Repairing Concrete
Solutions to Re-establish Structural Integrity
Master Builders Solutions from BASF

Building on partnership. Our Master Builders Solutions experts find innovative and sustainable solutions to meet your specific construction needs. Our global experience and network help you to be successful – today and tomorrow.

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Repair and Protection Systems from Master Builders Solutions

Competence profile of repair and protection systems
As a full-range supplier of repair and protection products, we offer customized solutions for your structure. We do not, however, only look at the visible damage, but also provide support for the evaluation of the causes of your structural damage. As a result, we are able to offer you an integrated solution, providing a specifically designed product combination based on the needs of your individual structure. The comprehensive technical construction knowledge of our sales representatives will ensure that you receive the best solutions for your construction requirements.

For owners, planners and architects we provide information and guidance on the advantages and benefits of the system solutions worked out by our experts.

Specialist applicators and contractors receive guidance and support concerning the application of the chosen system solution. Our development experts have placed special emphasis on making all products user friendly and easy to work with. With in-house training and support on construction sites, we can achieve the ambitious target of the safe and high quality application of our products.

We offer you a range of products for the repair and protection of concrete structures, including crack injection, chemical anchoring, reinforcement corrosion protection, structural repair mortars, trafficable repair mortars and repair mortars for cosmetic repair and reprofiling, as well as concrete protection to achieve the refurbishment.

All products are certified by independent testing institutes in compliance with national and/or international standard requirements. Our production sites are externally controlled in compliance with DIN ISO 9001.

As an applicator or owner, you will benefit from our safe and durable solutions specially designed for your construction needs. With our system solutions, we help you to extend the service life of your construction and, lastly, make a significant contribution to sustainability.

Life cycle extension
Today, if you are the owner or architect, the wide range of products available to specify for your construction presents a great challenge:

Construction products
All construction material suppliers offer similar products. But are the properties really comparable? Many of our products for protection and concrete repair are certified in compliance with EN 1504, and many decision makers choose their construction materials based on this standard. Therefore, it is well worth taking a closer look at this standard: mandatory and voluntary test methods do exist for testing products. Our MasterProtect products for protecting concrete, in particular, are tested over and above the mandatory testing methods, providing significantly better and more durable protection for concrete structures based on superior product properties. The properties of most of our repair mortars are far in excess of EN 1504’s requirements – very high compressive strengths, weather and freeze-thaw resistance allow continuous use of those mortars even in highly frequented traffic areas.

System solutions
Choosing the most suitable solution for refurbishment can have a big impact on the life cycle of a concrete structure. While many owners decide to use high quality concrete repair materials, they do not consider that there is more to do after the concrete repair is finished. Despite repairing a concrete structure with concrete repair mortars, further damages may occur some years later, because only the damaged concrete has been replaced – but insufficient concrete cover still remains. By using concrete protection after the concrete repair has been completed, the entire structure can be protected for longer and repair cycles can be prolonged significantly.

Torres Blancas, Alicante (Spain): Protection with Corrosion Inhibitor MasterProtect 8000 CI against chloride ingress.
Concrete repair strategies

Proper maintenance of a concrete structure is essential in order to guarantee the designed lifetime, since there can be many causes of concrete deterioration. Therefore, concrete repair is a specialist activity requiring fully trained and competent personnel at all stages of the process. Unsatisfactory understanding and diagnosis of concrete deterioration, incorrect repair specifications and choice of repair products/techniques, and short-term "patch and paint" strategies, have inevitably led to dissatisfaction from structure owners.

A large-scale independent and anonymous research project clearly showed this level of dissatisfaction.

“25 % of the structure owners are unhappy with the performance of the repair and protection materials within 5 years after the rehabilitation; 75 % are dissatisfied within 10 years!”

CONREPNET, November 2004

EN 1504 has standardized repair activities and provides an improved framework for achieving successful, durable repairs and satisfied clients.

EN 1504 – scope of the norm

European Standard EN 1504 is entitled: products and Systems for the Protection and Repair of Concrete Structures – Definitions, Requirements, Quality Control and Evaluation of Conformity. For the first time in the industry, EN 1504 deals with all aspects of the repair and/or protection process, including:

- definitions and repair principles
- the need for accurate diagnosis of deterioration causes before specification of the repair method
- detailed understanding of the needs of the client
- product performance requirements and test methods
- factory production control and evaluation of conformity, including CE marking
- site application methods and quality control of the works

When followed, this complex but comprehensive document should ensure good quality repair and protection work on the jobsite, which will result in the increased satisfaction of building owners.
European standard EN 1504 consists of 10 parts, each covered by a separate document. This provides a resource which helps specifying engineers and contractors as well as material manufacturing companies.

