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Agrément Certificate  
**14/5112**  
Product Sheet 1

## MAX FRANK LTD REINFORCEMENT SYSTEMS

### SHEARAIL PUNCHING SHEAR REINFORCEMENT SYSTEM

This Agrément Certificate Product Sheet<sup>(1)</sup> relates to Shearail Punching Shear Reinforcement System, comprising ribbed reinforcing bars with forged heads and steel flat rails for use as an integrated shear reinforcement to increase shear resistance in concrete slabs.

(1) Hereinafter referred to as 'Certificate'.

#### 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 will provide additional shear resistance when used as punching shear reinforcement for reinforced concrete structures provided it is designed and installed properly (see section 6).

**Behaviour in relation to fire** — the system will not affect the fire resistance of the reinforced concrete structures as long as the suitable covers are provided (see section 7).

**Durability** — under normal service conditions and protected by minimum concrete cover, the system can achieve a service life of at least 60 years (see section 9).



The BBA has awarded this 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: 16 April 2014

A handwritten signature in black ink that reads 'B Chamberlain'.

Brian Chamberlain  
Head of Approvals — Engineering

A handwritten signature in black ink that reads 'Claire'.

Claire Curtis-Thomas  
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](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.*

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# Regulations

In the opinion of the BBA, the Shearail Punching Shear Reinforcement System, if installed, used and maintained in accordance with this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



## The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	A1	Loading
Comment:		The system has sufficient strength and stiffness to sustain the design loads in accordance with sections 6.1 to 6.3 of this certificate
Requirement:	B3(1)	Internal fire spread (structure)
Comment:		When the system is suitably protected by the minimum concrete cover, the required fire resistance can be achieved. See section 7.1 to 7.2 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The system is acceptable. See section 9 and the <i>Installation</i> part of this Certificate.



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

Regulation:	8(1)	Durability, workmanship and fitness of materials
Comment:		The system is an acceptable material. See section 9 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	1.1(a)(b)	Structure
Comment:		The system will have sufficient strength and stiffness to transmit the design load, with reference to clause 1.1.1 <sup>(1)(2)</sup> , in accordance with sections 6.1 to 6.3 of this Certificate.
Standard:	2.3	Structural protection
Comment:		When the system is suitably protected by the minimum concrete cover, the required fire resistance can be achieved. See section 7.1 to 7.2 of this Certificate.
Standard:	7.1(a)(b)	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. See section 7.1 of this Certificate. (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



## The Building Regulations (Northern Ireland) 2012

Regulation:	23	Fitness of materials and workmanship
Comment:		The system is acceptable. See section 9 and the <i>Installation</i> part of this Certificate.
Regulation:	30	Stability
Comment:		The system has sufficient strength and stiffness to sustain the design loads in accordance with sections 6.1 to 6.3 of this Certificate.
Regulation:	35(1)(2)(3)	Internal fire spread structure
Comment:		When the system is suitably protected by the minimum concrete cover, the required fire resistance can be achieved. See section 7.1 to 7.2 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.

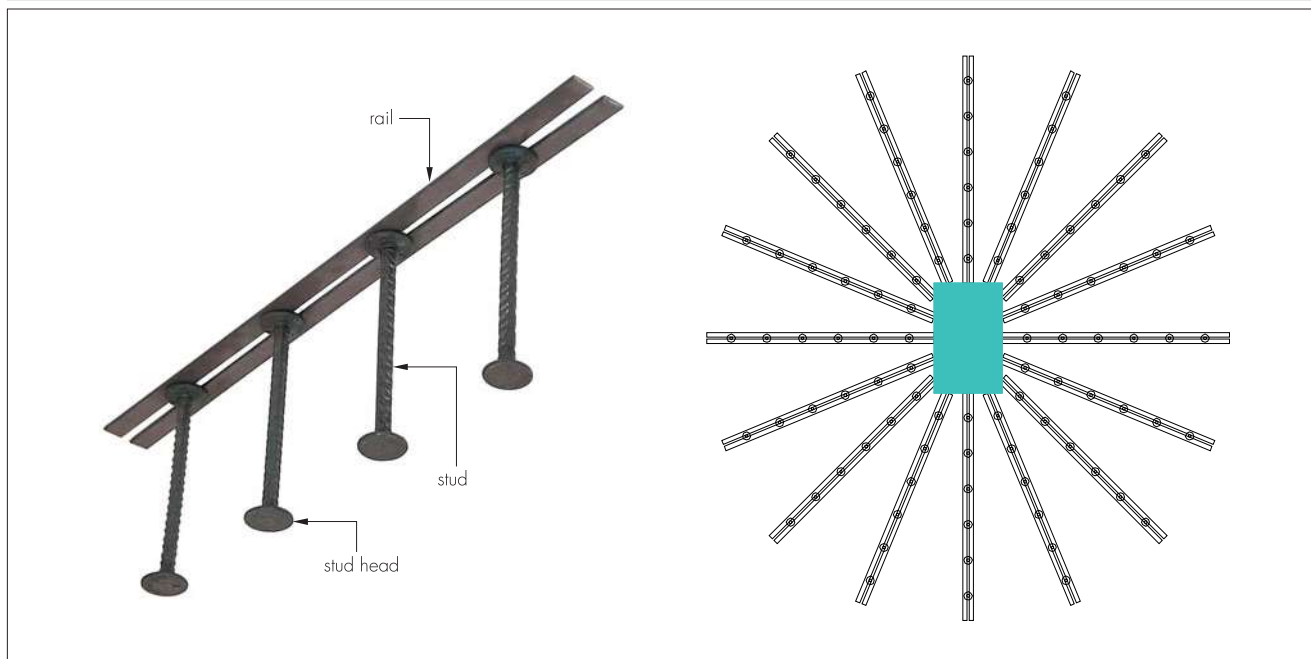
See section: 3 *Delivery and site handling* (3.1 to 3.3) of this Certificate.

# Technical Specification

## 1 Description

1.1 The Shearail Punching Shear Reinforcement System comprises a range of stud and rail elements each fabricated using double headed steel studs formed from ribbed reinforcement bar and welded to steel strip supporting rails (See Figure 1).

Figure 1 Typical Shearail detailing arrangements



1.2 The studs are manufactured from ribbed reinforcement bar in accordance with BS EN 10080 : 2005 or BS 4449 : 2005 +A2 : 2009. The studs are available in diameters of 10 mm, 12 mm, 14 mm, 16 mm, 20 mm and 25 mm. The heads are three times the diameter of the parent bar.

1.3 Two flat steel rails are used as the primary supporting platform both during the fabrication and installation process. The rail dimensions are 16 mm by 3 mm (for 10 mm to 16 mm diameter studs) and 20 mm by 5 mm (for 20 mm to 25 mm diameter studs).

