

BS 8102:2022

An overview of changes to basement waterproofing guidance

Introduction

The revision to BS 8102:2009 (Code of practice for protection of below ground structures against water from the ground⁽¹⁾) was published in March 2022. A key driver for the revision was the grades of performance for below ground spaces and these have been updated to focus on designing for the intended use of the space. The revision gives further guidance on achieving robust and maintainable waterproofing solutions with more focus on the construction stage. Additionally, the latest technologies and approaches are included to bring the standard in line with current best practice. This summary document is intended to assist those using the updated standard by highlighting key changes on a section by section basis.

1. Scope

As part of the revision, the scope of BS 8102 has been expanded and clarified. Reference is now made to other factors associated with the design of below ground structures, such as ground gases and flooding. It also recognises that in some cases, for example civil engineering or energy sector works, the guidance regarding acceptable levels of water ingress can be very different from those given in the standard.

2. Normative references

Previous references to material specification standards for damp-proof courses and bitumen or mastic asphalt products have been removed in favour of more detailed commentary under the relevant later sections. Standards concerning the execution of concrete structures, pertinent to Section 9 'Type B (structurally integral) protection' have been introduced.

3. Terms and definitions

Several existing terms have been the cause of debate within industry and this revision has sought to provide clarity on their use within the standard. In recognition of the revised scope, new definitions have been included, for example for buried decks and ground gas barriers. Further new definitions are included such as 'fully bonded' and 'water resisting admixture', to reflect their common use. 'Ground barrier' and 'vapour check' have both been removed in favour of more detailed technical definitions now being included either in this section or elsewhere in the standard.

4. Design philosophy

This section outlines the design process and key considerations for developing the waterproofing strategy. The revision gives further detail on the role and requirements for the waterproofing specialist. It states that the waterproofing specialist should be appointed at the early stages of a project, ideally before the technical design stage, and should be consulted on any amendments which may impact the overall waterproofing design.



Bank Station Capacity Upgrade, London. Image courtesy of Sika.

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 below ground structure. Internal drainage might be necessary to deal with seepage.	Tightness class 0 (to BS EN 1992-3:2006 ⁽⁴⁾) – 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 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.

Table 1: Grades of waterproofing protection with requirements for Type B systems - adapted from Table 2 of BS 8102:2022⁽²⁾

The design service life and ongoing maintenance are now included as principal considerations for developing a robust design. Additionally, the section on defects is expanded to consider defects in the design and defects caused by follow-on trades and site operations. These changes are reflected in the 'Design flowchart' (Figure 1 in BS 8102:2022⁽²⁾), which now includes the installation, commissioning, and ongoing maintenance.

5. Site evaluation

The section describes the assessment of risk to provide justification for the proposed waterproofing design. The approach includes a desk study and a risk assessment considering potential effects of climate change along with water table classification, inclusion of ground gas contamination and external risks. The revision expands on the guidance for inspection and survey of existing structures, highlighting what should be captured in the survey and the approach to be taken for buildings with historic significance or protected by legislation.

6. Water resisting design

Section 6 of BS 8102:2022 introduces the grades and types of waterproofing and gives guidance on appropriate protection for achieving performance requirements. Updating the grades of performance for below ground spaces was a key driver for the revision. Additionally sandwich waterproofing systems have seen a lot of failure and needed to be revisited.

Clause 6.1 on groundwater now includes:

- measures to resist water against any part of the structure from below DPC level.
- reference to BS EN 752 considering surcharge flooding from sewers.
- requirement for the waterproofing specialist to agree the head of water to design for together with the design team (based on section 5 risk assessment).

Waterproofing protection

Clause 6.2.1 includes additional considerations for the choice of systems or combinations, including buildability, durability and minimising whole life embodied carbon. A new clause on waterproofing design for existing structures (6.2.2) has been added.

Clause 6.2.3 on combined protection has been expanded to include internal and external Type A systems (A+A) and Type A+B+C systems. The use of combined systems where the elements have different performance characteristics is discussed as a method to overcome defects that can align.

Some changes have been made to the schematic illustrations in Figure 2. For Type A (barrier) systems, there is no longer a sandwiched waterproofing arrangement – the barrier is either internal or external. For Type B (structurally integral) systems, the reinforced concrete structure is referred to as watertight, not water resistant.

