

## KESKIN TENCON CONCRETE

### PRODUCT SHEET 2 — KESKIN TENCON GROUND BEAM SYSTEM (FAST BASE)

#### PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to the Keskin Tencon Ground Beam System (Fast Base), a fibre-reinforced concrete mix and an associated design procedure for use as a ground beam foundation.

#### 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

**Structural performance** — the system has adequate strength and stiffness when designed and installed in accordance with this Certificate (see section 5).

**Durability** — the system has equivalent durability to a conventional reinforced concrete ground beam (see section 7).

The BBA has awarded this Agrément Certificate for Keskin Tencon Ground Beam System (Fast Base) to Keskin Tencon Ltd as fit for its intended use provided it is installed, used and maintained as set out in this Agrément Certificate.

On behalf of the British Board of Agrément



Head of Approvals  
— Engineering



Chief Executive

Date of First issue: 28 May 2008

*The BBA is a UKAS accredited certification body — Number 1113. 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](http://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 Keskin Tencon Ground Beam System (Fast Base), 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 2000 (as amended) (England and Wales)

Requirement:	A1	Loading
Comment:		Ground beams constructed from the system can be designed to sustain and transmit dead and imposed loads to the piles or piers. See sections 5.1 to 5.11 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		Ground beams constructed from the system are acceptable. See sections 7.1 to 7.3 and the <i>Installation</i> part of this Certificate.



## The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Fitness and durability of materials and workmanship
Comment:		The system can contribute to a construction satisfying this Regulation. See sections 6 and 7.1 to 7.3 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards – construction
Standard:	1.1(a)(b)	Structure
Comment:		Ground beams constructed from the system can satisfy this Standard, with reference to clause 1.1.1 <sup>(1)(2)</sup> . See sections 5.1 to 5.11 of this Certificate. (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 sections 7.1 to 7.3 and the <i>Installation</i> part of this Certificate.
Regulation:	B3(2)	Suitability of certain materials
Comment:		The system does not normally require maintenance. See section 6 of this Certificate.
Regulation:	D1	Stability
Comment:		Ground beams constructed from the system can be designed to sustain and transmit dead and imposed loads to the piles or piers. See sections 5.1 to 5.11 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* (2.3) and 8 *Site preparation* (8.3).

# Non-regulatory Information

## NHBC Standards 2007

NHBC accepts the use of the Keskin Tencon Ground Beam System (Fast Base) when installed and used in accordance with this Certificate, in relation to *NHBC Standards*, Chapters 2.1 *Concrete and its reinforcement* and 4.5 *Raft, pile, pier and beam foundations*.

## Zurich Building Guarantee Technical Manual 2007

In the opinion of the BBA, the Keskin Tencon Ground Beam System (Fast Base), when installed and used in accordance with this Certificate, satisfies the requirements of the *Zurich Building Guarantee Technical Manual*, Section 3 *Substructure*, Sub-section *Foundations*.

# General

This Certificate relates to the Keskin Tencon Ground Beam System (Fast Base) for use to construct cast in-situ foundation ground beams of rectangular section.

It is used in conjunction with pile and pier-off pads foundations, shuttering and clay heave protection. These components are outside the scope of this Certificate.

The product may be used for the construction of foundations for all building types and is suitable for use with suspended ground floor systems, including the Keskin Tencon Suspended Floor System.

## 1 Description

1.1 The Keskin Tencon Ground Beam System (Fast Base) comprises a synthetic, structural fibre-reinforced concrete mix to one specification and designated 'Tencon Concrete to BBA Certificate No 05/4257', defined beam construction details and a design procedure. The system allows foundation ground beams to be constructed with sections of 500 mm to 700 mm by 500 mm. Tie beams are constructed with minimum section of 300 mm by 500 mm. Typical beam sections are shown in Figure 1. Typical beam intersections at piles are shown in Figure 2.

Figure 1 Typical beam sections (all dimensions in mm)

