Concrete repair and remediation to BS EN 1504

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Fosroc products are guaranteed against defective materials and manufacture and are sold subject to its standard terms and conditions of sale, copies of which may be obtained on request. Whilst Fosroc endeavours to ensure that any advice, recommendation, specification or information it may give is accurate and correct, it cannot, because it has no direct or continuous control over where or how its products are applied, accept any liability either directly or indirectly arising from the use of its products, whether or not in accordance with any advice, recommendation or information given by it.

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Welcome to Fosroc

Fosroc worldwide
Fosroc has over 70 years experience of supplying specialist chemicals to the construction industry.

In 1991 Fosroc merged with Expandite, another successful chemical company, which was established in 1934. The two companies combined to become one of the largest suppliers of construction chemicals in the world.

Fosroc has gained a reputation for developing innovative products in sealants, waterproofing, concrete repair, grouts and anchors, concrete admixtures and coatings. By concentrating on innovation and customer service, Fosroc leads the way in specification selling into the construction chemicals market. For further information visit our interactive web site:

www.fosroc.com

Fosroc’s wealth of experience is shared by our operations throughout the world, with group companies in over 15 countries and exports to a further 50 other countries.

Service support

CPD seminars
We can provide CPD approved seminars on:
- waterproofing below ground structures
- the new ISO11600 classification for joint sealants
- concrete repair, including the new EN1504 specification

Contact your local Fosroc office for further details on these informative 45 minute seminars, which demonstrate how our products meet construction industry requirements.

Technical helpline
Fosroc’s technical helpline is manned by an experienced team, committed to solving construction problems. Whatever technical enquiries you may have - from product selection and problem solving to health and safety issues - contact us for a fast and efficient service:

01827 262222
enquiryuk@fosroc.com

On site support
Internationally and locally, Fosroc has an enviable reputation for depth of expertise and quality of service. Our UK based Specification Managers and Area Sales Managers offer site visits where required to help solve problems, check applications and product performance.

Fosroc is working with customers to meet the high requirements set out in BS EN 1504 - supplying products to meet the standards the construction industry demands.

Fosroc offers a comprehensive range of concrete repair and remediation products tested to European Standard methods and CE Marked; including our internationally proven specialist Renderoc repair mortars and Dekguard anti-carbonation coatings.

Whatever the structure - from bridges to car parks and commercial buildings to jetties, Fosroc’s technical expertise in concrete repair technology can help guide you through the application of BS EN 1504, enabling you to develop a cost effective and highly beneficial solution for your concrete repair project.

Contents
An introduction to BS EN 1504

What is BS EN 1504? 2
Design philosophy - specifying to BS EN 1504 3
Principles for concrete repair and rehabilitation 4
Fosroc Quality 5

Fosroc solutions

Structural and non-structural repair (R1 - R4) 6
Renderoc range, Patchroc GP, Paveroc 10
Surface protection systems
Dekguard range, Nilocote range 11
Anchoring and grout products
Conbextra range, Lokfix S25 & P25 12
Additional concrete repair products
Fosroc range & contact numbers 13

Constructive solutions
What is BS EN 1504?

European Standard BS EN 1504: Products and systems for the protection and repair of concrete structures replaces existing individual national standards, providing an integrated framework for the concrete repair industry throughout Europe.

The Standard covers all stages of the concrete repair process from assessing the initial problem to methods of remediation, recommended site practice and specifications for products to ensure the future integrity of the structure.

Fosroc experts can help specifiers, clients and contractors apply BS EN 1504, developing appropriate solutions as well as specifying and applying the best materials to ensure optimum concrete repair and protection.

Using the definitions set out in BS EN 1504-1, parts 2 -7 focus on product specification, classifying materials by their properties and relevant test methods. These sections not only provide the principles for manufacturers designing products, but also provide specifiers and designers with an exact profile of properties for comparing and selecting products.

Part 8 describes how manufacturers must operate a permanent factory production control system which is subject to an annual audit in order to maintain quality and evaluate conformity.

Part 9 establishes general principles for the systems of concrete repair (see opposite) and part 10 details site procedures for carrying out a repair programme. Fosroc’s team of experts are always available to provide support and advise on any technical problems arising during a repair project.

Design Philosophy - Specifying to BS EN 1504

Part 9 of BS EN 1504 outlines a structured approach to the investigation of the causes of defects in concrete and explains the 11 Principles of remedial action which clients and designer/specifiers should use to prepare their specification. The system of options, principles and methods is the basis for the selection of products and Fosroc can help designers make optimal use of the repair principles to find the most appropriate action taking into account health and safety, structural and environmental factors.

