

Survey of national requirements used in conjunction with EN 206-1:2000

ICS 91.100.30

National foreword

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English Version

**Survey of national requirements used in conjunction with EN
206-1:2000**

État des prescriptions nationales utilisées avec l'EN 206-
1:2000

Überblick nationaler Anforderungen, die im
Zusammenhang mit EN 206-1:2000 verwendet werden

This Technical Report was approved by CEN on 3 February 2009. It has been drawn up by the Technical Committee CEN/TC 104.

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Foreword

This document (CEN/TR 15868:2009) has been prepared by Technical Committee CEN/TC 104 “Concrete and related products”, the secretariat of which is held by DIN.

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1 Scope

This CEN Report provides a summary of national requirements used with EN 206-1:2000. The aims of this CEN Report are to:

- a) provide a picture of how EN 206-1 is being applied in practice;
- b) identify areas where EN 206-1 is being interpreted in different ways;
- c) identify areas where CEN Member Countries have found simplification to be necessary;
- d) identify additional national requirements;
- e) show areas where CEN Member Countries have found it necessary to override the requirements of EN 206-1.

EN 206-1 uses the phrase 'national provisions'. However, recent CEN Guidance wishes to retain this term for regulatory requirements only. This survey uses the term 'national requirements' to include regulations, standards and other documents that form the basis of local practice.

As a summary of national requirements, the information in this CEN Report is incomplete and may have been subject to later revisions. It is insufficient and not intended to provide the basis for design and specification: for this the national requirements (see Table 1.1) should be studied.

Table 1.1 identifies CEN Member Countries who did not respond to the questionnaire. The other tables in this CEN Report only include information from CEN Member Countries who responded and CEN Member Countries who did not respond are not identified.

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CEN Member Countries

Austria	AT
Belgium	BE
Cyprus	CY
Czech Republic	CZ
Denmark	DK
Estonia	EE
Finland	FI
France	FR
Germany	DE
Greece	GR
Hungary	HU
Iceland	IS
Ireland	IE
Italy	IT

CEN Member Countries

Latvia	LV
Lithuania	LT
Luxembourg	LU
Malta	MT
Netherlands	NL
Norway	NO
Poland	PL
Portugal	PT
Slovakia (Slovak Republic)	SK
Slovenia	SI
Spain	ES
Sweden	SE
Switzerland	CH
United Kingdom	UK

Affiliates

Albania	AL
Bulgaria	BG
Croatia (Hrvatska)	HR
Romania	RO
Turkey	TR

2 Location of national requirements

Table 1.1 gives the title of the documents that contain the national requirements, together with an English translation of the title. Any person wishing to design and specify concrete in another CEN Member Country should consult the documents cited in Table 1.1. Please note that the documents will be written in the national language(s) of the CEN Member Country. It should also be noted that the survey was conducted during 2005 to 2006 and the answers reflect practice at that time, which may not be the same as current practice.

Table 1.1 — Location of national requirements

CEN Member Countries^a	Location of national requirements
Austria	ÖNORM B 4710-1: Beton — Teil 1: Festlegung, Herstellung, Verwendung und Konformitätsnachweis (Regeln zur Umsetzung der ÖNORM EN 206-1) (Concrete — Part 1: Specification, production, use and verification of conformity (Rules for the implementation of ÖNORM EN 206-1))
Belgium	NBN B 15-001: Supplément à la NBN EN 206-1 — Béton — Spécification, performances, production et conformité NBN B 15-001: Aanvulling op NBN EN 206-1 — Beton — Eisen, gedraging, vervaardiging en conformiteit (Supplement to NBN EN 206-1: Concrete — Specification, performance, production and conformity)
Cyprus	No response received
Czech Republic	CSN EN 206-1 Zmena Z2
Denmark	DS 2426: Beton — Materialer — Regler for anvendelse af EN 206-1 i Danmark (Concrete — Materials — Rules for the use of EN 206-1 in Denmark)
Estonia	No response received
Finland	Suomen rakentamismääräyskokoelma, B4 Betonirakenteet, Liite 3: Kansallinen liite standardiin SFS-EN 206-1 (National Building Code of Finland, B4 Concrete structures, Annex 3: national Annex to standard SFS-EN 206-1) Informative Guidance document: Betoninormit 2004, Suomen Betoniyhdistys (Concrete Code, Finnish Concrete Association)
France	National annex included in the NF EN 206-1 standard
Germany	DIN 1045-2: Tragwerke aus Beton, Stahlbeton und Spannbeton — Teil 2: Beton — Festlegung, Eigenschaften, Herstellung und Konformität — Anwendungsregeln zu DIN EN 206-1 (DIN 1045-2: Concrete, reinforced and prestressed concrete structures — Part 2: Concrete — Specification, properties, production and conformity — Application rules for DIN EN 206-1)
Greece	No response received
Hungary	No response received
Iceland	No response received
Ireland	National Annex; published with I.S. EN 206-1 as a single document.
Italy	UNI 11104: Calcestruzzo — Specificazione, prestazione produzione e conformità Istruzioni complementari per l'applicazione della EN 206-1 (Concrete — Specification, performance, production and conformity, Additional provisions for the application of EN 206-1)

Table 1.1 (continued)

CEN Member Countries^a	Location of national requirements
Latvia	No response received
Lithuania	No response received
Luxembourg	DNA EN 206: Document National d'Application luxembourgeois de l'EN 206-1: Béton — Partie 1: Spécification, performances, production et conformité (DNA EN 206: Luxembourgish national application document of the EN 206-1: Concrete — Part 1: specification, performance, production and conformity)
Malta	There are no national provisions, but in the past, local industry has used recommendations in European, British or German standards
Netherlands	NEN 8005:2004: Nederlandse invulling van NEN-EN 206-1: Beton — Deel 1: Specificatie, eigenschappen, vervaardiging en conformiteit (Dutch supplement to NEN-EN 206-1: Concrete — Part 1: Specification, performance, production and conformity)
Norway	NS-EN 206-1 National Annex
Poland	No response received
Portugal	The Portuguese requirements are in the National Annex to NP EN 206-1 and to NP ENV 13670-1 and in the following National Civil Engineering Laboratory (LNEC) specifications, referenced in the NA of NP EN 206-1 LNEC E 461:2004: Metodologia para prevenir reacções expansivas internas (Methodology for avoiding internal expansive reactions) LNEC E 464:2005: Metodologia prescritiva para uma vida útil de 50 e 100 anos face às acções ambientais (Prescriptive methodology for a 50 and 100 years design working life under the environmental exposures) LNEC E 465:2005: Metodologia para estimar as propriedades de desempenho do betão que permitam satisfazer a vida útil de projecto de estruturas de betão armado ou pré-esforçado sob as exposições ambientais XC e XS (Methodology for estimating the concrete performance properties allowing to comply with the design working life of the reinforced or prestressed concrete structures under the environmental exposures XC and XS)
Slovakia	STN EN 206-1: Zmena 1 Concrete — Part 1: Specification, performance, production and conformity supplements EN 206-1 with the national provisions STN 731210: Water-proof concrete and concrete types of the specific characteristics (Resistance to abrasion, Concrete for the massive constructions — Low hydrating warmth)
Slovenia	SIST 1026: Beton — 1.del: Specifikacija, lastnosti, proizvodnja in skladnost — Pravila za uporabo SIST EN 206-1 (SIST 1026: Concrete — Part 1: Specification, performance, production and conformity— Rules for the implementation of SIST EN 206-1)
Spain	Spain has not adopted EN 206-1
Sweden	SS 13 70 03: Betong – Användning av EN 206-1 i Sverige (Concrete — Application of EN 206-1 in Sweden) Vägledning för val av exponeringsklass enligt SS-EN 206-1, Betongrapport nr 11, Svenska Betongföreningen (Guidance for selection of exposure class according to SS-EN 206-1, Concrete report No 11, Swedish Concrete Association)

Table 1.1 (continued)

CEN Member Countries ^a	Location of national requirements
Switzerland	SN EN 206-1:2000: Beton — Teil 1: Festlegung, Eigenschaften, Herstellung und Konformität (mit Nationalem Vorwort und Nationalem Anhang) (SN-EN 206-1:2000: Concrete — Part 1: Specification, performance, production and conformity (with National Preface and National Annex)) SN EN 206-1:2000/A1:2004: Beton — Teil 1: Festlegung, Eigenschaften, Herstellung und Konformität (SN EN 206-1:2000/A2:2005: Concrete — Part 1: Specification, performance, production and conformity) Ergänzung zum Nationalen Anhang NB der Norm SN EN 206-1:2000: Teil 1: Verwendung von Zementen und Zusatzstoffen gemäss dem Prinzip der gleichwertigen Betonleistungsfähigkeit (in Arbeit) (Amendments to the National Annex of the SN EN 206-1: Part 1: Use of cements and mineral additions according to the equivalent performance concept of concrete properties (in preparation)) Ergänzung zum Nationalen Anhang der Norm SN EN 206-1:2000: Teil 1: Anwendung des k-Wert Konzeptes gemäss dem Prinzip der gleichwertigen Betonleistungsfähigkeit (in Arbeit); der Anhang wird <i>Nationaler Anhang NC</i> genannt (Application of the <i>k</i>-value concept according to the principle of the equivalent concrete performance)
United Kingdom	BS 8500: Concrete — Complementary British Standard to BS EN 206-1 — Part 1: Method of specifying and guidance for the specifier — Part 2: Specification for constituent materials and concrete
^a None of the CEN affiliates chose to respond to this survey.	

3 Exposure classes

In Table 2.1 exposure classes that have been grouped together are given. A significant number of CEN Member Countries have found the need to simplify the system. In its simplest form this reduces to interior, outside, severe and (chemically) aggressive. A significant number of CEN Member Countries have grouped classes (not always in the same way). For example, XC3 and XC4 are grouped together and often the XF1 is combined with XC4 and XF2 with XD3 or the concrete quality is the same. However, not all CEN Member Countries have to consider freeze-thaw action and so it may not be possible to group the carbonation-induced corrosion exposure classes (XC) and freeze-thaw exposure classes (XF) at a CEN level.

The reasons for grouping them together vary and include:

- a) simplifying the system to meet local needs;
- b) one exposure class cannot exist without the other exposure class in the local environment;
- c) not easy for engineers to select one exposure from another;
- d) the resulting concrete specification is the same.

Some CEN Member Countries have not grouped the exposure classes, but have the same quality of concrete for several exposure classes. If they are following EC2, this may lead to different minimum covers to reinforcement, but the same concrete quality.