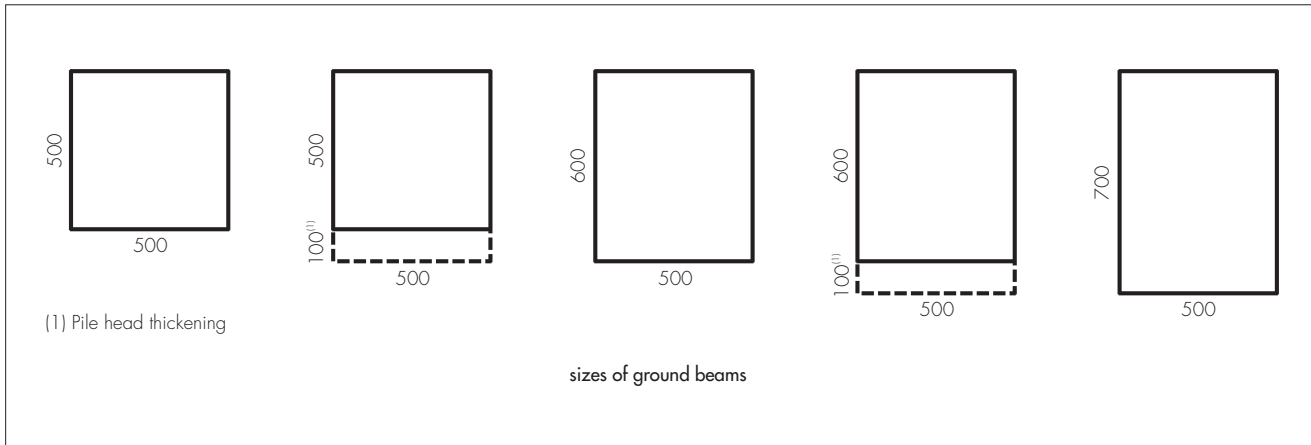
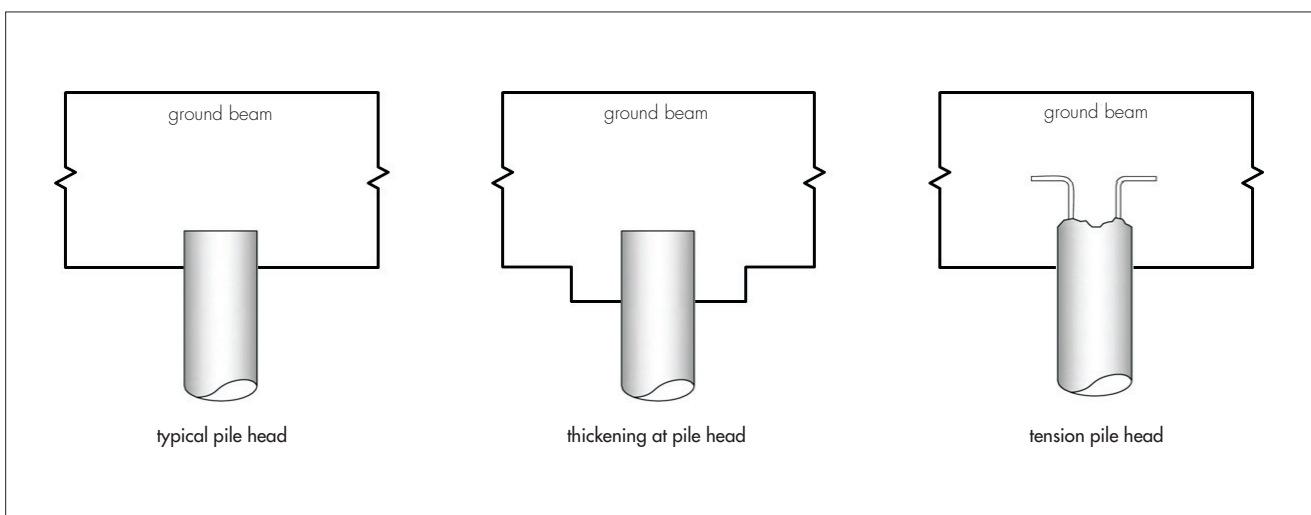


Figure 2 Pile to beam intersections



1.2 The beam is cast in-situ to span between piles or piers using the Certificate holder's specified ancillary items<sup>(1)</sup>. These include:

- formwork:
  - permanent formwork — a third-party approved system used in accordance with the requirements of the certification. Particular care must be taken to ensure the correct number of spacers are used to maintain the correct shape of the beam
  - temporary formwork — to be in accordance with BS 5975 : 1996
- polyethylene sheeting — minimum 1000 gauge, used as a permanent trench lining, where required
- clay heave protection — BBA approved compressible EPS fill suitable for use under ground beams. Thickness required will depend on ground conditions on a project specific basis. Details of suitable systems are available from the Certificate holder.

(1) These items are outside the scope of this Certificate, although many are covered by existing separate Certificates provided they are installed and used in accordance with the relevant manufacturer's instruction and the relevant BBA Certificate.

1.3 The Tencon Concrete is supplied by Cemex UK Materials Ltd, with production controls in accordance with their Quality Scheme for Ready Mixed Concrete (see section 2.2).

