REPAIR & RECTIFICATION SOLUTION GUIDE

www.quicseal.com

QUICSEAL is a leading manufacturer and supplier of specialty construction materials. We continually strive to improve ourselves by the constant pursuit of innovation, service excellence and quality with our state-of-the-art Research & Development centre, and highly dedicated and experienced personnel.

Accredited with ISO 9001:2008 Quality Management and ISO 14001:2004 Environmental Management certification, we are also corporate member of the Singapore Green Building Council (SGBC) and supply products that are Green Label certified under the Singapore Environment Council (SEC) to express our support for the sustainable built environment.

We provide a wide and comprehensive range of solutions and systems for specific needs of construction, which includes the following areas:

- Waterproofing, Sealers, Water Repellants
- Tile Adhesives, Mortar Additives, Stone Treatment & Protection
- Stain Removal
- Repairs & Refurbishments
- Flooring, Resurfacing & Restoration
- PVC Profiles & Joint Construction

Customers' confidence and support were well reflected with the many projects completed locally and overseas such as Gardens By the Bay, Esplanade Theatres, Fullerton Hotel, Park Hyatt Maldives Hadahaa (Maldives), Double Pool Villa, Banyan Tree (Phuket, Thailand), Elements Mall (Hong Kong) etc.

Established since 1988, QUICSEAL has developed into an established and much trusted brand in Singapore and throughout the region. We are easily available through our wide network of distributors in not only Singapore, but Malaysia, Indonesia, China, Hong Kong, Taiwan, The Philippines, Pacific Islands, Cambodia, Maldives, Myanmar, Thailand, Vietnam, Brunei, Sri Lanka and others.

QUICSEAL is part of the Ardex Group since 2012.