## 2 Manufacture

2.1 The incoming components forming the elements are bought in to an agreed specification and completed for final assembly. Reinforcing bars are sourced from suppliers of CARES approved steel. The fabrication process includes cutting the reinforcing bar and hot forging the double heads into shape and quenched, then welding the studs to the support rails at the required centres.

2.2 Frequent checking and testing of the properties of double headed studs after hot forging heat treatment is carried out.

2.3 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 nonconformities
- 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.

2.4 The management system of Max Frank has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by BM TRADA (Certificate 7005).

## 3 Delivery and site handling

3.1 The system elements are delivered to site in banding and packaging on wooden pallets. Each element is identified by a label that indicates the diameter, length and spacing of studs, overall length of element and location in which it is to be used in the slab.

3.2 Individual elements can be handled on site manually; banded packs of elements will require the use of mechanical lifting for offloading and movement on site.

3.3 The elements should be stored on a firm, dry base with original packaging to protect against damage and moisture.

## Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Shearail Punching Shear Reinforcement System.

## Design Considerations

### 4 General

4.1 The Shearail Punching Shear Reinforcement System, when designed and installed in accordance with recommendations of the Certificate holder and this Certificate, are suitable for providing punching shear resistance in reinforced concrete slabs designed in accordance with BS EN 1992-1-1 : 2004 or BS 8110 -1 : 1997.

4.2 The design of any structures incorporating the product must be carried out by a suitably qualified and experienced individual familiar with reinforced concrete structures.

### 5 Practicability of installation

The product must be installed by competent steel fixers and in accordance with the Certificate holder's installation instructions.

### 6 Structural aspects



6.1 The product is manufactured from ribbed weldable reinforcement steel bar with minimum characteristic yielding strength of 500 MPa in accordance with BS EN 10080 : 2005 or BS 4449 : 2005 +A2 : 2009.

6.2 The number, length and diameter of shear studs to be provided within each of the elements, to resist the applied loads, must be designed by a suitably qualified and experienced individual in accordance with BS EN 1992-1-1 : 2004 (Eurocode 2) or BS 8110-1 : 1997. The Certificate holder can provide design data on request.

6.3 The maximum stud spacing must not exceed the requirements given in BS EN 1992-1-1 : 2004 or BS 8110-1 : 1997.

### 7 Behaviour in relation to fire



7.1 When incorporating in reinforced concrete slabs, the use of the elements will not introduce any additional hazard in respect of behaviour in a fire situation if installed in accordance with the Certificate holder's instructions.

7.2 The nominal cover to reinforcement should be that appropriate to exposure condition in accordance with BS 8110-1 : 1997, Table 3.4 and Figure 3.2, or as required for fire resistance in accordance with BS 8110-2 : 1985, Section 4. The design fire resistance period for reinforced concrete structures, incorporating Shearail, designed and constructed in accordance with BS EN 1992-1-1 : 2004, is determined from Tables 5.8 to 5.11 of BS EN 1992-1-2 : 2004.

### 8 Maintenance

As the product is confined within a concrete construction and has suitable durability in the normal use, maintenance is not required.

### 9 Durability



The product, when installed in accordance with Certificate holder's instruction and this Certificate and with the appropriate concrete cover, will have a service life of not less than 60 years.

### 10 Reuse and recyclability

The steel elements can be recycled at the end of the life of the structure they are incorporated in, provided appropriate method used to retrieve them is adopted.

## Installation

### 11 General

11.1 Installation of Shearail Punching Shear Reinforcement System should be carried out by experienced steel fixers in accordance with the Certificate holder's *Design Manual and Detailers Manual*, also in accordance with the design drawings by a suitably qualified and experienced individual.

11.2 In line with normal procedures the quality of installation and workmanship of individual projects is subject to appropriate check on the site by a competent person.

11.3 The elements are generally designed symmetrically in each direction wherever possible so it can be placed either way round to avoid errors. Attention should be drawn to ensure that studs are properly upright, suitable covers are maintained on both ends of studs, studs will be in place during concreting.

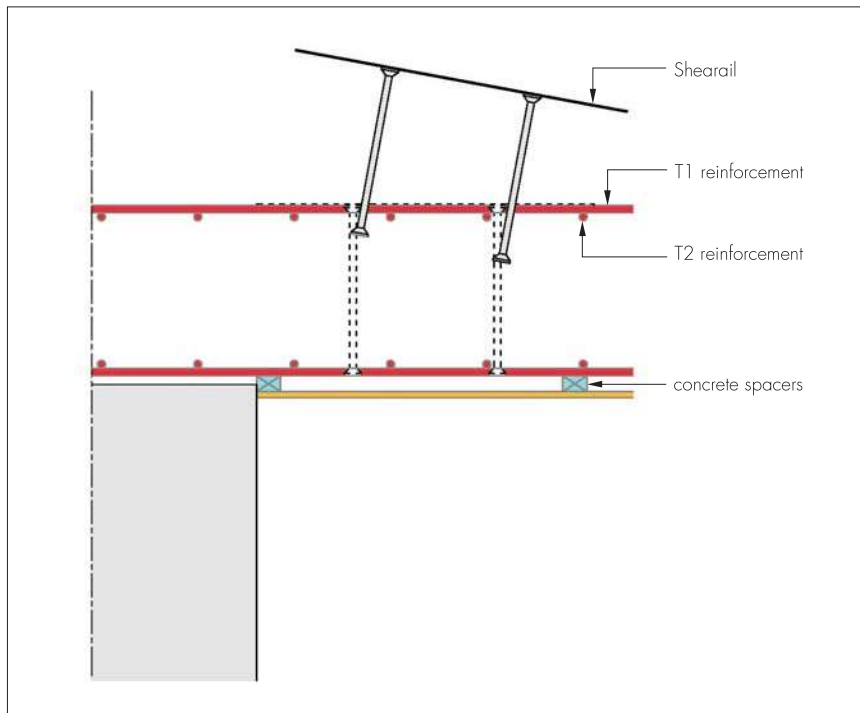
### 12 Procedure

12.1 The elements should be positioned in the required location in accordance with the reinforced concrete detailing drawings and as indicated in the label for each element.

### Top down method (Figure 2)

12.2 When using top down installation method, the top and bottom main reinforcement is placed as usual, then the studs are placed through the rebar with the rails supported on the T1 rebars and are secured with wire to prevent movement during concrete pour. If it is supported on T2 rebars, then spacers are needed to raise it to the level flush with the top of T1.

