

Rapidly Settling Solids

Settling rates

Total suspended solids (TSS) is the term given to describe the total concentration of suspended particulate matter in a column of water.

Suspended solids are typically subdivided into two main groups known as rapidly settling solids (settleable solids) and slow settling solids. Rapidly settling solid is the term given to particulate matter which has a settling velocity of at least 3 m/hr and slow settling solid is the term given to particulate matter which has a settling velocity of less than 0.25 m/hr.

Understanding the distinction between slow settling solids and rapidly settling solids is critical when determining the best practical water treatment solution for your site. Rapidly settling solids will settle by gravity separation alone, in which case a Siltbuster lamella clarifier is the most efficient treatment option.



Gravel



Sand



Silt



Clay

Near Surface Geology

The near surface geology at the site is critical, as the geological composition of the surface soils will have a bearing on the settling characteristics of the infeed waters to be treated.

The table below provides a breakdown of geological classification and the associated settling velocities.

Sediment	Particle Size	Settling Rate
Gravel	>2 mm	>1000 m/hr
Sand	63-2000 µm	200 m/hr
Silt	2-63 µm	11 m/hr
Clay	<2 µm	0.013 m/hr

As you can see, gravels, sands and silts are all classified as rapidly settling, whereas clays are slow settling. Waters containing clay particles will therefore require additional treatment prior to the lamella clarifier stage.

Slow Settling Solids

Chemical Pre-treatment

Waters containing very fine particles, particularly clays, with slow settling velocities will not settle out under gravity alone even in a lamella clarifier at normal flow rates. In these cases chemical dosing is used to aggregate the slow settling particles, increasing the particle settling rate so they can be removed by gravity separation techniques.

A typical process involves the sequential adding and mixing of chemicals to the water. First a coagulant is added and mixed, followed by a flocculant.

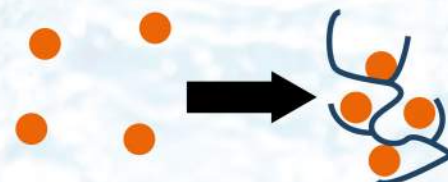
How Do Coagulants Work?

Fine particles in suspension often have negative electrical surface charges. These prevent aggregation due to repulsive forces between them, hence the particles remain in suspension. Coagulation is a chemical process that involves the neutralisation of these charges. A coagulant is typically a positively charged metal ion, the choice of which depends on the receiving water. When added, the destabilised particles are able to start coming together forming micro floc. Common metal based coagulants are ferric chloride and where permitted, poly aluminium chloride.

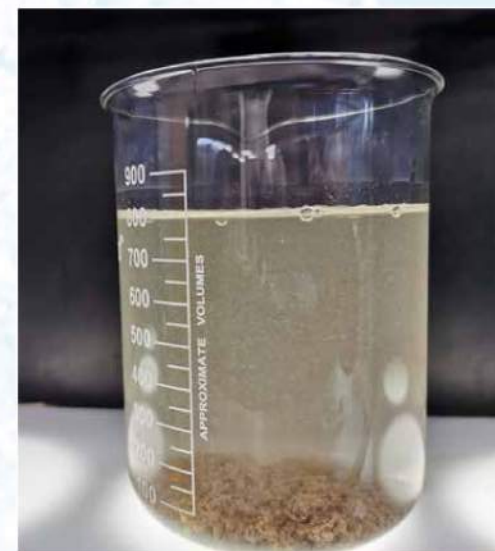


How Do Flocculants Work?

To further increase the settling rate a flocculant can be used which work through physical processes alone. In most cases a long string organic compound with charged negative sites is used which bind the micro floc together into rapidly settling aggregates known as flocs.



Settlement of clay particles from time 0-60 mins



Clay flocs rapidly formed after chemical dosing

Lamella Clarifiers

Gravity Settlement for Suspended Solids



The Unit

Siltbuster is the UK's leading provider of mobile settlement units, specifically lamella clarifiers. Each unit in the extensive range is designed to remove suspended solids and settleable matter from suspension.

Effective gravity based solid/liquid separation requires the largest possible settlement area and optimum hydraulic flow. Siltbuster lamella clarifiers utilise lamella plate technology to maintain ideal settlement conditions within each unit, thereby ensuring maximum particle settlement and minimum unit footprint.

