IRISH AGRÉMENT BOARD
CERTIFICATE NO. 26/0454
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SubTerra/Drytech White Tank System & GeoStruct Reactive Slab System

NSAI Agrément (Irish Agrément Board) is designated by Government to issue European Technical Approvals. NSAI Agrément Certificates establish proof that the certified products are **'proper materials'** suitable for their intended use under Irish site conditions, and in accordance with TGD Part D of the second schedule of the **Building Regulations 1997 to 2024.**



SCOPE

This Certificate relates to the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System for use in new residential and commercial concrete substructures, including podium decks and basements.

The Subterra/Drytech White Tank System is based on a single structure of watertight concrete combined with the waterproofing of cracks, joints, penetrations and openings by injecting a two-component expanding DRYflex resin.

The GeoStruct Reactive Slab System is the combination of the SubTerra/Drytech White Tank System with post-tensioning of horizontal substructure elements and application of Soil Structure Interaction Analysis (SSIA).

In the opinion of NSAI Agrément, the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System, as described in this Certificate, complies with the requirements of the Building Regulations 1997 to 2024.

Drytech is responsible for the design, manufacture and supply of all components to approved specifications. Drytech has appointed SubTerra as their distribution partners in Ireland. Approved systems are adapted to individual projects by SubTerra on a project specific basis in accordance with an approved design process.

The installation of the system is carried out by SubTerra installers that are trained and who adhere to the strict installation instructions as specified by SubTerra.

USE

The SubTerra/Drytech White Tank System can be used:

a) To provide a waterproofing protection for use in basements and podiums, Type B (structurally integral protection) in accordance with BS 8102[1];
b) As one of the measures to provide ground gases/radon protection in accordance with BS 8485[2];
c) To provide early age shrinkage control.

Readers are advised to check that this Certificate has not been withdrawn or superseded by a later issue by contacting NSAI Agrément, NSAI, Santry, Dublin 9 or online at http://www.nsai.ie

When the White Tank system is used in combination with post-tensioning of horizontal elements and SSIA, the GeoStruct Reactive Slab System can additionally provide:

a) Structural mitigation against ground movement, variable bearing conditions and differential settlement through soil-structure interaction design;
b) Potential reduction of substructure, pile requirements and slab deflection due to control stress distribution in the slab to the underside of the ground floor/basement slab in comparison to traditional/standard reinforcement concrete design.

This Certificate covers the system for use on new concrete substructures including basements slabs and podium decks.

The systems have not been assessed for use in aggressive environments (e.g. sea water, contaminated land, de-icing salts).

The system has not been assessed for use on existing buildings and roof elements.

MANUFACTURE, MARKETING, INSTALLATION & DESIGN

The product is designed and manufactured by:

DRYTECH Luzerne
Drytech AG
Industriestrasse 3
CH-6034 Inwil LU
Switzerland
T: +41 41 450 48 28
W: https://drytech.ch/

Project specific design, technical support, sales and installation are performed by:

Subterra Ltd.
Unit W9E/W9F Ladytown Business Park,
Ladytown
Naas, Co. Kildare.
W91NN84
Ireland
T: +353 45 83 1160
W: https://subterra.ie/

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1.0 ASSESSMENT

In the opinion of NSAI Agrément, the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System, when installed by SubTerra installers in accordance with this Certificate and SubTerra specific design, can meet the requirements of the Building Regulations 1997 to 2024, as indicated in Section 1.2 of this Agrément Certificate.

1.1 BUILDING REGULATIONS 1997 TO 2024

Part D – Materials and Workmanship

D3 – Proper Materials

The SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System, as certified in this Certificate, are comprised of 'proper materials' fit for their intended use (see Part 3 and 4 of this Certificate).

D1 – Materials and Workmanship

The SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System, as certified in this Certificate, meet the requirements for materials and workmanship.

Part A – Structure

A1 – Loading
A2 – Ground Movement
A3 – Disproportionate Collapse

Part C – Site Preparation and Resistance to Moisture

C1 – Preparation of Site
C2 – Subsoil Drainage

The SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System, when used as an integral part of a radon protection system, will meet this requirement with respect to radon gas

C3 – Dangerous Substances

The SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System, when used as an integral part of a radon protection system, will meet this requirement with respect to radon gas.

C4 – Resistance to Weather and Ground Moisture

R The SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System when used in accordance with Part 3 of this Certificate, will meet this requirement.

2.0 PRODUCT DESCRIPTION

2.0.1 SubTerra/Drytech White Tank System

The SubTerra/Drytech White Tank System is a Type B structurally integral waterproofing protection system in accordance with BS 8102[1] that can be used for new basement and podium slab applications.

The system is constructed of reinforced concrete (RC) elements (slabs, walls) that form a RC box; and injectable waterstops and crack inducers at joints between elements, construction joints and penetrations.

The reinforced concrete elements are designed and detailed to minimize water ingress by controlling cracking in accordance with BS 8102[1] and I.S. EN 1992-3[4]. Injectable waterstops and crack inducing units are utilised within the system. DRYflex resin manufactured in accordance with I.S. EN 1504-5[3] is injected at waterstops and crack inducing units at vulnerable locations.

The SubTerra/Drytech White Tank System utilises early age shrinkage control, through the application of crack inducing units to achieve the required maximum width crack, determined by the structural design and specification of the system. The cracks and crack inducing units are then injected with DRYflex resin to provide waterproofing at those locations.

Figure 1 shows principal elements of the SubTerra/Drytech White Tank System. System components are described in Section 2.1 of this Certificate.

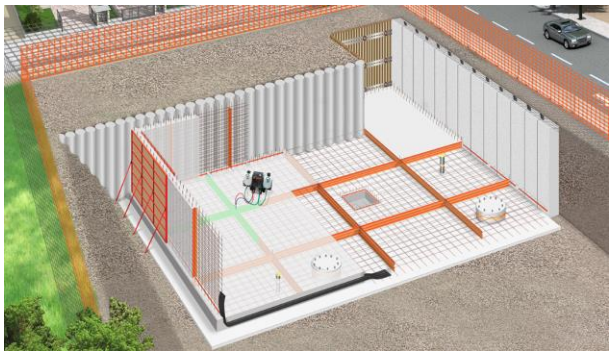

Figure 1. SubTerra/Drytech White Tank System

2.0.2 GeoStruct Reactive Slab System

The GeoStruct Reactive Slab System combines the SubTerra/Drytech White Tank System with post tensioning of horizontal substructure elements and application of Soil Structure Interaction Analysis (SSIA).

The waterproofing methodology utilises early age shrinkage control (as in The SubTerra/Drytech White Tank System) with the added step of closing all cracks, including the induced cracks through the stressing process with post tension methodology.
Similarly, as in the SubTerra/Drytech White Tank System, all crack inducing units and waterstops are injected with DRYflex resin. The waterproofing strategy in GeoStruct Reactive Slab System is therefore provided by a combination of Subterra/Drytech White Tank System principles and post tension strategy.

The use of Active Subspan SSIA Slab allows additional control of the stress distribution in the slab and to the underside of the ground floor/basement slab level, resulting in a potential reduction of substructure, pile requirements and slab deflection, in comparison to standard RC design.

Figure 2 shows the post tensioning of a basement slab constructed as a GeoStruct Reactive Slab.



Figure 2. Post tensioning of the GeoStruct Reactive Slab System

2.1 SYSTEM COMPONENTS

2.1.1 Reinforced concrete

The basement and podium structure are designed as a reinforced concrete box. For the GeoStruct Reactive Slab System, the basement slab utilises post tensioning technology where high strength steel strands are tensioned after the concrete has cured.
The reinforced concrete shall be designed by SubTerra's Structural Engineer, or by another competent Structural Engineer, with all design work carried out in consultation with SubTerra. The responsibility for design of substructure elements (basements/podiums) shall be agreed at

contract stage between the Client, SubTerra and Client's Engineering Team. The load transfer between superstructure and substructure elements shall be accounted for in the structural design.

