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Agrément Certificate

10/4784

Product Sheet 2

### DURISOL WALLING SYSTEM

### DURISOL PERMANENT FORMWORK SYSTEM USED WITH THE PAREX MONOREX GF RENDER FINISH

#### PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to the Durisol Permanent Formwork System used with the Parex Monorex GF Render Finish, for use in the formation of loadbearing and non-loadbearing internal, external and separating walls in dwellings and in buildings of similar occupancy subject to design and load limitations and fire considerations.

#### 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 aspects** — the components have adequate strength to resist the loads associated with installation loading (see section 5).

**Thermal insulation** — the system contributes to the overall thermal performance of the wall construction (see section 6).

**Condensation** — walls, openings and junctions with other elements will adequately limit the risk of surface condensation (see section 8).

**Weathertightness and damp-proofing** — the render system used in combination with formwork will perform adequately where the wind-driven index is less than 75 litres per m<sup>2</sup> (see section 9).

**Behaviour in relation to fire** — walls formed from the system provide fire resistance when used in conjunction with suitable finishes and fire stopping details. The Parex Monorex GF Render Finish (covered under BBA Certificate 06/4400) is classified as non-combustible (see section 10).

**Sound insulation** — separating and internal walls with a concrete core, finishes and detailing stated in this Certificate will provide sufficient sound resistance (see section 12).

**Durability** — the system components are durable (see section 14). The Parex Monorex GF Render Finish, when applied to the system as described in section 15.8 and 16.8 and BBA Certificate 06/4400, is durable.

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

On behalf of the British Board of Agrément

Brian Chamberlain  
Head of Approvals — Engineering

Greg Cooper  
Chief Executive

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*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 Durisol Permanent Formwork System used with the Parex Monorex GF Render Finish, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:



## The Building Regulations 2010 (England and Wales)

Requirement: A1	Loading
Requirement: A2	Ground movement
Requirement: A3	Disproportionate collapse
Comment:	Walls will have adequate strength and stiffness to satisfy these Requirements. See sections 5.1 to 5.4, 5.7 and 5.8 of this Certificate.
Requirement: B2(1)(a)	Internal fire spread (linings)
Comment:	The system is used in combination with internal finishes. See section 10.3 of this Certificate.
Requirement: B3(1)(2)(3)	Internal fire spread (structure)
Comment:	Walls can meet these Requirements. See sections 10.1 to 10.3 of this Certificate.
Requirement: B4(1)	External fire spread
Comment:	The external finish described in this Product Sheet can satisfy this requirement. See BBA Certificate 06/4400, section 11.
Requirement: C2(b)	Resistance to moisture
Comment:	When used in combination with the external finish described in this Certificate walls can adequately limit the risk of moisture penetration from precipitation and wind-driven spray. See sections 9.1 and 9.2 of this Certificate.
Requirement: C2(c)	Resistance to moisture
Comment:	Walls can adequately limit the risk of surface condensation and contribute to minimising the risk of interstitial condensation. See sections 8.1 to 8.4 of this Certificate.
Requirement: E1	Protection against sound from other parts of the building and adjoining buildings
Requirement: E2(a)	Protection against sound within a dwelling house etc
Comment:	Walls can adequately meet these Requirements. See sections 12.1 to 12.3 of this Certificate.
Requirement: L1	Conservation of fuel and power
Comment:	The system will enable, or contribute to enabling, a wall to satisfy these Regulations. See sections 6.1, 6.2, 6.4 to 6.6 and 7.2 of this Certificate.
Requirement: Regulation 7	Materials and workmanship
Comment:	The system is acceptable. See sections 14.1 and 14.2 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 meeting this Regulation. See sections 13.1, 13.2, 14.1 and 14.2 and the <i>Installation</i> part of this Certificate.
Regulation: 9	Building Standards – construction
Standard: 1.1(a)(b)	Structure
Standard: 1.2	Disproportionate collapse
Comment:	Walls will have adequate strength and stiffness to satisfy these Standards, with reference to clause 1.1.1 <sup>(1)(2)</sup> . See sections 5.1 to 5.4, 5.7 and 5.8 and the <i>Installation</i> part of this Certificate.
Standard: 2.1	Compartmentation
Comment:	Walls, with effective fire resisting finishes, can satisfy the short, medium and long fire-resistance durations required by this Standard, with reference to clauses 2.1.1 <sup>(2)</sup> , 2.1.5 <sup>(2)</sup> , 2.1.8 <sup>(2)</sup> , 2.1.9 <sup>(2)</sup> , 2.1.10 <sup>(2)</sup> , 2.1.11 <sup>(2)</sup> , 2.1.12 <sup>(2)</sup> and 2.1.13 <sup>(2)</sup> . Openings in walls can maintain the fire-resistance durations, with reference to clauses 2.1.14 <sup>(2)</sup> and 2.1.16 <sup>(2)</sup> . See section 10.1 of this Certificate. Junctions between walls can maintain the required fire-resistance durations, with reference to clauses 2.1.15 <sup>(2)</sup> . See section 10.1 of this Certificate.
Standard: 2.2	Separation
Comment:	Walls, with effective fire resisting finishes, can satisfy the short, medium and long fire-resistance durations required by this Standard, with reference to clauses 2.2.1 <sup>(1)(2)</sup> , 2.2.2 <sup>(1)(2)</sup> , 2.2.3 <sup>(1)(2)</sup> , 2.2.4 <sup>(1)(2)</sup> and 2.2.5 <sup>(1)(2)</sup> , 2.2.6 <sup>(1)(2)</sup> , 2.2.8 <sup>(1)</sup> , 2.2.9 <sup>(2)</sup> and 2.2.10 <sup>(1)</sup> . Junctions between walls can maintain the fire-resistance durations, with reference to clause 2.2.7 <sup>(1)(2)</sup> . See section 10.1 of this Certificate.
Standard: 2.3	Structural protection
Comment:	Walls can satisfy the short, medium and long fire-resistance durations required by this Standard, with reference to clauses 2.3.1 <sup>(1)(2)</sup> to 2.3.3 <sup>(1)(2)</sup> . Junctions between walls can maintain the fire-resistance durations, with reference to clauses 2.3.2 <sup>(1)(2)</sup> and 2.3.5 <sup>(1)(2)</sup> . See sections 10.1 to 10.3 of this Certificate. Reference to clause 2.3.4 <sup>(1)(2)</sup> should be made with regard to protection of openings through walls incorporating this product.
Standard: 2.5	Internal linings
Comment:	Walls can satisfy the reaction to fire required by this Standard, with reference to clause 2.5.1 <sup>(1)(2)</sup> , provided the system is used in conjunction with suitable materials. See section 10.3 of this Certificate.

