

Interim Advice Note 58/04**Changes to Concrete Specification affecting MCHW****Interim Advice Note 52/04 guidance for structural concrete**

Interim Advice Note 52/04 implemented major revisions to the 1700 series Specification for Highway Works (SHW) and Notes for Guidance (NG) for structural concrete, to ensure that they are generally compatible with, and complement 'BS EN 206-1 Concrete – Part 1: Specification, performance, production and conformity', and the complementary British Standards 'BS 8500-1: 2002 Method of specifying and guidance for the specifier' and 'BS 8500-2 Specification for constituent materials and concrete'. The 1700 series clauses accompanying IAN 52/04 have been formally published in the May 2004 edition of the SHW and NG, with minor changes, incorporating received feedback and comment.

Interim Advice Note 52/04 is now withdrawn with immediate effect.

However, it has become apparent that there are a number of other issues emerging, mainly associated with long-term concrete durability, where further guidance is required. Discussions have taken place with industry representatives, involved in the development of the updated BS 8500 and particularly from the precast concrete sector. As a result, it is understood that there will be further changes to BS 8500 – scheduled for the spring of 2005.

In the interim period, the following guidance is offered.

Fixing tolerances for reinforcement ΔC

BS 8500 suggests that reinforcement fixing tolerances should be between 5 and 15mm. In most insitu concrete construction applications this should be 15mm, unless a lesser tolerance can be justified or is necessary in special cases (however, where lesser fixing tolerances are adopted then additional measures for quality control are required as detailed below). For pre-cast concrete construction, where there is usually a higher degree of quality control and production, 5mm would be more appropriate. However certificates of compliance should be sought from the precast concrete supplier to ensure that such a low tolerance is justifiable and achievable.

For thin insitu concrete sections such as deck slabs of less than 250mm thickness a lower fixing tolerance may also be appropriate and necessary. However if this is adopted it should be expressly stated within contract documentation and drawings. Additional checks would be required on site to ensure compliance, and methods to achieve this should be detailed in contractor's site practices and agreed method statements. Contractors should provide certificates of compliance and a detailed record of measured covers before concrete is placed.

It is recommended that the following fixing tolerances should be adopted:-

Insitu concrete generally	$\Delta C = 15\text{mm}$
Precast concrete generally	$\Delta C = 5\text{mm}$
Insitu concrete slabs 150mm or less thick	$\Delta C = 5\text{mm}$
Insitu concrete slabs between 150 and 250mm thick	$\Delta C = 10\text{mm}$
Insitu concrete slabs over 250mm thick	$\Delta C = 15\text{mm}$

Intended Working Life

For the selected intended working life and nominal cover to reinforcement, Tables A.10

to A.16 of BS 8500-1:2002 give guidance on the limiting values for composition and properties of concrete, when using a particular maximum size of aggregate, to provide acceptable durability for each identified exposure class. For exposure classes relating to the risk of corrosion of reinforcement induced by carbonation (XC classes), these limiting values are given in Tables A.10 and A.11 for intended working lives of at least 50 years and at least 100 years respectively. For exposure classes relating to the environmental action of freezing and thawing (XF classes), the given limiting values in Table A.14 are considered to be suitable for an intended working life of at least 100 years. However, for exposure classes relating to the corrosion of reinforcement induced by chlorides, either from sea water (XS classes), or sources other than sea-water such as de-icing salts (XD classes), limiting values are given (in Tables A.13 and A.12 respectively) only for an intended working life of at least 50 years.

For longer intended working lives, and for most highway structures 120 years is appropriate, BS 8500-1 suggests that the relevant provisions should be selected and assessed on a case-by case basis. In particular, changes other than to concrete quality should be considered, such as increasing cover to reinforcement, reducing contact between chloride and the concrete or the use of stainless steel reinforcement. The spread of data from research and surveys of actual structures indicate that understanding of the processes involved is not yet adequate to produce precise recommendations for the concrete cover that is necessary to give a working life of "at least 100 years" in XD and XS exposures. However, as a first estimate for such working lives, BS 8500-1 suggests that the minimum covers given in Table A.12 and Table A.13 be increased by 15mm, and this should be adopted where these exposure classes apply. Since the final concrete requirements are dependent on the intended working life of the structure, Appendix 17/1 makes allowance for this to be given but it does not form part of the concrete specification.

