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Agrément Certificate

21/5985

Product Sheet 1

CPG UK INSULATED CONCRETE FORM (ICF) SYSTEM

NUDURA SOLID INSULATED WALL SYSTEM

This Agrément Certificate Product Sheet⁽¹⁾ relates to the Nudura Solid Insulated Wall System, comprising expanded polystyrene (EPS) panels mechanically fixed together with polypropylene web spacers. The system provides permanent insulated formwork for use in the formation of loadbearing and non-loadbearing internal, external, and separating walls in domestic and non-domestic buildings, subject to height restrictions.

(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 components have adequate strength to resist the loads associated with installation (see section 6).

Thermal performance — the system contributes to the overall thermal performance of the wall construction (see section 7).

Condensation — walls, wall junctions and openings can adequately limit the risk of condensation (see section 9).

Behaviour in relation to fire — the system's EPS components have a reaction to fire classification of E in accordance with BS EN 13501-1 : 2018 and the use of the system is restricted in some cases (see section 13).

Durability — the system will have a service life in excess of 60 years (see section 16).

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: 12 January 2022

Hardy Giesler
Chief Executive Officer

The BBA is a UKAS accredited certification body – Number 113.

The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk
Readers MUST check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.

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Regulations

In the opinion of the BBA, the Nudura Solid Insulated Wall 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)

| | | |
|---------------------|---|--|
| Requirement: | B3(4) | Internal fire spread (structure) |
| Comment: | The system is restricted by this Requirement. See section 13.1 of this Certificate. | |
| Requirement: | B4(1) | External fire spread |
| Comment: | The system is restricted by this Requirement. See sections 13.1 and 13.2 of this Certificate. | |
| Requirement: | C2(c) | Resistance to moisture |
| Comment: | The system can adequately limit the risk of surface condensation and contribute to minimising the risk of interstitial condensation. See sections 9.1, 9.3 and 9.4 of this Certificate. | |
| Requirement: | L1(a)(i) | Conservation of fuel and power |
| Comment: | The system can contribute to satisfying this Requirement. See sections 7 and 8.1 of this Certificate. | |
| Regulation: | 7(1) | Materials and workmanship |
| Comment: | The system is acceptable. See section 16 and the <i>Installation</i> part of this Certificate. | |
| Regulation: | 7(2) | Materials and workmanship |
| Comment: | The system is restricted by this Regulation. See sections 13.1 and 13.2 of this Certificate. | |
| Regulation: | 26 | Materials and workmanship |
| 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: | The system can contribute to satisfying these Regulations. See sections 7 and 8.1 of this Certificate. | |



The Building (Scotland) Regulations 2004 (as amended)

| | | |
|--------------------|---|---|
| Regulation: | 8(1)(2) | Durability, workmanship and fitness of materials |
| Comment: | The system can contribute to a construction satisfying this Regulation. See sections 15 and 16 and the <i>Installation</i> part of this Certificate. | |
| Regulation: | 9 | Building standards applicable to construction |
| Standard: | 2.1 | Compartmentation |
| Standard: | 2.2 | Separation |
| Standard: | 2.3 | Structural protection |
| Comment: | The system is restricted by these Standards, with reference to clauses 2.1.12 ⁽²⁾ , 2.2.4 ⁽²⁾ , 2.2.5 ⁽²⁾ , 2.2.6 ⁽¹⁾ , 2.2.7 ⁽¹⁾ , 2.2.8 ⁽¹⁾ and 2.3.2 ⁽¹⁾⁽²⁾ . See sections 13.1 and 13.8 of this Certificate. | |
| Standard: | 2.4 | Cavities |
| Comment: | The system is restricted by this Standard, with reference to clauses 2.4.2 ⁽¹⁾⁽²⁾ , 2.4.4 ⁽¹⁾ and 2.4.6 ⁽²⁾ . See section 13.1 of this Certificate. | |

| | | |
|--|-----------|--|
| Standard: Comment: | 2.6 | Spread to neighbouring buildings The system is restricted by this Standard, with reference to clauses 2.6.5 ⁽¹⁾ and 2.6.6 ⁽²⁾ . See sections 13.1 and 13.3 of this Certificate. |
| Standard: Comment: | 3.15 | Condensation Walls can adequately limit the risk of surface condensation, with reference to clauses 3.15.1 ⁽¹⁾⁽²⁾ and 3.15.4 ⁽¹⁾⁽²⁾ of this Standard. Walls can contribute to minimising the risk of interstitial condensation, with reference to clauses 3.15.1 ⁽¹⁾⁽²⁾ and 3.15.5 ⁽¹⁾⁽²⁾ of this Standard. See sections 9.2 to 9.4 of this Certificate. |
| Standard: Comment: | 6.1(b) | Carbon dioxide emissions The system can contribute to satisfying this Standard, with reference to clauses 6.1.1 ⁽¹⁾ , 6.1.2 ⁽¹⁾ and 6.1.6 ⁽¹⁾ . See sections 7 and 8.1 of this Certificate. |
| Standard: Comment: | 6.2 | Building insulation envelope The system can contribute to satisfying this Standard, with reference to clauses 6.2.1 ⁽¹⁾⁽²⁾ , 6.2.3 ⁽¹⁾ , 6.2.4 ⁽²⁾ and 6.2.5 ⁽²⁾ . See sections 7 and 8.1 of this Certificate. |
| Standard: Comment: | 7.1(a)(b) | Statement of sustainability 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. In addition, the system can contribute to meeting higher levels of sustainability as defined in this Standard, with reference to clauses 7.1.4 ⁽¹⁾ [Aspects 1 ⁽¹⁾⁽²⁾ and 2 ⁽¹⁾], 7.1.6 ⁽¹⁾⁽²⁾ [Aspects 1 ⁽¹⁾⁽²⁾ and 2 ⁽¹⁾], 7.1.7 ⁽¹⁾ [Aspect 1 ⁽¹⁾], 7.1.9 ⁽²⁾ [Aspect 1 ⁽²⁾] and 7.1.10 ⁽²⁾ [Aspect 1 ⁽²⁾]. See section 7 of this Certificate. |
| Regulation: Comment: | 12 | Building standards applicable to conversions Comments in relation to 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: Comment: | 23(a)(i) (iii)(b)(i) | Fitness of materials and workmanship The system is acceptable. See section 16 and the <i>Installation</i> part of this Certificate. |
| Regulation: Comment: | 29 | Condensation The system can contribute to minimising the risk of interstitial condensation. See sections 9.3 and 9.4 of this Certificate. |
| Regulation: Comment: | 35(4) | Internal fire spread - Structure The system is restricted by this Regulation. See sections 13.1 of this Certificate. |
| Regulation: Comment: | 36(a) | External fire spread The system is restricted by this Regulation. See sections 13.1 and 13.2 of this Certificate. |
| Regulation: Comment: | 39(a)(i) | Conservation measures The system can contribute to satisfying this Regulation. See sections 7 and 8.1 of this Certificate. |
| Regulation: Comment: | 40(2) | Target carbon dioxide emission rate The system can contribute to satisfying this Regulation. See sections 7 and 8.1 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 sections: 3 *Delivery and site handling* (3.4) and 18 *General* (18.21) and the *Installation* part of this Certificate.