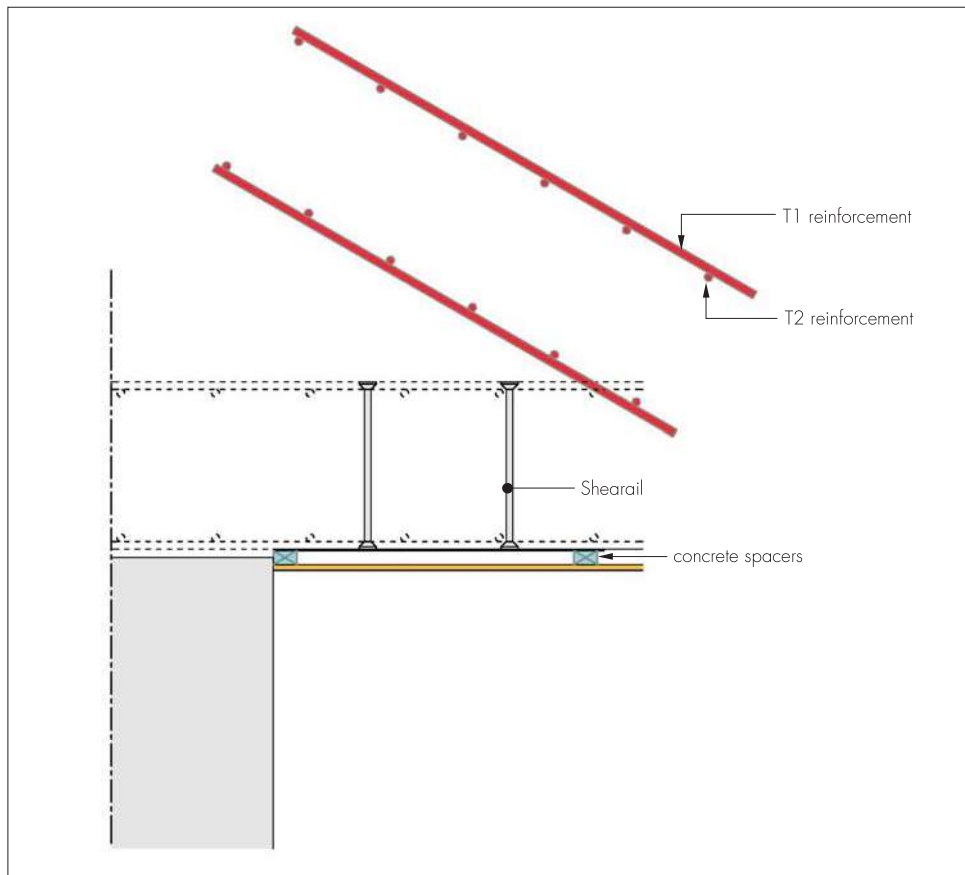
Figure 2 Top down installation



### Bottom up method (Figure 3)

12.3 Alternatively, rails are fitted by spacing off the formwork using concrete spacers. The bottom and top reinforcement can be laid as usual around the Shearail.

Figure 3 Bottom up installation



## 13 Finishing

13.1 A final check of the position of the elements is carried out prior to pouring concrete (see Figure 4).

13.2 During pouring, the concrete should be evenly distributed around the elements. Care should be taken when using vibrators not to dislodge the elements.

Figure 4 Completed Shearail installation



## Technical Investigations

### 14 Investigations

14.1 An examination was made of data relating to:

- Structural strength and performance to BS EN 1992-1-1 : 2004 and BS 8110-1 : 1997
- Calculations to confirm the results of tests on structural performance
- Fire resistance
- Durability and practicability of installation
- Material specification

14.2 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and compositions of materials used.

## Bibliography

BS 4449 : 2005 +A2 : 2009 *Steel for the reinforcement of concrete — Weldable reinforcing steel — Bar, coil and decoiled product — Specification*

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

BS 8110-2 : 1985 *Structural use of concrete — Code of practice for special circumstances*

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

BS EN 1992-1-2 : 2004 *Eurocode 2 General rules — Structural fire design*

BS EN 10080 : 2005 *Steel for the reinforcement of concrete. — Weldable reinforcing steel — General*

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

## 15 Conditions

15.1 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.

15.2 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.

15.3 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.

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

15.5 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
- actual 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
- any claims by the manufacturer relating to CE marking.

15.6 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.

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Agrément Certificate  
**16/5345**  
Product Sheet 1

## MAX FRANK EGCOBOX CANTILEVER CONNECTION SYSTEM

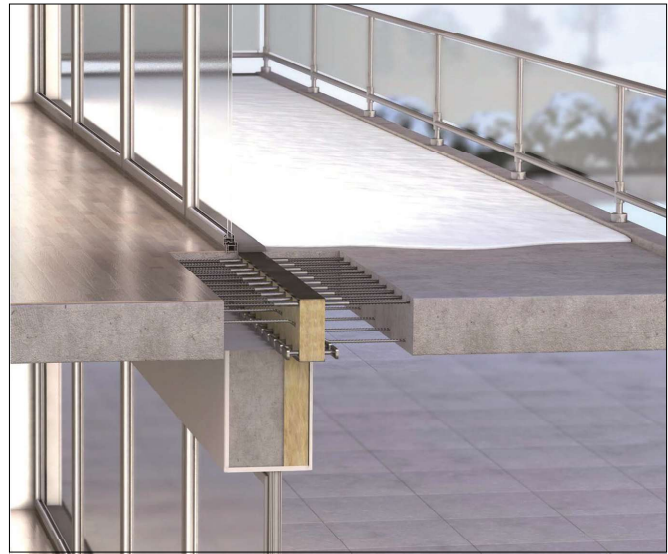
### EGCOBOX CANTILEVER CONNECTION SYSTEM

This Agrément Certificate Product Sheet<sup>(1)</sup> relates to the EgcoBOX Cantilever Connection System, for use in reinforced concrete structures to form a thermal break between the balcony and the internal floor, while transferring load and maintaining full structural integrity.

(1) Hereinafter referred to as 'Certificate'.

#### 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 aspects** — the system has adequate strength to resist the loads associated with permanent loading (see section 6).

**Thermal performance** — the system can contribute to limiting heat loss at junctions by minimising bridging of the wall insulation (see section 7).

**Behaviour in relation to fire** — the system, with either the fire protection plates incorporated in the products or the use of mineral wool as the insulation core, will provide up to 120 minutes' fire resistance (see section 9).

**Durability** — under the normal service conditions the system will have a service life of at least 60 years (see section 11).