1. Assess structure
   - Present condition
   - Conditions of use
   - Original design approach
   - History of structure
   - Environment and contamination
   - Conditions during construction

2. Consider options
   - Do nothing for a certain time
   - Downgrade function (e.g. reduce maximum loads)
   - Preservation of current state
   - Improving, strengthen or refurbish part or all of structure
   - Reconstruction of part or all of structure
   - Demolition of all or part of the structure
   - Other factors to be considered, for example:
     - Likely long term performance of repair system
     - The number and cost of repair cycles
     - Methods of preparation and appearance of repair
     - Intended use, design life and service life
     - Opportunities for additional protection and monitoring
     - Acceptable number and cost of future repair cycles
     - Appearance of protected or repaired structure

3. Select repair principle/s
   - 1) Protection against ingress
   - 2) Moisture control
   - 3) Concrete restoration
   - 4) Structural strengthening
   - 5) Physical resistance
   - 6) Resistance to chemicals
   - 7) Preserving or restoring passivity
   - 8) Increasing resistivity
   - 9) Cathodic control
   - 10) Cathodic protection
   - 11) Control of anodic areas

4. Choose remedial method/s
   - Appropriate to type and cause
   - Appropriate to future service conditions
   - Appropriate to protection or repair option chosen
   - Compliance with the Principle chosen
   - Availability of products/systems complying with BS EN 1504

5. Specify material performance
   - Minimum performance characteristics for all intended uses / certain intended uses / specific applications

6. Set out ongoing requirements
   - Record of the protection or repair works that have been carried out and instructions on future inspection and maintenance
The 11 Principles for concrete repair and rehabilitation (BS EN 1504-9)

**Defects in concrete**
Principles 1 - 6 cover defects to concrete or the structure caused by:
- Mechanical actions, eg: impact
- Chemical and biological actions from environments
- Physical actions, eg: freeze thaw, thermal cracking.

**Reinforcement corrosion**
Principles 7 -11 cover reinforcement corrosion caused by:
- Physical loss of concrete cover
- Chemical loss of alkalinity in the protective concrete
- Contamination of the protective concrete cover with corrosive agents, eg: chloride ions
- Stray electrical currents conducted or induced in the reinforcement from neighbouring electrical installations