Siltbuster mobile clarifiers are robust, skid-mounted, compact and modular making them simple to transport, install and operate.

They are ideal for sites with limited access, restricted spaces and temporary projects. Hopper bottomed units can be fitted (on request) with an automatic sludge removal system making their operation virtually maintenance-free.

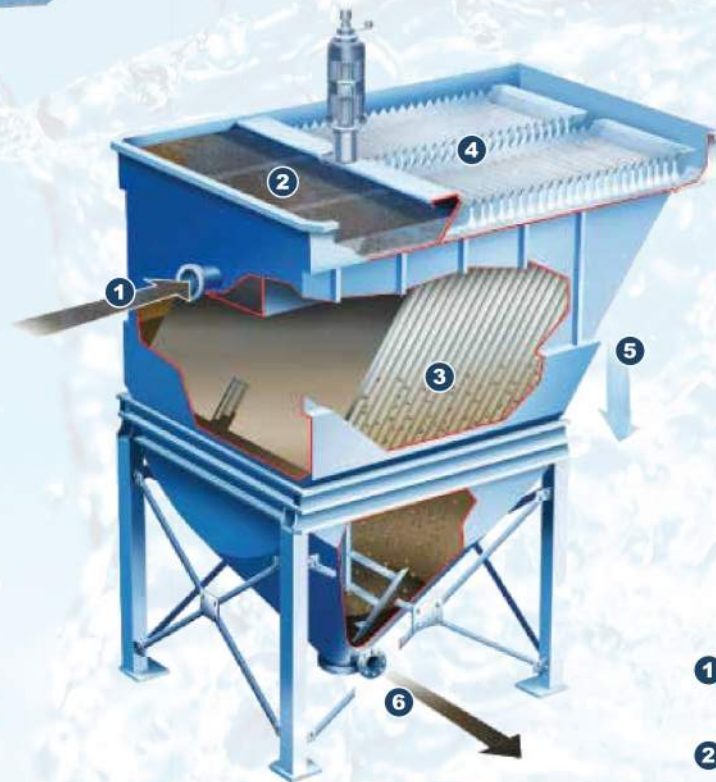
The range of lamella clarifiers can be supplied as single or multiple units in parallel. They can also be supplied as a complete, tailored, packaged treatment solution, including ancillary equipment such as lids, covers, walkways, flow meters, chemical dosing, sludge pumps, sludge storage etc.

How it Works

The diagram on the right shows the inlet flow through a feed channel to the base of the plates. The flow is then distributed with each flow diagonally upwards in parallel to the lamella plates. The particles settle on the plates and are retained in the sludge storage area of the unit with treated water discharging by gravity. Care should be taken to ensure the treated water doesn't scour the ground at the point of exit. The sludge hopper can be emptied via drain ports & valves by a range of methods, e.g. vacuum tanker or by manual or mechanical means.

Did you know...

Siltbuster's Lamella Clarifiers are up to 20 times more efficient than conventional settlement tanks and lagoons resulting in less space required on site!



KEY ADVANTAGES

- + Readily transportable, fast and simple to deploy, easy to operate
- + More efficient than conventional settlement tanks
- + Easy to clean lamella plates, no blockages, no backwashing required

TYPICAL APPLICATIONS

- + Surface water runoff
- + Groundwater treatment
- + Excavation dewatering
- + Drilling and mining



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Range of Siltbuster Lamella Clarifiers



FB50

Flat-bottomed, skid-mounted lamella clarifier. A favourite in the construction industry. Typical applications include general construction site, ground water, open excavations, trenching.

Operating Range:	1-50 m ³ /hr
Height:	1.90 m
Length:	4.03 m
Width:	1.45 m
Dry Weight:	2.5 tonne
Inlet Size:	4" F Bauer
Outlet Size:	6" F Bauer



HB10

Very transportable settlement unit, providing effective settlement area of 10m². Typical applications include pilot plants, batch processes, space restricted sites and borehole analysis.