As the examples in EN 206-1:2000, Table 1 are informative, Table 2.2 shows the extent to which the informative examples have been adopted in CEN Member Countries and gives the additional national examples of these exposure classes. There is a clear message in the responses showing that the informative examples for the XC1 and XC2 exposures should clearly identify that the water is non-aggressive.

The responses to Table 2.3 show that EN 206-1, Table 2 is applied to the majority of situations in CEN Member Countries including mobile groundwater. As such the limitation in Table 2 to static groundwater should be reviewed.

The principle of classification by deterioration process has been widely accepted. However, there seems to be a need to review the sub-divisions of the exposure classes as part of the review of durability to see if simplification is possible. Any changes to exposure classes should be co-ordinated with changes to the design codes.

The fib model code on service life design may lead to a better way of sub-dividing the exposure classes, but it is premature to take this path until the models have been thoroughly checked for robustness, reality, sensitivity, reliability and economy.

NOTE 1 It may be appropriate to review EN 206-1, annexes E and J.

NOTE 2 In future reviews of EN 206-1, it may be possible to use the fib model code to define the exposures in terms of relative humidity, temperature and days of rainfall, the performance requirements in terms of carbonation resistance and 'deemed to satisfy' limiting values, but in the view of the ad hoc group this is not achievable for the 2010 revision of EN 206-1.

If it is decided to keep the exposure class as a designation for a concrete, an alternative approach to exposure sub-classes would be to create sets of concretes for each main exposure class. CEN Member Countries would then be free to select the appropriate designations for their 'indoor' and 'outdoor' exposures.

Table 2.4 assesses the extent to which CEN Member Countries select the same exposure classes for the same elements. There is a clear difference in view over whether indoor reinforced concrete should be classed as X0 or XC1. This is sometimes reinforced by defining the relative humidity for the X0 exposure at low values that are unlikely to exist in normal buildings. The need to allow the designer some flexibility to select the appropriate class is also a common feature of this table. The inclusion of a freeze-thaw exposure class reflects local conditions.

Table 2.1 — Exposure classes that have been grouped together

CEN Member Countries	Grouped exposure classes
Austria	(XC1) = XC1 (A) (XC2, XC3, XC4) = XC2 (A)
Belgium	In Belgium exposure classes are recommended in an indirect way. They are linked to "environmental classes". "Environmental classes" are defined as environments which are very relevant to the Belgian concrete practice. They are indicated by the letter E (for Environment), followed by a letter (I for Interior, E for Exterior, S for Seawater, A for Aggressive) and a numeral for a more detailed description. For each environmental class the relevant exposure classes are identified for unreinforced and reinforced concrete.
Czech Republic	-
Denmark	(X0, XC1) = Interior (XC2, XC3, XC4, XF1, XA1) = Exterior without risk of water saturation (XD1, XS1, XS2, XF2) = Exterior with risk of water saturation and additional chlorides/alkalis to the surface (XD2, XD3, XS3, XF4, XA3) = Severe exterior with risk of accumulation of chlorides/alkalis
Finland	None

Table 2.1 (*continued*)

CEN Member Countries	Grouped exposure classes
France (for in-situ concrete)	(XC1, XC2) (XC3, XC4, XD1, XF1) (XS1, XS2)
Germany	(XD1, XS1); (XD2, XS2); (XD3, XS3) – grouped with respect to limiting values of concrete composition
Ireland	None
Italy	(XC1, XC2), (XS2, XS3), (XF2, XF3) in table 'Limiting values for composition and properties of concrete' (UNI 11104)
Luxembourg	No grouping for the specification! Following exposure classes shows equal values for the limits of composition: (XC1, XC2) (XC3, XC4) (XD1, XD2) (XF2, XF3) The exposure classes must be considered and documented separately for the specification
Netherlands	None
Norway	This depends on the matter under consideration. Groups might be different with respect to different matters such as, concrete composition, concrete cover, crack width requirements etc. With respect to concrete composition the following can be considered a grouping: (X0) (XC1, XC2, XC3, XC4, XF1) (XD1, XS1, XA1, XA2, XA4*) *XA4 is a special class for manure in agricultural buildings (XF2, XF3, XF4) (XD2, XD3, XS2, XS3, XA3) (XSA*) *XSA is a special class for particularly aggressive environments, other environments than those above
Portugal	(XS, XD); (XC4, XF1)
Slovakia	None so far, but we suggest (XC3, XC4) and (XD1, XD2) to be merged together
Slovenia	None
Sweden	No classes have been grouped
Switzerland	None
United Kingdom and Northern Ireland	(XC3, XC4) In 2006 revision of BS 8500-1, the recommendations for resisting the XD and XS exposures are adequate for resisting the associated XC exposure

