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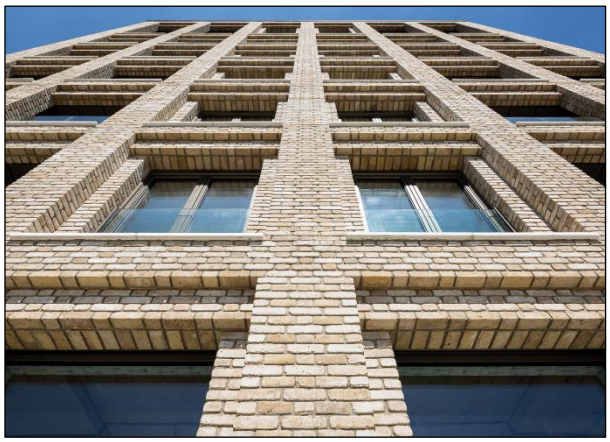
Agrément Certificate
15/5250
Product Sheet 2

IG MASONRY SUPPORT SYSTEMS

IG BRICK ON SOFFIT SYSTEM (B.O.S.S.)

This Agrément Certificate Product Sheet(1) relates to the IG Brick On Soffit System (B.O.S.S.), comprising prefabricated stainless steel units with adhesively factory-bonded brick slips, for use in external masonry walls.

(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

Properties in relation to fire — the system components are classified as either A1 or A2, except the adhesive which is classified as B, in accordance with BS EN 13501-1 : 2018, therefore the use of the system is restricted in some cases by the national Building Regulations (see section 7).
Thermal performance — where the system is used around opening head junctions, it can adequately limit heat loss (see section 8).
Condensation risk — where the system is used around opening heads, the risk of local surface condensation will be minimal (see section 9).
Durability — provided that the system is designed, installed and used in accordance with the Certificate, it will have a service life of at least 50 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 Second issue: 20 March 2020

Originally certificate on 26 September 2018

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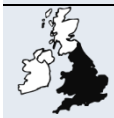
Regulations

In the opinion of the BBA, the IG Brick On Soffit System (B.O.S.S.), 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)

Requirement:	**A1**	**Loading**
Comment:		The system is acceptable for use as set out in section 6 of this Certificate.
Requirement:	**B3(2)**	**Internal fire spread (structure)**
Comment:		The system can contribute to satisfying this Requirement. See sections 7.1 to 7.3 of this Certificate.
Requirement:	**B4(1)**	**External fire spread**
Comment:		In England, the system is restricted by this Requirement in some cases. See sections 7.1 to 7.3 of this Certificate.
Requirement:	**L1(a)(b)**	**Conservation of fuel and power**
Comment:		Heads of openings in external walls incorporating the system can adequately limit heat loss and the risk of condensation. See sections 8.1, 8.2 and 9 of this Certificate.
Regulation:	**7(1)**	**Materials and workmanship**
Comment:		The system is acceptable. See section 11 and the *Installation* part of this Certificate.
Regulation:	**7(2)**	**Materials and workmanship**
		The system is restricted by this Regulation. See section 7.3 of this Certificate
Regulation:	**26**	**CO_2 emission rates for new buildings**
Regulation:	**26A**	**Fabric energy efficiency rates for new dwellings (applicable to England only)**
Regulation:	**26A**	**Primary energy consumption rates for new buildings (applicable to Wales only)**
Regulation:	**26B**	**Fabric performance values for new dwellings (applicable to Wales only)**
Comment:		Heads of openings in external walls incorporating the system can adequately limit heat loss and the risk of condensation. See sections 8.1, 8.2 and 9 of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Durability, workmanship and fitness of materials**
Comment:		The system is acceptable. See sections 10.2, 10.3 and 11 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
Standard:	1.1(a)(b)	Structure
Comment:		The system is acceptable, with reference to clauses $1.1.1^{(1)(2)}$ and $1.1.2^{(1)(2)}$ of this Standard. See section 6 of this Certificate.
Standard:	2.4	Cavities
Comment:		The system can contribute to satisfying this Requirement. See sections 7.1 and 7.4 of this Certificate.

Standard:	2.6	Spread to neighbouring buildings
Standard:	2.7	Spread on external walls
Comment:		The system is restricted by these Standards, with reference to clauses 2.6.4(1)(2), 2.6.5(1), 2.6.6(2) and 2.7.1(1)(2). See sections 7.1 and 7.4 of this Certificate.
Standard:	3.15	Condensation
Comment:		When incorporated in an external masonry cavity wall, the system can satisfy this Standard with reference to clauses 3.15.1(1)(2), 3.15.4(1)(2) and 3.15.5(1)(2). See section 9 of this Certificate.
Standard:	6.1	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		Heads of openings in external walls incorporating the system can limit heat loss and the risk of condensation, with reference to clauses 6.1.2(1), 6.1.6(1), 6.2.3(1), 6.2.4(1), 6.2.5(2), 6.2.6(2), 6.2.10(1) and 6.2.11(2) of these Standards. See sections 8.1, 8.2 and 9 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The systems can contribute to meeting the relevant Requirements of Regulation 9, Standards 1 to 6, and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	**12**	**Building standards applicable to conversions**
Comment:		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(1)(2) and Schedule 6(1)(2).

(1) Technical Handbook (Domestic).
(2) Technical Handbook (Non-Domestic).

