SIKA AT A GLANCE

- Global specialty chemicals company
- Supplying construction markets and the manufacturing industry
- Headquarters in Baar, Switzerland
- Founded in 1910
- Sales of CHF 5.14 billion (2013)
- Over 16,000 employees
- In 84 countries

TARGET MARKETS

- Concrete
- Waterproofing
- Roofing
- Flooring
- Sealing & Bonding
- Refurbishment
- Industry

SIKA WATERTIGHT CONCRETE

- Combining expertise and knowledge in both Concrete and Waterproofing
- Keeps water in or out or both
- No additional work to be carried out of site i.e no installation of secondary waterproofing material
WATERTIGHT STRUCTURES BELOW GROUND STRUCTURES

General Categorization
- Parking garages
- Equipment / Plant Rooms
- Habitable environments
- Archives

MONTEVETRO, GOOGLE EUROPEAN HQ, DUBLIN, IRELAND
SIKA WATERTIGHT CONCRETE

Project Description
Montevetro is one of the tallest commercial buildings in Dublin. It comprises 19,500 square metres of prime office space spread over 15 floors, and is located on the water’s edge on the Grand Canal Basin in Dublin. The development is owned by Google and is part of its European headquarters.

Sika Solution
To ensure a dry environment in the basement car park, consulting engineers Arup specified the Sika® Watertight Concrete.

WATERPROOFING MATERIALS AND TYPES
TRADITIONAL WATERPROOFING MATERIALS

- Bentonite Sheets and Membranes
- Torch-on Bitumen Sheets
- Cold Applied Bitumen
- Modified cement tanking mortars and slurries

WATERPROOFING MATERIALS AND TYPES
MODERN WATERPROOFING MATERIALS

- Synthetic Sheet Membrane
- Liquid Applied Membrane
- Watertight Concrete
- Cavity Drain
WATERPROOFING MATERIALS AND TYPES

WATERPROOFING TYPES

- **TYPE 1** External Barrier
- **TYPE 2** Internal Barrier
- **TYPE 3** Integral Barrier

SIKA WATERTIGHT CONCRETE CONSTRUCTION

**Advantages**
- Reduced excavation leading to a reduction in cost of work and waste
- No additional work to be carried out of site i.e no installation of secondary waterproofing material
- No external access required reducing the applied risk and cost
- Maximum building footprint enables the Owner to maximise the investment
- Effective barrier to water
- Good steel protection with improve durability
- Robust in use with reduced risk of damage during construction

SIKA WATERTIGHT CONCRETE CONSTRUCTION

**Disadvantages**
- Depends on good concrete practise and quality control
- Not suitable for ground conditions with extreme exposure to aggressive chemical and gases without additional measures
**Definition**

The water resistance of concrete is defined by the amount of water or moisture emerging on the opposite side to that being attacked by water.

**Cement**
- Minimum Binder Content 350 kg/m³
- Maximum SCM 40% (GGBS & Fly Ash)

**Water**
- Maximum water cement ratio of 0.45

**Aggregates**
- Use concrete mix designs with maximum size of approximately 32mm
- Select a balanced particle-size distribution curve
- Recycled aggregate should not be used

**Additions**
- Use specific additions for systematic improvement of the concrete properties as required

**Admixtures**
- A superplasticiser is required to ensure water cement ratio and initial flow and workability over time
- Sika® WT to ensure watertightness
Despite the apparent density of concrete it can be described as a porous material that allows the passage of water through a connected structure of capillary pores.

Capillarity
Capillaries are the voids created in concrete by the excess water that is needed to support placement (workability)
- Typically 155 liters is needed for a watertight concrete mix
- 90 liters is required for the chemical reaction (cement hydration)
- 65 liters is for workability only

Voids that affect the watertightness of Concrete:
- Capillary Voids, size < 1.3um quantity (theoretically 0% up to > 30%)
  - Results from water which is not used for hydration
  - Negative influences watertightness of concrete
  - Quantity depends “only” on w/c ratio
- Compaction Voids, size 0.05 – 10mm
  - Quantity depends on handling of concrete
  - Result of insufficient (wrong) compaction
  - Strongly negative influences watertightness of concrete

Capillarity also allow other water soluble chemicals passage:
- Chlorides
- Sulphates
- …
Creating Watertight Concrete

- Improve the quality of the concrete
- Reduce the volume and continuity of the capillary pores (mix design/superplasticiser)
- Block the remaining capillary pore to acceptable level
  - Inclusion of admixtures to block the remaining capillary pores

**SIKA WATERTIGHT CONCRETE CONSTRUCTION SUMMARY OF TEST METHODS**

<table>
<thead>
<tr>
<th>Required test method and limits for Sika® Watertight Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test Method</strong></td>
</tr>
<tr>
<td>Water penetration depth</td>
</tr>
<tr>
<td>Water conductivity</td>
</tr>
<tr>
<td>Drying shrinkage</td>
</tr>
</tbody>
</table>

**SIKA WATERTIGHT CONCRETE CONSTRUCTION TESTING METHODS**

**Water Penetration**

- Water penetration under hydrostatic pressure the water permeability limit for watertightness is defined as a maximum water penetration into the concrete under a specific pressure over a defined period
- Water penetration under hydrostatic pressure (according to EN 12390 – 8: 72 hours with 5 bar)

**Control / Blank**

Water penetration under hydrostatic pressure (according to EN 12390 – 8: 72 hours with 5 bar)

**Sika® WT**

Water penetration under hydrostatic pressure (according to EN 12390 – 8: 72 hours with 5 bar)
**SIKA WATERTIGHT CONCRETE CONSTRUCTION TESTING METHODS**

