



Technical Advice Note 6

The Current British Standards

Introduction to BS EN 1504

The British and European Standard for Concrete Repair and Remediation

European Standard BS EN 1504: Products and Systems for the Protection and Repair of Concrete Structures has been designed to standardize concrete repair processes to give a comprehensive set of standards.

The standard covers all of the stages of the repair process from correct diagnosis of deterioration and initial assessment of the problem, developing a detailed understanding of the client's needs, through to the various repair methods, products and their performance, and finally site application and practices to ensure good quality repair and future integrity of the structure.

The standard is made up of 10 separate documents as shown below

Document No	Description
EN 1504 -1	Provides the definitions and terms used within the standard
EN 1504 -2	Specifications for surface protection products and systems for concrete
EN 1504 -3	Specifications for structural and non-structural repair
EN 1504 -4	Specifications for structural bonding
EN 1504 -5	Specifications for concrete Injection
EN 1504 -6	Specifications for anchoring and reinforcement bars
EN 1504 -7	Specifications for reinforcement corrosion protection
EN 1504 -8	Details the quality control and evaluation of conformity for manufacturers
EN 1504 -9	Describes the general principles for the use of products and systems
EN 1504 -10	Details the site application of products and systems and quality control of the works

General overview of the 10 documents

Using the definitions in part 1, parts 2-7 deal with the classification products and are primarily aimed at the manufacturers of the specialist products.

Each document covers the products intended use and purpose, the performance requirements and the products characteristics.

Items such as temperature ranges, adhesion qualities, compressive and shear strength, thermal expansion and shrinkage, durability and chemical resistance are detailed ensuring the manufacturers can research, develop and create the products necessary to meet the intended use.

Part 8 details the requirements for the manufacturers to maintain and control conformity. It sets out procedures for quality control and evaluation of conformity. It includes marking and labelling as well as performance, identification and batch sampling tests.

Part 9 sets out the basic considerations for the design and specification for the repair works from initial inception and inspection through to any ongoing maintenance following completion of the works. It covers the general causes of concrete decay and is used to define a logical repair methodology whilst allowing the client to make choices based on whole life costings and economic viability.

It achieves this by laying out 11 principles for systems of concrete repair and are based on best practice methods with proven track records for success.

Part 9—Principles and Methods

Principle No	Principle Definition	Methods Based on Principle
Principle 1 (PI)	<i>Protection Against Ingress</i> Reducing or preventing the ingress of adverse agents, e.g. water, other liquids, vapour, gas chemicals and biological agents.	<ul style="list-style-type: none"> – Impregnation – Surface coating with and without crack bridging ability – Locally bandaged cracks – Filling Cracks – Erecting external panels – Applying membranes – Applying waterproof membranes
Principle 2 (MC)	<i>Moisture Control</i> Adjusting and maintaining the moisture content in the concrete within specified range of values.	<ul style="list-style-type: none"> – Hydrophobic impregnation – Surface Coating – Sheltering or over cladding – Electrochemical Treatment
Principle 3 (CR)	<i>Concrete Restoration</i> Restore the original concrete of an element of the structure to the originally specified shape and function. Restoring the concrete structure by replacing part of it.	<ul style="list-style-type: none"> – Applying mortar by hand – Recasting with concrete – Spraying concrete or mortar – Replacing elements
Principle 4 (SS)	<i>Structural Strengthening</i> Increasing or restoring the structural load bearing capacity of an element of the concrete structure.	<ul style="list-style-type: none"> – Adding or replacing embedded or external reinforcing steel bars. – Installing bonded rebars in preformed or drilling holes in the concrete. – Plate bonding. – Adding mortar or concrete – Injecting cracks, voids or interstices. – Filling cracks, voids or interstices – Pre-stressing – (Post tensioning)
Principle 5 (PR)	<i>Physical resistance</i> Increasing resistance to physical or mechanical attack.	<ul style="list-style-type: none"> – Overlays or coatings – Impregnation.

