BS EN 1504

Products and Systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity

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“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

BS EN 1504: A guide to concrete repair

- **BS EN 1504** is the new British Standard for the protection and repair of reinforced concrete.
- There are ten parts to the standard covering test methods for material properties and specification for the key repair materials, including coatings, mortars, bonding agents and injection materials.
- It also includes general principles for repair work and a standard for site application of products and systems.

Ten Parts

1. General scope & definitions
2. Surface protective systems
3. Structural & non structural repair
4. Structural bonding
5. Concrete injection
6. Anchoring of reinforcing steel bar
7. Reinforcement corrosion protection
8. Quality control & evaluation of conformity
9. General principles for use of products & systems
10. Site application of products & systems & quality control of works

Repair Phases

Management of the structure

Process of assessment

General Planning

Design of Repair work

Repair work

Acceptance of repair work

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Management of the structure

- Conditions and history of structure
- Documentation
- Commissions for maintenance

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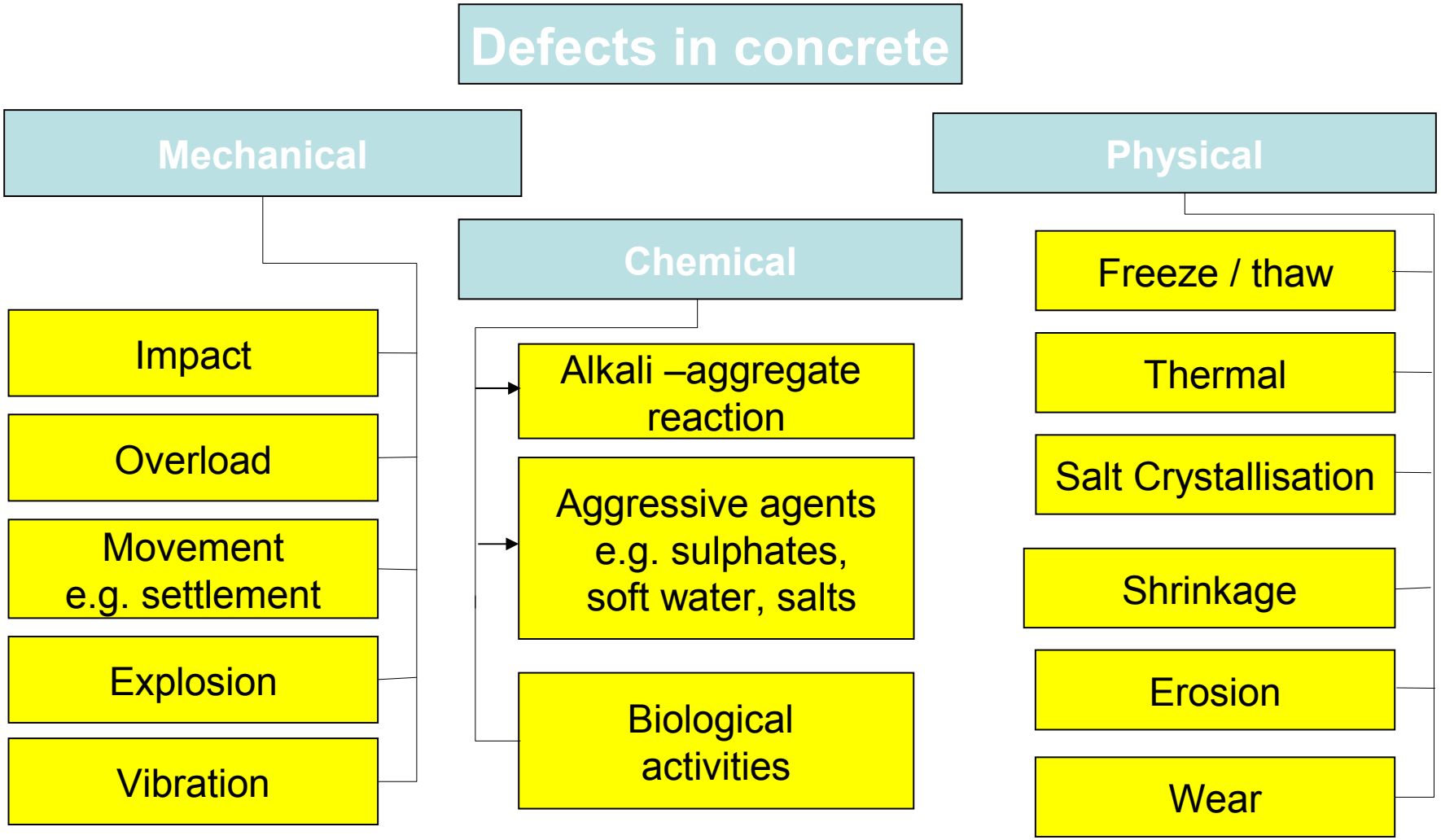
Process of assessment

