

# Principles and methods for protection and repair of concrete structures

August 31st, 2022



Colours correspond with frequency of application in the Benelux:

	Often	Sometimes	Rarely	Never
Repair				
Prevention				

**X** or **X**: If a method can be used both for repair and prevention, a **bold X** indicates the preferred application.

The first two columns taken from [NEN-EN 1504-9](#), table 1.

Total cost and durability of a specific repair or prevention method:

	Low	Limited	Moderate	High	Very high
Cost	€	<i>Not in use</i>	€€	€€€	€€€€
Durability	+	++	+++	++++	<i>Not in use</i>

Rating and validation of a specific repair or prevention method:

	Ineffective	Limited	Moderate	Effective	Highly effective
Rating	1	2	3	4	5

Principle	Examples of methods based on the principles	Repair	Prevention	Alkali-silica reaction (ASR)	Early age thermal cracks	Reinforcement corrosion chloride	Reinforcement corrosion carbonation	Frost-thaw +/- deicing salts	Sulphate attack	Delayed ettringite formation (DEF)	Overall rating of method (€, ease of use, durability, effectiveness)
<b>Principles and methods related to defects in concrete</b>											
1. Protection against ingress	1.1 Hydrophobic impregnation		X			€ / + / 3	€ / + / 2				5
	1.2 Impregnation		X			€ / + / 3	€ / + / 2				5
	1.3 Coating		X			€€ / ++ / 4	€€ / ++ / 4				7
	1.4 Surface bandaging of cracks	X			€ / ++ / 3						4
	1.5 Filling of cracks	X			€€€ / +++ / 5						8
	1.6 Transferring cracks into joints	X			Little experience						Little experience
	1.7 Erecting external panels <sup>a</sup>	X									-
	1.8 Applying membranes <sup>a</sup>	X			€€€ / +++ / 4						7
2. Moisture control	2.1 Hydrophobic impregnation		X				€ / + / 2	€ / + / 2	€ / + / 2		4
	2.2 Impregnation		X				€ / + / 2				4
	2.3 Coating		X	€€ / ++ / 3			€€ / ++ / 3	€€ / ++ / 3	€€ / ++ / 3	€€ / ++ / 3	7
	2.4 Erecting external panels	X									-
	2.5 Electrochemical treatment	X									-
3. Concrete restoration	3.1 Hand-applied mortar	X				€€ / + / 2	€€ / ++ / 3	€€ / + / 3	€€ / ++ / 2		6
	3.2 Recasting with concrete or mortar	X				€€€ / ++ / 3	€€€ / +++ / 4	€€€ / +++ / 4	€€ / ++ / 3		7
	3.3 Spraying concrete or mortar	X				€€€ / +++ / 3	€€€ / +++ / 4		€€€ / +++ / 3		8
	3.4 Replacing elements	X		€€€€ / ++++ / 5		€€€€ / ++++ / 5	€€€€ / ++++ / 5		€€€€ / ++++ / 5	€€€€ / ++++ / 5	8
4. Structural strengthening	4.1 Adding or replacing embedded or external reinforcing bars	X				€€ / ++++ / 3	€€ / ++++ / 4				7
	4.2 Adding reinforcement anchored in pre-formed or drilled holes	X				€€€ / ++++ / 3	€€€ / ++++ / 4				6
	4.3 Bonding plate reinforcement	X									-
	4.4 Adding mortar or concrete	X									-
	4.5 Injecting cracks, voids or interstices	X				€€€ / ++++ / 2					4
	4.6 Filling cracks, voids or interstices	X				€€ / +++ / 1					3
	4.7 Prestressing (post tensioning)	X		€€€€ / ++++ / 4						Little experience	8
5. Increasing physical resistance	5.1 Coating	X	<b>X</b>								-
	5.2 Impregnation	X	<b>X</b>								-
	5.3 Adding mortar or concrete	X	<b>X</b>								-
6. Resistance to chemicals	6.1 Coating		X					€€ / ++ / 3			7
	6.2 Impregnation		X								-
	6.3 Adding mortar or concrete	X	<b>X</b>								-

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<b>Principles and methods related to reinforcement corrosion</b>											
7. Preserving or restoring passivity	7.1 Increasing cover with additional mortar/concrete	X	X			€€ / ++ / 2	€€ / +++ / 3				5
	7.2 Replacing contaminated or carbonated concrete	X				€€€ / ++ / 4	€€€ / +++ / 4				7
	7.3 Electrochemical realkalisation of carbonated concrete	X									-
	7.4 Realkalisation of carbonated concrete by diffusion	X									-
	7.5 Electrochemical chloride extraction	X				€€€ / ++ / 2					3
8. Increasing electrical resistivity	8.1 Hydrophobic impregnation		X			N.A.	€ / + / 2				3
	8.2 Impregnation		X			N.A.	€ / + / 2				3
	8.3 Coating		X			N.A.	€€ / ++ / 2				4
9. Cathodic control	9.1 Limiting oxygen content (at the cathode) by saturation or surface coating		X								-
10. Cathodic protection	10.1 Applying an electrical potential	X	X			€€€ / +++ / 5	€€€ / +++ / 5				8
11. Control of anodic areas	11.1 Active coating of the reinforcement		X								-
	11.2 Barrier coating of the reinforcement		X			€ / ++ / 3					7
	11.3 Applying corrosion inhibitors in or to the concrete		X			€ / + / 2					3

<sup>a</sup> = These methods may also be applicable to other principles.

N.A. = Non-applicable. This principle is not suitable as a repair technique for chloride-initiated corrosion. Increasing the electrical resistance of the concrete by drying out is only suitable (under certain conditions) for carbonation-initiated reinforcement corrosion.