The BBA has awarded this 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: 17 August 2016

Brian Chamberlain  
Head of Technical Excellence

Claire Curtis-Thomas  
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](http://www.bbacerts.co.uk)*

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# Regulations

In the opinion of the BBA, the Egccobox Cantilever Connection System, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



## The Building Regulations 2010 (England and Wales) (as amended)

<b>Requirement:</b> A1	<b>Loading</b>
<b>Comment:</b>	The system has sufficient strength and stiffness to sustain and transmit the design loads in accordance with sections 6.1 to 6.6 of this Certificate.
<b>Requirement:</b> B3(1)	<b>Internal fire spread (structure)</b>
<b>Comment:</b>	The system, with either the fire protection plates incorporated or the use of mineral wool as the insulation core, will provide up to 120 minutes' fire resistance. See section 9.3 of this Certificate.
<b>Requirement:</b> L1(a)(i)	<b>Conservation of fuel and power</b>
<b>Comment:</b>	The system can contribute to meeting this Requirement. See sections 7.1 and 7.2 of this Certificate.
<b>Regulation:</b> 7	<b>Materials and workmanship</b>
<b>Comment:</b>	The system is acceptable. See section 11 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> 26	<b>CO<sub>2</sub> emission rates for new buildings</b>
<b>Regulation:</b> 26A	<b>Fabric energy efficiency rates for new dwellings (applicable to England only)</b>
<b>Regulation:</b> 26A	<b>Primary energy consumption rates for new buildings (applicable to Wales only)</b>
<b>Regulation:</b> 26B	<b>Fabric performance values for new dwellings (applicable to Wales only)</b>
<b>Comment:</b>	Compensating fabric/services measures may be required. See sections 7.1 and 7.2 of this Certificate.



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

<b>Regulation:</b> 8(1)(2)	<b>Durability, workmanship and fitness of materials</b>
<b>Comment:</b>	The system complies with the requirements of this Regulation. See sections 10 and 11 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> 9	<b>Building standards applicable to construction</b>
<b>Standard:</b> 1.1(a)(b)	<b>Structure</b>
<b>Comment:</b>	The system, when incorporated in reinforced concrete walls and floors, has sufficient strength and stiffness to sustain and transmit the design loads in accordance with sections 6.1 to 6.6 of this Certificate, with reference to clauses 1.1.1 <sup>(1)(2)</sup> to 1.1.3 <sup>(1)(2)</sup> .
<b>Standard:</b> 2.3	<b>Structural protection</b>
<b>Comment:</b>	Either the fire protection plates or the use of mineral wool as the insulation core will provide up to 120 minutes' fire resistance (medium), with reference to clauses 2.3.1 <sup>(1)(2)</sup> to 2.3.3 <sup>(1)(2)</sup> . See section 9.3 of this Certificate.
<b>Standard:</b> 6.1(b)	<b>Carbon dioxide emissions</b>
<b>Comment:</b>	Compensating fabric/services measures may be required. See sections 7.1 and 7.2 of this Certificate.
<b>Standard:</b> 6.2	<b>Building insulation envelope</b>
<b>Comment:</b>	The system can contribute meeting this Standard, with reference to clauses 6.2.3 <sup>(1)</sup> and 6.2.5 <sup>(2)</sup> . See sections 7.1 and 7.2 of this Certificate.
<b>Standard:</b> 7.1	<b>Statement of sustainability</b>
<b>Comment:</b>	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.
<b>Regulation:</b> 12	<b>Building standards applicable to conversions</b>
<b>Comment:</b>	All comments given for the system under Regulation 9, Standards 1 to 6 also apply to this Regulation, with reference to clause 0.12.1 <sup>(1)(2)</sup> and Schedule 6 <sup>(1)(2)</sup> . (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



## The Building Regulations (Northern Ireland) 2012 (as amended)

<b>Regulation:</b> 23(a)(i)	<b>Fitness of materials and workmanship</b>
<b>Comment:</b>	The system is acceptable. See section 11 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> 30	<b>Stability</b>
<b>Comment:</b>	The system has sufficient strength and stiffness to sustain and transmit the design loads in accordance with sections 6.1 to 6.6 of this Certificate.
<b>Regulation:</b> 35(1)	<b>Internal fire spread – Structure</b>
<b>Comment:</b>	Either the fire protection plates incorporated in the system or the use of mineral wool as the insulation core will provide up to 120 minutes' fire resistance. See section 9.3 of this Certificate.
<b>Regulation:</b> 39(a)(i)	<b>Conservation measures</b>
<b>Comment:</b>	The system can contribute to meeting this Regulation. See sections 7.1 and 7.2 of this Certificate.
<b>Regulation:</b> 40(2)	<b>Target carbon dioxide emission rate</b>
<b>Comment:</b>	Compensating fabric/services measures may be required. See sections 7.1 and 7.2 of this Certificate.

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 section: 3 *Delivery and site handling* of this Certificate.

## Additional Information

### NHBC Standards 2016

NHBC accepts the use of the Egccobox Cantilever Connection System, provided it is installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Chapter 7.1, *Flat roofs and balconies*.

## Technical Specification

### 1 Description

1.1 The Egccobox Cantilever Connection System consists of a range of prefabricated assemblies incorporating steel reinforcing bars, steel plates and insulation products that allow full transfer of load from an external balcony into the main structure, whilst providing a thermal break to reduce heat loss to the outside. The range of units is described in Table 1 and illustrated in Figure 1.

Table 1 Range of units

Unit designation	Type of element	Depth of connection (mm)
<i>Cantilevering Balconies</i>		
Egccobox MM/MXL	Element to transfer shear force and bending moments	160 – 280
Egccobox MM-F/M-FXL	Element to transfer bending moments and shear force into a semi pre-cast balcony (split unit in two parts), design similar to an MM/MXL unit	160 – 280
Egccobox MM-Eck/MXL-Eck	Corner element to transfer shear force and bending moments	160 – 280
Egccobox MM-HV/MXL-HV	Element to transfer shear force and bending moments for stepped slab connections	160 – 280
Egccobox MM-BH/MXL-BH	Element to transfer shear force and bending moments for stepped slab connections	160 – 280
Egccobox MM-WU/MXL-WU	Element to transfer shear force and bending moments for balcony to wall connections	160 – 280
Egccobox MM-WO/MXL-WO	Element to transfer shear force and bending moments for balcony to wall connections	160 – 280
<i>Supported Balconies</i>		
Egccobox VM/VXL	Shear force element to transfer shear forces only	160 – 280
Egccobox VM-K/VXL-K	Short length shear force element to transfer shear forces only	160 – 280
Egccobox VM-ZK/VXL-ZK	Short length shear force element to transfer shear forces only without compression bars	160 – 280
Egccobox VM±/VXL±	Shear force element to transfer positive and negative shear forces	160 – 280
Egccobox VM-K±/VXL-K±	Short length shear force element to transfer positive and negative shear forces	160 – 280
Egccobox MM±/MXL±	Element for changing loads to transfer positive and negative shear force and bending moments	160 – 280
<i>Parapet wall, console supports</i>		
Egccobox AS	Element for parapet walls (vertical connection)	150 – 280
Egccobox AXL	Element for parapet walls (vertical connection)	140 – 250
Egccobox FS	Element for parapet walls (horizontal connection)	160 – 280
Egccobox FXL	Element for parapet walls (horizontal connection)	160 – 250
Egccobox OS	Element for cantilevered brackets or corbels	180 – 250
Egccobox OXL	Element for cantilevered brackets or corbels	180 – 250
<i>Further standard elements</i>		
Egccobox M-S/M-SXL	Element for cantilevered beam	400 – 500 <sup>(1)</sup>
Egccobox M-W/M-WXL	Element for cantilevered shear walls	1500 – 3500 <sup>(1)</sup>
Egccobox MM-MODULE VH/NH/VNH	Short length element for slab connections to transfer positive and negative shear force and bending moments	160 – 280
Egccobox MXL-MODULE VH/NH/VNH	Short length element for slab connections to transfer positive and negative shear force and bending moments	160 – 280
Egccobox MM-MODULE	Short length element for slab connections to transfer bending moments and positive and Negative shear force	160 – 280

(1) Connection height.