- Inadequate structural design
- Poor mix design, insufficient compaction, insufficient mixing
- Low cover
- Defective waterproofing
- Contamination with chloride containing or reactive aggregates
- Inadequate curing

Defects in concrete (Common causes of defects; EN 1504 Part 9)



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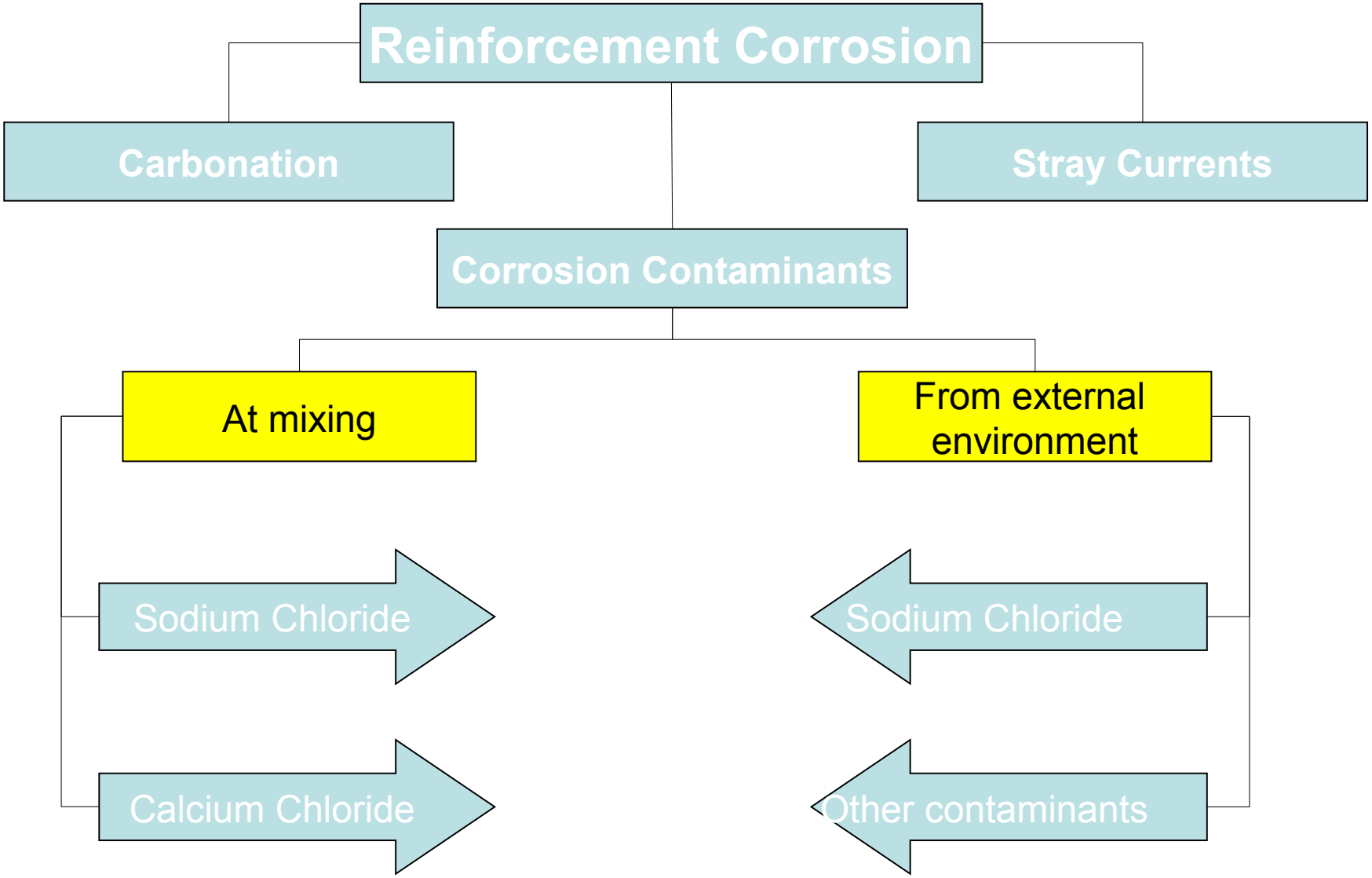