Reinforced concrete design of the basement and podium slab shall be in accordance with Section 3 of this Certificate.

2.1.2 DRYflex resin

DRYflex is an acrylic resin for waterproofing using high pressure injection into cracks, waterstops, joints, penetrations and openings.

DRYflex is also used for the expansive filling of voids (category "S" I.S. EN 1504-5[3]. The resin is manufactured in accordance with I.S. EN 1504-5[3]. At the time of injection, it has the same viscosity as water and seals micro-cracks. After a short time, the material reacts and expands, pressure-sealing the cracks and joints.



Figure 3. Filling and pressure sealing the joint with DRYflex resin

The Drytech system components are CE marked in accordance with relevant harmonised European standards, including EN 1504, under the Assessment and Verification of Constancy of Performance (AVCP) System 2+ as defined in the Construction Products Regulation (EU) No 305/2011.

Under AVCP System 2+, the notified body is responsible for the certification and ongoing surveillance of the Factory Production Control (FPC) system. This includes initial inspection and periodic audits to ensure continuous compliance. There is no requirement for annual product certification; compliance is maintained through this ongoing notified body surveillance and CE marking process.

2.1.3 DRYset injection cold joints

A DRYset injection profile is a plastic profile equipped with a resin injection duct. It has pre-bored bolt holes set at intervals, to adhere the injection profile to the concrete. The injection profile is used for joints and may also be used for penetrations as determined by the Certificate Holder. It is designed to ensure that the waterproofing resin spreads widely, rapidly and uniformly.

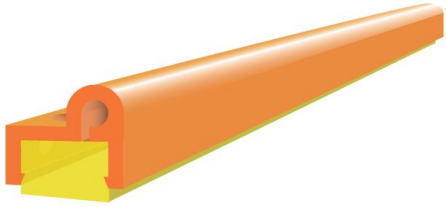

Figure 4. DRYset injection cold joint

The channel is laid at joints between; floor slab/floor slab, floor slab/wall, wall/wall and wall/ suspended floor slab. DRYset injection cold profiles are also specified at construction/day joints, in accordance with SubTerra's design specifications.

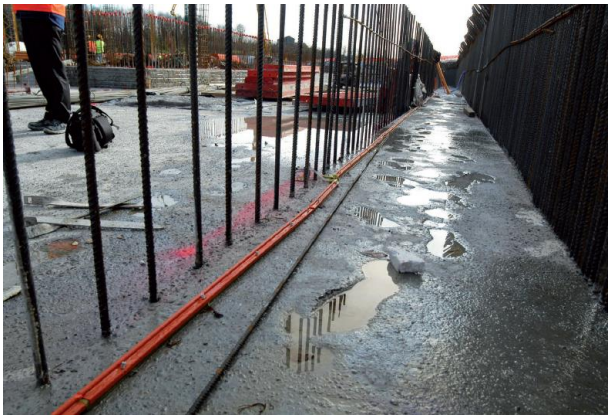

Figure 5. DRYset injection cold joint installed on site

2.1.4 DRYset crack inducing units

DRYset CIU – (Crack-Inducing Unit) is a plastic, trapezoidal shaped injection profile with a central injection duct. The injection profile is used to create controlled cracks and waterproof these cracks through the injection of the DRYflex resin. This element can also be combined with Drytech disposable formwork and corrugated compensating board when specified by SubTerra.

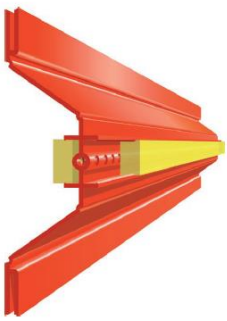

Figure 6. DRYset CIU (crack inducing unit)

DRYset crack inducing units are used to subdivide the concrete casting and induce cracking in their location. The positioning and spacing of the

DRYset crack inducing units are specified on a project specific basis in accordance with SubTerra's design specification.



Figure 7. DRYset crack inducing unit

2.1.5 DRYset sleeves

DRYset Sleeve is an open-cell, flexible, mouldable foam. The size and shape of the cells within the foam prevent cement grout from penetrating during casting, whilst allowing the DRYflex resin to spread when injected.



Figure 8. DRYset sleeve and its use in service penetration detailing

DRYset sleeve can be used to waterproof service penetrations when specified by SubTerra. SubTerra will provide a comprehensive specification and details for any type of penetration through basement walls, slabs and podium slabs. The design solution for waterproofing penetrations is dependent on concrete depth, project specific design, ease of installation and the location of the penetration.

2.1.6 DRYset waterproof spacer with end plugs

The DRYset waterproof spacer with end plugs is used to seal formwork holes.

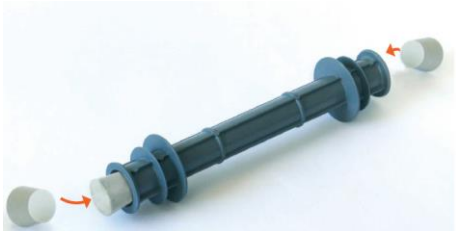

Figure 9. DRYset waterproof spacer with end plugs

Each formwork hole must be cleaned with a brush or disk grinder and sealed using the expandable plug, Hypalon tape and epoxy resin.

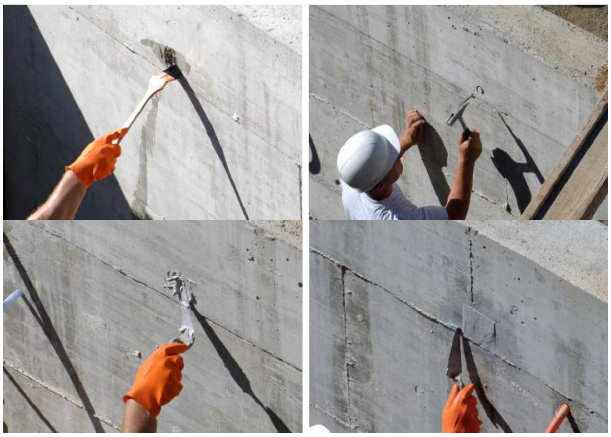

Figure 10. Sealing of formwork holes

2.1.7 DRYset movement or expansion waterstops

DRYset movement or expansion waterstops are used at movement or expansion joint's locations. The waterstops are made of waterproof material and are equipped with lateral injection ducts for DRYflex resin. The resin is injected when the concrete has matured to make the joint watertight.



Figure 11. DRYset movement or expansion waterstops

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2.2 DESIGN

The reinforced concrete basement and podium slab must be designed in accordance with I.S. EN 1992-1-1[5], BS 8102[1] and I.S. EN 1992-3[4] by a Chartered Structural Engineer. The structural design shall be carried out by SubTerra or the client's Chartered Structural Engineer. The Structural design shall be reviewed and checked by a Chartered Engineer, independent of the original designer.

The design of the waterproofing system, specification of the SubTerra/Drytech White Tank System & GeoStruct Reactive Slab System is the responsibility of SubTerra. SubTerra will prepare a site package for each project.

2.3 MANUFACTURE

The concrete for substructure elements shall be manufactured to I.S. EN 206[6].

The main elements of the SubTerra/Drytech White Tank System & GeoStruct Reactive Slab System are composed of DRYset waterstops, DRYset injection units and DRYflex resin. All are manufactured in the Drytech factory. The DRYflex resin is manufactured to I.S. EN 1504-5[3].

Quality control checks are carried out on the incoming raw materials, during the production process and on the finished product.

2.4 DELIVERY, STORAGE AND MARKING

SubTerra/Drytech is responsible for the supply and design of the DRYset waterstops, injection units and DRYflex resin.

The DRYset waterstops and injection units are supplied in rolls and sealed packaging. The elements must be covered and protected from sunlight, oil, dirt and moisture.

