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The New Concrete Standards

An Introduction to EN 206-1

THE IRISH CONCRETE SOCIETY

IRISH CONCRETE FEDERATION

Set for life

This booklet was drafted by a joint working group from the Irish Concrete Society and the Irish Concrete Federation.

Every care has been taken to ensure that the information contained herein is correct and accurate at the date of publication. However, the Irish Concrete Society and the Irish Concrete Federation Ltd cannot accept any responsibility or liability for any errors, inaccuracies or omissions.

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The Irish Concrete Society and The Irish Concrete Federation wish to recognise the assistance of the Concrete Society and the Quarry Products Association in the United Kingdom.

Published April 2004

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1. GENERAL

1.1 Introduction

Insitu is the most widely used form of concrete. The addition of new raw materials such as synthetic fibres and the development of new additives and techniques such as self-compacting concrete and shotcrete are revolutionising the use of insitu concrete and broadening its applications.

Insitu concrete is incredibly durable and flexible in its use. As a construction material, concrete is robust and has excellent sound reduction and fire properties. These inherent properties, combined with the great potential for the development of new specifications and techniques, suggest that concrete will continue to be the world's most important construction material for many years to come.

Ireland, compared to other countries in Europe, has substantially more resources per capita of the constituent materials which go into the manufacture of concrete. For this reason concrete is produced on a local basis and generally delivered within a radius of 30 miles with the resulting savings in the fossil fuel consumption associated with transport. The fact that concrete is 100% recyclable is further evidence of its sustainability credentials.

Exposed concrete acts as a thermal moderator preventing rapid thermal swings, greatly reducing the need to cool office buildings, which is typically the biggest running cost. Only 10% is related to the construction of the building. Designing with energy in mind can reduce in-use energy costs by up to 75% and greatly reduce carbon dioxide emissions.

On 1st December 2003, the Irish Standard for Concrete IS326 Part 2[(1)] was replaced by the new European Standard IS EN 206-1. This publication guides specifiers through the process of determining the recommended concrete quality and specifying the concrete to the manufacturer.

1.2 Durable Concrete Structures

Design, detailing, specification, execution and maintenance all influence the durability of a structure regardless of the materials used for its construction.

This publication explains how to select the appropriate concrete quality in relation to the cover to reinforcement to provide a structure that is required to be durable in the identified exposure classes for the intended working life. To achieve a durable structure, other aspects of the process of design, specification and construction are equally important and should not be overlooked – in particular, achieving the minimum cover, attention to detailing and care during the execution of the works.

Structures will be durable for their intended (working) life, if made from properly compacted concrete which is in compliance with compressive strength and other speicified requirements, and in which the achieved cover to reinforcement meets the minimum levels specified.

Concrete structures are robust; however, this robustness - even with increased concrete quality and cover to reinforcement - will not compensate for gross errors in design or construction.

1. GENERAL

1.3 The New European Standards

CONCRETE SPECIFICATION

IS EN 206-1 Concrete – Part 1: Specification, performance, production and conformity.

This is a first generation CEN standard for concrete and it makes a substantial step towards common standards for concrete in Europe. However, European standard EN 206-1 leaves many important aspects to be specified in national provisions. The Irish version comprises the core text of the European standard EN 206-1, along with the Irish National Annex.

This European Standard forms part of a group of related construction standards, which will include design and construction in concrete within the countries of the CEN members (Fig. 1 of EN 206-1:2000). This group of standards will include test methods for the constituent materials of concrete.

CONCRETE TEST METHODS

There are three series of standards for concrete testing:

• I.S. EN 12350: Testing fresh concrete
(7 parts published to date)

• I.S. EN 12390: Testing hardened concrete
(8 parts published to date)

• I.S. EN 12504: Testing concrete in structures
(2 parts published to date)

Appendix 1 gives the equivalents for testing of new European and British Standards, some of which still remain in force.

WHAT DOCUMENTS DO I NEED TO SELECT

The main specification document is IS EN 206-1. This has references to all the materials' standards and testing standards and should be sufficient for the majority of projects.
Where conditions exist which are not covered by IS EN 206, reference should be made to other (national) provisions and technical publications.

CONCRETE DESIGN

The following design parts of Eurocode 2 are likely to be available within the next few years:
• EN 1992-1-1:
Eurocode 2: Design of concrete structures
- Part 1-1: General rules and rules for buildings.
• EN 1992-1-2:
Eurocode 2: Design of concrete structures
- Part 1-2: General rules – Structural fire designs.

The following Eurocode is already published:
• IS EN 1990: 2002
Eurocode – Basis of structural design.

SUPPORTING DESIGN DOCUMENTS:

• IS 326: 2004
Concrete - Code of Practice for the structural use of concrete
• B.S. 8110 (1997)
Concrete : Part 1; Code of Practice for the structural use of concrete(2)
• Building Regulations :Technical Guidance Documents (DoELG)(3)
• BRE Special Digest 1 'Concrete in aggressive ground'(4)
• IEI/ICS
Alkali-Silica Reaction in Concrete(5)
• BS 6089
Guide to Assessment of concrete strength in existing structures(6)

1. GENERAL

CONFORMITY

One of the essential differences between EN 206-1 and the previous standard IS 326 is that the new standard places more responsibility for conformity with the manufacturer. Under IS 326, conformity was substantially established by site testing. In the new approach, IS EN 206-1 places the onus of establishing conformity on the concrete manufacturer. A formal declaration of conformity to IS EN 206-1 is now required on despatch documentation for readymixed concrete. This declaration of conformity can
only be achieved through the obligatory production and conformity control scheme, operated in accordance with the requirements set out in sections 8 and 9 of the standard.

To further ensure that the correct quality of concrete is delivered to site, and where required by the contract, an independent third-party certification scheme is proposed, to underpin the declaration of conformity by the concrete manufacturer. Independent auditing of all aspects of the production and conformity control process will be undertaken by an approved inspection and certification body in accordance with the requirements of Annex C in IS EN 206-1. Consequently, this should reduce the need for site testing of delivered concrete.

As is currently the case, the contractor must use good practice in placing, compacting and curing the delivered concrete to ensure strength anddurability.