Standard:	2.6	Spread to neighbouring buildings
Comment:		Walls using the appropriate lining, can achieve a period of fire resistance of 'medium' duration, with reference to clause 2.6.1 <sup>(1)</sup> . See sections 10.1, 10.2, 10.5 and 10.7 of this Certificate.
Standard:	2.7	Spread on external walls
Comment:		Walls can satisfy the reaction to fire required by this Standard when used in combination with the external finish described in this Certificate, with reference to clause 2.7.1 <sup>(1)(2)</sup> . See BBA Certificate 06/4400, section 11.
Standard:	3.10	Precipitation
Comment:		When used in combination with the external finish described in this Certificate walls can adequately limit the risk of moisture penetration from precipitation, with reference to clause 3.10.2 <sup>(1)(2)</sup> . See sections 9.1 and 9.2 of this Certificate.
Standard:	3.15	Condensation
Comment:		Walls can adequately minimise the risk of surface condensation, with reference to clauses 3.15.1 <sup>(1)</sup> , 3.15.4 <sup>(1)</sup> and 3.15.5 <sup>(1)</sup> . See sections 8.2 to 8.4 of this Certificate.
Standard:	5.1	Resisting sound transmission to dwellings using appropriate constructions
Comment:		Separating walls satisfy this Standard, with reference to clauses 5.1.1 <sup>(1)(2)</sup> , 5.1.2 <sup>(1)(2)</sup> , 5.1.4 <sup>(1)(2)</sup> , 5.1.7 <sup>(2)</sup> , 5.1.8 <sup>(1)</sup> , 5.2.1 <sup>(1)(2)</sup> and 5.2.2 <sup>(1)(2)</sup> . See sections 12.1 and 12.2 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The system will enable, or contribute to enabling, a wall to meet these Standards, with reference to clauses 6.1.1 <sup>(1)(2)</sup> , 6.1.4 <sup>(1)</sup> , 6.1.5 <sup>(1)</sup> , 6.2.1 <sup>(1)(2)</sup> , 6.2.3 <sup>(1)</sup> , 6.2.4 <sup>(1)(2)</sup> and 6.2.5 <sup>(2)</sup> . See sections 6.1, 6.2, 6.4 to 6.6 and 7.3 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The product 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. (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 14.1 and 14.2 and the <i>Installation</i> part of this Certificate.
Regulation:	B3(2)	<b>Suitability of certain materials</b>
Comment:		The system is acceptable. See sections 13.1 and 13.2 of this Certificate.
Regulation:	C4	<b>Resistance to ground moisture and weather</b>
Comment:		When used in combination with the external finish described in this Certificate walls can adequately limit the risk of moisture ingress from the weather. See sections 9.1 and 9.2 of this Certificate.
Regulation:	C5	<b>Condensation</b>
Comment:		Walls can contribute to minimising the risk of interstitial condensation. See sections 14.1 and 14.2 of this Certificate.
Regulation:	D1	<b>Stability</b>
Comment:		Walls will have adequate strength and stiffness to satisfy this Regulation. See sections 5.1 to 5.4, 5.7 and 5.8 of this Certificate.
Regulation:	D2	<b>Disproportionate collapse</b>
Comment:		Walls, when suitably reinforced, will have adequate strength and stiffness to satisfy this Regulation. See section 5.4 of this Certificate.
Regulation:	E3	Internal fire spread – Lining
Comment:		Walls can satisfy this Regulation. See section 10.3 of this Certificate.
Regulation:	E4	<b>Internal fire spread – Structure</b>
Comment:		Walls can satisfy this Regulation. See section 10.1 to 10.3 of this Certificate.
Regulation:	E5(a)	<b>External fire spread</b>
Comment:		When used in combination with the external finish described in this Certificate walls can satisfy this Regulation. See section 10.4 of this Certificate and BBA Certificate 06/4400, section 11.
Regulation:	F2(a)(i)	Conservation measures
Regulation:	F3(2)	Target carbon dioxide Emissions Rate
Comment:		The system will enable, or contribute to enabling, a wall to satisfy these Regulations. See sections 6.1, 6.2, 6.4 to 6.6 and 7.2 of this Certificate.
Regulation:	G2	<b>Separating walls and separating floors</b>
Comment:		Separating walls can satisfy this Regulation. See sections 12.2 and 12.3 of this Certificate.

## Construction (Design and Management) Regulations 2007

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

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

See sections: 2 *Delivery and site handling* (2.1, 2.3 and 2.4), 4 *Practicability of installation* and 15 *General (Installation)* of this Certificate.

# Non-regulatory Information

## NHBC Standards 2011

NHBC accepts the use of the Durisol Permanent Formwork System used with the Parex Monorex GF Render Finish in sheltered and moderate exposure conditions only [where wind-driven index is less than 75 litres per m<sup>2</sup> — see *NHBC Standards Chapter 6.1, Appendix 6.1-A (map)*] when installed and used in accordance with this Certificate and BBA Certificate 06/4400.

## General

The Durisol Permanent Formwork System used with the Parex Monorex GF Render Finish is for use in loadbearing and non-loadbearing internal or external and separating walls in dwellings and buildings of similar occupancy. The system provides permanent formwork for in-situ dense-aggregate concrete walls and contributes to the thermal insulation and acoustic performance of the finished construction.

The Parex Monorex GF Render Finish, with additional reinforcing mesh, has been assessed for use in combination with the Durisol Permanent Formwork System. A full description of the Parex Monorex GF Render Finish is set out in BBA Certificate 06/4400<sup>(1)</sup>.

(1) Should this Certificate become invalid for any reason, the use of the render described, in combination with the system, will cease to be valid.

This Product Sheet only refers to use of the system above and does not cover external or internal finishes other than the Parex Monorex GF Render Finish described.

## Technical Specification

### 1 Description

1.1 The Durisol Permanent Formwork System used with the Parex Monorex GF Render Finish comprises a range of woodchip-aggregate hollow block units with cross-webs, for laying in a stretcher bond with dry joints (staggered 250 mm) to form the wall construction. Mineral wool or PIR inserts (100 mm thick for 300 mm wide units and 165 mm thick for 365 mm thick units) are inserted into the unit hollows (adjacent to the outside face for external wall use), with the remaining 120 mm thick void to be filled with concrete. The webs vary in thickness between 38 mm and 90 mm depending on unit type. The concrete forms vertical columns connected horizontally with concrete (110 mm deep) between the unit webs to form a grid pattern. Vertical and horizontal steel reinforcement is introduced into the voids, for structural purposes, as required by the building design.

1.2 The units interlock at the sides and are a flush fit at the top and bottom. All units are 250 mm high and 500 mm long. Dimensions are given in Table 1.

Table 1 Unit characteristics

Unit type	Unit dimension (mm)			Insulation thickness (mm)
	Width	Concrete core thickness	Web thickness	
D170/120	170	120	25	None
D250/180	250	180	35	None
D300/120	300	120	40	100
D365/120	365	120	40	165

1.3 The units are illustrated in Figure 1. Further details on standard units and a description of additional formwork system units are given in Table 2. A typical wall layout using standard and modified units is shown in Figure 2.