As a structure owner, it will give you an increased level of confidence as, for the first time, all issues of concrete repair and protection are addressed by a single integrated European standard.

### Document No. Description

- **EN 1504 – 1**: Describes terms and definitions within the standard.
- **EN 1504 – 2**: Provides specifications for surface protection products/systems for concrete.
- **EN 1504 – 3**: Provides specifications for structural and non-structural repair.
- **EN 1504 – 4**: Provides specifications for structural bonding.
- **EN 1504 – 5**: Provides specifications for concrete injection.
- **EN 1504 – 6**: Provides specifications for anchoring of reinforcing bars.
- **EN 1504 – 7**: Provides specifications for reinforcement corrosion protection.
- **EN 1504 – 8**: Describes the quality control and evaluation of conformity for manufacturing companies.
- **EN 1504 – 9**: Defines the general principles for the use of products and systems, for the repair and protection of concrete.
- **EN 1504 – 10**: Provides information on site application of products and quality control of the works.

### Common causes of defects

The nature and causes of defects, including combinations of causes, shall be identified and recorded. Many defects result from inadequate design, specification, execution and materials. Common causes of defects are shown below:

- **Mechanical**
  - impact
  - overload
  - movement (e.g., settlement)
  - explosion
  - vibration

- **Chemical**
  - alkali-aggregate reaction
  - aggressive agents (e.g., sulphates, soft water, salts)
  - biological activities

- **Physical**
  - freeze/thaw
  - thermal
  - salt crystallization
  - shrinkage
  - erosion
  - wear

- **Carbonation**
- **Chloride Attack**
- **Stray Currents**
- **Degradation due to Reinforcement Corrosion**
- **De-icing salts**
- **Other contaminants**
**General principles for use of products and systems**

**Concrete degradation**

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<td>Reducing or preventing the ingress of adverse agents, e.g. water, other liquids, vapour, gas, chemicals and biological agents.</td>
<td>1.2 Surface coating with and without crack-bridging ability</td>
<td>MasterProtect protective coatings, MasterSeal waterproofing</td>
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Note: for more detailed information, consult the official EN 1504-9 document.
EN 1504

General principles for use of products and systems

Reinforcement corrosion
In addition to these principles, the concrete itself shall be repaired where necessary according to principles 1 to 6.

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Note: for more detailed information, consult the official EN 1504-9 document.

Principle 7, method 7.1
Increasing reinforcement cover with spray-applied MasterEmaco.

Principle 7, method 7.2
MasterEmaco used to replace chloride-contaminated concrete.

Principle 8, method 8.1
Hydrophobic treatment using MasterProtect.

Principle 9, method 9.1
MasterProtect coatings applied directly on to the concrete to protect the underlying reinforcement.

Principle 8, method 8.1
MasterSeal coatings limit the moisture content within the concrete.

Principle 9, method 9.1
Corrosion at the cathodic areas of the reinforcement is inhibited by the use of MasterProtect corrosion inhibitors.

Principle 10, method 10.1
MasterProtect CP coatings protect reinforced concrete without significant additional dead load.

Principle 11, method 11.1
Active corrosion protection of the reinforcement with MasterEmaco active primers.
Concrete Repair Mortars

Concrete replacement mortars: EN 1504, part 3
One of the most important principles within part 9 of EN 1504 is Principle 3: the restoration of damaged concrete with formulated repair mortars. The MasterEmaco brand of pre-bagged concrete repair mortars has consistently been at the forefront of the search to provide cost-effective, long-term solutions to this problem.

The MasterEmaco range represents best-in-class concrete repair mortars with exceptional properties:
- improved bond strengths
- improved densities and impermeability
- reduced shrinkage
- improved tensile strengths and reduced cracking tendency
- improved compatibility with concrete
- improved thixotropy
- easier and quicker application and finishing
- reduced application problems
- increased durability

Mortar classification according to EN 1504, part 3
The European standard defines 4 classes of repair mortar: R4, R3, R2 and R1. These are then divided between structural and non-structural repairs, i.e. those applications where load transfer has to be considered in the design of the repair specification, or alternatively for cosmetic works. Furthermore, the standard classifies the repair products for each type of application, ensuring that the repair mortar is adapted to the quality of the parent concrete. The current choice of products depends on ease, type and field of application. The Master Builders Solutions experts offer a broad range of repair mortars, customized for structural and non-structural repair for trafficable, vertical and overhead application.

