WATERTIGHT CONCRETE STRUCTURES TO BS 8102

Emily Halliwell of **The Concrete Centre** and **Basement Information Centre** provides a snapshot of some of the key changes in the 2022 revision of BS 8102.

(Photo: ASF Waterproofing.)

The revision to BS 8102[1] was published in March 2022. A key driver for the revision was the grades of performance for below-ground spaces, which had been a source of debate for many. The new version removes the existing example applications and focuses on understanding the intended use of the below-ground space so that the expectations of the client and users can be met.

The revised Standard also gives further guidance on developing robust and maintainable waterproofing solutions, including greater consideration of the buildability and potential issues that can occur during follow-on works. To reflect the latest developments, new technologies, particularly Type A barrier protection systems and remedial solutions, are also now referred to in BS 8102. Additional guidance is also now available in the Standard for achieving watertight concrete structures and this is considered here in more detail.

TYPE B PROTECTION

The section in BS 8102 on Type B protection has been expanded to give further practical guidance to designers on the design of watertight concrete structures. While many of the requirements are familiar to engineers, the revision has clarified how existing guidance and Standards may be used to meet the grade of performance required.

Key considerations for watertight concrete design include:

- Limiting pour sizes and accounting for the construction sequence – BS 8102:2009[2] gave a list of factors to consider for achieving watertight concrete, including structural design, material specification and quality of workmanship. BS 8102:2022 has expanded on this list, highlighting additional factors such as pour sizes and

aspect ratios, site logistics and on-site quality assurance programmes. The construction sequence is key to controlling crack widths, particularly as many cracks form due to early-age thermal effects. For further guidance on limiting early-age cracking, BS 8102:2022 makes reference to CIRIA C766[3].

- Limiting crack widths – in BS 8102:2022, grades of protection have been mapped to Eurocode 2 tightness classes (BS EN 1992-3[4]) as shown in Table 1 opposite. BS 8102:2009 made reference to controlling crack widths as part of achieving watertight concrete but did not outline how the performance grades aligned with crack widths limits and requirements given in Eurocode 2. The revised Standard indicates that Grade 1a and 1b may be achieved through designing for the applicable tightness classes, whereas for Grades 2 and 3, additional measures such as combined protection or water-resisting admixtures are required.
- Water-resisting admixtures – where admixtures are incorporated, BS 8102 states that they 'should be deemed to have a lower degree of water/vapour transmission' if the admixture is 'assessed and certified' and the casting of the structure is 'adequately supervised'.
- Specifying cast-in penetrations – BS 8102:2022 states that 'service entries are particularly vulnerable to water penetration' and it is important to consider the location and spacing to minimise the risk of leakage. It also recommends that services should be cast in – this requires early co-ordination with the services designer to ensure locations are agreed before the construction of the concrete.

Grade[A]	Performance definition	Requirements for Type B protection
1a	Seepage[B] and damp areas[C] from internal and external sources are tolerable, where this does not impact on the proposed use of the below-ground structure. Internal drainage might be necessary to deal with seepage.	Tightness class 0 (to BS EN 1992-3:2006) – the provisions in 7.3.1 of EN 1992-1-1[5] may be adopted.
1b	No seepage[B]. Damp areas[C] from internal and external sources are tolerable.	Tightness class 1 (to BS EN 1992-3:2006) – any cracks that can be expected to pass through the full thickness of the section should be limited to w_{k1}.
2	No seepage[B] is acceptable. Damp areas[C] as a result of internal air moisture/condensation are tolerable; measures might be required to manage water vapour/condensation[D].	Additional measures (such as a combined protection, water-resisting admixture, pre- or post-tensioning) should be used.
3	No water ingress or damp areas[C] is acceptable. Ventilation, dehumidification or air conditioning necessary; appropriate to the intended use[D].	Additional measures (such as a combined protection, water-resisting admixture, pre- or post-tensioning) should be used.

[A] The agreed grade should meet with the client's expectations for the intended use of the below-ground space. Reducing the grade could increase the risk of not meeting the expectations of the client for the intended use of the below-ground space.

[B] Seepage (sometimes referred to as weeping) is defined in BS 8102:2022.

[C] Damp area is defined in BS 8102:2022.

[D] The scope of BS 8102:2022 is limited to detailing the process and best practices that can be followed when creating a waterproof or water-resistant structure below ground; the additional considerations that are required to achieve the required environment are beyond the scope of BS 8102:2022.

ABOVE:
Table 1 – requirements of Type B systems for different performance grades (adapted from Table 2 of BS 8102:2022).

FURTHER PRACTICAL GUIDANCE

BS 8102:2022 has built on the previous version of the Standard to provide designers with further practical guidance for protecting below-ground structures from water. The update reflects the latest developments in the industry, including new technologies and approaches, as well as addressing the issues of buildability and maintainability, which are vital for achieving robust and effective solutions. For concrete structures, the revision provides clearer guidance to designers on how watertight solutions may be achieved.

The Basement Information Centre (TBIC) provides guidance on the design and construction of basements to encourage best practice. TBIC will be publishing a summary document outlining the key changes in the revised BS 8102. This will be followed by updates to TBIC publications 'Basements: Waterproofing', 'Basements: Ground gases and structural waterproofing' and The Concrete Centre publication 'Concrete Basements'. Visit: *www.basements.org.uk*.

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References:

1. BRITISH STANDARDS INSTITUTION, BS 8102. *Protection of below-ground structures against water ingress. Code of practice*. BSI, London, 2022.
2. BRITISH STANDARDS INSTITUTION, BS 8102. *Code of practice for protection of below-ground structures against water from the ground*. BSI, London, 2009, withdrawn.
3. BAMFORTH, P. *Control of cracking caused by restrained deformation in concrete*. C766, CIRIA, London, 2018
4. BRITISH STANDARDS INSTITUTION, BS EN 1992-3. *Eurocode 2. Design of concrete structures – Liquid retaining and containing structures*. BSI, London, 2006.
5. BRITISH STANDARDS INSTITUTION, BS EN 1992-1-1. *Eurocode 2 – Design of concrete structures. General rules and rules for buildings*. BSI, London, 2004+A1:2014.