Figure 1 Standard, corner and face units

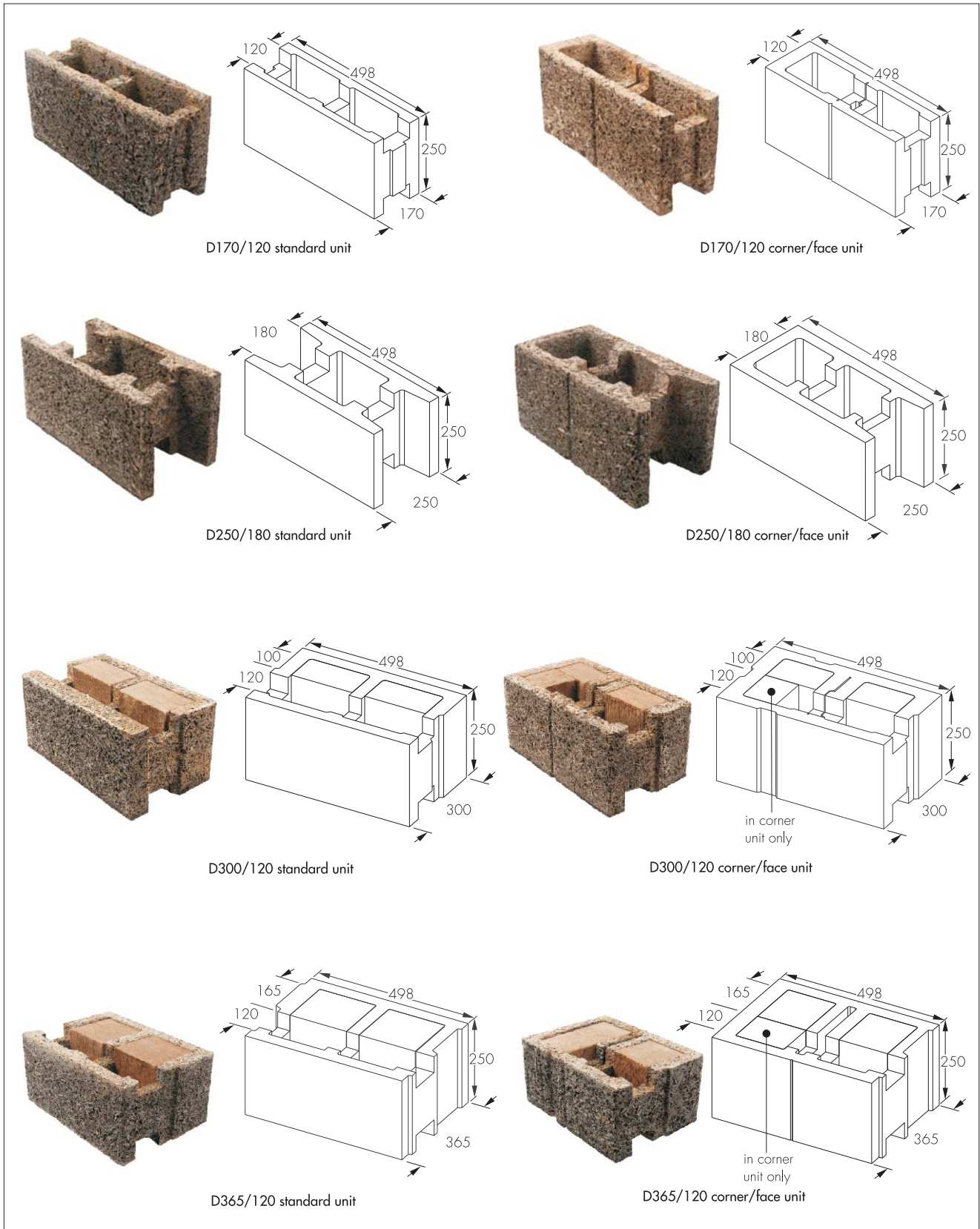


Table 2 Durisol unit references and description

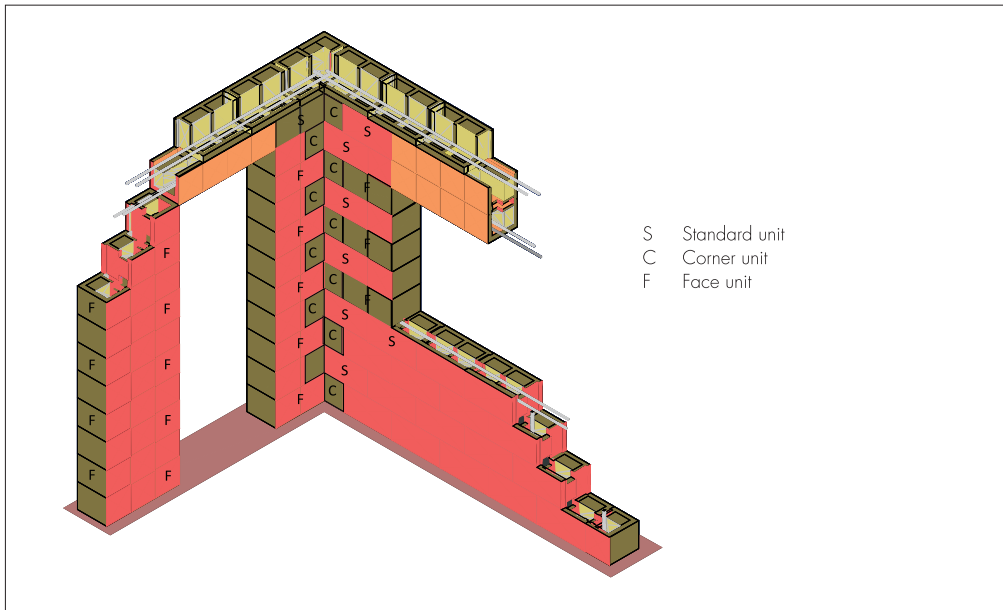
Unit reference	Description
S	Standard unit used for forming the walls where a modular dimension of 250 mm is used allowing a running bond to be achieved
C	Corner unit for an outer corner in combination with the standard unit
F	Face unit, having one flat face and one rebated, used to form window and door reveals and lintels

1.4 Mineral wool or PIR inserts — 100 mm or 165 mm thick, with a thermal conductivity value of  $0.034 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  and  $0.022 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  respectively, are pushed into the unit voids after casting and once the elements have dried.

1.5 Unit skins and webs have a nominal dry density in the range of  $500 \text{ kg}\cdot\text{m}^{-3}$  to  $600 \text{ kg}\cdot\text{m}^{-3}$ .

1.6 Top and bottom surfaces are trimmed flat and the vertical faces routed, as part of factory production, to ensure that adjacent units mate tightly or interlock to form a flush fit when joined together (see Figure 2) and restrict concrete seepage through the joints.

Figure 2 Typical method of jointing



1.7 Structures with non-modular dimensions can be accommodated using standard or face units cut to suit.

1.8 For structures with in-situ reinforced concrete or precast floors, units modified on site are used to form the wall/floor joint (see Figures 2, 6 and 7). When timber floors are used, cut-outs are made in the side of standard or facing units for casting in anchor bolts to receive rim joists.

1.9 Lintels to doors and windows are formed from face units by partly cutting the web and one outer vertical side (see Figure 3) for allowing the insertion of a lintel reinforcement cage or individual bars. Generally, spans up to 1750 mm can be formed using this method. For larger spans, the face units can be modified as shown in Figure 2 and turned through  $90^\circ$ , laid in a soldier course formation, on a temporary timber support frame, to form the structural opening. Further modification of face units can be carried out to form cast lips for insertion of window frames and sills. A typical opening jamb detail is shown in Figure 4.

Figure 3 Larger span lintel detail (vertical section)

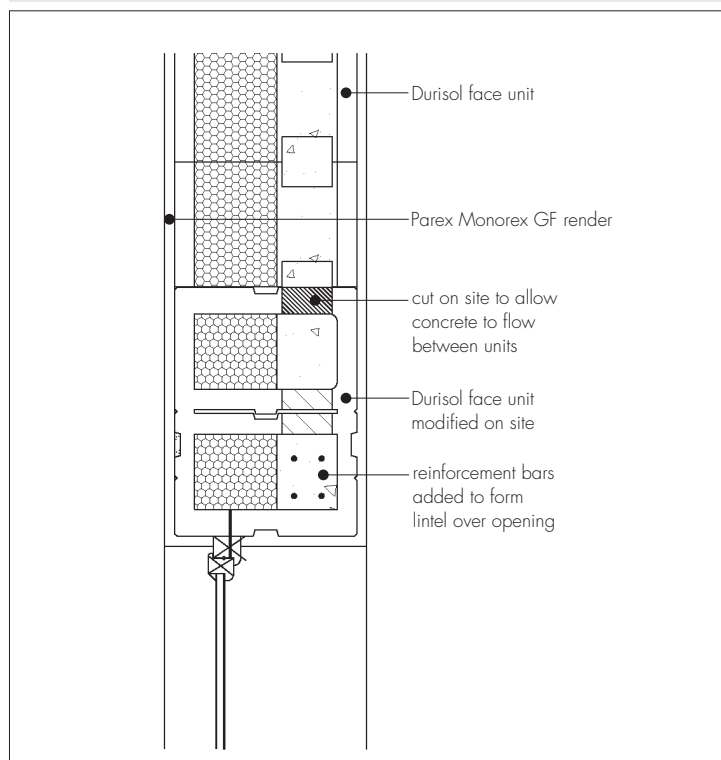
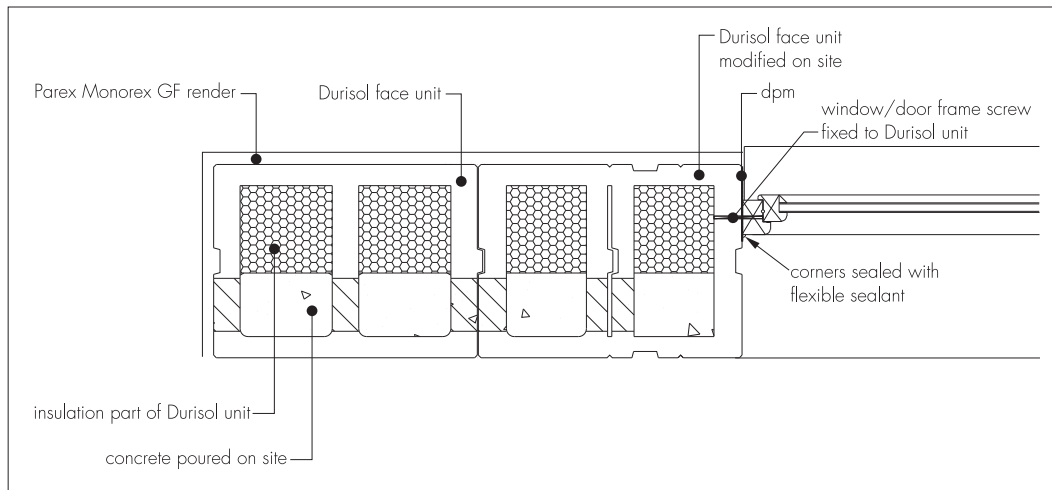


