NAUE GmbH & Co KG
Gewerbestrasse 2
D-32339 Espelkamp/Fiestel
Germany
Tel: 00 49 574341-0 Fax: 00 49 57434124-0
e-mail: info@naue.com
website: www.naue.com

BBA APPROVAL INSPECTION TESTING CERTIFICATION
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
05/4256
Product Sheet 2

NAUE WATERPROOFING SYSTEMS

BENTOFIX X2 BFG 5300 WATERPROOFING SYSTEM

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to the Bentofix X2 BFG 5300 Waterproofing System, a composite membrane incorporating sodium bentonite for use in waterproofing and damp-proofing underground reinforced concrete structures. The system also restricts the flow of radon and methane from landfill and naturally occurring underground sources into the structure.

AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Resistance to water and water vapour — the system, including joints, will resist the passage of moisture into the structure (see section 5).

Resistance to underground gases — the system will provide an effective barrier to radon and methane (see section 6)

Resistance to mechanical damage — the membrane is resistant to damage and has the ability to self-heal if punctured (see section 7).

Durability — when fully protected, the system will provide an effective barrier to the transmission of moisture and will restrict the ingress of radon and methane for the life of the structure in which it is incorporated (see section 12).

The BBA has awarded this Agrément Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 10 June 2011

Simon Wroe
Head of Approvals — Materials

Greg Cooper
Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

Regulations

In the opinion of the BBA, the Bentofix X2 BFG 5300 Waterproofing System, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:

The Building Regulations 2010 (England and Wales)

Requirement:	A1	**Loading**
Comment:		Application of the system will not adversely affect a structure's ability to transmit loadings and will satisfy this Requirement. See section 9 of this Certificate.
Requirement:	C1(2)	**Site preparation and resistance to contaminants**
Comment:		The system, including joints, can contribute to a structure satisfying this Requirement with regard to radon and methane. See sections 6.1 to 6.4 of this Certificate.
Requirement:	C2(a)	**Resistance to moisture**
Comment:		The system, including joints, will enable a structure to satisfy this Requirement. See section 5 of this Certificate.
Requirement:	Regulation 7	**Materials and workmanship**
Comment:		The system is acceptable. See section 12 and the *Installation* part of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)	**Fitness and durability of materials and workmanship**
Comment:		The system can contribute to a construction satisfying this Regulation. See section 12 and the *Installation* part of this Certificate.
Regulation:	9	**Building standards — construction**
Standard:	1.1(a)(b)	Structure
Comment:		Application of the system will not adversely affect a structure's ability to transmit loadings, with reference to clause 1.1.1[(1)(2)]. See section 9 of this Certificate.
Standard:	3.1	Site preparation — harmful and dangerous substances
Standard:	3.2	Site preparation — protection from radon gas
Comment:		The system, including joints, can contribute to a structure satisfying clauses 3.1.6[(1)(2)], 3.2.1[(2)] and 3.2.2[(1)] of these Standards, with regard to control of the ingress of radon and methane. See sections 6.1 to 6.4 of this Certificate.
Standard:	3.4	Moisture from the ground
Comment:		The system, including joints, will enable a structure to satisfy clauses 3.4.1[(1)(2)], 3.4.2[(1)(2)], 3.4.5[(1)(2)], 3.4.6[(1)(2)] and 3.4.7[(1)(2)] of this Standard. See section 5 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The system can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	12	**Building standards — conversions**
Comment:		Comments made in relation to the system under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1[(1)(2)] and Schedule 6[(1)(2)]. (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).

The Building Regulations (Northern Ireland) 2000 (as amended)

Regulation:	B2	**Fitness of materials and workmanship**
Comment:		The system is acceptable. See section 12 and the *Installation* part of this Certificate.
Regulation:	C2(1)(2)	**Preparation of site and resistance to dangerous and harmful substances**
Comment:		The system, including joints, can contribute to a structure satisfying this Regulation with regard to radon and methane. See sections 6.1 to 6.4 of this Certificate.
Regulation:	C4(a)	**Resistance to ground moisture and weather**
Comment:		The system, including joints, will enable a structure to satisfy the requirements of this Regulation. See section 5 of this Certificate.
Regulation:	D1	**Stability**
Comment:		Application of the system will not adversely affect a structure's ability to transmit loadings and will satisfy the requirements of this Regulation. See section 9 of this Certificate.