1 MasterEmaco S – Structural repair
2 MasterEmaco N – Non-structural repair
3 MasterEmaco T – Repair of trafficable areas
Concrete Repair Mortars

MasterEmaco S

Structural repair
One of the greatest challenges facing the successful performance and durability of a repair mortar is its dimensional compatibility with the existing concrete. Repair mortar acts as replacement concrete in the structure and load is transferred onto and supported by the repair during service conditions to restore structural function. To fulfill dimensional compatibility, repair mortars under the Master Builders Solutions brand from BASF match, as closely as possible, the properties of the existing concrete. With reduced shrinkage and improved tensile strength, cracking tendency is reduced to a minimum. A long-term, crack-free repair area does not provide a pathway for carbonation, moisture and chlorides into the concrete to protect against further corrosion of the embedded steel.

To match the properties of the existing concrete, our Master Builders Solutions experts offer a tailor-made repair mortar range. In addition, these repair mortars are designed to offer excellent application properties. Whatever your application demands, we can provide easy-to-apply mortars for hand application on vertical and overhead areas, systems for spray application, and flowable mortars for pourable applications.

Typically, our repair mortars, require no special primers or bonding slurries. For critical substrates, the mortars themselves can be used as a bonding slurry by mixing them with slightly more water.

Thixotropic mortars

MasterEmaco S 5300
(formerly Emaco Nanoccrete R3)
Cement-based, single-component, lightweight, polymer-modified, high-build structural repair mortar, which meets the requirements of European Norm EN 1504-3 class R3 and is particularly suitable for vertical and overhead work. Application thickness: 5 to 75 mm. This mortar is typically hand-applied but can also be spray-applied in large area applications.

Flowable mortar

MasterEmaco S 5450 PG
(formerly Emaco Nanoccrete R4 fluid)
Cement-based, single-component, high-strength, shrinkage-compensated, fast-setting thixotropic mortar, which meets the requirements of European Norm EN 1504 part 3, class R4. Due to its fast-setting properties, this product is the perfect choice where rapid repairs are needed in order to reduce the downtime of structures.

Fast-setting mortar

MasterEmaco S 544 RS
(formerly Thoro Structurite R4)
Cement-based, single-component, polymer-modified, high-strength, shrinkage-compensated structural repair mortar, which meets the requirements of European Norm EN 1504-3 class R4, which can easily be spray or trowel applied. Application thickness is 5 to 50 mm.
Concrete Repair Mortars

MasterEmaco N

Reprofiling, cosmetic repair
These repair mortars are used to improve the appearance of the structure, e.g. patching of spalled concrete, repair of minor damage during new construction or on precast panels during transport or storage. Fairing coats are used for finishing repaired areas, to level uneven surfaces and fill honeycombs and pin holes to give a smooth and uniform appearance to the surface. A smooth surface is ideal for applying a protective coating on top of it.

Reprofiling mortar

MasterEmaco N 5200 (formerly Emaco Nanocrete R2)
Cement-based, single-component, polymer-modified, lightweight, fast-setting, universal repair, repinning and levelling mortar, which is ideal for general, non-structural repairs where fast setting properties with short over-coating times are needed. It exhibits excellent high built properties allowing up to 100 mm thickness in one layer.

Fairing coat

MasterEmaco N 5100 FC (formerly Emaco Nanocrete FC)
Cement-based, single-component, polymer-modified, fast-setting levelling mortar and blowhole filler, which is ideal for fine finishing and levelling repairs on large vertical and overhead areas, where fast setting properties with short over-coating times are needed.
MasterEmaco T

Repair of trafficable areas
Traffic congestion and delays not only have a negative impact on general productivity, but also cost European contractors billions of euros each year by wasting time, fuel and money stuck in traffic. Researchers say that the authorities’ roadworks are responsible for a significant proportion (e.g. 16% in London in 2005) of the total amount of congestion on European roads. In addition to considerable financial losses, a significant risk of accident is created by congestion impacting driving comfort through lane and road closure. Therefore, road authorities across Europe have targeted the reduction of congestion due to road works by speeding up the repair and maintenance process.