1.4 The sizes and spans of the beams are determined by total design loads and permissible stress in the Tencon Concrete. The design and detailing of the beams is project specific and is carried out using one of two methodologies (see also sections 5.1 to 5.4):

- standard design load/span graphs — undertaken by the Certificate holder or chartered structural engineers authorised by the Certificate holder
- finite element analysis — undertaken by the Certificate holder or chartered structural engineers proficient in the use of this method for foundation design and authorised by the Certificate holder.

1.5 Where aggressive ground conditions are encountered, protection must be provided to the concrete, such as by the use of suitable protective permanent formwork. This aspect is outside the scope of this Certificate.

1.6 The beams are constructed to be supported by piled foundations or piers built off pads. The design of the pile and pier systems is outside the scope of this Certificate.

## 2 Delivery and site handling

2.1 Manufacturer's instructions for storage and handling should be adhered to for ancillary components.

2.2 The ready-mixed concrete is delivered to site by the producer. All delivery notes must state that the concrete is in accordance with BBA Certificate No 05/4257.

2.3 Tencon Concrete should be handled in accordance with standard good practice for handling concrete paying attention to BS 8000-2.2 : 1990. Concrete should not be placed when the temperature of the air or concrete is 5°C or below.

## Assessment and Technical Investigations

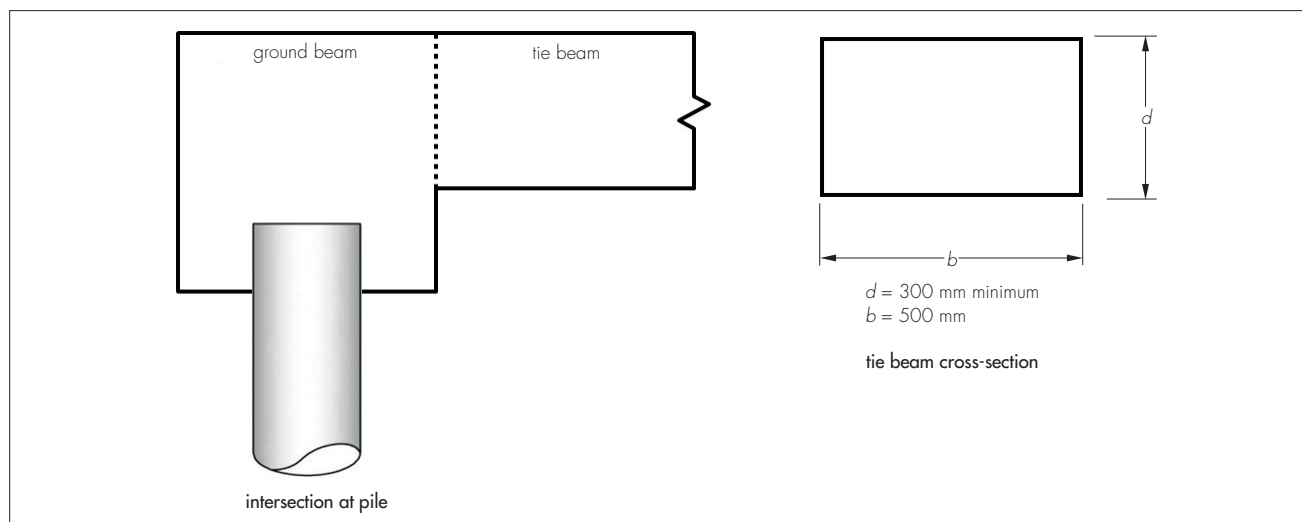
The following is a summary of the assessment and technical investigations carried out on the Keskin Tencon Ground Beam System (Fast Base).

## Design Considerations

### 3 General

3.1 The Keskin Tencon Ground Beam System (Fast Base), when designed and constructed in accordance with this Certificate, is satisfactory for transferring dead and imposed loads from the building to the piles or piers. Rectangular beams are designed to support dead and imposed loads from the building and provide lateral restraint of piles and piers. Where additional lateral restraint is required tie beams are used. Tie beams do not support any vertical loads from the building structure (see Figure 3).

Figure 3 Typical tie beam detail



3.2 All design and detailing involving the use of the system must be carried out in accordance with section 1.4 and the Certificate holder's design procedures, UK good working practice and Building Regulations.

3.3 For each project the structural engineer described in section 1.4 will examine the loading to be applied to the foundations and specify a suitable design.

3.4 Services may pass through the ground beams but this must be strictly in accordance with the design specifications given by the Certificate holder (see section 5.8).

3.5 In areas where ground heave may be an issue, adequate compressible material as described in section 1.2 should be provided below the beams and at vertical faces of the beams. The specification of the clay heave protection is the responsibility of the building designer.