Construction (Design and Management) Regulations 2007

Construction (Design and Management) Regulations (Northern Ireland) 2007

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 2 *Delivery and site handling* (2.1 to 2.4) and 13 *Installation — General* (13.3) of this Certificate.

Non-regulatory Information

NHBC Standards 2011

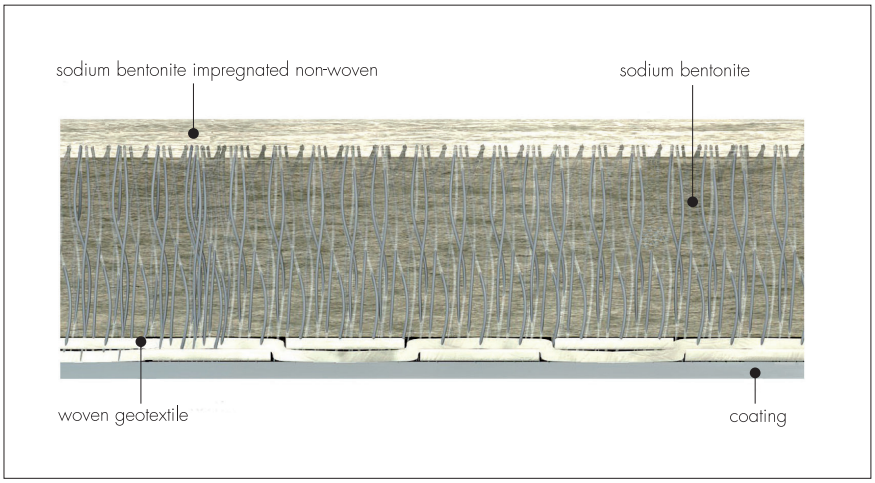
NHBC accepts the use of the Bentofix X2 BFG 5300 Waterproofing System, when installed and used in accordance with this Certificate, in relation to *NHBC Standards*, Part 5 *Substructure and ground floors*, Chapter 5.1 *Substructure and ground bearing floors*.

Technical Specification

1 Description

1.1 The Bentofix X2 BFG 5300 Waterproofing System is a waterproofing membrane consisting of two polypropylene geotextiles (a lower woven fabric and upper non-woven fabric) enclosing powdered sodium bentonite. The outer layer of the non-woven geotextile is impregnated with an additional layer of bentonite. The membrane has a total bentonite weight of 5 kg·m^{-2}. The two geotextiles are mechanically joined by a needle-punching process, pushing the fibres of the upper non-woven geotextile through the bentonite layer and securing them in the retaining lower woven layer. This process links the geotextiles and contains and confines the bentonite. The woven geotextile is coated with a polyolefin layer to provide additional resistance to moisture, radon and methane (see Figure 1).

Figure 1 Cross-section through Bentofix X2 BFG 5300



1.2 Bentofix X2 BFG 5300 is 6 mm thick and is available in three roll sizes. Dimensions and uses are given in Table 1.

Table 1 Dimensions and uses of Bentofix X2 BFG 5300

Membrane	Size (m)		Use
	Width	Length	
Micro liner	1.20	4.5	Backfill or vertical applications
Mini liner	2.42	15	For lining medium-size horizontal areas with limited obstructions or where access is restricted
Maxi liner	4.85	40	For lining large areas, such as horizontal floor slabs

1.3 Other components used with Bentofix X2 BFG 5300 include:

- Bentofix X Tape A — a single-sided, butyl adhesive tape with a coated aluminium foil backing, available in dimensions 0.8 mm by 150 mm by 35 mm and used to seal lapped membrane joints over fixings and around penetrations
- Proprietary soft washers — for fixing the membrane in vertical applications and used at 300 mm centres around the perimeter of the membrane and at 500 mm centres within the membrane
- Bentostrip T — a waterstop joint ribbon of sodium bentonite/butyl rubber with a cross sectional area of 25 mm by 19 mm, used to seal concrete construction joints
- Bentonite paste — a sodium bentonite paste mixed with water in the ratio of 4 : 1 and used to seal around penetrations
- Bentonet fixing mesh — a metal fastening profile used to secure and protect Bentostrip T during concrete placement.