1.4 Transition

IS EN 206-1 is the only current national Irish standard for concrete specification and production since December 2003.

Concrete producers are in the process of adapting their quality and production control systems to become fully compliant with the requirements of IS EN 206-1 during 2004. From this point onwards they will operate to the requirements of this new standard.

Designers and users are required to specify concrete in accordance with the requirements of IS EN 206-1, to ensure uniformity and clarity in the full construction process.

Structural design will continue to be guided by the existing design standards (IS 326/ BS8110 etc.) and some disparities may occur in the interim period until IS EN 1992 becomes available and is used.

1.5 New Terminology

One of the main difficulties with the new standards is getting familiar with the new terms. The following explanations are a summary of main terms used. Section 3 of the standard has a fuller list of terms and definitions.

ADDITIONS

This is the term for constituent materials, such as fly ash, ground granulated blastfurnace slag, silica fume, etc., that are added at the concrete mixer.

CHLORIDE CLASS

The way of expressing the maximum chloride content of a concrete. For example, a chloride class of Cl 0,40 means a maximum chloride ion content of 0.40% by mass of cement.

COMMA

IS EN 206-1 uses a ‘comma’ where we would expect to see a decimal point. Where a ‘comma’ has been used in a class notation (e.g. Cl 0,40) the comma has been retained.

1. GENERAL

COMPRESSIVE STRENGTH CLASS
A more complex way of expressing the 'grade' of concrete using letters ('C' for normal-weight and heavyweight concrete and 'LC' for lightweight concrete) followed by the minimum characteristic strength of a 150mm diameter by 300mm cylinder, a slash, and the minimum characteristic cube strength e.g. C40/50.

CONCRETE
A specifier species a 'concrete' and a producer designs a 'mix' that satisfies all the specified requirements for the concrete.

CONFORMITY
Tests and procedures undertaken by the producer to verify the claims made on the delivery ticket. This replaces the compliance testing procedures in or IS 326.

CONSISTENCE
Workability.

CONSISTENCE CLASS
A recommended alternative to specifying consistence by a target value.

DESIGNED CONCRETE
Called Designed Mix in IS 326.

ESTABLISHED SUITABILITY
The concept of established suitability allows materials and procedures to be used on a national basis that are not currently covered by European standards, but have a satisfactory history of local use.

EXECUTION
Workmanship.

FLY ASH
Pulverised-fuel ash.

IDENTITY TESTING
Acceptance testing in all but name. It 'identifies' whether a particular batch or batches of concrete come from a conforming population.

INTENDED WORKING LIFE
Period of time that a properly maintained structure is required to be serviceable and durable.

MINIMUM COVER TO REINFORCEMENT
Cover to reinforcement assumed to be achieved when determining the concrete quality.

MIX
A composition that satisfies all the requirements specified for the concrete. Different producers may have different mixes, all of which satisfy the concrete specification.

NOMINAL COVER
Cover to reinforcement shown on the drawings equal to the minimum cover plus a tolerance (margin) for fixing precision.

PRESCRIBED CONCRETE
Called 'prescribed mix' in IS 326 (see 'Concrete' and 'Mix').

RECYCLED AGGREGATES
Aggregates resulting from the reprocessing of inorganic material previously used in construction. A sub-set of
this is 'recycled concrete aggregate', which is mostly crushed concrete.

SPECIFICATION
Final compilation of documented technical requirements, in terms of performance or composition, given to the producer by the specifier.

SPECIFIER
Term reserved for the person or body who passes the specification to the producer.

STANDARDIZED PRESCRIBED CONCRETE
Called 'Standard mix' in IS 326 (see 'Concrete' and 'Mix'). The new term correctly identifies the type of concrete and avoids the misunderstanding caused when 'standard' is taken to mean 'normal'.

USER
Person or body using fresh concrete.

2. SPECIFICATION PROCESS

2.1 Introduction

The new specification standards do not change the normal process of design. However, a number of aspects that were implicit in previous standards, e.g the intended working life and the type of aggressive actions on the concrete and reinforcement, are addressed explicitly in the new standards. The process comprises (see Flowchart Fig 1).

- Gathering information relating to the structural and fire design
- Determining the intended working life
- Identifying relevant exposure classes
- Identifying other requirements for the concrete
- Selecting the method of specifying
- Selecting the concrete quality and cover to reinforcement
- Preparing the specification
- Exchange of information

2.2 Gathering information relating to the structural and fire design

IS.EN 206-1:2002 is operational before the European structural and fire design codes are in place. Consequently, in the short term, the output of the design process will come from the application of Standards such as IS 326 or BS 8110 and be in the form of the required concrete strength which is usually the minimum characteristic cube strength required. This needs to be converted to the new notation for the compressive strength class, using Table 1.

The first number in each notation in the compressive strength class is the minimum required characteristic strength of 150mm diameter by 300mm cylinders. This is the design strength used in the European structural design codes. Consequently it is important that the new classification is always used in full, as the concrete manufacturer will not know if a single value is the minimum required characteristic cylinder or cube strength.