SINGAPORE GREEN BUILDING COUNCIL

bizSAFE 3

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001
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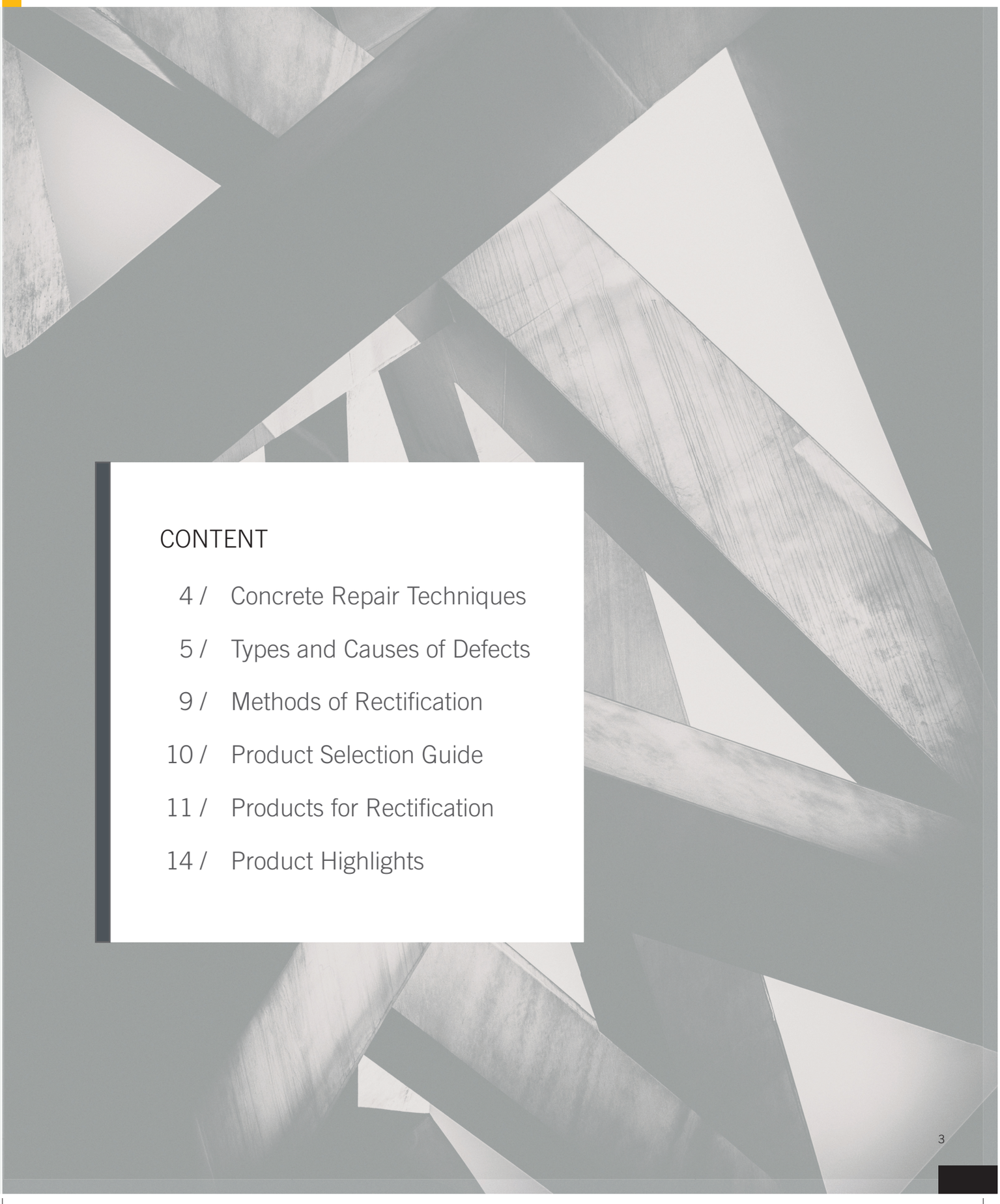
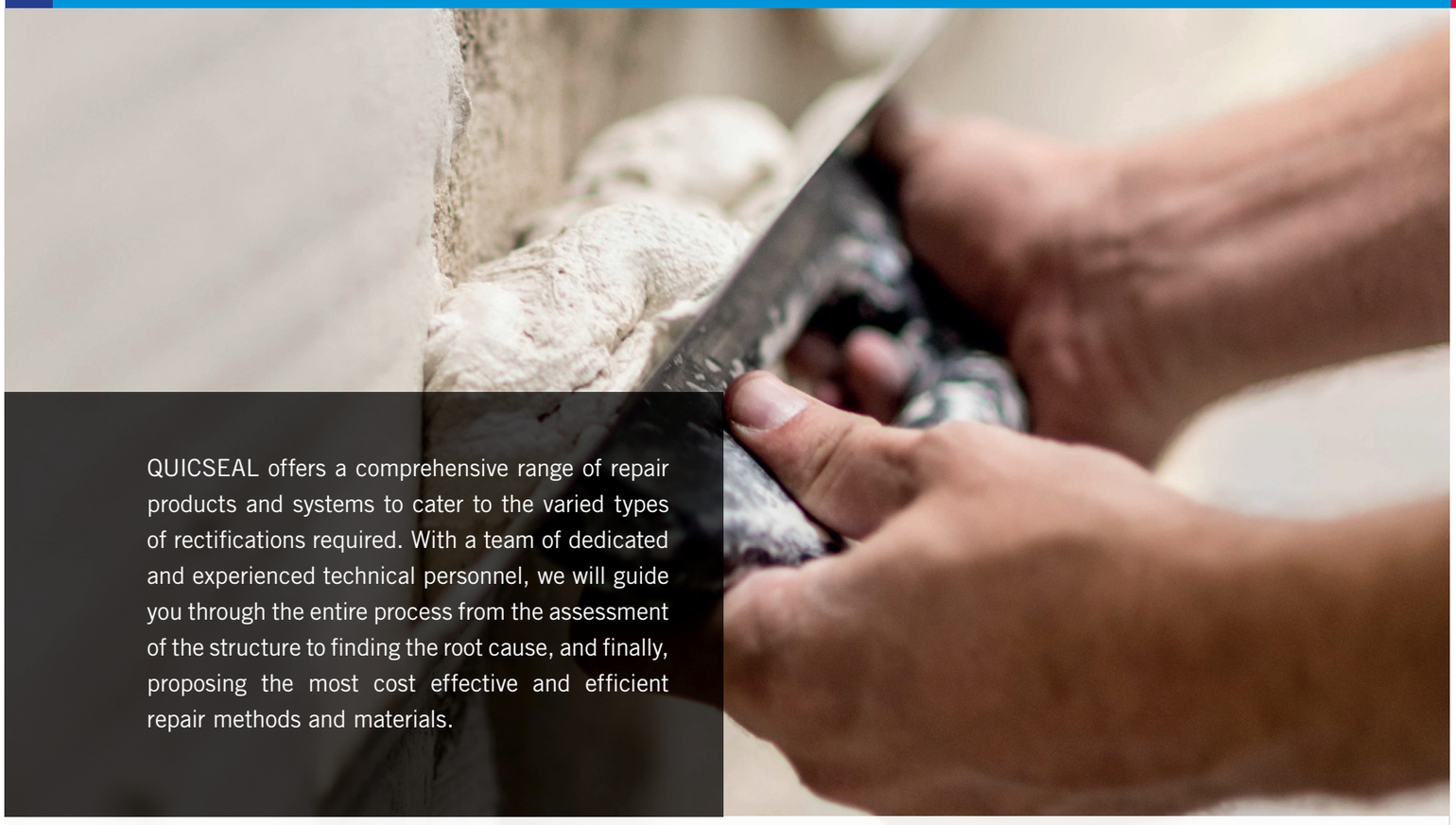
ENVIRONMENTAL SYSTEM CERTIFICATION DNV·GL ISO 14001
165582CC1-2014-AE-GER-DAkkS