DRYflex resin components must be stored at a temperature of about 18-20°C and once mixed can be used at temperatures between 5-40°C when handled in controlled conditions in accordance with the manufacturer's instructions. The components of the resin have a limited shelf life (typically up to 6 months when stored in accordance with the manufacturer's instructions) and shall be used in accordance with the Manufactures Application Guide and Data Sheet for the product.

All system components are clearly marked to indicate manufacture date, type of product and essential instructions for storage and installation.

As an exothermic system, ambient temperature influences curing time rather than performance. Installation conditions, including ambient and substrate temperatures are recorded as part of the Site Installation Control Checks in accordance with the project Inspection & Test Plan (ITP). Reaction times are managed through the use of accelerators or retarders as required.

2.5 INSTALLATION

2.5.1 Site Survey, Geotechnical Investigation and Preliminary Work

The Client's Engineering Team shall be responsible for undertaking all necessary surveys and desktop studies in accordance with BS 5930[8] and I.S. 1997-2[9] in order to:

a) evaluate the geological and hydrogeological conditions of the site, including soil permeability characteristics, the presence of radon, methane, or other ground gases and contaminants;
b) establish the site boundaries and the spatial relationship of the proposed works to adjoining buildings and public roads;
c) establish the likely impact of flooding on the proposed works;
d) establish the location of existing services and obstructions below ground level;
e) assess the topography of the surrounding terrain in relation to the proposed below-ground structure;
f) determine the anticipated highest level of the water table and identify any potential for the formation of a perched water table.

Guidance on undertaking site surveys, desktop studies and geotechnical investigations prior to design of the basement and waterproofing system are given in The Concrete Centre "Concrete Basements" publication[10] and BS 8102[1]. Guidance on assessing the aggressive chemical environment is included in BRE Special Digest 1[14].

Based on the above, and the Client's requirements, the grade of usage of the basement is specified by the Client's Engineering Team. The advice on selecting the grade of the basement is provided in The Concrete Centre "Concrete Basements" publication[10] and BS 8102[1].

Depending on the water table classification (low, variable, high), the type of water resisting construction can be selected using advice given in The Concrete Centre "Concrete Basements" publication[10] and BS 8102[1].

The Certificate Holders are responsible for the selection of the waterproofing system.
When selecting the appropriate waterproofing approach, the following factors shall be considered:

a) whether a combined protection strategy is required;
b) the classification of the water table and the performance grade to be achieved;
c) the presence and level of radon, methane or other ground gases;

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d) the requirement to limit water vapour transmission;
e) the form of the system and the practicality of carrying out any necessary repairs;
f) buildability issues, including the level of protection needed during construction;
g) the long-term durability of the chosen system, including its expected performance and any maintenance obligations.

This certificate only covers the SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System that can be classified as a Type B (structurally integral protection) waterproofing system in accordance with BS 8102[1]. Use of the combined systems may be necessary where the consequence of failure to achieve the required internal environment, as specified by the client is high and/or where the output of a risk assessment carried out in accordance with BS 8102[1] is deemed high. In general, grade 3 and above will require a combined protection for RC box design (refer to The Concrete Centre "Concrete Basements" publication[10]). Other systems that are available and could be considered for a combined system for waterproofing are Type A (barrier protection) and Type C (drained protection) in accordance with BS 8102[1].

When considering radon, methane and other gas protection, the risk assessment as described in BS 8485[2] shall be carried out to establish the required measures for ground gas protection. The required measures will depend on the building type and its usage, and its gas risk based on ground investigation and radon maps published by the Environmental Protection Agency (EPA). Where the risk of ground gases is high in accordance with BS 8485[2] and/or radon maps published by the EPA, the use of a combined system may be necessary. The combined system may consist of structural barrier of basement slab, ventilation measures and gas resistant membrane. In accordance with TGD to Part C of the Building Regulations, the installation of protection measures for radon and ground gases is not a warranty that radon/ground gases concentration levels will be reduced below the relevant National Reference Levels. Building owners are recommended to have the radon concentration level assessed when the building is occupied.

SubTerra/Drytech is responsible for the review of site surveys, geotechnical investigation data, client's requirements, and to provide a design and specification for the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab to meet the client's Engineering Team's (BS 8102[1], BS 8485[2]) requirements.

2.5.2 Site Installation

In all applications the manufacturers Application Guide and Data Sheet should be followed and adhered to for installation.
Site dewatering is the responsibility of the main contractor and must be undertaken as necessary (and shall be conducted taking the advice in BS 8102[1] into account) to ensure that installation works are carried out in a controlled environment. Localised water management measures may be required to relieve hydrostatic pressure prior SubTerra's works starting.

Site installation of reinforced concrete is the responsibility of the Main Contractor. The concrete shall be placed in accordance with I.S. EN 206[6] and I.S. EN 13670[11].

The quality of workmanship in preparing substrates and placing concrete is essential for Type B waterproofing systems. The following shall be considered when placing the concrete:

a) strict adherence to the Structural Engineer's specification and drawings for concrete and reinforcement;
b) continuous quality control of the installation of reinforcement and concrete on site;
c) pour sizes and aspect ratios;
d) requirements for curing of concrete;
e) required formwork, formwork spacers and plugs;
f) design for crack widths and effects of shrinkage cracking.

SubTerra can advise and design the system to minimise the effects of shrinkage cracking through application of crack inducing units (SubTerra/Drytech White Tank System) and post tensioning of the system (GeoStruct Reactive Slab).

SubTerra is responsible for the installation of the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System including placement of DRYset waterstops, injection units, DRYflex resin and the sealing of formwork holes. The installation of SubTerra/Drytech White Tank System & GeoStruct Reactive Slab System must be carried out by SubTerra installers that are trained and who adhere to the strict installation instructions as specified by SubTerra. Figure 12 and Figure 13 shows some of the installation steps carried out by SubTerra.

SubTerra is responsible carrying out a pre-installation inspection, prior to the placement of the concrete and prior to DRYflex resin injection, to check for any concrete defects (e.g. honeycombing, cracking) and inspecting the SubTerra/Drytech White Tank System and GeoStruct Reactive Slab elements installation. All remedial action to repair the concrete is the

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responsibility of the Main Contractor. Repairs to concrete shall be carried out in accordance with the relevant parts of I.S. EN 1504. SubTerra is responsible for any remedial actions if necessary to SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab elements.

Guidance on verification checks on Type B waterproofing protection is provided in the Construction Industry Research and Information Association (CIRIA) C801 guide[12].

Note: This Certificate contains illustrations to explain the various elements of the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System – these illustrations are not intended to be used as construction drawings. SubTerra, in conjunction with the Design Team on a project, will produce a set of project specific details on a project specific basis. All drawings should be compliant with the relevant codes of practice and standards, along with the Irish Building Regulations.