Figure 4 Typical opening jamb detail (horizontal section)



1.10 Concrete, typically strength class from RC25 to RC35 for reinforced walls and from C20 to C25 for unreinforced (plain) walls, is specified to BS EN 206-1 : 2000, BS 8500-1 : 2006 and BS 8500-2 : 2006. Pumping is the recommended method of placement using concrete with a maximum aggregate size of 10 mm and a high slump classification (Class S5). Pumpable and self-compacting concrete (SCC) mixes should contain an admixture complying with BS EN 934-2 : 2001 or BS EN 480-1 : 2006 to allow placement using the free-flow technique. Other specific concrete mixes are dependent on individual requirements and are outside the scope of this Certificate; further details and advice can be obtained from the Certificate holder.

1.11 The Parex Monorex GF Render Finish, when used in combination with the system, is a, through-colour, single-coat render applied in a thickness of between 15 mm and 20 mm with a layer of TV10 glassfibre mesh encapsulated within the centre of the render.

1.12 Components and typical finishes<sup>(1)</sup> specified for use with the system by the Certificate holder but not assessed or covered by this Certificate include:

- steel reinforcement — where required, should comply with BS 4449 : 2005
- external masonry — may be of brickwork or stonework fixed in accordance with the provisions of BS 5628-3 : 2005 or BS 8298 : 1994 respectively, including a minimum 50 mm cavity and breather membrane
- timber weatherboarding or hung tiles on treated timber battens or rails, together with breather membrane
- external rainscreens when used in conjunction with a ventilated cavity and breather membrane with third-party certification and complying with current NHBC Standards
- internal finish — typically directly applied plaster in accordance with BS EN 13914-2 : 2005, or 12.5 mm thick plasterboard or a dry-lined finish with or without a plaster skim coat conforming to BS 8212 : 1995
- brickwork/stonework ties to BS EN 845-1 : 2003.

(1) Generic cladding and render finishes other than that defined in section 1.11, have not been assessed by the BBA. Cladding systems should carry third-party certifications and should be assessed for use with the Durisol Permanent Formwork.

## Quality controls

1.13 System components are bought-in to agreed specifications or in accordance with British or European Standards and/or current Agrément Certificates.

1.14 Quality checks are made during the moulding process and on the finished components.

## 2 Delivery and site handling

2.1 Good site practice should be observed to prevent damage to the components.

2.2 The system units are supplied shrink-wrapped, according to type and shape of unit; the wrapping should not be opened until the contents are required.

2.3 Packs should be stored either near to the work area for immediate use or stored in a holding area, on level ground and above any standing water away from site traffic movements. Multiple handling should be avoided to reduce the risk of damaging units.

2.4 Due to rough edges, care must be taken by site personnel when handling the units, using appropriate protective wear in all cases.

2.5 The details for delivery and site handling requirements for the Parex Monorex GF Render finish are given in BBA Certificate 06/4400, section 6.

# Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Durisol Permanent Formwork System used with the Parex Monorex GF Render Finish.

## Design Considerations

### 3 Use

3.1 The Durisol Permanent Formwork System is for use in loadbearing and non-loadbearing internal or external and separating walls in dwellings or buildings of similar construction.

3.2 The system provides permanent formwork for in-situ dense aggregate concrete plain and reinforced walls and contributes to the thermal insulation and acoustic performance of the finished construction.

### 4 Practicability of installation

4.1 The system should only be installed by installers who have been trained by the Certificate holder (see sections 16 and 17).

4.2 Parex Monorex GF Render Finish should only be installed by contractors approved by Parex Ltd (see *Installation* part of BBA Certificate 06/4400).

### 5 Structural aspects

#### General



5.1 The system is satisfactory for use in loadbearing and non-loadbearing walls as permanent formwork for in-situ dense aggregate plain or reinforced concrete. Foundations (not assessed) should be adequate for the intended use.

5.2 Structures subject to the national Building Regulations incorporating the system should be designed to the relevant sections of BS 8110-1 : 1997 or BS EN 1991-1-4 : 2005, BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004 and certified by a qualified and experienced Structural Engineer.

5.3 Other buildings not subject to any of the Regulations defined in section 5.2 should also be built in accordance with the same standards stated in section 5.2.

5.4 When using the system, designers should take account of the requirements for temporary propping of the formwork during the construction phase along with robustness and when taking into account building usage and overall building height, disproportionate collapse of the completed structure.

5.5 The concrete is not easily examined after casting, hence, as specified in BS 8110-1 : 1997, Section 2, or BS EN 1992-1-1 : 2004, Section 2, care must be taken to ensure full compaction. Compaction is best checked by removal of small sections of unit face, observation and repair, if required. Particular attention should be given to areas adjacent to formed openings. Suitable supervision must be provided during placing and compacting of the concrete. Concrete requiring vibration and self-compacting concrete (SCC) can be used. Care must be taken, for SCC, to control the water content and to ensure segregation of the mix does not occur (see section 1.10).

5.6 Concrete walls are normally constructed in lifts of six unit courses. Once built, concrete is poured into the formwork voids terminating 50 mm below the top of the highest course. Exceeding 1.5 m heights can lead to excessive bleeding of concrete fines through the unit joints. Particular care is necessary to maintain alignment during concrete filling, and checking between pours. The flow rate and height of pour must be controlled to ensure that the thermal performance of the wall is not compromised through compression of the mineral wool due to pressure from the wet concrete. Details of measured values for filling pressures are given in BS EN 15498 : 2008, Appendix A, Table A1.

#### Strength and stability



5.7 Walls constructed using the system may be treated as conventional unreinforced (plain) or reinforced concrete walls and should be designed in accordance with BS 6399-1 : 1996 or BS EN 1991-1-1 : 2002, BS 6399-2 : 1997 or BS EN 1991-1-4 : 2005, BS 8110-1 : 1997, BS 8110-2 : 1985 or BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004. Attention is required to ensure voids do not occur within the wet concrete around formed openings and congested areas of reinforcement. The Certificate holder is able to provide suitable design mixes on request.

5.8 The nominal concrete cover to reinforcement should be that appropriate to exposure classes X0 and XC1 stated in BS 8500-1 : 2006, Table A.1, and BS EN 206-1 : 2000, Table 1.

5.9 Strength testing is carried out on formwork units, as part of routine production, to determine the tensile strength of the formwork in accordance with BS EN 15498 : 2008.

5.10 To achieve structurally stable formwork during the construction process, the system should be braced sufficiently to resist the loads imparted on the system by the wet concrete and other construction loads.



## 6 Thermal insulation



6.1 The thermal performance of each building incorporating the walls must be evaluated in accordance with the relevant national Building Regulations, and is the responsibility of the overall designer of the building.

6.2 Calculations of thermal transmittance (U value) for a particular construction can be carried out in accordance with the 'combined method' given in, BS EN ISO 6946 : 2007, BS EN ISO 10211 : 2007 and BRE report (BR 443 : 2002) *Conventions for U-value calculations*. The thermal conductivities ( $W \cdot m^{-1} \cdot K^{-1}$ ) given in Table 3 may be used to conduct a 'combined method' calculation.

6.3 The U value of a wall will depend on the thickness of web in the units (see Table 4), the amount of reinforcement used in the concrete and the construction of the wall, incorporating any other insulation used.