CONTENT

Concrete Repair Techniques



QUICSEAL offers a comprehensive range of repair products and systems to cater to the varied types of rectifications required. With a team of dedicated and experienced technical personnel, we will guide you through the entire process from the assessment of the structure to finding the root cause, and finally, proposing the most cost effective and efficient repair methods and materials.

Assessing the Structure

- Present condition of structure
- History of structure
- Environment
- Contamination

Selecting the Diagnostic Methods

- Visual inspection
- Chloride test
- Carbon dioxide test
- Core test
- Hammer test

Analysing the Root Cause

- Determine the factors that cause the damage to the concrete (shrinkage, impact, corrosion, abrasion etc)

Selecting the Repair Method

- Choose the most suitable method of application based on the enviromental conditions and feasibility. Engage specialised applicators when necessary.

Selecting & Applying the Repair Materials

- Choose the correct product based on the problems identified. Select the correct material base (cementitious, epoxy, polyurethane etc)

Types and Causes of Defects

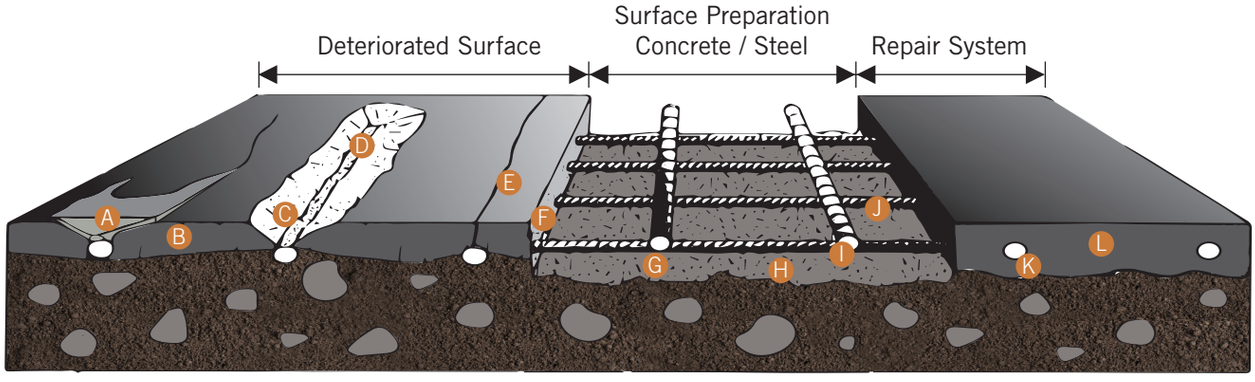
Before deciding on the most feasible method of repair and the correct repair material to use, it is essential to identify the various types of defects commonly encountered, and determine the factors that cause these damages. In this section, we are providing some basic knowledge for your better understanding.

TYPES OF DEFECTS

- Structure cracks
- Spalling concrete
- Water seepage
- Honeycombing
- Hairline cracks
- Negative water pressure
- Surface imperfection
- Corrision of embedded steel reinforcement

CAUSES OF DEFECTS

- Bad building design
- Poor concrete construction habits and practice
- Wrong material selection
- Overloading
- Chemical spill
- Freeze-thaw effect
- Erosion
- Chloride induced corrosion
- Alkali-aggregate reaction
- Sulphate attack
- Carbonation