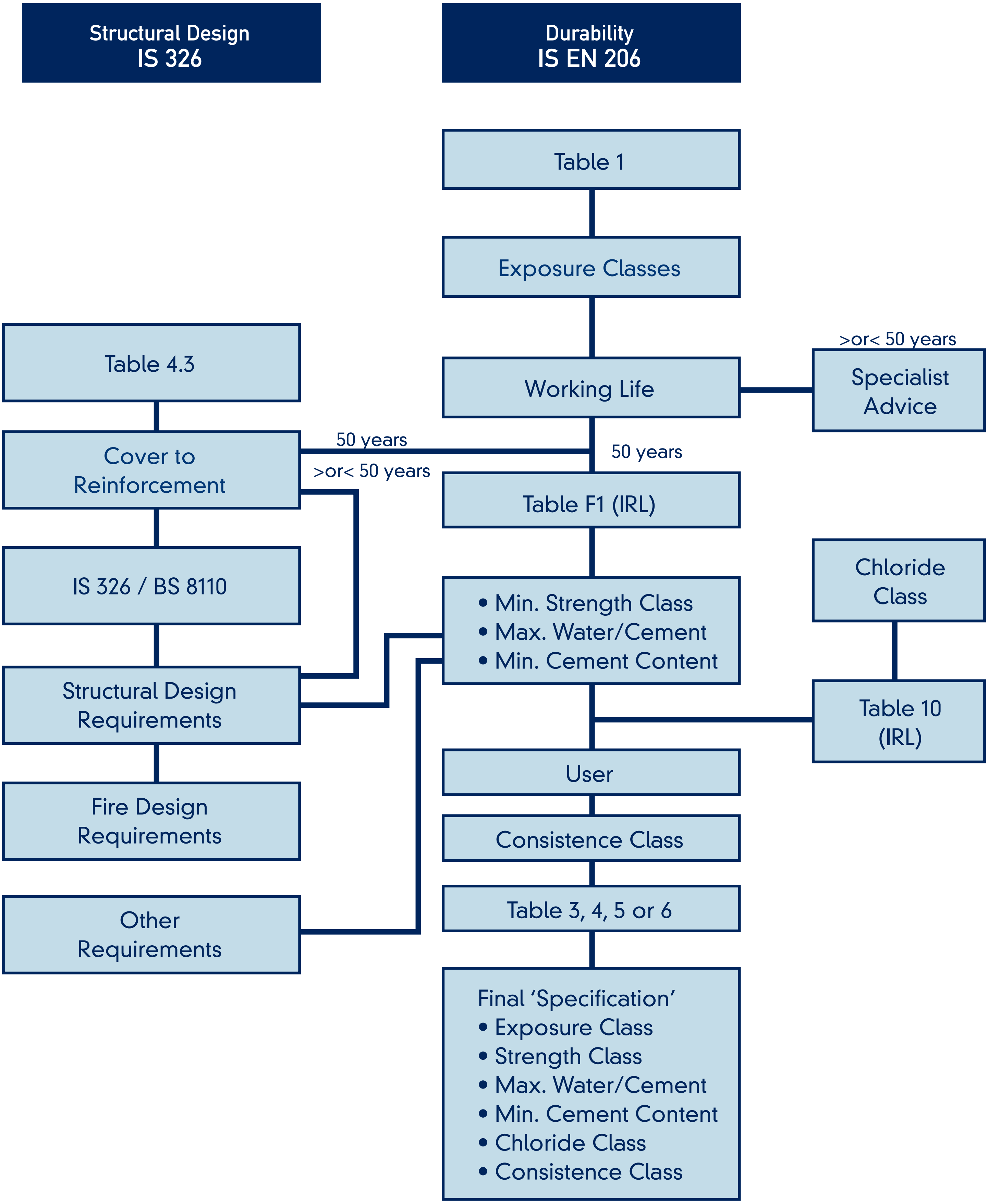
In addition to the minimum required characteristic strength of concrete (expressed as a compressive strength class), the other key output from designing to the Irish Standard is the nominal cover to reinforcement. The margin △c (the difference between the nominal cover and the minimum cover) needs to be established. The margin can be determined from IS 326 and is 5mm for normal cases. While this is a suitable margin in some conditions, e.g. internal concrete, this is the lower limit of the recommended range (5mm to 15mm). In an aggressive environment, careful consideration should be given to what is practical and an appropriate margin selected. This does not mean that you have to change the section size or nominal cover, just the concrete quality.

Required grade, i.e. required minimum characteristic cube strength N/mm2	Specify compressive strength class Cylinder/Cube
10	C8/10
15	C12/15
20	C16/20
25	C20/25
30	C25/30
35	C28/35
37	C30/37
40	C32/40
45	C35/45
50	C40/50
55	C45/55
60	C50/60
67	C55/67
75	C60/75
85	C70/85
95	C80/95
105	C90/105
115	C100/115

Table 1 (IRL)
Compressive strength classes for normal-weight and heavyweight concrete

Fig 1

Flowchart of Specification Process



2. SPECIFICATION PROCESS

2.3 Determining the intended working life

IS EN 1990: 2002 Eurocode - Basis of structural design gives recommended intended working lives for different types of structure. These are shown in Table 2. Where IS EN 206-1:2002 gives recommended concrete qualities, it uses the phrase 'for an intended working life of at least 50 years' to indicate that most structures will continue to perform adequately well beyond the intended working life. For longer working lives see Note 2 to Table 4.3 of Appendix C (page 88) in the National Annex to IS EN 206-1, or IS EN 1992-1–1, when published.

Temporary structures	10 years
Replaceable structural parts	10 - 25 years
Agricultural & similar structures	15 - 30 years
Building structures and other common structures	50 years
Monumental building structures, bridges and other civil engineering structures	100 years

Table 2
Intended working lives recommended in IS EN 1990

2.4 Identifying relevant exposure classes

The main exposure classes are given in Table 3.

With the exception of X0, all these exposure classes are split into a series of sub-classes. These exposure classes, sub-classes and informative examples are all given in IS EN 206-1: 2002 Table 1. Moisture conditions given in the class description are those in the concrete cover to reinforcement, but, in many cases, conditions in the concrete cover can by taken as being the same as those in the surrounding environment.

There will always be one, and often more than one, relevant exposure class. Different element faces may have different exposures and all should be identified. Examples of exposure classes for different typical structures and elements are shown in the diagrams in Appendix 3.

Designation	Description
XO	No risk of corrosion or attack
XC	Corrosion induced by carbonation
XD	Corrosion induced by chlorides other than from seawater
XS	Corrosion induced by chlorides from seawater
XF	Freeze/thaw attack with or without de-icing agents
XA	Chemical attack
*	Abrasion

Table 3
Main exposure classes

* IS EN 206-1: 2002 covers all these exposure classes except abrasion. For guidance on abrasion you need to consult other standards, such as IS EN 13813 Screed materials and floor

2. SPECIFICATION PROCESS

2.5 Other requirements

Identifying other requirements for the concrete

There are a number of other requirements for the structure that affect the choice of concrete. These include:

AESTHETIC CONSIDERATIONS
- High-quality as-struck surface finish
- White or coloured concrete
- Exposed aggregate, tooled or other surface finishes that remove the surface

MINIMISING CRACKING DUE TO
- Restrained early-age thermal effects
- Long-term drying shrinkage

CONSTRUCTION REQUIREMENTS
- Method of placement
- Accelerated or retarded setting
- Plastic settlement cracking
- High early strength
- Low early strength
- Overcoming problems caused by congested reinforcement
- Overcoming difficult placing conditions
- Self-compacting concrete
- Coping with high/low ambient temperatures

2.6 Selecting a method of specifying

Concrete may be specified as designed concrete or as prescribed concrete. For structural concrete subject to environmental actions described in Table 1 – Exposure Classes, it is preferable to specify the concrete as designed concrete, unless the specifier requires specific concrete mixes to be used. It is important to avoid contradictions within the specification requirements.