6.4 Thermal conductivity values of individual components are listed in Table 3.

**Table 3 Thermal conductivity of individual components**

Construction component (external to internal)	$\lambda$ value ( $W \cdot m^{-1} \cdot K^{-1}$ )
Durisol D300/120 unit comprising:	
• mineral wool insulation	0.04 <sup>(1)</sup>
• PIR inserts	0.022 <sup>(2)</sup>
• reinforced concrete	2.5
• dense unreinforced concrete	1.7 <sup>(3)</sup>
• Durisol wood-chip concrete	0.13 <sup>(4)</sup>

(1) Typical value for mineral wool insulation.

(2) Typical value for PIR insulation.

(3) From BS 5250 : 2002.

(4) Based upon a density of  $536 \text{ kg} \cdot \text{m}^{-3}$ .

**Table 4 Webs in units**

Web	Typical amount of web thickness in total longitudinal cross-section area of unit (%)
In mineral wool and concrete	30
In mineral wool only	20
None in mineral wool and concrete	50

6.5 Junctions with other elements should be designed to limit heat loss. Detailed guidance for junctions and on limiting heat loss by air infiltration can be found in:

**England and Wales** — Approved Documents to Part L and, for new thermal elements to existing buildings, Accredited Construction Details (version 1.0) (for new-build, see also SAP 2009, Appendix K, and the *iSBEM User Manual*)

**Scotland** — Accredited Construction Details (Scotland)

**Northern Ireland** — Accredited Construction Details (version 1.0).

## 7 Air leakage

7.1 Without additional sealing between the wall and other building elements, interfaces will allow air leakage and the main contractor should make provision for this in the overall construction.



7.2 In England, Wales and Northern Ireland, completed buildings are subject to pre-completion testing for airtightness in accordance with the requirements of Approved Documents L1A and L2B, sections 58 to 63 and 74 to 76 respectively; Technical Booklet F1, sections 2.49 to 2.54; and Technical Booklet F2, sections 2.57 to 2.60 respectively.



7.3 Completed dwellings in Scotland are subject to pre-completion airtightness testing if the target air permeability of the proposed building is less than  $10 \text{ m}^{-3} \cdot \text{h}^{-1} \cdot \text{m}^{-2}$ , or if the figure is between  $10 \text{ m}^{-3} \cdot \text{h}^{-1} \cdot \text{m}^{-2}$  and  $15 \text{ m}^{-3} \cdot \text{h}^{-1} \cdot \text{m}^{-2}$  and the designer does not wish to use the  $15 \text{ m}^{-3} \cdot \text{h}^{-1} \cdot \text{m}^{-2}$  default figure in the proposed dwelling, in accordance with the Technical Handbook (Domestic).

## 8 Condensation

8.1 The risk of interstitial condensation in the external walling is greatest when the building is drying out after construction. Guidance on preventing condensation is given in BRE Digest 369 *Interstitial condensation and fabric degradation*, and BRE report (BR 262 : 2002) *Thermal insulation: avoiding risks*.

### Surface condensation



8.2 The product has a minimum surface temperature factor of 0.75 and will adequately limit the risk of surface condensation on plane wall elements.

8.3 Care must be taken by the designer to ensure that reveals are insulated where required (this will depend upon the position of the frame with relation to the front face of the wall and the type of frame) and there is continuity of insulation around junctions and openings.

### Interstitial condensation

8.4 The formwork material has a water vapour resistance factor ( $\mu$ ) of 8, similar to medium-weight blockwork, and does not present a significant risk of interstitial condensation. However, care should be taken by the designer to ensure that internal and external linings and claddings, junctions, opening details and penetrations are suitably designed and installed to limit the risk of vapour migration by diffusion and convection. Assessments of condensation risk should be carried out in accordance with BS 5250 : 2002, Section 8 and Annex D.

## 9 Weathertightness and damp-proofing

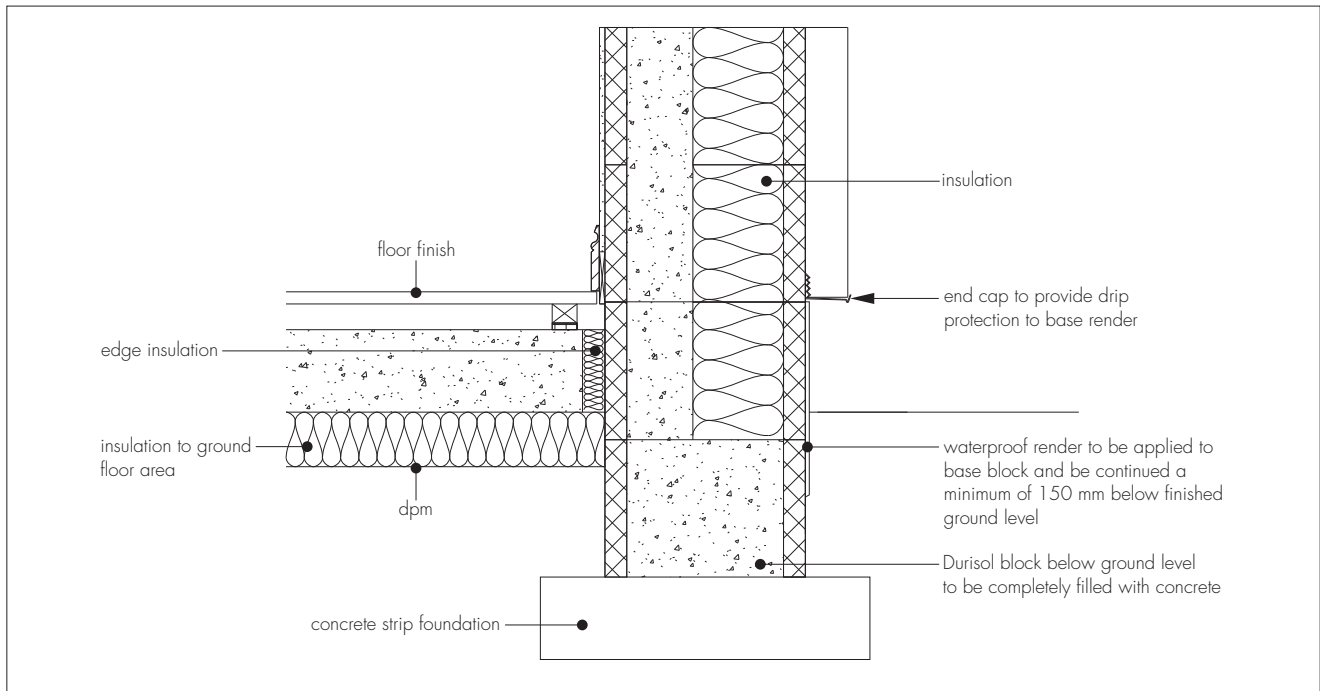
9.1 Weather resistance of the product is provided by the external finish described in this Product Sheet (see sections 1.11, 17.1 and BBA Certificate 06/4400). Other external finishes are not covered by this Product Sheet.

9.2 When used in combination with the Parex Monorex GF Render System, the final weather resistance of the building is dependent on good design detailing and site practice. In addition to general details set out in BBA Certificate 06/4400, the guidance given in BRE report (BR 262 : 2002) should be followed with regard to rain penetration in that the designer selects a construction appropriate to the local wind-driven rain index<sup>(1)</sup>, paying due regard to the design detailing, workmanship and materials to be used.

(1) Parex Monorex render is limited for use where the wind-driven index is less than 75 litres per m<sup>2</sup>.

9.3 A typical damp proofing detail for when the system is used between foundation level and dpc is shown in Figure 5.

Figure 5 Damp proof detail



## 10 Behaviour in relation to fire



10.1 Walls constructed from the system have been assessed in terms of fire resistance under structural loading in accordance with BS EN 1363-1 : 1999 and BS EN 1365-1 : 1999. A panel of thickness 170 mm (using a D170/120 unit) and overall dimensions 3000 mm long by 3260 mm high was tested with an applied vertical loading of 260 kN·m<sup>-1</sup>. The 120 mm thick concrete core used C16/20 strength concrete. Additional finishes were not provided. Results obtained were:

- Loadbearing capacity (R) 90 minutes
- Integrity (E) 90 minutes
- Insulation (I) 90 minutes.