<table>
<thead>
<tr>
<th>Principle no.</th>
<th>Principle</th>
<th>EN 1504 part</th>
<th>Methods for protecting or repairing structure</th>
<th>Fostroc products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (P)</td>
<td>Protect against ingress</td>
<td>2</td>
<td>1.1 Hydrophobic impregnation</td>
<td>Dekguard range/Rendoce ST 05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1.2 Impregnation</td>
<td>Exopare H45</td>
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<tr>
<td></td>
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<td>2</td>
<td>1.3 Coating</td>
<td>Nitofil LV</td>
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<tr>
<td></td>
<td></td>
<td>5</td>
<td>1.4 Surface bandaging of cracks</td>
<td>Proflex 3000</td>
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<td></td>
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<td>5</td>
<td>1.5 Filling of cracks</td>
<td>Nitoseal MS660/Thioflex 600</td>
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<td></td>
<td></td>
<td>5</td>
<td>1.6 Transferring cracks into joints</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>1.7 Erecting external panels*</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>5</td>
<td>1.8 Applying membranes*</td>
<td></td>
</tr>
<tr>
<td>2 (MC)</td>
<td>Moisture control</td>
<td>2</td>
<td>2.1 Hydrophobic impregnation</td>
<td>Nitodek/Dekguard coatings</td>
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<tr>
<td></td>
<td></td>
<td>2</td>
<td>2.2 Impregnation</td>
<td></td>
</tr>
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<td>2</td>
<td>2.3 Coating</td>
<td></td>
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<td></td>
<td></td>
<td>2</td>
<td>2.4 Erecting external panels</td>
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<tr>
<td></td>
<td></td>
<td>2</td>
<td>2.5 Electrochemical treatment</td>
<td></td>
</tr>
<tr>
<td>3 (CR)</td>
<td>Concrete restoration</td>
<td>3</td>
<td>3.1 Hand-applied mortar</td>
<td>Rendoce hand applied mortars</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>3.2 Recasting with concrete or mortar</td>
<td>Rendoce fluid mortars</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>3.3 Spraying concrete or mortar</td>
<td>Rendoce spray applied mortars</td>
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<tr>
<td></td>
<td></td>
<td>3</td>
<td>3.4 Replacing elements</td>
<td></td>
</tr>
<tr>
<td>4 (SS)</td>
<td>Structural strengthening</td>
<td>6</td>
<td>4.1 Adding or replacing embedded or external reinforcing bars</td>
<td>Conbextra grouts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4.2 Adding reinforcement anchored in pre-formed or drilled holes</td>
<td>Lokfix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4.3 Bonding plate reinforcement</td>
<td>Nitofil LV/TH</td>
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<tr>
<td></td>
<td></td>
<td>4</td>
<td>4.4 Adding mortar or concrete</td>
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<td></td>
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<td>4</td>
<td>4.5 Injecting cracks, voids or interstices</td>
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<td></td>
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<td>5</td>
<td>4.6 Filling cracks, voids or interstices</td>
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<td></td>
<td></td>
<td>5</td>
<td>4.7 Pre-stressing - (post tensioning)</td>
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<tr>
<td>5 (PR)</td>
<td>Increasing physical resistance</td>
<td>2</td>
<td>5.1 Coating</td>
<td>Nitocote/Dekguard coatings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>5.2 Impregnation</td>
<td>Rendoce range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>5.3 Adding mortar or concrete</td>
<td></td>
</tr>
<tr>
<td>6 (RC)</td>
<td>Resistance to chemicals</td>
<td>2</td>
<td>6.1 Coating</td>
<td>Nitocote/Dekguard coatings</td>
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<tr>
<td></td>
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<td>6.2 Impregnation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>6.3 Adding mortar or concrete</td>
<td></td>
</tr>
<tr>
<td>7 (RP)</td>
<td>Preserving or restoring passivity</td>
<td>3</td>
<td>7.1 Increasing cover with additional mortar or concrete</td>
<td>Rendoce range</td>
</tr>
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<td></td>
<td></td>
<td>3</td>
<td>7.2 Replacing contaminated or carbonated concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>7.3 Electrochemical revitalisation of carbonated concrete</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3</td>
<td>7.4 Realisation of carbonated concrete by diffusion</td>
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<td></td>
<td></td>
<td>3</td>
<td>7.5 Electrochemical chloride extraction</td>
<td></td>
</tr>
<tr>
<td>8 (IR)</td>
<td>Increasing resistivity</td>
<td>2</td>
<td>8.1 Hydrophobic impregnation</td>
<td>Nitocote/Dekguard coatings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>8.2 Impregnation</td>
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<tr>
<td></td>
<td></td>
<td>2</td>
<td>8.3 Coating</td>
<td></td>
</tr>
<tr>
<td>9 (CC)</td>
<td>Cementitious control</td>
<td>9.1</td>
<td>Limiting oxygen content (at the cathode) by saturation or surface coating control</td>
<td>Nitocote/Dekguard coatings</td>
</tr>
<tr>
<td>10 (CP)</td>
<td>Cathodic protection</td>
<td>10.1</td>
<td>Applying an electrical potential</td>
<td></td>
</tr>
<tr>
<td>11 (CA)</td>
<td>Control of anodic areas</td>
<td>7</td>
<td>11.1 Active coating of the reinforcement</td>
<td>Nitocote coatings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>11.2 Barrier coating of the reinforcement</td>
<td>Rendoce Primer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>11.3 Applying corrosion inhibitors in or to the concrete</td>
<td></td>
</tr>
</tbody>
</table>

**Case Study - Bridge repair**

The defective concrete was assessed as having been damaged by aggressive salts, requiring a solution that would ensure the integrity of the structure, enabling continued safe use as well as providing protection against future deterioration.

Applying Principle 3 Concrete Restoration, the damaged part of the structure was removed and the repair method selected was 3.3 spray applying concrete.

The product selected was Fosroc Renderoc DS, which is dry spray applied and has high resistance to carbon dioxide and chloride penetration which resulted not only in an effective repair but provided long-term protection to the steel.

| Damage caused by aggressive agents is removed | Fosroc Renderoc DS spray applied | Completed repair |

**Quality (BS EN 1504-8)**

BS EN 1504 as a product standard leads to CE marking of concrete repair products across Europe ensuring the use of products and systems to meet minimum performance requirements for a range of repair applications.