Where a special finish is required (e.g. exposed aggregate, tooled surface) the specifier may specify a prescribed concrete to help obtain an appealing finish, where a special mix design is needed. In these cases, it is recommended that initial testing is undertaken, including a trial panel, the results of which will assist in specifying the prescribed concrete.

For concrete in housing or agriculture applications, reference should be made to specialist specifications (see references 3, 8, 9 in References).

2.7 Selecting the concrete quality and cover to reinforcement

Guidance on the selection of concrete quality and cover to reinforcement is given in the Irish National Annex to IS EN 206-1:2002 (Page 73-88) and also in I.S. 326:2004[10]. The recommendations for concrete quality in IS.EN 206-1: 2002 are based on the use of normal steel reinforcement, and an intended working life of 50 years (Table F1 IRL)

Guidance on the use of stainless steel reinforcement is given in Concrete Society Technical Report 51: Guidance on the use of stainless steel reinforcement[11]. For guidance on non-ferrous reinforcement, see state-of-the-art literature. The International Standards Organisation (ISO TC 71:SC6) is in the process

2. SPECIFICATION PROCESS

of developing standards and guidance on the use of non-ferrous reinforcement.

In principle, the selection process is simple. For each of the identified exposure classes, intended working life, the recommended concrete quality is noted for the minimum cover to reinforcement used in the structural design and the most onerous values are selected. Nominal cover is specified on the drawings and this includes the minimum cover Cmin plus △c, an allowance in design of tolerance (there is no 'trade-off between reinforcement cover and concrete quality in IS EN 206-1).

An example of this process is given in the example below for a designed concrete.

Where exposure classes include aggressive chemicals and chloride-induced corrosion, identifying the options is more complex and reference should be made to specialist literature or specialist advice sought.

EXAMPLE: EXPOSED COLUMN OF A BUILDING – DETERMINATION OF COVER FOR A 50 YEAR INTENDED WORKING LIFE

Step 1

Define exposure class from

IS EN 206-1:2000
Table 1 – Exposure Classes

Description of Environment -
- Corrosion induced by carbonation: cyclic wet and dry

→Class designation = XC4

- Freeze-thaw attack; Moderate water saturation

→Class designation = XF1

Step 2

Define limiting values of composition and properties of concrete from

IS EN 206-1: 2002
Table F.1 (IRL) Recommended limiting values for composition and properties of concrete

Exposure Class	XC4	XF1
Max. w/c ratio:	0.55	0.60
Min. strength class:	C30/37	C28/35
Min. cement content:	320	300

Select most onerous - XC4

Step 3

Define minimum cover from

IS EN 206-1: 2002
Appendix C Table 4.3 Minimum cover Cmin requirements with regard to durability

C_{min} reinforcing steel = 30mm

Nominal cover = C_{min} + △c
(Specified on drawings)

2. SPECIFICATION PROCESS

2.8 Preparing the specification and exchange of information

Appendix 2 contains forms to help with the specification of designed concrete. Electronic versions of these forms are also available from the Irish Concrete Society.

The 'specification' is defined in IS EN 206-1 as the final compilation of all the specified requirements from the different parties involved. The contractor (or user) normally specifies the concrete consistence depending on the methods of placing, compaction and finishing involved in a particular project. Consistence should normally be specified by the appropriate class for the chosen method of measurement (eg. slump). Consistence can alternatively, in special cases, be specified by target value. However, consistence cannot be specified by both methods. While the mid-point of a slump or flow class might be assumed by the contractor, any test result within the range in Table 4 is in conformity.

Slump Class	Slump Range (mm)
S1	10 - 40
S2	50 -90
S3	100 - 150
S4	160 - 210
S5	≥ 220

Flow Class	Flow Range (mm)
F1	≤ 340
F2	350 - 410
F3	420 - 480
F4	490 - 550
F5	560 - 620
F6	≥ 630

Table 4
Range for slump and flow classes

IS EN 206-1 permits a maximum allowed deviation for single test results for consistence from the limits of the specified class. For slump, the maximum allowed deviation is -20mm (from the lower limit) or +30mm (from the upper limit) for consistence testing from initial discharge of truck mixers (see table 18).

2.9 Ordering Process

DESIGNED MIXES

The ordering process i.e. minimum information to be provided to the manufacturers to ensure compliance with ISEN 206-1, is set out in the table below.

SELECTION	RESPONSIBILITY	ISEN 206-1 REFERENCE	COMMENT
Exposure Class(es)	Specifier	Table 1	Select Exposure Class Designation(s)
Exposure Class Designation(s)	Specifier	Table F1 (IRL)	(a) Min Strength Class (b)Min Cement Content (c) Max W/C Ratio
Strength Class	Specifier	Table F1 (IRL)	Check Compatibility With Exposure Class Designation
Consistence Class	User	One of Table 3, 4, 5 or 6	Check Compatibility With Cl. 5.2.7 (Annex)
Other Requirements	Specifier/User		Provide details to Manufacturer

Table 5
Range for slump and flow classes for typical uses

3. CONCRETE PRODUCTION

3.1 Concrete Production Control

IS EN 206-1 formally requires all concrete to be subject to production control under the responsibility of the manufacturer. It defines the production control measures necessary to maintain the properties of concrete in conformity to the specified requirements. Sections 8 and 9 of the standard cover all these requirements.

The manufacturer is required to have and operate to a documented production control system, (including production control manual). Tables 20-24 in section 9 of the standard set out specific requirements to be complied with in this production control system, for data recording, equipment control and tolerances, constituent material control, production procedures and concrete properties.