Additional Information

NHBC Standards 2022

In the opinion of the BBA, the Nudura Solid Insulated Wall System, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to *NHBC Standards*, Part 3 *General*, Chapter 3.1 *Concrete and its reinforcement*.

Technical Specification

1 Description

1.1 The Nudura Solid Insulated Wall System is formwork comprising factory-assembled units consisting of two panels of expanded polystyrene (EPS) each 67 mm thick (standard form) or 102 mm thick (XR-35), mechanically fixed together using an arrangement of hinged polypropylene webs moulded into each panel at the production stage.

1.2 The elements interlock and build, horizontally and vertically, into a tight, rigid formwork (see Figures 1 and 2). The wall is formed by placing steel reinforcement and pouring concrete into the formwork. Various forms are available within the range, allowing overall wall widths of 235, 286, 337, 387 and 438 mm (standard ICF) and 305, 356, 407, 457 and 508 mm (XR-35) to be formed. For nominal dimensions of the EPS panels, see Figures 1 and 2.

1.3 The EPS panels are green in colour, and are moulded from EPS beads. The panels have a nominal density of $21.6 \text{ kg}\cdot\text{m}^{-3}$ and a declared thermal conductivity of $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$.

1.4 The formwork components are detailed in Table 1.

Table 1 Components

| Component | Material | Length (mm) | Width (mm) | Height (mm) | Thickness (mm) |
|---------------------------|---------------|--------------------|-------------------------|-------------|----------------|
| Standard form | EPS | 2438 | 241, 298, 343, 394 | 457 | 67 |
| Half-height form | EPS | 2438 | 241, 298, 343, 394 | 228 | – |
| Corner form - long | EPS | 953-803 | 241, 298, 343, 394 | 457 | – |
| Corner form - short | EPS | 400-470 | 241, 298, 343, 394 | 457 | – |
| Brick ledge form | EPS | 2438 | 397, 441, 492 | 457 | – |
| Taper top form | EPS | 2438 | 298, 343, 394 | 457 | – |
| Double taper top form | EPS | 2438 | 241, 298 | 457 | – |
| 45° corner form | EPS | 648, 241 | 241, 298, 343, 394 | 457 | – |
| Transition form | EPS | 1200-1219 | 298 | 457 | – |
| Stop end form | EPS | 102, 159, 203, 254 | – | 457 | 57 |
| Height adjuster | EPS | 600-610 | – | 76 | 67 |
| XR-35 standard form | EPS | 2438 | 306, 356, 407, 458, 509 | 457 | 102 |
| XR-35 corner form - long | EPS | 1143 | 306, 356, 407, 458, 509 | 457 | – |
| XR-35 corner form - short | EPS | 737 | 306, 356, 407, 458, 509 | 457 | – |
| Spacer/web | polypropylene | – | – | – | – |

Figure 1 Standard component details (all dimensions in mm)