3.6 The ground beams for a building are to be completed in a single casting. If the proposed foundation design is too large to be completed in a single casting, it should be divided into smaller units.

3.7 The loadbearing capacity of the system has been verified by testing of full-scale and small-scale beams.

## 4 Practicability of installation

The system may be installed and handled using standard good practice for concrete placement by operatives with experience of ready-mixed concrete.

## 5 Structural performance



5.1 The system has adequate strength and stiffness to withstand the loads given in Figures 4 to 6 when used in accordance with this Certificate. The load/span data in Figures 4 to 6 make allowance for torsional stresses that may occur due to an eccentric loading of 100 mm. Eccentricities greater than 100 mm will require specific calculations.

Figure 4 Design load/span curves for B1 beam type

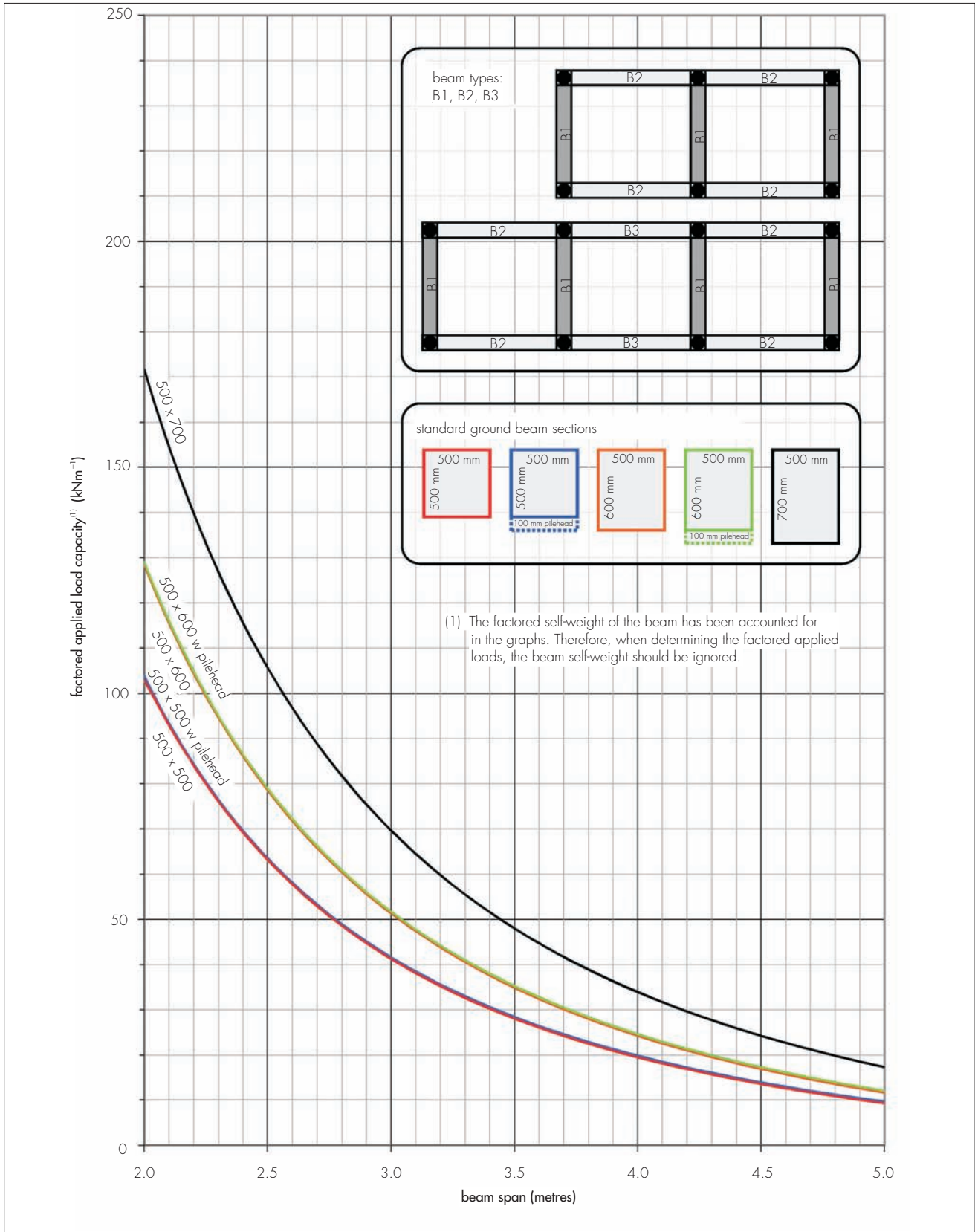


Figure 5 Design load/span curves for B2 beam type

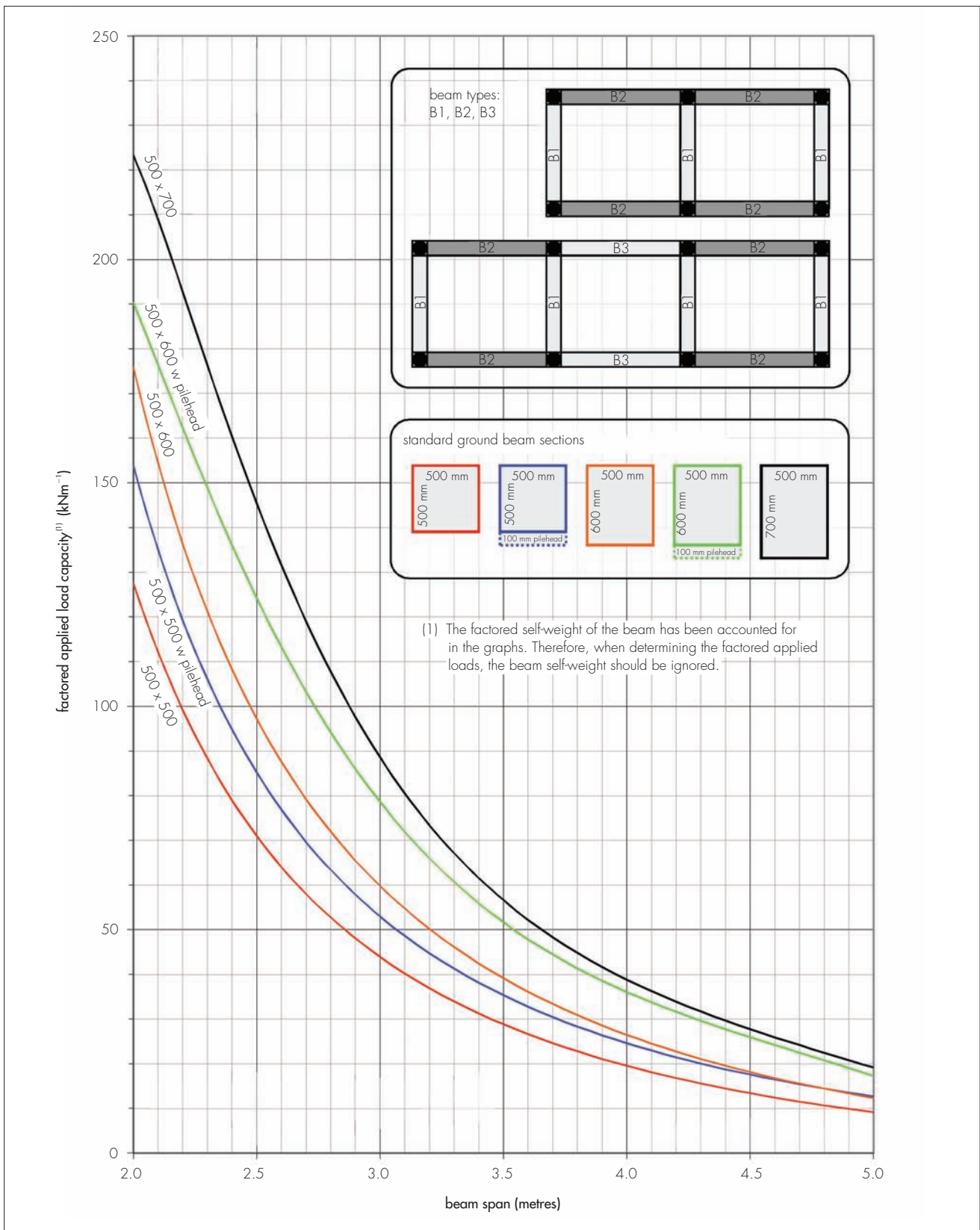
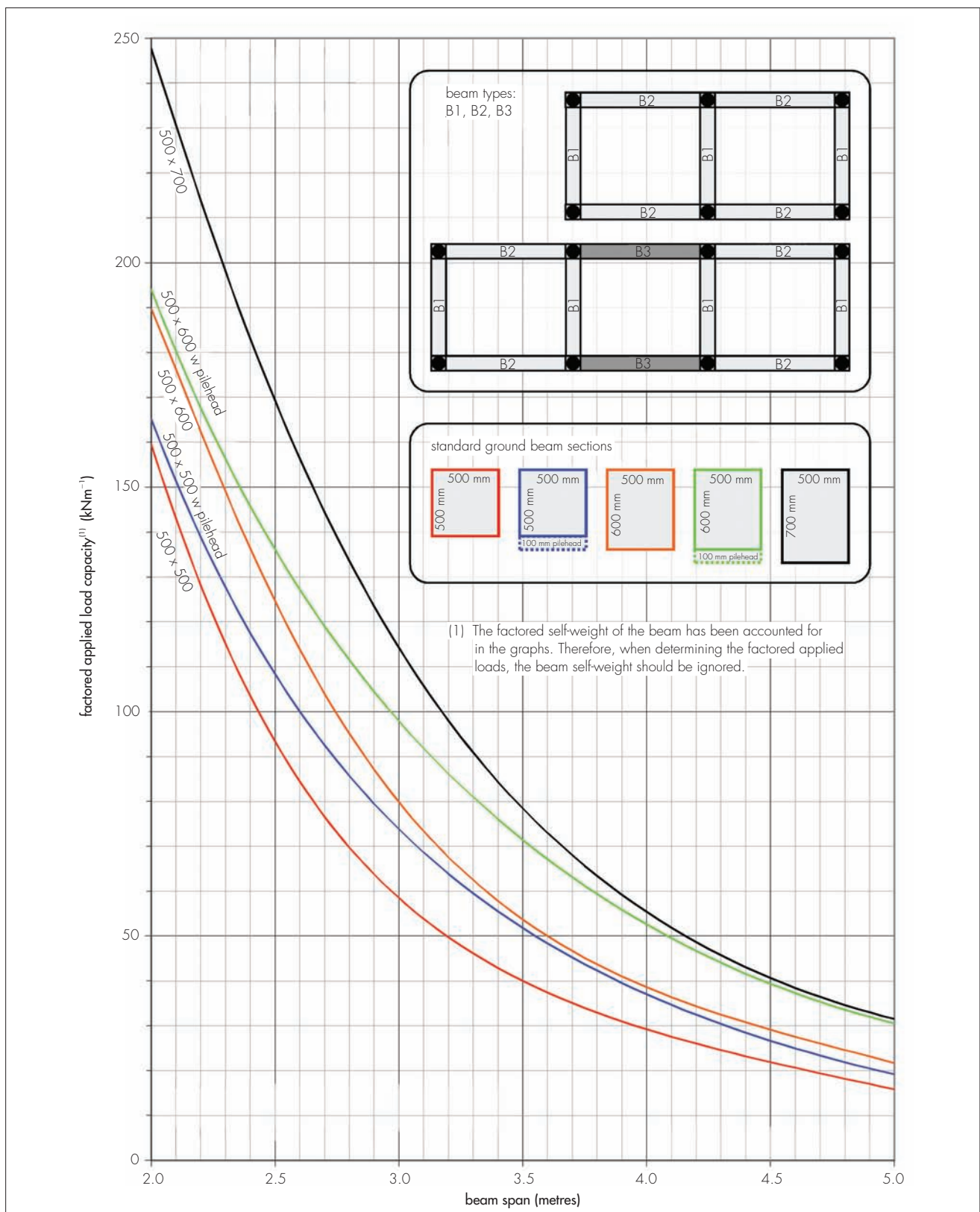