1.4 Quality control tests are conducted on the raw materials, during production and on the final products.

2 Delivery and site handling

2.1 Bentofix X2 BFG 5300 is labelled and wrapped in a polythene film. The label details the company and product name, unique roll number and weight and dimensions. Specific details are given in Table 2.

Table 2 Supply information

Membrane	Roll diameter (mm)	Roll weight (kg)	No per pallet	Supplied
Micro liner	170	32	60	Supplied 60 on a pallet, shrink wrapped in black polythene film
Mini liner	350	220	1 or 6	Supplied individually or on a pallet strapped together with steel bands
Maxi liner	600	1050	—	Supplied individually on carpet poles for ease of handling

2.2 Bentofix X Tape A is supplied in a cardboard box containing two rolls of tape. Each box weighs 15 kg.

2.3 Rolls of Bentostrip T are packaged in cardboard boxes. Each box contains four rolls of 10 m length and they are supplied 28 boxes to a pallet. Bentonet fixing mesh is supplied in 1 m lengths. Each box weighs 27 kg.

2.4 Bentonite paste is supplied in 30 kg woven bags.

2.5 The membrane and components should be stored in dry conditions, under cover and away from the possibility of damage or premature contact with water. Bentostrip T should also be stored away from direct heat.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Bentofix X2 BFG 5300 Waterproofing System.

Design Considerations

3 General

The Bentofix X2 BFG 5300 Waterproofing System is satisfactory for use as a waterproofing and damp-proofing membrane in type A reinforced concrete basement constructions for grades 2 and 3 as defined in Table 2 of BS 8102 : 2009. The system will also restrict the ingress of radon and methane gases into the structure from landfill and naturally occurring sources.

4 Practicability of installation

The system is designed to be installed by contractors experienced with this type of system.

5 Resistance to water and water vapour

The system, including joints, when completely sealed with Bentofix X Tape A, will adequately resist the passage of moisture into the structure.

6 Resistance to underground gases

6.1 The system, including joints, when completely sealed with Bentofix X Tape A, will restrict the ingress of radon and methane from landfill and naturally occurring sources into the structure.

6.2 Structures in areas at risk from landfill gas should be constructed in accordance with the recommendations laid out in BRE Report 212 (BR 212 : 1991) *Construction of new building on gas-contaminated land* and BRE Report 414 (BR 414 : 2001) *Protective measures for housing on gas-contaminated land.*

6.3 Structures in areas at risk from radon gas should be constructed in accordance with the recommendations laid out in BRE Report 211 (BR 211 : 2007) *Radon : Guidance on protective measures for new buildings* and BRE Report 414 (BR 414 : 2001).

6.4 BRE Reports 211, 212, 376[1], 413[2] and 414 recommend that the minimum required thickness for a polyethylene gas-resistant membrane is 300 µm. It is generally accepted that other materials with comparable or higher gas resistance can be suitable, provided they can withstand the construction processes. Test data indicate that the system's resistance to radon and methane is greater than a 300 µm thick polyethylene sheet.

(1) BRE Report (BR 376 : 1999) *Radon : Guidance on protective measures for new dwellings in Scotland.*

(2) BRE Report (BR 413) *Radon : guidance on protective measures for new dwellings in Northern Ireland.*

7 Resistance to mechanical damage

The membrane is robust and resistant to normal site activities. The dropping of heavy objects will normally have no damaging effect on the membrane. Any accidental cuts will self heal when the membrane is hydrated following correct installation, provided that bentonite material is not lost from the edges of the cut. If the damage is more extensive or material is lost from the membrane it must be repaired (see section 17).