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

Regulation:	**23(a)(i)**	**Fitness of materials and workmanship**
Comment:	**(iii)(b)(i)**	The system is acceptable. See section 11 and the *Installation* part of this Certificate.
Regulation:	**29**	**Condensation**
Comment:		The system can contribute to satisfying this Regulation. See section 9 of this Certificate.
Regulation:	**30**	**Stability**
Comment:		The system is acceptable as set out in section 6 of this Certificate.
Regulation:	**35(4)**	**Internal fire spread – Structure**
Comment:		The system can contribute to satisfying this Requirement. See sections 7.1 and 7.2 of this Certificate.
Regulation:	**36(a)**	**External fire spread**
Comment:		The system is unrestricted under this Regulation. See sections 7.1 and 7.2 of this Certificate.
Regulation:	**39(a)(i)**	**Conservation measures**
Regulation:	**40**	**Target carbon dioxide emissions rate**
Comment:		Heads of openings in external masonry cavity walls incorporating the system can limit heat loss and the risk of condensation. See sections 8.1, 8.2 and 9 of this Certificate.

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

Additional Information

NHBC Standards 2020

In the opinion of the BBA, the IG Brick On Soffit System (B.O.S.S.), if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Chapter 6.9 *Curtain walling and cladding*.

Technical Specification

1 Description

1.1 The IG Brick On Soffit System (B.O.S.S.) is a prefabricated soffit system comprising brick slips adhesively bonded to a stainless steel carrier to achieve project design requirements (see Figures 1 to 4). The stainless steel carrier is designed to be fixed to the underside of the IG Welded Masonry Support (WMS) System (which is outside the scope of this Certificate).

1.2 The system is available in four standard profiles: BOSS 65 x 215 mm with header bond (see Figure 1 and Table 1), BOSS 65 x 327 mm with stretcher bond (see Figure 2 and Table 2), BOSS 215 x 327 mm half lap bond (see Figure 3 and Table 3) and BOSS 215 x 215 mm with soldier bond (see Figure 4 and Table 4).

Figure 1 BOSS 65 x 215 mm with header bond (welded masonry support, shims and anchor bolts are outside the scope of this Certificate)

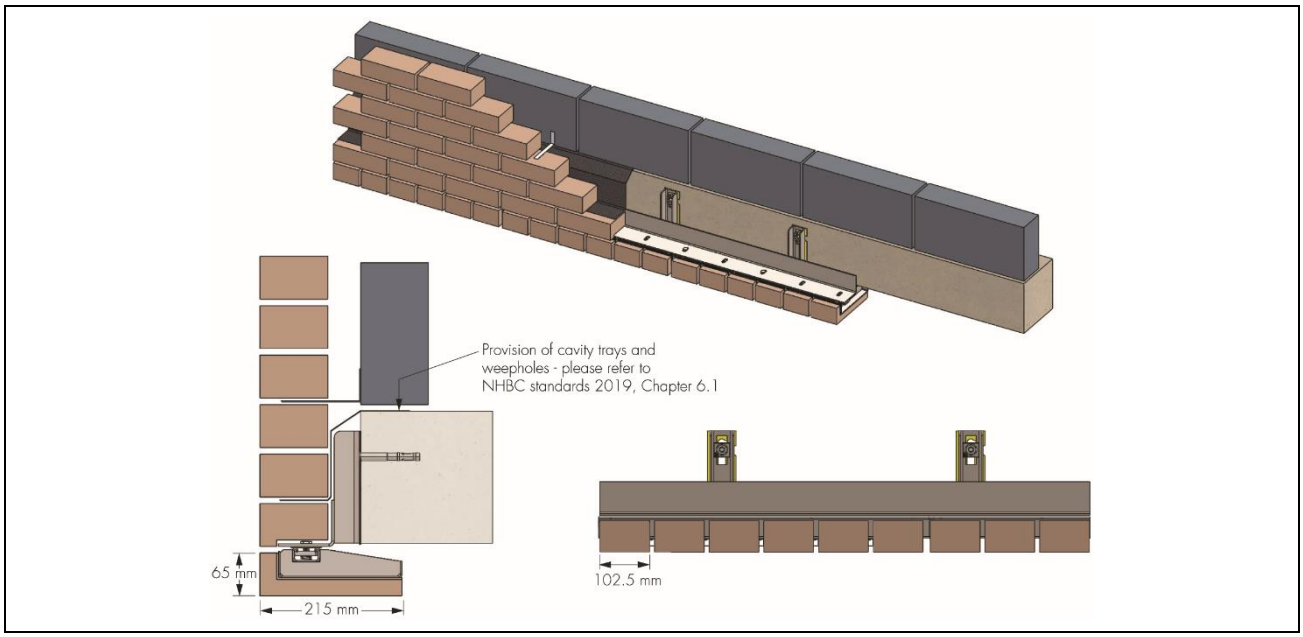


Figure 2 BOSS 65 x 327 mm with stretcher bond (welded masonry support, shims and anchor bolts are outside the scope of this Certificate)