Table 2.2 — Examples of exposure classes

Class designation	Examples where exposure classes may occur		
X0	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Concrete inside buildings with very low air humidity	CH CZ ^a BE FI FR ^b IE IT LU NL NO PT UK ^c SI SE SK	AT DE DK
	Other local examples		
	Humidity below 35 %	AT	
	A very dry environment is not (or rarely) found in Belgium	BE	
	Unreinforced concrete basements in environment without frost Unreinforced concrete inside buildings	CZ	
	Concrete inside buildings with low air humidity Foundations below ground for low and normal safety classes		
	Information guidance: dry, heated indoor spaces	FI	
	Foundations without reinforcement or without embedded metal and not subjected to freeze/thaw attack; interior components without reinforcement or without embedded metal	DE	
	House strip foundations, unreinforced or nominally reinforced; in non-aggressive soils	IE	
	Unreinforced concrete inside buildings. Unreinforced concrete either placed below grade or submerged in non-aggressive water. Unreinforced concrete undergoing cycles of drying and wetting but not subjected to abrasion, frost or chemical attacks	IT	
	Unreinforced concrete. Concrete permanently submerged in non-aggressive water	NL SE	
	Certain soil-covered foundations (non-aggressive soil/water) Unreinforced concrete surfaces inside structures. Unreinforced concrete completely buried in non-aggressive soil. Unreinforced concrete permanently submerged in non-aggressive water Unreinforced concrete in cyclic wet and dry conditions not subject to abrasion, freezing or chemical attack	UK PT	
	Reinforced concrete in structures with very low air humidity	PT	
	Permanent relative air humidity of less than 30 %. Concrete of the foundations without reinforcement and without freeze/thaw	SK	
XC1	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Concrete inside buildings with low air humidity	CH CZ ^d BE DK FR IE IT LU NL SI NO PT SE SK UK	AT DE
	Concrete permanently submerged in (non-aggressive) water	BE DE SI PT	DK
	Other local examples		
	Parts of structures inside buildings with low air humidity (inc kitchens, bathrooms & laundries) in residential buildings Unsplashy bridges elements in contact with air	CZ ^d	
	Foundations below ground for low and normal safety classes	DK	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
	Bathrooms, stairways, structures below the water level. Inner surface of a layered wall surface. Underwater parts of bridges	FI	
	Components in rooms with normal air humidity (inc kitchens, bathrooms, laundries in residential buildings); concrete permanently submerged in water	DE	
	Ordinary reinforced concrete or prestressed concrete with surfaces inside structures, excepting parts exposed to condensation or submerged in water	IT	
	Permanent relative air humidity between 30 % to 60 %	SK	
XC2	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Concrete surfaces subject to long-term (non-aggressive) water contact	CH BE FR DE IT LU NL NO UK SI SE PT AT ^e SK	
	Many foundations	BE FI SI DE IE	PT
	Other local examples		
	Parts of water tanks	CZ	
	Foundations partly above ground Foundations below ground for high safety class External walls, columns and facades External beams with sheltered top surface Structural parts in contact with slightly aggressive chemical water	DK	
	Bridge foundations, transition slabs	FI	
	Parts of water tanks; foundation members	DE	
	Portions of structures devised for containing liquids, foundations. Ordinary reinforced or prestressed concrete mainly submerged in water or below non-aggressive grade	IT	
	Reinforced and prestressed concrete completely buried in non-aggressive soil	UK	
	Reinforced concrete into non-aggressive soil	PT	
	Permanent relative air humidity of over 85 %. Parts of the water tanks, inside areas like canteens, bathrooms, laundries, areas of the sheltered pools and stables	SK	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
XC3	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Concrete inside buildings with moderate or high air humidity	CH CZ ^f BE FR DE IT LU NL NO UK SI SE SK	DK PT
	External concrete sheltered from rain	BE DE IE UK SI IT	PT
	Other local example		
	Parts of structures in contact with outside air e.g. halls, interiors with high air humidity (kitchens of community feeding, bath, laundries, swimming-pools, stables)	CZ DE PT	
	Foundations partly above ground Foundations below ground for high safety class External walls, columns and facades External beams with sheltered top surface Structural parts in contact with slightly aggressive chemical water	DK	
	Facades and other vertical outdoor surfaces sheltered from rain. Car park slabs swimming baths, saunas, industrial kitchens, many industrial buildings. Bridge superstructures sheltered from rain such as lower surfaces of decking slabs and beams, beams, columns, retaining walls and abutments and intermediate supports	FI PT	
	Either ordinary reinforced or prestressed concrete placed outdoors with external surfaces protected from rain or placed inside buildings with moderate to high air humidity	IT	
	Permanent relative air humidity between 60 % to 85 %. Parts of buildings that are in permanent or temporary contact with the outside air, e.g. open space halls	SK	
XC4	None given as grouped with XC4	UK	
	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Concrete surfaces subject to water contact, not within exposure class XC2	CH BE FI FR IE IT LU NL NO PT UK SI SE SK	DE DK
	Other local examples		
	Outside buildings parts from concrete exposed to rain	CZ DE	
	Foundations partly above ground Foundations below ground for high safety class External walls, columns and facades External beams with sheltered top surface Structural parts in contact with slightly aggressive chemical water	DK	
	Balcony slabs, facades exposed to rain, footings. Bridge structures exposed to rain such as edge beams, lateral sides of abutments, retaining walls, columns	FI	
	Either ordinary reinforced or prestressed concrete place outdoors with surfaces undergoing alternatively dry and wet cycles. Architectural concrete in urban settings. Surfaces in contact with water not included in the XC2 class Reinforced concrete under dry-wet cycles	IT PT	
	Reinforced and prestressed concrete surfaces exposed to alternate wetting and drying	UK	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
XD1	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Concrete surfaces exposed to airborne chlorides	CH BE FI FR DE IE IT LU NL NO PT UK SI SE SK	AT DK
	Other local examples		
	Parts of traffic areas, individual garage	CZ DE	
	External deck slabs, staircases and retaining walls External beams without sheltered top surface Light shafts External basement walls partly above ground Canals and other structural parts in contact with moderately aggressive chemical water	DK	
	Noise barriers on road sides. Indoor spaces of swimming baths	FI	
	Either ordinary reinforced or prestressed concrete used for portions of bridges and viaducts exposed to chloride-containing water sprays	IT	
	Garages	SK	
	Reinforced and prestressed concrete surfaces in parts of bridges away from direct spray containing de-icing agents. Parts of structures exposed to occasional or slight chloride conditions	UK	
XD2	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Swimming pools	CH BE FI FR (DE) IT LU NL NO PT SI SE SK	AT UK ⁹
	Concrete exposed to industrial waters containing chlorides	BE DE IE PT SI	UK ⁹
	Other local examples		
	Salt water baths; components exposed to industrial waters containing chlorides (Note: special requirements for concrete bridges and tunnels)	DE	
	External parking decks, balconies, balcony accesses and staircases Swimming pools Bridge column and edge beams Marine structures Structural parts in contact with highly aggressive chemical water	DK	
	Either ordinary reinforced or prestressed concrete used for structural elements that are totally submerged in water, including also chloride-containing industrial water (swimming pools)	IT	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
XD3	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Parts of bridges exposed to spray containing chlorides	CH BE FI FR IT LU NL NO PT SE SK	AT DE
	Pavements	BE DE IE PT	
	Car park slabs	BE (DE) PT	
	Other local examples		
	Parts of bridges & engineering structures exposed to water with chlorides	CZ	
	External parking decks, balconies, balcony accesses and staircases Swimming pools Bridge column and edge beams Marine structures Structural parts in contact with highly aggressive chemical water	DK	
	Heated garages, bridge parts exposed to de-icing agents, such as edge beams, transition slabs, concrete railings, bridge piers and abutments and intermediate supports exposed to salty fog	FI	
	Parts of bridges frequently exposed to splashing; pavements; car park slabs (only with additional measures, i.e. crack-covering coating). (NOTE Special requirements for concrete bridges and tunnels).	DE	
	Either ordinary reinforced or prestressed concrete; structural elements directly subjected to de-icing agents or sprays containing de-icing agents. Either ordinary reinforced or prestressed concrete: element with one side submerged in chloride-containing water and the other one exposed to air. Portions of bridges, pavements and parking lots	IT	
	Reinforced and prestressed concrete surfaces directly affected by de-icing salts or spray containing de-icing salts (e.g. walls, abutments and columns within 10 m of the carriageway, parapet edge beams and buried structures less than 1 m below carriageway level)	UK SE	
	All bridges	SK	
	In Portugal, these examples shall generally be considered to belong to the exposure class XD1	PT	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
XS1	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Structures near to or on the coast	BE FI FR ^h DE IE IT NL NO UK SE	CH LU PT SK
	Other local examples		
	External components near to the coast	DE	
	External deck slabs, staircases and retaining walls External beams without sheltered top surface Light shafts External basement walls partly above ground Canals and other structural parts in contact with moderately aggressive chemical water	DK	
XS2	Reinforced concrete in salt saturated maritime ambient. Reinforced concrete in coastal areas less than 200 m from the sea, directly exposed to air salts. This distance may be increased to 1 km in plane coastal areas and in the mouth of rivers	PT	
	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Parts of marine structures	FI FR (DE) IE IT NL NO UK ⁱ SE	CH LU PT SK
	Other local examples		
	Permanently submerged components in harbours	DE	
	External deck slabs, staircases and retaining walls External beams without sheltered top surface Light shafts External basement walls partly above ground Canals and other structural parts in contact with moderately aggressive chemical water	DK	
	Either ordinary reinforced or prestressed concrete of marine structures totally under water	IT	
	Reinforced and prestressed concrete completely submerged and remaining saturated, e.g. concrete below mid-tide level	UK PT	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur	Adopted locally	
		Yes	No
XS3	Examples from EN 206-1, Table 1		
	Parts of marine structures	BE FR (DE) IE IT NL NO UK ¹ SE	CH LU PT SK
	Other local examples		
	External parking decks, balconies, balcony accesses and staircases Swimming pools Bridge column and edge beams Marine structures Structural parts in contact with highly aggressive chemical water	DK	
	Parts of marine and bridge structures exposed to fluctuation and splashing of sea water such as intermediate supports	FI	
	Quay walls	DE	
	Either ordinary reinforced or prestressed concrete with structural elements at the water's edge or exposed to sea water sprays and waves	IT	
	Reinforced and prestressed concrete surfaces in the upper tidal zones and the splash and spray zones	UK	
	Reinforced concrete in tidal, splash and spray zones, from 1 m below the minimum tidal to 10 m above maximum tidal, namely on the west coast of Portugal and on the Azores and Madeira islands. Reinforced concrete in which one of the surfaces is immersed in sea water and the other is air exposed (e.g. submerged tunnels). This exposure will require eventually supplementary protection measures	PT	
XF1	Examples from EN 206-1, Table 1		
	Vertical concrete surfaces exposed to rain and freezing	AT CH BE FI FR ^k (DE) IE IT LU NL NO PT UK SE SK	
	Other local examples		
	Facades, footings. Parts of bridge on roads outside the de-icing route such as decking slab, beams abutments and intermediate supports	FI	
	External components	DE	
	Foundations partly above ground Foundations below ground for high safety class External walls, columns and facades External beams with sheltered top surface Structural parts in contact with slightly aggressive chemical water	DK	
	Vertical concrete elements, e.g. façades and columns, exposed to rain and freezing. Non-vertical surfaces not subjected to complete saturation but exposed to freezing, rain or water	IT	
	Non-vertical concrete surfaces not highly saturated, but exposed to freezing and to rain or water	NL UK PT	
	Facades of buildings and columns, parts of buildings not too wet		
	Inner parts of unheated industrial buildings, inside of silos, tunnels and other structures not exposed to rain but in humid conditions and exposed to freezing	SE	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
XF2	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Vertical concrete surfaces of road structures exposed to freezing and airborne de-icing agents	AT CH BE FI FR ^k IE IT LU NL NO UK SE SK	PT (DE)
	Other local examples		
	External deck slabs, staircases and retaining walls External beams without sheltered top surface Light shafts External basement walls partly above ground Canals and other structural parts in contact with moderately aggressive chemical water	DK	
	Noise barriers and footings on road sides. Parts of bridges on roads on the de-icing route, for example surface structure beams and decking slabs, abutments and intermediate supports	FI	
	Concrete members in spray and splash zones of traffic areas, with de-icing agent (mainly vertical concrete members) (other than XF4); sea water spray zone	DE	
	Elements like bridge portions, otherwise classified as XF1 that are exposed, either directly or indirectly, to de-icing agents	IT	
	Concrete surfaces not highly saturated, but exposed to freezing and to rain or water including de-icing agents	NL	
	De-icing agents are not directly in contact with the concrete surface. E.g. parts of the anti-noise walls, supporting walls, and those not included in XF4	SK	
XF3	Non-vertical concrete surfaces exposed to rain or freezing	PT	
	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Horizontal concrete surfaces exposed to rain and freezing	AT CH BE FI FR ^k IE IT LU NL NO UK SE SK	DE PT
	Other local examples		
	Opened water tanks. Structure parts in zone with variation of fresh water, spillway blocks of hydraulic structures	CZ	
	External deck slabs, staircases and retaining walls External beams without sheltered top surface Light shafts External basement walls partly above ground Canals and other structural parts in contact with moderately aggressive chemical water	DK	
	Balconies, bridge columns and other structures at the water level of inland water, dam structures, fresh water basins. Bridge parts on roads outside the de-icing route, for example edge beams transition slabs, column-like intermediate supports, base plates of frame bridges and unprotected structures in water fluctuation area of waterway bridges	FI	
	Open water tanks; components in fresh water tidal zone	DE	
	Horizontal building surfaces where water can accumulate and that may be exposed to freezing; elements exposed to frequent wetting and freezing	IT	
	All concrete surfaces	NL	

Table 2.2 (continued)

Class designation	Examples where exposure classes may occur		
(XF3)	External parts of buildings that are often subject to water and freezing, e.g. open-space water tanks, parts of buildings with variable surfaces of sweet-water level. Overflow parts of water buildings	SK	
	Horizontal concrete surfaces, such as parts of buildings, where water accumulates and which are exposed to freezing. Elements subjected to frequent splashing with water and exposed to freezing	UK	
XF4	Examples from EN 206-1, Table 1	Adopted locally	
		Yes	No
	Road and bridge decks exposed to de-icing agents	AT CH BE FI FR ^k IT LU NL NO UK SI SE SK	DE PT
	Concrete surfaces exposed to direct spray containing de-icing agents and freezing	BE IE UK	UK
	Splash zones of marine structures exposed to freezing	BE	
	Other local examples		
	Water tanks at the roads, concrete crash barriers	CZ	
	External parking decks, balconies, balcony accesses and staircases Swimming pools Bridge column and edge beams Marine structures Structural parts in contact with highly aggressive chemical water	DK	
	Parking levels, surface layers, garages. Edge beams, transition slabs, concrete railings of de-icing roads, base plates of frame bridges intermediate supports, when the road travelling beneath the bridge is de-iced. Unprotected structures of bridges in sea water from the level NW-1 upwards	FI	
	Traffic areas treated with de-icing agents; predominantly horizontal components exposed to spray from traffic areas treated with de-icing agents; scraper raceways in sewage treatment plant; components in sea tidal zone	DE	
	Horizontal surfaces, e.g. roads and pavements, exposed to freezing and to the direct/indirect action of de-icing salts, elements exposed to freezing and to frequent wetting in the presence of de-icing salts or sea water	IT	
	For road and bridge decks a special standard is used in Slovakia. Similar to EN 13877. Local examples: constructions near the roads that are exposed to direct spray containing de-icing agents, e.g. pavement kerbs, leaders and gadroons, safety barriers, tanks near roads	SK	
	Outdoor swimming pools	SE	

a	Very low defined as a relative humidity less than 30 %
b	Not applicable to pre-stressed concrete
c	Only if unreinforced
d	Low defined as a relative humidity of 30 % to 60 %
e	Grouped with XC3 and XC4
f	Moderate defined as a relative humidity of 60 % to 85 %, or high, more than 85 %
g	The answer would be 'yes' for elements that are totally immersed in water containing chlorides
h	Up to 1 km from the sea shore
i	This example considered to be too vague to be of any practical use
k	When the destination of the concrete in a structure is not precisely defined, selection of exposure class is made in accordance with its location following guidance given in the national annex to EN 206-1