8 Chemical resistance

8.1 The gelling of sodium bentonite is adversely affected by the presence of electrolytes (particularly trivalent ions) and may also be affected by the presence of soluble cations such as those found in chalk or lime soils. In these situations or in chemically contaminated areas, advice should be sought from the Certificate holder.

8.2 The membrane is not affected by organic contaminants.

9 Resistance to loading

Provided the system is adequately confined, properly hydrated, and not subject to point loading, an installation beneath a foundation slab will transmit dead and imposed loads to the ground safely without excessive deformation. In situations where point loading is anticipated the Certificate holder's advice should be sought.

10 Adhesion

When concrete is cast against the non-woven side of the membrane the free ends of the needle-punched fibres become embedded in the concrete, creating a permanent bond between the concrete and membrane.

11 Maintenance

As the system is confined by the concrete and has suitable durability (see section 12), maintenance is not required. Any damage occurring during installation must be repaired in accordance with section 17.

12 Durability

The Bentofix X2 BFG 5300 Waterproofing System, when fully-protected and subjected to normal service conditions, will provide an effective barrier to the transmission of moisture and will restrict the ingress of radon and methane for the life of the structure in which it is incorporated.

Installation

13 General

13.1 The Bentofix X2 BFG 5300 Waterproofing System must be installed in accordance with the relevant requirements of BS 8102 : 2009 and the Certificate holder's instructions.

13.2 To ensure satisfactory adhesion of the Bentofix X Tape A, the system must be applied in dry conditions at temperatures between 5°C and 40°C.

13.3 Once installed the system is unaffected by most site conditions, including sub-zero temperatures and heavy rainfall. Under wet conditions the system can withstand light construction traffic without significant extrusion of the bentonite. Slight losses at the exposed edges of a lap joint will not impair the watertightness but may have an adverse effect on site safety. Excess pressure should be avoided once the membrane is hydrated.

13.4 The system must be installed on flat, smooth surfaces without wrinkles or folds in the membrane that could cause the membrane to sag during concrete placing. The Certificate holder can advise on suitable surfaces for a particular installation.

13.5 All surfaces to which the membrane is applied must be sound and solid to ensure no movement occurs during the pouring of concrete.

13.6 The membrane is either installed with the non-woven geotextile uppermost (horizontal) and outermost (vertical) ensuring it will be in contact with the fresh concrete when it is poured or can be fixed to existing concrete substrates (eg secant or contiguous piling), with the coated geotextile uppermost (horizontal) or outermost (vertical).