The concept is that the control system should monitor not only the final product but also the input materials, the production process and the accuracy of the testing process.

Statistically based control systems are in operation for many different types of production. These systems are used successfully for the control of concrete production and conformity across the world for many years.

3.2 Conformity

With ISEN 206-1 there is a change in emphasis regarding the assessment of conformity. While previously the manufacturer was responsible for conformity, assessment of compliance was generally by means of 'Acceptance Testing' on site, undertaken on the behalf of the specifier. Under the new standard the manufacturer is given clear responsibility for conformity but in a novel departure, is also required to make a 'Declaration of Conformity' to ISEN 206-1 with each delivery. The implementation of formally documented production procedures involving routine testing of the concrete and application of conformity criteria that are defined in I.S. EN 206 – 1 underpin this declaration.

If the concrete is found to be non-conforming and the non-conformity was not obvious at delivery, the manufacturer has to inform the specifier and user. Non-conformities that will be regarded by manufacturers as being obvious at delivery include consistence, air content, colour and maximum aggregate size. Non-conformities that are not obvious at delivery include strength, maximum w/c ratio and minimum cement content. When the manufacturer measures the consistence or air content, the results should be conveyed to the user. If the tolerances exceed the limits for an individual delivery, the user decides whether to accept or reject the delivery.

To ensure that the number of tests is manageable, but still adequate for effective statistical control, related concretes may be

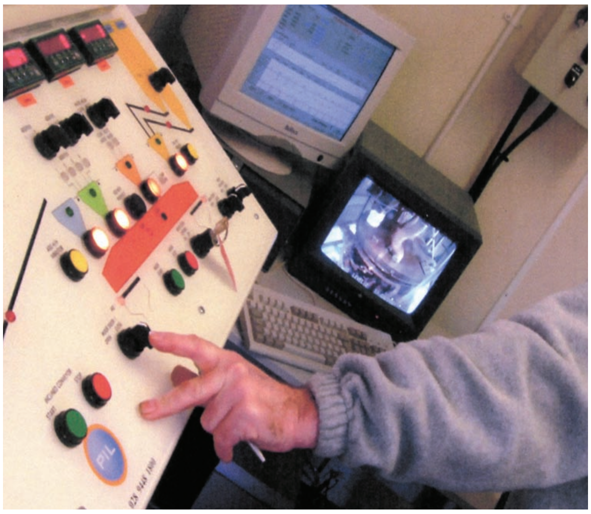
3. CONCRETE PRODUCTION

statistical control, related concretes may be grouped into families. A concrete family is a group of concrete compositions for which a reliable relationship between relevant properties is established and documented. Concrete manufacturers on this island (and also in Europe) have used the family system of control for a number of years and it has been proved to be extremely effective. Its main benefit is that changes in quality can be detected rapidly and effective action taken to ensure that the production remains in a state of statistical control.

Furthermore, where it is required by the contract, or otherwise, that the production control procedure be certified by an approved certification body, the provisions for assessment, surveillance and certification are detailed in Annex C page 59 of the document. In return for the 'Declaration of Conformity' the specifier acknowledges the primacy of the production control procedures, particularly when independently certified by an approved body. There is commitment from the concrete manufacturers to a policy of independent 3rd party certification and this process had already commenced.

For more guidance on concrete families, see CEN Report 13901: The use of the concept of concrete families for the production and conformity control of concrete[12].

For guidance on the application of the conformity criteria, see ICF Guidance on the application of the EN 206-1 conformity rules [13].



3.3 Identity Testing

Conformity testing is intended to replace compliance testing in IS 326 Part 2 (or BS 5328).

Provision has been made in IS EN 206-1 for testing of concrete on site by the user in the form of Identity Testing. The main function of these tests is to verify that an individual batch or load of concrete is as specified and belongs to the same population represented by the conformity test results. Identity testing should normally only be undertaken where there is a doubt about the quality of a batch or load of concrete or in special cases required by the project specification. The details of sampling and identity test criteria are given in Appendix B of IS EN 206-1 (Page 57) and in the National Annex (Page 79).

Regular identity testing, in addition to conformity testing, should be limited to special cases.

The specifier or user may also use identity tests for strength to assess if the concrete in a structural element or series of elements came from a conforming population, i.e. is acceptable. Where such testing is to be routinely undertaken, the specifier needs to inform the concrete manufacturer of the type and number of tests on each element or series of elements cast with the same concrete and whether a non-accredited laboratory will be used for these tests. The specifier should accept elements in which the concrete satisfies the identity criteria. Where they fail the identity criteria, further investigations might be required.

APPENDIX 1

Equivalent European tests to the BS 1881 100 series

Where the Part number of BS 1881 Testing concrete is in bold, this indicates that the standard remains in force after 1 December 2003, the date on which many parts of BS 1881 were withdrawn.

IS EN 12350: 2000. TESTING FRESH CONCRETE

IS EN 12350:2000. TESTING FRESH CONCRETE	BS 1881 TESTING CONCRETE	COMMENT
Part 1. Sampling	Part 101. Method of sampling fresh concrete on site.	
Part 2. Slump test	Part 102. Method for determination of slump	
	Part 103. Method for determination of Compacting factor	These tests are different, but as they are used on the same types of concrete,BS 1881 Part 103 will be withdrawn.
Part 4. Degree of compatibility		
Part 3. Vebe test	Part 104. Method for determination of Vebe time	
Part 5. Flow table test	**Part 105. Method for determination of flow**	
Part 7. Air content of fresh concrete Pressure methods	Part 106. Methods for determination of air content of fresh concrete	
	Part 125. Methods for mixing and sampling fresh concrete in the laboratory	No European equivalent
	Part 128. Methods for analysis of fresh concrete	See also CEN Report 13902:2000: Test methods for determining water/cement ratio of fresh concrete
	Part 129. Method for determination of density of partially compacted semi-dry fresh concrete	

IS EN 12504-1: 2000. TESTING CONCRETE IN STRUCTURES

IS EN 12350:2000 TESTING CONCRETE AND TESTING CONCRETE IN STRUCTURES	BS 1881 TESTING CONCRETE	COMMENT
Part 1: Cored specimens – Taking, examining & testing in compression	Part 120. Method for determination of the compressive strength of concrete cores	