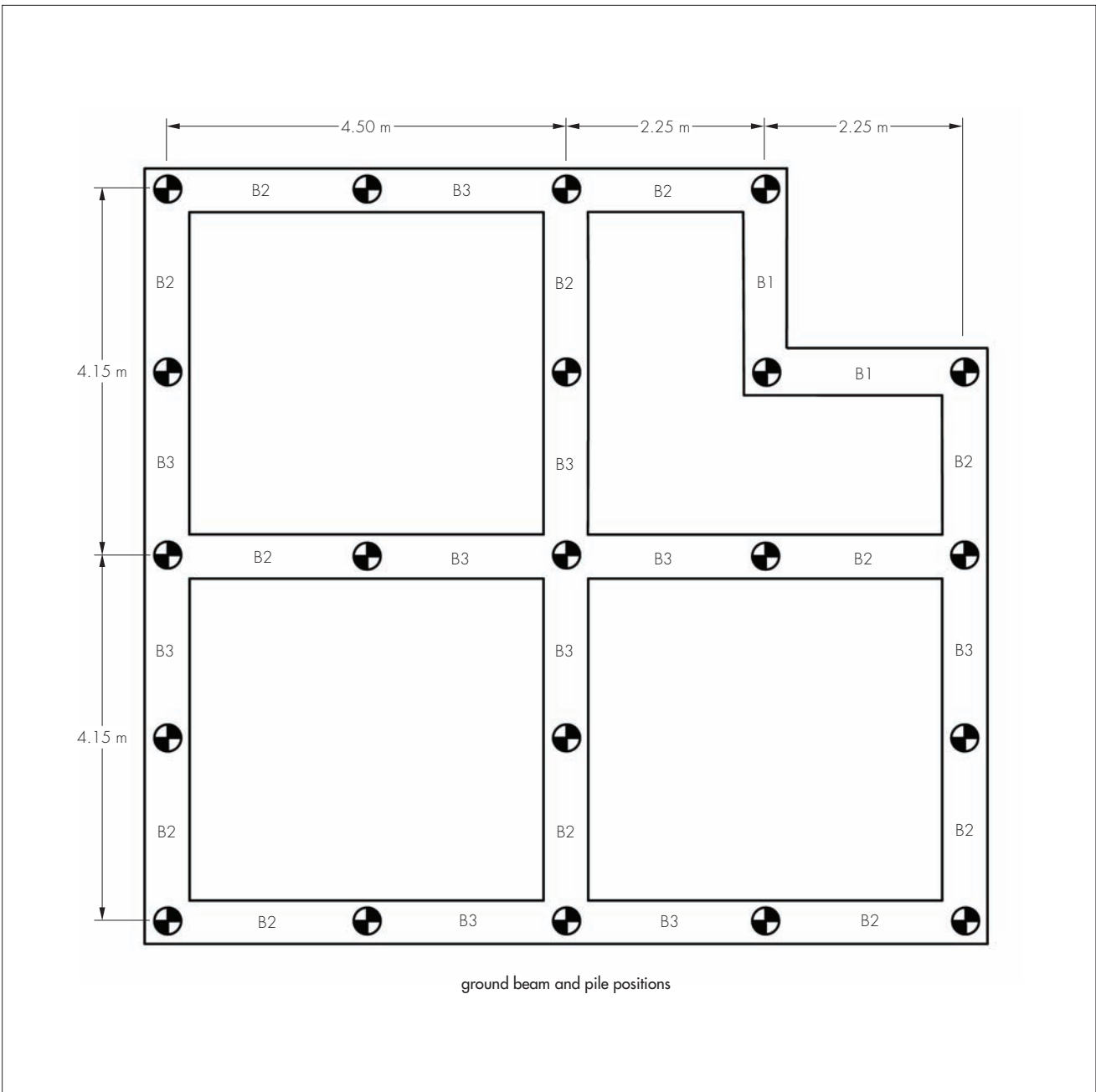
Figure 6 Design load/span curves for B3 beam type