- A Delamination
- B Contaminated Concrete with chlorides or carbonation
- C Spall
- D Heavily corroded reinforcing bar
- E Crack
- F Edge conditioning
- G Removal of contaminated concrete undercutting of
- H Concrete surface conditioning
- I Reinforcing steel cleaning
- J Reinforcong steel protection
- K Bonding new to old
- L Durable repair material

Types of Defects

CRACKS / All concrete cracks. With so many causes and types of cracks, it can be difficult to identify which cracks or defects indicate a more serious structural issue and which are simply architectural. Generally, cracks in the concrete can be classified into 2 main types – structural or non structural cracks. Non structural cracks are often hairline cracks and do not usually cause major problems. However, if these cracks are left untreated, they may become an avenue for water and chemicals ingress into the concrete structure. Structural cracks in the concrete are usually larger than 0.016inch in width for dry air exposure and extend deeper into the concrete slab. Structural cracks are often caused by overload, restrained shrinkage, thermal contractions, earthquakes and etc.

In better understanding of some of the causes of concrete cracks as well as different cracking pattern types, engineers, construction managers, and others may be able to avoid major structural catastrophes. If concrete is cracking when it should not be, it needs to be identified quickly and repaired before a structural failure.

WATER LEAKAGE / Reinforced concrete is the primary construction material on earth and is susceptible to cracking due to different factors. Cracks in the concrete are often what first lead to water damage though there are many other causes like punctured waterproofing, leaking pipework etc.

If cracks and the resulting leaks are ignored or left unrepaired, that can lead to concrete leaching, molds, mildew, dust mites, and other biological air contaminants. At this point, the damage is extensive, and significant time and money will be required to repair the damage. Floor cracks also may lead to ceiling deterioration in lower levels, causing the overhead concrete to spall, creating potential safety hazards and structural deficiencies.

SPALLING / Spalling concrete is concrete that has broken up, flaked, or become pitted, often appearing as circular or oval depressions on surfaces or as elongated cavities along joints. This is usually the result of a combination of poor installation, environmental factors that stress the concrete, causing it to become damaged. On a low level, it can be purely cosmetic in nature, but it can also result in structural damage, such as damage to reinforcing bars positioned inside the concrete. For this reason, it is important to address spalling when it first starts to appear.

Causes of Defects

CARBONATION / Carbonation occurs when carbon dioxide from the air penetrates the concrete and reacts with hydroxides, such as calcium hydroxide, to form carbonates. In the reaction with calcium hydroxide, calcium carbonate is formed:

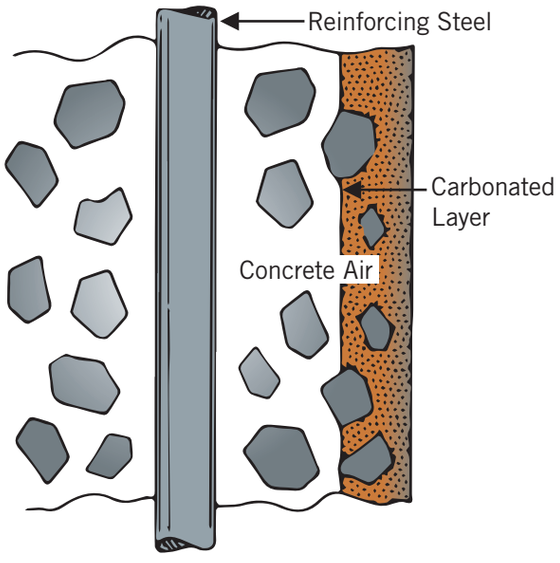
$$CO^2 + Ca(OH)^2 ==> CaCO^3 + H^2O$$

This reaction reduces the pH of the pore solution to as low as 8.5, at which level the passive film on the steel is not stable. The steel becomes depassivated and corrosion will develop. When steel corrodes, the resulting rust occupies a greater volume than the steel. This expansion creates tensile stresses in the concrete, which can eventually cause cracking, delamination, and spalling.