13.7 The membrane is easy to handle and can be cut using a sharp knife.

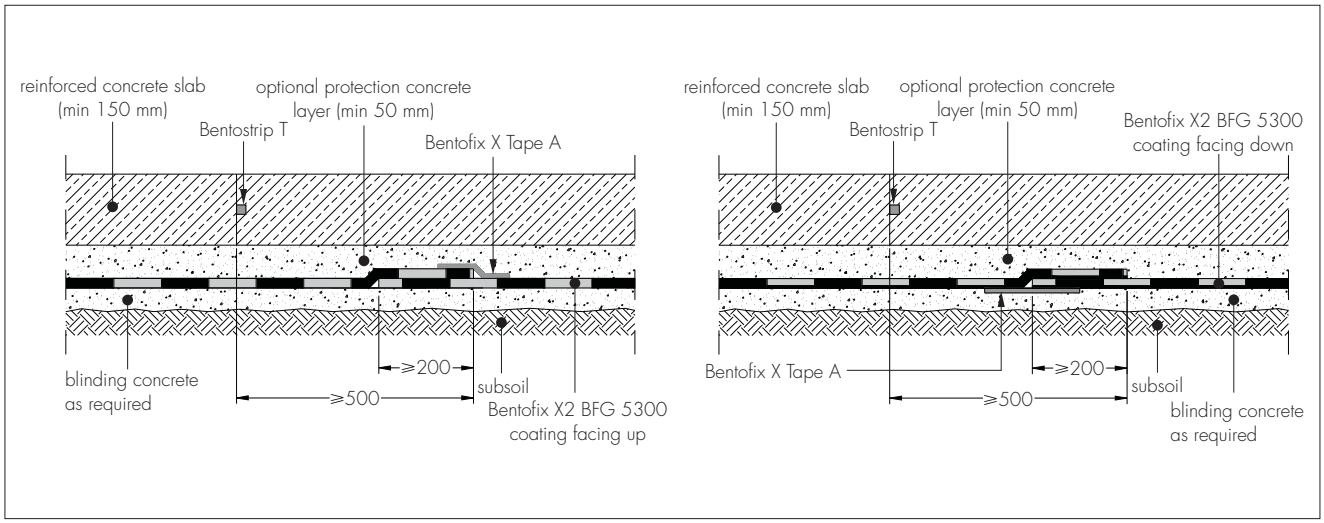
13.8 The membrane will swell on contact with moisture and must be confined to ensure a watertight seal is achieved in service. The Certificate holder should be consulted for a particular application to ensure that this is adequately achieved and the operation properly supervised.

13.9 The membrane and components must never remain permanently exposed.

14 Joints

14.1 The formation of a continuous barrier is achieved using minimum 200 mm lap joints. It is recommended that laps be staggered by a minimum of 300 mm to avoid four sheets overlapping in one location. All lap joints are sealed with Bentofix X Tape A (see Figure 2).

Figure 2 Bentofix X2 BFG 5300 installation overlap position at base concrete joint