Operating Range:	1-10 m ³ /hr
Height:	2.14 m
Length:	2.01 m
Width:	0.98 m
Dry Weight:	0.6 tonne
Inlet Size:	2" F Bauer
Outlet Size:	3" M Bauer



HB20

The Siltbuster HB20 Settlement Unit provides an effective settlement area of 20m², and is a transportable settlement trap providing effective separation of suspended particulates from water.

Operating Range:	1-20 m ³ /hr
Height:	2.49 m
Length:	2.38 m
Width:	1.48 m
Dry Weight:	1 tonne
Inlet Size:	4" F Bauer
Outlet Size:	4" M Bauer



HB40

The Siltbuster HB40 Settlement Unit provides an effective settlement area of 40m². It has a single hopper and fits in an ISO container.

Operating Range:	1-40 m ³ /hr
Height:	2.61 m
Length:	3.10 m
Width:	2.14 m
Dry Weight:	2.2 tonne
Inlet Size:	4" F Bauer
Outlet Size:	6" F Bauer



HB50

The Siltbuster HB50 Settlement Unit provides an effective settlement area of 50 m². Typical applications include cofferdams, ground water, trenching, open excavations.

Operating Range:	1-50 m ³ /hr
Height:	3.10 m
Length:	3.85 m
Width:	1.70 m
Dry Weight:	2.4 tonne
Inlet Size:	4" F Bauer
Outlet Size:	6" F Bauer



HB50E

Designed for the export market, the HB50E provides an effective settlement area of 50 m² within a shorter frame size.

Operating Range:	1-50 m ³ /hr
Height:	2.61 m
Length:	3.26 m
Width:	2.03 m
Dry Weight:	2.7 tonne
Inlet Size:	4" F Bauer
Outlet Size:	6" M Bauer



HB50M

The Siltbuster HB50M Settlement Unit provides an effective settlement area of 50m², and has an increased sludge hopper volume and slope to give improved sludge thickening and storage volume.

Operating Range:	1-50 m ³ /hr
Height:	3.15 m
Length:	3.69 m
Width:	2.46 m
Dry Weight:	3.5 tonne
Inlet Size:	4" F Bauer
Outlet Size:	6" M Bauer



Flow Proportional Chemical Dosing

Flow Proportional Dosing

By controlling the dosing of chemicals in proportion to the flow rate of the water, Siltbuster systems ensure that excess reagents are not added, saving money and ensuring better quality water as an output. Over-dosing of chemicals can affect the pH of the water causing problems to the environment and making the resulting treated water out of consent.

The administered reagents will be bound to the suspended solids and will be retained in the clarifier.

Process Using a Mix Tank

The incoming water passes through a magnetic flow meter in to a Mix Tank. The magnetic flowmeter records the total volume of water treated and allows the flow proportional dosing of water treatment chemicals based on manually entered control parameters.

The reaction tank is split into either two or three compartments via internal baffle walls. Each compartment is fitted with a top mounted variable speed mixer designed to mix the dosing chemicals.

Following chemical pre-treatment, the once fine particulates have now become larger, more rapidly settling particles. The treated solids can then be removed with a Siltbuster Lamella Clarifier.



1 The incoming flowrate is measured in real time through the use of a digital magnetic flowmeter and relays the information to on-board chemical dosing equipment.



2 Proportional to the incoming flowrate, dosing pumps ensure the correct amount of chemicals are automatically introduced. Removing the risks associated with under/over manual dosing.



3 The chemicals are injected into a Mix Tank which provides contact time and mixing energy required to fully disperse and intermix the coagulant and flocculant.



4 The chemically conditioned material then passes through an inclined lamella where the solids causing the waters to become dirty and discoloured are captured.

Chemical Dosing Systems

Mix Tanks

Siltbuster's range of Mix Tanks vary from 1 m³ to 30 m³. The larger unit is based on an ISO 20 container for ease of transport.

Optional integral variable speed mixers (1 per stage) ensure the rapid and controlled mixing of any treatment chemicals with the waste water as well as ensuring any suspended particles remain in solution.

Typical applications for these mixing tanks are:

- Final water quality monitoring
- Reaction tanks
- pH correction
- Aeration (metals removal)
- Sludge storage
- Buffer tanks

Mixing tanks can be supplied as a standalone unit or as part of a complete water treatment package.