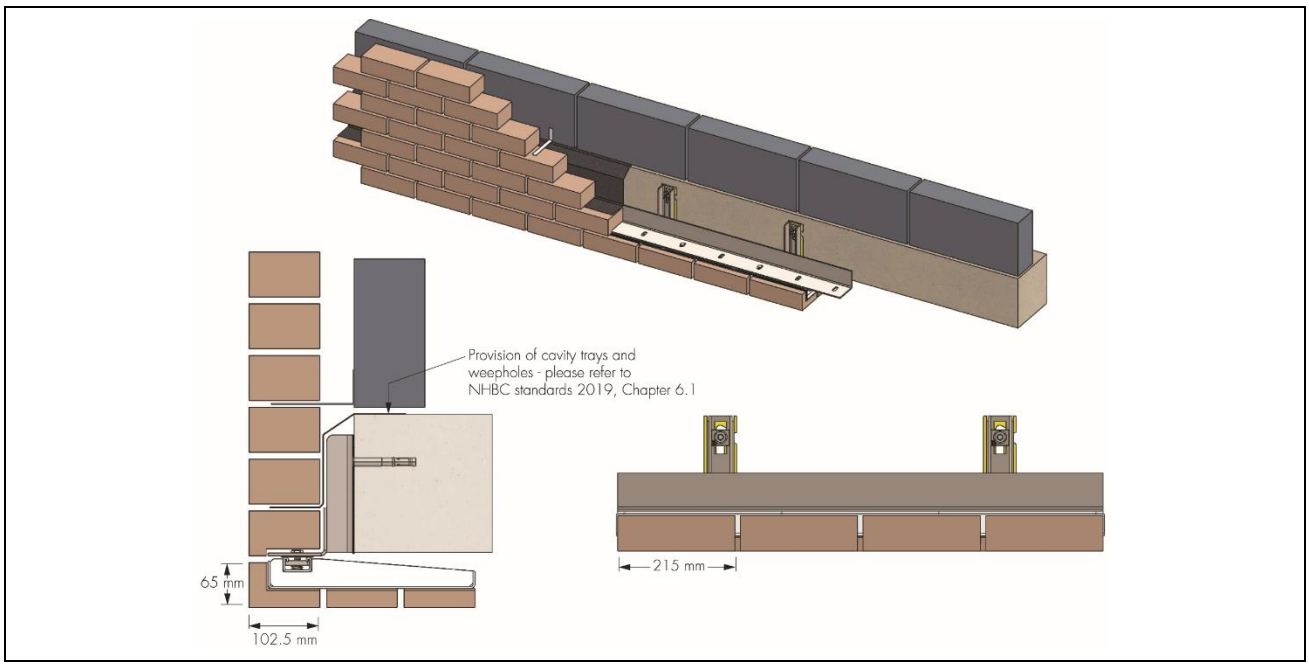


Figure 3 BOSS 215 x 327 mm with half lap bond (welded masonry support, shims and anchor bolts are outside the scope of this Certificate)

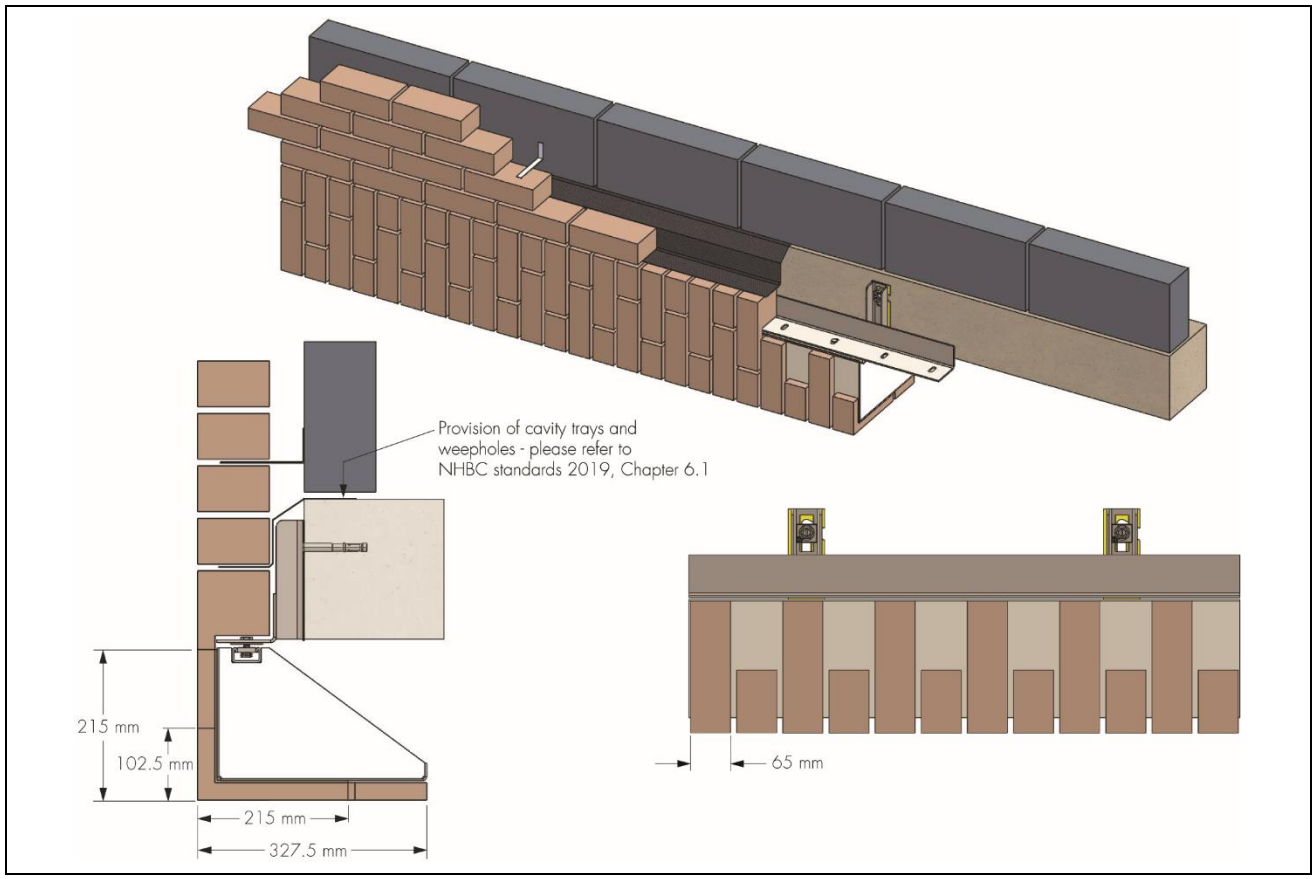


Figure 4 BOSS 215 x 215 mm with soldier bond (welded masonry support, shims and anchor bolts are outside the scope of this Certificate)