MasterEmaco T products under the Master Builders Solutions brand from BASF are rapid curing products, which allow traffic and production facilities to return to service more quickly. Construction work on airport runways in particular requires very brief delays to air traffic. With our MasterEmaco products, work can be carried out at night for reopening to traffic on the next day. Even in sub-zero temperatures, almost all products are suitable to work with and even cure more quickly at these temperatures. The MasterEmaco T 1000 series already achieves an impressively high compressive strength of above 50 MPa at temperatures of –5°C after 24 hours (gauging water and powder temperature at 20°C). Prolong the construction season by being able to apply our products even at sub-zero temperatures: urgent construction repair can be carried out and does not have to be delayed for weeks or months during the cold season.

Our repair mortars reinstate the functionality of concrete, especially when associated with the repair of trafficked areas and street furniture such as pothole re-setting, joint repair or installation of manhole covers.

Traffic repair mortars

MasterEmaco T 1100 TIX
(formerly Emaco Fast Tixo)
Cement-based, single-component, fast-setting and hardening thixotropic repair and bedding mortar, which has rapid strength build-up even at sub-zero temperatures, improved durability and unmatched low drying shrinkage.

MasterEmaco T 1200 PG
(formerly Emaco Fast Fluid)
Cement-based, single-component, fast-setting and hardening pourable repair and bedding mortar, which has rapid strength build-up even at sub-zero temperatures, improved durability and unmatched low drying shrinkage.

MasterEmaco T 1400 FR
(formerly Emaco Fast Fibre)
Cement-based, single-component, steel-fibre reinforced, fast-setting and hardening pourable repair and road/joint nosing mortar, which has rapid strength build-up even at sub-zero temperatures, improved durability and unmatched low drying shrinkage.

Advanced polymer systems

MasterEmaco T 2800 PG
(formerly Masterflow APS T 2800)
Polymer-based, three-component, fast-setting and hardening pourable repair mortar, which has rapid strength build-up down to –25°C and offers excellent impact, abrasion and scratch resistance as well as an excellent resistance to many chemicals.

MasterEmaco T 2040
(formerly Emaco APS T 2040)
Polymer-based, three-component, fast-setting and hardening thixotropic repair mortar, which has rapid strength build-up down to –25°C and offers excellent impact, abrasion and scratch resistance as well as an excellent resistance to many chemicals.

Magnesia-phosphate cement mortar

MasterEmaco T 545
Magnesia-phosphate based repair mortar for rapid horizontal repair. It gives controlled, extremely high early strengths in temperatures ranging from –20°C up to 30°C.
Crack Injections

Injection products are used to fill the cracks and voids in concrete elements to repair and protect the structure. Part 5 of EN 1504 specifies the requirements of injection products used for:

- Ductile filling (D) of cracks, voids and interstices in concrete
- Force transmitting filling (F) of cracks, voids and interstices in concrete (i.e. situations with structural load transfer)
- Swelling fitted filling (S) of cracks, voids and interstices in concrete

A range of products is available to meet the needs of both wet and dry, structural and non-structural conditions. Viscosity of the injection resin has to be low enough to ensure effective penetration through the crack’s width and depth.

“F” injection with epoxy based products is used for structural requirements in existing civil designs to strengthen the concrete structure by force transmitting filling. It restores the structural integrity of the cracked elements, such as columns, beams and slabs, and provides continuous load transfer through the filled crack line.

“D” injection with polyurethane-based products is used where non-structural flexible sealing of cracks is required.

“S” injection with polyurethane and acrylic-based products is used to seal water bearing cracks even under hydrostatic pressure. Where there is high water outflow from the cracks, “S” injection is used to stop the water as a first attempt. After the pre-injection is cured and therefore the high water outflow is stopped, a final “D” or “F” injection with polyurethane or epoxy-based products takes place to seal the cracks permanently.

MasterInject

Ductile Filling (D)

MasterInject 1330
(formerly Concresive 1330/1336)
PU-based, two-component, flexible and low viscosity injection resin, which hardens both in dry and moist conditions into a watertight and flexible product.

Force Transmitting (F)

MasterInject 1360
(formerly Concresive 1360/1366)
Epoxy-based, two-component, low viscosity injection resin, which is used for low/high pressure injection and gravity feeding of concrete cracks to maintain the structural integrity of the cracked sections.

