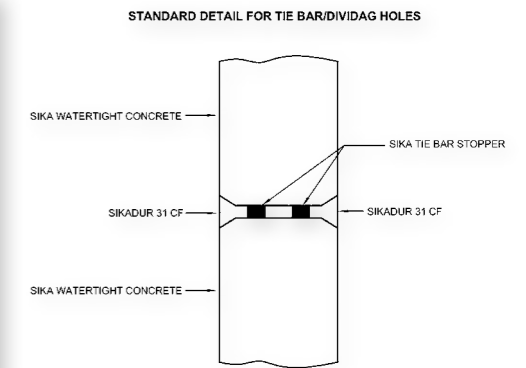
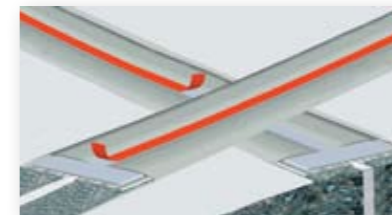
Limitations

- Application more difficult under extreme weather conditions (cold, rain)
- Additional protection needed if used in a trafficked area

Fixings

- If possible, expanding bolts (rawbolts or similar) should be avoided, as over tightening could cause cracking
- When drilling into the concrete, for grades 1-3, 100mm of concrete should be left undrilled, 300mm for grade 4
- Recommend using **Sika® AnchorFix®** epoxy anchoring adhesive for fixing of bolts

Sikadur® Combiflex straddles the joint and, being elastic, stretches and relaxes with any movement taking place with the structure



Watertight Concrete Construction

Specification

Specifying the **Sika® Watertight Concrete System** is simple.

Standard Specification Clauses are available.

Standard details in PDF or DWG are available from our website: www.sika.co.uk - click on **Watertight Concrete System**.

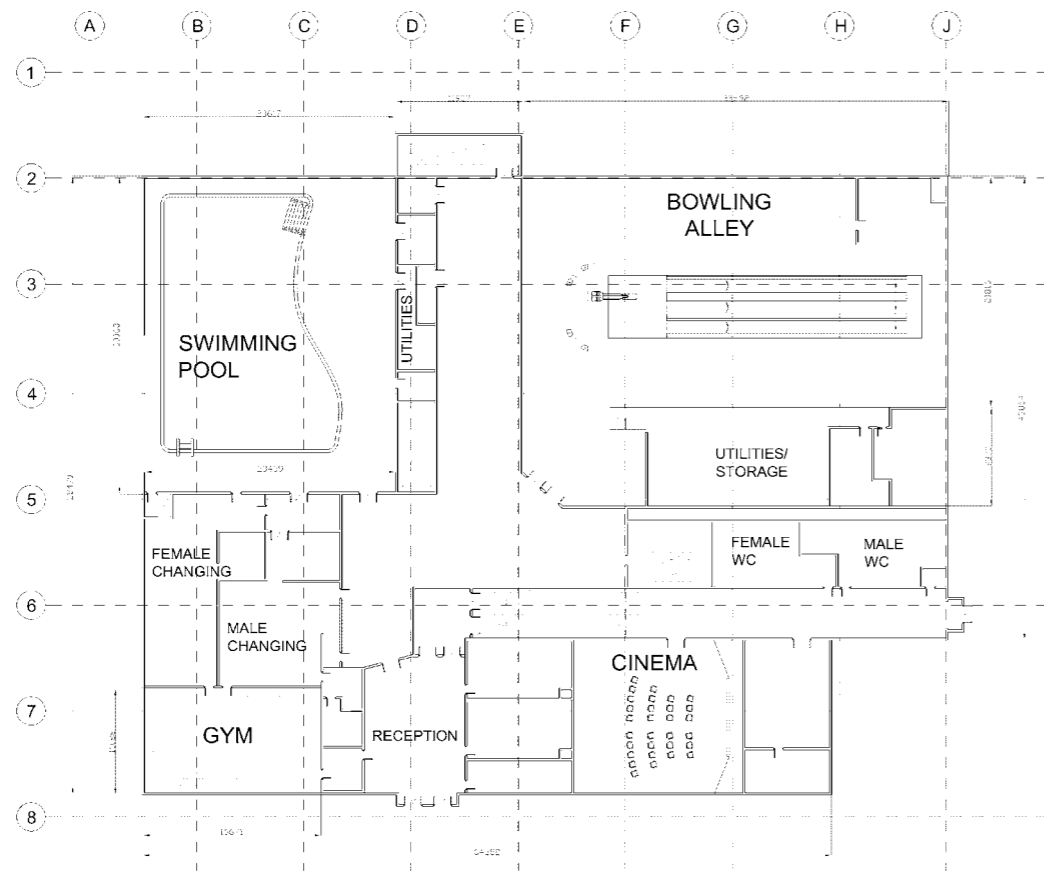
Bespoke details are available upon request.

Sika Technical personnel are on hand to assist and advise.

BS 8102:1990 is currently being revised. It will recognise that problems occur due to incorrect selection and installation of waterproofing systems. Consideration to be given to:-

- Ground conditions
- Construction method
- Ease of installation
- Selection of a suitable waterproofing system for the individual circumstances

- Possible combination of systems for increased security such as type B plus type A
- External drainage to reduce water pressure
- An easily repairable system should problems occur
- Early involvement of the experts (Sika Limited)



Concrete Practice

Good site practice is the key to ensuring the concrete technology from Sika and the correct structural design come together to achieve a watertight structure:

- Formwork
- Steel reinforcement
- Consistence (workability)
- Concrete placement
- Curing

Any concrete needs thorough and correct curing to ensure the risk of surface crazing and plastic shrinkage cracks are minimised. Efficient curing also helps reduce the porosity and capillary pore size in the concrete, increasing durability.

A high quality spray on curing membrane such as **Sikafloor® ProSeal®** is recommended which acts as a continuous evaporation reduction system.

After Sales Service

Sika concrete technologists are involved during every stage of the project, from design to completion.

During the construction phase they will conduct tool box talks on site in order to familiarise site operatives with items such as the installation of joint systems. Regular inspections are carried out at the readymixed concrete plant and on-site to ensure compliance with the specification and instructions issued.

A warranty is issued on successful completion of the project (draft copy available on request). Being backed by a multi-billion pound global organisation, this gives the client peace of mind and demonstrates our confidence in the system.

PHOTOGRAPH BELOW

Project: Swinhay House, Gloucestershire

Structural Engineer: Roberts Gardner Associates

Main Contractor: Barnwood Construction Limited

Basement to house swimming pool, gym, bowling alley and cinema using the Sika® Watertight Concrete System



Sika Worldwide



Sika - Your Local Partner with a Global Presence

The information, and, in particular, the recommendations relating to the application and end use of Sika® products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users should always refer to the most recent issue of the Product Data Sheet for the product concerned, copies of which will be supplied on request.

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ISO 14001



ISO 9001