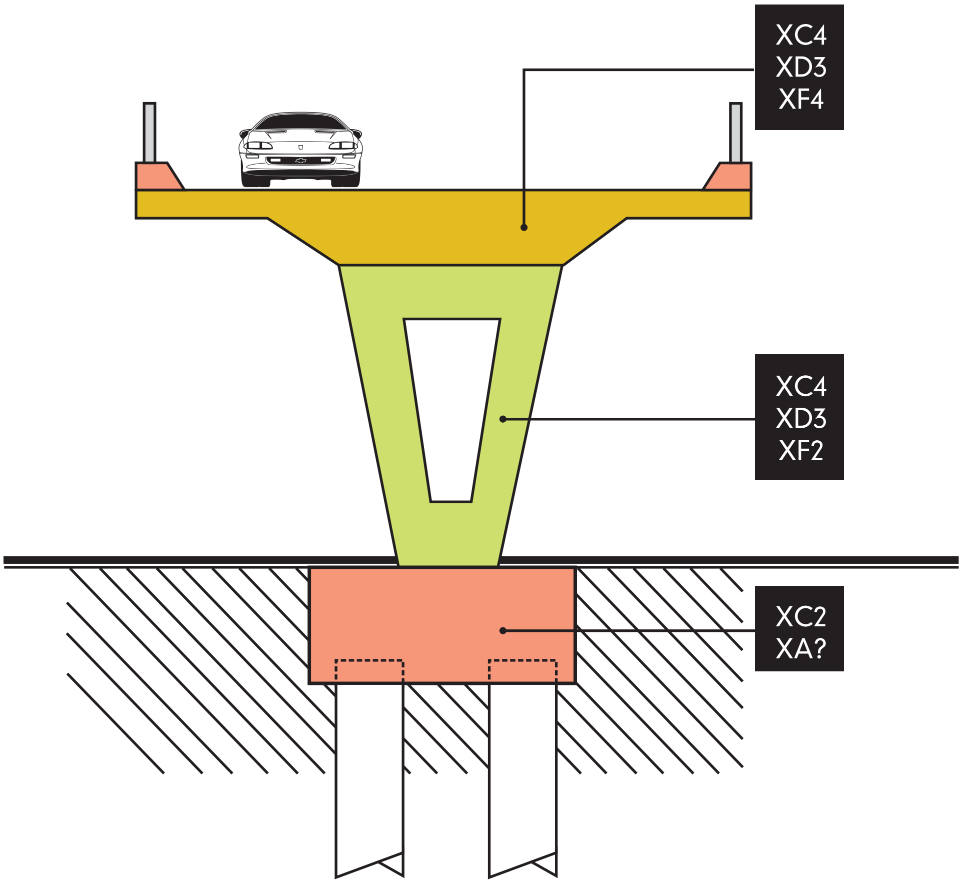
APPENDIX 1

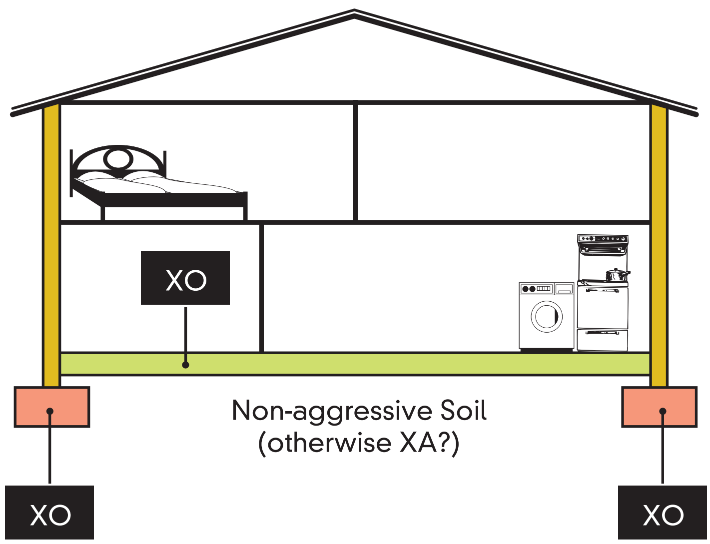
IS EN 12390: 2000. TESTING HARDENED CONCRETE		
IS EN 12390:2000. TESTING HARDENED CONCRETE	BS 1881 TESTING CONCRETE	COMMENT
Part 1. Shape, dimensions and other requirements for test specimens and moulds		Replaces equivalent text in BS
Part 2. Making and curing specimens for strength tests	Part 108. Method for making test cubes from fresh concrete	IS EN 12390-1 covers part of BS 1881:Part 108
	Part 109. Method for making test beams from fresh concrete	IS EN 12390-1 covers part of BS 1881:Part 109
	Part 110. Method for making test cylinders from fresh concrete	IS EN 12390-1 covers part of BS 1881:Part 110
	Part 111. Method of normal curing of test specimens (20°C method)	
	Part 112. Method of accelerated curing of test cubes	No European Equivalent
	Part 113. Method for making and curing no-fines test cubes	No European Equivalent
Part 3. Compressive strength of test specimens	Part 116. Method for determination of compressive strength of concrete cubes	
Part 4. Compressive strength - Specification of compression testing machines	Part 115. Specifications for compression testing machines for concrete	
Part 5. Flexural strength of test specimens	Part 118. Method for determination of flexural	
Part 6. Tensile splitting strength of test specimens	Part 117. Method for determination of tensile splitting strength	
Part 7. Density of hardened concrete	Part 114. Methods for determination of density of hardened concrete	
	Part 119. Method for determination of compressive strength using portions of beams broken in flexure (equivalent cube method)	No European Equivalent
	Part 121. Method for determination of static modulus of elasticity in compression	European standard under preparation
	Part 122. Method for determination of water absorption	No European equivalent
Part 8. Depth of penetration of water under pressure		This is a completely different test to the BS 1881: Part 122 test
	Part 124. Methods for analysis of hardened concrete.	No European Equivalent
	Part 127. Method of verifying the performance of a concrete cube compression machine using the comparative cube test	No European Equivalent
	Part 130. Method for temperature-matched curing of concrete specimens	No European Equivalent
	Part 131. Methods for testing cement in a reference concrete	No European Equivalent