MasterInject 1380
(formerly Concresive 1380)
Epoxy-based, two-component, low viscosity fast setting injection resin, which is used for low and high pressure injection and even for filling wet cracks in underwater conditions.

Swelling Fitted Filling (S)

MasterInject 1325
(formerly Concresive 1325)
PU-based, two-component, fast expanding (foaming) injection resin, which stops rush of water in water-bearing cracks.

MasterInject 1776
(formerly Concresive 1776)
Acrylic-based, three-component, low viscosity injection resin, which is used for low pressure injection of concrete and masonry for permanent water crack sealing and curtain injection.

MasterInject 1777
(formerly Concresive 1777)
Acrylic-based, three-component, rapid curing, low viscosity injection resin, which is used for low pressure injection of concrete and masonry for permanent water crack sealing with excellent elongation properties and curtain injection.

MasterInject 1778
(formerly Concresive 1778)
Water soluble low viscosity polymer dispersion, which replaces the mixing of water and acrylic is used to improve the flexibility, durability and adhesion of MasterInject 1776 and MasterInject 1777.

MasterInject 1779
(formerly Concresive 1779)
Acrylic-based, three-component, low viscosity injection resin, which is used for low pressure injection of large scale concrete and masonry elements for permanent water crack sealing and curtain injection.
Repairing Concrete
Solutions to Re-establish Structural Integrity

MasterFlow

Anchoring grouts
Anchoring grouts are used to anchor reinforcing steel, which is used for structural strengthening to ensure the continuity of reinforced concrete structures. Anchoring grouts are also used for embedding galvanized or stainless steel and threaded rods into concrete or masonry for non-structural purposes.

Non-structural fixing

MasterFlow 915 AN
Polyester-based, two-component, thixotropic, chemical anchoring mortar in cartridge, which is specially designed for applications where light to medium loads are to be fixed in hollow blocks or solid material such as concrete.

Structural fixing

MasterFlow 920 AN
Methacrylate-based, two-component, thixotropic and high performance chemical anchoring mortar in cartridge, which is ETA approved and specially designed for applications where medium to high loads are to be fixed in hollow blocks or solid material such as concrete.

MasterFlow 935 AN
Pure epoxy-based, two-component, thixotropic, and high performance chemical anchoring mortar in cartridge, which is specially designed for applications where very heavy loads under critical conditions are to be fixed into concrete.

Reinforcement Corrosion Protection

MasterEmaco P

Reinforcement corrosion protection is an important part of structural repair of concrete. EN 1504-7 specifies requirements for the identification and the performance (including durability aspects) of products and systems for active and barrier coatings for protection of existing uncoated steel reinforcement and embedded steel in concrete structures under repair.

Active primers
Primer containing special additives, which function as inhibitors or provide localised cathodic protection.

MasterEmaco P 5000 AP (formerly Emaco Nanocrete AP)
Cement based single component, active primer, which contains active corrosion inhibiting additives for the protection of reinforcement steel and reinstates a high pH environment around the reinforcement.

MasterEmaco P 5000 AN
Cement based single component, active primer, which contains active corrosion inhibiting additives for the protection of reinforcement steel and reinstates a high pH environment around the reinforcement.
Concrete Protection

MasterProtect

Designing concrete according to the minimum requirements of EN 206 might not be enough to achieve a durable concrete in the field. The proper placing of concrete, including installing the required concrete cover, are the most important key parameters, combined with the concrete’s design, to achieve a durable structure. From design to curing – whenever a small deviation regarding the specified design and application occurs, it opens the way for concrete degradation and deterioration. Then it is only a question of time before accelerated carbonisation, chemical attack and de-icing salts will start to damage the concrete structure and even the structure itself. In order to avoid this kind of concrete degradation, protection materials are used for new and refurbished structures.

For protection, EN 1504-2 generally differentiates between two kind of protections:

Hydrophobic impregnation
Treatment of concrete to produce a water-repellent surface.

- MasterProtect H 303
  (formerly Masterseal 303)
  Single-component, hydrophobic impregnation based on alkylalkoxysilane emulsion for long-lasting, invisible protection of concrete surfaces.