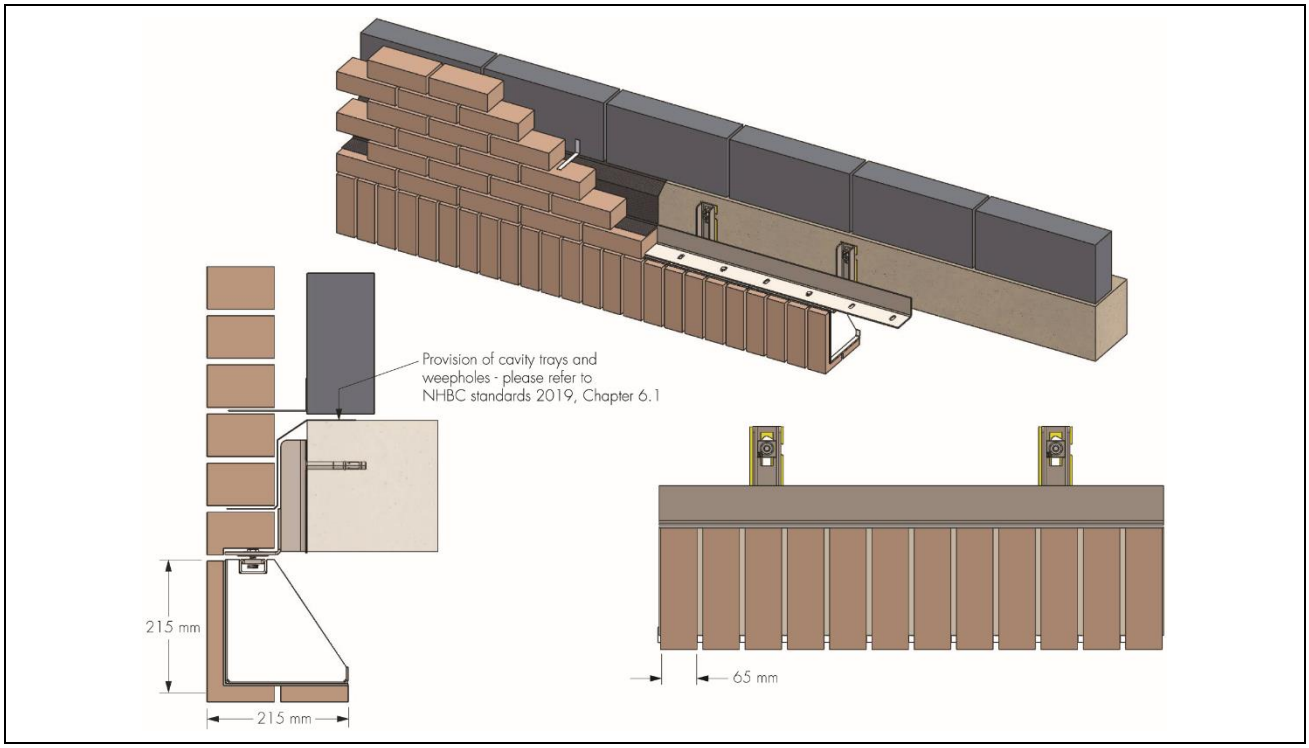


Table 1 BOSS 65 x 215 mm with header bond	
Length of soffit profile (mm)	890
Height of soffit profile (mm)	65
Width of soffit profile (mm)	215
Thickness of steel profile (mm)	2.5
Mass with brick slip (kg·m^{-1})	18.75

Table 2 BOSS 65 x 327 mm with stretcher bond	
Length of soffit profile (mm)	890
Height of soffit profile (mm)	65
Width of soffit profile (mm)	327
Thickness of steel profile (mm)	2.5
Mass with brick slip (kg·m^{-1})	26.98

Table 3 BOSS 215 x 327 mm with half lap bond	
Length of soffit profile (mm)	890
Height of soffit profile (mm)	215
Width of soffit profile (mm)	327
Thickness of steel profile (mm)	2.5
Mass with brick slip (kg·m^{-1})	41.33

Table 4 BOSS 215 x 215 mm with soldier bond	
Length of soffit profile (mm)	890
Height of soffit profile (mm)	215
Width of soffit profile (mm)	215
Thickness of steel profile (mm)	2.5
Mass with brick slip (kg·m^{-1})	31.71

Materials

1.3 The perforated soffit plates, gusset plates and channel are manufactured using austenitic stainless steel to BS EN 10028-7 : 2016, Grade 304 2B (1.4301/1.4307 or Grade 1.4301/1.4307 HR) or Grade 316 (Grade 1.4401/1.4404). The profiles are fabricated by welding.