Additional examples for XA exposures from the Czech Republic and Slovakia

Other local examples for XA exposures		
XA1	Tanks of sewage clarification plants, cesspools, septic tanks, buildings basements	CZ
	Slightly aggressive chemical environment according to table 2. Tanks of water purifying plants, sumps, septic tanks and foundations	SK
XA2	Building parts in corrosive foundation soil, buildings basements	CZ
	Moderately aggressive chemical environment according to table 2. Foundations on buildings in aggressive soils	SK
XA3	Manufacturing tanks of sewage clarification plants with chemical corrosive water, basements of buildings, stores for chemical de-icing substances and soil conditioners. Bunkers in farm sector. Cooling towers with industrial smoke. (See ^d and ^f)	CZ
	Highly aggressive chemical environment according to table 2. Industrial water purifying plants with chemically aggressive water, silage holes, feeding canals, cooling towers, etc.	SK
Slovakian specifications: at the level of exposure class XA3 if: — there are aggressive chemicals not listed in EN 206-1, Table 2 or — there is chemical pollution or — the groundwater is mobile and contains chemicals listed in EN 206-1, Table 2, secondary protection of the concrete is required and/or a special investigation is required		
Slovakian specifications to table EN 206-1: with exposure classes XC, XD, XS, it is possible to substitute each lower level with the higher one. Considering XA, it is possible only if it has the same chemical characteristics as shown in EN 206-1, Table 2. Considering XF, it is possible to substitute exposure class XF1 by XF3, and exposure class XF2 by XF4. For constructions exposed to exposure classes X0, it is possible to use concrete of any exposure class.		

Additional exposure classes from Austria and Germany 'concrete exposed to wear'

XM1 ^a	Industrial floor slabs with a load-bearing or stiffening function, subjected to traffic from vehicles with pneumatic tyres
XM2 ^a	Industrial floor slabs subjected to traffic from forklift trucks with pneumatic tyres or solid rubber wheels
XM3 ^a	Industrial floor slabs subjected to traffic from forklift trucks with elastomer or steel wheels; surfaces subjected to frequent traffic from tracklaying vehicles; hydraulic structures in agitated waters (e.g.

	settling basins)
^a	Exposure of concrete to wear (XM1 = moderate wear; XM2 = considerable wear; XM3 = extreme wear)

Table 2.3 — Chemical attack outside the scope of EN 206 1, Table 2

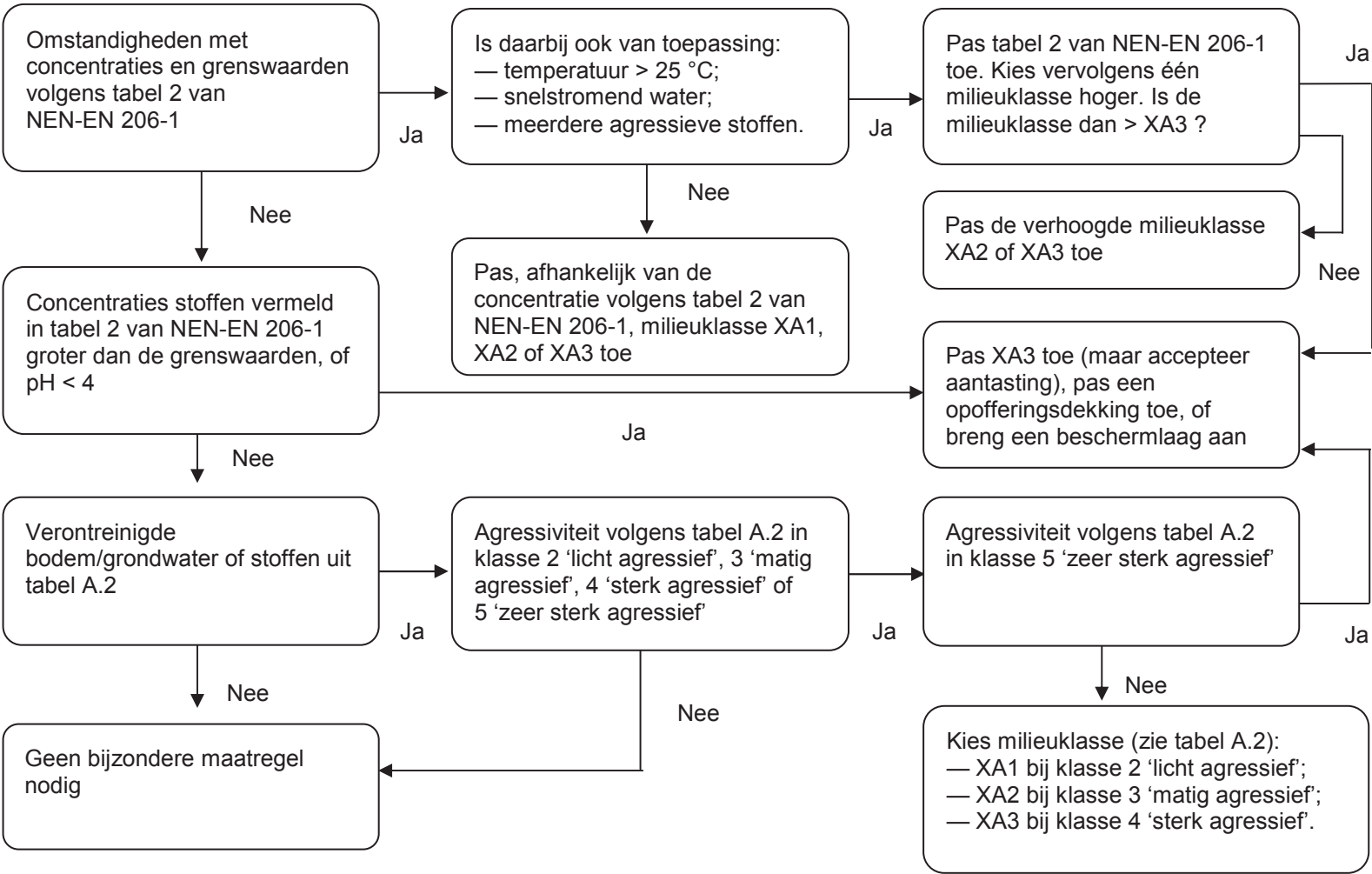
CEN Member Countries	Exposure classification/national guidance
Austria	No additional provisions
Belgium	No provisions
Czech Republic	No provisions
Denmark	No provisions
Finland	No provisions
France	Provisions are given in FD P18-011 which is called up in NF EN 206-1
Germany	NOTE in table 1 of DIN 1045-2: In exposure class XA3 or under environmental actions outside the limits of table 2 of DIN EN 206-1: if other aggressive chemicals are present, ground water or soil is chemically polluted, or there is a combination of high water velocity and chemicals from table 2 of DIN EN 206-1: the requirements relating to concrete or protective measures given in subclause 5.3.2 of the present standard shall apply. DIN 1045-2, 5.3.2: Where concrete is exposed to chemical attack of exposure class XA3 or higher, or to fast flowing water combined with chemical attack as set out in table 2 of DIN EN 206-1, measures shall be taken to protect the concrete (such as the application of protective coatings or permanent cladding) unless expert opinion proposes an alternative solution. In the presence of aggressive chemicals other than those given in table 2 of DIN EN 206-1 or if the substrate is chemically contaminated, the impact of the chemical attack shall be investigated and precautionary action taken, where necessary. Paragraph 1 of table 2 is supplemented by the following NOTE: See DIN 4030-1 for the occurrence and effects of chemically aggressive soil and ground water.
Ireland	Specifiers would generally follow guidance in BRE Special Digest 1/BS8500
Italy	No provisions
Luxembourg	No provisions
Netherlands	In NEN 8005:2004 a flowchart is given in Annex A for the assessment of chemical attack and the selection of exposure classes XA1 to XA3. This flowchart may be used in cases mentioned in the NOTE in section 6 of table 1 of NEN-EN 206-1. Informative Annex A of NEN 8005:2004 is attached at the end of this survey.
Norway	No particular provisions, soil conditions in Norway are generally of low aggressiveness.
Portugal	The EN 206-1 provisions stated in Table 2 were not changed.
Slovakia	Provisions including the above mentioned national notice.
Slovenia	In SIST 1026, additional exposure classes are added for concrete exposed to surface abrasion as follows: XB1 — moderate exposure (bearing industrial pavements for vehicles with pneumatic wheels). XB2 — severe exposure (industrial pavements with full rubber wheels; structures in contact with running water; wearing course of pavement for light/moderate loads). XB3 — extremely severe exposure (industrial pavements for vehicles with elastomer/steel wheels; wearing course of pavement for heavy/very heavy loads; structures in contact with sand-bearing running water).
Sweden	Cases not dealt with in Table 2 require special investigation. Some provisions are given in Concrete Report No 11, Swedish Concrete Association. Fundamental facts can be found in the Concrete Handbook — Material, 1997 (In Swedish).
Switzerland	No provisions
United Kingdom	Because these cases form the majority of situations in the UK, the UK uses an 'aggressive chemical environment for concrete (ACEC)' classification. This is given in Building Research Establishment Special Digest 1 and BS 8500-1. A revision of BRE SD1 has been published in 2005 and BS 8500-1 is being revised to align with the new Special Digest.