Carbonation

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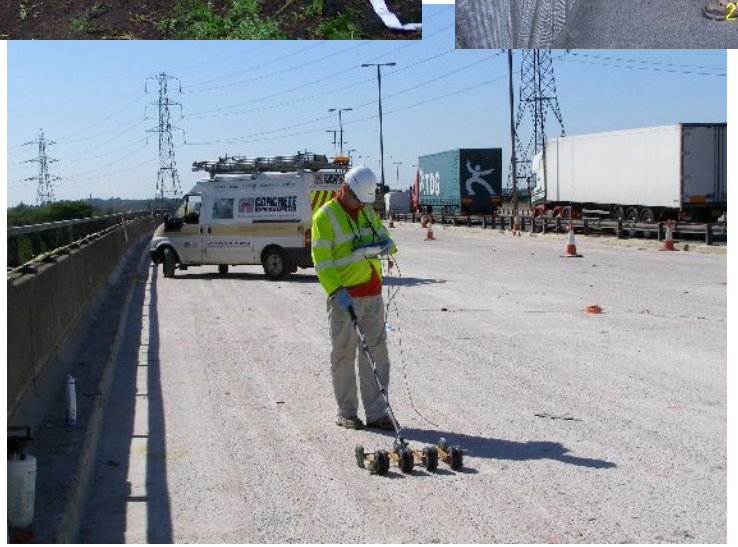

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General Planning

- Do nothing for a certain time
- Re-analyse the structural capacity; possibly down grade the function
- Prevention or reduction of further deterioration
- Improvement, strengthening of concrete structure
- Reconstruction of concrete structure
- Demolition

- Use and design life
- Required performance characteristics
- Long term performance of the repair
- Opportunities for additional protection
- Acceptable number of repair cycles
- Cost and funding of these
- Properties and preparation of substrate
- Appearance of repair or protection

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Parts

Part	Description
1	Definitions
2	Surface protection systems
3	Structural and non-structural repair
4	Structural Bonding
5	Concrete injection
6	Anchoring of reinforcing bar
7	Reinforcement corrosion protection
8	Quality control and evaluation of conformity
9	General principles for the use of products and systems
10	Site application of products and systems and quality control of the works

Principles

Principle		Definition
1	PI	Protection against ingress
2	MC	Moisture control
3	CR	Concrete restoration
4	SS	Structural strengthening
5	PR	Increasing physical strength
6	RC	Resistance to chemicals
7	RP	Preserving or restoring passivity
8	IR	Increasing resistivity
9	CC	Cathodic control
10	CP	Cathodic protection
11	CA	Control of anodic areas

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Choice of protection & repair principles and methods