- MasterProtect 8000CI
  (formerly Protectosil CIT)
  Single-component, organo-functional silane-based corrosion inhibitor, which penetrates into concrete and inhibits the electro-chemical corrosion process between the rebar and the chloride ions, oxygen and moisture present in the concrete.

Coating
Treatment to produce a continuous protective layer on the surface of concrete.

- MasterProtect 330 EL
  (formerly Masterseal F1131/367 Elastic)
  Single-component, water-based, anti-carbonation coating-based on acrylic polymers, which provides an excellent protection of concrete surfaces with crack bridging ability.

- MasterProtect 320
  (formerly Masterseal F1120/326/368)
  Single-component, water-based, anti-carbonation coating based on acrylic polymers.

For more detailed information please refer to the brochure Protecting Concrete from Master Builders Solutions. With additional protective coating technologies like resin based coatings under the Master Builders Solutions Brand from BASF, a very broad protection portfolio is introduced in this brochure. Based on your protection requirements you can choose the best fit for purpose solution from our concrete protection range.
Repairing Concrete
Solutions to Re-establish Structural Integrity

EN 1504 – Examples in Use

Highway bridge structures

Recommended investigation/diagnosis:
- Visual inspection and/or hammer testing to identify existing spalled or delaminated areas
- Determination of condition of reinforcement, especially loss of steel diameter
- Half-cell potential (or other electronic non-destructive testing method) mapping to assess active corrosion
- Concrete sampling to determine chloride levels and depths of contamination
- Determine requirements of client: budget, life expectancy of repair, future loading requirements, practical considerations such as traffic management, access problems etc.

Typical defects found in this situation:
- High structural loading
- Chloride contamination from de-icing salts – visible red rusting and large-scale spalling
- Joints and deck requiring waterproofing
- Large-scale surface damage of concrete crush barriers caused by freeze-thaw action
- Structural or traffic carrying capacity inadequate

Supporting columns, beams, crash barriers, joints and waterproof decking

Possible repair strategies and recommended products: Surface preparation
- Delineate repair zones by saw-cutting to 5 mm
- Remove damaged and/or contaminated concrete by high power water-jetting or similar.
- Clean steel in exposed areas to Sa2 (EN ISO 8501-1). Material application
- Replace any steel where > 30 % loss of profile using MasterFlow resin anchors (Principle 4 of ENV 1504 part 9). Do not use resin anchors if structure is to be CP protected
- Restore passivity to steel by use of active primer MasterEmaco P 5000 AP or high pH, impermeable, repair mortar MasterEmaco S 5400 (Principle 7)
- Structural repair columns and beams: option 1: spray apply highstrength, high-modulus, expansive cement-based mortar to required profile: MasterEmaco S 5400. Option 2: in areas of heavy congested reinforcement, or for enlarged areas, erect watertight formwork and recast using highly flowable, self-compacting fluid repair mortar MasterEmaco S 5450 PG (Principle 3)
- Reprofiling crash barriers: apply skim coat repair mortar: MasterEmaco N 5200 and S 5300 (Principle 3)

- Protect and improve aesthetics with MasterProtect protective coating (Principle 1 & 2)
- Renew deck waterproofing where necessary with MasterSeal elastomeric deck membrane system (Principle 1)
- Renew jointing system. Repair concrete nosings with Emaco S 540 FR or MasterEmaco T as appropriate
- Protect rest of structure by reducing corrosion rates of the steel using spray-applied corrosion inhibitor (MasterProtect 8000 CI) (Principles 2 & 11). NB: MasterProtect 8000 CI prevents the formation of ring-anodes, only actual spalled or delaminated areas need to be repaired
- Or apply appropriate MasterProtect 830 CP / 860 CP cathodic protection for 25+ years of maintenance-free life (Principle10)
- Where appropriate, strengthen structure with MasterBrace strengthening systems (Principle 4)
- Add additional capacity by broadening traffic lanes and strengthening cantilever, using MasterBrace LAM or MasterBrace BAR carbon-fibre laminates and bars (Principle 4)
Multi-storey car park structure

Recommended investigation/diagnosis:
- Visual inspection and/or hammer testing to identify existing spalled or delaminated areas
- Determination of condition of reinforcement, especially loss of steel diameter
- Half-cell potential (or other electronic non-destructive testing method) mapping to assess active corrosion
- Concrete sampling to determine chloride levels and depths of carbonation
- Determine requirements of client: budget, life expectancy of repair, practical considerations such as traffic management, access times/loss of revenue while car park is closed