Attachment related to the response of The Netherlands to Table 2.3

Bijlage A

(informatief)

Tabel A.1 — Keuzeschema voor de beoordeling van de chemische agressiviteit



Tabel A.2 — Overzicht chemicaliën met globale indicatie van de agressiviteit voor beton

Naam	Reactie-type ^a	Agres-siviteit ^b	Naam	Reactie-type ^a	Agres-siviteit ^b
zuren			sulfaten van		
azijnzuur	O	3-4	aluminium	E	4
boorzuur	O	2	ammonium	U/E	5
carbolzuur (fenol)	O/U	2-3	calcium	E	4
citroenzuur	O	4	kalium	E	4
fosforzuur	O	4	koper	E	4
humuszuur	O	4	mangaan	E	4
melkzuur	O	3	magnesium	U/E	5
mierenzuur	O	3	natrium	E	4
oxaalzuur	O	1	nikkel	E	4
salpeterzuur	O	5	ijzer	E	4
tannine (looistof)	O	1-2	zink	E	4
waterstoffluoride	O	5	petroleum-destillaten		
wijnsteenzuur	O	1	benzine		1
zoutzuur	O/C	5	kerosine		1
zwavelwaterstof	O	2	naftaleen		1
zwavelzuur	O/E	5	petroleum		1
zouten en alkaliën			lichte olie		1
<i>carbonaten van</i>			zwarte olie		1
ammonium	U	2	dieselolie		1
kalium	E	2	koolteer-destillaten		
natrium (soda)	E	2	anthraceen		1
<i>chloriden van</i>			benzeen		1
aluminium	U/C	3	cumeen		1
ammonium (salmiak)	U/C	3	kreosoot (olie)	U	2
calcium	C	1	kresol	U	2
kalium	C/E	1	paraffine		1
koper	C	1	teer		1
kwik	C	1	tolueen		1
magnesium	U/C	3	xyleen		1
natrium (pekkel, zout)	C/E	2	plantaardige oliën		
ijzer	C	2	amandelolie	U	3
zink	C	2	chinese houtolie	U	3
<i>fluoriden</i>			katoenzaadolie	U	3
ammonium	U	4	kokosolie	U	3
<i>hydroxyden van</i>			lijnolie	U	3
ammonium		1	maanzaadolie	U	3
calcium		1	olijfolie	U	3
kalium (loog)	E	2	pinda-olie	U	3
natrium (loog)	E	2	raapolie	U	3
<i>nitraten van</i>			ricinusolie	U	3
ammonium	U	5	soyaboonolie	U	3
calcium		1	terpentijn	U	3
kalium (salpeter)	U/E	3	walnootolie	U	3
natrium	U/E	3			

Tabel A.2

Naam	Reactie- type ^a	Agres- siviteit ^b	Naam	Reactie- type ^a	Agres- siviteit ^b
dierlijk vet en vetzuren			(diversen)		
beenderolie	O	2	karnemelk	O	3
varkensvet	O	2	koolzuurgas		1
visolie	O	2	kuilvoer (silage)	O	5
slachtafval	O	3	lood		1
diversen			looistoffen		1
alcohol		1	melasse, suikerstroop	U	3
aceton		1	melk		1
ammoniak (water)		1	mest	O/U	4
bier	O	2	suiker: droog		1
bleekwater	C	2	suikeroplossing	U	3
borax		1	tetra		1
caustic soda		1	tolueen		1
cider, appelwijn	O	4	tri(chlooretyleen)		1
ether		1	ureum		1
etherische olie		1	urine	O/U	3
fenol	U	3	vaseline		1
formaldehyde	U	3	vruchtensap	O	4
glucose	U	3	waterglas		1
glycerine	U	2	wei	O	3
honing		1	wijn		1
houtpap, houtslip		1	zacht water ^c	O	3
kalium-permanganaat		1	zeep		1
kalk		1	zwavel		1

^a O = Oplossing
U = Uitwissling
E = Expansie
C = Corrosie wapening

^b 1 = onschadelijk
2 = licht agressief
3 = matig agressief
4 = sterk agressief
5 = zeer sterk agressief

^c Water met een totale hardheid kleiner dan 0,55 mmol/l, bepaald volgens NEN 6441.

OPMERKING De agressiviteit in werkelijke omstandigheden wordt bepaald door de concentratie, de pH, de temperatuur en de mate van verversing.

Table 2.4 — Recommended exposure classes for selected concrete elements

Notation used in this table		
Where more than one exposure class is in brackets, separated by a comma and has an ^a outside the bracket, this indicates that the exposure classes are grouped		
Where choice is left to the engineer, the word 'or' is used, e.g. XC3 or XC4		
Where a plus sign is used, this indicates the exposure is a combination of the cited classes, e.g. XC4 + XF3		
Use of concrete	Exposure classification Give exposure class(es)	CEN Member Countries Add country code
Indoor unreinforced concrete	X0	NL UK AT FI FR PT SI CH DE IE LU SE CZ IT NO
	(X0, XC1) ^a	DK
	EI (X0) ^b	BE
Indoor reinforced concrete	X0	FI*
	XC1	FR UK AT NL DE LU CH SI CZ
	XC1 (except high humidity rooms)	PT
	XC1 or XC3	IE
	(X0, XC1) ^a	DK
	EI (XC1) ^b	BE
	X0 or XC1 or XC3	SE
	X0 or XC1	IT
	X0 or XC1	NO

Table 2.4 (continued)

Use of concrete	Exposure classification Give exposure class(es)	CEN Member Countries Add country code
Exposed vertical surfaces of inland concrete buildings with no significant levels of external chlorides	XC1 + XF1	AT
	XC4 + XF1	FR SI
	XC2 (or XC2 or XF1)	PT
	(XC2 or XC4) + XF1	IE
	XC1 or XC2 or XC3 or XC4 and XF1 (depends on situation)	CZ
	EE3 (XC4 + XF1) ^b	BE
	(XC2, XC3, XC4, XF1, XA1) ^a	DK
	XC3 (or XC4) + XF1	FI
	(XC3 + XF1) or (XC4 + XF1)	NL
	(XC3, XC4) ^a + XF1	UK
	XC4 + XF1	CH DE LU SE
	(XC2, XC3; XC4, XF1) ^a	NO
	XC1, XC2 + XF1	IT
Exposed vertical surfaces of concrete buildings near the coast but not in direct contact with sea spray	Not relevant	AT CH CZ LU
	XC3 or XC4 + XS1? (designers decision) + XF1	FI
	(XS1, XS2) ^a (up to 1 km from the sea)	FR
	XS1, XS1+ XC4	PT
	XC4 + XS1	SI
	(XC2, XC3; XC4, XF1) ^a + XS1	NO
	(XD1, XS1, XS2, XF2, XF3, XA2) ^a	DK
	XC3 or XC4 + XS1 + XF1	NL
	ES2 (XC4 + XS1 + XF1) ^b	BE
	XC4 + XS1 + XF2	DE SE
	XF1 + XC4 + XS1	IE
	XS1 + (XC3, XC4) ^a + XF1	UK
	XS1	IT
Reinforced buried foundations in exposure class XA1 (slightly aggressive chemical environment = NL)	XA1 + XC2	FI FR IE LU AT IT SI DE NL
	XA1 + XC2	PT
	(XC2, XC3, XC4, XF1, XA1) ^a	DK
	XC2	UK
	(EA1 + EE2) (XA1 + XC2) ^b	BE
	None	CH
	X0 or XC1 or XC2 or XC4	SE
	XA1	CZ NO
Unreinforced pavements	XF4 + XM2	AT
	XF2	PT
	XF4	LU SE
	XF1 or XF4 or XA1 (depending on location)	IT
	(XD1, XS1, XS2, XF2, XA2) ^a	DK
	XF3 or XF4	CH CZ DE NL NO FR IE FI SI UK
	EE4 (XF4) ^b	BE

Table 2.4 (continued)

Use of concrete	Exposure classification Give exposure class(es)	CEN Member Countries Add country code
Reinforced pavements	XF4 + XM2	AT
	(XC4 + XF3) or (XC4 + XD3 + XF4) (de-icing)	FI NL
	XF3 or XF4	FR
	(XD3 + XF4)	SI
	XC4 + XD3 + XF4	CH LU UK
	XF2 or XF4 (depends on situation)	CZ
	(XD2, XD3, XS3, XF4, XA3) ^a	DK
	EE4 (XC4 + XD3 + XF4) ^b	BE
	Not common	DE SE
	XD3 + XC4 + XF3 or XF4	IE
	XD3 + XF4	UK
	XC3 or XC4 + XF1 + XF4 + XA1; alternatively (XD3 + XF3) (depending on location)	IT
	XC3 or XC4; (XC3 or XC4) + (XS1 or XS3)+XA1	PT
	(XD2, XD3) ^a + (XF2, XF3, XF4) ^a + (XC2, XC3, XC4) ^a as appropriate	NO
Bridge abutment	XF2 or XF4 (roads)	AT
	(XC3 or XC4) + XF1 or (XC3 or XC 4) + XD3 + XF2 (de-icing)	FI
	XC4 + XF2 or XF4 if de-icing agent	FR
	XF2 or XC4 or XF4 (depends on situation)	CZ
	XD3 + XF2 + XC4	IE
	(XD2, XD3, XS3, XF4, XA3) ^a	DK
	XC4 + XF3 or XD3 + XC4 + XF4 Plus XA1 or XA2 depending on the aggressive chemical class given in EN 206-1, Table 2 or Annex A of NEN 8005:2004 (see Table 2.3)	NL
	XD3+(XC3, XC4) ^a +XF2+ACEC class depending on the soil	UK
	EE4 (XC4 + XD3 + XF4) ^b Supposing contact with de-icing salt and the soil is not aggressive	BE
	(XC3 or XC4) + (XS1 or XS2 or XS3)	PT
	Class depending on the soil + XF3	SI
	(XC4 + XD1 + XF3) or (XC + XD3 + XF4)	CH
	Class depending on the soil XC4, XD1 (airborne chloride)/XD2 (splash zones), XF2	DE
	XC4 + XD1 + XF2	LU
	XD3 + XF4 or XD1 + XF2	SE
	XD1-XD3 + XF1 to XF4 + XA (depending on location and soil)	IT
	XD3, XS1, XS2, XS3, XF3, XF4, (XC2, XC3, XC4) ^a as appropriate	NO
* Dry heated indoor spaces. ^a Grouped classes. ^b In Belgium exposure classes are recommended in an indirect way. They are linked to "environmental classes". "Environmental classes" are defined as environments which are very relevant to the Belgian concrete practice. They are indicated by the letter E (for Environment), followed by a letter (I for Interior, E for Exterior, S for Seawater, A for Aggressive) and a numeral for a more detailed description. For each environmental class the relevant exposure classes are identified for unreinforced and reinforced concrete.		

4 Constituent materials

Most constituents for concrete have been standardized at the European level and the aim of this part of the survey is to identify constituents that are outside European standardization. If a number of CEN Member countries have the need for a standard on a particular constituent, this is indicative of a need to develop a European standard. However, if a constituent is standardized in a single CEN Member Country or a local product, e.g. a particular type of natural pozzolana, there seems to be little justification for developing a European standard.

National standards for cement are listed in Table 3.1. Most cements are (or are in the process of being) standardized at the European level. The exception is natural prompt cement which is the subject of a developing European Technical Approval. CEN/TC 51 is working on standardization of sulfate-resisting cements which should lead to the withdrawal of the national sulfate-resisting cement standards.

A number of the listed national cements are better described as being additional properties of cement already standardized in Europe, e.g. low alkali, high early strength, white cement.

National standards for additions are described in Table 3.2. National standards for silica fume and ground granulated blastfurnace slag will be replaced by European standards.

NOTE CEN/TC 104 has already agreed to extend the silica fume standard to cover all silica fumes that are on the European market.