The mix tank also facilitates the introduction of gases such as air or carbon dioxide via spargers, for applications where pH adjustment is required or where aeration is needed to optimise metal removal.

Did you know...

The variable speed of the mixer driver allows the fine tuning of the mixing energy. This gives the best control over floc formation.

MT8

The Siltbuster MT8 is an 8 m³ mix tank for small and medium size projects.



MT30

The Siltbuster MT30 is a 30 m³ mix tank based on an ISO 20 container and is ideal for large scale water treatment systems.



Pipe Flocculators

Siltbuster Pipe Flocculators provide a secure and consistent method of effectively mixing treatment chemicals with waste water. The use of in-line static mixers eliminates the need for powered mixers minimising power requirements.

As standard our Pipe Flocculators come complete with 4 dosing ports allowing the multi-stage dosing (sequential addition) of a range of treatment chemicals

The range of Pipe Flocculators available can handle flow rates of up to 150 cubic metres an hour depending on which unit is chosen.

- No power requirements
- No moving parts
- Rapid and uniform mixing
- No reverse mixing



Stands

By elevating the mixing tank on a stable and secure steel stand the subsequent treatment stage(s) can be gravity fed. This means a pump is not needed for this transfer, saving cost and energy.



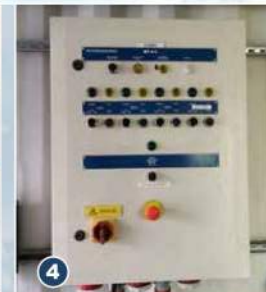
Chemical Dosing Skid

The Siltbuster free standing chemical dosing skid comprises a splash proof enclosure (housing) for the storage of dosing pumps and ancillary equipment. It is used for controlled chemical dosing.



Containerised Chemical Dosing

Secure, self contained dosing and inline mixing



Overview

The Siltbuster Containerised Chemical Dosing system provides a secure means of locating a dosing system and treatment chemicals within a 20 ft ISO container.

The Containerised Settlement Treatment system comes complete with all necessary equipment to allow the flow proportional/pH proportional dosing of the treatment chemicals and their mixing with the water to be treated.

The container can be configured with a range of options including:

- Bunded chemical storage
- Flow-proportional dosing systems
- Reaction/aging tanks and pipefloculators
- Control panels and data logging
- Insulation, lighting and heating
- Automatic monitoring of feed and discharge water (Clarity)

How Containerised Chemical Dosing works

- Water containing slow settling solids, is pumped into the Siltbuster water treatment system.
- The flowrate is monitored and a signal is relayed to the chemical dosing pump.
- The chemical dose is automatically adjusted to ensure it can react to changes to the water flowrate.
- Following chemical treatment, the water then passes through a Siltbuster lamella clarifier, capturing solids allowing the treated water to be safely discharged.
- Should the pH level of the water be either acidic or alkaline, the system has the ability to include an optional neutralisation stage.



KEY ADVANTAGES

- + Secure (vandal-resistant) and safe housing of chemicals
- + Double bunded chemical storage provides enhanced environmental protection
- + All-weather housing, with integral heating for frost protection

TYPICAL APPLICATIONS

- + Water with presence of slow settling solids
- + Long duration construction schemes
- + Discharge to surface watercourse

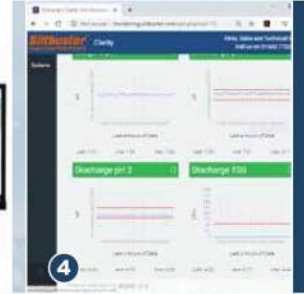


- | | |
|-------------------------------------|------------------------------------|
| 1 BUNDED CHEMICAL STORAGE | 4 CONTROL PANELS |
| 2 FLOW-PROPORTIONAL DOSING | 5 LIGHTING AND HEATING |
| 3 REACTION TANK OR PIPE FLOCCULATOR | 6 MONITORING OF FEED AND DISCHARGE |



Clarity

Real-time Online Monitoring and Reporting



Overview

The regulators often request the recording of data as proof of conformance to the discharge criteria.

To remove ambiguity and enable commercial resilience, real-time water quality monitoring supports best practice and delivers a robust data set.

Moving away from traditional, qualitative spot checks, Clarity by Siltbuster now provides continuous quantitative measurements forming a crucial audit trail.