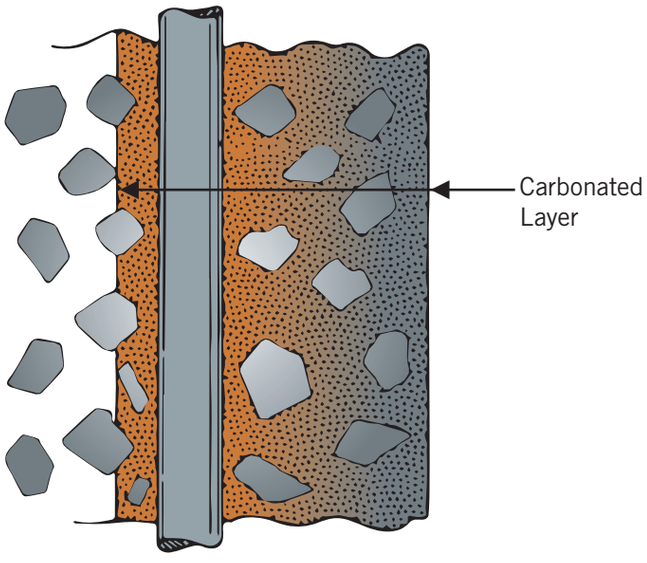
CHLORIDE INDUCED CORROSION / Exposure of reinforced concrete to chloride ions is the primary cause of premature corrosion of steel reinforcement. The intrusion of chloride ions, present in deicing salts and seawater, into reinforced concrete can cause steel corrosion if oxygen and moisture are also available to sustain the reaction. Chlorides dissolved in water can permeate through sound concrete or reach the steel through cracks. Chloride-containing admixtures can also cause corrosion.

The risk of corrosion increases as the chloride content of concrete increases. When the chloride content at the surface of the steel exceeds a certain limit, called the threshold value, corrosion will occur if water and oxygen are also available.

Although chlorides are directly responsible for the initiation of corrosion, they appear to play only an indirect role in the rate of corrosion after initiation. The primary rate-controlling factors are the availability of oxygen, the electrical resistivity and relative humidity of the concrete, and the pH and temperature.