In Table 2 of BS 8102:2022⁽²⁾, the grades of protection have been amended, with the acceptability of seepage and damp now outlined for each grade. Differentiation is also made between damp from external and internal sources. The examples for grades of performance have been removed as they are always dependant on intended use and caused some confusion. Table 1 above gives the grades in BS 8102:2022 with the addition of the corresponding requirements for Type B systems. The revised standard is more centred on managing the clients' expectations for their intended use and states that this should be agreed at the earliest stage.

Clause 6.2.5 on continuity of protection now includes requirement for continuity from DPC level, as in the 1990 version of the standard.

Clause 6.4 on external sub-surface drainage includes newer technologies and highlights maintainability issues. A new section (clause 6.5) has been added to give guidance for buried decks below ground level. Clause 6.6 on ground gases has been updated with newer references to relevant codes of practice and guidance documents, including The Basement Information Centre guide on 'Basements: Ground Gases and Structural Waterproofing'⁽³⁾.

7. General construction issues

This section covers construction issues including dewatering and protection of waterproofing systems. Clause 7.1 on site dewatering has been expanded to include the requirement for a 'Water Management Plan' and to give further guidance on mitigating damage in the event of escape of water or flooding. Additional clauses on continuity in construction and protecting waterproofing are added to avoid damage during follow-on works and ensure installations are robust.

8. Type A (barrier) protection

This section covers a wide range of waterproofing barrier protection options. The barrier material categories have been updated to reflect the latest technologies and standards. Further information has been added on movement, penetrations, and continuity, to reflect their importance in achieving robust systems.

Clause 8.1.3 has been amended to clarify that barriers 'should' be continuous, although it is noted that barrier discontinuity can occur when the barrier is enhancing other systems.

A new clause covering 'structural penetration and loading through waterproofing barriers' (8.1.4) has been added to expand upon the existing guidance. The aims are to ensure designers consider detailing as vital to providing full continuity of waterproofing and to ensure that where external membranes are selected, the system can still perform should the system become unsupported due to settlement. The clause also gives clearer examples for when the designer must consider engineering requirements e.g. presence of props, waling beams, anchors, piles.

Movement joints are now covered by a new clause (8.1.5). This highlights the need not only for the designer to understand anticipated movements but also for the manufacturer/supplier to ensure the proposed product is fit for purpose for both movement and environmental conditions. The clause also underlines the need to view the entire waterstop network in three-dimensions and not just through a section.

The single pile to floor slab junction detail has been replaced by three details showing typical transitions through walls, across pile caps and pile heads.

Table 3 has been updated to include reference to additional relevant standards and to indicate types of bond available for each barrier type – further information on the changes to each barrier type are included in Table 2 on page 4 of this document.

9. Type B (structurally integral) protection

This section covers the specification of materials used in Type B protection, in particular concrete and steel. It also covers embedded retaining walls in both concrete and steel.

The aim of the revision was to improve the specification of watertight concrete construction. Measures for achieving this include:

- Limiting the risk of penetrations by specifying cast-in penetrations – requiring more coordination with the services design before the construction of the concrete.
- Expanded list of factors to be considered to achieve watertight construction in concrete, including pour sizes and sequence.

- Mapping of grades of protection to Eurocode 2 tightness classes (BS EN 1992-3:2006) – this informs the design of crack width limits for Grades 1a and 1b and requires additional measures, beyond crack control, to achieve Grades 2 and 3 below ground spaces. See Table 1 in this summary document.
- Water resisting admixtures.
- Requirement for waterstops to be designed as a continuous system.

10. Type C (drained) protection

This section covers drained protection, where water penetrating the structure is collected and discharged at an appropriate point. The waterproofing specialist, who is responsible for design, must ensure that the design complies with all applicable requirements and uses of the structure. Clause 10.1 now clarifies that any external element can control water ingress, not just the outer leaf.

The revision covers multi-level systems, with amendments focussed on the continuity of systems, as Type C systems are commonly used in deeper basements. Figure 8 has been added to show a standard detail for draining through intermediate floors. Clause 10.2.2 also directs designers to consider fire regulations and compartmentalisation in multi-level basements.

Further specific details on pump systems and discharge of these are included in the revision.

The section on maintenance and repair has been expanded, along with due considerations for commissioning and future servicing requirements.

Type C systems are used for waterproofing where ground gases and contaminants are present – the use of these is discussed in relevant guidance documents (including The Basement Information Centre guide on 'Basements: Ground Gases and Structural Waterproofing'⁽³⁾), so reference to these has been added to the standard.