Figure 1 Product types

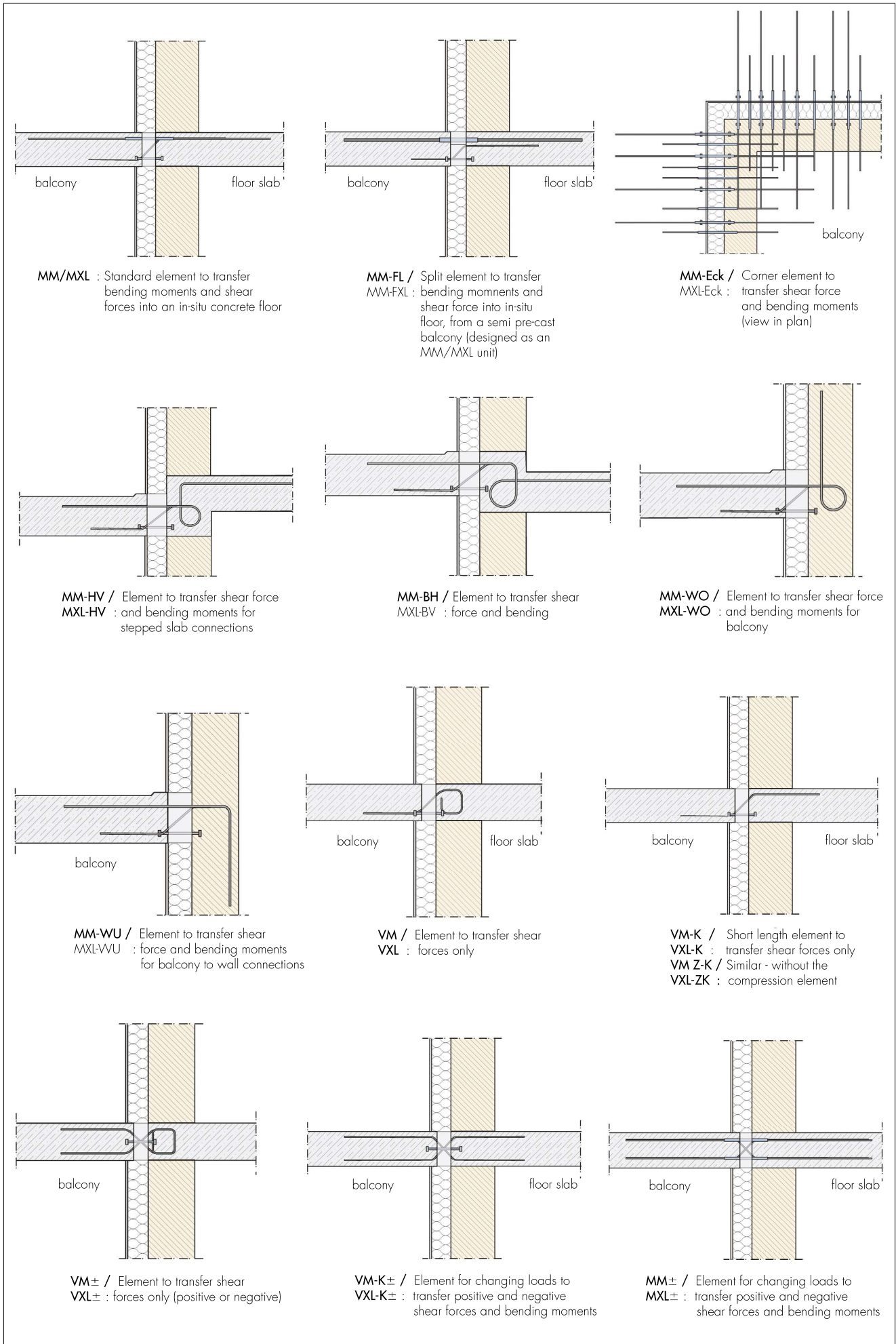
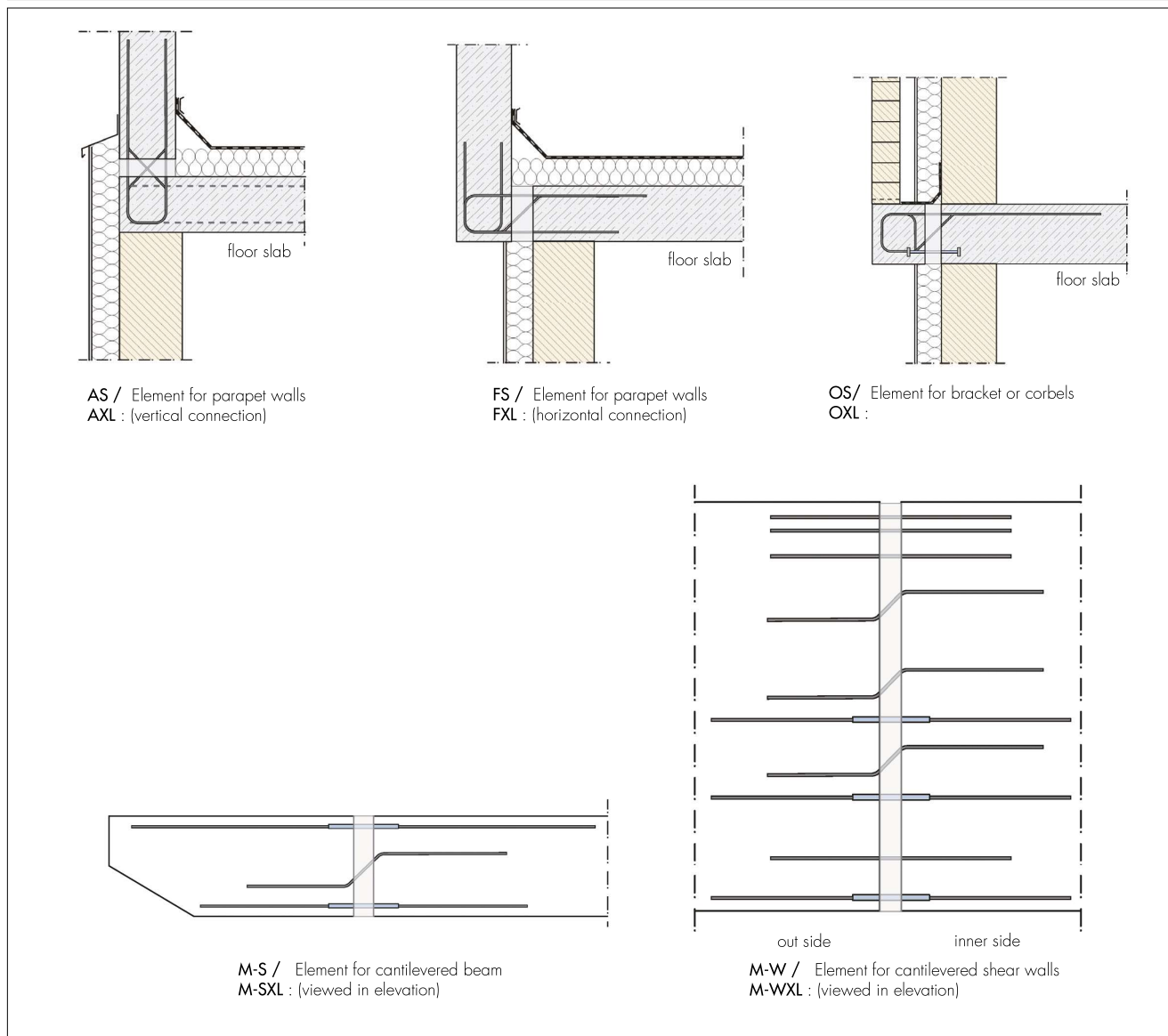