APPENDIX 2

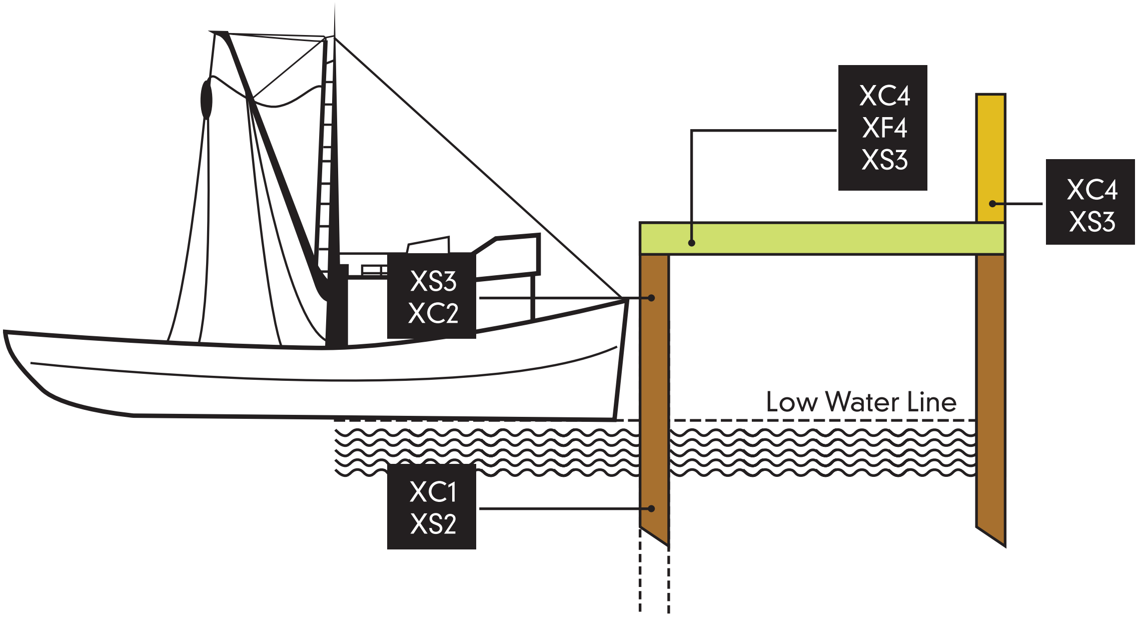
FORM A	SCHEDULE FOR THE SPECIFICATION REQUIREMENTS OF DESIGNED CONCRETE				
These mixes below shall be supplies as designed mixes in accordance with the relevant clauses of IS EN 206-1					
1. Mix reference					
2. Strength Class					
3. Nominal maximum size of aggregate, in mm (D)					
4. Types of aggregate	Coarse Other (specify requirements) Fine Other (specify requirements)	IS EN 12620 IS EN 12620			
5. Sulfate class		XA 1 XA 2 XA 3			
6. Cement type(s) or combinations complying with (ring those permitted)	CEM I N IS EN 197-1 CEM I R IS EN 197-1 CEM I SR B.S. 4027 Others (specify requirements)	CEM I N CEM I R CEM I SR			
7. Exposure Class (As in IS EN 206-1) (or combinations)		XO XC1, XC2, XC3, XC4 XS1, XS2, XS3, XS4 XD1, XD2, XD3, XD4 XF1, XF2, XF3 XA1, XA2, XA3			
8. Chloride Class		C1 1,0 C1 0,40 C1 0,20 C1 0,10			
9. Minimum cement content, kg/m3					
10. Maximum free water/cement ratio					
11. Quality assurance requirements					
12. Rate of sampling intended by the purchaser for strength testing (for information)					
13. Other requirements (alkali, etc. as appropriate)					
IN CASES OF FRESH CONCRETE THE FOLLOWING SHALL BE COMPLETED BY THE PURCHASER.					
14. Consistence (Choose one method)	Slump Class Vebe Class Compaction Class Flow Class	S1, S2, S3, S4, S5, V0, V1, V2, V3, V4 C0, C1, C2, C3 F1, F2, F3, F4, F5, F6			
15. Method of placing (for information)					
16. Other requirements by the purchaser of fresh concrete (only if appropriate)					

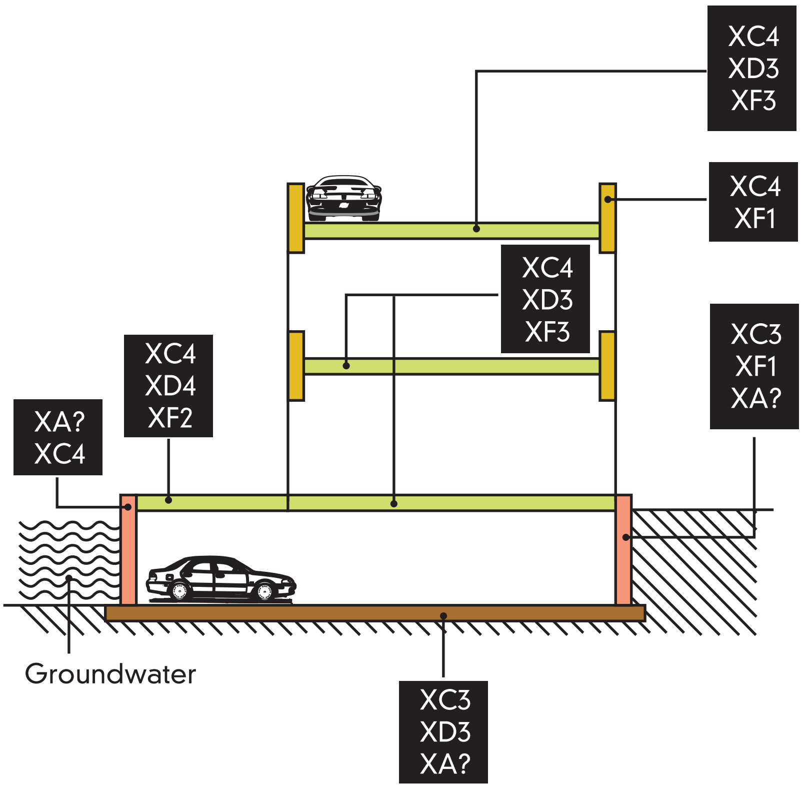
APPENDIX 3


XC4
XD3
XF4
XC4
XD3
XF2
XC2
XA?