Principle	Examples of Methods based on the Principles	Relevant Part of EN 1504
Principles and methods related to defects in concrete		
1. Protection against ingress	1.1 Hydrophobic impregnation	2
	1.2 Impregnation	2
	1.3 Coating	2
	1.4 Surface bandaging of cracks	
	1.5 Filling cracks	5
	1.6 Transferring cracks into joints	
	1.7 Erecting external panels	
	1.8 Applying membranes	
2. Moisture control	2.1 Hydrophobic impregnation	2
	2.2 Impregnation	2
	2.3 Coating	2
	2.4 Erecting external panels	
	2.5 Electrochemical treatment	
3. Concrete restoration	3.1 Hand-applied mortar	3
	3.2 Recasting with concrete	3
	3.3 Spraying concrete or mortar	3
	3.4 Replacing elements.	
4. Structural strengthening	4.1 Adding or replacing embedded or external reinforcing bars.	
	4.2 Adding reinforcement anchored in pre-formed or drilled holes	6
	4.3 Bonding plate reinforcement	4
	4.4 Adding mortar or concrete	3, 4
	4.5 Injecting cracks, voids or interstices	5
	4.6 Filling cracks, voids or interstices	5
	4.7 Prestressing - (post tensioning)	
5. Increasing physical resistance	5.1 Overlaying or Coating. Overlaying is in Part 3 or EN 206-1 or sprayed concrete	2
	5.2 Impregnation	2
6. Resistance to chemicals	6.1 Overlaying or Coating [see 5.1]	2
	6.2 Impregnation	
Principles and methods related to reinforcement corrosion		
7. Preserving or restoring passivity	7.1 Increasing cover with additional mortar or concrete	3
	7.2 Replacing contaminated or carbonated concrete	3
	7.3 Electrochemical realkalisation of carbonated concrete	
	7.4 Realkalisation of carbonated concrete by diffusion	
	7.5 Electrochemical chloride extraction	
8. Increasing resistivity	8.1 Hydrophobic impregnation	2
	8.2 Impregnation	2
	8.3 Coating	2
9. Cathodic control	9.1 Limiting oxygen content (at the cathode) by saturation or surface coating	
10. Cathodic protection	10.1 Applying an electrical potential	
11. Control of anodic areas	11.1 Active coating of the reinforcement	7
	11.2 Barrier coating of the reinforcement	7
	11.3 Applying corrosion inhibitors to the concrete	