1.4 The brick slip façade is created from 25 mm thick brick slips cut from standard brick masonry units to BS EN 771-1 : 2011 or BS EN 771-2 : 2011, and bonded to the soffit plates using 3 mm thick Chemfix Metofix 3-1 adhesive(1) at the factory.

(1) Chemfix Metofix 3-1 is the subject of BBA Certificate 12/4893.

1.5 Ancillary items used with the system, but outside the scope of this Certificate, are:

- the IG Welded Masonry Support System — comprising brackets, support angles, shims and anchor bolts including stainless steel spring nuts. All elements are manufactured in grade 1.4301 austenitic stainless steel
- wall ties
- pointing mortar — expansion joint mastic sealant, colour matched to the mortar to ensure it blends seamlessly with the surrounding brickwork.

2 Manufacture

2.1 The stainless steel profiles are manufactured from sheet material which is folded and formed in the factory. The system is fabricated by pressing and welding.

2.2 The brick slips are cut from bricks and factory-bonded to the soffit unit using Chemfix Metofix 3-1.

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 the Keystone Group has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 and BS EN ISO 14001 : 2015 by BSI (Certificates FM 523686, IG, ISO 9001 : 2015; FM 21541, Keystone Lintels Ltd, ISO 9001 : 2015 and EMS553955, Keystone Group, ISO 14001 : 2015).

3 Delivery and site handling

3.1 The system is delivered to site or to builders' merchants at specified lengths, each carrying a label bearing the Certificate holder's name. The BBA logo incorporating the number of this Certificate is marked on each system.

3.2 Reasonable care must be taken during unloading, stacking and storage to avoid damage to the system. A system that has suffered deformation or damage must not be used. Any damages to the brick, steel or bond between the brick and steel must be assessed by the Certificate holder. Repairs of the bond between the brick and steel can only be carried out by the Certificate holder.

3.3 The system must be stored off the ground in such a manner as to avoid the risk of mechanical damage or contamination by corrosive substances.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the IG Brick On Soffit System (B.O.S.S.).

Design Considerations

4 Use

4.1 The IG Brick On Soffit System (B.O.S.S.) is satisfactory for use in brickwork and/or blockwork.

4.2 It is important for designers, planners, contractors and/or installers to ensure that the installation of the system is in accordance with the Certificate holder's instructions and the information given in this Certificate.

4.3 The cavity wall construction should be in accordance with the recommendations of PD 6697 : 2010 and where applicable, NHBC Standards 2020, in respect of provision of cavity trays and weepholes.

5 Practicability of installation

The system is designed to be installed by a competent general builder, or a contractor, experienced with this type of system.

6 Structural performance

6.1 The IG Brick On Soffit System (B.O.S.S.) has adequate strength and stiffness to sustain its own weight and imposed wind actions, provided the IG Welded Masonry Support System is designed to withstand the loads and limit the deflections and installed by an appropriately qualified individual. The system is not designed to take any load other than its own weight and imposed wind actions and must be separated from the walling above by the expansion joint mastic sealant.

6.2 The characteristic wind loads on the system should be calculated in accordance with BS EN 1991-1-4 : 2005. Special consideration should be given to locations with high wind-load pressure coefficients. In accordance with BS EN 1990 : 2002, a partial factor of 1.5 should be used to determine the design wind load to be resisted by the system.

6.3 An assessment of the structural performance for a particular building must be carried out by a suitably qualified and experienced individual to confirm that the proposed system provides adequate resistance to design wind loads and transfers them through the masonry support system to the structure.

6.4 The characteristic bond resistance between the soffit plate and brick-slip interface derived from test results is 68.5 $kN \cdot m^{-2}$. The design resistance of the bond between the soffit plate and brick-slip should be taken as the characteristic bond resistance divided by a partial factor of 9.

6.5 In addition to the requirements specifically referred to in this Certificate, structures of brickwork or blockwork in which the system is incorporated must be designed and constructed in accordance with BS EN 1996-1-1 : 2005 and BS EN 1996-1-2 : 2005 and their UK National Annexes, and the following technical specifications of the national Building Regulations, as appropriate:

England and Wales — Approved Document A1/2, Part C, Section 1
Scotland — Section 1, Small Building Guide
Northern Ireland — Technical Booklet D *Structure*, Section 3.

7 Properties in relation to fire

7.1 All components of the system are not classified as non-combustible or of limited combustibility in accordance with BS EN 13501-1 : 2018.

7.2 In England, Wales and Northern Ireland, the system is not classified as non-combustible or of limited combustibility and may be used on buildings at any proximity to a boundary. For buildings with a storey more than 18 m above the ground, designers should consider the impact on the risk of fire spread over the wall. See also section 7.3.

7.3 The system should not be used on buildings in England and Wales that have a storey at least 18 m above ground level and contain: one or more dwellings, an institution, a room for residential purposes (excluding any room in a hostel, hotel or boarding house), student accommodation, care homes, sheltered housing, hospitals or dormitories in boarding schools.

7.4 In Scotland, the system may be used on buildings with no storey at a height of more than 11 m above the ground and more than 1 m from the boundary. With minor exceptions, the system should be included in calculations of unprotected area.

8 Thermal performance

8.1 Typical example details containing the system, based on the construction details shown in Figures 1 and 3, were analysed numerically to determine their likely hygrothermal performance.

8.2 If designed appropriately, exposed floor junctions with the insulated system can adequately limit excessive heat loss and allow use of the following Ψ values in carbon emissions rate calculations (see Table 5). Detailed guidance in this respect and on limiting heat loss by air infiltration can be found in the documents referred to in section 9.2.