**Water Conductivity**
- Water conductivity of wet concrete surfaces the water permeability limit for watertightness is defined as g/m² x h, where water permeability is smaller than vapour volume of water without pressure over a defined period
- Water conductivity (SIA 262/1)

**SIKA WATERTIGHT CONCRETE CONSTRUCTION TESTING METHODS**

**Water Conductivity – Sika Defined Limit**
- Water conductivity (SIA 262/1)
- Maximum 6g/m² x hour
  (Limit shown by red line)

**SIKA WATERTIGHT CONCRETE CONSTRUCTION TESTING METHODS**

**Drying Shrinkage – Sika Defined Limit**
- Drying Shrinkage (SIA 262/1)
- Shrinkage is caused by the slow drying of hardened concrete
- Maximum <0.05%
  - Supports reduced shrinkage of concrete

**SIKA WATERTIGHT CONCRETE CONSTRUCTION TESTING METHODS**

**SIKA SOLUTIONS FOR WATERTIGHT CONCRETE**

**Sika® ViscoCrete®**
- Effective water reduction
- Production of high quality durable concrete
  - Ensured workability on construction site

**Sika® WT-200 Series**
- Based on crystalline technology (self healing)
- Non-soluble crystalline structure formation in the capillaries

**Sika® ViscoFlow®**
- Effective water reduction
  - Production of high quality durable concrete
  - Ensured workability on construction site
SIKA WATERTIGHT CONCRETE CONSTRUCTION
SIKA SOLUTIONS FOR WATERTIGHT CONCRETE

Sika® WT-200 Series
- Crystalline pore blocker
- Based on crystalline technology (self healing)
- Consists of specially selected chemicals and silica sand
- Crystalline chemicals react when in the presence of calcium hydroxide Ca(OH)₂ and other hydration by-products and moisture
- Crystalline structure forms and fills and blocks the capillary structure, small voids and micro-cracks
- Lack of moisture will stop the reaction (reactivation if re-wetted)
- High-performance when water exposure is consistent

3 Days
5 Days
9 Days
13 Days
1.8x magnification
Crack width 0.4-0.5mm
Laboratory Conditions

Definition of Joint
A joint is defined as the place in a concrete structure where two concrete sections meet (weakness)
- Construction Joints (non movement)
- Movement Joints

Sika® Waterbar A-19
Sika® Waterbar A-24
Sika® Waterbar D-19
Sika® Waterbar D-24
- Internally placed PVC waterstops
- Externally placed PVC waterstop

SikaSwell® S2
- Internally placed hydrophilic waterstop
- Construction joints
- Service penetrations

16/04/2015
SUMMARY OF MIX DESIGN RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Components</th>
<th>Comments</th>
<th>Specification</th>
</tr>
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<tbody>
<tr>
<td>Aggregate</td>
<td>- Balanced particle-size distribution curve required&lt;br&gt;- Clean and compliant to local standard&lt;br&gt;- Recycled aggregate should not be used</td>
<td>- Maximum size of approximately 32mm</td>
</tr>
<tr>
<td>Cement</td>
<td>- Compliant with local standards&lt;br&gt;- Fly ash and ground granulated blast furnace slag only</td>
<td>- Minimum binder content 350kg/m³</td>
</tr>
<tr>
<td>Secondary Cement Material (SCM)</td>
<td>- Fly ash and ground granulated blast furnace slag only</td>
<td>- Maximum 40% of total binder content</td>
</tr>
<tr>
<td>Water</td>
<td>- Fresh water and recycled water with requirement regarding fines. Water cement ratio according to local standards for exposure class</td>
<td>- Maximum 0.45</td>
</tr>
<tr>
<td>Concrete Admixtures</td>
<td>- Type dependent to ensure water cement ratio, initial flow workability over time&lt;br&gt;- Sika® ViscoCrete® / Sika® ViscoFlow® 0.60 – 1.50 %</td>
<td>- Sika® WT 1.00 – 2.00%</td>
</tr>
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SUMMARY OF DESIGN AND CONSTRUCTION GUIDANCE

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<th>Components</th>
<th>Guidance</th>
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<tbody>
<tr>
<td>Design</td>
<td>- Restrained shrinkage and thermal movement. Crack formation to a maximum single crack width ≤ 0.3mm</td>
</tr>
<tr>
<td>Concrete Thickness</td>
<td>- Sika Watertight Concrete should a minimum thickness of 200mm</td>
</tr>
<tr>
<td>Site Preparation</td>
<td>- The site should be level and a separation membrane should be applied</td>
</tr>
<tr>
<td>Concrete Pours</td>
<td>- Maximum pour dimension aspect ratio should not exceed 3:1&lt;br&gt;- Watertight wall = maximum 25 m²&lt;br&gt;- Watertight slabs maximum 100 m²</td>
</tr>
<tr>
<td>Formwork</td>
<td>- Well constructed&lt;br&gt;- Joints to be grout tight (grout loss/honeycombing)</td>
</tr>
<tr>
<td>Concrete Curing</td>
<td>- Curing should take place at the earliest opportunity</td>
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SUMMARY OF TEST METHOD AND LIMITS

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LINCOLN MEMORIAL POOL, WASHINGTON D.C. USA

SIKA WATERTIGHT CONCRETE

Project Description
The old reflecting pool, completed in 1924 and demolished in 2009, held 6.75 million gallons of water, much of which evaporated or continually leaked from the pool and which was replenished with more than 30 million gallons of city potable water annually.

Requirements
A concrete mix design was required to meet all the project specifications for durability, shrinkage and watertightness. To ensure the watertightness of the entire project, a cost effective and efficient joint sealing system was also needed.
THANK YOU FOR YOUR ATTENTION