5.2 The system's design is based on Finite Element Analysis of the foundation system. This method of analysis has been verified by laboratory testing of sample beams.

5.3 For the majority of foundations the load/span information in Figures 4 to 6 may be used. An example foundation layout is given in Figure 7. Beams should be designated B1 (single span between two piles), B2 (double span over three piles) or B3 (multiple spans over four or more piles). The dead and imposed factored loads required to be supported are determined (the beam self-weight is accounted for during the derivation of the load/span data). The minimum required beam cross-section is determined from the graphs shown in Figures 4 to 6 and, typically, the largest size is used for the entire building. Where required, tie beams have a cross-section of 300 mm deep by 500 mm wide.

Figure 7 Building plan for design process example



5.4 The design of all ground beams not covered in Figures 4 to 6 must be designed by the Certificate holder or a chartered structural engineer, proficient in the use of Finite Element Analysis for foundation design, and authorised to do so by the Certificate holder. Such designs should be in accordance with:

- the data provided in Table 1
- the requirements for fixed end conditions
- the stress in the concrete at ultimate design loads
- positioning of the beam (B1, B2, B3) (see Figures 4, 5, 6 and 7).

Table 1 Concrete characteristics/design criteria for Tencon ground beams

Characteristic (units)	Value
Modulus of elasticity (Nmm <sup>-2</sup> )	30 500
Allowable stress (Nmm <sup>-2</sup> )	
for beams up to 500 mm depth	2.32
for beams greater than 500 mm depth	2.10
Minimum compressive strength (Nmm <sup>-2</sup> )	40.0
Density of concrete (kNm <sup>-3</sup> )	24

(1) This stress limit incorporates an adequate material factor for Tencon Concrete when used in a ground beam application.

5.5 The top of the pile will be a maximum of 200 mm above the bottom of the beam. Where tension piles are specified, the steel reinforcement from the pile may project a maximum of 200 mm into the beam from the base (see Figure 2).