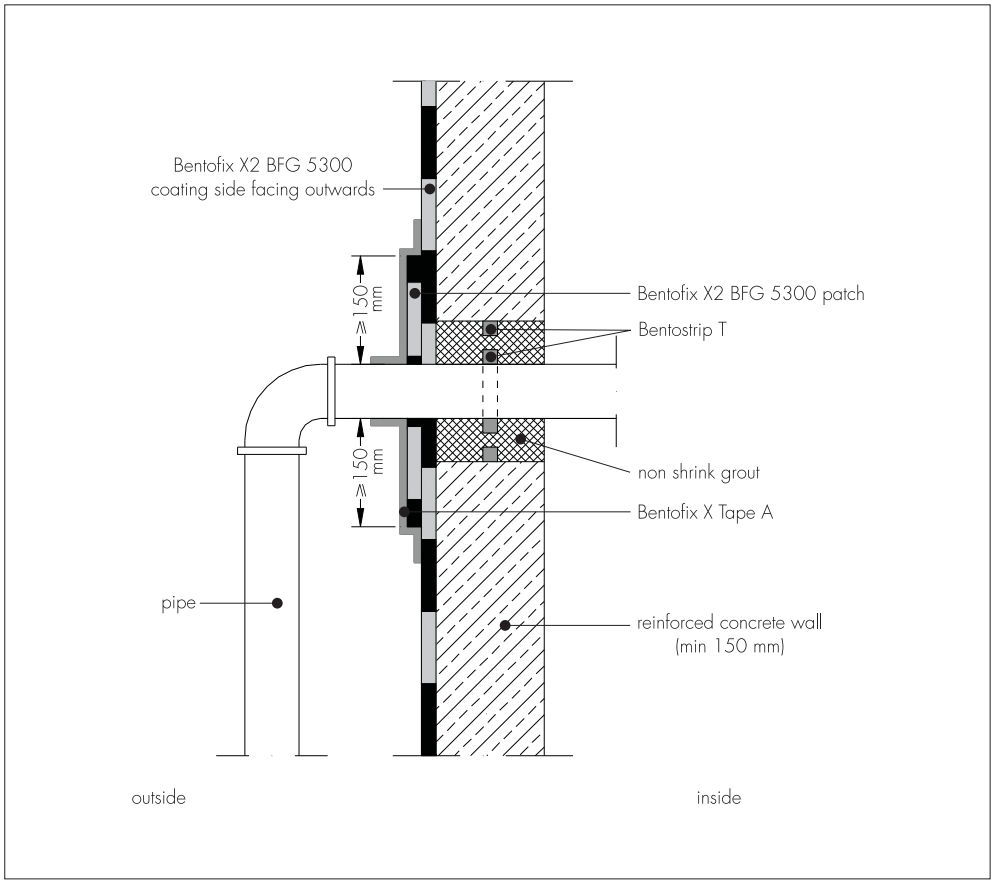


14.2 Overlaps should be planned to ensure they all run in a uniform direction. The concrete should be placed on top of the membrane following the direction of the overlaps to avoid folding of the membrane during concrete placing.

15 Penetrations and sealing

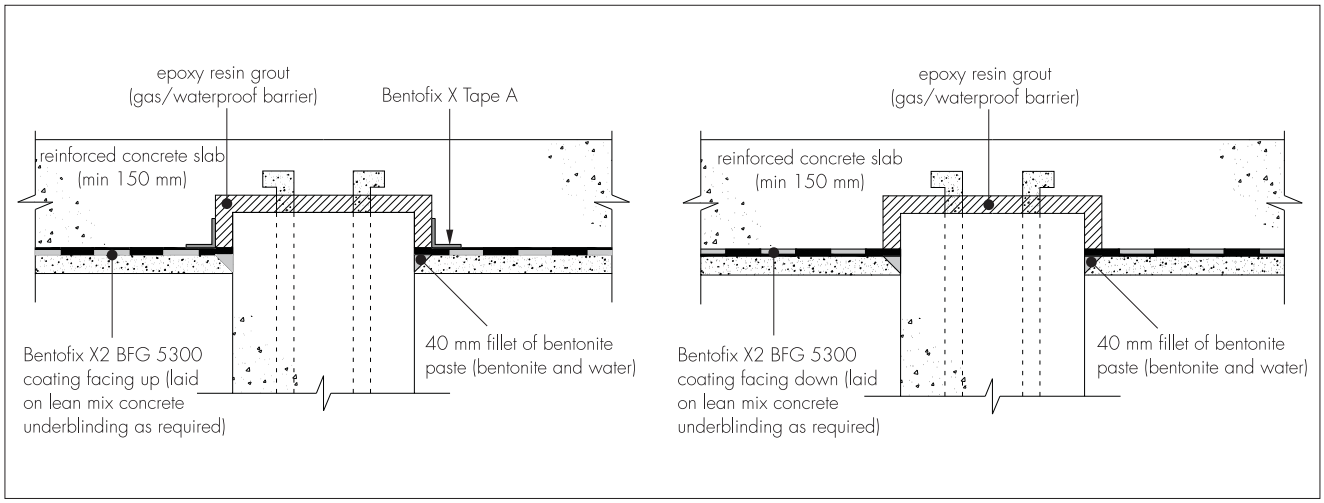
15.1 Sealing around protrusions through the membrane, eg at such details as service pipes, is accomplished by cutting a hole in the membrane, fitting the membrane over the protrusion and sealing around the protrusion on top of the membrane with a patch of Bentofix X2 BFG 5300 with the coated side facing outwards and extending a minimum of 150 mm each side of the protrusion. The patch is held in place with Bentofix X Tape A to ensure a gas-tight seal is achieved (see Figure 3).

Figure 3 Bentofix X2 BFG 5300 installation pipe penetration after core hole drilling



15.2 Sealing around pile heads is accomplished by installing a 40 mm fillet of Bentonite paste around the pile head. A hole is cut in the membrane and fitted over the pile head. The pile head is then sealed with a gas-resistant epoxy resin, which must contact the membrane (see Figure 4). The Certificate holder can advise on suitable products. When installing the membrane with the coated side uppermost, the joint between the membrane and the cured epoxy resin is sealed with Bentofix X Tape A.