10.2 The use of the formwork with the specified finishes will not reduce the fire resistance of the overall wall construction. Wall constructions incorporating other formwork units will require fire testing to prove resistance under design axial load in the fire situation. Alternatively, wall constructions, incorporating a reinforced concrete core can be assessed using the requirements set out in BS EN 1992-1-2 : 2004.

10.3 The risk of fire spread over the internal wall surface will depend on the finishes used. The relevant requirements of the national Building Regulations should be observed. A typical plasterboard lining will provide a Class 0 surface ('low risk' in Scotland).

10.4 For the risk of fire spread over the external wall surface, reference should be made to BBA Certificate 06/4400, section 11.



10.5 Attention is drawn to building designers of the need to protect openings through walls incorporating this product.

## 11 Proximity of flues and appliances

When installing the product in close proximity to certain flue pipes and/or heat-producing appliances, the following provisions to the national Building Regulations are acceptable:

**England and Wales** — Approved Document J3

**Scotland** — Mandatory Standards 3.18, clause 3.18.5<sup>(1)(2)</sup>, and 3.19, clause 3.19.4<sup>(1)(2)</sup>

**Northern Ireland** — Technical Booklet L.

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non-Domestic).

## 12 Sound insulation



12.1 In England and Wales, separating walls are subject to pre-completion testing in accordance with Approved Document E, Section 1. A similar approach is described in the Scottish Building Standards, Mandatory Standard 5.1, clause 5.1.12<sup>(1)</sup>.

(1) Technical Handbook (Domestic).



12.2 Good working practice should be adopted for sealing all construction joints with suitable fill material. Plasterboard joints should be taped and double layers of plasterboard staggered. Relevant practices detailed within Robust Details, Part E *Resistance to the passage of sound* should be adopted.



12.3 It is essential that care is taken in the design and during installation to avoid direct paths for airborne sound transmission and to minimise paths for flanking sound transmission.

12.4 A separating wall, made up as listed below, when subject to field tests to BS EN ISO 140-4 : 1998, achieved an average  $D_{nT,w} + C_{tr}$  value of 61 dB. The construction consisted of:

- plaster skim on 12.5 mm thick plasterboard
- Durisol D250/180 formwork unit, concrete filled
- plaster skim on 12.5 mm thick plasterboard.

## 13 Maintenance and repair



13.1 Although maintenance is not envisaged for the walling system, regular checks should be carried out on the finishes to ensure damage is detected and repaired as soon as possible.

13.2 Minor repairs can be carried out on the formwork units prior to concrete pouring operations).

13.3 For maintenance and repair requirements for the Parex Monorex GF Render Finish, reference should be made to BBA Certificate 06/4400, section 12.

## 14 Durability



14.1 Concrete walls constructed with the system will have a service life of not less than 60 years provided they are designed in accordance with section 5.2. The formwork will have a similar service life provided it is protected by the external and internal finishes of the wall construction (see section 13) and these are adequately maintained during the life of the building.

14.2 The nominal concrete cover to reinforcement, for durability purposes, should be that appropriate to 'mild' exposure in accordance with BS 8500-1 : 2006, Table A.1, and BS EN 206-1 : 2000, Table 1.

14.3 For durability statements on the Parex Monorex GF Render Finish, reference should be made to BBA Certificate 06/4400, section 13.

# Installation

## 15 General

### Durisol Permanent Formwork

15.1 The preparation and installation must be in accordance with the *Durisol Walling System Installation Manual*. Particular attention must be given to the requirements given in sections 16.2 to 16.5 of this Certificate.

15.2 The units can be cut using conventional hand or mechanically operated wood saws.

15.3 Concrete can be placed using a concrete pump, crane bucket with a small outlet or by hand using hoppers to feed the concrete into the formwork. The requirements given in sections 16.5 to 16.7 must be observed during placing and compacting of the concrete. The pump delivery rate for the concrete should be set at its lowest flow setting (the concrete volume regulated by a reducer or elbow at the end of the pump line) to allow accurate placement, reduction of any pressure surge in the delivery pipe and likelihood of overspill. Good co-ordination between the pump operator and site operative directing the hose at the formwork is essential.

15.4 Suitably durable and mechanically adequate fixings must be used for all structural elements or support brackets and must be post-drilled or cast into the concrete core. The formwork units must not be used as a structural medium. In specifying wall fixings carrying heavy vertical loads, consideration should be given to the effect of bending between the face of the concrete core and outer edge of the units.

15.5 Consideration should be given at the design stage to the incorporation of wall fixings, support brackets, service entry points, ducting, pipework and other building elements, to minimise post-construction cutting or chasing of the formwork units or concrete core. Service penetrations should be sealed effectively and fire stopped. Specific design detailing requirements can also be incorporated into the construction of the formwork subject to the Certificate holder's advice.

15.6 When cutting or making modifications to the system, care must be taken not to damage or weaken the formwork elements that could result in the loss of integrity or overall stability of the temporary construction. Cold-bridging effects must also be considered where any services pass through the wall construction.

15.7 Minor repairs to the system can be carried out prior to concrete pouring using inserts made from unit off-cuts, plywood plates and expanding foam to reduce leakage of wet concrete and maintain the thermal integrity of the formwork.

15.8 The system requires that the foundation be level, smooth finished and within a tolerance of 10 mm. Any out-of-tolerances must be made good prior to placement of formwork or by laying a bedding joint on top of the foundation.

15.9 All reinforcement should be accurately positioned to ensure that the minimum required concrete cover is provided. Starter or dowel bars, where required, must be to the engineer's design. For placing and locating reinforcement, internal webs should only be cut or modified in accordance with the Certificate holder's standard details (see section 1.9 and Table 2) and further advice sought from the Certificate holder.

15.10 Whenever possible, construction joints should be avoided but, when necessary, 6 mm minimum diameter starter bars, for the subsequent lift, should be positioned at 500 mm maximum horizontal centres and penetrate into the concrete core by at least 200 mm.

15.11 Effective bracing and propping of formwork should be used during construction. The amount of bracing should be verified by calculation, by the engineer responsible for the design, to ensure stability is not compromised at any stage of the construction.

15.12 Window and door openings (see Figures 2 and 3) are formed during construction of the formwork, generally using timber framing. To ensure that the framing remains square, propping and internal bracing should be provided.

### **Electrical and plumbing installation**

15.13 Electrical and plumbing services can be fixed within the formwork voids by cutting small holes or chases into the formwork skins, subject to the Certificate holder's approval. All electrical services should be ducted. Any services introduced should conform to Building Regulation and Health and Safety requirements. Further details on fixing methods can be obtained from the Certificate holder.

### **Intermediate floors and roof**

15.14 A range of installation and floor systems can be accommodated with the system. Typical methods of jointing are shown in Figures 6 and 7.