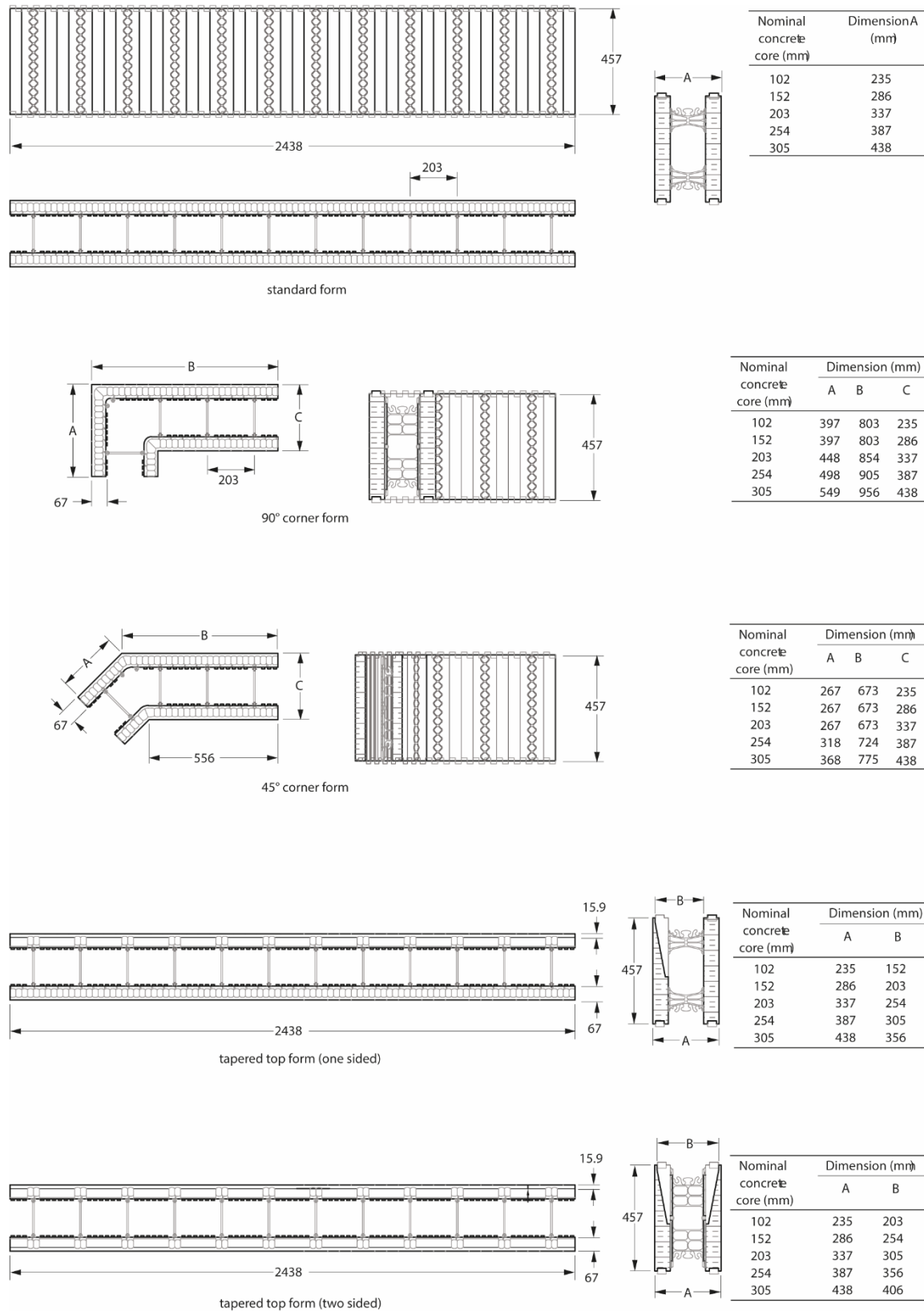


Figure 1 Standard component details (all dimensions in mm) (continued)

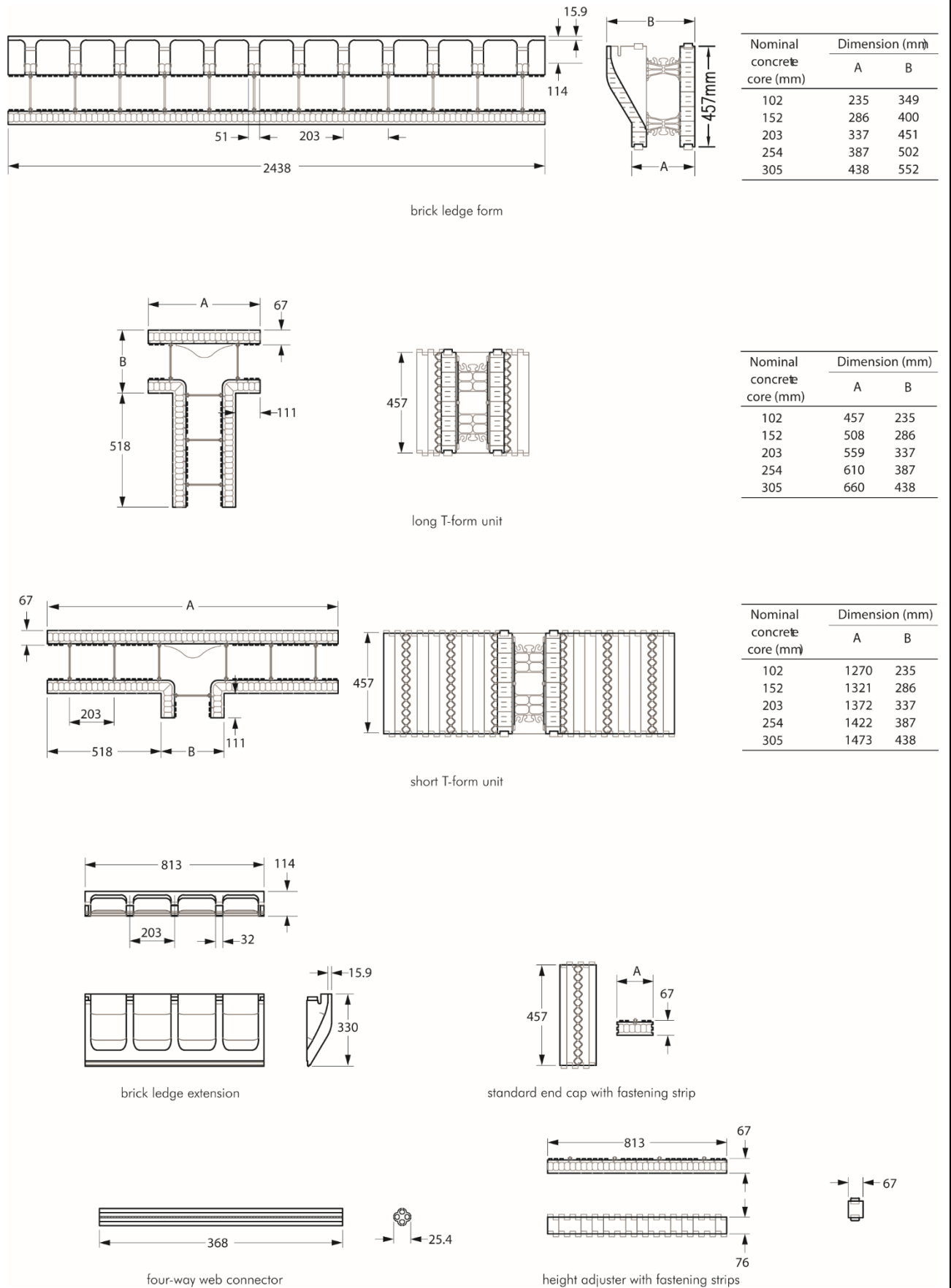
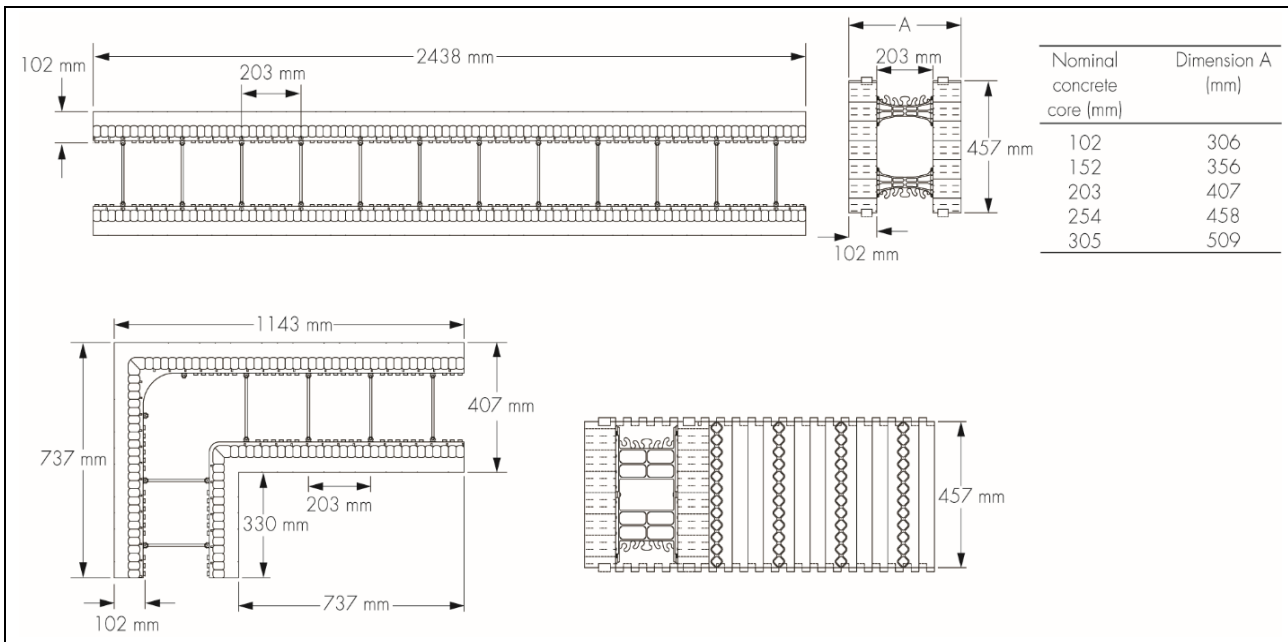