Figure 1 Product types (continued)



1.2 Ecocobex units, depending on model designation, incorporate some of the following components:

- high-density expanded polystyrene insulation to BS EN 13163 : 2012, 50 mm to 120 mm wide by 160 mm to 250 mm deep
- mineral wool insulation to BS EN 13162 : 2012
- ribbed steel tensile reinforcing bars (B500 to DIN 488-1 2009-08)
- 1 mm thick stainless steel sleeve (1.4301 or 1.4571 to BS EN ISO 1127 : 1997)
- ribbed stainless steel shear and compression reinforcement to BS EN 10088-3 : 2014 (tensile strength greater than  $500 \text{ N}\cdot\text{mm}^{-2}$ )
- two-component resin
- 50 mm by 40 mm or 63 mm by 40 mm structural steel (grade S235 / S355 JRG1 to BS EN 10025-2 : 2004) compression thrust blocks welded to stainless steel ribbed reinforcement by applying a continuous fillet weld around the circumference of the bar.

### Tensile reinforcement

1.3 Tensile forces are transferred by ribbed tensile steel reinforcing bars using either sleeved tension bars or welded tension bars:

- sleeved tension bar — the bar is protected by a stainless steel sleeve where the bars pass through the insulation (see Figure 2a). The inside diameter of the sleeve is 2 mm wider than the nominal diameter of the reinforcing bar. The sleeve extends beyond the sides of the insulation (see Figure 2a) by 60 mm to allow it to bond with the concrete. The area between the sleeve and the reinforcement is completely filled with the two-component resin
- welded tension bar — the middle part of the bar is a welded stainless steel bar that passes through the insulation (see Figure 2b). The stainless steel bar extends beyond the sides of the insulation by 60 mm to allow it to bond with the concrete.

Figure 2a Sleeved tension bar

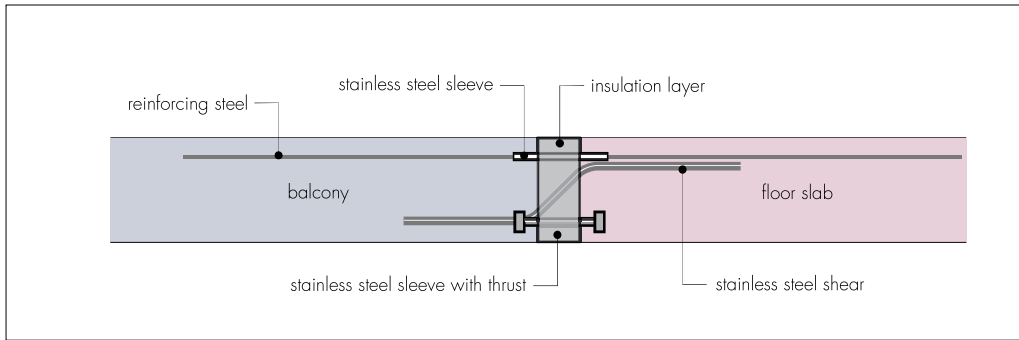
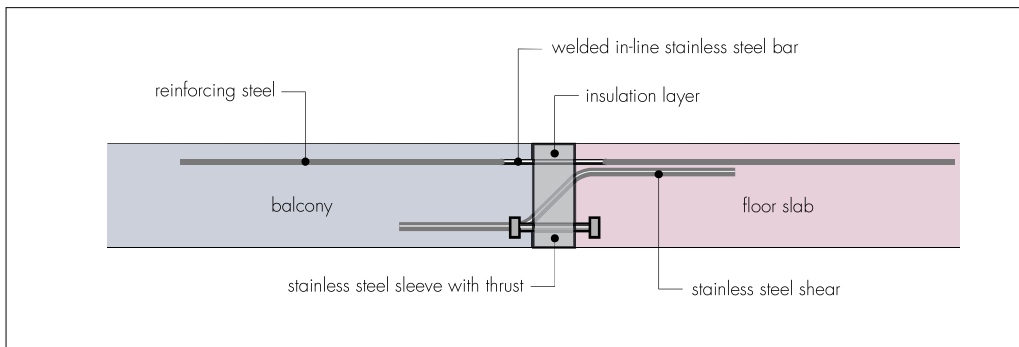


Figure 2b Welded tension bar



### Compression reinforcement

1.4 Compressive forces are transferred from the balcony to the floor construction by use of a steel compression thrust block welded to stainless steel ribbed compression reinforcement, which passes through the insulation.

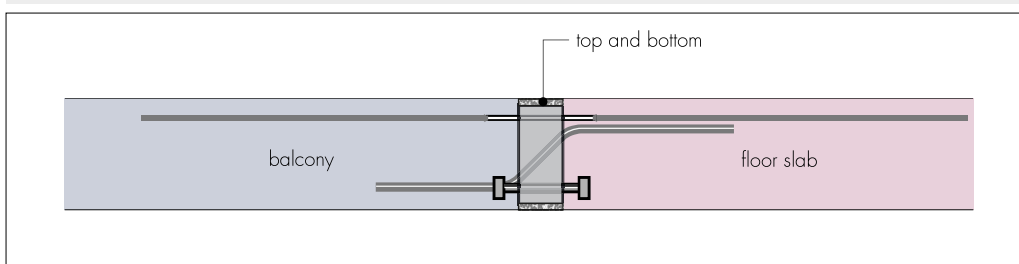
### Shear reinforcement

1.5 Shear forces are resisted by ribbed stainless steel reinforcement passing diagonally through the insulation (see Figures 2a and 2b).