Typical defects found in this situation:
- Chloride contamination from de-icing salts – visible red rusting and large-scale spalling on lower levels and ramps
- Large-scale corrosion caused by carbonation in thin-section precast concrete panels
- Joints and decking requiring waterproofing and anti-slip coatings. Water ingress into ground floor retail units
- Existing car park very dark and subject to constant graffiti attack
- Existing car park is now too small

Possible repair strategies and recommended products:

Surface preparation
- Delineate repair zones by saw-cutting to 5 mm
- Remove damaged and/or contaminated concrete by high power water-jetting or similar
- Prepare horizontal surfaces by captive grit blasting or similar
- Clean steel in exposed areas to Sa2 (EN ISO 8501-1)

Material application
- Replace any steel where > 30% loss of profile using MasterFlow anchoring grouts resin anchors (Principle 4). (NB do not use resin anchors if structure is to be CP protected)
- Protect passivity to steel by use of active primer MasterEmaco P 5000 AP or high pH, impermeable, repair mortar MasterEmaco S 5400 (Principle 7)
- Reprofiling precast panels and scab repairs: apply shrinkage compensated, fibre-reinforced, high-build repair mortar MasterEmaco S 5300 / N 5200 (Principle 3)
- Protect and improve aesthetics with MasterProtect anti-carbonation or anti-graffiti coating (Principle 1)
- Where necessary, resurface and level large-scale horizontal surfaces using MasterTop fast-setting high-strength toppings (EN 13813)
- Provide crack-bridging barrier, waterproofing over retail units with MasterSeal elastomeric deck membrane system (Principles 2 & 5)
- Protect intermediate decks with corrosion protection against water-borne chloride ingress with MasterProtect 8000 CI (Principles 1, 2 & 11)
- Provide hard-wearing, anti-slip intermediate deck coating MasterTop coatings (Principle 1 & 5)
- Renew jointing system with MasterSeal NP 474

Optional extra treatments/alternative systems
- Protect structure by reducing corrosion using spray-applied corrosion inhibitor MasterProtect 8000 CI (Principles 2 & 11) OR
- Apply appropriate MasterProtect 830 CP / 860 CP cathodic protection for 25+ years of maintenance-free life (Principle 10)
- Constructing additional storeys: add additional local capacity, using MasterBrace LAM, MasterBrace BAR or MasterBrace FIB systems (Principle 4)

Precast façade panels and floor slabs, supporting columns and beams

EN 1504 – Examples in Use
**EN 1504 – Examples in Use**

**Marine structures**

**Recommended investigation/diagnosis:**
- Visual inspection and/or hammer testing to identify existing spalled or delaminated areas
- Determination of condition of reinforcement, especially loss of steel diameter
- Half-cell potential (or other electronic non-destructive testing method) mapping to assess active corrosion
- Concrete sampling to determine chloride levels
- Determine requirements of client: budget, life expectancy of repair, practical considerations such as access times, loss of revenue while structure is out of commission etc.
- Agree repair option is viable rather than demolish and rebuild

**Typical defects found in this situation:**
- Chloride contamination from seawater – visible red rusting and large-scale spalling on underside of superstructure
- Splash/tidal zone and immediately below water level heavily damaged by erosion and impact damages plus some corrosion spalling
- Existing crane rail needs to be upgraded with new rails and anchoring/grouting systems

**Jetties, sea walls and desalination plants**

**Possible repair strategies and recommended products:**

**Surface preparation**
- Delineate repair zones by saw-cutting to 5 mm
- Remove damaged and/or contaminated concrete by high power water-jetting or similar
- Existing steel needs to be protected by use of the active primer MasterEmaco P 5000 AP or of high pH, impermeable, repair mortar MasterEmaco S 5400 (Principle 7)
- Structural repair to superstructure columns and beams: spray apply high-strength, sulphate-resistant, shrinkage-compensated cement-based mortar MasterEmaco S 5400 to the required profile (Principle 3)
- Install new crane rail and fenders with high-strength precision grout, capable of high dynamic loading, e.g. MasterFlow 648 (epoxy-based) or MasterFlow 4800 (cement-based with metallic aggregate)