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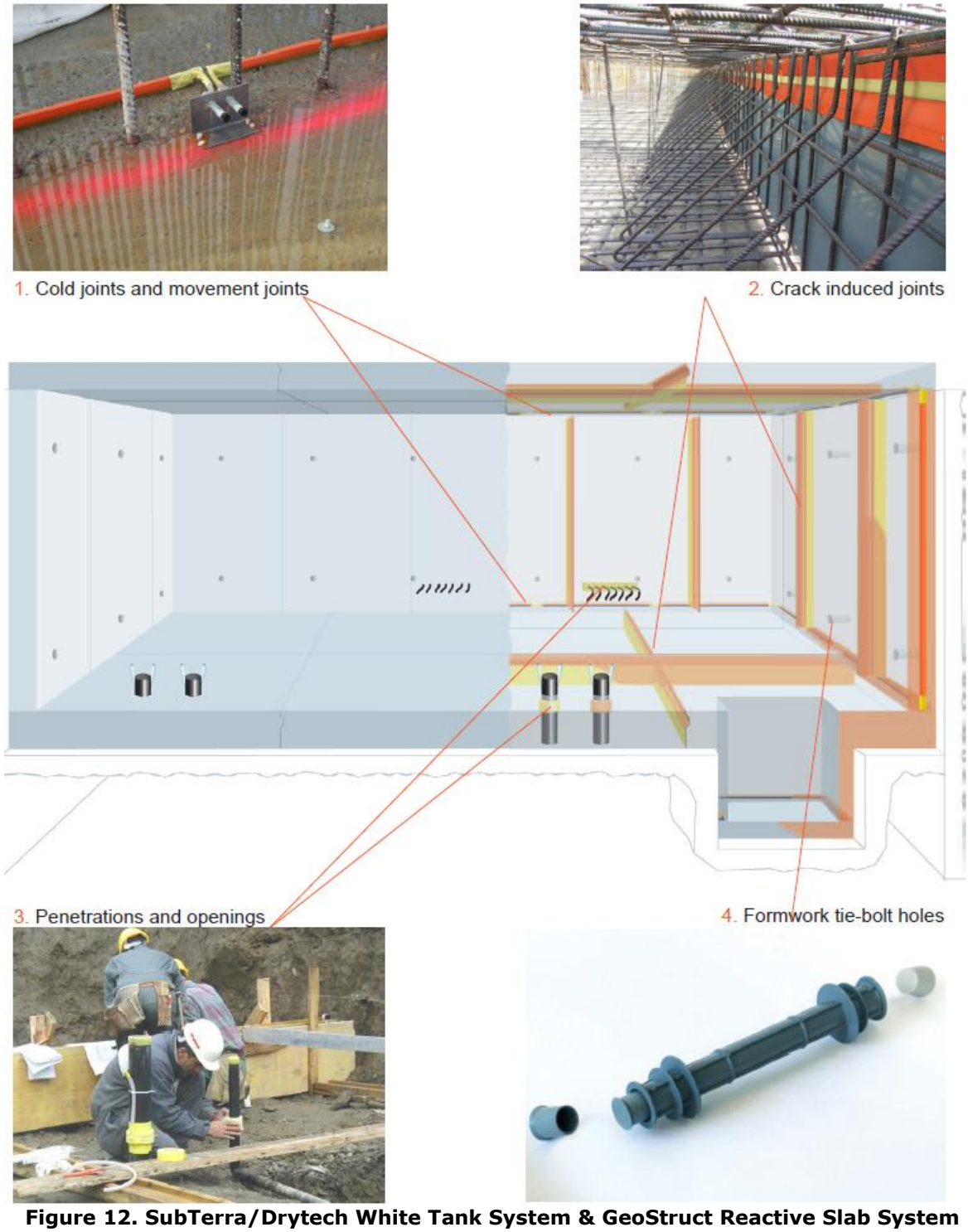

Figure 12. SubTerra/Drytech White Tank System & GeoStruct Reactive Slab System

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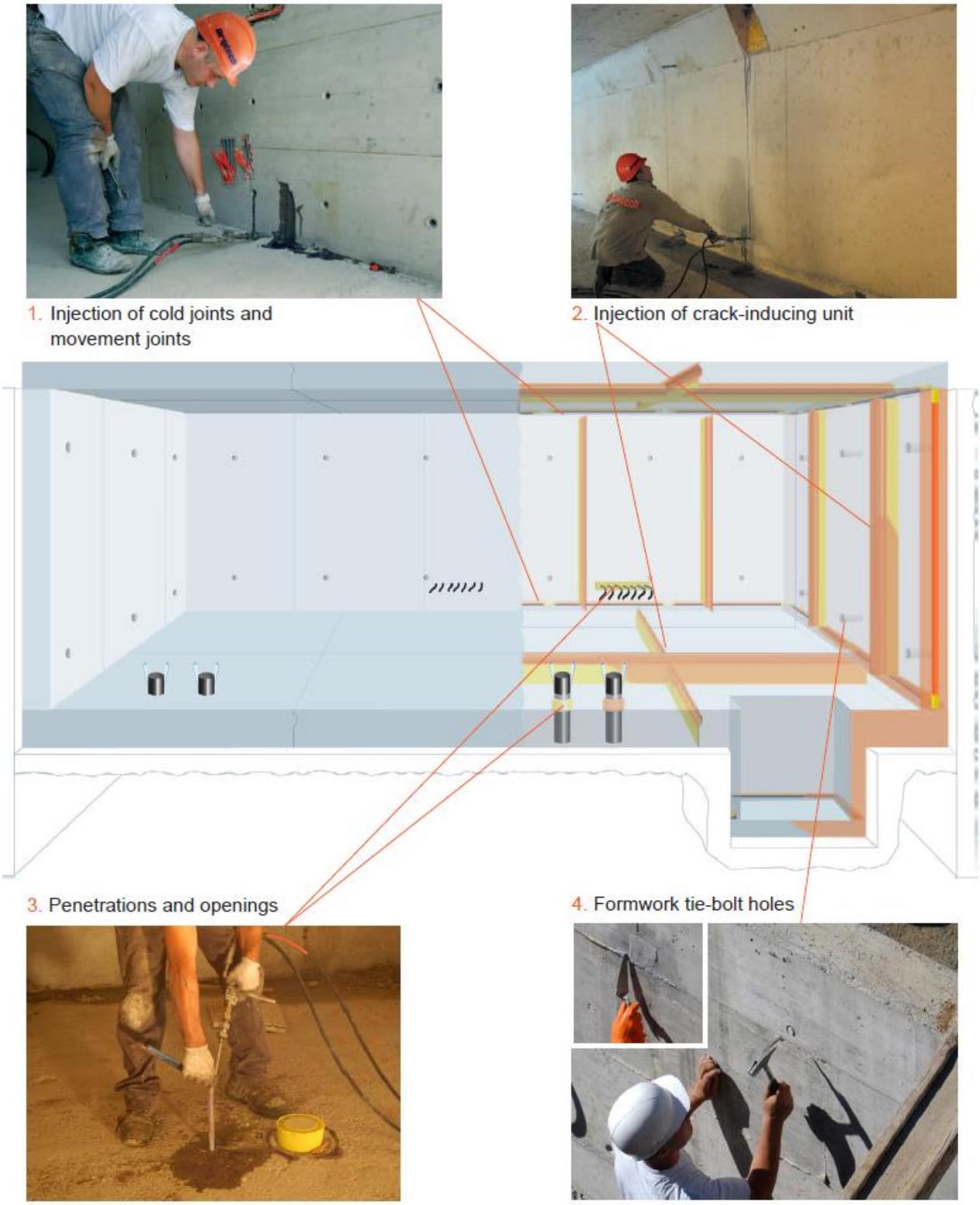

Figure 13. Injection process

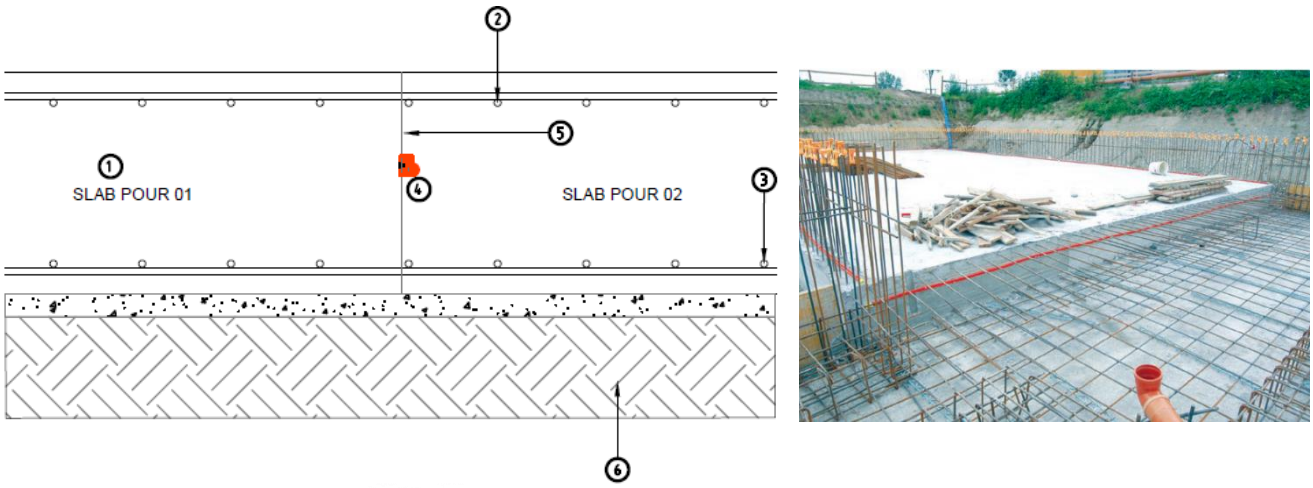

Figure 14: Typical slab-slab cold joint detail

1. Reinforced concrete slab to Structural Engineer's specification
2. Top reinforcement to Structural Engineer's specification
3. Bottom reinforcement to Structural Engineer's specification
4. DRYset injection joint to SubTerra's specification
5. Cold joint
6. Granular material to Structural Engineer's specification