Figure 4 Bentofix X2 BFG 5300 installation and sealing around pile heads



16 Procedure

Horizontal surfaces

16.1 Following the required groundwork preparation, a 50 mm blinding layer consisting of lean concrete or sand or gravel is placed, compacted and levelled. This layer should be free from debris and have a smooth surface.

16.2 The membrane is rolled out manually or, to assist handling of larger rolls, with a spreader bar, and trimmed to fit.

16.3 An additional 30 mm blinding layer can be placed on top of the membrane as a protective measure to allow the erection of shuttering and steel fixing.

16.4 At the edge of the slab, between the horizontal and vertical joint, the membrane is turned up by 90° and nailed to the vertical shuttering. A sufficient length of membrane should be left to ensure the formation of the recommended overlap joint with the vertical member. All floor to wall joints must be sealed with Bentofix X Tape A.

16.5 Where construction joints are planned the exposed membrane should be protected from premature hydration and mechanical damage using a suitable water-resistant liner.

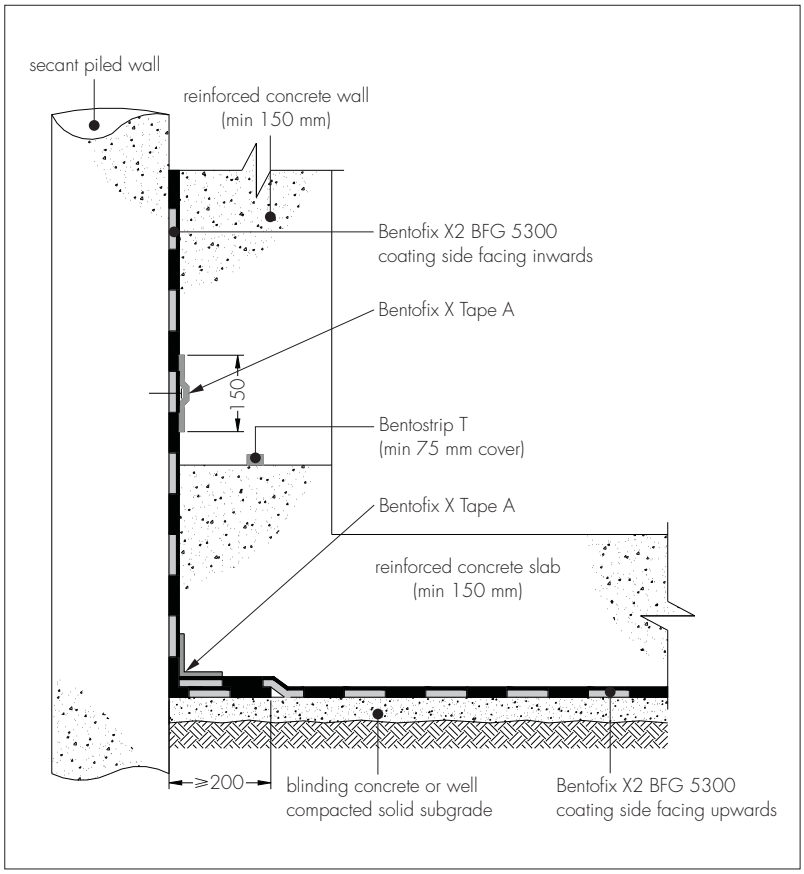
16.6 If expansion joints are required, a suitable waterbar should be used. The Certificate holder can advise on suitable products and installation procedures.

16.7 The concrete slab to be poured should have a minimum thickness of 150 mm.

Vertical surfaces

16.8 In vertical applications, Bentofix X2 BFG 5300 is fixed to the concrete substrate (ie secant/contiguous pile wall) using proprietary soft washers every 250 mm to 300 mm around the perimeter of the membrane and at 500 mm centres within the membrane. Each washer head is sealed using a 150 mm by 150 mm patch of Bentofix X Tape A (see Figure 5).