5.6 Tie beams, when used, are of 300 mm (deep) by 500 mm (wide) cross-section.

5.7 The bottom face and side faces of the beams must be protected from contamination from the ground by the permanent formwork or by a separate membrane.

5.8 If service penetrations are required through the beam, the design must use finite element analysis methodology as described in section 1.4. Restrictions will apply to the size and location of service ducts, thus:

- maximum of one hole per beam length
- maximum hole diameter of 100 mm
- hole centre must be through the neutral axis of the beam
- hole centre must be located at least 500 mm from the nearest support and less than span/10 from the point of contraflexure.

5.9 Pile and pier tops must be positioned to within  $\pm 75$  mm of their designed locations in the horizontal plane. Ground beam dimensions given in this Certificate are minimum and ground beams must be cast to the designed depth and width dimension  $+50/-0$  mm.

5.10 Ground beams must always be installed as a closed loop when viewed in plan.

5.11 Where openings in walls are located centrally between pile locations, the load/span graphs shown in Figures 4 to 6 may be used. If openings are positioned asymmetrically between piles, the beam must be designed using finite element analysis as described in section 1.4.

## 6 Maintenance



As the installed system is not easily accessible and has suitable durability, maintenance is not normally required.

## 7 Durability



7.1 The system will sustain the long-term design loads without deterioration in strength or stiffness when designed and installed in accordance with this Certificate.

7.2 The exposure condition of the beam is considered to be 'moderate' as defined in BS 8110-1: 1997. The structural concrete will have equivalent durability to a conventional reinforced concrete ground beam.

7.3 Where aggressive ground conditions exist adequate protection must be provided to the concrete from the substances present in the ground by the permanent formwork or by a separate membrane. The performance of the products used to protect the concrete are outside the scope of this Certificate.

# Installation

## 8 Site preparation

8.1 The position and level of piles or piers and condition of pile tops for the Keskin Tencon Ground Beam System (Fast Base) must be checked prior to installation.

8.2 If trenches are required, they should be excavated to the correct levels using conventional methods.

8.3 Excavations must be carried out in accordance with BS 6031: 1981, paying particular attention to safety procedures.

## 9 Procedure

9.1 When using permanent formwork, it should be positioned in accordance with the manufacturer's instructions ensuring that it is adequately supported by backfill and that clips used to stabilise the sides are in place. Where temporary formwork is used, it should be installed in accordance with standard good working practice. The installed formwork should be checked against the beam design to ensure that the cast beam meets the specified tolerances.

9.2 Where required, clay-heave protection and polythene sheeting should be installed in accordance with the foundation design drawings.

9.3 Any service ducts passing through the beam must be positioned in accordance with the design drawings and within the specified tolerances (see section 5.8).

9.4 The concrete is poured and compaction ensured by use of a vibrating poker as for normal good practice.

## 10 Tests

10.1 Full-scale tests were carried out to determine:

- load capacity of the beams when subjected to a range of anticipated loading configurations.
- consistency between the predicted and actual structural response of the beams
- ability to resist shear.

10.2 Other tests were carried out to determine:

- compressive strength of Tencon Concrete
- flexural strength and stiffness of small beams
- resistance to torsion of small-scale beams
- tensile strength of samples of Tencon Concrete
- resistance to shear of small-scale beams.

## 11 Investigations

11.1 An examination was made of existing data in relation to the durability of the system.

11.2 Examination of full-scale test data in conjunction with mathematical predictions from conventional structural analysis and from finite element analysis was carried out to verify the suitability of the design procedures.

11.3 An examination was carried out on the production control procedure.

## Bibliography

BS 5975: 1996 *Code of practice for falsework*

BS 6031 : 1981 *Code of practice for earthworks*

BS 8000-2.2 : 1990 *Workmanship on building sites — Code of practice for concrete work — Sitework with in-situ and precast concrete*

BS 8110-1 : 1997 *Structural use of concrete — Code of practice for design and construction*

BS 8666 : 2005 *Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete — Specification*

BS EN 1992-1-1 : 2004 *Eurocode 2 : Design of concrete structures. General rules and rules for buildings*

## 12 Conditions

12.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- 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.

12.2 References in this Certificate to any Act of Parliament, Statutory Instrument, Directive or Regulation of the European Union, British, European or International Standard, Code of Practice, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

12.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant 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.

12.4 In granting this Certificate, the BBA is not responsible for:

- 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 the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

12.5 Any information relating to the manufacture, supply, installation, use and maintenance 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 and maintained. It does not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date 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. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the manufacture, supply, installation, use and maintenance of this product/system.