In line with Part 8 of BS EN 1504 - Quality control and evaluation of conformity, Fosroc’s range of concrete repair products are manufactured to satisfy the repair principles and perform according to specification. They are independently tested and CE mark approved.

In addition to BS EN 1504 quality control guidelines, Fosroc concrete repair products are also backed by the ISO 9000 Standard for Quality control and many are BBA approved.

It is important to realise that CE marking is only the minimum requirement.

For example for a physical resistant coating the characteristics tested for all intended uses to gain CE marking are:
- Abrasion resistance
- Capillary absorption and permeability to water
- Impact resistance
- Adhesive bond

For BS EN 1504 compliance additional characteristics are also tested:
- Freeze thaw resistance
- Slip / skid resistance
- Anti-static behaviour
- Coefficient of thermal expansion
- Crack bridging ability
- Resistance to chemical attack
- Permeability to carbon dioxide
Structural and non-structural repair
(BS EN 1504-3)

Fosroc world-renowned range of Renderoc mortars has been developed to provide appropriate solutions to the wide variety of problems resulting in defective concrete. These pre-bagged single component products are available in the 4 different classes specified in BS EN 1504 for structural and non-structural concrete repair products:

Non-structural products
Class R1 ≥ 10MPa
Class R2 ≥ 15MPa

Structural products
Class R3 ≥ 25MPa
Class R4 ≥ 45MPa

Product selector

This basic classification is by compressive strength, however additional test data is required for each product depending on the application for which it is being used. The BS EN 1504 Principles and Methods which apply to structural and non-structural repairs are:

Principle 3 [CR] Concrete restoration
3.1 Applying Mortar by hand
3.2 Recasting with concrete
3.3 Spraying mortar or concrete

Principle 4 [SS] Structural Strengthening
4.4 Adding mortar or concrete

Principle 7 [RP] Preserving or restoring passivity
7.1 Increasing cover to reinforcement with mortar or concrete
7.2 Replacing contaminated concrete
Fosroc’s technical experts can help guide you through the 11 principles to find the most appropriate concrete repair method. We can also identify products that will give you the best, cost-effective solution with real long-term improvements in the quality of the structure.

### Non - structural repair products

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Product Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2</td>
<td>Renderoc FC</td>
<td>Polymer modified fairing coat. Designed for application in thin layers to produce a fair-faced appearance to concrete or masonry surfaces in readiness to receive a protective coating. BBA approved.</td>
</tr>
<tr>
<td></td>
<td>Renderoc HB</td>
<td>High performance lightweight concrete reinstatement mortar. Used for vertical and overhead high build applications. BBA approved.</td>
</tr>
</tbody>
</table>

### Structural repair products

<table>
<thead>
<tr>
<th>Product Code</th>
<th>Product Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Renderoc HBM</td>
<td>Lightweight concrete reinstatement mortar. Used for vertical and overhead repairs.</td>
</tr>
<tr>
<td></td>
<td>Renderoc GP</td>
<td>General purpose concrete reinstatement mortar. Used for patch repairs. Can be used as a render. BBA approved.</td>
</tr>
<tr>
<td></td>
<td>Renderoc RP252</td>
<td>Two component fibre and polymer modified cementitious mortar for re-profiling and protection. Wide range of application thickness. Excellent bond to the concrete substrate. Shrinkage compensated.</td>
</tr>
<tr>
<td>R4</td>
<td>Renderoc HB45</td>
<td>High performance fibre reinforced, medium weight concrete reinstatement mortar. Used for high build applications such as columns, beams and soffits.</td>
</tr>
<tr>
<td></td>
<td>Renderoc DS / SC</td>
<td>Dry spray repair mortar. Used for large area repairs such as bridges, tunnels, retaining walls, dams etc. Polymer modified Renderoc DS conforms to Department of Transport requirements.</td>
</tr>
<tr>
<td></td>
<td>Renderoc S</td>
<td>Structural grade polymer modified concrete reinstatement mortar. For reinstatement of large areas of concrete or small repairs. BBA approved.</td>
</tr>
</tbody>
</table>

### Patchroc GP


- **Rapid setting cement based, waterstopping mortars**
- **Emergency waterstopping capability**
- **Single component - pre-bagged to overcome variations in site batching**
- **Excellent bond to substrate**
- **Low exotherm minimises thermal cracking**
- **Chloride free**

Fosroc also provide CPD seminars on concrete repair including the new BS EN 1504 specification.
Surface protection systems
BS EN 1504-2

Once damaged concrete has been repaired, consideration should be given to the protection of the structure against future attack from the surrounding environment.