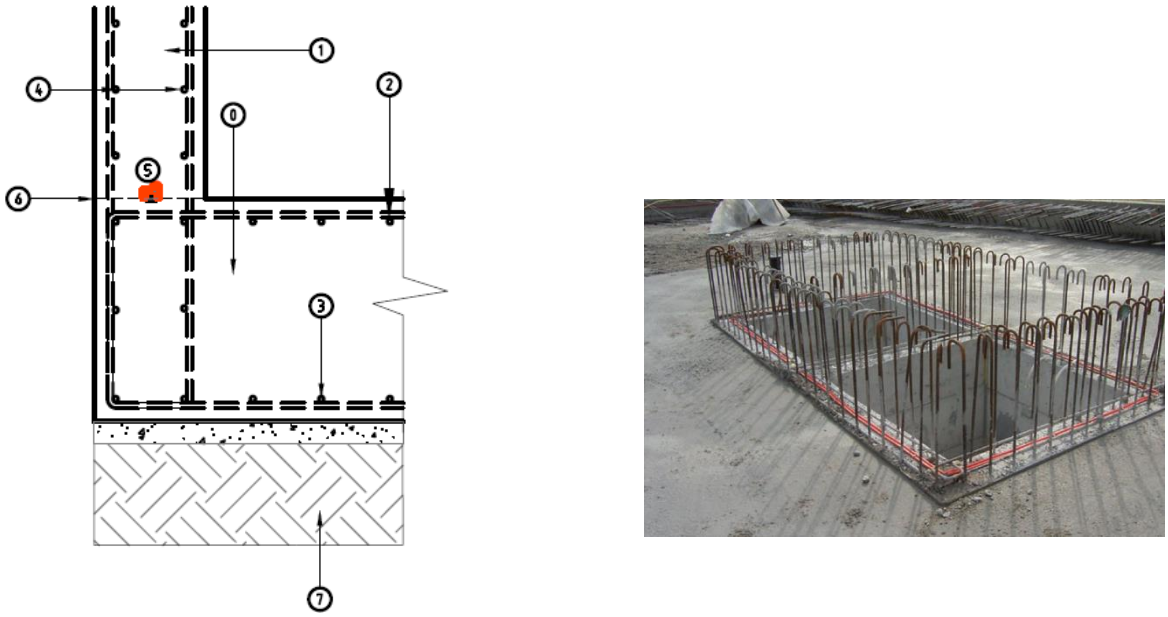

Figure 15: Typical slab-wall cold joint detail

1. Reinforced concrete wall to Structural Engineer's specification
2. Reinforced concrete slab to Structural Engineer's specification
3. Slab reinforcement to Structural Engineer's specification
4. Wall reinforcement to Structural Engineer's specification
5. DRYset injection joint to SubTerra's specification
6. Cold joint
7. Granular material to Structural Engineer's specification

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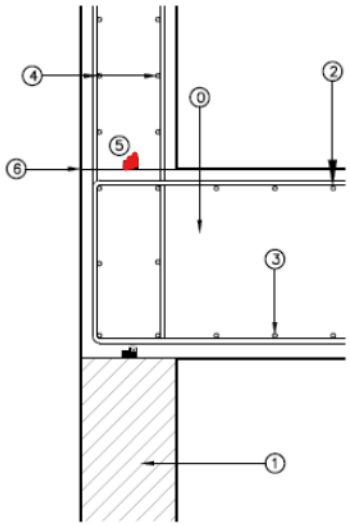

Figure 16: Typical floor slab-wall cold joint detail

0. Reinforced concrete slab to Structural Engineer's specification
1. Reinforced wall
2. Top reinforcement to Structural Engineer's specification
3. Bottom reinforcement to Structural Engineer's specification
4. Wall reinforcement to Structural Eningeer's specification.
5. DRYset injection joint to SubTerra's specification
6. Cold joint

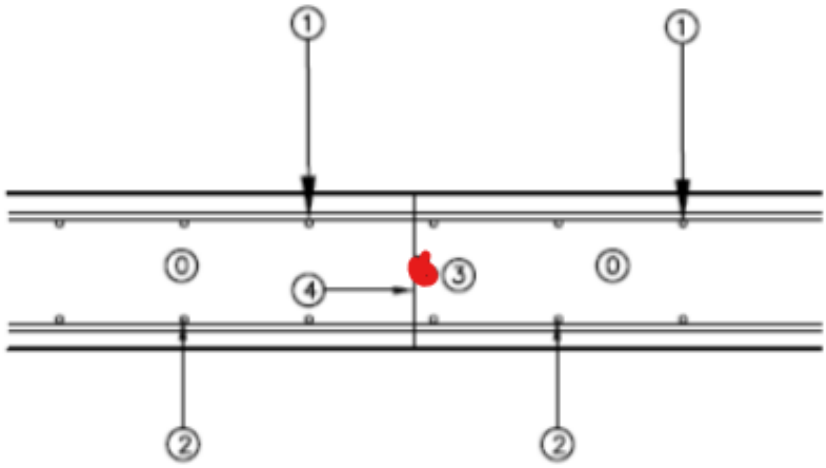



Figure 17: Typical wall-wall cold joint detail – plan view

0. Reinforced concrete wall to Structural Engineer's specification
1. Wall reinforcement to Structural Eningeer's specification
2. Wall reinforcement to Structural Engineer's specification
3. DRYset injection joint to SubTerra's specification
4. Cold joint

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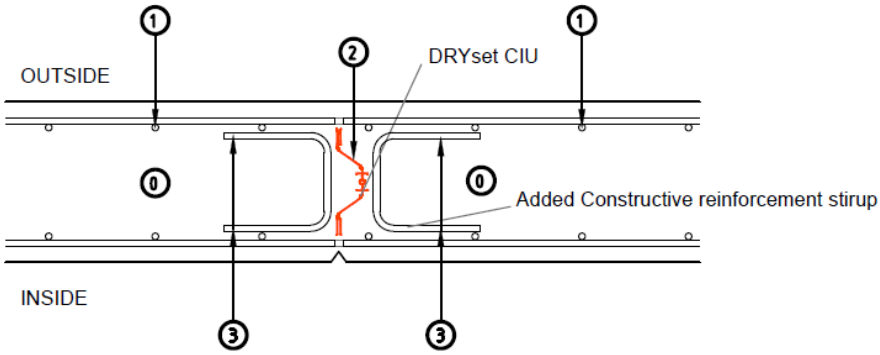
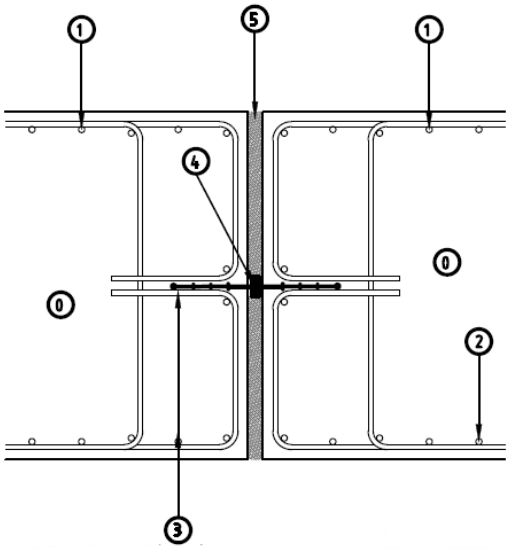




Figure 18: Typical floor wall-wall crack inducing unit

0. Reinforced concrete wall to Structural Engineer's specification
1. Reinforcement to Structural Engineer's specification
2. DRYset crack inducing unit to SubTerra's specification
3. Reinforcement stirrups to Structural Engineer's specification



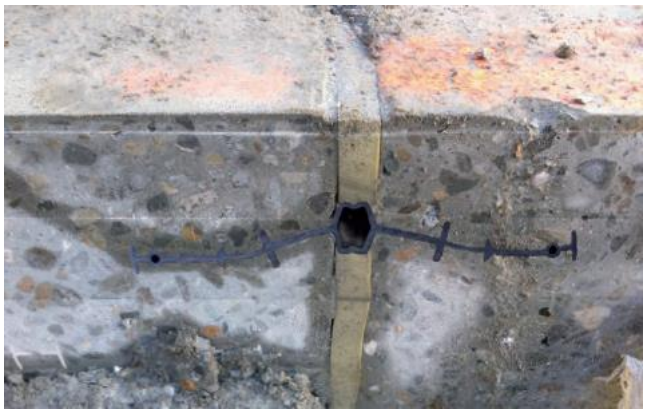


Figure 19: Typical slab-slab expansion joint

0. Reinforced concrete slab to Structural Engineer's specification
1. Top reinforcement to Structural Engineer's specification
2. Bottom reinforcement to Structural Engineer's specification
3. Reinforcement stirrups to Structural Engineer's specification
4. DRYset expansion waterstop
5. Polystyrene to SubTerra's specification

3.0 GENERAL

The SubTerra/Drytech White Tank System can be used to provide a waterproofing protection for use in basements and podiums as Type B (structurally integral protection) in accordance with BS 8102[1], as one of the measures to provide ground gases/radon protection in accordance with BS 8485[2] and to provide early age shrinkage control.

When used in combination with the post-tensioning of horizontal elements and SSIA, the GeoStruct Reactive Slab System can additionally provide:

a) structural mitigation against ground movement, variable bearing conditions and differential settlement through soil-structure interaction design.
b) Potential reduction of substructure, pile requirements and slab deflection due to control stress distribution in the slab to the underside of the ground floor/basement slab in comparison to traditional/standard reinforcement concrete design can also be achieved using the GeoStruct Reactive Slab System.

The SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System is intended for use where the architect's finalized construction and fire strategy drawings are available and satisfy the Irish Building Regulations. The Architect and Engineering Design Team of the client are responsible for the architectural drawings and compliance of the building design with the Irish Building Regulations.

3.1 STRUCTURAL DESIGN

Basement and podium structures are constructed as a reinforced concrete (RC) box structure.

The reinforced concrete design shall be undertaken either by SubTerra's Chartered Structural Engineer or by the Client's appointed Chartered Structural Engineer. Responsibility for the design of all substructure elements—including basements and podiums—shall be formally agreed during the contract stage between the client, SubTerra, and the client's Engineering Team.
When the GeoStruct Reactive Slab System is adopted for a project, SubTerra's Chartered Structural Engineer assumes responsibility for the structural design of that system.

The design of the reinforced concrete box structure shall take the following factors into consideration:

a) Results from all necessary geotechnical, hydrogeological and other surveys including desktop studies as indicated in Section 2.6.1 of this Certificate;
b) Concrete mix design to meet its end use, client's specification, concrete cover, exposure class and durability criteria. The concrete shall be designed considering the requirements of I.S. EN 206[6];
c) The site's chemical conditions to determine the appropriate ACEC (Aggressive Chemical Environment for Concrete) Classification and DC (Design Chemical) Classification in accordance with the guidance set out in BS 8500-1[7]. The resulting DC Classification shall be communicated to the concrete supplier to ensure the correct concrete specification is adopted. Risk assessment of the proposed solution shall be carried out by a Geotechnical Engineer and the Structural Engineer when the aggressive environment is identified on site and there is no proposal to remove the contaminated soil/material. However, it should be noted that the system has not been assessed for use in aggressive environments, and this is outside of this Certificate scope;
d) Reinforced concrete elements shall be designed to I.S. EN 1992-1-1[5] and I.S. EN 1992-3[4]. Tightness class and maximum permissible crack widths shall be in accordance with I.S. EN 1992-3[4];
e) Pour sizes, aspect ratios, curing, materials storage shall be considered in the design;
f) Ground movement and settlement shall be factored in;
g) Effects of shrinkage and cracking due to early age thermal effect, drying and restraint locations should be taken into consideration;
h) Load transfer between superstructure and basement/podium elements shall be taken into account for structural design (in permanent condition and during construction).
i) Loading due to ground pressure, heave, upward buoyancy, groundwater, lateral restraint, adjacent buildings, construction loading shall be considered in the structural design (in permanent condition and during construction);
j) Method of construction and movement joints shall be accounted for.

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Additional considerations may also apply depending on client's requirements, scope of the project and project specific criteria.

Design for ultimate limit states in accordance with I.S. EN 1990[15] including equilibrium (EQU), strength of structural elements (STR) and resistance of the soil (GEO) shall be verified by the Chartered Structural Engineer on the project. For the design of serviceability limit states, deflections shall be checked to I.S. EN 1992-1-1[5] and cracking to I.S. EN 1992-3[4].

The SubTerra/Drytech White Tank System can provide early age shrinkage control by incorporating crack-inducing units to limit crack widths in accordance with the structural design and system requirements. These induced cracks, along with the crack-inducing units themselves, are subsequently injected with DRYflex resin to ensure watertightness at those locations.

The GeoStruct Reactive Slab System can provide structural mitigation for ground movement, variable bearing conditions and differential settlement through soil–structure interaction.

General requirements and guidance on structural design of basements can be found in The Concrete Centre "Concrete Basements" publication[10] and BS 8102[1].

3.2 WATERPROOFING PROTECTION

SubTerra is responsible for design of the SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System. Approved systems are adapted to individual projects by SubTerra on a project specific basis in accordance with an approved process.

SubTerra is responsible for all SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System component's specification and design to meet the client's criteria.
The main criteria to be considered include:

a) Grade of the use of the basement in accordance with BS 8102[1];
b) Type of waterproofing protection to meet client's requirements;
c) Water table classification;
d) Form of construction;
e) Tightness class to I.S. EN 1992-3[4];
f) Reinforced concrete specification;
g) Other client's criteria such as gas protection measures, drainage, ventilation and access;
h) Service penetrations;
i) Structural design considerations as per Section 3.2 of this Certificate.

The SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System are considered Type B waterproofing solutions, providing structurally integral protection in line with BS 8102[1]. Resin injectable DRYset waterbars, as per Section 2.1 are used with the systems. DRYflex injection resin manufactured to I.S. EN 1504-5[3] are used together with the DRYset waterbars.

A combined waterproofing strategy may be required where maintaining the client's specified internal environment is critical, and/or where the BS 8102[1] risk assessment identifies a heightened level of risk. Typically, reinforced concrete box structures designed for Grade 3 conditions or higher will require more than one form of protection (refer to The Concrete Centre's *Concrete Basements* publication[10] and BS 8102[1]). Additional measures that may be incorporated into a combined approach including Type A (barrier protection) and Type C (drained protection) systems, as defined in BS 8102[1].

Drytech has taken responsibility of CE marking the DRYflex resin to I.S. EN 1504-5[3].
The testing confirmed that the DRYflex resin is:

a) waterproof;
b) not corrosion-promoting;
c) swellable and reversible in its swelling and drying properties;
d) compatible with concrete;
e) elastic and resistant to aging.

The NSAI assessment was performed against the Certificate holders Declaration of Performance (DoP) listed in the bibliography [19][20] which should be referenced for the essential characteristic values of the DRYflex resin.

Waterproofing effectiveness of the Type B (structurally integral protection) system is dependent on good workmanship at construction site. Site installation shall be in accordance with Section 2.6 of this Certificate. A high level of quality control shall be implemented on site to ensure the effectiveness of the system.

3.3 GROUND GASES/ RADON PROTECTION

The SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System can be used as one of the measures to provide ground gases/radon protection to basement structures in accordance with BS 8485[2].

Drytech has independently tested their system to radon gas resistance.
The results indicated that:

a) Drytech white tank concretes tested at 60 days have a radon gas diffusion coefficient less than or equal to 2.82 x 10-9 m^2/s and a diffusion length less than or equal to 36.7

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mm; they are to be considered waterproof for thicknesses greater than 110 mm;
b) at 7 days of age DRYflex resin is characterized by a radon gas diffusion coefficient of 0.35 x 10-9 m^2/s; its permeability to radon gas is lower than that of Drytech white tank concrete in which it is injected;
c) the formwork system as described in Section 2.2.6 of this Certificate is to be considered gas-tight to radon gas.

The results of the above testing confirmed that Drytech white tank concretes in combination with DRYflex resin can provide ground gases/radon protection measure as a as part of structural barrier type protection. BS 8485[2] requires a minimum of two protection measures, either structural barrier, ventilation measures and/or a gas resistant membrane. The method of selecting the protection measures will depend on the risk assessment to BS 8485[2] as described in the next paragraph.

When the SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System is used as one of the ground gases/radon protection measures to basement structures, the risk assessment shall be provided to the client in accordance with BS 8485[2]. The risk assessment is used to indicate protective measures depending on the building type, its intended use and the level of gas risk identified through ground investigation including the radon maps issued by the Environmental Protection Agency (EPA). Where BS 8485[2] and EPA radon mapping indicates a high ground-gas risk, a combined protection strategy may be necessary. Such a system may include the the SubTerra/Drytech White Tank System or the GeoStruct Reactive Slab System acting as a structural barrier, ventilation measures, and/or a gas-resistant membrane.

In line with TGD Part C of the Building Regulations, the installation of radon or ground-gas protection measures does not guarantee that concentrations will be reduced below the relevant National Reference Levels. Building owners are therefore advised to test radon levels once the building is occupied. For advice on radon testing visit EPA website.

Similarly to waterproofing protection, the effectiveness of the SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System use for ground gases/ radon protection measures is dependent on good workmanship at construction site. Site installation shall be in accordance with Section 2.5 of this Certificate. A high level of quality control shall be implemented on site to ensure the effectiveness of the system.

3.4 ANCILLARY CERTIFICATION OF COMPLIANCE

Ancillary certificates of compliance shall be provided for the project to satisfy the Building Control (Amendment) Regulations (BC(A)R)[18]. When considering only the SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System, as a minimum the following shall be provided on completion of the project:

a) Structural Engineer's ancillary certification of compliance (completion: design and inspection);
b) Waterproofing specialist's ancillary certification of compliance (completion: design and inspection);
c) Waterproofing installers and Main Contractor's ancillary certification of compliance on completion;

SubTerra is responsible for providing ancillary certification to as agreed project scope and to meet BC(A)R.

3.5 INSPECTION, REMEDIALS AND MAINTENANCE

3.5.1.1 Inspection

A basement structure, unlike a purpose-designed water-retaining element, cannot normally be subjected to a controlled watertightness test once construction is complete. After backfilling, the external face that resists hydrostatic pressure is typically buried and inaccessible, eliminating the possibility of direct observation, leak tracing, or pressure testing. This constraint means that the performance of the waterproofing system is governed almost entirely by the integrity of the as-built works rather than any post-installation validation.

Because the primary barrier to water ingress is concealed, the construction process must achieve a high degree of dimensional accuracy, continuity of waterproofing, and defect-free joint formation. Critical operations—such as concrete placement, compaction, curing, joint detailing, service penetrations, and installation of waterbars or resin injection —must be executed within tight tolerances. Quality assurance therefore relies on a structured inspection and test plan, including hold points, documented checks, and verification of substrate preparation, material compatibility, and environmental conditions during installation. Any deviation from specified workmanship standards may introduce latent pathways for water migration that cannot be rectified without major excavation.

This places a premium on rigorous supervision, traceable records, and adherence to formalised procedures throughout the construction sequence, as these are the only practical means of ensuring long-term watertight performance in the absence

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of feasible post-completion testing. SubTerra has provided evidence of their robust quality control and inspection regime and are responsible for inspection and ancillary certification of the SubTerra/Drytech White Tank System & the GeoStruct Reactive Slab System.

3.5.1.2 Remedials

Remedial measures may be needed due to the nature of basement structures. Minor repairs may need to be designed and specified by SubTerra to satisfy client's requirements. Remedial measures are covered in BS 8102[1].

A key advantage of the system is its capability to re-inject DRYset units with DRYflex resin if required.

3.5.1.3 Maintenance

Operation and Maintenance (O&M) Manual provided for the project shall include information on the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System component's specification and routine maintenance required. SubTerra will provide the above information for inclusion in the O&M Manual.

In general, no maintenance of the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System is required when it is installed in accordance with this Certificate, inspection by Building Owner is provided as per next paragraph and any remedial measures identified during the inspections are carried out.

In general, the inspection of the basement shall take place after:

a) any water issues such as pooling water, dampness, water ingress, flooding, etc.;
b) any cracking appearing in the basement structure;
c) identified structural issues with basement structure;
d) major weather events such as extended rain, floods and/or storms;

It is the Building Owners responsibility to carry out regular inspections of the building when occupied. It shall be the responsibility of the Building Owner to monitor the condition of the building and commission maintenance and repairs as required. and they shall be carried out by the Building Owner in accordance with BS 8210[16].

It is important to note that alterations to the basement and podium structure subsequent to the installation of the system, must take into account the integrity of the system. In any case, any damage to the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System shall be repaired immediately in consultation with the Certificate Holder.

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4.1 STRUCTURAL DESIGN

An assessment was carried out to I.S. EN 1992-1-1[5], I.S. EN 1992-3[4] for reinforced concrete basement and podium structures incorporating the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System and indicated that the systems meet the requirements of TGD Part A (Structure) in relation to the Irish Building Regulations.

The following was assessed to determine if the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System meet the requirements of TGD Part A (Structure) in relation to the Irish Building Regulations and current standards and codes requirements:

a) Structural design of the systems,
b) Engineering Manual provided by Drytech/SubTerra,
c) Structural drawings,
d) Structural testing of DRYset elements,
e) Competencies of the designers.

4.2 WATERPROOFING PROTECTION

An assessment was carried out to BS 8102[1] and indicated that the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System can be classified, and meet the requirements, for a Type B structurally integral protection waterproofing system to BS 8102[1].

The following was assessed to determine if the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System meet BS 8102[1], Part C4 of the Building Regulations and current standards and codes requirements:

a) The manuals for the systems;
b) Component specifications and tests;
c) Manufacturing facility inspection;
d) Site visit inspections;
e) Installation procedures as outlined in the Application Guide and Data Sheet;
f) Typical drawing details for the systems

4.3 GROUND GASES/ RADON PROTECTION

An assessment was carried out to BS 8485[2] and indicated that the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System can be classified and meet the requirements for a structural barrier system in accordance with BS 8485[2]. When the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System are installed as grade 2 waterproofing in accordance with BS 8102[1], then the gas protection value for the structural barrier has been shown that it can achieve a score of 2.