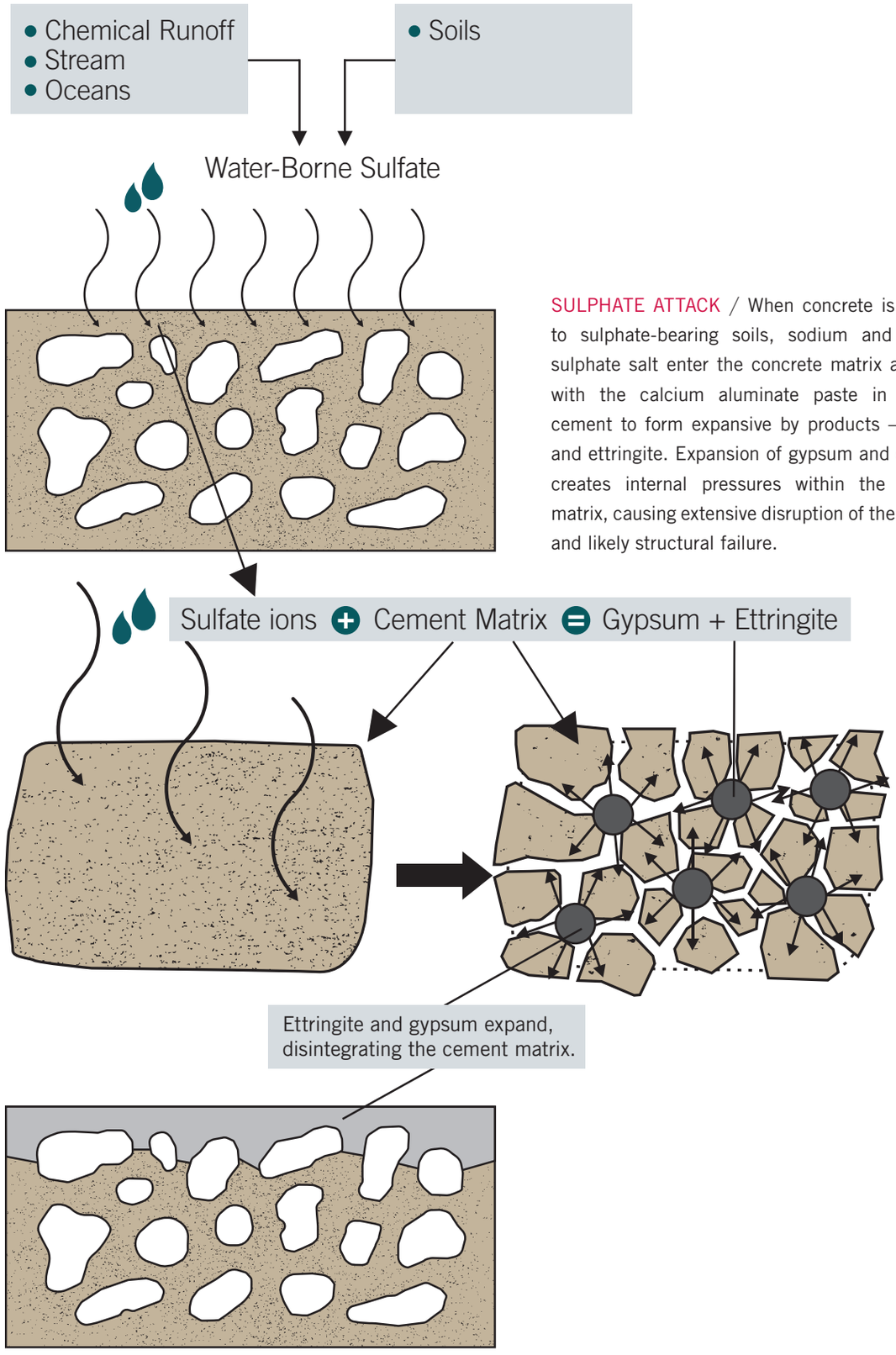


The carbonated layer



Reinforcement no longer protected

Causes of Defects



SULPHATE ATTACK / When concrete is exposed to sulphate-bearing soils, sodium and calcium sulphate salt enter the concrete matrix and react with the calcium aluminate paste in portland cement to form expansive by products – gypsum and ettringite. Expansion of gypsum and ettringite creates internal pressures within the concrete matrix, causing extensive disruption of the concrete and likely structural failure.

Methods of Rectification

Deciding and engaging the method of rectification is as important as selecting the correct material for repair because it can determine the effectiveness of the repair

PATCHING / Patching is a repair technique for concrete structures which consists of replacing the lost, unsound or contaminated concrete with a material that can be new concrete, a repair mortar, a grout etc. The objective of patching is to restore structural integrity and renews or preserves steel reinforcement or where concrete has spalled or defective in order to maintain its structural safety and increase its durability. The repair mortars from QUICSEAL have been modified with polymers and other admixtures to offer additional protection to reinforcement from the effects of aggressive elements like carbon dioxide or chloride. The specialist repair mortars provide good workability, low permeability and non-shrink characteristics. We at QUICSEAL advise the use of QUICSEAL 607 for priming the substrate to increase its bond to the mortars and QUICSEAL 504 to protect the steel reinforcement from further corrosion. If the deterioration has affected strength, there are other methods which may be more suitable for the repair.

INJECTION / Injection is "the pumping of a stable fluid generally named injection grout into rock and soil to fill completely all cavities, voids and cracks, creating a solid sealed mass" (Volpi 1998). Injection grouts aid in waterproofing and corrosion protection and are useful for structural purposes. We at QUICSEAL offers an array of different grouts from low viscosity Epoxy resin to PU resin with different characteristics necessary for different purposes. Epoxy injection has been successfully used in the repair of structural cracks in buildings, bridges, dams and other type of concrete structures. It is used to repair mainly dormant cracks in reinforced concrete components to avoid progressive damage, maintain integrity of the concrete and improve durability. Injection should not be used where reinforcement is severely corroded and ASR affected structures. Other rehabilitation techniques, for example, removal and replacement of contaminated concrete will be more appropriate. For Live cracks, it must be sealed with a flexible material, which can accommodate the movement in the crack. This is especially so when cyclic movements are anticipated.

Polyurethane injection has been used commonly in the repair of cracks that are leaking in buildings, tunnels, and other water-containment structures. It consists of a polyol and isocyanate and when mixed, it reacts with the moisture/water in the crack to form an either expansive closed cell foam or a gel which blocks the passage of water.

PRESSURE GROUTING / Cementitious pressure grouting is the process of pumping cement grout to fill the gap created between bearing components or base plates and foundation or other supporting elements in vertical or overhead application. It is mixed and pumped via concrete line connected to the formwork until the cavity is filled and pressurised. Consolidation and bonding is provided by the internal form pressure.