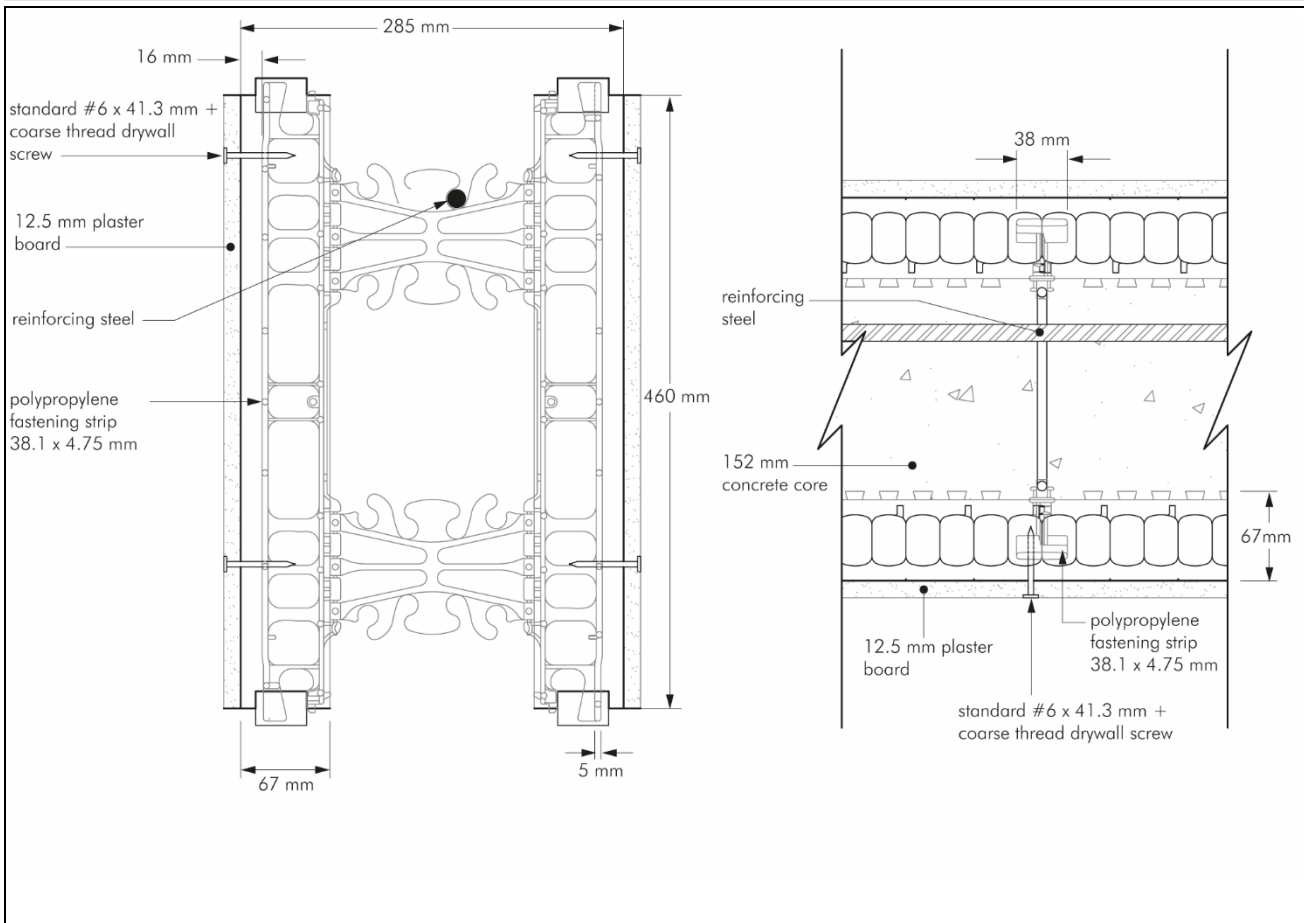
Figure 2 NUDURA XR-35 details ⁽¹⁾



(1) 203 mm XR-35 core forms shown; other core widths as listed in Table 1 of this Certificate, are available.

1.5 Polypropylene spacers are black in colour, manufactured from recycled polymer and hinged at the internal face of the EPS panels to allow ease of transporting to site. They are available in five sizes, to give nominal concrete core widths of 102, 152, 203, 254 and 305 mm. The spacer webs are designed with slots to receive horizontal reinforcement, and the flanges, built into the EPS forms, can be used to screw-fix lightweight fixtures and finishes (see Figure 3) such as plasterboard and weatherproofing systems (subject to load limitations — see data sheets held by the Certificate holder).