Figure 5 Bentofix X2 BFG 5300 secant pile wall detail



16.9 When fixed to the inside face of shuttering the membrane is aligned vertically, (although horizontal alignment is possible) ensuring that all laps face down, away from the flow of the poured concrete. The overlaps are secured to the shuttering using proprietary soft washers fixed every 250 mm to 300 mm and sealed using Bentofix X Tape A.

16.10 A minimum overlap of 350 mm should be achieved between the kicker and the wall. If necessary an additional 400 mm membrane sealing strip can be used. This is placed directly over the construction joint running parallel, to ensure the overlap of the liners is sealed tightly. The upper liner should overlap the lower to prevent ingress of soil and debris during backfilling. All floor to wall joints must be sealed with Bentofix X Tape A.

16.11 Backfilling should be carried out as soon as possible after placing the membrane. Backfill material should be free from builders' debris and angular aggregate, and should be compacted to a minimum 85% Modified Proctor. Protection boards can be installed to prevent soil or debris from damaging the installed liners. The Certificate holder can advise on suitable products.

16.12 After backfilling, the application of the membrane is continued. The membrane should not be installed above the intended final ground level and should be terminated at that point on the concrete structure.

Bentostrip T

16.13 Bentostrip T is satisfactory for sealing reinforced concrete construction joints, on Type B constructions as defined in Table 1 of BS 8102 : 2009.

16.14 Bentostrip T should not be applied during heavy rainfall or where there is free-standing water.

16.15 Bentostrip T is not designed for use in movement joints.

16.16 Joint surfaces should be clean, dry and free from cavities and spalling. Any irregularities in the surface do not normally need to be filled. If required, a cement grout or mortar of suitable strength should be used while the concrete is still green, and made smooth.

16.17 A strip of Bentostrip T is cut to length, and fixed to the middle of the joint (normally on the inside of the outermost reinforcing bars), ensuring 75 mm concrete cover to all sides.

16.18 To prevent movement during concrete placement, the strip of Bentostrip T is fixed to the concrete using Bentonet fixing mesh secured with steel nails at spacings of approximately 300 mm to 400 mm.

16.19 Continuity of consecutive strips is maintained by butt jointing.

16.20 If the material exhibits significant swelling prior to confinement in the joint, it must be replaced with new material.

16.21 Casting of retaining walls and floor slabs is carried out immediately after fixing Bentostrip T in position.

17 Repair

Where material is lost from the membrane, a patch of Bentofix X2 BFG 5300 should be applied. The patch is secured using Bentofix X Tape A, ensuring that the patch extends a minimum of 100 mm on each side. If the damage is more extensive, the membrane should be replaced with fresh Bentofix X2 BFG 5300.

Technical Investigations

18 Tests

18.1 Tests were conducted and the results assessed to determine:

- resistance to liquid water
- resistance to liquid water at lap joint
- resistance to water vapour
- mass per unit area of bentonite
- peel strength of the Bentofix X Tape A.

18.2 An evaluation was made of data relating to:

- radon diffusion including a taped joint
- methane permeability including a taped joint.

19 Investigations

19.1 The manufacturing process was evaluated, and the raw material specifications and quality control procedures established.

19.2 A visit was made to sites in progress to assess the application properties of the system.

19.3 Existing data on the effectiveness and durability of natural sodium bentonite as a waterproofing membrane were evaluated.

Additional Information

The management systems of NAUE GmbH have been assessed and registered as meeting the requirements of DIN EN ISO 9001 : 2008 by TÜV Nord Cert GmbH (Certificate No 44 100 940655).

Bibliography

BS 8102 : 2009 *Code of practice for protection of below ground structures against water from the ground*

DIN EN ISO 9001 : 2008 *Quality management systems — Requirements*

20 Conditions

20.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

20.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

20.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

20.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

20.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal.

20.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

British Board of Agrément
Bucknalls Lane
Garston, Watford
Herts WD25 9BA

tel: 01923 665300
fax: 01923 665301
e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk