

ECOCRIB RETAINING WALLS

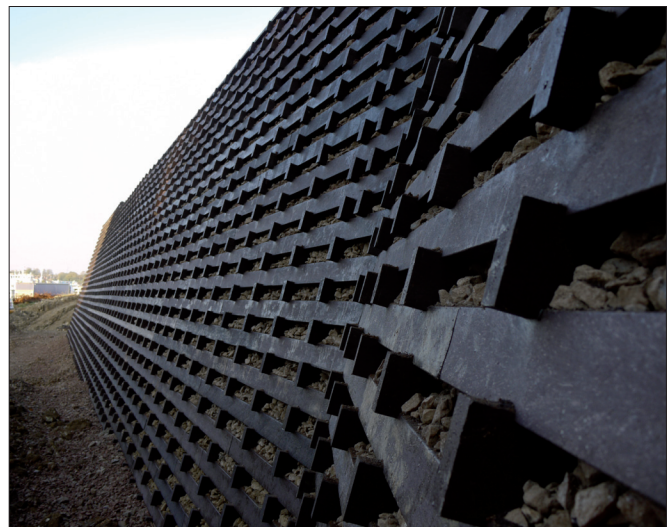
ECOCRIB RANGE OF POLYMER CRIB EARTH RETAINING WALL SYSTEMS

This HAPAS Certificate Product Sheet⁽¹⁾ is issued by the British Board of Agrément (BBA), supported by Highways England (HE) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Assembly Government and the Department for Infrastructure, Northern Ireland), the Association of Directors of Environment, Economy, Planning and Transport (ADEPT), the Local Government Technical Advisers Group and industry bodies. HAPAS Certificates are normally each subject to a review every three years.
(1) Hereinafter referred to as 'Certificate'.

This Certificate relates to Ecocrib Range of Polymer Crib Earth Retaining Wall Systems, comprising interlocking, polymer headers and stretchers for use when constructing earth retaining wall systems.

CERTIFICATION INCLUDES:

- factors relating to compliance with HAPAS requirements
- factors relating to compliance with Regulations where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal five-yearly review.



KEY FACTORS ASSESSED

Structural performance — the components, when used in accordance with this Certificate, have satisfactory structural characteristics when used in an earth retaining wall system (see section 6).

Durability — the wall systems can achieve a design life greater than 120 years (see section 8).

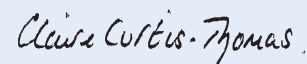


The BBA has awarded this Certificate to the company named above for the systems described herein. These systems have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément



Paul Valentine
Technical Excellence Director



Claire Curtis-Thomas
Chief Executive

Date of Second issue: 8 June 2018

Originally certificated on 12 December 2012

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.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

Requirements

In the opinion of the BBA, Ecocrib Range of Polymer Crib Earth Retaining Wall Systems, when used in accordance with the provisions of this Certificate, will meet or contribute to meeting the following requirements of BS EN 1997-1 : 2004 Eurocode 7, BS 8002 : 2015 and the *Manual of Contract Documents for Highways Works (MCHW)*⁽¹⁾, Volume 1 *Specification for Highways Works (SHW)*.

(1) The MCHW is operated by the Overseeing Organisations: Highways England (HE), Transport Scotland, the Welsh Assembly Government and the Department for Infrastructure (Northern Ireland).

Regulations

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See sections: 1 *Description (1.2)* and 3 *Delivery and site handling (3.2)* of this Certificate.

Technical Specification

1 Description

1.1 Ecocrib Range of Polymer Crib Earth Retaining Wall Systems comprise interlocking, polymer headers and stretchers and ancillary components of pillow blocks and fixings. The stretchers form the front and back of the wall and the headers tie the two faces together. Pillow blocks are used to act as a support in constructions utilising long headers.

1.2 The headers are available in a range of sizes, from 490 to 3000 mm in length, with cross-sectional dimensions of 125 by 50 mm. The stretchers are available in one size of 3000 mm long by 125 mm high by 50 mm wide. To erect a curved wall, a minimum radius of 24.0 m is used with 3000 mm stretchers. The members have a nominal density of $910 \text{ kg}\cdot\text{m}^{-3}$, and are available in a brown timber effect finish.

1.3 The headers feature a 12.5 mm deep notch cut 50 mm from either end to enable the headers and stretchers to interlock (see Figure 1). A typical build-up can be seen in Figure 2.

Figure 1 Component details

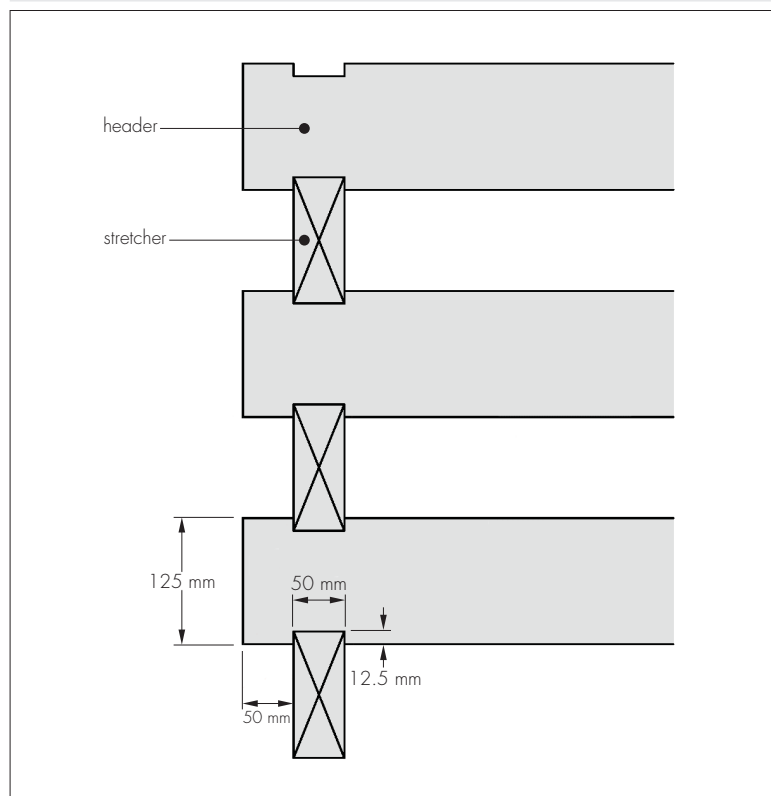
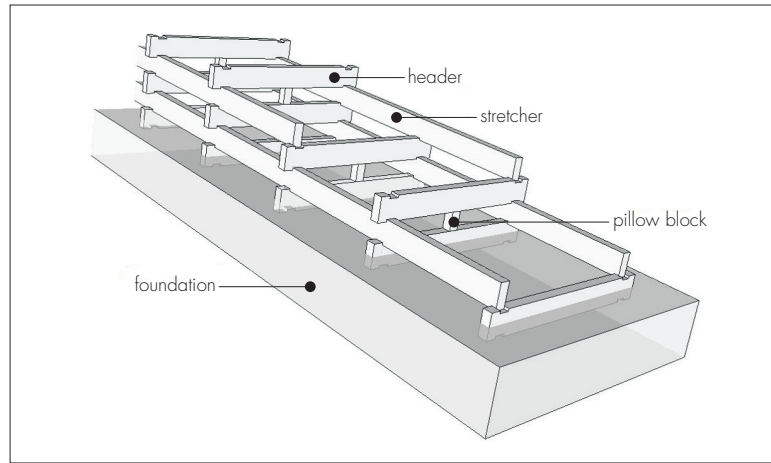


Figure 2 Example of typical build-up



2 Manufacture

2.1 Headers and stretchers are manufactured from a mix of recycled polymer using an injection moulding process. Once the moulding process is complete, and the members have set, the interlocking notch is cut into the headers.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of non-conformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

3 Delivery and site handling

3.1 The members are delivered to site banded together on pallets. Components should be stored on flat, level ground, as close to the build location as possible.

3.2 When handling, routine precautions of wearing personal protective equipment and adhering to manual handling policies should be followed. Individual members can be lifted by site personnel.

3.3 The members can withstand the normal loads associated with site handling and installation. Damaged members should not be used.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Ecocrib Range of Polymer Crib Earth Retaining Wall Systems.

Design Considerations

4 Use

4.1 Ecocrib Range of Polymer Crib Earth Retaining Wall Systems are satisfactory for use in providing an earth retaining structure with stability achieved through interaction of the crib components and the granular infill.

4.2 When an Ecocrib wall system is constructed beside a carriage way or subjected to traffic loading in accordance to PD 6694-1 : 2011, it should be provided with adequate protective measures, eg crash barriers.

5 Practicability of installation

The systems are designed to be installed by a competent general builder, or a contractor experienced with these types of wall systems.

6 Structural performance

6.1 Design of Ecocrib Range of Polymer Crib Earth Retaining Wall Systems is carried out in accordance with BS EN 1997-1 : 2004, PD 6694-1 : 2011 and BS 8002 : 2015, and employs the monolith theory (gravity walls) for global stability.

6.2 The purpose the retaining wall has to fulfil, the variable nature of the backfill and surrounding soil, and individual site conditions, have to be regarded as a whole. The site-specific parameters relating to the angle of internal friction and unit weight of the retained soil and the allowable bearing pressure should be obtained by site investigations, laboratory testing or assessment. For these reasons the design and supervision of the construction must be carried out by a suitably qualified and experienced individual, to ensure that the parameters used in the design are appropriate to each application.

6.3 In-situ soil conditions can vary from those assumed in design. Therefore, it is recommended that these conditions be inspected immediately prior to and, if necessary, during wall construction, to ensure that any variation is noted and the design reassessed accordingly.

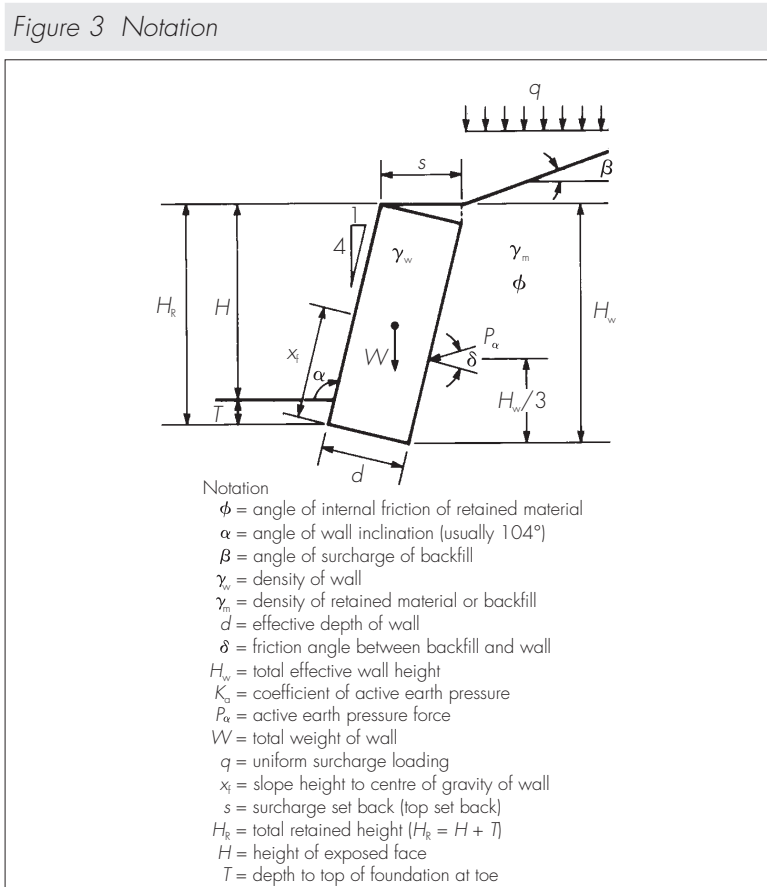
6.4 Crib walls are usually built to a batter which should not be steeper than 1 (horizontal) to 4 (vertical), or 1 (horizontal) to 6 (vertical), as defined in BS 8002 : 2015.

6.5 Low walls with a height less than their thickness may be vertical and by applying appropriate partial factors of safety against overturning and sliding at the underside of the Ecocrib/top-of-foundation interface, as derived from BS EN 1997-1 : 2004. It is assumed that the concrete foundation pad has a rough finish and the angle of friction between the infilled Ecocrib and the concrete is taken as 30°. The angle of internal friction (ϕ_w) of the wall infill and backfill has been taken as 35°. Passive resistance is ignored. Unit weight of the unfilled Ecocrib is taken as 9.0 kN·m⁻³.

6.6 To design an earth retaining wall system, a series of steps must be completed to assess the suitability of the wall system as defined in BS 8002 : 2015:

- site survey
- determine characteristic weight of material values for wall, retained and founding soil
- calculate characteristic values of actions for unfavourable and favourable conditions
- calculate design values of above actions
- design against overturning of overall wall structure
- design against sliding of overall wall
- design against bearing failure
- check the overturning and sliding between foundation and the base of wall
- check subsequent layers of Ecocrib wall for overturning and shear resistance
- check failure of the headers and stretchers
- check for deformation of the structure.

6.7 Parameters to consider when designing and constructing a retaining wall can be seen in Figure 3 (drained condition).



6.8 Typical values for the angle of internal friction are given in Table 4.

<i>Table 4 Typical design values of angle of internal friction⁽¹⁾</i>			
Soil type			Drained angle of internal friction (ϕ) (°)
Clay	plasticity index	15	30
		30	25
		50	20
		80	15
Silt and silty sand, loose sand			30
Dense sand and sandy gravel			35
Dense, well-graded gravel or rock			40

(1) As defined in BS 8002 : 2015.

6.9 Due to the variable nature of soils, this assessment does not include consideration of foundations to the walls. The bearing capacity of the ground and possible sliding at the underside of the foundation or through the underlying soils should be considered separately. Guidance is given in BS EN 1997-1 : 2004 and PD 6694 : 2011.

6.10 The walls are flexible and can accommodate differential settlement. Therefore, the effect this may have on adjacent structures should be considered.

6.11 Where an excavation is made to accommodate a wall, the undisturbed in-situ material may have differing properties to those of the backfill. This must be taken into consideration in the design.

6.12 The retaining wall design should sustain a minimum load of 10 kN·m⁻² or equivalent.

6.13 Backfilling should comply with the requirements of Class 6N fill. The infill material should be to Class 6G, as defined in the MCHW, Volume 1, Series 600.

6.14 Where the backfill is free-draining and extends to the critical failure plane, the possibility of hydrostatic pressure above the lowest drainage point may be excluded from the design. However, where seepage above wall-base level is anticipated or found during construction, specialist advice should be sought.

6.15 When used in areas accessible to vehicles and pedestrians, consideration must be given to protection against damage by vehicle impacts, and vehicle and pedestrian containment (outside the scope of this Certificate).

7 Maintenance

7.1 Periodic inspections should be carried out for evidence of physical damage, casual plant growth or crib in-fill contamination from outside sources.

7.2 Any damage should be rectified promptly (advice should be sought from the Certificate holder).

7.3 Any plant growth, which is not within areas approved in the original design, should be removed to prevent accumulation of leaf litter and other organic debris and to avoid disturbance by root growth.

7.4 The development of adjacent planted areas or landscaping should include precautions to avoid contamination of the crib in-fill by fines or organic debris.

7.5 Contamination of the in-fill by outside materials may impair drainage or introduce unusual chemicals. Remedial action procedures are not covered by this Certificate and advice should be sought from the Certificate holder.

8 Durability

8.1 The infill is specified to provide effective drainage around the crib components.

8.2 The systems, under UK conditions, have been assessed as appropriate for a Design Service Life of 120 years.

8.3 It should be recognised that this is an indication of the minimum expectation of performance, based upon the design, materials and maintenance used for the systems and under normal UK conditions of use. It is recognised that Actual Service Life may commonly exceed the Design Service Life.

9 Re-use and recyclability

The systems comprise mixed polymer, which can be recycled using conventional polymer recycling procedures.

Installation

10 General

10.1 The preparation, installation and completion of Ecocrib Range of Polymer Crib Earth Retaining Wall Systems must be in accordance with the Certificate holder's recommendations. Excavations must be carried out generally in accordance with BS 6031 : 2009, in particular, sections 7 and 13, with attention paid to safety procedures.

10.2 The concrete foundations must be cast with the surface of the concrete left rough to reduce the risk of sliding failure, and the wall erected to give a batter on the wall of 1 (horizontal) in 4 (vertical). Concrete must comply with the requirements of BS EN 1992-1-1 : 2004. Construction of the wall must not start until the concrete has reached a minimum strength of $10 \text{ N}\cdot\text{mm}^{-2}$ or twice the stress to which it will be subjected.

10.3 A continuous subsoil drain must be provided at the rear of the base slab to carry the ground water to an outfall.

11 Procedure

11.1 The base course of headers and stretchers are screwed together, using conventional self-tapping screws, and set in the concrete foundation pad. The screws do not contribute in the stability of the wall system.

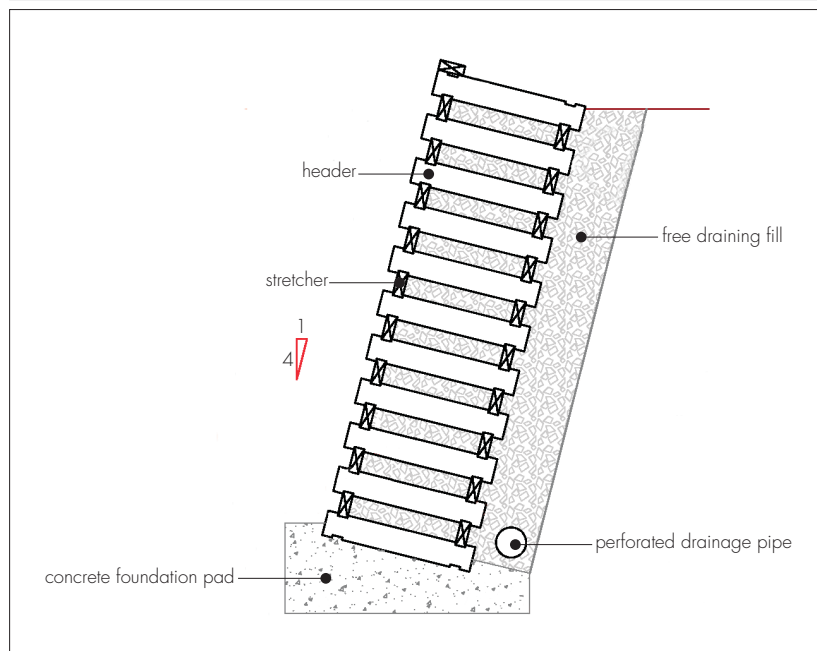
11.2 Once the concrete has reached sufficient strength, the remaining courses of headers and stretchers can be laid.

11.3 A further four layers of headers and stretchers are placed by hand on top of the base units. These and further layers do not require screwing together. The infill and back fill is then placed.

11.4 Once the first course has been filled with the appropriate infill, the next four courses are infilled with material. The process continues until the desired wall height has been reached.

11.5 An example wall construction is shown in Figure 4.

Figure 4 Example wall construction



Technical Investigations

12 Tests

Tests were carried out to determine:

- connection capacity between members
- resistance to damage caused by longitudinal settlement
- flexural strength
- compressive strength
- resistance to UV and microbiological degradation
- resistance to tensile and compressive creep
- resistance to water absorption.

13 Investigations

13.1 Samples of 100 mm by 50 mm by 65 mm were immersed in diesel, engine and pump oil in accordance to an agreed test method based on ISO 175 : 2010, BS EN 13575 : 2012 and ISO 13274 : 2013. The results obtained were below 1.5% absorption rate which is deemed to be an acceptable industry level. A full test report can be provided by the client.

13.2 Samples of 50 mm thick Ecocrib retaining wall were tested in accordance to BS 476-7 : 1997 to determine the surface spread of the flame classification. The specimens were classified as Class 3. A full test report can be provided by the client.

Bibliography

- BD 68/97 *Design Manual for Roads and Bridges (DMRB), Volume 2 Highway Structures : Design (Substructures and Special Structures), Materials, Section 1 Substructures — Part 3 Crib Retaining Walls*
- BS 476-7 : 1997 *Fire tests on building materials and structures — Method of test to determine the classification of the surface spread of flame of products*
- BS 6031 : 2009 *Code of practice for earthworks*
- BS 8002 : 2015 *Code of practice for earth retaining structures*
- BS EN 1992-1-1 : 2004 + A1 : 2014 *Eurocode 2 : Design of concrete structures — General rules and rules for buildings*
- BS EN 1997-1 : 2004 + A1 : 2013 *Eurocode 7 — Geotechnical design — General rules*
- BS EN 13575:2012 *Thermoplastics tanks made from blow or rotational moulded polyethylene — Tanks for the above ground storage of chemicals — Requirements and test methods*
- ISO 175 : 2010 *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals*
- ISO 13274 : 2013 *Packaging — Transport packaging for dangerous goods — Plastics compatibility testing for packaging and IBCs*
- Manual of Contract Documents for Highway Works, Volume 1, Series 600 *Specification for Highway Works — Earthworks*
- PD 6694-1 : 2011 *Recommendations for the design of structures subject to traffic loading to BS EN 1997-1 : 2004*

14 Conditions

14.1 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.

14.2 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.

14.3 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
- remain in accordance with the requirements of Highway Authorities' Product Approval Scheme.

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

14.5 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.

14.6 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.