LABC warranty

TECHNICAL MANUAL

VERSION 11

2: BASEMENTS

2. Basements

Contents

Limitations of Functional Requirements

1. These Functional Requirements do not and will not apply to create any policy liability for any remedial works carried out by the contractor or otherwise, nor to any materials used in those remedial works.
2. The guidance provided in this section, is guidance that provides a suggested solution to meeting the Functional Requirements. If an alternative solution is selected, then this must still meet the Functional Requirements.
3. Only Basements described in the Policy document are covered by this section.
4. The reference to a basement in this Technical Manual is a structure that is constructed partly or wholly below ground. For Warranty purposes this can include: Foundations, retaining basement walls, floors and below ground roof decks (including podium and transfer decks), sub-base drainage, sumps, light wells and pavement lights at or below ground level, that are included within the defined basement within the habitable area.

Workmanship

1. All workmanship must be within the tolerance requirements set out in this Technical Manual.
2. All work is to be carried out by a technically competent person in a workmanlike manner.
3. Concreting shall not take place during cold weather periods where the working temperature is below 2°C or where ground conditions are frozen.

Materials

1. All materials should be stored, installed and protected correctly in a manner that will not cause damage or deterioration of the product.
2. All materials, products and building systems shall be appropriately tested and approved for their intended purpose.
3. All load bearing structural elements providing support to the Home will have a service life of not less than 60 years, unless specifically agreed otherwise with us. All other parts of the Home will have a lesser durability and need planned maintenance, repair or replacement during that reduced period.
4. All materials should be suitable for the relative exposure of the building in accordance with the relevant British Standards.

Design

1. The Foundations and basement retaining walls shall be designed by an Engineer to support vertical loading, resist horizontal loading and surcharges including the influence of nearby trees and topography.
2. Basements shall be appropriately designed to ensure that they adequately provide a suitable barrier against contaminants, ground gases, surface and ground water.
3. At least 8 weeks before the commencement of the basement, the Developer shall provide to us, a waterproofing design specification for protecting the below ground environment of the basement and include a ‘Site investigation’ report.
4. All basements must be designed and constructed to resist water penetration to the habitable areas of a basement and include a combined system of waterproofing protection. The only exception to not providing two forms of waterproofing protection is where defined in the supporting technical guidance and confirmed prior to commencement.
5. The waterproofing design must be provided by a suitably qualified Waterproofing Design Specialist i.e. Certificated Surveyor in Structural Waterproofing (CSSW). The Waterproofing Design Specialist must:
    a. Have an understanding of hydrogeology and soil mechanics.
    b. Be competent for the proposed scheme complexities.
    c. Provide a design philosophy which clearly sets out the desired grade of the environment to be achieved. The design philosophy should clearly set out how the specified design will provide the required environmental grade based on the specific hydrogeology and ground conditions of the site.
    d. Co-ordinate the proposals from the design team to provide a site specific design.
    e. Ensure there is a continuity of damp proofing provided between the basement and the above ground damp proof course constructions.
6. The following additional elements shall be supported by structural calculations designed by an Engineer:
    a. Structural elements outside the parameters of Building Regulations.
    b. Specialist structural works.
    c. Reinforced concrete elements.
    d. Precast structural elements.
    e. Any engineered beams/posts manufactured off-site.
7. Projects consisting of Non-standard/Modern methods of construction must be supported with evidence of valid independent third party product conformity certification before an offer of Warranty is provided. These types of constructions must be declared before commencement.
8. Type C systems and drainage systems necessary for the Waterproofing design must be maintainable.

2.
Basements

2.1
General Requirements

Introduction

All basements and below ground structures will need to be evaluated on a project specific basis for performance against the required environmental grade prior to any work commencing on site. The Developer must provide evidence to us that the water proofing design is appropriate for the risk.

Provision of information

1. The Developer is to provide, **at least 8 weeks before the commencement** of the basement, evidence to us of a **waterproofing design specification** for protecting the below ground environment of the basement and include as a minimum:
   a) A site specific waterproofing design philosophy provided by a suitably qualified Waterproofing design specialist.
   b) A site investigation report (Phase 1 & 2 Geo-Environmental Assessment Report - see the 'Ground Conditions' section of this Technical Manual) to identify the risks, for which the waterproofing design is to be based on.
   c) Specify the 'Environmental Grade' requirement for below ground structures in accordance with BS 8102.
   d) Survey drawings showing Site Levels and existing site features.
   e) Proposed general arrangement drawings identifying all the plots and location of below ground storey levels, lift pits and basements.
   f) Drainage layout plans showing maintainable drainage runs, access provisions and outfalls (this includes all drainage relating to the structural waterproofing proposals).

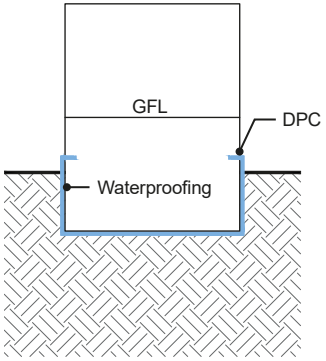
2. Additional supporting information will be required **prior to the work commencing** on site and must include, but not limited to:
   a) Waterproofing materials – Systems and material specification for the Design Strategy including sump(s) and pump(s) specification.
   b) Site specific detailing for waterproofing of all construction jointing and service penetrations.
   c) Below ground drainage provisions e.g. below slab - internal drainage systems, surface and foul water, storm water attenuation tanks, etc.
   d) Drainage provisions to hardstanding features e.g. light wells and flush pavement lights.
   e) Landscaping - Intensive roof, podium deck and transfer decks – drainage and waterproofing provisions (see also the 'Roofs' section of this Technical Manual).
   f) Construction and structural waterproofing methodology e.g. Engineers foundation design, walls, floor(s) and roof slab design, temporary and permanent works.
   g) Evidence of a competent approved installer for the structural waterproofing works.

3. **On completion of the works** the following documentation will need to be provided.
   a) Sump pump(s) commissioning certificate.
   b) Operations and Maintenance manual for maintainable systems installed including land drains.

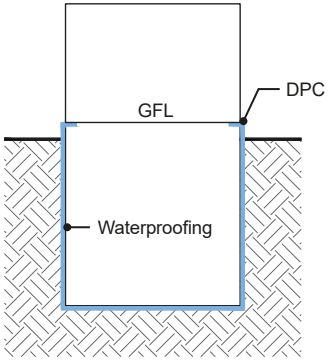
The Warranty Surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

Examples of structures wholly or partially below ground

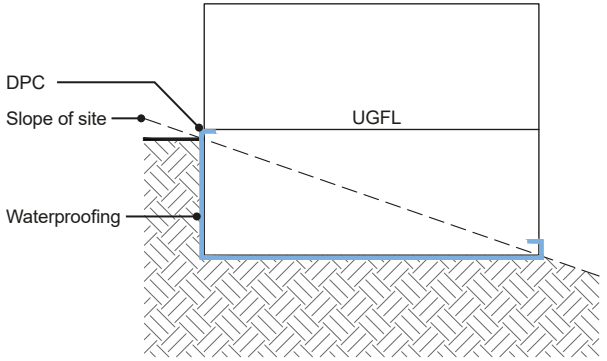
A basement can be a structure that is constructed partly or wholly below ground. The following show examples of basements / structures that will require water proofing.



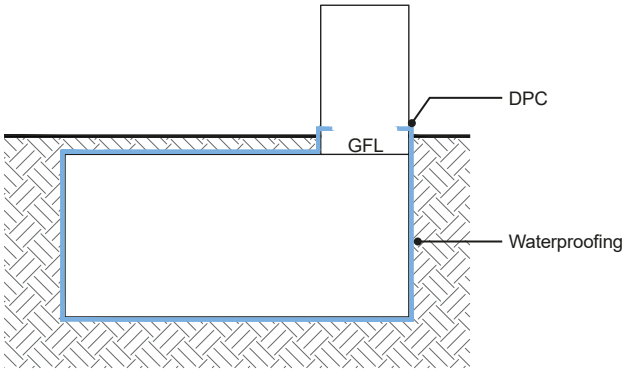
Storey partially below ground



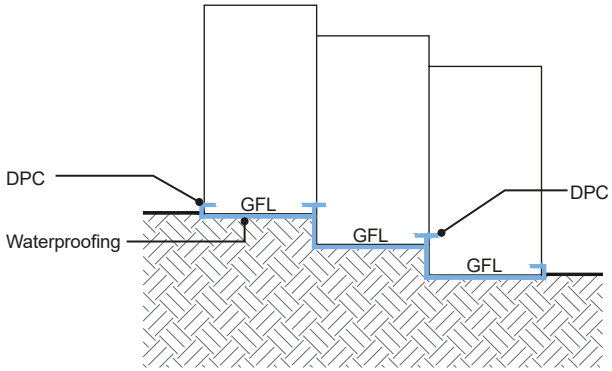
Storey wholly below ground



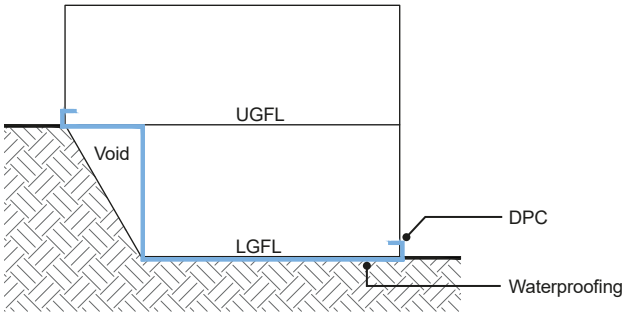
Semi-basement on 3 sides



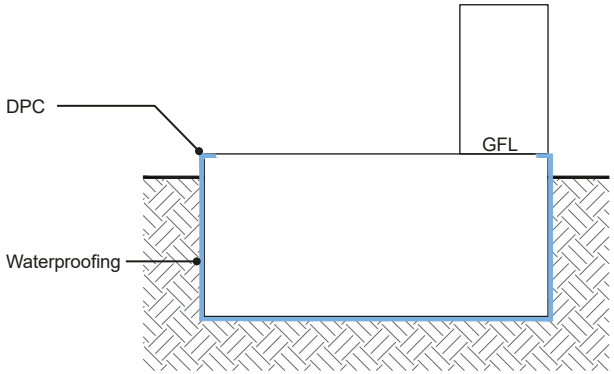
Buried roof



Stepped site



Split level



Podium above ground

The waterproofing design

The waterproofing design must be appropriate for the specific environment required and be provided by a suitably qualified Waterproofing Design Specialist e.g. Certificated Surveyor in Structural Waterproofing (CSSW).

Evidence of the site investigation reports, along with a site specific waterproofing design philosophy must be provided by a suitably qualified Waterproofing Design Specialist **8 weeks** before the commencement of the basement construction.

The Waterproofing Design Specialist must be appointed early in the design stage to coordinate with the other members of the Design team for the project.

The early involvement of a Waterproofing Design Specialist is an important consideration because the waterproofing design typically has an influence on other elements of the structural and/or architectural design.

The Design team should include:
- The Developer.
- Waterproofing Design Specialist: To provide an integrated waterproofing solution to the specified environmental grade.
- Structural Engineer: Responsible for all the structural elements for the development.
- Geotechnical specialist: To provide ground information of the site including geology, hydrology, hydrogeology and topography.
- Drainage consultant: To provide guidance for the water control of ground and surface water including Sustainable Urban Drainage system (SUDS) provisions across the development site.

Risk based design

The proposed waterproofing should be appropriate to the risk.

The Waterproofing Design Specialist must take account of the:
- Information contained in the site investigation report to identify the risks associated with geology, hydrology, hydrogeology and topography for the specific project and not a generic approach.
- The 'Environmental Grade' required.
- The existing and proposed site levels and any features which may impact on the areas of building below ground level.
- Drainage, both new and any retained elements, relating to the structural waterproofing proposals.
- Information provided by other members of the Design team and co-ordinate to ensure the waterproof design can be achieved.

The Developer should ensure:
- The Design team provides a coordinated design, based on the waterproofing design.
- The workmanship of the trades / contractors involved during the construction stage will achieve the waterproofing design requirements.
- Any changes to the waterproofing design or associated construction 'proposed' during the construction phase, must be reverted to the waterproofing design specialist to confirm the design will still be appropriate and the waterproofing design updated.

The approach detailed within BS 8102 involves assessment of a given site to determine the characteristics that influence risk. With the benefit of knowledge gained through this investigation and assessment, suitable designs for dealing with the risk of water ingress, gases and contaminants can then be devised and constructed.

Note:
1. Where relying on the use of a waterproofing product manufacturer's standard details, they typically disclaim design responsibility, so it is incumbent on the Waterproofing Design Specialist to ensure that such details are correct and appropriate for the site and structure or offer suitable variation.
2. For our Warranty purposes, it must be assumed that the basement will be exposed to a full height of water during the design life of the building.
3. The design must include a combined system of waterproofing protection (unless otherwise stated within this guidance).

Site investigation to determine ground conditions

The degree of water present within the ground and the propensity for water-logging to occur over the lifetime of a structure is a principal driver in assessing risk and the waterproofing system required. Simplistically, if a basement is constructed into a permanently high water table then the degree of protection will necessarily be greater than a similar structure constructed into a generally dry site.

Therefore:
- An assessment of a site must be based on the results of the site investigation report and other site-specific factors.
- Seasonal variations in the water table must be accounted for unless long-term monitoring is undertaken.
- Where standing water levels are not noted during a pre-start site investigation, the drainage characteristics of the ground must receive particular attention.
- Soils with low permeability represent a risk of water-logging or encouraging a 'perched water table', where water stands temporarily or permanently within the ground against a structure. Arguably this affects more properties with basements versus the true water table level.

Other factors such as site topography and building orientation may have an impact on the propensity for pressure to come to bear against a below ground structure and should also receive consideration.

Further guidance on the drainage characteristics associated with different types of ground maybe found within The Basement Information Centre (TBIC) Basements: Waterproofing – BS 8102 Principle Considerations 4.3.

Ground gases and contaminants must also be considered within the risk assessment for the waterproofing design.

While the Site investigation report (Geo-Environmental reports) assess the risk and guides the waterproofing design, an equally important consideration is the intended use of the space and the consequences in the event that water penetration should occur. For example, in properties where the consequences of water penetration would be severe, such as in a habitable space, an accessible and maintainable system must be considered and provided.

It could be derived that based upon site investigation reports, the risk of water pressure ever occurring is low. However given the effects of climate change, burst water mains or sewers, or any other topographical features e.g. ponds, watercourses, etc., there still remains a risk of water coming to bear on the structure.

In summary:
- Evidence of the site investigation reports, along with a site specific waterproofing design philosophy must be provided by a suitably qualified Waterproofing Design Specialist **8 weeks** before the commencement of the basement construction.
- The site investigation reports assesses the risk and guides the design, but it should always be assumed that some degree of water pressure will come to bear on the structure during its lifetime.

The water resisting structure

The principle is to consider and design robustly for expected water pressures that the structure and waterproofing must resist, based upon the site investigation reports and site risk assessment. Design considerations may also be influenced by sub-surface drainage by which the degree of water on the structure could be reduced.

The ability of the structure to provide resistance to water penetration has a bearing on the various forms of waterproofing. Retaining walls in plain or reinforced masonry provide comparatively little resistance to the penetration of water under pressure because of:
- The porosity of masonry materials.
- The existence of bed and perpendicular joints.

The flow of water (seepage) through reinforced concrete can be controlled by structural or concrete mix design. While concrete itself is relatively impermeable, the degree to which water is excluded will be greatly influenced by crack sizes and the detailing of construction joints and service penetrations.

Defects and remedial measures

Waterproofing Design Specialists are to consider the probability that systems may not be installed perfectly and that defects may occur as a result of poor workmanship, or that defects may be present in the supplied materials.

Designing on the assumption that a system will not be totally perfect or free of defects, necessitates that consideration is given to the feasibility of repairing those defects at construction stage. A remedial repair strategy should be included within a design.

For our Warranty provision, where a Grade 3 environment is required, combined protection must be provided (consisting of 2 systems recognised by BS8102). An accessibility and reparability option is essential and should form part of any structural waterproofing design.

Similar strategies for repair of a Grade 1 or 2 environment must be considered as part of the design process. Further commentary is provided within each of the specific system type sections.

Stability and durability

The construction elements that support a building below the ground e.g. foundations, walls, floors, etc., shall be designed to structurally resist movement from the applied loads and surcharges both from above and below the ground. The structure should also be suitably durable for the below ground environment.

Design considerations shall be informed by the:
a) Geo-environmental report (Phase 2).
b) Structural design.
c) Expected structural movement e.g. deflection, surcharge of loads.
d) Below ground environment.
e) Durability of materials.
f) Waterproofing co-ordination

Geo-environmental report (Site Investigation report)
A report will establish the nature of the ground conditions and the potential hazards. In some locations, existing underground services or utilities may also impact on the design.

Structural design
Analysis of the applied loadings should be considered in the design of the structure, and shall include for:
- Loading from the superstructure and other parts of the building.
- Lateral forces from retained ground, ground water and surcharges.
- Ground movement and the effect of trees.
- Buoyancy and ground heave.
- Temporary loading conditions e.g. the effects of site traffic, proximity of heavy plant placement.

Expected structural movement
Movement of the structure is determined by the limitations of the waterproofing system applied to ensure that the performance design and level of water tightness is achieved. Specified tolerances of movement should be provided where appropriate.

A movement joint in any below ground structures should be avoided wherever possible. Where the Engineer deems such a movement joint is of necessity, the design of the joint should ensure both service performance requirements and water tightness.

Movement joints shall not be concealed. This is to allow for adequate inspection and accessibility for maintenance.

Below ground environment
Building spaces below ground level which include the foundations for the whole building shall be designed by an Engineer and consider:
- Site topography and site characteristics.
- Trees in relation to the foundations.
- Ground conditions.
- Nearby buildings.
- Identified site hazards.

Durability of materials
The below ground structure should be designed to be durable against the identified site hazards found in the ground investigation and include for the effects of:
- Freeze-thaw actions.
- Dispersal of water on the structure.
- Aggressive chemicals in the ground.

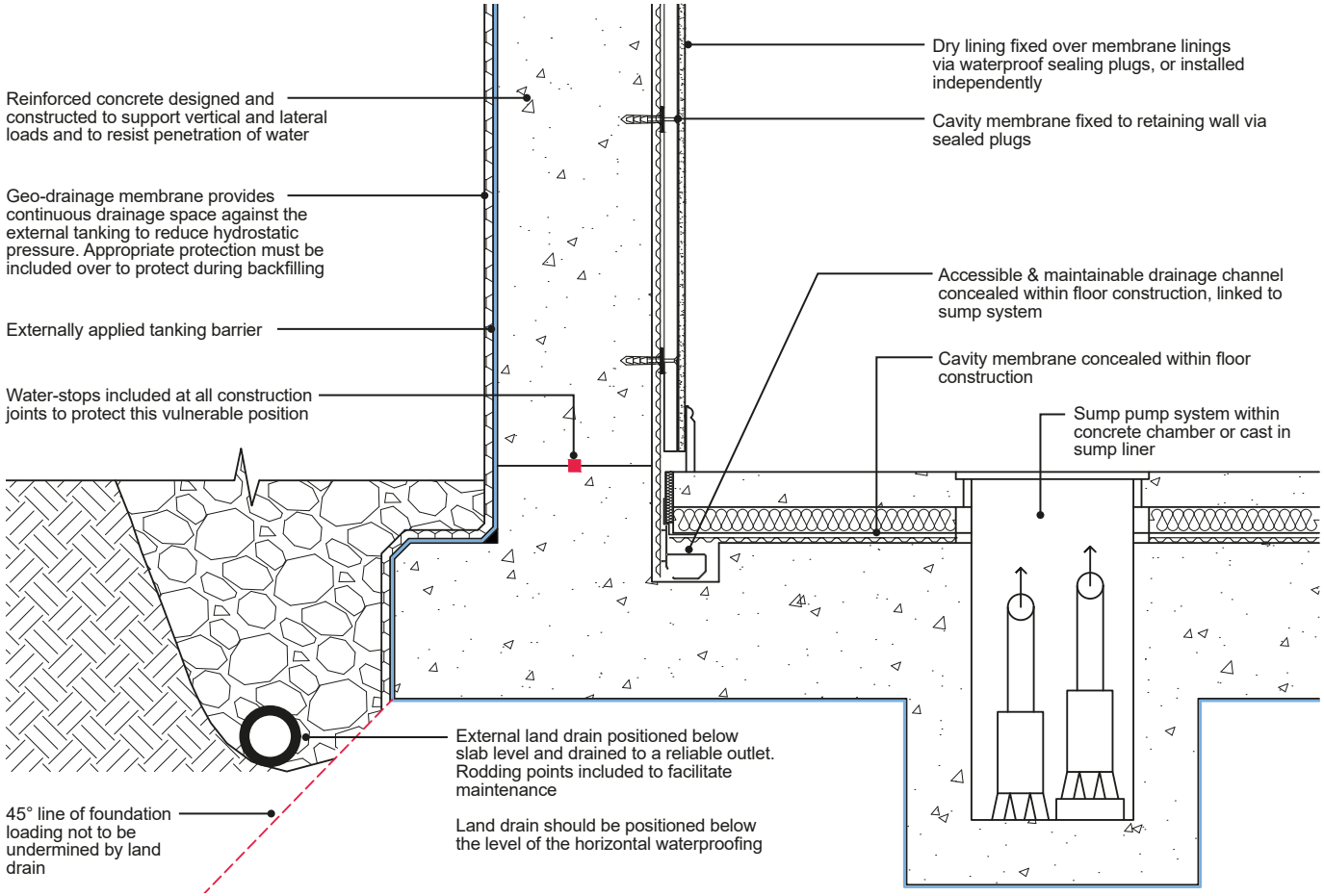
Waterproofing co-ordination
The design of the waterproofing must consider the impact of any proposed application of waterproofing materials applied to the structure, and this requires co-ordination with the appointed Design team.

Forms of waterproofing

BS 8102 refers to three forms of waterproofing protection:

- Type A Barrier protection (often referred to as ‘tanking’).
- Type B Structurally integral protection.
- Type C Drained protection (often referred to as ‘water management’).

Example of combined waterproofing A, B, and C



Intended use and required standard of environment

Usage dictates the required performance grade of an internal environment, e.g. how 'dry' a given below ground space must be in order to be suitable for a given usage.

The Waterproofing Design Specialist must therefore consider how this will be achieved in a particular site and structure. Reference to Table 2, from BS 8102, provides four definitions of environmental grades (Grades 1a, 1b, 2 and 3). The table below provides guidance for use on our Warrantied projects. Application of these performance levels are subject to the exclusions within the relevant applicable Policy document:

Grade	Example of structure	Performance level
1a	Enclosing structure of underground car parking[1], underground refuse stores, cycle stores, external light well enclosures.	Seepage and damp areas 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.
1b	Non habitable use: e.g. Enclosing structure of underground car parking[2], plant rooms[3], lift pits[4].	No seepage. Damp areas from internal and external sources are tolerable (dependent on intended use).
2	Non habitable use: e.g. Enclosing structure of underground car parking[5], plant rooms[6], lift pits[7], access stairs and lobbies serving non-habitable storeys.	No seepage is acceptable. Damp areas as a result of internal air moisture/condensation are tolerable; measures might be required to manage water vapour/ condensation e.g. ventilation might be required.
3	Habitable accommodation: e.g. Enclosing structure to ventilated residential and commercial areas including offices, restaurants, leisure facilities, associated access stairs and lobbies serving habitable storeys or habitable spaces within non-habitable storeys.	No water ingress or damp areas is acceptable. Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use.

Notes:
1. Standard car parking environment where seepage and damp areas from internal and external sources are tolerable
2. Parking structures where no seepage is acceptable.
3. A room containing equipment which supplies building services, and remain unaffected in their operation within a damp environment e.g. water tanks and pipework, sprinkler system pumps and pipework, etc.
4. A lift pit containing structure or working components of the lift remaining unaffected in their operation by the presence of dampness
5. Private car parking where no seepage or dampness through the structure is acceptable.
6. A room containing equipment which supplies building services, and may be affected in their operation by the cumulative effects of dampness e.g. electrical components and services, generators, communication systems, etc.
7. A lift pit containing electrical equipment and/or working components and may be affected in their operation by the cumulative effects of dampness.

To assist with quantifying an acceptable level of moisture ingress, the following definitions of water tightness are provided for Warranty purposes.

- Damp: When touched, a damp patch may leave a slight film of moisture on the hand, but no droplets of water or greater degrees of wetness are left on the hand. On a concrete surface a damp patch is discernible from a darkening of the colour of the concrete.
- Beading: Beading of water is the state in which individual droplets of water (held by surface tension effects) form on the surface of the wall and adhere to the wall. The water beads do not coalesce and do not flow.
- Weeping (seepage): Weeping of water is the state in which droplets of water form on the surface of the wall and coalesce with other droplets. The coalesced water does not remain stationary on the wall surface, but instead flows down the wall.

These are taken from the publication 'Specification for piling and embedded retaining walls'.

Grades of waterproofing protection

- For Warranty purposes we require all basements to be designed and constructed to a minimum of Grade 2, with Grade 3 being necessary for habitable space.
- Any form of habitable space is considered as Grade 3, where water penetration is unacceptable. Appropriately designed environmental control measures must be included to control vapour introduced by occupation, and thereby preventing problems of condensation.
- Any space designed to Grade 2 (e.g. plant and store rooms), where water penetration is not acceptable, does not require the inclusion of ventilation. However some degree of ventilation is recommended, even in basic storage space, to avoid condensation related issues.
- Where there is policy cover provided for underground car parking, the grade of waterproofing should be clearly defined as part of the waterproofing design. Depending on the design criteria, the degree of seepage or dampness (water tightness) that can be tolerated for this particular end use needs to be established and agreed with all interested parties, including the Warranty Surveyor at the design stage.

For our Warranty provision, where a Grade 3 performance is required, a combined system of waterproofing protection must be provided.

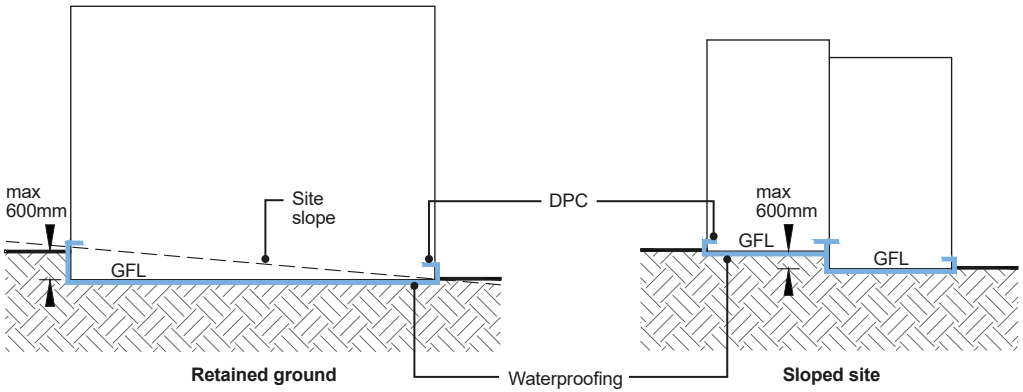
However; in the following specific circumstances only, a single form of waterproofing protection where a Grade 3 performance is required, may be acceptable subject only to:

- On shallow stepped / gentle sloping sites where only part of the structure could result in retaining ground above the lowest finished floor level but in no situation greater than 600mm.
- And, the water table being proven to be permanently below the lowest floor level.

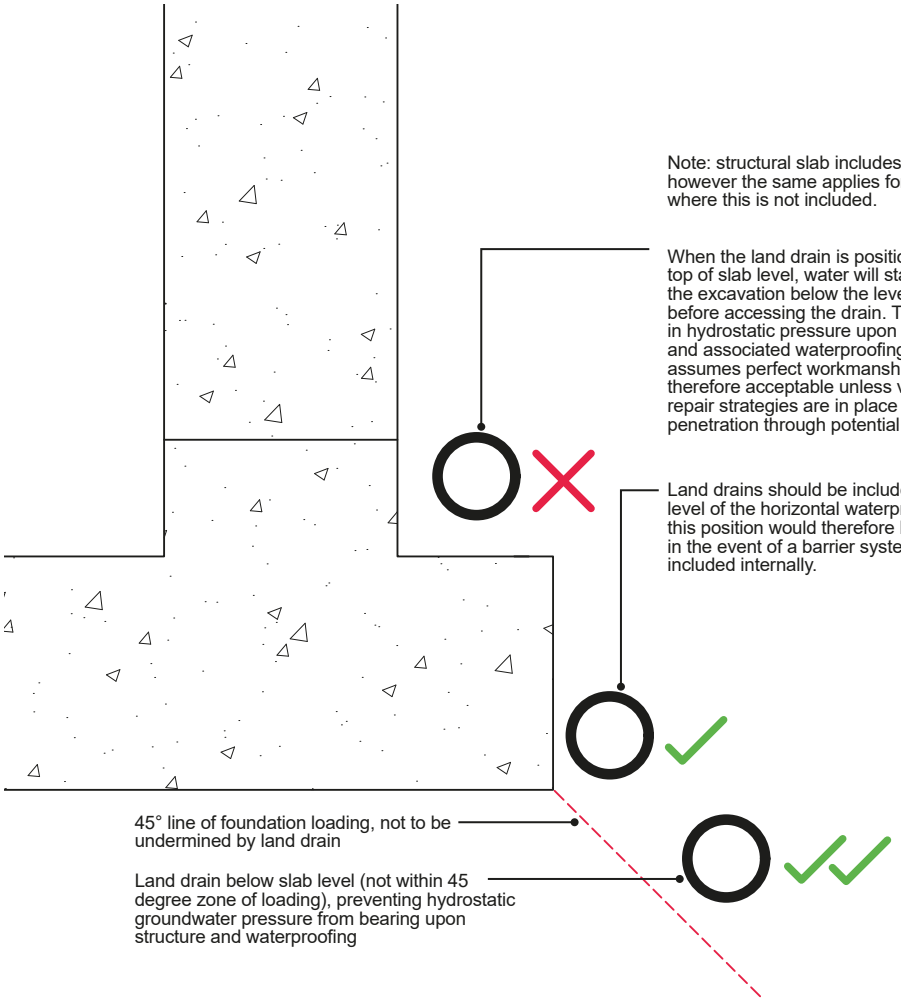
In these circumstances, the site conditions must be proven to not result in an unacceptably high risk and the consequences of failure are substantially low. This must be substantiated by a site investigation report and agreed with the Warranty provider before commencing work on site.

A site specific design proposal must be provided before commencement of construction on site, to demonstrate the proposed waterproofing solution (Type A, B or C) is appropriate for the ground conditions (based on the site investigation report). This will include for the wall and floor waterproofing proposals.

Such scenarios are limited to the above described and as shown in the below images.



Land drain positioning and external drainage



Exclusion of surface water

Surfaces external of the basement structure at ground level can act to limit or attenuate penetration into vulnerable positions, i.e. the more permeable excavated and backfilled ground directly around the basement structure. The inclusion of surface and cut-off drains which remove standing water away from the vulnerable areas are also of benefit.

Sub-surface drainage

The use of land drainage can act to remove water from around the structure, thus alleviating pressure and should be considered in all cases to reduce the risk of water ingress where practical.

However, the use of land drainage might not be viable on all sites, examples being:

- Where there is no available location to discharge collected ground water.
- Where high water tables and permeable ground conditions make it impractical to sufficiently remove the quantities of water present.
- Restrictions on the site curtilage due adjacent buildings close to or on the site boundary.
- Draw down, i.e. affecting the stability of other structures by the introduction of a land drain.

Depending on the required 'environment', if land drainage is not feasible, a combination of at least two systems in order to mitigate the risk of water ingress will need to be adopted. The waterproofing design specialist will be required to provide a solution specific to the site conditions.

Notwithstanding such conditions, the provision of effective land drains is often an economic means of greatly reducing risk and must be included where viable.

The following considerations apply:

- Perforated land drains must be surrounded in clean graded stone and wrapped in a suitable geo-textile filter fabric to reduce the risk of clogging. This is particularly important in fine granular and clay soils where land drains are susceptible to clogging.
- Rodding points must be included (ideally at changes in direction) to facilitate maintenance, which will allow the system to function in the long term (this particularly applies to land drains where there is no viable access for repair). This maintenance should be undertaken at suitable intervals (annually as a minimum), with the detail of this being written into the documentation passed to homeowners.
- Land drains must be positioned at a low enough position to prevent pressure from bearing upon the structure and waterproofing.
- The use of geo-drainage membranes applied to the external face of a retaining wall can provide a continuous drainage space external of the structure, which assists in encouraging water to drain down to the level of the land drains without pressuring the structure.
- Land drains must link to a reliable point of discharge. Where sump pump systems are employed, the implications of power cuts should be considered in that land drains may in such scenarios not function as intended. The effectiveness of battery back-up systems, where employed in sumps servicing land drains, should be considered in relation to assessment of the likely degree of ground water.
- Land drains must not be directly linked to soakaways by gravity, unless it is not possible for water to surcharge, i.e. where the top of the soakaway is below the level of the actual land drains.
- Where land drains are included this should be in association with a permeable stone backfill compacted in layers, which also encourages water to drain down to the level of the land drains without perching and pressuring the structure.
- The use of maintainable land drains is a necessity when employed in association with some forms of inaccessible/ external tanking systems, i.e. where the structure itself provides little resistance. In such cases if it is not feasible to include reliable land drains, alternative methods of waterproofing must be used.

The Warranty Surveyor is to be supplied with design details where external land drainage is included.

Please note: Where combined forms of waterproofing are required, the inclusion of land drainage is not considered an additional type of protection and a combination of type A, B or C protection should be used.

Introduction

Where policy cover is provided for lift pits, the grade of waterproofing should be clearly defined as part of the waterproofing design. Depending on the design criteria, the degree of dampness that can be tolerated for this particular end use needs to be established and agreed with all interested parties, including the Warranty Surveyor at the design stage.

Please note: Where policy cover is provided, Glass Reinforced Plastic (GRP) liners are not acceptable for Warranty purposes.