1.6 Accessories and fixings used in conjunction with the panels include:

- instruction label — attached to reinforcement of each element type
- fire protection plate — 15 mm thick, made from glassfibre cement-bonded board complying with BS EN 13501-1 : 2007, for use with polystyrene insulation (see Figure 2c)
- damage protection channel — C-shaped black plastic, 1 mm thick, provided at top and bottom of products.

Figure 2c Fire plates



## 2 Manufacture

2.1 The manufacturing method varies according to the unit. Insulation is cut from sheets according to the requirements for each specific product type. Tension bars are formed from reinforcing bars which are cut to length, and either friction-welded onto a stainless steel reinforcing bar or inserted into a stainless steel tube and injected with resin. Stainless steel for shear force bars is taken from coils and bent according to production drawings. After assembly the bars are connected transversely with non-structural tack welds.

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 nonconformities

- 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.

2.3 The management system of Max Frank Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by BMTRADA (Certificate 7005).

### 3 Delivery and site handling

Units are normally supplied to order, in palletised and shrink-wrapped packages containing full or part orders. During off-loading, care must be taken to avoid bending reinforcement or damaging the expanded polystyrene or mineral wool core. Packages must be stored away from direct sunlight, and contact with solvents or other harmful chemicals should be avoided.

## Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Egcoibox Cantilever Connection System.

### Design Considerations

#### 4 Use

The system is for use in reinforced concrete balconies within domestic and commercial structures, to form a thermal break between the balcony and internal floor and transfer the load while maintaining full structural integrity.

#### 5 Practicability of installation

The system is designed to be installed by operatives familiar with the fixing of reinforcement. The operatives must be competent and appropriately trained and take account of the installation instructions provided with each unit.

#### 6 Structural aspects



6.1 The system, when designed and installed in accordance with the Certificate holder's installation instructions, has the capability of transferring tensile, shear and compressive forces via the steel reinforcement and the compression elements through to the supporting structure.

6.2 The minimum strength of concrete that should be used in the balcony construction is C25/30 to C30/37. The supporting floor concrete strength must be at least C20/25.

6.3 The amount of concrete cover depends on the prevailing exposure conditions and fire resistance requirements, and must be in accordance with BS EN 1992-1-1 : 2004 or BS 8110-1 : 1997. The minimum concrete cover must be at least 30 mm from the outer edge.

6.4 The quantities of tensile and/or shear reinforcement to be provided within each unit to resist the balcony or other direct loads must be calculated by a competent structural engineer in accordance with BS EN 1992-1-1 : 2004 or BS 8110-1 : 1997. Both tension and shear reinforcement must be between 6 mm and 16 mm in diameter. A minimum of three compression and shear reinforcing bars is provided every 1 m length of each of the products.

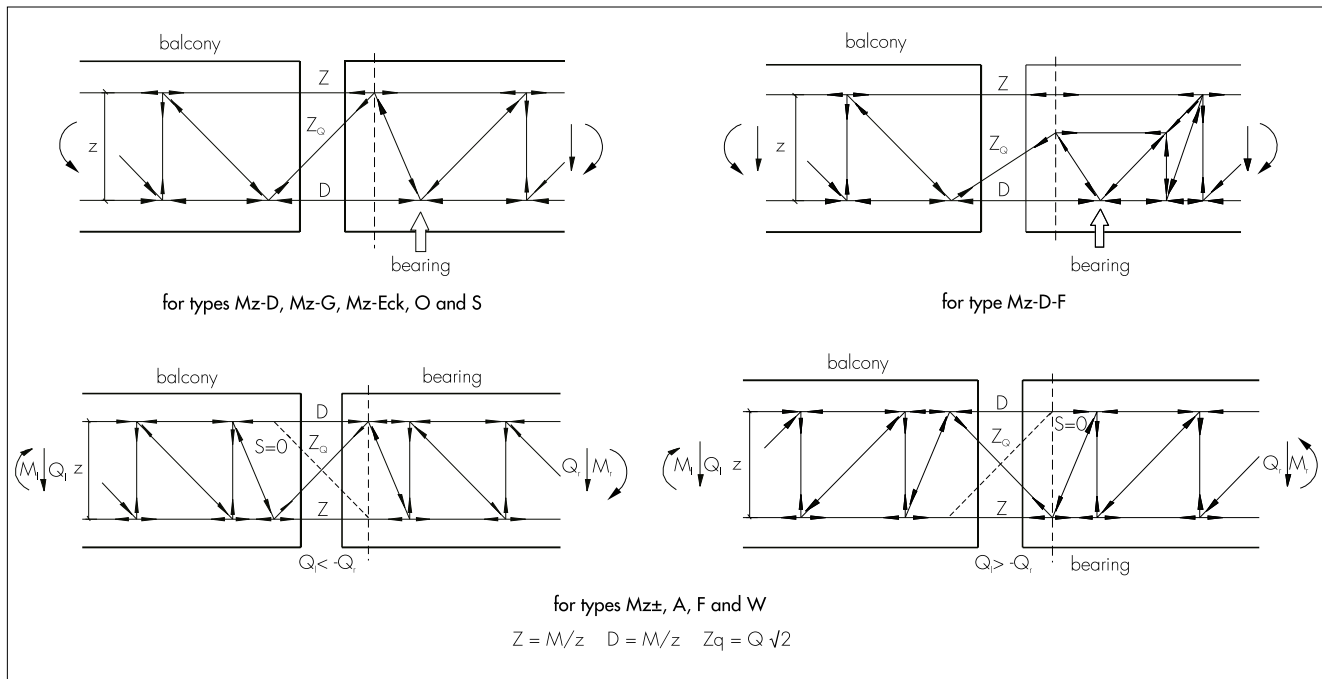
6.5 A minimum of four tensile reinforcing rods is provided per metre run or in accordance with the spacing requirements given in BS EN 1992-1-1 : 2004 or BS 8110-1 : 1997.

6.6 The anchor length of steel reinforcement should be in accordance with BS EN 1992-1-1 : 2004 or BS 8110-1 : 1997.

6.7 Site welding must not be undertaken under any circumstances.

6.8 The mechanism of structural resistance of the units is shown in Figure 3 in a framework model form. Structural analysis of individual balconies can be carried out using the framework models.