Principle 1, PI – protection against ingress

Principle 2, MC – moisture control

Principle 3, CR – concrete restoration

Principle 4, SS – structural strengthening

Principle 5, PR – physical resistance

Principle 6, RC – resistance to chemicals

Principle 7, RP – preserving or restoring passivity

Principle 8, IR – increasing resistivity

Principle 9, CC – Cathodic control

Limiting Oxygen Ingress

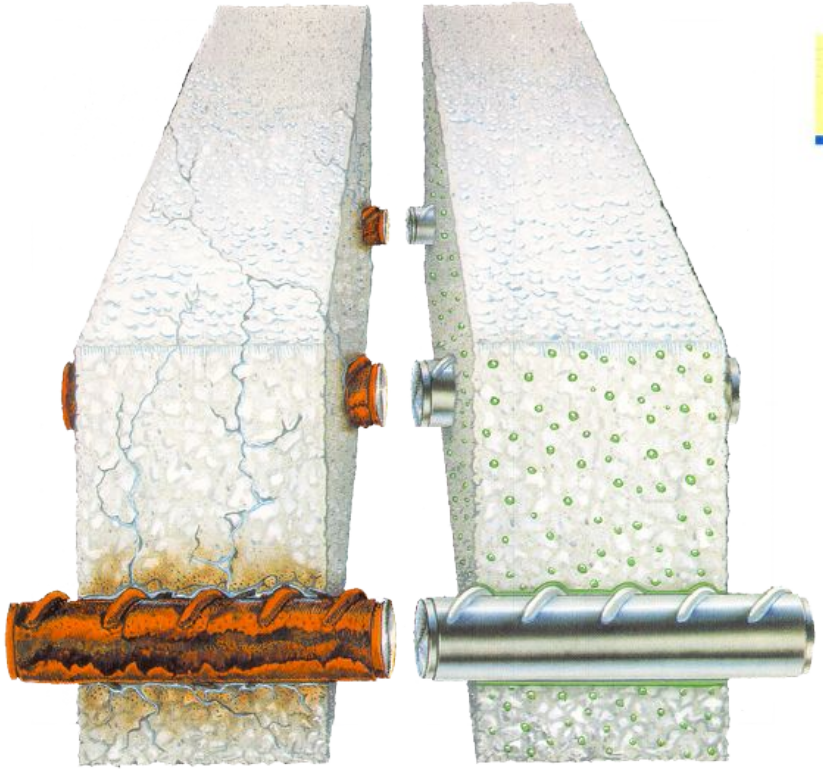
- **Saturation**
- **Surface coating**

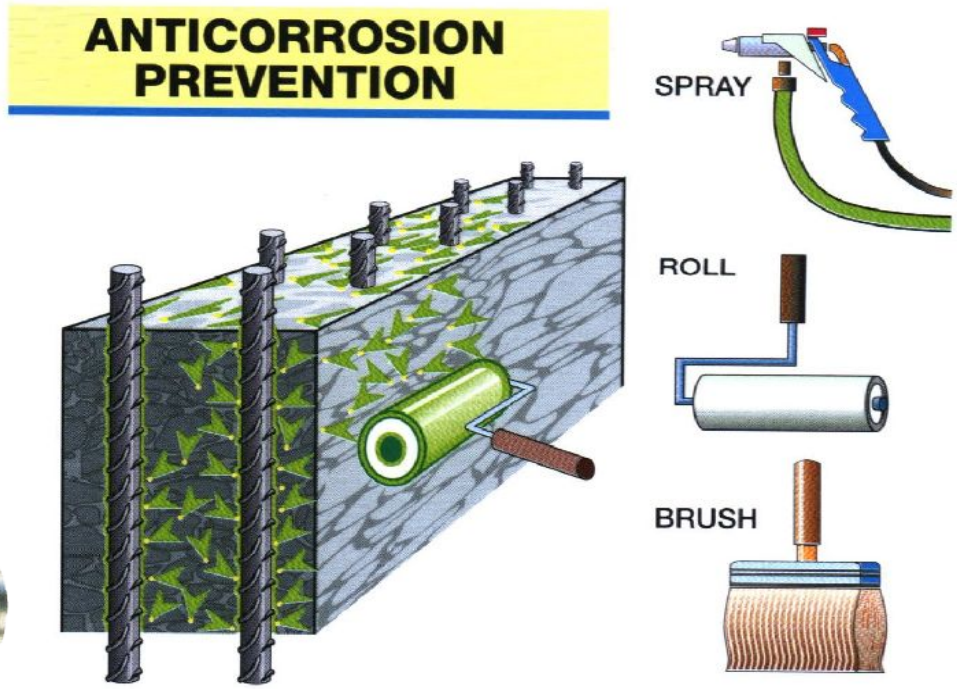
Principle 10,CP – Cathodic Protection

Impressed Current CP

Galvanic Anode CP

Principle 11, CA – control of anodic areas





Corrosion Inhibitors

Principle 11

Before

After

Additional Information

- Concrete Society Technical Report No.69 – Repair of concrete structures with reference to BS EN 1504

- Concrete Society – repair guidance notes visit www.concrete-repairs.co.uk to download pdf copies

- Material suppliers
  - Weber
  - Fosroc
  - BASF
  - Sika

Summary

- A significant proportion of the UK construction budget is spent on bridge maintenance and this is likely to increase
  - Concrete repairs
  - Bridge bearing replacement
  - Bridge deck waterpoofing
  - Structural strengthening
- The implementation of BS EN 1504 will improve the performance of concrete repairs taking into account whole life costs and durability

Future Conferences

- The Design and Installation of Replacement Bridge Bearings – 14th October Aston University
- The Infrastructure Show – 18th-20th October NEC Birmingham

Thank You

Any Questions ?

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EN 1504: Products and systems for the repair and protection of concrete structures

- 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
- factory production control and evaluation of conformity, including CE marking
- site application methods and quality control of the works