Where lift pits are constructed at the same time as foundations are excavated, consideration for waterproofing is often not considered. Lift pits serve two purposes:

a) Providing a fixing platform for construction of the shaft.
b) Housing for the lift mechanisms and associated plant, and facilitating future servicing of the lift.

To have water in a lift pit whilst working is uncomfortable and the humid internal environment can affect other building elements and finishes due to damp rising up the walls. This can lead to:

- Corrosion of fixings.
- Damage to the lift mechanism.
- Lift failures and breakdowns.
- Health and safety related issues.

It is therefore a requirement that seepage from ground water does not occur and that the lift pit remains free from water.

This applies to lift pits in isolation or as part of a larger waterproofed scheme.

Design considerations

Construction method
As lift pits are the first to be constructed, the developer is to provide the design of the waterproofing systems before any construction commences on site. For more information, please refer to the ‘Provision of information’ in this section.

Fixings
Within the lift pit there may be plant associated with the operation of the car and guide rails which will require fixity. The effect on the chosen waterproofing method should be fully considered e.g. when structurally integral waterproof concrete has been specified for the slab and walls then proprietary self-sealing waterproof plugs should be specified.

Workmanship
Waterproofing materials are specialised materials and do require knowledge and training for their placement on a below ground structure such as a lift pit. A specialist installer should be considered depending on the degree of risk / impact of failure.

2.
Basements

2.2
Waterproofing Systems

Combined protection

This guidance is for Type A Barrier (tanked) protection.

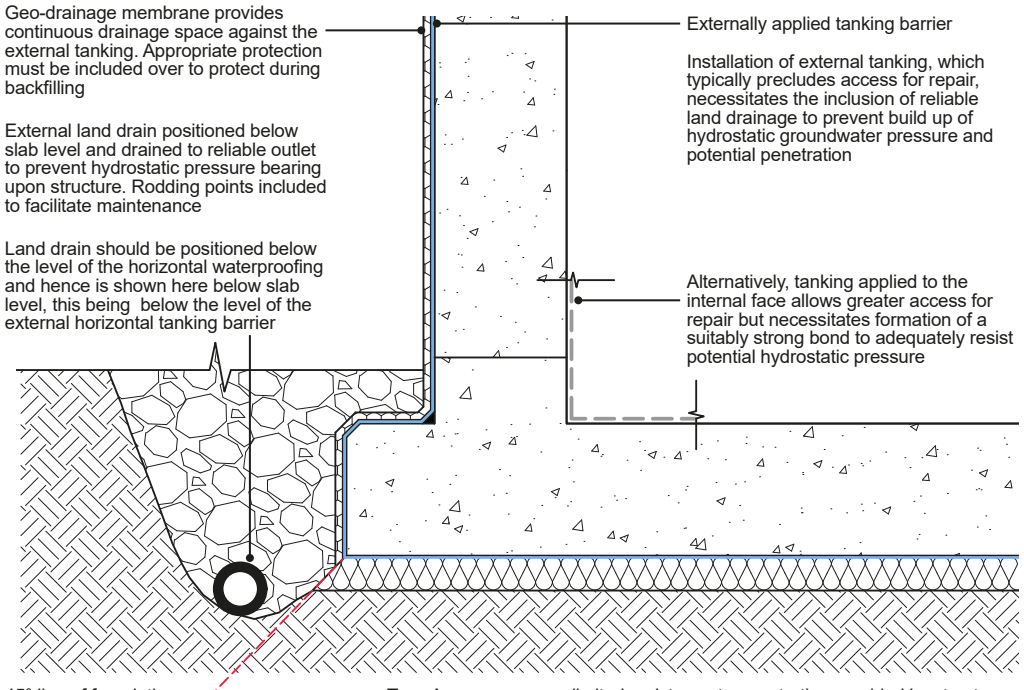
A combination of BS 8102 systems of waterproofing may need to be employed to substantially lower the risk, and may be necessary where the consequences of failure are particularly great, additionally, combined BS 8102 systems should be employed where site conditions would result in an unacceptably high risk when employing a single system.

Type A barrier protection

This form of waterproofing relies on the inclusion of a physical barrier material applied on or within the structure, often where the structure itself provides little resistance to the penetration of water.

A variety of considerations apply:

- Suitability of the substrate, primarily applicable where tanking products are applied internally in that the bond between the product and the substrate on which it is applied, must be sufficient to resist hydrostatic ground water pressure.
- The requirement for preparation of substrates to accept membranes and cementitious materials.
- Movement which in rigid barrier protection systems may encourage cracking through which water may penetrate, where pressure comes to bear on the structure.
- Loading, where hydrostatic pressure is applied to the structure as a result of exclusion of the barrier protection system i.e. structures must be designed to resist loads applied to them.
- Continuity, in that systems must be 'continuous'. A gap in a barrier system represents a point at which water under pressure can penetrate.
- 'Buildability', namely whereby sheet membrane products are proposed with the consideration being the practicality of wrapping a flat sheet around complex three dimensional shapes, such as external corners and beneath raft slab thickened toe details.
- Application – Surfaces on which barrier protection systems are applied must be sufficiently prepared to gain maximum bond strength. Also temperature and weather conditions must be considered when application is made.



Commentary on Type A barrier protection

- Whilst BS 8102 advises that 'reparability' must be considered, the use of external adhesive membrane systems on permeable constructions is precluded, unless employed in association with long-term strategies for preventing ground water from pressuring, e.g. serviceable land drains.
- External systems have a greater implication, in that accessibility for repair is typically impractical post-construction and where combined with relatively permeable wall constructions, makes it difficult to confidently determine the point of a defect externally, because water can track within the wall construction to show itself internally at a position not local to the external defect.
- Internal systems have the benefit of greater accessibility meaning that repair is more feasible. Where this system is chosen, the strength of the substrate, its surface preparation and the bond of the waterproofing system are critical considerations and need to be properly considered by the waterproofing specialist.
- The correct use of land drains assists to minimise the potential for hydrostatic pressure coming to bear on to the structure.
- Risk can be lessened by using a 'fully bonded' system, where the bond is such that water cannot track along between the structure and barrier product, in association with a structure of lesser permeability which would allow localised repair to be undertaken.
- Product guarantees, quality assurance schemes and product certification does not negate the Functional Requirement that a waterproofing design specialist is required to provide a suitable waterproofing design.

Other considerations

Ground gases and contaminants
Aggressive ground conditions may require the inclusion of a suitable ground barrier to protect the structure appropriately. Specialist advice must be sought in respect of dealing with ground gases, and designers are advised to check current standards at the time of construction for suitable guidance.

Existing structures
Waterproofing existing structures differs from new construction in that designers must work within the confines of the existing structure. However, many of the same considerations apply in that the required standard of environment appropriate to usage must be created and maintained in the long term.

Interface with external wall damp proof courses
Whichever type of waterproofing system is deemed appropriate, there must be a continuation provided with the horizontal damp proof courses above ground level. Waterproofing materials used must be compatible with the damp proof course components and adequately lapped and bonded.

The waterproofing design specialist should take responsibility for this junction as part of the barrier protection design.

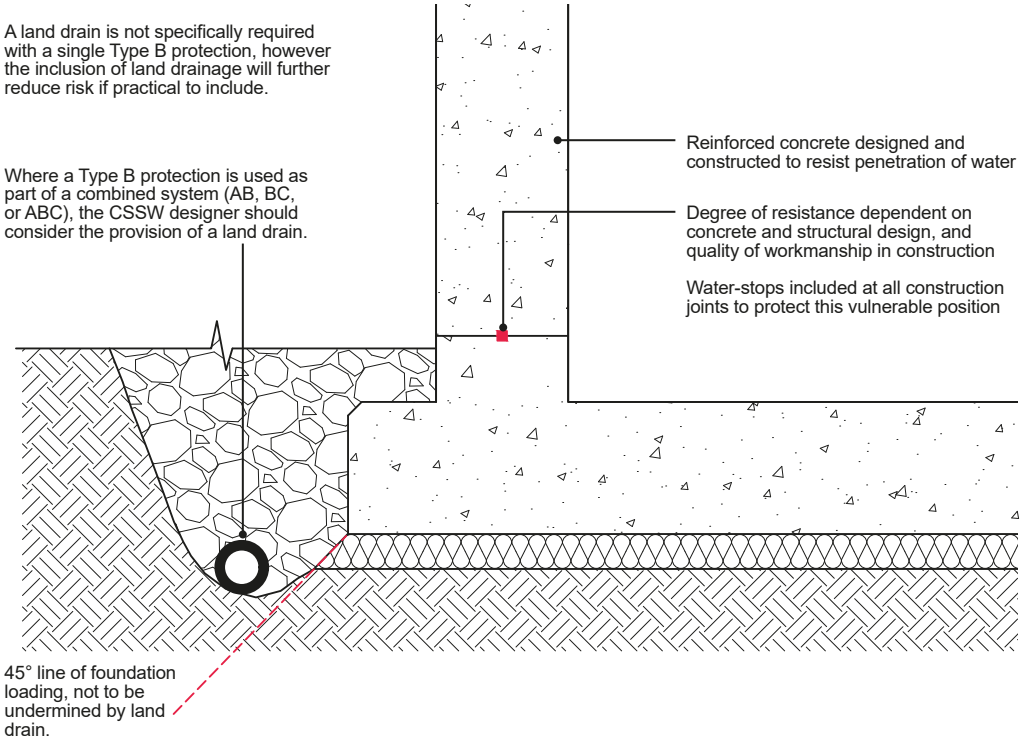
Combined protection

This guidance is for Type B structurally integral protection.