Figure 6 Typical timber floor detail using cast-in bolt

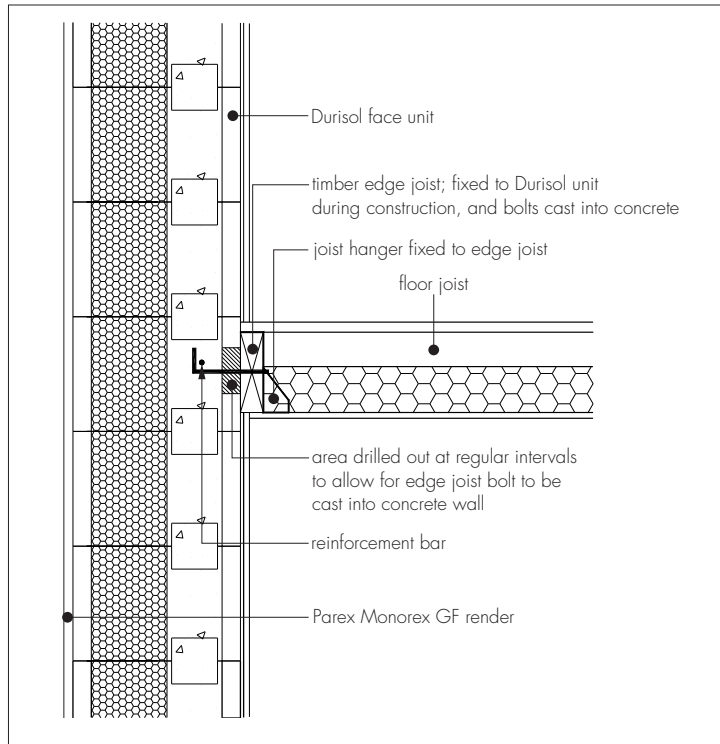
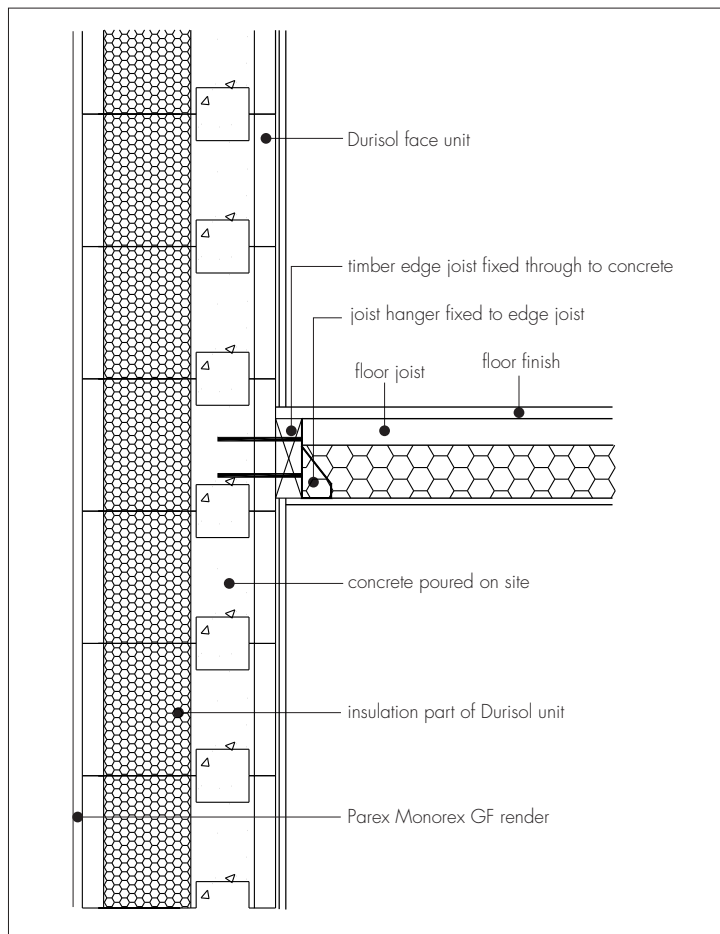


Figure 7 Typical timber floor detail post-fixed with joist hanger



### Internal finishes

15.15 A range of internal finishes can be applied or fixed directly to the system. Common dry lining systems, such as gypsum plasterboard, should be bonded to formwork units using a compatible adhesive. The Certificate holder recommends a period of from 4 to 7 days from concrete pour to the application of internal finishes. Internal finishes are outside the scope of this Certificate.

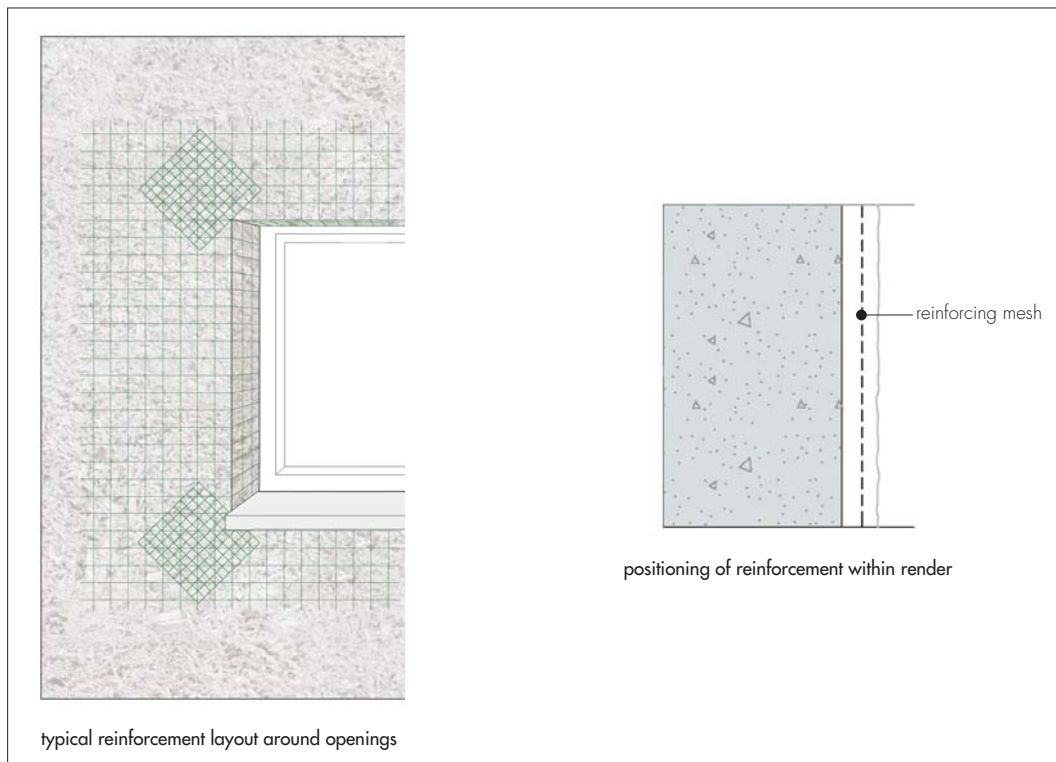
## Heavy wall loads

15.16 Heavy wall loads (such as kitchen wall units or central heating boilers) should be fixed back to the concrete core and not directly into the formwork unit skins. Typical methods include the use of timber blocks, screwed or bolted into the concrete core, or cast-in anchor bolts and metal plates. Further details can be obtained from the Certificate holder.

## Parex Monorex GF Render Finish

15.17 For application requirements, reference should be made to the general requirements set out in BBA Certificate 06/4400, section 17. When used in combination with the Durisol Permanent Formwork System, the addition of TV-glassfibre mesh must be used (see Figure 8).

Figure 8 Location of reinforcing mesh within render thickness and around openings



## 16 Procedure

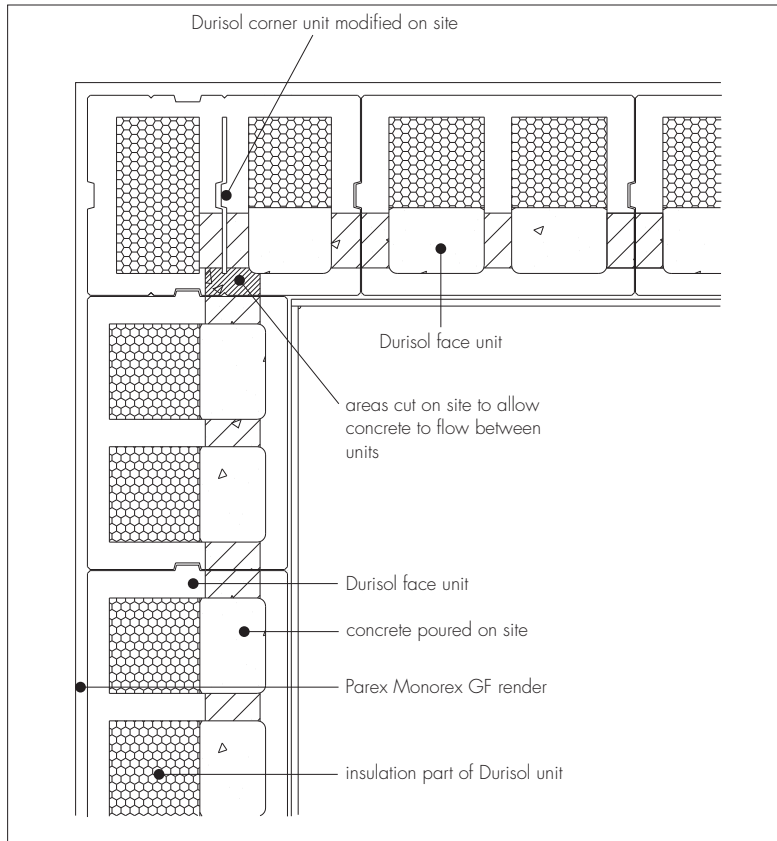
### Durisol Permanent Formwork System

#### Laying

16.1 The foundation level is checked and the setting out lines for the formwork are made by the main contractor. Any out-of-tolerance levels or inaccuracies in foundations should be made good using a bed of levelling mortar.