Table 5 Linear thermal transmittance, Ψ-values, for the IG Brick On Soffit System (B.O.S.S.)

System	Example Ψ value[1][2] ($W \cdot m^{-1} \cdot K^{-1}$)	Default Ψ value[3] ($W \cdot m^{-1} \cdot K^{-1}$)
215 x 215 mm with soldier bond[4]	0.21	1.0

(1) 120 mm cavity width, comprising 50 mm vented cavity adjacent (R = 0.183 $m2 \cdot K \cdot W^{-1}$), 70 mm insulation.
(2) Soffit unit assumed to be filled with loose fill insulation with thermal conductivity, λ = 0.040 $W \cdot m^{-1} \cdot K^{-1}$
(3) Where a junction detail has not been calculated in accordance with BS EN ISO 10211 : 2017 and BRE Report BR 497 : 2007, the default value must be used.
(4) Assumed wall construction: 102.5 mm brickwork (λ = 0.77 $W \cdot m^{-1} \cdot K^{-1}$), 50 mm vented cavity [see footnote (1)] PUR [see footnote (1)] insulation (λ = 0.025 $W \cdot m^{-1} \cdot K^{-1}$), 100 mm blockwork (λ = 0.162 $W \cdot m^{-1} \cdot K^{-1}$, inclusive of 6.7% mortar bridging), 15 mm service cavity (R = 0.17 $m2 \cdot K \cdot W^{-1}$), 12.5 mm plasterboard (λ = 0.25 $W \cdot m^{-1} \cdot K^{-1}$). Assumed intermediate floor slab: 225 mm dense reinforced concrete slab (λ = 2.5 $W \cdot m^{-1} \cdot K^{-1}$).

8.3 For other junction details, the linear thermal transmittance and temperature factor should be calculated in accordance with BS EN ISO 10211 : 2017, following the guidance in BRE Report BR 497 : 2007.

9 Condensation risk

9.1 The construction described in section 8.2 will achieve a surface temperature factor (f_{Rsi}), in excess of 0.80, which can be compared to the critical temperature factors (f_{CRsi}), in BRE Information Paper IP 1/06 for the relevant building type. The risk of surface condensation is low when the f_{Rsi} is equal to or greater than the f_{CRsi}. The system can therefore contribute to limiting the risk of surface condensation in buildings of some building types. For other constructions, the f_{Rsi} must be established by numerical modelling (see section 8.3).

9.2 Further guidance on limiting the risk of surface condensation can be found in:

England and Wales — Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings or Accredited Construction Details (version 1.0)
Scotland — Accredited Construction Details (Scotland)
Northern Ireland — Accredited Construction Details (version 1.0).

10 Maintenance and repair

10.1 If the brick finish becomes damaged or stained the advice of the Certificate holder should be sought.

10.2 Regular checks should be made on the installed system, including:

- visual inspection of the brick-slips for signs of disbondment. Dislodged slips must be re-fixed using brick-slip adhesive
- visual inspection of architectural details designed to shed water to confirm that they are performing properly
- visual inspection to ensure that water is not leaking from external down pipes or gutters; such leakage could penetrate behind the brick slips
- direct jet cleaning of the brick slips should be avoided and if brick slips are stained the advice of the Certificate holder should be sought.

10.3 Damaged areas must be repaired using the appropriate components and procedures detailed in the Certificate holder's installation instructions and the advice of the Certificate holder should be sought.

11 Durability

11.1 Provided that the system is designed, installed and used in accordance with the temperature and humidity conditions described in section 9, it will have a service life of at least 50 years.

11.2 The brick slips will have an equivalent durability to the bricks from which they were cut (see section 1.4).

12 Reuse and recyclability

12.1 The stainless steel and steel components can be recycled.

12.2 The brick slips contain fired clay which can be recycled.

Installation

13 General

13.1 Weep-holes should be provided in the outer leaf above the system to drain moisture from the cavity. A minimum of two weep-holes should be provided per system. For fair-faced masonry, weep-holes should be provided at centres not greater than 450 mm.

13.2 Brick slips should be pointed using the same mortar as the rest of the brickwork. Pointing of the system should be conducted using a pointing gun and should not take place in wet weather or in temperatures below 3°C.

14 Procedure

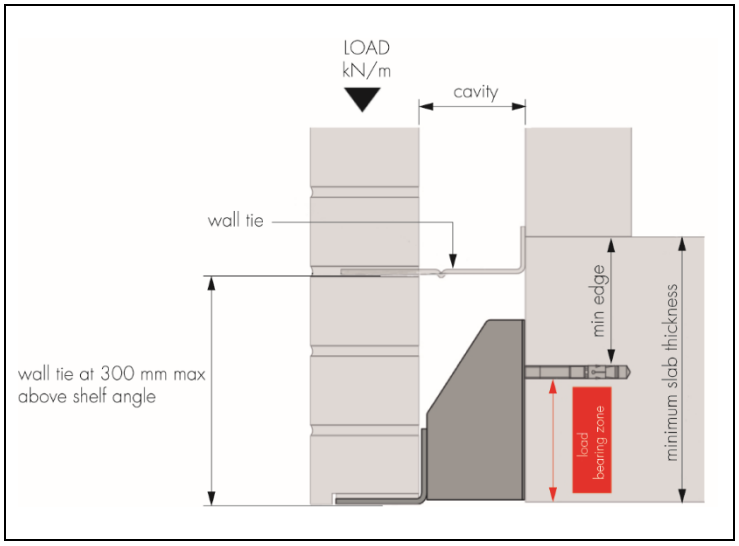
14.1 The IG Brick On Soffit System (B.O.S.S.) is typically fixed to the underside of welded masonry support units. Welded masonry support should be supplied by the IG Masonry Support System. Welded masonry support, combined with the system, offers adjustability in all three planes.