A combination of BS 8102 systems of waterproofing may need to be employed to substantially lower the risk, and may be necessary where the consequences of failure are particularly great and/or where difficult site conditions result in an unacceptably high risk when employing a single system.

Type B structurally integral protection

Type B also relies on the exclusion of water, but employs the structure itself as opposed to applied barrier products included on or within it. In the main, as shown in the image below Type B Structurally Integral Protection is formed using reinforced concrete.



Concrete without additives and including typical levels of steel reinforcement (with cracking <0.3mm); whilst providing good resistance to the penetration of water, will allow seepage given hydrostatic pressure, and as such is not suitable in isolation unless forming basic (non-habitable, non-storage) standards of environment. Further guidance can be found on controlling crack widths in BS EN 1992-3:and CIRIA publication C766: Control of cracking caused by restrained deformation in concrete.

As with any structure that aims to entirely block out water, this must be free of defects which would otherwise allow water to penetrate. In achieving this, the following must be considered:

- Structural design and specification of materials (based in part on-site assessment).
- Water stop detailing at construction joints.
- Service penetration detailing.
- Appropriate specialist site supervision to ensure high standards of workmanship.
- Good placement and compaction.
- Curing.

Particular consideration must be given to the formation of construction joint details, which form a typical weak point in Type B structures. Furthermore, specialist supervision is required on site during construction.

Systems which function by excluding water may not be tested until the ground water pressure comes to bear. Therefore, it is advantageous where external water pressure comes to bear prior to completion, that any areas of penetration can be remedied during construction.

Commentary on Type B protection

- With regard to appraisal of repair, this method has a benefit in that; the point of penetration is typically the point of the defect or pathway through which water penetration occurs. Coupled with the impermeable nature of the structure generally, this allows localised repair to be undertaken via resin injection, grouting and associated repair methods.
- The main consideration is locating the point of any penetration, and it is therefore beneficial where reasonable access to the concrete structure remains viable.
- Product guarantees, quality assurance schemes and product certification does not negate the Functional Requirement that a waterproofing design specialist is required to provide a suitable waterproofing design.

Other considerations

Ground gases and contaminants
Aggressive ground conditions may require the inclusion of a suitable ground barrier to protect the structure appropriately. Specialist advice must be sought in respect of dealing with ground gases, and designers are advised to check current standards at the time of construction for suitable guidance.

Existing structures
Waterproofing existing structures differs from new construction, in that designers must work within the confines of the existing structure. However, many of the same considerations apply in that the required standard of environment appropriate to usage must be created and maintained in the long term.

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Whichever type of water proofing system is deemed appropriate, there must be a continuation provided with the horizontal damp proof courses above ground level. Water proofing materials used must be compatible with the damp proof course components and adequately lapped and bonded.

The waterproofing design specialist should take responsibility for this junction as part of the barrier protection design.

Combined protection

This guidance is for Type C drained protection.

A combination of BS 8102 systems of waterproofing may need to be employed to substantially lower risk, and may also be necessary where the consequences of water seepage is particularly great. Additionally, combined BS 8102 systems should be employed where site conditions would result in an unacceptably high risk when employing a single system.

Type C drained protection

Type C – Drained protection system are often referred to as water management systems as they collect and remove any seepage of water occurring through the structure. This method of protection differs from Type A and Type B, which provide barriers to water penetration.

The Structure

- The 'structure' provides the primary resistance to the presence of ground water pressure. The Type C drained protection system is designed to mitigate the risk by removing any minor water seepage occurring through the structure and in doing so maintains the required internal environment.
- An assessment of the structure is required to ensure it provides the primary level of water resistance by the waterproofing design specialist.

Internal drainage

The internal drainage system comprises of three elements:

- A drainage channel detail recessed into the floor construction at the perimeter of basement slab with the basement wall.
- A means of water discharge, which in a basement fully below ground, requires a sump pump system or in a sloping site may be through a gravity drain..
- Vapour barrier drainage membranes included above or internal of the drainage system which isolate the internal environment from the damp substrates behind.

Whilst the cavity membrane perimeter drainage channel is intended only to deal with seepage it could discharge to a deeper fixed drains to drain out via gravity. The potential risk of surcharge from blocked external drains is high and therefore the system must be protected by a non-return valve on the drainage outfall. The details of its position and accessibility for maintenance must be provided in the operations and maintenance manual for maintainable systems.

Drained protection systems are reliant on their ability to remove seepage water and so the mechanism by which water is removed requires careful consideration. The extent of seepage water penetration also has a bearing on the capacity required, with the degree of penetration being influenced by the permeability of the structure and the ground water conditions externally.

Notwithstanding the above, the capacity of such systems to remove water must be adequate to deal with a worst-case scenario and should be engineered with this in mind to provide a suitably low-risk system.

- Sump pump systems must include mechanical redundancy (dual mains powered pumps) to protect against pump failure and also sufficient battery back-up protection to protect in the event of a power cut.
- Each pump within a given system should have independent direct spur RCD/power supply so that in the event of an issue with a pump the others will still have power. Direct spur is advised to prevent accidental turning off by homeowners.
- A Commissioning certificate for the pump system should be provided upon completion.
- Drainage systems typically discharge into surface water gullies at external ground floor level, and an overflow detail must be formed at the point of discharge to allow water to spill out externally in the event of drains blocking or surcharging.
- Systems can drain by gravity to low ground externally, i.e. where properties are part retaining and constructed into sloping sites. As with pumped systems, if connecting to mains drains, an overflow detail must be employed to allow water to spill externally in the event of an issue.
- Internal drained protection systems must include drainage channels local to the external wall floor junctions which facilitates maintenance and allows systems to function and protect in the long term. Where larger footprints are involved, cross floor channels must be included, ideally local to construction joints where the structure is more vulnerable to ground water penetration.

Maintenance

Type C Systems must be maintained annually as a minimum. The detail of this requirement must be included in the documentation provided to the homeowner who will then be responsible for ongoing operation and maintenance of the system. The ongoing maintenance should include:

- The service records of the maintenance of the system.
- Accessibility to drainage channels and sumps are available at all times.
- That the drainage channels and sumps are checked at the service intervals to ensure they are clear and free of any free lime build up.
- Ensure that the electrical supply, battery back-up and alarm systems are fully operational at all times.

Free lime

Water moving over and through new concrete walls and floors leaches free lime within the early life of the structure, and suitable treatments should be applied to concrete to minimise this.

- The waterproofing design specialist should provide a specification of the treatments to be used appropriate for the particular construction and made available to the Warranty Surveyor.
- Where basements are formed under existing buildings in conjunction with new under pinning works; the choice of dry packing should be carefully specified and a waterproof expanding type mortar is recommended to help avoid free lime occurrences.
- Substrates should be clean and free of loose or friable materials prior to the application of membrane linings.

General

- Flood testing of a system should be undertaken during construction to check efficiency and that water flows freely to the discharge point. Testing in this manner to prove that the system functions as intended, is a key benefit of this method of waterproofing and must be part of the process.
- Systems creating a habitable space require the inclusion of vapour barrier drainage membranes within the wall and floor construction.
- Where elements of the drained protection system are included within cavities, the cavities must be kept clear of mortar snots and debris.
- Continuity of the structure must be considered because the resistance to water provided by a given structure is reduced by apertures through which water can freely move. Examples could include holes present within existing buildings, or in new construction where land drains are linked to sump pump systems, with the sumps being installed internal of the retaining shell, e.g. in light wells, thus providing a pathway for water to enter.
- Temporary 110v pumps should be included during construction to address water penetration as necessary; 240v systems should be installed and commissioned as soon as viable once the 240v supply is installed.
- Systems must not link directly by gravity to soakaways where any of the previously stated scenarios occur, and because of the danger of back-flow of water through the pipes or water-logging of the local ground above slab/DPM level. However, where such conditions are not present, sump pump systems may be employed to lift water up to ground level externally, discharging into gullies linked to soakaways. This detail should be designed by the Waterproofing Specialist.