Principle 6 (RC)	<i>Resistance to chemicals</i> Increasing resistance of the concrete surface to deterioration by chemical attack.	<ul style="list-style-type: none"> – Overlays and coatings – Impregnation.
Principle 7 (RP)	<i>Preserving or restoring passivity.</i> Creating chemical conditions in which the surface of the reinforcement is maintained in or is returned to a passive condition.	<ul style="list-style-type: none"> – increasing cover to reinforcement with additional cementitious mortar or concrete. – Replacing contaminated or carbonated concrete. – Electrochemical realkalisation for carbonated concrete. – Realkalisation of carbonated concrete by diffusion – Electrochemical chloride extraction.
Principle 8 (IR)	<i>Increasing resistivity</i> Increasing the electrical resistivity of the concrete.	<ul style="list-style-type: none"> – Limiting moisture content by surface treatments, coating or sheltering.
Principle 9 (CC)	<i>Cathodic Control</i> Creating conditions in which potentially cathodic areas of reinforcement are unable to drive an anodic reaction.	<ul style="list-style-type: none"> – limiting oxygen content (at the cathode) by saturation or surface coatings.
Principle 10 (CP)	<i>Cathodic Protection</i>	<ul style="list-style-type: none"> – Applying electrical potential.
Principle 11 (CA)	<i>Control of anodic areas</i> Creating conditions in which potentially	<ul style="list-style-type: none"> – Painting reinforcement with coatings containing active pigments – Painting reinforcement with barrier coatings – Applying inhibitors to the concrete.

These principles do not provide a detailed assessment methodology, the final scope of works will still need to be assessed and defined by a competent engineer or specialist concrete repair contractor. But they do give a 6 step framework for the whole process.

Step 1

Information about the structure

- History and condition of the structure, what it is used for and any potential changes to use etc.
- Review any Documents such as previous reports or schedules.
- Condition Survey including assessment of any previous repair works, extent of damage, including visible and non-visible defects and likelihood of potential defects. There are a range of non-destructive and destructive tests that can be carried out to help determine the causes and extent of damage.

- Step 2**
Process of Assessment
- Correct diagnosis of defects is essential so the correct set of repairs or treatments can be determined. This should include mechanical damage (movement, subsidence etc) chemical damage (carbonation, chloride, H₂S etc) and physical damage (impact, fire, explosion etc).
 - Root causes of the defects need to be identified to ensure that any repair programme deals with the causes and not just treats the symptoms. Sometimes a full condition survey is the only way to fully identify the defects and causes properly.
 - Analysis of any results from any testing or documents such as old surveys or reports can then be made.
 - Structural Appraisal is also carried out and in some instances it may be necessary to have some or all areas assessed by a qualified structural Engineer.
- Step 3**
Management Strategy
- Repair options are then considered to give the client the best range of options available.
 - Select Correct Principles taking into account the clients long and short term requirements and the level of protection (after repair) required.
 - Select Methods, hand placing, shuttering and recast, sprayed concrete, coating application by brush and roller or spray techniques etc.
 - Health & Safety Measures to protect the workforce and anyone else who could come into contact with our works during the repair and cure process.
- Step 4**
Design of Repair Work
- Define intended performance requirements based on the client's needs and expectations.
 - Preparation of Substrate to ensure that the initial substrate is suitable to accept the repair products and also between various layers and treatments of the repair process.
 - Product Selection for each individual aspect of the works, full manufacturer concrete repair systems. Compatibility of various products.
 - Application
 - Specifications and Drawings
- Step 5**
Repair Work
- Final Product and Method Selection
 - Equipment to be used
 - Health & Safety Assessment
 - Quality Control Testing
- Step 6**
Acceptance of Repair Work
- Acceptance of Testing
 - Completion & Handover
 - Final Documentation
 - Minor Remedial Works
 - Maintenance Strategy

Part 10 details the site application of the products and quality control of the works.

By following the 6 step system described in part 9 a true and honest appraisal of the requirements for the project can be made and the relevant works executed in a controlled and professional manner.