Installation of the IG Welded Masonry Support System (outside the scope of this Certificate)

14.2 The IG Welded Masonry Support System must be installed as per the installation instructions and manufacturer's drawings (outside the scope of this Certificate) in the manufacturer's detailed guidelines. The specification of the bolt will be determined by the Certificate holder. The welded masonry support can also be fixed into a cast in channel in the concrete slab. Particular attention must be paid to the load bearing zone for each bracket (see Figure 5). The load bearing zone is the area of the bracket that is in contact with the support structure and will be marked on the manufacturer's drawings. Adhering to these dimensions on site is critical to the performance of the system. The maximum shimming of the masonry support should not exceed 12 mm or the outside diameter of the bolt, whichever is less. For the installation of the IG Welded Masonry Support System, only IG Thermal Shims or IG Stainless Steel Shims can be used. Vertical adjustment of +/-15 mm is catered for by the serrated areas at the back of the bracket.

14.3 The serrated lock washer, washer and bolt should be installed to fix the welded masonry support system in place. The bolt must not be fully fastened until the welded masonry support system is level and in the correct location. The manufacturer's instructions should be followed for the correct torque setting for the bolt, and a calibrated torque wrench should be used.

Figure 5 The IG Welded Masonry Support System



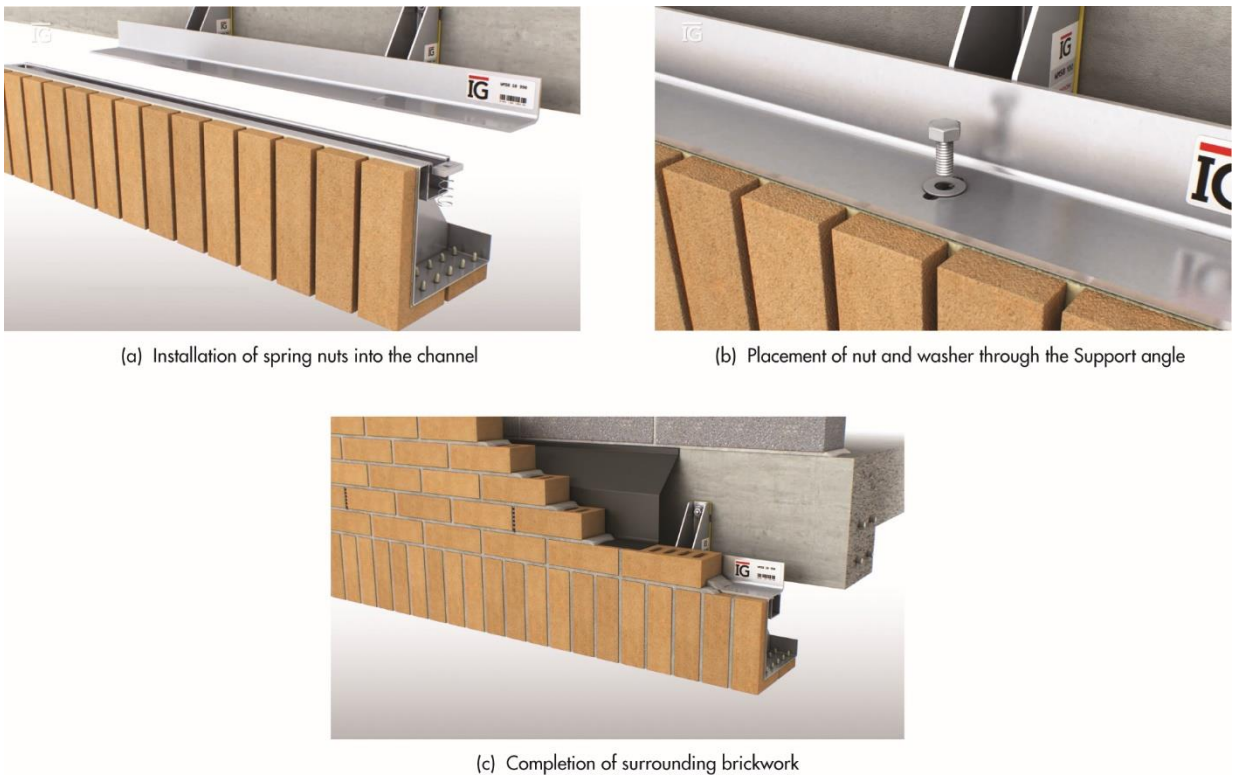
Installation of the IG Brick On Soffit System (B.O.S.S.)

14.4 The stainless steel spring nuts should be installed into the channel in the IG Brick On Soffit System (B.O.S.S.) unit. The quantity of spring nuts required will match the number of slotted holes in the welded masonry support [see Figure 6 (a)]. A minimum of two fixings must be installed per unit.

14.5 The IG Brick On Soffit System (B.O.S.S.) unit is offered up to the underside of the IG Welded Masonry Support System, aligning the spring nuts with the slotted hole in the angle. An M10 stainless steel nut and washer is placed through the welded masonry support angle, into the spring nut and hand tighten. Once alignment and levels are correct, bolts are torqued to 20 N·m [see Figure 6 (b)].