Commentary to Type C

In consideration of the repair of defects, the inclusion of drained protection systems internally, generally ensures that systems can be accessed for localised repair. However, this may be lessened where systems are sandwiched within the structure, i.e. within cavities.

- Part of the underlying rationale of drained protection is that water is removed continuously, so that it does not collect and removes pressure upon membrane linings installed over the drainage. If water does not place pressure upon such membranes, then the incidence of any defects within them is generally of no consequence, and so maintaining the efficiency of the drainage in the long term ensures that such defects are negated.
- Product guarantees, quality assurance schemes and product certification does not negate the Functional Requirement that a waterproofing design specialist is required to provide a suitable waterproofing design.

Other considerations

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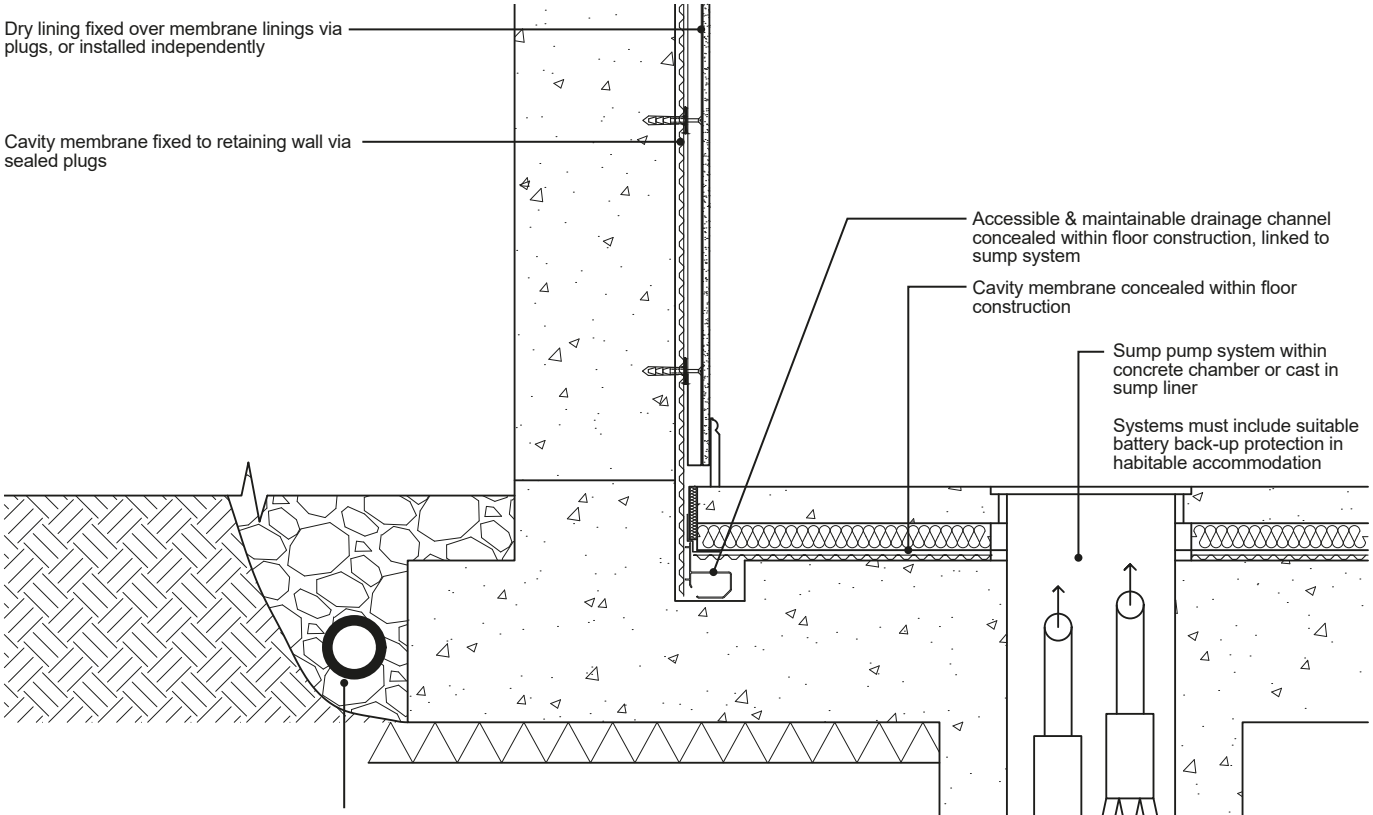
Type C drained protection



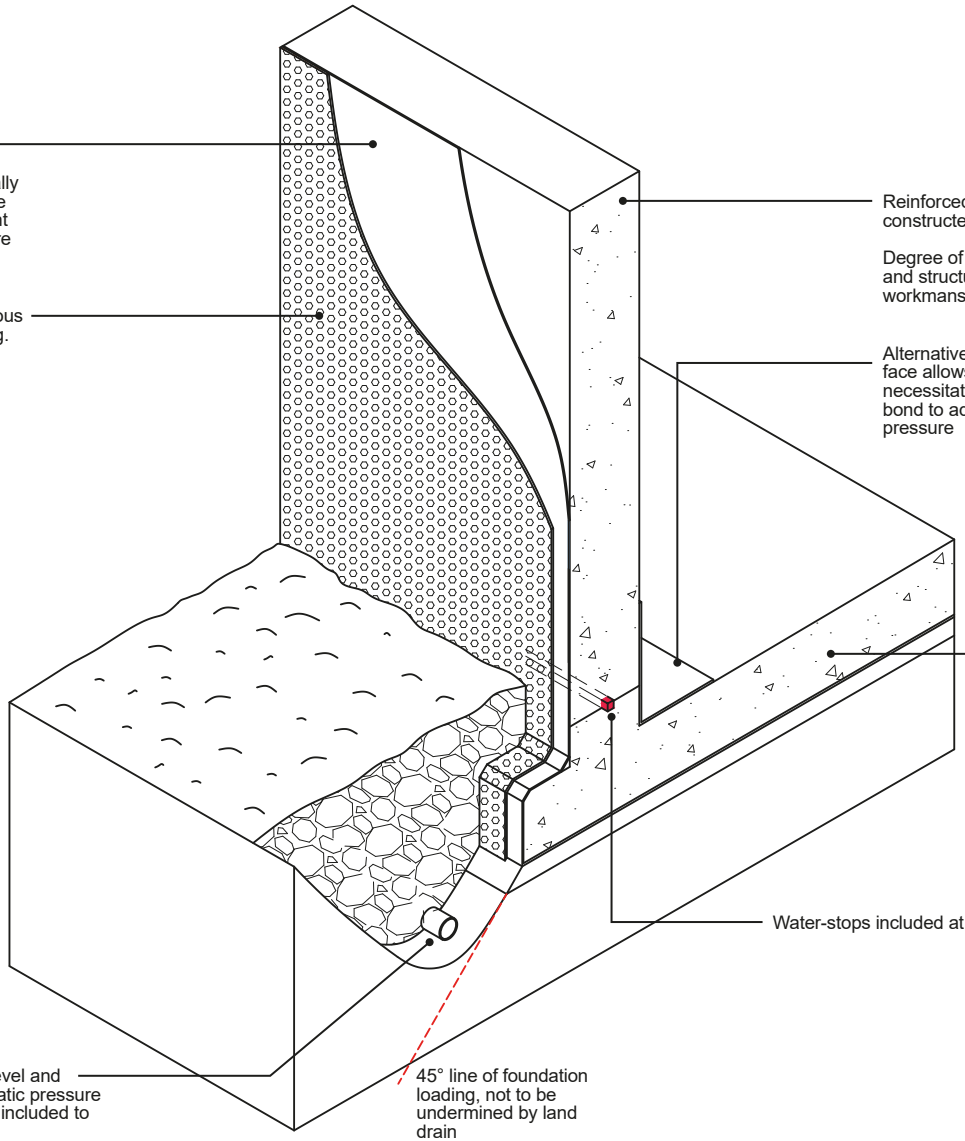
Land drainage is not a specific requirement with this method of waterproofing; however it acts to reduce risk further if practical to include.

Land drainage may be advisable depending on the permeability of the structure, in association with the nature of the ground conditions, which must be assessed as part of the design process.

External land drain positioned at or below slab level and drained to reliable outlet to prevent or limit hydrostatic pressure bearing upon structure. Rodding points included to facilitate maintenance.

Land drain positioned at the side of the slab remains below the level of internal slab membrane.

WATERPROOFING SYSTEMS: Typical example of a combined system - Type A+B



Externally applied tanking barrier.