Product Selection Guide

TYPE	METHOD OF REPAIR	SUBSTRATE	AREA OF APPLICATION			PRODUCT
			Vertical	Horizontal	Overhead	
Structure cracks	Trowel applied	Concrete	■	■	■	301 / 304
	Injection / pourable	Concrete	■	■	■	302 / 302LV
Spalling concrete	Trowel applied	Concrete	■	■	■	514 / 515 / 517 / 518
	Pourable / pumpable	Concrete	■	■	■	510 / 511
Chemical effects*	Trowel applied	Concrete	■	■	■	515 / 517
	Pourable / pumpable	Concrete	■	■	■	510 / 511
Column enlargement	Pourable / pumpable	Concrete	■			510 / 511
Water seepage (leaking cracks)	Injection	Concrete	■	■	■	172 / 178 / 179
	Hand or trowel applied	Concrete	■	■	■	516
Honeycomb	Trowel applied	Concrete	■	■	■	514 / 515 / 518
	Pourable / Pumpable	Concrete	■	■		510 / 511
Hairline cracks	Roller applied	Concrete	■	■		161
	Roller applied	Concrete	■			103M
Negative waterproofing pressure, interfloor leaking	Roller applied	Concrete	■	■		119
Surface imperfection	Trowel applied	Concrete	■			304 / 551
	Trowel applied	Concrete		■		304 / 531 / 532 / 532HD / 534 / 534HD / 571 / 579

* Chemical effects include carbonation corrosion, chloride intrusion, alkaline aggregate reaction

The products recommended above are based on generalisation, and not comprehensive. Product recommendation may vary depending on actual defect.

Please contact our local QUICSEAL sales representative.

Products for Rectification

STRUCTURAL REPAIR

QUICSEAL 301

Two-component, high strength epoxy mortar for repairs, bedding and fixing

QUICSEAL 304

Two-component epoxy putty for repair, bonding, anchoring, sealing and crack filling. Comes in a thixotopic paste

QUICSEAL 515

Single-component, polymer modified, fibre-reinforced structural cementitious repair mortar. Designed for horizontal and vertical patching of spalled concrete and the recommended thickness for vertical repair is up to 40mm per layer

QUICSEAL 302

Two-component epoxy resin for injection sealing of cracks

QUICSEAL 510

Premixed, chloride-free cementitious non-shrink grout that can be used in plastic or flowable consistency states depending on applications and method of repair

QUICSEAL 517

Single-component, light weight polymer modified, fibre-reinforced structural cementitious repair mortar. Designed for vertical and overhead patching of spalled concrete and the recommended thickness for vertical repair is up to 40mm per layer and overhead repair is up to 25mm per layer

QUICSEAL 302LV

Two-component, low viscosity moisture tolerant epoxy resin for injection sealing of cracks

QUICSEAL 511

High strength, premixed non-shrink grout that is suitable for pumping or pouring over a wide range of applications including free flowing precision grouting

Products for Rectification

NON-STRUCTURAL REPAIR

QUICSEAL 172/171

Single-component, hydrophobic polyrurethane (PU) injection resin which stops water ingress. With the addition of QUICSEAL 171 catalyst component, the reaction can be reduced to approximately one minute

QUICSEAL 514

Two-component, lightweight repair mortar that provides good resistance to water and good protection to embedded steel reinforcement

QUICSEAL 178

Two-component, hydrophilic acrylic-polyurethane injection gel which stops water ingress. When mixed and injected using a high pressure twin pump, it produces a flexible gel to seal both dry and wet cracks in concrete structures

QUICSEAL 516

Single-component, fast-setting hydraulic repair mortar which expands and bonds well to substrate, thus stopping running water and leakages through cracks

QUICSEAL 179

Single-component, hydrophilic pre-polymerised water reactive Polyurethane injection gel, which is suitable for water cut-off in wet cracks and joints. It reacts with the water present in the injection area to form a permanent, flexible gel to seal off and waterproof the wet dynamic cracks and joints. The reaction time is within 30-70 seconds upon contact with water. No addition of catalyst is required as it is internally pre-catalysed

QUICSEAL 518

Single-component, polymer modified, fibre-reinforced, fast setting cementitious repair mortar. Designed for vertical and overhead patching of spalled concrete and the recommended thickness for vertical repair is up to 40mm per layer and overhead repair is up to 25mm per layer

SURFACE REPAIR

QUICSEAL 103M

Single-component, ready-to-use, water-based liquid applied acrylic waterproofing membrane that provides UV resistance and is suitable for vertical facade applications

QUICSEAL 119

Two-component, water-based, epoxy moisture barrier coating that can withstand both positive and negative hydrostatic pressure

QUICSEAL 161

Single-component, polyurethane (PU)-based waterproofing membrane that has good chemical, UV, mechanical and thermal resistance that is suitable for exposed and concealed applications

