Commissie Degradatie

Tunnel repair methods

CONCEPT - Januari 2021

Principles and Methods for protection and repair of concrete structures (first 2 columns taken from Table 1, NEN-EN 1504-9)

Principle	Examples of methods based on the principles	Repair	Prevention	ASR	Early age thermal cracks	Reinforcement corrosion Chloride	Reinforcement corrosion Carbonation	Frost-thaw +/- deicing salts	Sulphate attack	DEF	
Principles and methods related to defects in concrete											
1. Protection against ingress	1.1 Hydrophobic impregnation		X			€ / +	€ / +				
	1.2 Impregnation		X			€ / +	€ / +				
	1.3 Coating		X			€€ / ++	€€ / ++				
	1.4 Surface bandaging of cracks	X			€ / ++						
	1.5 Filling of cracks	X			€€€ / ++++						
	1.6 Transferring cracks into joints	X			?						
	1.7 Erecting external panels [a]	X									
	1.8 Applying membranes [a]	X			€€€ / +++						
2. Moisture control	2.1 Hydrophobic impregnation		X				€ / +	€ / +	€ / +		
	2.2 Impregnation		X				€ / +				
	2.3 Coating		X	€€ / ++			€€ / ++	€€ / ++	€€ / ++	€€ / ++	
	2.4 Erecting external panels	X									
	2.5 Electrochemical treatment	X									
3. Concrete restoration	3.1 Hand-applied mortar	X				€€ / +	€€ / ++	€€ / +	€€ / ++		
	3.2 Recasting with concrete or mortar	X				€€€ / +++	€€€ / +++	€€€ / +++	€€ / ++		
	3.3 Spraying concrete or mortar	X				€€€ / +++	€€€ / +++		€€€ / +++		
	3.4 Replacing elements	X				€€€€ / ++++	€€€€ / ++++		€€€€ / ++++	€€€€ / ++++	
4. Structural strengthening	4.1 Adding or replacing embedded or external reinforcing	X				€€ / ++++	€€ / ++++				
	4.2 Adding reinforcement anchored in pre-formed or drilled holes	X				€€€ / ++++	€€€ / ++++				
	4.3 Bonding plate reinforcement	X									
	4.4 Adding mortar or concrete	X									
	4.5 Injecting cracks, voids or interstices	X				€€€ / ++++					
	4.6 Filling cracks, voids or interstices	X				€€ / +++					
	4.7 Prestressing - (post tensioning)	X		€€€€ / ++++						?	
5. Increasing physical resistance	5.1 Coating	X	**X**								
	5.2 Impregnation	X	**X**								
	5.3 Adding mortar or concrete	X	**X**								
6. Resistance to chemicals	6.1 Coating		X						€€ / ++		
	6.2 Impregnation		X								
	6.3 Adding mortar or concrete	X	X								
Principles and methods related to reinforcement corrosion											
7. Preserving or restoring passivity	7.1 Increasing cover with additional mortar/concrete	**X**	X			€€ / ++	€€ / +++				
	7.2 Replacing contaminated or carbonated concrete	X				€€€ / ++	€€€ / +++				
	7.3 Electrochemical realkalisation of carbonated concrete	X									
	7.4 Realkalisation of carbonated concrete by diffusion	X									
	7.5 Electrochemical chloride extraction	X				€€€ / ++					
8. Increasing electrical resistivity	8.1 Hydrophobic impregnation		X			1	€ / +				
	8.2 Impregnation		X			1	€ / +				
	8.3 Coating		X			1	€€ / ++				
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			€€€ / +++	€€€ / +++				
11. Control of anodic areas	11.1 Active coating of the reinforcement		X								
	11.2 Barrier coating of the reinforcement		X			€ / ++					
	11.3 Applying corrosion inhibitors in or to the concrete		X			€ / +					

[a] These methods may also be applicable to other principles.

Color codes correspond with frequency of application in the Benelux:

Repair	Often	Sometimes	Rarely	Never		
Prevention						

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

Cost	€	Low	€€	Moderate	€€€	High	€€€€	Expensive

Durability	+	Low	++	Limited	+++	Moderate	++++	High

1: Als reparatietechniek voor chloride geïnitieerde corrosie niet geschikt. Verhogen van de elektrische weerstand van het beton door uitdroging alleen geschikt (onder voorwaarden) bij carbonatatie geïnitieerde wapeningscorrosie.