Type C has been used extensively for vaults but also for flat soffits and this was not covered in the standard. Clause 10.2.5 on inverted cavity drain systems is now included for flat soffits (laid to falls) as well as vaulted soffits and outlines the higher risk associated with this application, especially at penetrations for services or fixings.

11. Remedial measures

This section covers general causes of seepage and consideration of solutions. It describes methods of repair externally, using resins and cementitious materials or bentonites, and methods of crack sealing repair internally, using resins and cementitious materials. It also covers replacement of locally defective material.

This section has been updated to include guidance on remediation of each of the protection systems (Type A, B or C), rather than using one of the systems to remediate a leaking structure. Clause 11.1 includes mention of high-risk construction techniques such as modular or ICF and also directs the reader back to considerations of reparability at design stage in section 4.

Clauses 11.2 and 11.3 includes the following additional remedial methods:

- external grouting.
- injection of resin or grout into structure.
- repairing with cementitious or polymeric systems.

Historic or traditionally built masonry structures are covered in clause 11.5. This includes the requirement for an engineer to be involved to reduce the risk of structural damage. Clause 11.5.2 directs the reader back to section 5 for guidance on detailed surveys prior to remediation work.

Type of barrier	Key updates and additions
Pre-applied and post-applied sheet membranes	Differentiation added between Pre-Applied and Post-Applied membranes. Descriptions added of bonded and unbonded membranes. New additions inform designers of the multiple technologies now available and provide guidance on differing performance levels, highlighting that sheets have varying technologies to achieve bond to prevent water tracking. Further guidance on suitable substrates.
Liquid applied membranes	New Note highlights wide variety of technologies available and the need to check with manufacturers / suppliers on required substrate preparation, suitability of primers and weather windows. Addition of Note 2 highlights that protection is required and provides example forms of protection i.e. bitumen board, composite drainage or extruded insulation. New text advises products come in two forms i.e. weldable and non-weldable.
Active core liners (renamed from Geosynthetic Clay Liners)	Additional information on different forms of technology now available. Easier to understand applications i.e. pre and post-applied, this is in line with other technology descriptions throughout the document. Guidance on options for overlaps. Highlights that substrate preparation does need to be taken into account.
Mastic asphalt membranes	Previous section only referred to bentonite as technology. Now updated to include information that these technologies can be bentonite, polymer or a combination of both.
Cementitious crystallization coatings	Further guidance provided on the application process. Text added to advise that a powdery residue may be left on surfaces.
Cementitious multi-coat renders, toppings and coatings	Further guidance provided on delaying application to allow for settlement and drying shrinkage and for construction activities involving vibration to be completed. Highlights importance of assessing substrate and following manufacturer's guidance.

Table 2: Key updates for each barrier type

Summary

The publication of BS 8102:2022 provides designers with updated guidance on delivering robust, maintainable waterproofing solutions which meet their client's requirements. It incorporates new technologies, highlights the importance of low carbon solutions and gives further practical guidance on buildability and robustness.

Further guidance on using BS 8102:2022 will be published by The Basement Information Centre. This will include updates to the following publications: *Basements: Waterproofing*, *Basements: Ground gases and structural waterproofing* and The Concrete Centre publication *Concrete Basements*.

References:

1. BRITISH STANDARDS INSTITUTION. BS 8102:2009 Code of practice for protection of below ground structures against water from the ground. BSI, 2009.
2. BRITISH STANDARDS INSTITUTION. BS 8102:2022 Protection of below ground structures against water ingress — Code of practice.
3. THE BASEMENT INFORMATION CENTRE. Basements: Ground gases and structural waterproofing. TBIC, 2021.
4. BRITISH STANDARDS INSTITUTION, BS EN 1992-3. Eurocode 2. Design of concrete structures – Liquid retaining and containing structures. BSI, 2006.
5. BRITISH STANDARDS INSTITUTION, BS EN 1992-1- 1. Eurocode 2 – Design of concrete structures. General rules and rules for buildings. BSI, 2004+A1:2014.

The Basement Information Centre aims to encourage and enable the design and construction of quality basements on new developments and the improvement of existing and retro-fit basements.

The following Basement Information Centre members were represented on the committee responsible for revising BS 8102:

Delta Membrane Systems, The Concrete Centre, Property Care Association, NHBC, Newton Waterproofing, Sika, GCP Applied Technologies.

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