Products for Rectification

SURFACE REPAIR

QUICSEAL 531

Two-component, high performance acrylic polymer cementitious coating (APCC) that is designed for resurfacing, patching and repairing of concrete surface with high vehicular traffic, and allow for thin applications of between 3 and 6mm

QUICSEAL 534

Single-component screed that is suitable for use on new concrete substrate or repair old worn-out substrate in housing estates or industrial floors

QUICSEAL 571

Single-component, fast-setting, self-levelling mortar that is easily applied over concrete floors as an interior underlayment for carpets, vinyl floor coverings or subsequent finishes, and is ready for foot traffic after 3 hours

QUICSEAL 532

Single-component, fast-setting screed with special additives to achieve rapid strength gain. Suitable for use in areas where rapid return to service in 2 hours is critical

QUICSEAL 534HD

Single-component, polymer-modified, high strength screed that is suitable for use in precision and tolerance control floorings

QUICSEAL 579

Two-component, fast-setting, self-levelling mortar that is easily applied over concrete slab, screed as an overlayment at corridors, walkways for direct foot traffic after approximately 1 hour

QUICSEAL 532HD

Single-component, fast-setting, polymer-modified screed that is suitable for use in heavily vehicular trafficked areas where a rapid return to service in 3-4 hours is critical

QUICSEAL 551

Single-component, polymer modified, thin finishing skim coat for concrete surfaces, precast panels, blocked walls or rendered surfaces

Product Highlights

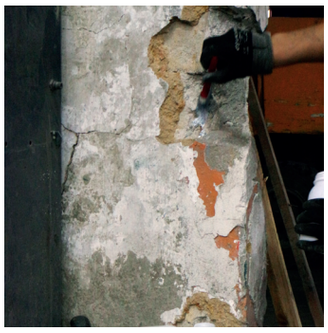
Spalling concrete is concrete that has broken up, flaked, or become pitted, often appearing as circular or oval depressions on surfaces or as elongated cavities along joints. This is usually the result of a combination of poor installation, environmental factors that stress the concrete, causing it to become damaged. It can be purely cosmetic in nature, but it can also result in structural damage, such as damage to reinforcing bars positioned inside the concrete. For this reason, it is important to address spalling when it first starts to appear.

Spalling concrete repair using QUICSEAL 515 Repair Mortar – a single-component, polymer modified, fibre-reinforced structural cementitious repair mortar.

1 Corroded reinforcement observed behind spalling concrete

2 Hack out weak or carbonated concrete until sound concrete is detected

3 Use a wire brush to remove rust from the reinforcement



4 Use a brush to prime the reinforcement with QUICSEAL 504 Rust Protector

5 Use a brush to prime the substrate with QUICSEAL 607 Easi-Bond SBR latex admixture

6 Mix QUICSEAL 515 repair mortar with water until a homogenous paste is obtained

7 Use a trowel to apply the mixed QUICSEAL 515 to the prepared substrate

8 Smoothen the repaired area to achieve the desired finish

9 Completed

Product Highlights

Whether it is new construction or refurbishment projects, levelling the concrete floor is an almost compulsory works for all builders. A pre-packed screed material typically consists mainly of cement, sand, aggregates etc, and will require a minimum thickness of 10mm. We acknowledge and understand that not all areas will have the luxury of this allowance. For this reason, we have formulated a levelling or resurfacing product that can be applied at 3mm to 6mm, and it is strong enough to withstand vehicular traffic after 12 hours of application.

Concrete floor levelling using QUICSEAL 531 Paver-Crete – a high performance, acrylic polymer cementitious coating (APCC)

1 Roughen the area of repair with a hacker or other appropriate tools. Ensure substrate is clean and sound, free of dust and loose particles

2 Use a brush or roller to prime the substrate with QUICSEAL 113 Primer C

3 Pour Part A liquid of QUICSEAL 531 Paver-Crete into a clean pail. Pour Part B powder and slowly mix with a mechanical mixer for 3 - 5 minutes to a homogeneous consistency

4 Immediately after mixing, discharge the mix to the area of repair. As QUICSEAL 531 is semi-flowable, it is easily spread with a steel trowel

5 For large area, a leveller can be used to spread the mortar for a smooth surface finish

6 The area can be finished to a smooth surface or you can use a broom to sweep-finish to the desired surface required

Project References

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INSTITUTE OF MENTAL HEALTH

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