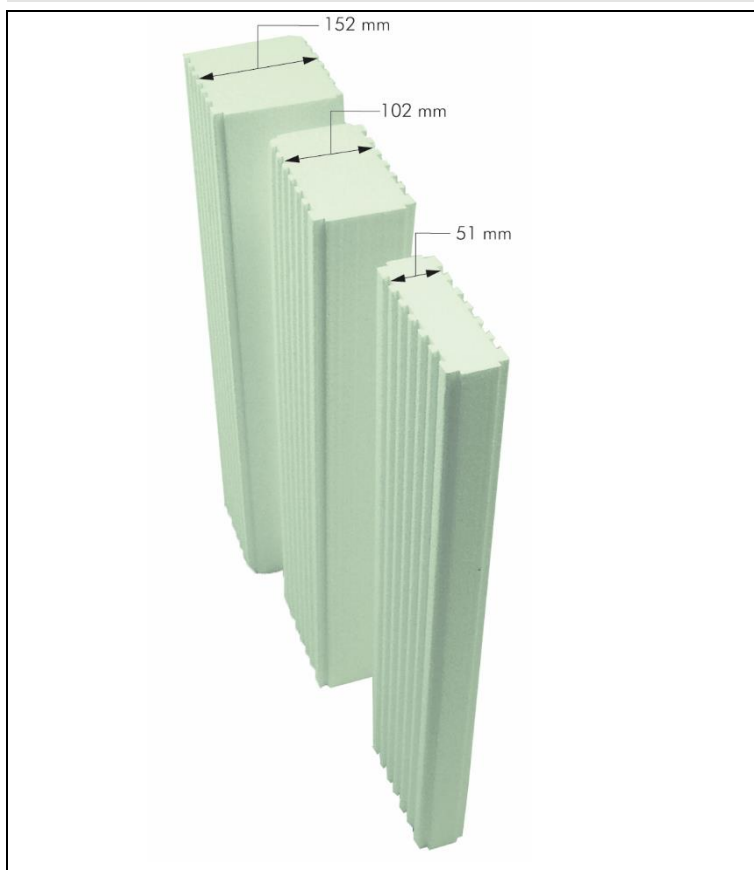
Figure 3 Polypropylene spacers / EPS mechanical fixings (all dimensions in mm)



1.6 The upper and lower surfaces of the EPS forms incorporate small castellations so that adjoining forms lock together utilizing the Nudura Duralock system without fixings. Forms can be used either way up (except brick ledge forms). The spacers run the full height of the form and serve to hold the forms together and prevent lifting during the concrete pour. The inner surfaces of the EPS panels feature vertical, dovetail grooves that allow full bonding with the concrete and provide locks for the end caps. The outer surfaces are lightly grooved vertically at 51 mm centres to aid cutting and trimming.

1.7 NUDURA Plus Series inserts (see Figure 4) are additional EPS inserts which may be attached to the 67 and 102 mm formwork panels to increase the thickness and thermal resistance of the formwork. The inserts are available in thicknesses of 25, 51, 102 and 152 mm, with an EPS thermal conductivity of $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$.

Figure 4 EPS Plus Series Inserts (all dimensions in mm)



1.8 The formwork requires temporary support during concrete filling and until the concrete has gained sufficient strength to allow the wall to become stable.

1.9 The Certificate holder recommends a pumpable concrete, strength class C16/C20⁽¹⁾ for plain walls and C20/C25 to C50/C60 for reinforced concrete, in accordance with BS EN 206-1 : 2013, BS 8500-1 : 2015 and BS 8500-2 : 2015. An aggregate with a maximum size of 10 to 15 mm is specified for walls up to 152 mm nominal core thickness, and aggregate with a maximum size of 20 mm is specified for walls of 203 mm, or more, nominal core thickness. The concrete should contain an admixture complying with BS EN 934-2 : 2009 or BS EN 480-1 : 2014 to allow placement by free-flow without compaction, or it can be compacted using vibrating poker. Specific concrete mixes⁽¹⁾ are dependent on individual requirements and are outside the scope of this Certificate.

(1) Sourced from suppliers who operate a full quality control scheme, such as the Quality Scheme for Ready-Mixed Concrete (QSRMC) or BSI Kitemark.

1.10 Components and finishes specified for use with the system, but outside the scope of this Certificate, are:

- concrete core — as specified in section 1.9
- 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 EN 1996-2 : 2006 or BS 8298-1 : 2010, BS 8298-2 : 2010 and BS 8298-3 : 2010 as appropriate
- waterproofing membrane as required (see section 12.2)
- brickwork/stonework ties — to BS EN 845-1 : 2013
- temporary bracing and alignment support system as supplied by the Certificate holder
- Dryvit ICF 500 render system — in accordance with BS EN 13914-1 : 2016 and suitable for use with the system
- brick slip systems with third-party certification — the Certificate holder's advice should be sought
- cladding — timber, cement board or metal sheet
- internal finish — typically 12.5 mm thick plasterboard or a dry-lined finish, with or without a plaster skim coat conforming to BS EN 1992-1-2 : 2002
- frame ties — type 6, stainless steel frame ties can be screwed into the web of the spacers for walls up to 10 m high and in areas likely to experience low wind loads.
- Trestle supports – supplied by the Certificate holder.

2 Manufacture

2.1 The Nudura Solid Insulated Wall System is manufactured from expanded polystyrene (EPS) in accordance with BS EN 13163 : 2012.

2.2 The polypropylene web spacers are manufactured from recycled polymer.

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 manufacturer has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by DQS Inc (Certificate 10017820 QM15).

3 Delivery and site handling

3.1 Good site practices should be observed to prevent damage to the components.

3.2 The system components are supplied shrink wrapped on protective bases, bearing a label with details of the products including component type and dimensions, and the BBA logo incorporating the number of this Certificate. The wrapping should not be opened until the contents are required.

3.3 The EPS components should be stored on their sides to protect toothed edges from damage.

3.4 Care must be taken when handling the EPS components to avoid damage and contact with solvents or materials containing volatile organic components such as newly treated timber. The elements must not be exposed to open flame or other ignition sources.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the NUDURA Integrated Building Technology Insulated Concrete Form System.