There are several national standards/ETAs for fly ashes outside the scope of EN 450-1 and other pozzolanas. The information supplied is insufficient to identify the types of pozzolanas, but they are likely to include various types of natural pozzolanas and high calcium fly ashes.

A few CEN Member Countries have national standards for limestone additions. Some CEN Member Countries also use limestone filler aggregate conforming to EN 12620 as a Type I addition.

Table 3.3 lists national standards for aggregates for concrete. Some of the listed documents give the national choices of categories from the European standard on aggregates for concrete, EN 12620. As EN 12620 provides categories that cover all the materials that are found in Europe, it is not surprising that some CEN Member Countries have selected categories that reflect local experience.

The scope of EN 12620 covers natural, manufactured and recycled aggregates. In reality, the 2002 version of EN 12620 does not deal adequately with recycled aggregates.

NOTE Work is in progress within CEN/TC 154 to provide European test methods, classification and requirements for recycled aggregates.

Table 3.4 lists national standards for admixtures. Only three CEN Member Countries reported national product standards for admixtures outside the scope of EN 934. This is slightly surprising as it is known that there are admixtures available in Europe that are outside the scope of EN 934-2.

NOTE When CEN/TC 104 discussed extending the scope of EN 934-2, there was the view that CEN should not standardize admixtures where the main characteristic could not be specified and verified by testing, e.g. the pumping effect of a pumping aid. Work is in progress on defining corrosion-resisting admixtures and method of test.

The last table in this Part, Table 3.5, covers other constituents for concrete. The only responses cited national standards on fibres for concrete. The European standards for steel and polymer fibres are likely to lead to the withdrawal of these national standards.

There is no evidence of a need for further European standardization work on admixtures not covered by EN 934 or fibres for concrete not covered by prEN 14889.

Information for ground granulated blastfurnace slag is given in Annex C.

Table 3.1 — National cement standards

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Austria	ÖNORM B 3327-1: Zemente gemäß ÖNORM EN 197-1 für besondere Verwendungen — Teil 1: Zusätzliche Anforderungen (Cements according to ÖNORM EN 197-1 for special use — Part 1: Additional requirements)	No
Belgium	NBN B 12-108: Ciment à haute résistance aux sulfates — Cement met hoge bestandheid tegen sulfaten (Highly sulphate resisting cement) NBN B 12-109: Ciment à teneur limitée en alkalis — Cement met begrensd alkali-gehalte (Cement with restricted alkali content) NBN B 12-110: Ciment Portland à haute résistance initiale — Portlandcement met hoge aanvangsterkte (High early strength Portland cement) NBN B 12-111: Ciment sur-sulfaté — Overgesulfateerd (Supersulfated cement)	
Czech Republic	CSN EN 206-1: Zmena Z2 (paragraph NA.9 — Cement usability) (CSN 72 2103: Sulfate-resisting cement)	
Denmark	DS/INF 135: Klassifikation af cement (Classification of cement regarding alkali and sulfate resistance)	See UK reply
Finland	Sulfate resistance is added as voluntary in Informative national annex to SFS-EN 197-1	Yes
France	NF P 15-302: Liants hydrauliques — Ciments à usage tropical — composition, spécifications et critères de conformité NF P 15-314: Ciment prompt naturel (natural prompt cement) NF P 15-315: Ciment alumineux fondu (calcium aluminate cement) NF P 15-317: Ciments pour travaux à la mer (sea water resisting cement) NF P 15-319: Ciments pour travaux en eaux à haute teneur en sulfates (sulfate resisting cement) NF P 15-330: Ciments sur-sulfaté (supersulfated cement)	No ETA (CUAP) EN 14647 No Awaiting TC 51 document prEN XXXXX
Germany	DIN 1164-10: Zement mit besonderen Eigenschaften — Teil 10: Zusammensetzung, Anforderungen und Übereinstimmungsnachweis von Normalzement mit besonderen Eigenschaften (Special cement — Part 10: Composition, requirements and conformity evaluation for special common cement (Remark: Sulphate resisting cements, low alkali cements)) DIN 1164-11: Zement mit besonderen Eigenschaften — Teil 11: Zusammensetzung, Anforderungen und Übereinstimmungsnachweis von Normalzement mit verkürztem Erstarren (Special cement — Part 11: Composition, requirements and conformity evaluation for cement with short setting time) DIN 1164-12: Zement mit besonderen Eigenschaften — Teil 12: Zusammensetzung, Anforderungen und Übereinstimmungsnachweis von Normalzement mit einem erhöhten Anteil an organischen Bestandteilen (Special cement — Part 12: Composition, requirements and conformity evaluation for cement with higher quantity of organic constituents)	SR cements: See UK reply No No
Ireland	Sulfate-resisting Portland cement conforming to BS 4027	

Table 3.1 (*continued*)

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Italy	UNI 9156: Sulphate resistant cements — Classification and composition UNI 9606: Calcium hydroxide leaching resistant cements — Classification and composition UNI 10764: Micro hydraulic binders — Specifications and requirements (M.D. 03.06.1968) Cement for dams (M.D. 03.06.1968) Aluminate cement (M.D. 31.08.1972) Rapid setting cement	Yes No No Yes (EN 14216) Yes (EN 14647) ETA (CUAP)
Luxembourg	CDC-CIM: Cahier des charges ciments — Partie 1: Ciments à haute résistance aux sulfates (CDC-CIM: Specifications for cements — Part 1: High sulfate resisting cements)	
Netherlands	NEN 3550: 2006 (white and HS cement) Cement volgens NEN-EN 197-1, NEN-EN 197-4 of NEN-EN 14216, met aanvullende speciale eigenschappen — Definities en eisen (NEN 3550:2006 Cements conforming to NEN-EN 197-1, NEN-EN 197-4 or NEN-EN 15216, with additional special properties — Definitions and requirements) CUR Recommendation 48, 1999 (see NOTE 1) Geschiktheidsonderzoek van nieuwe cementen voor toepassing in beton (Assessment of new cements for use in concrete) (CUR Recommendation 48 (published in 1999 by CUR, Gouda) was developed in relation to NEN 5950:1995 (this standard has obviously been replaced with EN 206-1)) NOTE 1 CUR Recommendations are not NEN standards	NEN 3550:2006 covers cements conforming to NEN-EN 197-1, NEN-EN 197-4 or NEN-EN 14216 with as special properties the colour white and HS cements
Norway	NS 3086: Cement with special properties, cements with: Sulphate resistance, low alkali, and particularly rapid hardening	To be replaced with ENs
Portugal	There are no Portuguese standards, although some specifications on sulphate resisting cements appear in the LNEC E 464.	
Slovakia	STN 72 2103: Sulphate-resisting Portland cement conforming	
Slovenia	None	
Sweden	SS 13 42 02: Cement — Sammansättning och fordringar för cement med begränsad värmeutveckling (BV-cement) (Cement — Composition and requirements for low heat cements) SS 13 42 03: Cement — Sammansättning och fordringar för cement med låg alkalihalt (LA-cement) (Cement — Composition and requirements for low alkali cements) SS 13 42 04: Cement — Sammansättning och fordringar för sulfatresistent cement (SR-cement) (Cement — Composition and requirements for sulphate resisting cements)	To be replaced by SS-EN 197-1/A1 Awaiting TC 51 decision
Switzerland	Sulfate-resisting Portland cement conforming to SN EN 197-1	Yes
United Kingdom	Sulfate-resisting Portland cement conforming to BS 4027 The following cements are not cited in our complementary concrete provisions, but exist High alumina cement conforming to BS 915 Supersulfated cement conforming to BS 4248	Awaiting CEN TC 51 decision on SR cements Yes by EN 14647 Work has just started on an EN

Table 3.2 — National additions standards

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Austria	ÖNORM B 3309: Aufbereitete hydraulisch wirksame Zusatzstoffe für die Betonherstellung (AHWZ) (Processed hydraulic additions for concrete production, marking of conformity)	No
Belgium	Guide d'agrément technique Laitier moulu de haut-fourneau — Technische Goedkeuringsleidraad Gemalen hoogovenslakken (Guideline for national technical approval Ground granulated blast furnace slags)	Yes, by hEN 15167
Czech Republic	No provisions	
Denmark	Sewage sludge incineration ash is allowed and the requirements are described in DS 2426 (see Table 1.1)	No
Finland	Ground blast furnace slag and silica fume are covered by 1.1	Yes
France	NF P 18-502: Fumées de silice (Silica fumes) NF P 18-506: Laitier vitrifié moulu de haut-fourneau (ground granulated blastfurnace slag) NF P 18-508: Additions calcaires (Limestone additions) NF P 18-509: Additions siliceuses (Siliceous additions)	EN 13263-1 (partly) EN 15167-1 No No
Germany	Silica fume (NTA = National Technical Approval) DIN 51043: Trass — Anforderung, Prüfung (Trass — requirements, tests) Fly ashes not covered by EN 450 (NTA = National Technical Approval)	EN 13263-1 and -2 No No
Ireland	B.S. 6699 GGBS; B.S. 3892 -2 Pfa as Type I addition	hEN 15167 for GGBS
Italy	None	
Luxembourg	None	
Netherlands	CUR Recommendation 94:2004: Toepassing van poederkoolvliegias in mortel en beton (Use of pfa in mortar and concrete) (see NOTE 1) NOTE 1 CUR Recommendations are not NEN standards	CUR recommendation 94 is partly replaced by ETA 05/0095 and ETA 05/0168, both based on CUAP Fly ash for concrete
Norway	NS 3045 Silica fume	Yes
Portugal	NP 4220:1993: Pozolanas para betão — Definições, Especificações e verificação da conformidade (Pozzolans for concrete — Definitions, specifications and conformity verification) LNEC E 466:2005: Fíleres calcários para ligantes hidráulicos — Características e requisitos de conformidade (Limestone fillers for hydraulic binders — Characteristics and conformity requirements)	— Listing the requirements to be regulated
Slovakia	STN 72 2014: Aggregates from slag into the concrete	

Table 3.2 (*continued*)

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Slovenia	If necessary, Slovenian Technical Approval has been required for fly ash and silica fume until relevant European standards are issued	
Sweden	Requirements for ground granulated slag to be used in concrete are included in SS 13 70 03 Concrete — Application of EN 206-1 in Sweden	By hEN 15167
Switzerland	None	
United Kingdom	BS 3892-1: Pulverised-fuel ash — Part 1: Specification of pulverised-fuel ash for use with Portland cement BS 3892-2: Pulverized-fuel ash — Part 2: Specification for pulverized-fuel ash to be used as a Type I addition BS 6699: Ground granulated blastfurnace slag for use with Portland cement BS 7979: Specification for limestone fines for use with Portland cement	Yes, hEN 450 No Yes, by hEN 15167 No