Fosroc’s range of protective and decorative Dekguard anti-carbonation, anti-chloride high performance coatings offer protection in line with BS EN 1504-2 and are compatible with Fosroc’s range of Renderoc mortars, providing an effective and attractive repair and protection system.

Dekguard Range
Dekguard Elastic, Dekguard S, Dekguard W
- Anti-carbonation, anti-chloride higher performance coatings
- For use on atmospherically exposed concrete
- Highly UV resistant
- Flexible, crack bridging systems
- Wide colour range
- BBA approval for Dekguard Elastic and S

Nitocote Range
Chemical resistant cementitious and resin based coatings for use in aggressive environments or below ground

Nitocote EP403
Damp-tolerant, solvent free epoxy resin coating

Nitocote EP 405
Solvent-free epoxy resin coating for water retaining structures. WRAS approved

Nitocote EP410
Highly chemical resistant two pack epoxy system

Nitocote SN511
Conforms to Department of Transport specifications
- Hard wearing - durable, low maintenance costs
- High chemical resistance
- Hygienic - impervious finish provides easily cleaned substrate

(See page 4 for relevant method)

Anchoring and grout products
BS EN 1504-6 Anchoring of reinforcing steel bar

Where structural strengthening is required to increase the load bearing capacity of part of a concrete structure, Fosroc’s range of Conbextra grouts or Lokfix anchors provide the appropriate solution in accordance with Repair Principle 4.

Fosroc Lokfix S25 and P25
Rapid curing polyester resin anchoring grouts
Compliant with the requirements of BS EN 1504-6, with a compressive strength of 100 MPa at 29 days
Suitable for anchoring steel bars into concrete, as well as brickwork, masonry and rock

Conbextra GP
General purpose grout for stanchion plates, bolt pockets and void filling

Conbextra HF
For filling around large stanchion base plates, bolt pockets

Conbextra EP10 & EPR
Where heavy dynamic or mobile loads are encountered and also in refineries and chemical plants where spillage may be encountered

Conbextra TS
Ideally suited to grouting thick section voids beneath baseplates and voids around below ground tanks as well as large bolt pockets
Additional concrete repair products

Resins
Nitomortar Range
Range of epoxy reinstatement mortars, with high resistance to a wide range of chemicals, suitable for emergency repairs where fast strength gain is important.

Nitomortar S
Ideally suited for acid tanks, sea walls, industrial floors and as a bedding mortar

Nitomortar HB
Used for vertical and overhead locations

Nitomortar PE
Used for repairing and re-profiling of precast concrete units, damaged arisises and treads

Crack Injection Resins
Nitofil LV /TH
Pre-packaged low viscosity or thixotropic epoxy resin injection grout.
- Achieve high strength bond to dry or wet concrete
- Material designed for low creep
- Non shrink - no loss of bond or surface contact
- High compressive, tensile and flexural strengths
- Excellent chemical resistance

Nitokit LV /TH
Pre-packaged low viscosity or thixotropic epoxy resin crack injection systems including everything necessary to complete crack injection.

Floor Coatings
Nitoflor FC130 /FC140
High performance epoxy resin floor coatings
- Hard wearing - durable, low maintenance costs
- High chemical resistance
- Hygienic - impervious finish provides easily cleaned surface

Protective Coatings
Fosroc Polyurea
Anti-corrosion, waterproof and protective coating for concrete and steel in a wide range of environmental conditions
- Fast setting, seamless coating
- Very long lifecycles and high durability

Fosroc solutions for structural improvement or reconstruction

Fosroc’s comprehensive range of products means that not only can we provide solutions for maintaining structures, but where the damage to the concrete structure is severe we can offer solutions for improving or reconstructing all or part of the structure, such as
- Conplast and Structuro, Concrete admixtures
- Proofex waterproofing membranes.

Fosroc’s technical experts can help guide you through the 11 principles to find the most appropriate concrete repair method.

We can also identify the products and systems that will give you the best, cost effective solution with real long-term improvements in the quality of the structure.

Contact Fosroc...

All the products featured in this brochure are available either direct from Fosroc or from one of our specialist construction chemical distributors.

If you require further information on any of our products, please contact us:
Tel: 01827 262222
Fax: 01827 262444
email: enquiryuk@fosroc.com

Alternatively, up-to-date technical information is available on our website at:
www.fosroc.com

up-to-date technical information