**Material application**
- Replace any steel where > 30% loss of profile using MasterFlow anchoring grouts (Principle 4)
- Do not use resin anchors if structure is to be CP protected
- Replace passivity to steel by use of the active primer MasterEmaco P 5000 AP or of high pH, impermeable, repair mortar MasterEmaco S 5400 (Principle 7)
- For heavily chloride contaminated structure, spray apply 8 – 12 mm MasterProtect 860 CP cathodic protection for 25+ years of maintenance-free life (Principle10)
- For less contaminated structures, provide additional protection with MasterProtect 8000 CI spray-applied silane-based corrosion inhibitor (Principle 11)
Repairing Concrete
Solutions to Re-establish Structural Integrity

Cooling towers, silos and chimneys
Possible repair strategies and recommended products:

Surface preparation
- Delineate repair zones by saw-cutting to 5 mm
- Remove damaged and/or contaminated concrete by high-power water-jetting or similar
- Clean steel in exposed areas to Sa2 (EN ISO 8501-1)

Material application
- Replace any steel where > 30% loss of profile using MasterFlow anchoring grouts (Principle 4). Do not use resin anchors if structure is to be CP protected
- Restore passivity to steel by use of active primer MasterEmaco P 5000 AP or of high pH, impermeable repair mortar MasterEmaco S 5400 (Principle 7)
- Structural repair: spray apply high-strength, sulphate-resistant, shrinkage-compensated cement based mortar MasterEmaco S 5400 to the required profile (Principle 3)
- Where necessary, install MasterBrace FIB sheets or MasterBrace BAR systems (Principle 4) in order to stiffen, strengthen or increase the capacity of the structure
- Protect the concrete from chemical attacks using MasterSeal chemical-resistant membrane systems (principles 1 and 6)

Optional extra treatments / alternative systems
- In areas of high chloride contamination, apply appropriate MasterProtect 830 CP / 860 CP cathodic protection for 25+ years of maintenance-free life (Principle 10)
- For less contaminated structures, provide additional protection with MasterProtect 8000 CI spray-applied silane-based corrosion inhibitor (Principle 11)

Industrial buildings

Recommended investigation / diagnosis:
- Visual inspection and/or hammer testing to identify existing spalled or delaminated areas
- Visual inspection of surface appearance, especially where there is chemical damage
- Determination of condition of reinforcement, especially loss of steel diameter
- Half-cell potential (or other electronic non-destructive testing method) mapping to assess active corrosion
- Determination of the carbonation depth
- Concrete sampling to determine chloride levels and depths of contamination
- Determine requirements of client: budget, life expectancy of repair, future loading requirements, practical considerations such as access times, loss of revenue while structure is out of commission etc.

Typical defects found in this situation:
- Carbonation in areas with low reinforcement cover due to complex formwork (and installation method) during casting of the concrete
- Acid attack due to emissions from industrial chimneys
- Constantly wet / humid conditions
- Deterioration due to soft water, which is formed during water condensation in cooling towers
- Loss of surface hardness showing a powdery or non-cohesive surface due to chemical attack on the cement matrix
- Cracking of the concrete in chimneys, requiring external structural strengthening

EN 1504 – Examples in Use
Master Builders Solutions from BASF for the Construction Industry

MasterAir
Complete solutions for air entrained concrete

MasterBrace
Solutions for concrete strengthening

MasterCast
Solutions for the manufactured concrete product industry

MasterCem
Solutions for cement manufacture

MasterEmaco
Solutions for concrete repair

MasterFinish
Solutions for formwork treatment and surface improvement

MasterFlow
Solutions for precision grouting

MasterFiber
Comprehensive solutions for fiber reinforced concrete

MasterGlenium
Solutions for high performance concrete

MasterInject
Solutions for concrete injection

MasterKure
Solutions for concrete curing

MasterLife
Solutions for enhanced durability

MasterMatrix
Advanced rheology control for concrete

MasterPel
Solutions for water tight concrete

MasterPolyheed
Solutions for mid-range concrete

MasterPozzolith
Solutions for water-reduced concrete

MasterProtect
Solutions for concrete protection

MasterRheobuild
Solutions for high strength concrete

MasterRoc
Solutions for underground construction

MasterSeal
Solutions for waterproofing and sealing

MasterSet
Solutions for set control

MasterSure
Solutions for extraordinary workability retention

MasterTop
Solutions for industrial and commercial floors

Master X-Seed
Advanced accelerator solutions for concrete

Ucrete
Flooring solutions for harsh environments

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