Product Detail

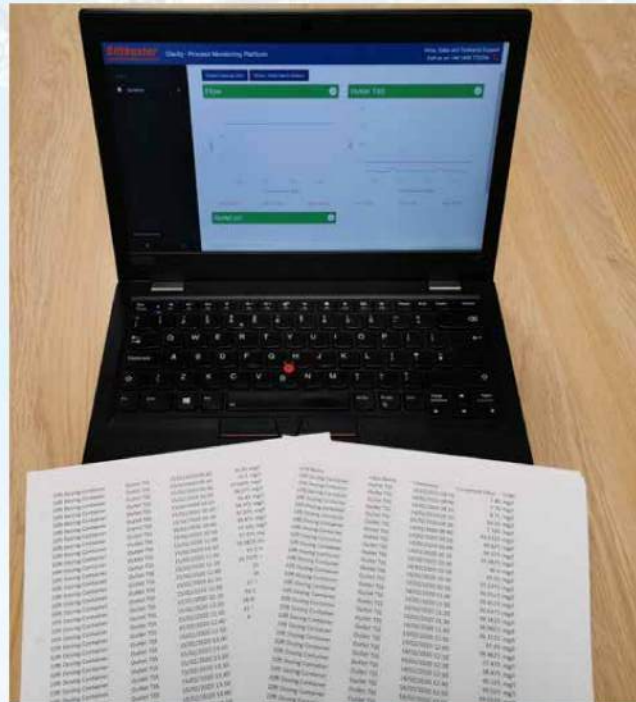
Any number of key parameters can be logged and monitored (for both inlet and/or outlet waters), be that Total Suspended Solids, pH, Flow rate, Dissolved Oxygen, Conductivity, Temperature to name a few.

Accessible via both a web and mobile app interface, Clarity enables Environmental Advisors to maintain a high level overview of multiple sites compliance (via a red, amber, green flagging system) whilst still having access to exact performance data where required.

Historical records can be extracted via the search functionality and the data can be exported as a .csv file, providing robust evidence of permit compliance.

Clarity offers alarm notifications by text message (SMS) or email, should water reach pre-defined limits. Depending on feed pump choice, the system can even shut down the pump automatically to prevent a breach.

Site managers and operatives can continue with their daily tasks without the need for constant supervision.



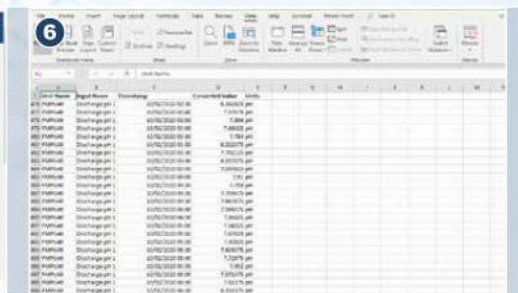
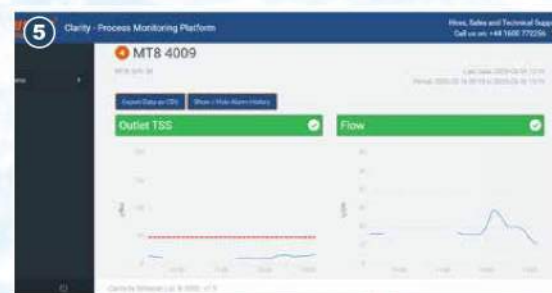
KEY ADVANTAGES

- + Data logging for proof of compliance
- + SMS and email process alarms
- + Available for hires and sales and can be retro-fitted

TYPICAL PARAMETERS

- + Total Suspended Solids (TSS)
- + Acidity (pH)
- + Dissolved oxygen
- + Flow rate, conductivity and more....

- 1 CONFIGURE PROBES
- 2 DOWNLOAD APP FROM GOOGLE PLAY
- 3 WEB INTERFACE
- 4 SET ALARMS AND NOTIFICATIONS
- 5 TRAFFIC LIGHT COLOUR CODING
- 6 DATA LOGGING



Gravity Settlement Case Studies

Road improvement project, Heathrow Airport Galldris Construction / Balfour Beatty

A main southern perimeter road running adjacent to London's busy Heathrow Airport required repairs and upgrading. Various excavations were needed to be carried out in roads and within the central reservations. As work was taking place close to a canal, the high water table quickly resulted in filling with solids in the water.