4 Use

4.1 The Nudura Solid Insulated Wall System is for use in loadbearing and non-loadbearing internal, external or separating walls, in domestic and non-domestic buildings subject to structural and fire considerations and building use.

4.2 The system provides permanent formwork for in-situ dense aggregate concrete walls and contributes to the thermal insulation of the finished construction.

4.3 The system is for use with the internal and external finishes specified in this Certificate.

4.4 Walls formed from the system are subject to design and supervision by a suitably qualified and competent individual, and adherence to structural design to British or European Standards (see section 6.1).

5 Practicability of installation

Construction of the system is carried out by trained operatives experienced with this type of system, in accordance with the Certificate holder's *Installation Manual*.

6 Structural performance

General

6.1 Walls formed from the system subject to the national Building Regulations should be designed in accordance with the relevant recommendations of BS 8102 : 2009 and limit principles set out in BS EN 1990 : 2002 to loadings in BS EN 1991-1-1 : 2002, BS EN 1991-1-2 : 2002, BS EN 1991-1-3 : 2003, BS EN 1991-1-4 : 2005, BS EN 1991-1-5 : 2003, BS EN 1991-1-6 : 2005, BS EN 1991-1-7 : 2006, BS EN 1992-1-1 : 2004 and BS EN 1992-1-2 : 2004. A suitably qualified individual such as a Chartered Structural Engineer must ensure that foundations (outside the scope of this Certificate) are adequate to support the intended loads.

6.2 Walls formed from the system not subject to the national Building Regulations should also be designed in accordance with the Standards listed in section 6.1.

6.3 The concrete is not easily examined after casting; hence, as specified in BS EN 1992-1-1 : 2004, Sections 4 and 8, care must be taken to ensure full compaction. Compaction may be checked by removal, observation and replacement of a section of EPS panel.

6.4 Concrete is poured in maximum lifts of 1.2 metres per hour, progressing around the perimeter of the building using free-flowing, pumpable concrete mixes (see section 1.9). Particular care is necessary to maintain alignment during concrete filling and checking between pours. Propping systems used in conjunction with the system must be checked prior to and during concrete filling to ensure stability and alignment is maintained.

6.5 The Certificate holder recommends the careful use of a small diameter vibrating poker for the compaction of wet concrete.

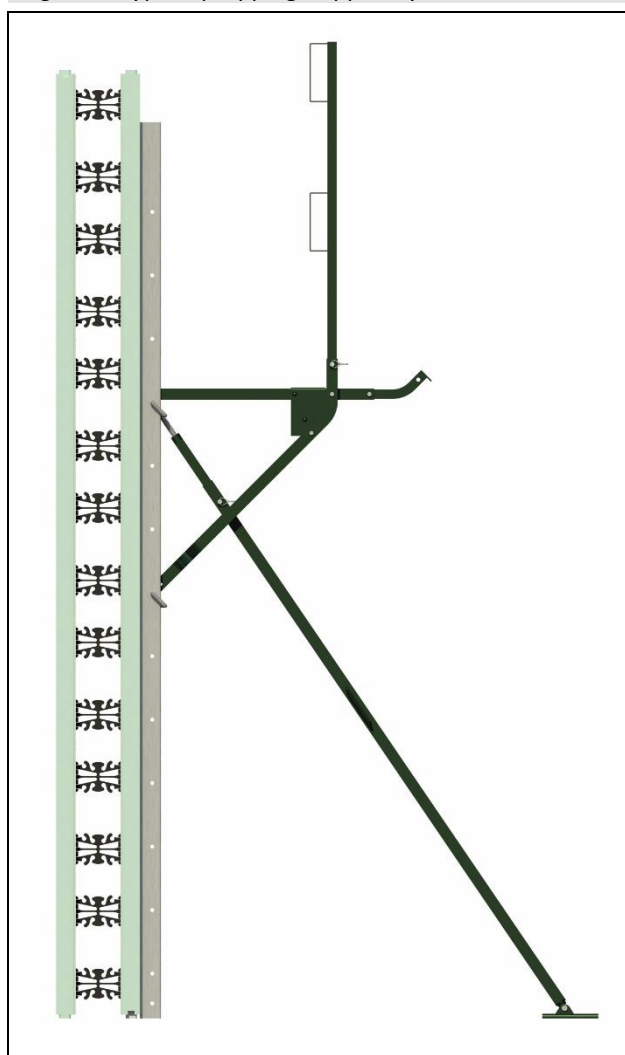
6.6 Heavy wall attachments or finishes, fixed either internally or externally, must be attached via support systems designed to take account of the applied load using suitable fixings or plates fixed or cast into the concrete core.

6.7 Particular attention should be given to the type of concrete mix used, to ensure segregation does not occur and the wet concrete is allowed to flow freely around formed openings and through congested areas of reinforcement. It is recommended that a pumpable concrete of grade C16/C20 or C20/C25 and aggregate with a maximum size of 10 to 15 mm, is used. The Certificate holder can provide guidance on concrete strength and water-cement ratio. Generally, slump should be tested in accordance with BS EN 12350-2 : 2019. Guidance is given in the *Installation Manual*, or can be requested from the Certificate holder.

6.8 The nominal concrete cover to reinforcement should be suitable for the environmental exposure conditions X01 and XC1 for the concrete as described in BS EN 206 : 2013, Table 1, using the appropriate location of the polypropylene spacer.

6.9 To achieve structurally stable formwork during the construction process, the system must be braced sufficiently to resist the loads imparted on the system by wet concrete, wind loads and other construction loads acting on both faces of the wall. The Certificate holder recommends a specific propping/support system (see Figure 5), designed to give lateral support during the pouring of the concrete and curing stage. The propping/support system also provides platform access for operatives and includes screw props for adjustment purposes both prior to and immediately following pouring operations.

Figure 5 Typical propping/support system



6.10 Attention is drawn to the need for accurate levelling of the foundation and initial setting out of the propping (see sections 18.12 and 18.13), which should prevent the need for significant adjustments to be made.

7 Thermal performance



7.1 Calculations of thermal transmittance (U value) should be carried out in accordance with BS EN ISO 6946 : 2017 and BRE Report BR 443 : 2006, using the declared thermal conductivity (λ_D) value of the EPS (green) insulation is $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$.