Figure 3 Framework models



Bending moment ( $M$ ) and shear force ( $Q$ ) from balconies pass through connectors in tension ( $Z$ ,  $Zq = Q\sqrt{2}$ ) and compression ( $D$ ) to supporting structures.

6.9 Tension reinforcement forming each of the units must remain straight and should not be bent.

6.10 Where an opening forms part of the balcony support, additional transverse reinforcement should be provided to compensate for the reduction in continuous support.

6.11 The characteristic yield strength of both steel and stainless steel reinforcing bars used in the units can be taken as  $500 \text{ N}\cdot\text{mm}^{-2}$ . Test result data can also be obtained from the Certificate holder to verify specified tensile resistance figures.

6.12 During construction, an upwards camber should be provided to the balcony formwork, in accordance with the Certificate holder's own design tables or by calculating the deflection by structural analysis.

## 7 Thermal performance

7.1 The linear thermal transmittance ( $\psi$  value) of a junction incorporating the product, and its minimum temperature factor, can be modelled in accordance with the requirements and guidance in BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors*, BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings* and the provisions in the documents supporting the national Building Regulations relating to competency to perform calculations, determining robustness of design/construction and limiting heat loss by air infiltration. Alternatively, a conservative default junction  $\psi$  value (eg  $1.0 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  for a balcony connector) can be taken from the SAP conventions document.

7.2 A construction incorporating an Egccobox type Mz5-D,  $h = 180 \text{ mm}$  (with thermal break conductivity  $\lambda = 0.040 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  with rebars at  $160 \text{ mm}$  centres), in a concrete floor slab abutting a wall comprising a  $105 \text{ mm}$  thick reinforced concrete ( $\lambda = 1.8 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ) inner leaf,  $80 \text{ mm}$  of thermal insulation ( $\lambda = 0.040 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ), a  $20 \text{ mm}$  wide cavity and a  $105 \text{ mm}$  thick masonry external leaf, when modelled had an estimated  $\psi$  value of  $0.35 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  and a minimum temperature factor of  $0.84$ .

Table 2 Material properties

Material	Thermal conductivity ( $\text{W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ )
Mild steel	50
Stainless steel	17
Epoxy resin	0.2
Polystyrene	0.031
Mineral wool	0.037

## 8 Condensation

8.1 The condensation risk associated with a particular construction should be assessed in accordance with BS 5250 : 2011. Additional ventilation may be required if the connector is to be used in situations where the internal relative humidity is expected to exceed 70% for any significant length of time.

8.2 Constructions should be appropriately vapour-resistant, to ensure that the risk of interstitial condensation is minimised.

## 9 Behaviour in relation to fire

9.1 The use of the system when incorporating top and bottom fire protection plates will not introduce any additional hazard in respect of behaviour in a fire situation, provided the system is installed in accordance with the Certificate holder's instructions.

9.2 The nominal concrete cover to reinforcement should be that appropriate to 'mild' exposure in accordance with BS EN 1992-1-1 : 2004 or BS 8110-1 : 1997, Table 3.4 and Figure 3.2, or as required for fire resistance in accordance with BS EN 1992-1-2 : 2004 or BS 8110-2 : 1985, Section 4, whichever is the greater.



9.3 Either top and bottom fire protection plates or the use of mineral wool as the insulation core will provide a fire resistance of up to 120 minutes.

9.4 Test results have indicated that the units incorporating 15 mm thick AESTUVER fire protection plates and minimum 130 mm thick polystyrene, or when using minimum 16 mm thick mineral wool as the insulation core, are capable of achieving up to 120 minutes' loadbearing capacity, 120 minutes' integrity and 120 minutes' insulation.

## 10 Maintenance



Once properly installed within the structural construction, the units should not require maintenance throughout their serviceable life. The fire plates, when installed, should be inspected periodically for damage and adhesion to the surrounding concrete, and replaced or repaired as necessary.

## 11 Durability



11.1 Balconies constructed with the Egcoflex range of products will have a service life of not less than 60 years.

11.2 Reinforcement, forming part of each product, should be provided with the nominal concrete cover as stated in BS EN 1992-1-1 or BS 8110-1 : 1997, Table 3.3 to meet durability requirements, depending on conditions of exposure.

# Installation

## 12 General

Installation instructions are provided by the Certificate holder. Width and depth measurements and direction of lay (in the form of an arrow pointing towards the balcony) are given on the label affixed to top of each unit.

## 13 Procedure

The following procedure applies to the model type MM/MXL:

- top and bottom reinforcement is laid and fixed to standard detailing requirements, leaving sufficient space to insert the balcony connector
- the balcony connector, with the top and bottom fire plates fitted, is seated within the reinforcement and its position checked for correct alignment, and is wired to the top and bottom reinforcement
- a final position check is made prior to pouring concrete
- during pouring, the concrete should be evenly distributed around the balcony connector. Care should be taken when using vibrators to avoid dislodging the balcony connector from its intended position.

# Technical Investigations

## 14 Investigations

14.1 An assessment was made of data relating to:

- behaviour in fire
- thermal attributes
- structural calculations.

14.2 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

14.3 A site visit was carried out to witness the installation process, including the construction of various reinforced balcony constructions, placement of the Egcoflex balcony connectors and general reinforcement and pouring of concrete.



## Bibliography

- BS 5250 : 2011 *Code of practice for control of condensation in buildings*
- BS 8110-1 : 1997 *Structural use of concrete — Code of practice for design and construction*
- BS 8110-2 : 1985 *Structural use of concrete — Code of practice for special circumstances*
- BS EN 1992-1-1 : 2004 + A1 : 2014 *Eurocode 2 : Design of concrete structures — General rules and rules for buildings*
- BS EN 1992-1-2 : 2004 *Eurocode 2 : Design of concrete structures — General rules — Structural fire design*
- BS EN 10025-2 : 2004 *Hot rolled products of structural steels — Technical delivery conditions for non-alloy structural steels*
- BS EN 10088-3 : 2014 *Stainless steels — Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*
- BS EN 13162 : 2012 + A1 : 2015 *Thermal insulation products for buildings — Factory made mineral wool (MW) products — Specification*
- BS EN 13163 : 2012 + A1 : 2015 *Thermal insulation products for buildings — Factory made products of expanded polystyrene (EPS) — Specification*
- BS EN 13501-1 : 2007 + A1 : 2009 *Fire classification of construction products and building elements — Classification using test data from reaction to fire tests*
- BS EN ISO 1127 : 1997 *Stainless steel tubes — Dimensions, tolerances and conventional masses per unit length*
- BS EN ISO 9001 : 2008 *Quality management systems — Requirements*
- DIN 488-1 : 2009-08 *Reinforcing steels — Grades, properties, marking*

## 15 Conditions

15.1 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.

15.2 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.

15.3 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.

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

15.5 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
- actual 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
- any claims by the manufacturer relating to CE marking.

15.6 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.