Installation of external tanking, which typically precludes access for repair,necessitates the inclusion of reliable land drainage to prevent build up of hydrostatic groundwater pressure and potential penetration

Geo-drainage membrane provides continuous drainage space against the external tanking. Appropriate protection must be included to protect during backfilling

Reinforced concrete designed and constructed to resist penetration of water

Degree of resistance dependent on concrete and structural design, and quality of workmanship in construction

Alternatively, tanking applied to the internal face allows greater access for repair but necessitates formation of a suitably strong bond to adequately resist potential hydrostatic pressure

Type A assumes no or limited resistance to penetration provided by structure,however risk is reduced where employing structures with greater or total water resistance (combined protection)

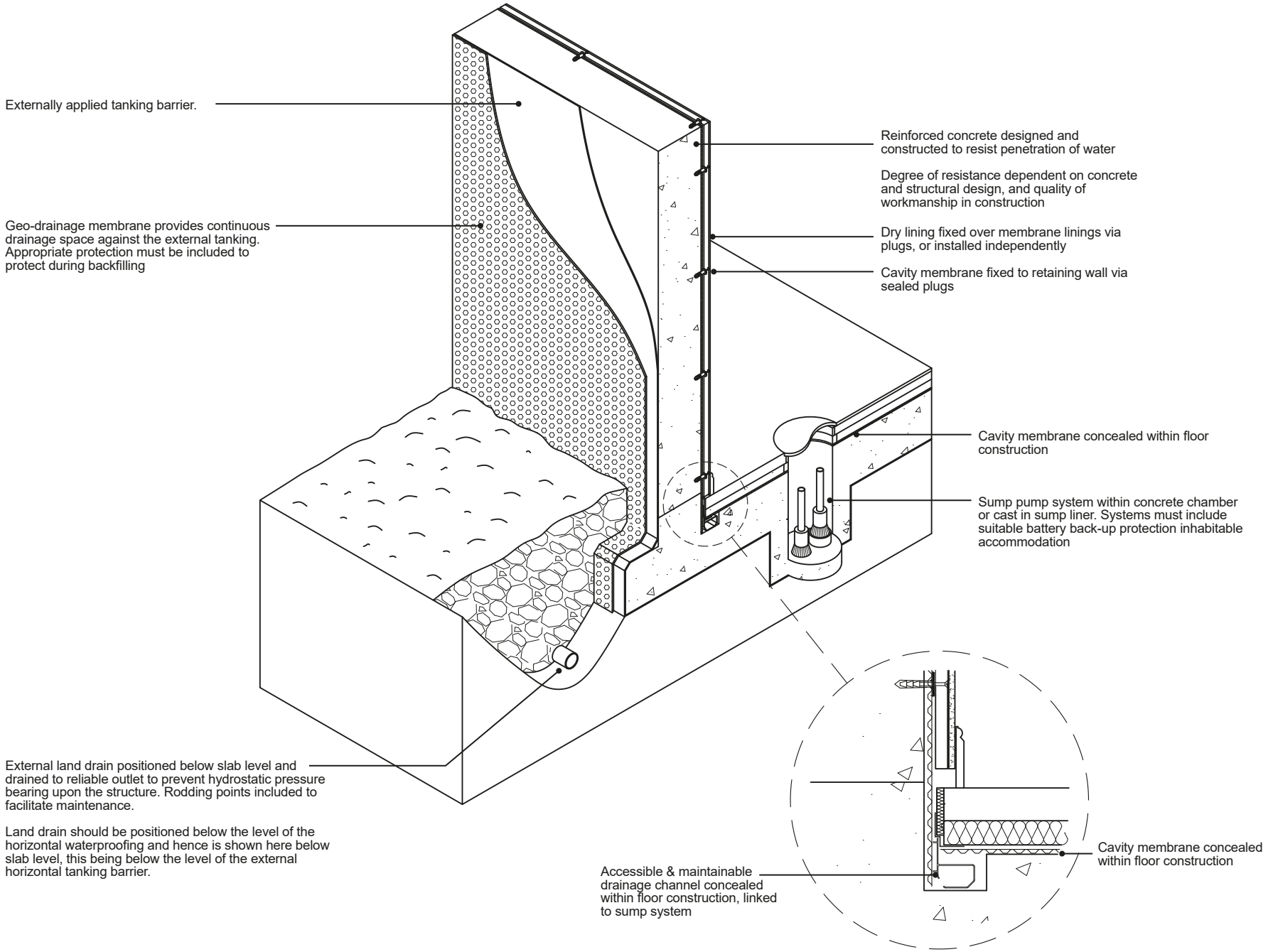
Water-stops included at all construction joints

External land drain positioned below slab level and drained to reliable outlet to prevent hydrostatic pressure bearing upon the structure. Rodding points included to facilitate maintenance.

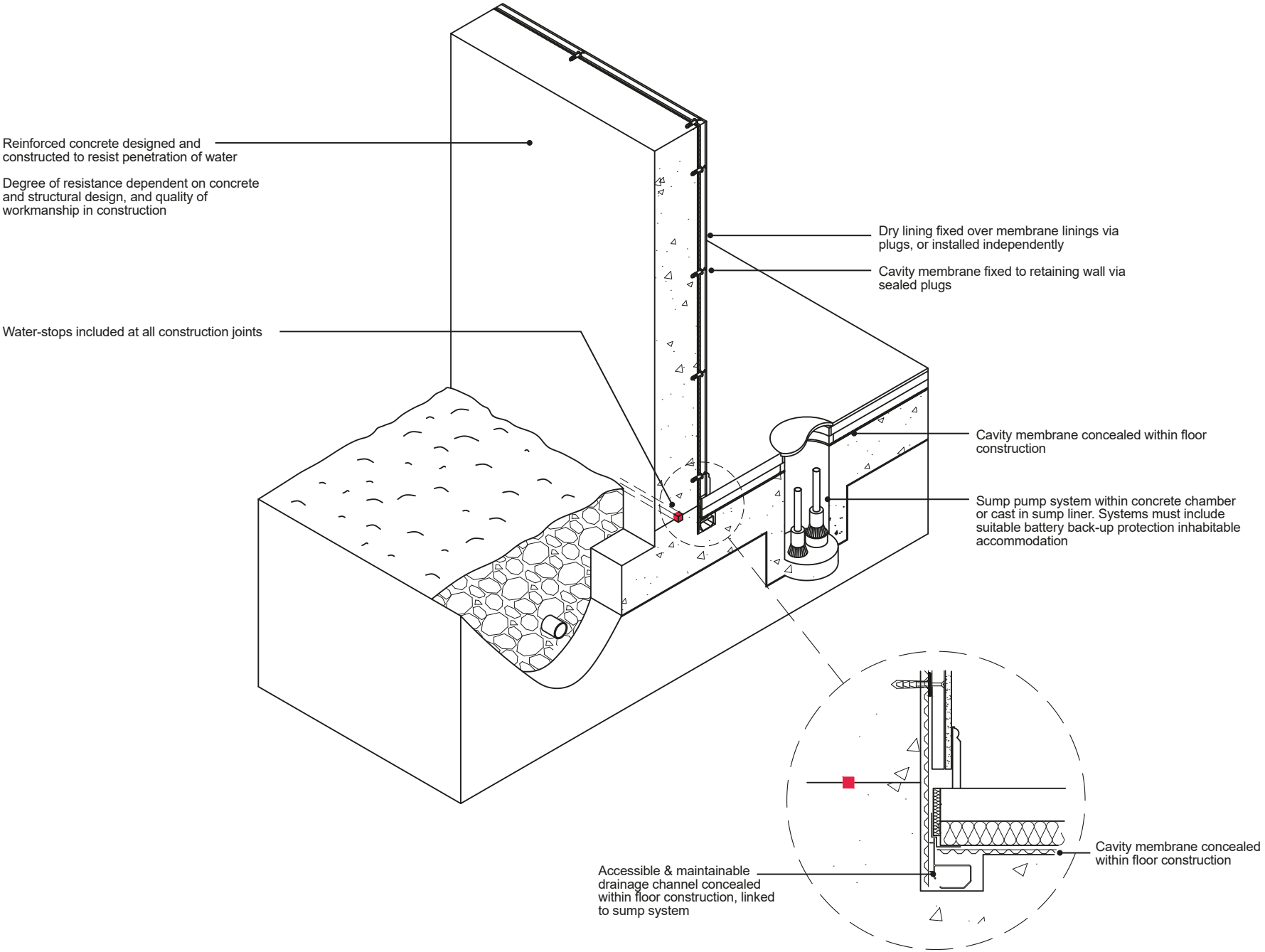
Land drain should be positioned below the level of the horizontal waterproofing and hence is shown here below slab level, this being below the level of the external horizontal tanking barrier.

45° line of foundation loading, not to be undermined by land drain

WATERPROOFING SYSTEMS: Typical example of a combined system - Type A+C



WATERPROOFING SYSTEMS: Typical example of a combined system - Type B+C



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