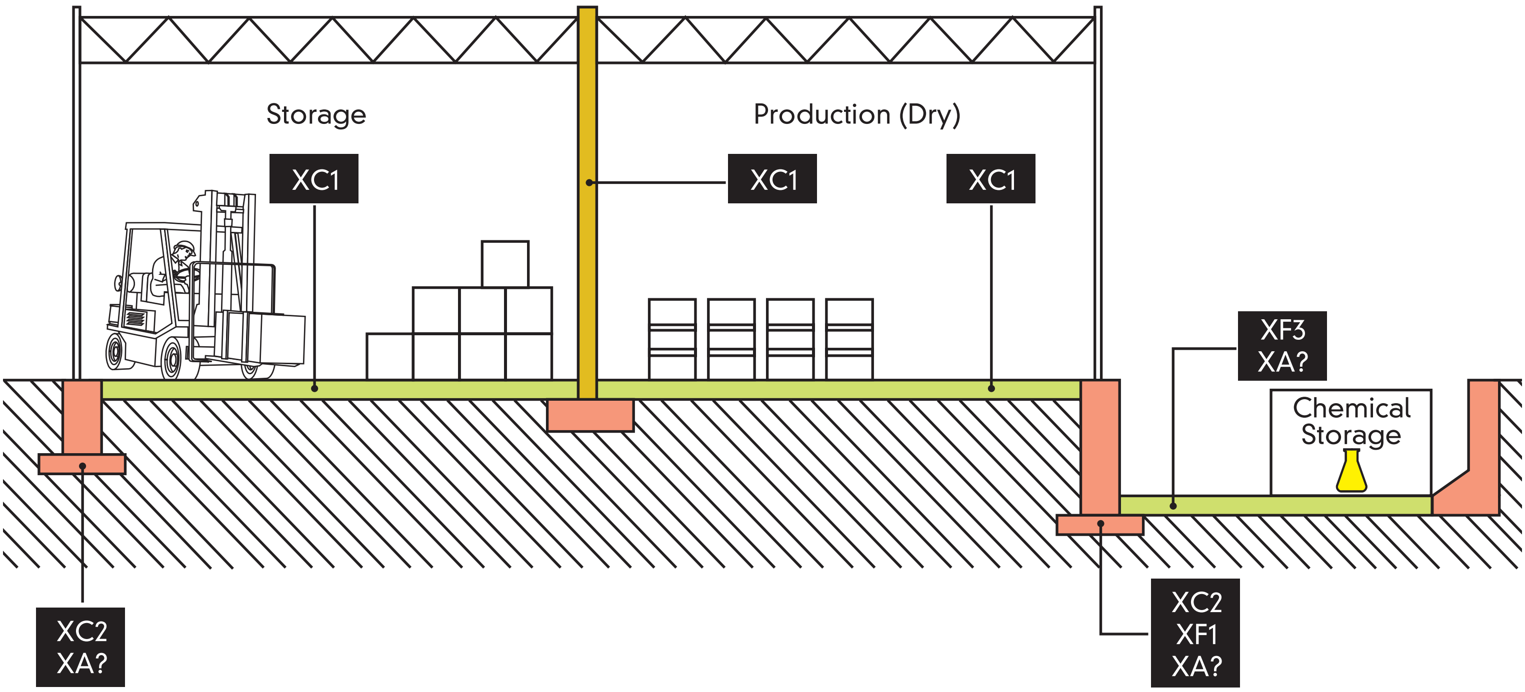

XO
Non-aggressive Soil
(otherwise XA?)
XO
XO

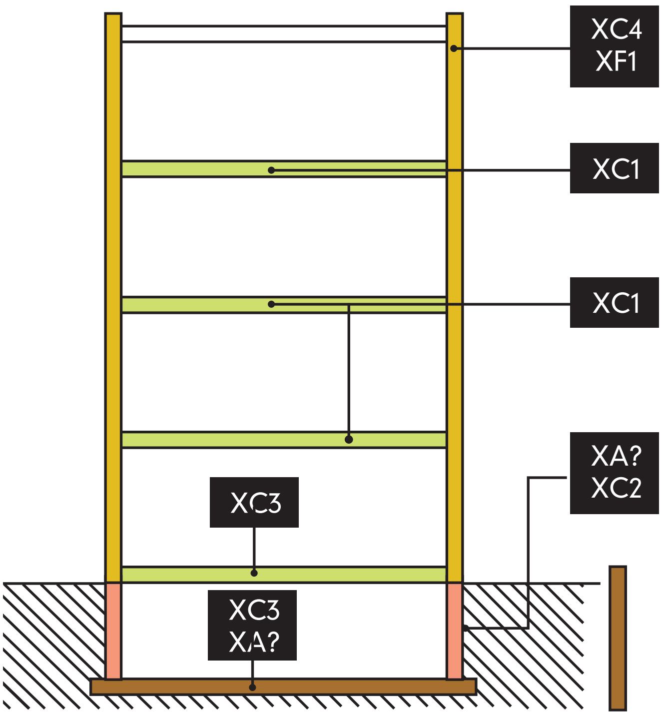
APPENDIX 3


XC4
XF4
XS3
XC4
XS3
XS3
XC2
Low Water Line
XC1
XS2


XC4
XD3
XF3
XC4
XF1
XC4
XD3
XF3
XC3
XF1
XA?
XC4
XD4
XF2
XA?
XC4
Groundwater
XC3
XD3
XA?

APPENDIX 3


Storage
Production (Dry)
XC1
XC1
XC1
XF3
XA?
Chemical Storage
XC2
XA?
XC2
XF1
XA?


XC4
XF1
XC1
XC1
XA?
XC2
XC3
XC3
XA?

REFERENCES

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