Table 3.3 — National aggregates — Including recycled aggregates — Standards

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Austria	EN 13139: Aggregates for mortar: F1 < 4 mm	
Belgium	None	
Czech Republic	No provisions	
Denmark	Recycled aggregates are allowed and the requirements are described in DS 2426 (see Table 1)	A future version of EN 12620
Finland	Blast furnace slag and ferrochrome slag as artificial aggregates are covered by Table 1 and by	Yes
	Betonikiviainekset (Concrete aggregates), Finnish Concrete Association, Guidance document under revision	No
France	None	
Germany	DIN 4226-100: Gesteinskörnungen für Beton und Mörtel — Teil 100: Rezyklierte Gesteinskörnungen (Aggregates for concrete and mortar — Part 100: Recycled aggregates) NOTE Application of recycled aggregates is specified in a separate guideline of the DAfStb based on DIN 1045-2 and DIN EN 206-1.	Amendments to EN 12620 to incorporate clauses for recycled aggregates are under preparation
	DIN V 20000-103: Anwendung von Bauprodukten in Bauwerken — Teil 103: Gesteinskörnungen nach DIN EN 12620:2003-04 (Use of building products in construction works — Part 103: Aggregates according to DIN EN 12620:2003-04) NOTE This standard contains mainly the specifications for the national application of aggregates; e. g. selection of classes given in DIN EN 12620.	No (will be part of DIN 1045-2 in the future)
	DIN V 20000-104: Anwendung von Bauprodukten in Bauwerken — Teil 104: Leichte Gesteinskörnungen nach DIN EN 13055-1:2002-08 (Use of building products in construction works — Part 104: Lightweight aggregates according to DIN EN 13055-1:2002-08) NOTE This standard contains specification for the national application of light weight aggregates.	No (will be part of DIN 1045-2 in the future)
	Hüttenbims nach DIN 4301 (Porous blast furnace slag)	No
Ireland	None	
Italy	UNI 8520-1: Aggregati per calcestruzzo — Designazione e criteri di conformità Istruzioni complementari per l'applicazione della EN 12620:2002	[Texts are being published]
	UNI 8520-2: Aggregati per calcestruzzo — Requisiti Istruzioni complementari per l'applicazione della EN 12620:2002	
Luxembourg	CDC-GRA: Cahier des charges granulats et sables (CDC-GRA: Specifications for aggregates and sands)	

Table 3.3 (continued)

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Netherlands	NEN 3543:2005: Nederlandse aanvulling op NEN-EN 13055-1:Lichte toeslagmaterialen — Lichte toeslagmaterialen voor beton, mortel en injectiemortel (Dutch supplement to NEN-EN 13055-1: Lightweight aggregates — Lightweight aggregates for concrete, mortar and grout) NEN 3833:2005: Nederlandse aanvulling op NEN-EN 13139: Toeslagmaterialen voor mortel (Dutch supplement to NEN-EN 13139: Aggregates for mortar) NEN 5905:2005: Nederlandse aanvulling op NEN-EN 12620: Toeslagmaterialen voor beton (Dutch supplement to NEN-EN 12620: Aggregates for concrete) CUR Recommendation 5, 1984: Metselwerkpuingranulaat als toeslagmateriaal voor beton (Crushed clay brick masonry aggregates for concrete) (see NOTE 1) CUR Recommendation 80, 2001: Beton met menggranulaten als grof toelagmateriaal (Concrete with recycled concrete or recycled masonry as coarse aggregate, see NOTE 1) NOTE 1 CUR Recommendations are not NEN standards	
Norway	Guidelines from the concrete society for recycled aggregates NBP 26	
Portugal	LNEC E 467:2005: Guia para a utilização de agregados em betões de ligantes hidráulicos (LNEC E 467:2005: Guide for the use of aggregates in concrete) LNEC E 471:2006: Guia para a utilização de agregados reciclados grossos em betões (LNEC E 471:2006: Guide for the use of coarse recycled aggregates in concrete)	Listing the requirements to be regulated
Slovakia	None	
Slovenia	None	
Sweden	Recycled aggregates allowed. Requirements found in BA 99 (The National Board of Housing, Building and Planning's handbook of recycled materials)	
Switzerland	None. A separate document will be elaborated	
United Kingdom	(Further requirements for lightweight aggregates, RA and RCA are given in our complementary concrete standard, BS 8500-2 (see Table 1 for details))	

Table 3.4 — National admixtures standards

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Austria	None	
Belgium	None	
Czech Republic	None	
Denmark	None	
Finland	Certified product declaration	Yes
France	None	
Germany	DIN V 18998: Beurteilung des Korrosionsverhalten von Zusatzmitteln nach Normen der Reihe DIN EN 934 (Assessment of Corrosion Behaviour of Admixtures According to EN 934) DIN V 20000-100: Anwendung von Bauprodukten in Bauwerken — Teil 100: Betonzusatzmittel nach DIN EN 934-2:2002-02 (Application of building products in structures — Part 100: Concrete admixtures according to DIN EN 934-2:2002-02) (NOTE This standard contains specifications for the national application of concrete admixtures)	Partly integrated in EN 934-1 No (will be part of DIN 1045-2 in the future)
Ireland	None	
Italy	UNI 10765:1999: Additivi per impasti cementiti — Additivi multifunzionali per calcestruzzo — definizioni, requisiti e criteri di conformità (Admixtures for concrete — Multifunctional admixtures for concrete — Definition, requirements and conformity criteria)	
Luxembourg	None	
Netherlands	None	
Norway	None	
Portugal	None	
Slovakia	None	
Slovenia	None	
Sweden	None	
Switzerland	None	
United Kingdom	BS 8443: Specification for establishing the suitability of special purpose concrete admixtures	Publication expected in late 2005

Table 3.5 — National standards for others constituents, e.g. fibres

CEN Member Countries	Reference and title	Due to be replaced by an EN/ETA
Austria	No standard; other national guidelines	
Belgium	None	
Czech Republic	None	
Denmark	Fibres — Requirements for fibres are described in: DS 2426 (see Table 1 for details)	
Finland	None	
France	None	
Germany	Steel fibres and polymer fibres (NTA = National Technical Approval)	EN 14889-1 und -2
	DIN 1100: Hartstoffe für zementgebundene Hartstoffestriche — Anforderungen und Prüfverfahren (Hard aggregates for cement-bound floor screeds — Requirements and test methods) (NOTE Aggregates acc. to DIN 1100 have to be used for concrete in the exposure class XM3 acc. to DIN 1045-2)	—
Ireland	None	
Italy	UNI 11037: Fibre di acciaio da impiegare nel confezionamento di conglomerato cementizio rinforzato (Steel fibre to be used in the preparation of reinforced concrete conglomerate)	
Luxembourg	None	
Netherlands	None	
Norway	None	
Portugal	None	
Slovakia	None	
Slovenia	None	
Sweden	None	
Switzerland	None	
United Kingdom	None	

5 Limiting values

Table 4.1 contains the number of CEN Member Countries recommending requirements for aggregate categories for normal-weight aggregate concrete used in general construction. Annex A contains the details of these requirements. Table 4.1 shows the selected requirements for aggregates vary significantly and reflect local experience and what is locally available.

NOTE 1 It is inevitable that when a constituent material standard is a list of what is available somewhere in Europe, the national complementary requirements will select categories that reflect their experience.

NOTE 2 As EN 12620 reflects the needs somewhere in Europe, EN 206-1 should not attempt to set tighter classes as a general requirement for concrete. Leave this to complementary national provisions.

Table 4.1 — Number of CEN Member Countries with requirements for national minimum aggregate categories for normal weight aggregate concrete used in general construction

Annex A contains the details of the CEN Member Country requirements			
Aggregate categories	Number of CEN Member Countries with:		
	Requirements	Conditional requirements	No requirements
Coarse aggregate grading categories	5	3	9
Graded coarse aggregate categories	3	3	11
All-in aggregate	3	3	9
Flakiness Index categories	7	2	8
Shape Index categories	3	3	11
Shell content categories	5	4	8
Fines content categories for coarse aggregate, natural graded 0/8 mm aggregate, all-in aggregate and fine aggregate	8	3	6
Fines content categories	8	3	6
Los Angeles categories	4	5	8
Resistance to impact categories	1	2	14
Resistance to wear categories	3	2	12
Resistance to polishing categories	3	3	11
Resistance to surface abrasion (AAV) categories	0	2	15
Resistance to abrasion by studded tyres	0	3	14
Freeze-thaw resistance categories	5	9	3
Magnesium sulfate categories	1	7	9
Acid-soluble sulfate categories	7	3	7
Drying shrinkage not greater than 0,075 %	2	6	8
Lightweight organic contaminators	5	5	7

While EN 206-1, Annex F gives some recommended limiting values for CEM I concrete with each of the exposure classes, in reality limiting values for durability are given in the national requirements. It should be noted that CEN Member Countries use different exposure classes for similar concrete elements and similar environments, see national examples in Table 2.2 and Table 2.4. In addition the effect of 'grouping' exposure classes may result in the rounding up of requirements. This Part of the CEN Report provides a comparison of these limiting values based on exposure class and detailed information is given in Annex B. Figures 1 to 17 give the national requirements/recommendations for maximum w/c ratio, minimum cement content and minimum compressive strength class in exposure classes XC1 to XA3. Annex B contains more detailed information including permitted cement types. However, this information is for comparison purposes and for specification purposes the national provisions should be used.

These figures show a wide range of requirements for the concrete composition in the different European countries even for the same exposure class. The data show that there is no agreed relationship between

compressive strength class, maximum w/c ratio and minimum cement content. Often the values with regard to the compressive strength class, the maximum water cement ratio and the minimum cement content do not correspond with the recommended values given in EN 206-1, Table F.1. In France, different requirements are used for precast and in-situ concrete. The values given in this Technical Report are for in-situ concrete.

An overview of the requirements is presented in Table 4.2 in terms of the minimum and maximum value, the most frequently used value with respect to the minimum concrete cover, (i.e. the nominal cover less the allowance for deviation), the minimum compressive strength class, the maximum water cement ratio and the minimum cement content. The most frequently used value (m. f. v.) is the value selected by more CEN Member Countries than any other value and it should not be interpreted as meaning that most CEN Member Countries use this value.