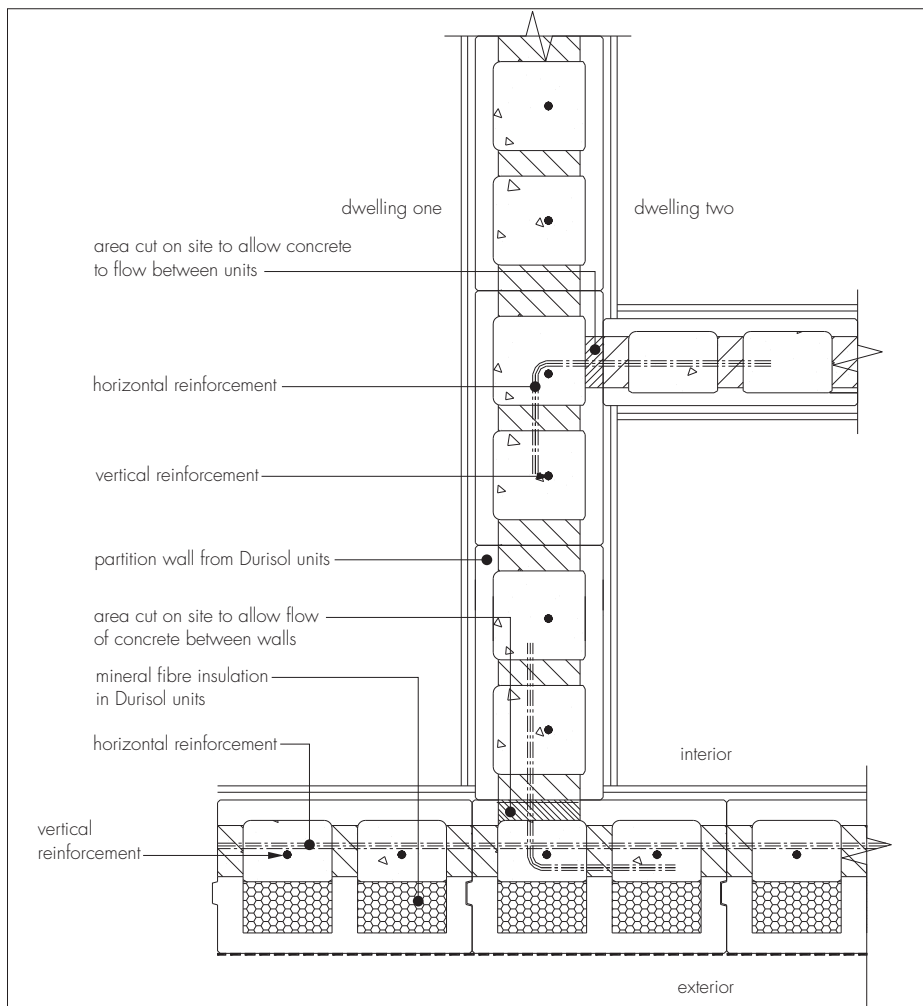
16.2 Construction commences by forming the corners (see Figure 9) of the external walls using corner units and working inwards towards the mid-point of each wall line using standard units (reference S). On subsequent courses, a running bond should be maintained with vertical joints staggered in stretcher bond fashion. It is important to ensure that horizontal and vertical joints abut tightly. Standard units (reference S) are cut to size to accommodate window and door openings as laying proceeds.

Figure 9 Typical corner detail



16.3 Following completion of the first course, the formwork is checked for plumb and level and the next five courses laid in a running bond. Separating or internal walls are jointed as shown in Figure 10.

Figure 10 Typical separating/internal wall jointing



## Reinforcement

16.4 The quantities of reinforcement placed within the system are dependent on design and detail requirements (see section 2). Horizontal reinforcement can be placed in the centre or adjacent to core edges using the preformed slots. Vertical reinforcement can be placed against the horizontal reinforcement and secured using standard reinforcement wire tying methods. Bar lapping lengths in accordance with BS 8110-1 : 1997 or BS EN 1992-1-1 : 2004 should be adopted. The system requires that, in plain walls, horizontal reinforcement be provided to tie in internal walls, above structural openings and horizontally at floor levels.

## Concrete placement

16.5 Prior to concrete pouring, a check should be carried out on the system to include conformance to design and layout, correct alignment and plumb, bracings and props secured. Reinforcement should be checked for correct cover distance and rigidity.

16.6 Concrete placement should be directly into the formwork voids, directing the line pump nozzle, when used, first around the external walls of the building in a continuous pour allowing concrete to free-flow into corners, above and below window openings. Concrete placement should cease once the concrete is within 50 mm of the top of the sixth course. Where a construction or day joint is to be formed, starter bars should be pushed into the concrete (see section 16.4).

16.7 Once the first pour has reached its initial set, placing the second lift of formwork units can commence and the pouring operation repeated up to the first and subsequent storey heights.

## Parex Monorex GF Render Finish

16.8 The render is mixed by adding water and stirring with a drill and paddle and is applied in a single-coat application. The glass fibre reinforcing mesh is embedded within the render coat as work proceeds ensuring that it is located centrally within the render thickness. Additional mesh is placed at corner points of openings (see Figure 7 of this Product Sheet) and sections 16, 17 and 18 of BBA Certificate 06/4400.

# Technical Investigations

## 17 Tests

17.1 Tests were carried out to MOAT No 22 : 1988 on Monorex GF Render Finish in combination with the system to determine:

- effectiveness of the application of the render to the system
- effect of wet/heat cycling
- effect of freeze/thaw cycling
- effect of accelerated aging on bond strength
- impact resistance.

## 18 Investigations

18.1 A site visit was carried out to witness the installation process including construction of formwork, placement of reinforcement, pouring of concrete and general performance of the formwork.

18.2 An assessment was made on technical data relating to:

- resistance to hydrostatic head pressure during concrete placement
- fire performance
- thermal performance
- durability.

18.3 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of both quality and composition of materials.



## Bibliography

- BS 4449 : 2005 *Steel for the reinforcement of concrete — Weldable reinforcing steel — Bar, coil and decoiled product — Specification*
- BS 5250 : 2002 *Code of practice for control of condensation in buildings*
- BS 5628-3 : 2005 *Code of practice for the use of masonry — Materials and components, design and workmanship*
- BS 6399-2 : 1997 *Loading for buildings — Code of practice for wind loads*
- 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 8212 : 1995 *Code of practice for dry lining and partitioning using gypsum plasterboard*
- BS 8298 : 1994 *Code of practice for design and installation of natural stone cladding and lining*
- BS 8500-1 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Method of specifying and guidance for the specifier*
- BS 8500-2 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*
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- BS EN 480-1 : 2006 *Admixtures for concrete, mortar and grout — Test methods — Reference concrete and reference mortar for testing*
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- BS EN ISO 140-4 : 1998 *Acoustics — Measurement of sound insulation in buildings and of building elements — Field measurements of airborne sound insulation between rooms*
- BS EN ISO 6946 : 2007 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*
- BS EN ISO 10211 : 2007 *Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations*
- MOAT No 22 : 1988 *UEAtc Directives for the Assessment of External Insulation Systems for Walls (Expanded Polystyrene Insulation Faced with a Thin Rendering)*

## 19 Conditions

19.1 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.

19.2 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.

19.3 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.

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

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

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

19.6 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.