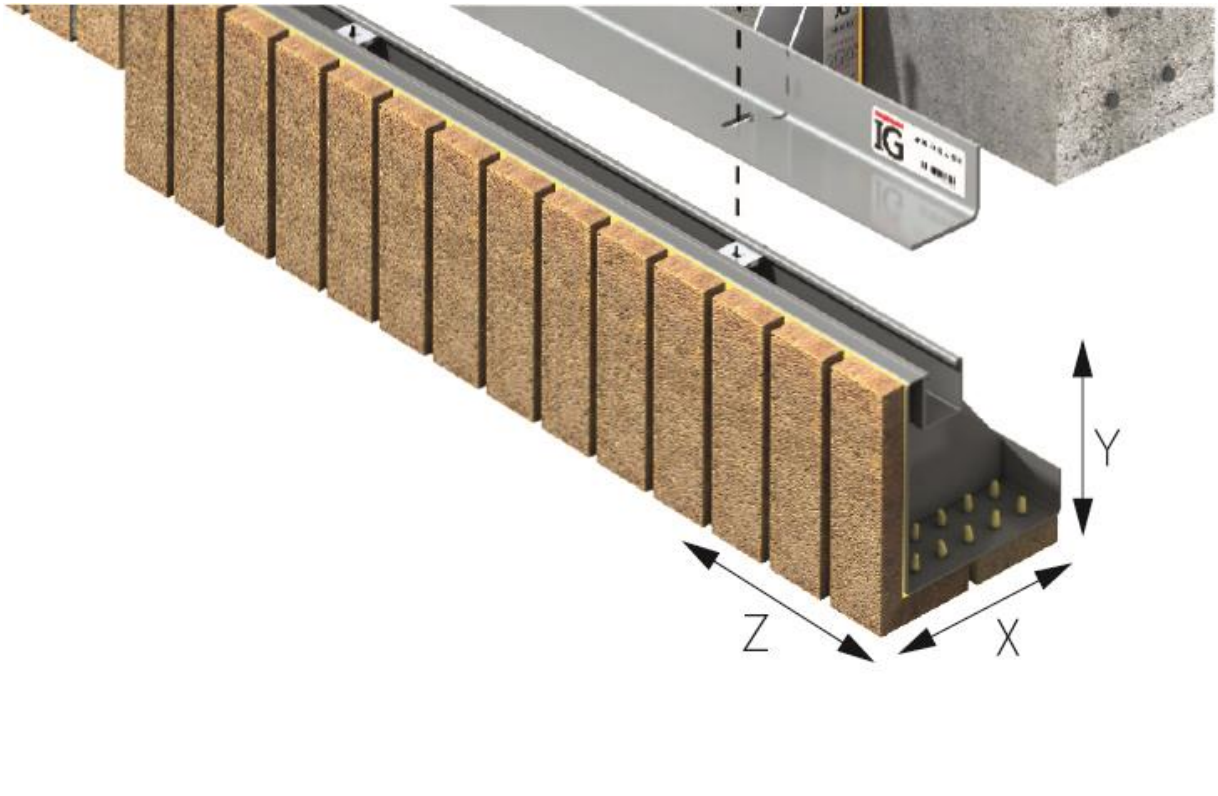
14.6 Surrounding brickwork is completed with the inclusion of weep holes, wall ties and damp proof course. IG Brick On Soffit System (B.O.S.S.) spring nuts are placed in the channel to align with the slots in the angle, and the system is lifted to the underside of the masonry support angle. The system should continue to be supported through the steps given in sections 14.3 to 14.8 [see Figure 6 (c)].

Figure 6 Installation of the IG Brick On Soffit System



14.7 Lateral adjustment (Z) is achieved by utilizing the channel in the IG Brick On Soffit System (B.O.S.S.) unit. The unit can be moved +/-25mm left or right on the fixed IG Welded Masonry Support System. Vertical adjustment (Y) is achieved by shimming between the unit and the underside of the welded masonry support system. Maximum shimming in this location is 6 mm. Horizontal adjustment (X) is achieved by the utilizing slotted hole in the masonry support shelf. Adjustment provided is +/-15mm (see Figure 7).

Figure 7 Adjustment of the IG Brick On Soffit System (B.O.S.S.)



Brickwork

14.8 Once the IG Brick On Soffit System (B.O.S.S.) units are installed, brickwork is continued above the IG Welded Masonry Support System. In an ideal scenario, a pistol or lipped brick should be installed above the IG Welded Masonry Support System to ensure mortar joints are maintained at the same width. Brickwork overhang must not exceed 1/3 of the brick width. A minimum masonry bearing of 2/3 on the shelf must be maintained unless otherwise stated by the manufacturer. The installation of wall ties is crucial to the performance of the IG Welded Masonry Support System and the IG Brick On Soffit System (B.O.S.S.). Wall ties should be positioned at a maximum horizontal spacing of 450 mm and should be placed within 300 mm above the shelf angle.

Technical Investigations

15 Tests

Tests were carried out on the system, and the results assessed to determine:

- bond strength after accelerated ageing
- integrity of the bond at maximum design deflection.

16 Investigations

16.1 An assessment was made of data relating to:

- calculations to establish minimum temperature factors and the Ψ values of typical constructions incorporating the system, undertaken to BRE Information Paper IP 1/06
- durability
- practicability of installation.

16.2 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.

Bibliography

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