TMB ELEMENT

Appendix 1

Concrete cover, exposure classes 11/2013

CONCRETE COVER

The concrete cover is one of the most important parameters in manufacturing reinforced concrete elements, since the concrete cover must ensure:

1) firm transference of adhesive powers between concrete and reinforcement;
2) sufficient fire resistance of a structure;
3) sufficient protection of steel reinforcement against corrosion.

Table 2 presents descriptions of exposure classes and Table 1 presents minimum requirements for concrete cover according to increase in exposure class and concrete strength class.
The values of minimum concrete cover conform to the standard EVS-13369 "Common rules for precast concrete products" Appendix A and the descriptions of exposure classes conform to the standard EVS-EN 206-1 "Concrete. Part 1: Specification, performance, production and conformity".

Table 1.

Dependence of the concrete cover on exposure class and concrete strength class

Exposure class	XC0	XC1	XC2, XC3	XC4	XD1, XS1, XF1, XA1	XD2, XS2, XF2, XA2	XD3, XS3, XF3, XF4, XA3
Concrete class	<C30/37	<C30/37	<C35/45	<C40/50	<C40/50	<C40/50	<C45/55
Min. concrete cover (mm)	10	10	15	20	25	30	35
Concrete class	≥C30/37	≥C30/37	≥C35/45	≥C40/50	≥C40/50	≥C40/50	≥C45/55
Min. concrete cover (mm)	10	10	10	15	20	25	30

Table 2.

Exposure classes

Class indic.	Description of the environment	Examples about the application of exposure classes
1. No risk of corrosion		
X0	If the concrete does not contain reinforcement or structural steel: All conditions, excluding those with freezing/melting, wearing or chemical agents	Concrete in interior space with very dry air
	If the concrete contains reinforcement or structural steel: very dry	
2. Corrosion caused by carbonation		
If concrete containing reinforcement or structural steel is exposed to air and moisture, the environmental conditions are classified as follows:		
XC1	Dry or permanently wet	Concrete in interior space with low air humidity
		Concrete permanently under water
XC2	Wet, rarely dry	Concrete surfaces, which are in contact with water for a long time
		Numerous foundations
XC3	Moderately moist	Concrete in interior space with moderate or high air humidity
		Concrete exposed to outside air, protected from rain
XC4	Alternately wet and dry	Surfaces in contact with water, that do not belong to class XC2
Note. The moisture condition is connected to the condition of the concrete cover of reinforcement or structural steel, but in many cases the conditions of the concrete cover and the ambient environment can be considered the same. In these cases the classification of ambient environment can be used. The situation is different, if the concrete and the environment have been separated from each other by some kind of barrier.		

OÜ TMB ELEMENT
Betooni 7, 51014 Tartu, Estonia
Telephone +372 7 315 400
Fax +372 7 315 401
E-mail: info@tmbelement.ee
www.tmbelement.ee

TMB ELEMENT

Appendix 1

Exposure classes

Class indic.	Description of the environment	Examples about the application of exposure classes
3. Corrosion caused by chloride (except sea water chlorides)		
If concrete containing reinforcement or structural steel is exposed to chloride, including water containing anti-icing salts, which do not originate from sea water, the exposure classes are:		
XD1	Moderately moist	Concrete surfaces, whereto drops containing chlorides are falling
XD2	Wet, rarely dry	Swimming pools
		Concrete exposed to process water containing chlorides
XD3	Alternately wet and dry	Bridge parts, whereto drops containing chlorides are falling
		Pavements
		Parking lot panels
Note. See also division 2 of this table for moisture conditions.		
4. Corrosion caused by sea water chloride		
If concrete containing reinforcement or structural steel is exposed to sea water or sea air containing salts, the exposure classes are:		
XS1	Air containing salts, but no direct exposure to sea water	Structures located on shore or near it
XS2	Under water	Parts of marine buildings
XS3	Tide, dripping and drizzling water belts	Parts of marine buildings
5. Impact of freezing/melting with or without anti-icing agent		
If wet concrete is exposed to a considerable number of freezing/melting cycles, the exposure classes are:		
XF1	Moderately saturated with water, without anti-icing agent	Vertical concrete surfaces unprotected from rain and cold
XF2	Moderately saturated with water, with anti-icing agent	Vertical concrete surfaces of road structures unprotected from freezing and drizzle containing anti-icing agents
XF3	Highly saturated with water, without anti-icing agent	Horizontal concrete surfaces unprotected from rain and cold
XF4	Highly saturated with water, with anti-icing agent or sea water	Road and bridge decks exposed to the impact of anti-icing agents
		Concrete surfaces exposed to spatter containing anti-icing agents and cold
		Marine buildings located in the spatter zone and exposed to cold
6. Chemical agents		
XA1	Environment with low chemical aggressiveness	Chemical agents found in ground and groundwater
XA2	Environment with moderate chemical aggressiveness	Chemical agents found in ground and groundwater
XA3	Environment with high chemical aggressiveness	Chemical agents found in ground and groundwater

OÜ TMB ELEMENT
Betooni 7, 51014 Tartu, Estonia
Telephone +372 7 315 400
Fax +372 7 315 401
E-mail: info@tmbelement.ee
www.tmbelement.ee