Table 4.2 — Observations with regard to the national recommendations for exposure classes for an intended working life of at least 50 years in terms of the minimum and maximum value and the most frequently used value with regard to the minimal concrete cover, the compressive strength class, the maximum water cement ratio and the minimum cement content

Exposure class	Minimum cover, mm		Minimum compressive strength class				Maximum w/c ratio			Minimum cement content, kg/m ³			
	min	max	min	max	m. f. u.		min	max	m. f. u.	min	max	m. f. u.	
XC1	10	20	NR	C25/30	C 20/25		0,60	NR	0,65	NR	300	260	
XC2	15	35	NR	C28/35	C25/30		0,55	NR	0,60	150	300	280	
XC3	10	35	NR	C32/40	NR, C25/30		0,45	NR	0,55	150	340	280	
XC4	15	40	NR	C32/40	NR		0,45	NR	0,50	150	340	300	
XD1	25	40	NR	C40/50	C30/37		0,45	0,60	0,55	150	360	300	
XD2	25	55	NR	C40/50	C30/37		0,40	0,55	0,50, 0,55	150	360	300	
XD3	33	55	NR	C50/60	C35/45		0,40	0,45	0,45	150	400	320	
XS1	25	40	NR	C40/50	C30/37		0,45	0,55	0,50, 0,45	150	360	300	
XS2	25	45	NR	C40/50	C35/45		0,40	0,55	0,45	150	360	320, 360	
XS3	30	50	NR	C50/60	C35/45		0,35	0,45	0,45	150	400	320	
XF1	-	-	NR	C32/40	NR		0,55	0,60	0,60	NR	300	300	
XF2	-	-	NR	C35/45	NR		0,45	NR	0,55	NR	340	300	
XF3	-	-	NR	C40/50	NR		0,45	0,60	0,50	NR	340	300, 320	
XF4			NR	C40/50	NR		0,40	NR	0,45	NR	400	340	
XA1	-	-	NR	C35/45	NR		0,40	0,60	0,55	150	380	300	
XA2	-	-	NR	C40/50	C35/45		0,40	0,50	0,50	150	380	320	
XA3	-	-	NR	C40/50	NR	C35/45	C40/50	0,35	0,45	0,45	150	400	360
m. f. u. most frequently used value													

Table 4.3 compared the most frequently used values with the recommended values given in EN 206-1, Table F.1. These data show that in the majority of cases (~ 82 %) the most frequently used values with regard to the maximum water cement ratio and the minimum cement content correspond with the recommended values given in EN 206-1, Table F.1.

Most CEN Member Countries set a value for the compressive strength class. In nine cases (~ 53 %) the most frequently used values with regard to the compressive strength class corresponds with the recommended values given in EN 206-1, Table F.1.

Table 4.3 — Comparison of the most frequently used values with regard to the compressive strength class, the maximum water cement ratio and the minimum cement content with the recommended values given in EN 206-1, Table F.1

Exposure class	Compressive strength class				Maximum w/c ratio		MCC			
	EN 206-1	m. f. u.			EN 206-1	m. f. u.		EN 206-1	m. f. u.	
XC1	C20/25	C 20/25			0,65	0,65		260	260	
XC2	C25/30	C25/30			0,60	0,60		280	280	
XC3	C30/37	NR	C25/30	C30/37	0,55	0,55		280	280	
XC4	C30/37	C30/37			0,50	0,50		300	300	
XD1	C30/37	C30/37			0,55	0,55		300	300	
XD2	C30/37	C 30/37			0,55	0,50		300	300	
XD3	C35/45	C35/45			0,45	0,45		320	320	
XS1	C30/37	C30/37			0,50	0,50	0,45	300	300	
XS2	C35/45	C35/45			0,45	0,45		320	340	
XS3	C35/45	C35/45			0,45	0,45		320	320	360
XF1 ^a	C30/37	NR			0,55	0,60		300	300	
XF2 ^b	C25/30	NR			0,55	0,55		300	300	
XF3 ^c	C30/37	NR	C30/37		0,50	0,50		320	300	320
XF4 ^d	C30/37	NR			0,45	0,45		340	340	
XA1	C30/37	NR			0,55	0,55		300	300	
XA2	C30/37	C35/45			0,50	0,50		320	320	
XA3	C35/45	NR			0,45	0,45		360	360	
^a EN 206-1: No Air entrainment required; No Air entrainment required in 16 of 17 countries.										
^b EN 206-1: Air entrainment required; 12 countries: Air entrainment required; 3 countries: No air entrainment required; 2 countries: Solutions with and without AEA available										
^c EN 206-1: Air entrainment required; 10 countries: Air entrainment required; 3 countries: No air entrainment required; 3 countries: Solutions with and without AEA available										
^d EN 206-1: Air entrainment required;12 countries: Air entrainment required; 2 countries: No air entrainment required; 2 countries: Solutions with and without AEA available										
	Most frequently used values correspond with the recommended values given in EN 206-1, Table F.1.									
	Most frequently used values do not correspond with the recommended values given in EN 206-1, Table F.1.									

In five cases (XC1, XC2, XC4, XD1 and XD3) the most frequently used values with regard to the compressive strength class, the maximum water cement ratio and the minimum cement content correspond with the recommended values given in EN 206-1, Table F.1 for all three categories.

Denmark, which has the lowest minimum cement contents, has an additional requirement for minimum fines content. In the case of Denmark, the minimum cement content cannot be reduced when Type II additions are used.

When assessing the implications of these data, both the type of element and the selected exposure class need to be taken into account, e.g. for example, indoor concrete may be classed as X0 or XC1, see Clause 2.

There is no consistent view on the concrete quality required to resist a given exposure class with a given minimum cover and intended working life.

NOTE Relatively small changes in requirements may have significant impacts on the competitiveness of concrete solutions and there will be strong resistance to proposals that take the worse values and potential liability issues if CEN/TC 104/SC 1 were to select values that were not worse case.

Annex B includes information on permitted cement types. With the exception of one CEN Member Country, they all provide guidance for the use of cements with several main constituents (blended cements) besides Portland cement (CEM I).

Annex B shows, sometimes, substantial differences in the types of cement permitted in the national application documents for the same exposure class. This reflects not only the traditionally different factors of the market and building practice but also different philosophies in setting regulations. For example, specifications are given in the German application standard DIN 1045-2 for the application of all 27 basic types of cement and also for a number of CEM II-M cements. Other national annexes to EN 206-1 seem to regulate the application of only a few types of cement that traditionally play a part in the particular national market.

In a few cases for a given exposure class, the use of some blended cements is linked to a higher/lower cement content and a lower/higher water cement ratio than CEM I concrete for a certain exposure class. See for example the entry for Portugal in Table B.2 and the UK in Table B.11.

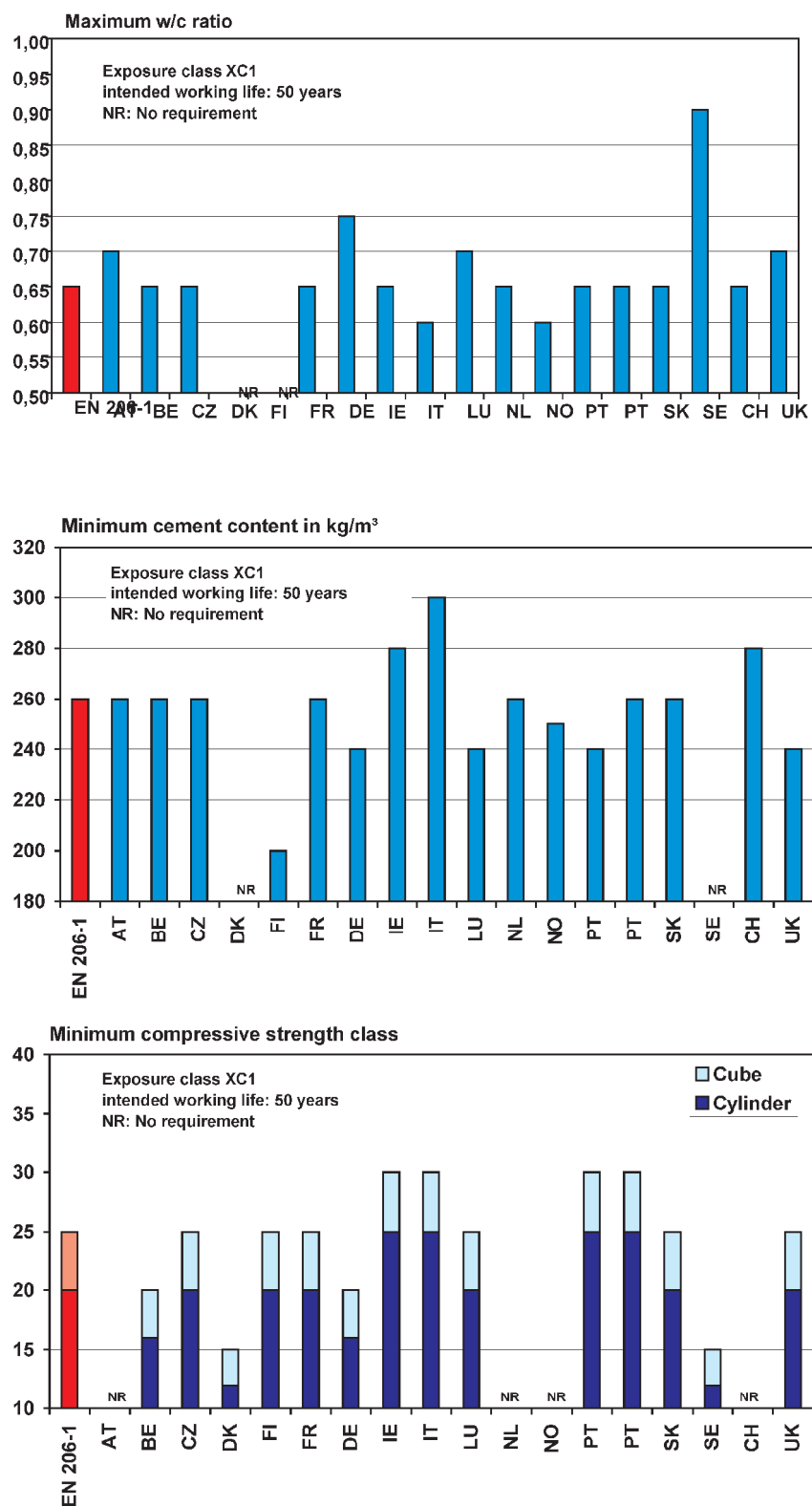


Figure 1 — Comparison of National Provisions to EN 206-1 – Exposure Class XC1