7.2 The U-value will depend on the construction of the wall, the external and internal finish and the number and type of fixings used. Example construction types comprising the NUDURA Integrated Building Technology Insulated Concrete Form System can achieve the U values and thermal resistances (R) given in Table 2, below.

Table 2 Thermal transmittance ⁽¹⁾

| Construction type | Plus Series Inserts (mm) | Standard 67 mm ($\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$) | Standard 67 mm Thermal resistance ($\text{m}^2\cdot\text{K}\cdot\text{W}^{-1}$) | XR-35 102 mm ($\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$) | XR-35 102 mm Thermal resistance ($\text{m}^2\cdot\text{K}\cdot\text{W}^{-1}$) |
|---|--------------------------|---|---|---|---|
| ICF with 152 mm concrete core | n/a | 0.29 | 3.49 | 0.17 | 3.49 |
| | 25 | 0.24 | 4.18 | 0.15 | 4.18 |
| | 51 | 0.20 | 4.91 | 0.14 | 4.91 |
| | 102 | 0.16 | 6.32 | 0.12 | 6.32 |
| | 152 | 0.13 | 7.71 | 0.10 | 7.71 |
| ICF with 152 mm concrete core, brick outer leaf, cavity and plasterboard lining ⁽²⁾ | n/a | 0.24 | 4.15 | 0.15 | 6.49 |
| | 25 | 0.21 | 4.84 | 0.14 | 7.18 |
| | 51 | 0.18 | 5.57 | 0.13 | 7.90 |
| | 102 | 0.14 | 6.98 | 0.11 | 9.32 |
| | 152 | 0.12 | 8.37 | 0.09 | 10.71 |
| ICF with 152 mm concrete core, external Dryvit ICF 500 render system and plasterboard lining ⁽³⁾ | n/a | 0.26 | 3.85 | 0.16 | 6.17 |
| | 25 | 0.22 | 4.55 | 0.15 | 6.90 |
| | 51 | 0.19 | 5.27 | 0.13 | 7.57 |
| | 102 | 0.15 | 6.69 | 0.11 | 9.01 |
| | 152 | 0.12 | 8.07 | 0.10 | 10.42 |

(1) Internal and external finishes are outside the scope of this Certificate. Contact the Certificate holder for advice.

(2) 102 mm brick outer leaf with stainless steel wall ties, 50 mm vented cavity, with 12.5 mm gypsum board on 15 mm dabs and 3 mm gypsum plaster internally.

(3) External Dryvit ICF 500 render system (See Product Sheet 2 of this Certificate), with 12.5 mm gypsum board and 3 mm gypsum plaster internally.

Junctions

7.3 The system can contribute to maintaining continuity of thermal insulation at junctions with other elements and minimise thermal bridges and air infiltration. Detailed guidance can be found in the documents supporting the national Building Regulations.

7.4 Accredited ψ values for a number of common junction types are available from the Certificate holder. ψ Values are not covered by this Certificate.

8 Airtightness



8.1 Walls formed from the system can achieve adequate resistance to unwanted air infiltration provided there is effective sealing around junctions and penetrations.

8.2 Completed buildings are subject to pre-completion testing in accordance with the requirements, and exceptions, in the documents supporting the national Building Regulations.

9 Condensation

Surface condensation



9.1 Walls will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed $0.7 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point, and the junctions with other elements are designed in accordance with the guidance referred to in section 7.3 of this Certificate.



9.2 For buildings in Scotland, wall constructions will be acceptable when the thermal transmittance (U value) does not exceed $1.2 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point, and the junctions with other elements are designed in accordance with the guidance referred to in BS 5250 : 2011, Annex G. Further guidance may be obtained from BRE Report BR 262 : 2002 and section 7.3 of this Certificate.

Interstitial condensation



9.3 Walls will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, Annexes D and G, and the relevant guidance.

9.4 The water vapour diffusion resistance factor (μ) of the EPS taken from BS EN 13163 : 2012, Table F2, is 60μ (equivalent to a vapour resistivity of $300 \text{ MN}\cdot\text{s}\cdot\text{g}^{-1}\cdot\text{m}^{-1}$).

10 Sound insulation

10.1 Separating walls with a concrete core density greater than $2000 \text{ kg}\cdot\text{m}^{-3}$ and a thickness of 203 mm, together with a single layer of plasterboard on each side, will achieve a minimum mass per unit area for the core of $415 \text{ kg}\cdot\text{m}^{-2}$. When used in conjunction with suitable framing, lining and flanking details, the wall can satisfy the requirements of a Type 3 wall, as described in Approved Document E, Sections 2 and 3. of the England and Wales Regulations.

10.2 Separating walls are subject to pre-completion testing in accordance with the documents supporting the national Building Regulations.

10.3 Internal walls and walls flanking separating walls in new dwellings, and rooms for residential purposes, should have a minimum mass per unit area, excluding finishes, in excess of $120 \text{ kg}\cdot\text{m}^{-2}$.

11 Weathertightness

Resistance to rain ingress is provided by the external finishes but this has not been assessed by the BBA and is outside the scope of this Certificate. Care should be taken to ensure the design and construction comply with the good practice described in the relevant building regulations and the Certificate holder's installation procedures.

12 Damp-proofing and waterproofing

12.1 The system's elements will not transmit moisture by capillary action. The concrete wall formed with the system should be constructed using the specified concrete recommended by the Certificate holder (see sections 1.9 and 6.7).

12.2 Use of the system below ground to resist the effect of hydrostatic head or ground water ingress has not been assessed and is outside the scope of this Certificate. However, for general guidance, when used below ground or at formation level, eg basements or retaining walls, waterproofing membranes compatible with EPS should be used. A suitable collector drain and backfilling medium should be provided to eliminate the build-up of hydrostatic head behind the wall, where required. The Certificate holder should be consulted for advice on suitable waterproofing materials and methods of waterproofing.

12.3 Where required, the damp proofing of the wall constructed from the system must be continuous with the damp proof membrane provided in the floor and must achieve continuity with any membrane or damp proof course provided in the external finish of the wall.

13 Behaviour in relation to fire



13.1 The EPS component of the system has a reaction to fire classification of E in accordance with BS EN 13501-1 : 2018; therefore, the system is limited for use in buildings subject to height restrictions – see sections 13.2 and 13.3.