As water was entering at multiple locations, a number of pumps were required to frequently dewater the area. Initially, 1 FB50 settlement unit was deployed to address a single section. As the unit provided significant results, 3 more were installed to ensure the waters being discharged were of a suitable quality.

In addition, Siltbuster have been tasked in a number of both Airside and Landside projects at Heathrow Airport, including the construction of Terminal 5.



Decommission of Battersea Power Station Skanska, Carillion & Blu-3



A large area of hard standing was being used as a holding area for stockpiles of potentially contaminated soil excavated from the Battersea Power Station site. The volume of water runoff from the stockpiles was significant during periods of heavy rain causing local flooding of site roads and potentially silting up surface and foul drainage.

Siltbuster provided a HB50 settlement unit to provide up to 50m³/hr of treatment capacity preventing site flooding and discharging only treated water to foul sewer under Consent to Discharge regulated by Thames Water.

Groundwater in London Skanska

Excavation work in the city centre began to fill with ground and surface water. As work needed to continue in poor weather conditions, Siltbuster were tasked to quickly dewater the area into the mains sewer, whilst remaining compliant with the site's discharge consent.

The restricted space required a compact solution. Siltbuster provided its HB20 unit to meet the needs of the project and successfully carry out the work.

In addition, the Siltbuster HB20 was fitted with an impeller flowmeter enabling the site to record the volume of water discharged, as required in their discharge permit.



Chemical Dosing Case Studies

Dam grouting project, Exmoor National Park Bachy Soletanche

Siltbuster supplied two water treatment plants to help prevent any environmental impact as a result of a major dam maintenance project in Exmoor National Park, Somerset.

At the base of the dam a 150 m³/hr treatment system captured leaking water from under the dam and removed sand particles from suspension, resulting in neutralization of the alkaline pH.

A second, larger 500 m³/hr Siltbuster treatment plant was located further downstream to treat the groundwater from a series of natural springs in the valley below.

Siltbuster installed both plants and they were operational in just 12 weeks, where they remained for the duration of the project.



A465 Heads of the Valleys, South Wales Carillion PLC

During one of the wettest winters on record, Siltbuster were required to install their systems to treat a large volume of surface water as a result of multiple excavations on one of Wales' largest construction sites.

Due to the size of the construction site, a number mobile Siltbuster systems were required to treat the water generated to ensure the working area remained dry.

In addition, flocc blocks were introduced with the Siltbuster settlement units where glacial deposition had left behind pockets of clay.



Metro Cityring, Copenhagen Holscher Wasserbau

In Copenhagen's city centre, work on the expansion of the metro system are underway, spanning 15 km in length with 17 upgraded stations when complete which will improve commuting times. The natural high water table and predominantly limestone geology, has caused a number of issues during construction.

Siltbuster were tasked with treating slow settling groundwater laden with very slow settling Calcium Carbonate. A number of Siltbuster chemical dosing systems with digital dosing systems, were quickly transported and installed on site to accurately treat the water with the use of coagulant's and flocculant's. The digital dosing systems were operated in conjunction with SCADA so that all data could be remotely monitored and controlled.





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APPENDIX I: BASEMENT WATERPROOFING INFORMATION

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 repairability 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*.

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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INFORMATION CENTRE**



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TYPE C, CAVITY DRAINAGE MEMBRANES

Delta MS 20

Description

Delta MS 20 is an 20mm studded Type C, Cavity Drainage Membrane that is suitable for use on internal faces, floors or where a higher drainage capacity is required.

This High-Density Polyethylene (HDPE) cavity drainage membrane has an 20mm studded brown profile creating a large 10 litre per square meter void, ideal for high levels of water management. With its higher drainage capacity and compressive strength, this waterproof and vapour proof membrane can be used as part of a Type C waterproofing solution in accordance with BS 8102:2022 for the protection of below ground structures against the potentially adverse effects of ground water ingress.

Delta MS 20 provides an effective barrier to the transmission of salts and other contaminants.

Delta MS 20 is also suitable for tunnels, civil construction and for large commercial projects.

