



PREVENTION OF CORROSION

DONADIO MICHEL

SIKA SERVICES AG / TM REFURBISHMENT

BUILDING TRUST



THE
RULE
BOOK



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REINFORCED CONCRETE CORROSION ISSUES



CARBONATION INDUCED CORROSION

Often combined with low concrete cover issues
Low corrosion rate



MARINE STRUCTURES

Damages can happen few years after erection
Fast corrosion rate



CHLORIDE INDUCED CORROSION

FROM DE-ICING SALTS

Damages associated with freeze and thaw cycles
Fast corrosion rate

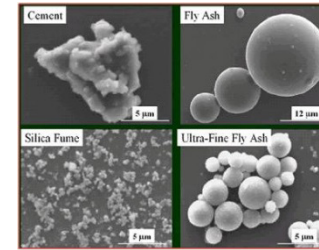
CHLORIDE ISSUES – EN 206-1 CLASSIFICATION

Class Designation	Description of the environment	Informative examples where exposure classes may occur
XS1	Exposed to airborne salt but not in direct contact with sea water	Structures near to or on the coast
XS2	Permanently submerged	Parts of marine structures
XS3	Tidal, splash and spray zones	Parts of marine structures

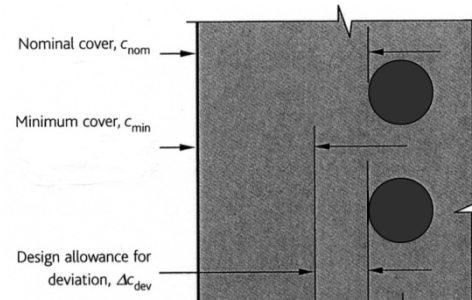
Where concrete containing reinforcement or other embedded metal is subject to contact with chlorides from sea water or air carrying salt originating from sea water, the exposure shall be classified as above:

CHLORIDE ENVIRONMENT – 100 YEARS DURABILITY

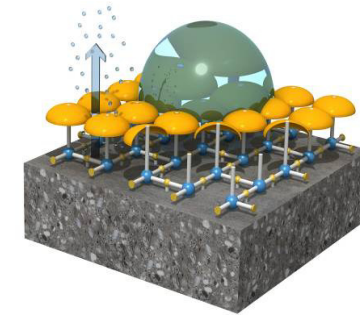
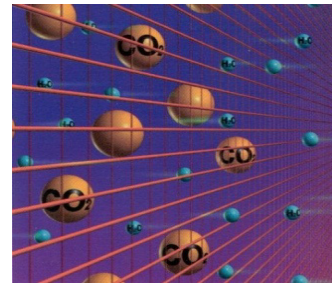
- Durable Concrete



- Thick Concrete Cover



- Hydrophobic impregnation or Protective Coating



- Admixed Corrosion Inhibitor



CHLORIDE ENVIRONMENT – 100 YEARS DURABILITY

- Durable Concrete
 - Main Defence:
 - Low chloride permeability (e.g. $< 3 \times 10^{-12}$)
- Thick Concrete Cover
 - Primary Defence:
 - 75 mm cover
- Hydrophobic impregnation or Protective Coating
 - Complementary Defence:
 - Retard the ingress of chloride
 - Can be part of maintenance program
- Admixed Corrosion Inhibitor
 - Last line of Defense:
 - Increase chloride threshold
 - Reduce corrosion speed

CHLORIDE ISSUES – EN 206-1 CLASSIFICATION

Table A.13 — Limiting values for composition and properties of concrete exposed to risk of corrosion of reinforcement induced by sea water for an intended working life of at least 50 years

Exposure class	Nominal cover ^a to reinforcement mm	Minimum strength class	Maximum w/c ratio	Minimum cement or combination content kg/m ³	Cements and combinations ^b
XS1	40 ^c + Δc	C35/45	0.50	As in Table A.18 plus 20 kg/m ³	Group 4
		C32/40	0.50		Group 5
		C25/30	0.55		Group 6
	35 + Δc	C40/50	0.45		Group 4
		C35/45			Group 5
		C28/35	0.50		Group 6
	30 + Δc	C50/60	0.35		Group 4
		C45/55			Group 5
		C35/45	0.40		Group 6
XS2	40 ^c + Δc	C28/35	0.55		Group 4
		C25/30			Group 5
		C20/25			Group 6
	35 + Δc	C32/40	0.50		Group 4
		C28/35			Group 5
		C25/30			Group 6
	30 + Δc	C40/50	0.40		Group 4
		C35/45			Group 5
		C32/40			Group 6
XS3	50 ^c + Δc	C40/50	0.40	Group 4	
		C28/35	0.50	Group 5	
		C25/30		Group 6	
	45 + Δc	C45/55	0.35	Group 4	
		C32/40	0.45	Group 5	
		C28/35		Group 6	
	40 + Δc	C35/45	0.40	Group 5	
		C32/40		Group 6	

^a Expressed as the minimum cover to reinforcement plus a tolerance, Δc, to accommodate fixing precision.
^b See Table A.17 for the cements and combinations permitted in each of the groups.
^c Where the minimum cover to reinforcement is greater than this value, the concrete quality should not be reduced below that given in this row.

XS 1:
Cover 30 to 40 mm

XS 2:
Cover 30 to 40 mm

XS 3:
Cover 40 to 50 mm