At least one additional gas protection measure such as ventilation measures and/or a gas resistant membrane must be installed within the building to meet the requirements of BS 8485[2]. The total gas protection score is calculated by adding the scores of all the proposed measures and the final value must meet or exceed the minimum score required under BS 8485[2]. Where BS 8485[2] and/or the EPA radon mapping indicate a high ground-gas risk, a combined protection strategy may be necessary.

The following aspects were assessed to determine if the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System meet BS 8485[2] and TGD Part C3 of the Irish Building Regulations and current standards and code requirements:

a) Independent radon testing of Drytech concrete, DRYflex resin and formwork system as indicated in Section 3.3 of this Certificate;
b) Radon monitoring data for completed buildings incorporating the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System;
c) SubTerra's risk assessments to BS 8485[2] for projects;
d) Independent radon mitigation risk assessments reports for projects.

4.4 DRYFLEX RESIN

DRYflex resin is manufactured to I.S. EN 1504-5[3]. The DRYflex resin is classified as an "(S)", "Injection product for swelling fitted filling of cracks" in accordance with I.S. EN 1504-5[3].

The following tests to I.S. EN 1504-5[3] were reviewed as part of the assessment:

a) Watertightness;
b) Corrosion behaviour;
c) Viscosity;
d) Expansion ratio and rate of water storage,
e) Workable time;
f) Sensitivity to water: expansion ratio caused by water storage;
g) Sensitivity to drying-wetting cycles;
h) Compatibility with concrete.

DRYflex resin as described in this Certificate is adequate for the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System

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as an injectable resin product for DRYset units and waterbars - see Clause 3.2 if this certificate.

4.5 DURABILITY

Under normal service conditions, the SubTerra/Drytech White Tank System and the GeoStruct Reactive Slab System will have a service life equivalent to the structure in which it is incorporated, provided it is designed, installed and maintained in accordance with this Certificate and the Certificate holder's instructions.

The durability of the reinforced concrete elements will depend on the client's criteria and the design of the structure to I.S. EN 1992-1-1[5] and I.S. EN 206[5].

The following were reviewed as part of the durability assessment:

a) Tests to I.S. EN 1504-5[3];
b) Inspection of as completed buildings;
c) Specification of materials.
d) Maintenance and repair manuals.

4.6 PRACTICABILITY & INSTALLTION

The practicability of construction and the adequacy of site supervision arrangements were assessed and considered adequate. The project specific designs and method statements for application, inspection and repair were reviewed and found to be satisfactory. The installation procedures as outlined in the Application Guide and Data Sheets were reviewed, and the installation of the systems was observed on site. The installation procedures were found to be satisfactory.

4.7 OTHER INVESTIGATIONS

(i) Existing data on product properties in relation to fire, toxicity and the effect on mechanical strength/stability and durability were assessed.

(ii) The manufacturing process was examined including the methods adopted for quality control and details were obtained of the quality and composition of the materials used.

(iii) Site visits to assess the practicability of installation, constructability and quality control were undertaken.

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5.1 National Standards Authority of Ireland ("NSAI") following consultation with NSAI Agrément has assessed the performance and method of installation of the product/process and the quality of the materials used in its manufacture and certifies the product/process to be fit for the use for which it is certified provided that it is manufactured, installed, used and maintained in accordance with the descriptions and specifications set out in this Certificate and in accordance with the manufacturer's instructions and usual trade practice. This Certificate shall remain valid for five years from date of latest revision so long as:

(a) the specification of the product is unchanged;

(b) the Building Regulations and any other regulation or standard applicable to the product/process, its use or installation remains unchanged;

(c) the product continues to be assessed for the quality of its manufacture and marking by NSAI;

(d) no new information becomes available which, in the opinion of the NSAI, would preclude the granting of the Certificate;

(e) the product or process continues to be manufactured, installed, used and maintained in accordance with the description, specifications and safety recommendations set out in this certificate;

(f) the registration and/or surveillance fees due to IAB are paid.

5.2 The NSAI Agrément mark and certification number may only be used on or in relation to product/processes in respect of which a valid Certificate exists. If the Certificate becomes invalid the Certificate holder must not use the NSAI Agrément mark and certification number and must remove them from the products already marked.

5.3 In granting Certification, the NSAI makes no representation as to;

(a) the absence or presence of patent rights subsisting in the product/process; or

(b) the legal right of the Certificate holder to market, install or maintain the product/process; or

(c) whether individual products have been manufactured or installed by the Certificate holder in accordance with the descriptions and specifications set out in this Certificate.

5.4 This Certificate does not comprise installation instructions and does not replace the manufacturer's directions or any professional or trade advice relating to use and installation which may be appropriate.

5.5 Any recommendations contained in this Certificate relating to the safe use of the certified product/process are preconditions to the validity of the Certificate. However, the NSAI does not certify that the manufacture or installation of the certified product or process in accordance with the descriptions and specifications set out in this Certificate will satisfy the requirements of the Safety, Health and Welfare at Work Act 2005, or of any other current or future common law duty of care owed by the manufacturer or by the Certificate holder.

5.6 The NSAI is not responsible to any person or body for loss or damage including personal injury arising as a direct or indirect result of the use of this product or process.

5.7 Where reference is made in this Certificate to any Act of the Oireachtas, Regulation made thereunder, Statutory Instrument, Code of Practice, National Standards, manufacturer's instructions, or similar publication, it shall be construed as reference to such publication in the form in which it is in force at the date of this Certification.

NSAI Agrément

This Certificate No. **26/0454** is accordingly granted by the NSAI to **Drytech Waterproofing Limited** on behalf of NSAI Agrément.

Date of Issue: **07th August 2026**

Signed



Kevin D. Mullaney
Director of Certification, NSAI

Readers may check that the status of this Certificate has not changed by contacting NSAI Agrément, NSAI, 1 Swift Square, Northwood, Santry, Dublin 9, Ireland. Telephone: (01) 807 3800. Fax: (01) 807 3842. www.nsai.ie

Bibliography

[1] BS 8102:2022 *Protection of below ground structures against water ingress — Code of practice*

[2] BS 8485:2015+A1:2019 *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*

[3] I.S. EN 1504-5:2013 *Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 5: Concrete injection*

[4] I.S. EN 1992-3:2006 Eurocode 2 - *Design of concrete structures - Part 3: Liquid retaining and containment structures*

[5] I.S. EN 1992-1-1:2004 +AC:2010+A1:2014 *Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings*

[6] I.S. EN 206:2013+A2:2021 *Concrete - Specification, performance, production and conformity*

[7] BS 8500-1:2023 *Concrete. Complementary British Standard to BS EN 206 - Method of specifying and guidance for the specifier*

[8] BS 5930:2015+A1:2020 *Code of practice for ground investigations*

[9] I.S. EN 1997-2:2007 *Eurocode 7 - Geotechnical design - Part 2: Ground investigation and testing*

[10] The Concrete Centre (2012) *Concrete Basements. Guidance on the design and construction of in-situ concrete basement structures*

[11] I.S. EN 13670:2009&LC:2019 *Execution of concrete structures*

[12] CIRIA C801 (2021) *Hazardous ground gas- a site management guide*

[13] CIRIA C735 (2014) *Good practice on the testing and verification of protection systems for buildings against hazardous ground gases*

[14] BRE Special Digest 1 (2005) *3rd edition. Concrete in aggressive ground*

[15] I.S. EN 1990:2002 *Eurocode – Basis of Structural Design*

[16] BS 8210:2020 *Facilities maintenance management — Code of practice*

[17] CIRIA C139 (1995) *Water resisting basement construction – A Guide*

[18] *S.I. No. 9/2014 - Building Control (Amendment) Regulations 2014.*

[19] *Declaration of Performance (DoP No. 17R2) DRYFLEX 1 (received 24.05.2022).*

[20] *Declaration of Performance (DoP No. 17R2) DRYFLEX 2 (received 24.05.2022).*