Please follow manufacturer's instructions for installation.

Features

- 20mm studded profile suitable for higher volumes of water penetration
- Compressive Strength: >150 kN/m²
- Drainage capacity: 10 L/s m²
- BBA Approved
- BS 8102:2022 Type C Waterproofing Protection
- Suitable for Waterproofing and damp proofing
- Suitable for flood resilience (PFR)
- Resistant to chemicals, root penetration, rotproof

Specification

- BS 8102:2022 Protection of below ground structures against water ingress. Code of practice.
- J40/290 High-density polyethylene/polypropylene studded cavity drain membrane
- J40/47 High-density polyethylene/polypropylene studded cavity drain membrane
- Classification Pr_25_57_51_74

Product details

DMS 009

Associated products

- Delta Cornerstrip
- Delta Sealing Rope
- Delta Perimeter Drainage Channel
- Delta Basement Drainage Systems
- Delta MS 500



Technical data

Material	High Density Polyethylene (HDPE)
Sheet Thickness	1mm
Stud Height	20mm
Roll Size	2m x 20m
Compressive Strength	150 kN/M²
Drainage Capacity	10 L/s m 600 L/min m 36 100 L/h m
Air volume between studs	14 L/m²
Temperature Resistance	-30°C to +80°C
Reaction to Fire	EN13501-1 Class E
R Value	0.18 M² K/W

'R' Value Delta MS 20

Direction of Heat Stream		TR of 20mm air gap
Horizontal		0.18 m² K/W
Upwards		0.16 m² K/W
Downwards		0.18 m² K/W

The thermal resistance values are calculated following DIN EN ISO 6946

Delta MS 500

Description

Delta MS 500 is an 8mm studded Type C, Cavity Drainage Membrane that is suitable for use on internal faces of walls, floors and vaulted ceilings as a water management system for the protection of below ground structures against the potentially adverse effects of ground water ingress.

This High-Density Polyethylene (HDPE) cavity drainage membrane has an 8mm studded clear profile creating a 2.25 litre per square meter void suitable for use as part of a Type C waterproofing solution in accordance with BS 8102:2022 for the protection of below ground structures against the potentially adverse effects of ground water ingress, in waterproofing structures below ground level (basements) and isolating damp walls above ground level. The stud depth of 8mm provides a suitable air gap for use as a wall applied membrane.

Delta MS 500 provides an effective barrier to the transmission of salts and other contaminants.

Please follow manufacturer's instructions for installation.

Features

- 8mm clear studded profile
- Compressive Strength: >250 kN/m²
- Drainage capacity: 2.25 L/s m²
- BBA Approved
- BS 8102:2022 Type C Waterproofing Protection
- Suitable for Waterproofing and damp proofing
- Suitable for flood resilience (PFR)
- Resistant to chemicals, root penetration, rotproof

Specification

- BS 8102:2022 Protection of below ground structures against water ingress. Code of practice.
- J40/290 High-density polyethylene/polypropylene studded cavity drain membrane
- J40/47 High-density polyethylene/polypropylene studded cavity drain membrane
- Classification Pr_25_57_51_74

Product details

- DMS 005 2m x 20m
- DMS 007 2.4m x 20m

Associated products

- Delta Cornerstrip
- Delta Qwikseal Plugs
- Delta Plugs
- Delta Sealing Tape
- Delta MS 20



Technical data

Material	High Density Polyethylene (HDPE)
Sheet Thickness	0.5mm
Stud Height	8mm
Roll Size	2m x 20m 2.4m x 20m
Compressive Strength	>250 kN/M²
Drainage Capacity	2.25 L/s m 135 L/min m 8 100 L/h m
Air volume between studs	5 L/m²
Temperature Resistance	-30°C to +80°C
Reaction to Fire	EN13501-1 Class E
R Value	0.12 M² K/W
Chemical Properties	Resistant to chemicals, root penetration, rotproof, neutral towards drinking water

'R' Value Delta MS 500

Direction of Heat Stream		TR of 8mm air gap
Horizontal		0.12 m² K/W
Upwards		0.10 m² K/W
Downwards		0.12 m² K/W

The thermal resistance values are calculated following DIN EN ISO 6946