The above guidance is included in the May 2004 NG, however it does not distinguish between precast and insitu concrete construction, or indeed between reinforced, prestressed and post-tensioned concrete, and nor does BS8500. It has also become apparent that the adoption of an additional 15mm for precast concrete results in significantly increased covers compared to the previous adopted requirements resulting from BS5400. As a result it is recommended that an additional 5mm only is added to the nominal covers included in Table A.12 and A.13 when using precast concrete, where 120 years working life is required. The requirements of BD43 'The impregnation of reinforced and pre-stressed concrete highway structures using hydrophobic pore-lining impregnants' also apply, and BD/BA57 'Design for

durability', although the additional cover of 10mm for insitu concrete construction, in clause 3.1 of BD57 has been waived, providing that BS8500, May 2004 SHW/NG and this IAN are adopted.

(NOTE. When BS8500 is updated it is expected that other guidance to provide enhanced durability will be provided, apart from by the provision of additional cover. One particular proposal under consideration is splitting exposure class XD3 into two sub-classes. BS8500-1 recommendations are based on a worst case situation and it is clear that the range in the present XD3 is too wide giving increases in requirements where UK experience does not justify such an increase. For instance bridge deck soffits may be placed in a lower sub-class compared to more vulnerable structural elements).

Exposure Classes

There has also been some discussion on the appropriate exposure classes for different structural elements. Table A.1 of BS8500 – 1 provides some limited guidance, but requires amplification – some examples are given below in relation to certain highway structure elements. However, designers should identify all exposure classes pertaining to the particular concrete element, and then compare limiting values for concrete composition and properties relevant to all the identified exposure classes (refer NG 1703.5).

Element	Exposure class
Unreinforced concrete not exposed to aggressive chemicals or freezing whilst wet	X0
Concrete deck surfaces protected by effective waterproofing membrane (in particularly vulnerable or aggressive conditions XD2 could be considered)	XD1
Concrete surfaces where protected by participating permanent formwork	XD1
All concrete within 10 metres of a carriageway directly exposed to de-icing salts or spray (including bridge soffits where there is a carriageway below)	XD3

Note 1:- Other exposure classes may also apply to these concrete elements, and govern concrete properties selected.

Note 2:- The exposure class applies whatever the form of concrete used – reinforced, prestressed, post-tensioned, insitu, precast, or reinforced concrete permanent formwork.

Structures such as subways, culverts and those with large exposed horizontal surfaces will require some judgement, on the particular exposure classes to be adopted. Retaining walls will clearly have different exposure classes on each face. Other locations require designer assessment, based on the principles in BS8500-1.

In all situations, the applicable exposure classes for particular structural elements should be recorded in Technical Approval AIP documentation in accordance with

BD2. These are matters to be agreed with the Technical Approval Authority and will not require departure from standard submissions, unless the guidance provided in this Interim Advice Note and BS8500 are not to be followed. In the latter case thoroughly justified departures will be required.

Interaction with BS5400

Designers should exercise some care and discretion in applying design standards, in respect of concrete properties, cover and cracking. With the advent of BS8500, May 2004 SHW/NG and this IAN, these documents take precedence over BS5400 requirements for concrete materials issues and cover, and Table 13 of BS5400 for cover and concrete grades is effectively redundant. However, Table 1 of BS5400 dealing with crack widths is still relevant, though it is apparent that there are some anomalies in the descriptions of exposure conditions between BS5400 and BS8500. It is also evident that there may be some inconsistency with developing Eurocodes – this is being considered separately.

For the purposes of calculating crack widths, as part of the design process, in accordance with Table 1 of BS5400, the nominal cover (including any additions for long service life) derived from BS8500-1 should be utilised, however it is recommended that the fixing tolerance ΔC is deducted from the nominal cover in order to undertake reinforcement design based on the limiting crack widths – this matter is under continuing review.

What happens next?

It is expected that this guidance will remain in place until the amendments to BS8500 have been finalised and published. Depending on the nature of the amendments further guidance will be issued by Highways Agency, if necessary. Further changes to the SHW and NG will be instigated as soon as possible.