13.2 In England, Wales and Northern Ireland, the system should not be used in buildings with a storey more than 18 m above ground level.



13.3 In Scotland, the system may be used without restriction on proximity to a relevant boundary, as external walls of buildings with no storey more an 18 m above the ground, provided it is installed with an outer leaf of masonry at least 75 mm thick, and has a cavity barrier around all openings in the wall and at the top of the wall head. For other constructions, the system should not be used at 1 m or less from a boundary or in a building with a storey more than 11 m above the ground. Additional restrictions apply to separating elements.

13.4 The risk of fire spread over the wall surfaces will depend on the finishes used. The relevant requirements of the national Building Regulations must be observed. Internal and external finishes are not covered by this Certificate.

13.5 Where the documents supporting the national Building Regulations require fire barriers (outside the scope of this Certificate) to prevent the spread of fire between compartment floors, they must be installed at each floor level above the first floor, ie starting with the second storey. Fire barriers must completely seal any cavity and be chased into the outer EPS formwork.

13.6 Care must be taken to ensure that all detailing at junctions, including internal wall/floor junctions, adequately maintains the required periods of fire resistance, any cavities formed in the completed walls or service entry points are appropriately fire stopped and detailing around any openings provide sufficient protection to the EPS at the compartment lines of multi occupancy buildings. The EPS on the interior face should be discontinuous across wall / floor junctions.

Fire resistance of concrete core

13.7 For reinforced concrete walls designed in accordance with BS EN 1992-1-1 : 2004, fire resistance values for various concrete wall thicknesses given in Table 5.4, BS EN 1992-1-2 : 2002, can be used subject to cover and design load considerations (see Table 3 of this Certificate). For unreinforced walls acting as fire walls, the minimum thickness requirements set out in BS EN 1992-1-2 : 2002, clause 5.4.2, must be taken into account. This assessment does not take account of any additional protection provided by the internal and external finishes.

Table 3 Minimum concrete core thickness for loadbearing reinforced concrete walls ⁽¹⁾

| Standard fire resistance | Minimum dimensions (mm) Wall thickness/axis ⁽²⁾ | | | |
|--------------------------------|---|------------------------------|-----------------------------|------------------------------|
| | $\mu_{fi}^{(3)} = 0.35$ | | $\mu_{fi}^{(3)} = 0.7$ | |
| | wall exposed on one side | wall exposed on two sides | wall exposed on one side | wall exposed on two sides |
| REI 30 | 100/10 ⁽⁴⁾ | 120/10 ⁽⁴⁾ | 120/10 ⁽⁴⁾ | 120/10 ⁽⁴⁾ |
| REI 60 | 110/10 ⁽⁴⁾ | 120/10 ⁽⁴⁾ | 130/10 ⁽⁴⁾ | 140/10 ⁽⁴⁾ |
| REI 90 | 120/20 ⁽⁴⁾ | 140/10 ⁽⁴⁾ | 140/25 | 170/25 |

(1) Taken from BS EN 1992-1-2 : 2002, Table 5.4.

(2) Centre of reinforcement to nearest exposed surface.

(3) The definition of μ_{fi} is given in BS EN 1992-1-2 : 2002, section 5.3.2(3).

(4) Normally, the cover specified in BS EN 1992-1-1 : 2004 will control this distance.



13.8 For buildings in Scotland, completed walls with appropriate finishes can satisfy the required durations of fire resistance and, therefore, may be used in separating walls. Where external walls are one metre or less from a relevant boundary, the construction should comply with the relevant exceptions on the use of combustible materials permitted by the guidance supporting the Building Regulations in Scotland.

13.9 Designers should refer to the relevant national Building Regulations and guidance for detailed conditions of use, particularly in respect of requirements for fire resistances of concrete, cavity closers and barriers, fire stopping of service penetrations and combustibility limitations for other materials and components used in the overall wall construction.

14 Proximity of flues and appliances

Detailed guidance can be found in the documents supporting the national Building Regulations for the provisions that are applicable when the system is installed in close proximity to certain flue pipes and/or heat-producing appliances.

15 Maintenance and repair



Minor repairs to the formwork can be carried out prior to concrete pouring using plywood or suitable expanded foam, to reduce leakage of wet concrete and maintain the thermal integrity of the EPS panels. Further guidance on repair is given in the Certificate holder's *Installation Manual*.

16 Durability



16.1 The EPS formwork will have a service life in excess of 60 years, provided it is protected from damage by the external and internal finishes of the wall construction and these are adequately maintained.

16.2 The polypropylene spacers will have a durability compatible with the EPS, if similarly protected.

16.3 Concrete walls constructed with the system will have a service life in excess of 60 years provided they are designed in accordance with section 6.

17 Reuse and recyclability

The system components comprise EPS and polypropylene, which can be recycled.

Installation

18 General

18.1 Installation of the Nudura Solid Insulated Wall System is carried out by trained operatives in accordance with the Certificate holder's installation instructions. Typical construction details are shown in Figures 6, 7 and 8.

18.2 In general, concrete should be placed by line pump and nozzle although a skip can also be used; small quantities of concrete, eg for window sills, can be placed by hand.

18.3 Suitably durable and mechanically adequate fixings must be used for all structural elements and must be post-drilled or cast into the concrete core. The EPS forming each of the system components must not be used as a structural medium. In specifying wall fixings carrying vertical loads or where lightweight fixings are attached to the polypropylene webs, consideration should be given to the effect of bending between the face of the concrete core and outer edge of the EPS.

18.4 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 out or chasing of the concrete core. Other detailing can also be incorporated in the construction of the formwork subject to the Certificate holder's recommendations. In carrying out any cutting or 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.

18.5 The preparation, installation and support of the system and application of any specified finishes must be in accordance with the Certificate holder's *Installation Manual*.

Foundation

18.6 The foundation must be level, smooth finished and within a tolerance of ± 6 mm in any direction. Any out-of-tolerances must be made good prior to placement of formwork.

18.7 Where specified, a damp-proof membrane is laid through the wall or under the slab (depending on the detailing) to prevent the ingress of damp during the construction process. The external detail must be such that protection is provided to at least 150 mm above the external ground level. For ground bearing floors, the dpm should link to the wall dpc to provide complete protection and eliminate the possibility of capillary action between the slab and wall.

Erection of Insulated Concrete Formwork blocks

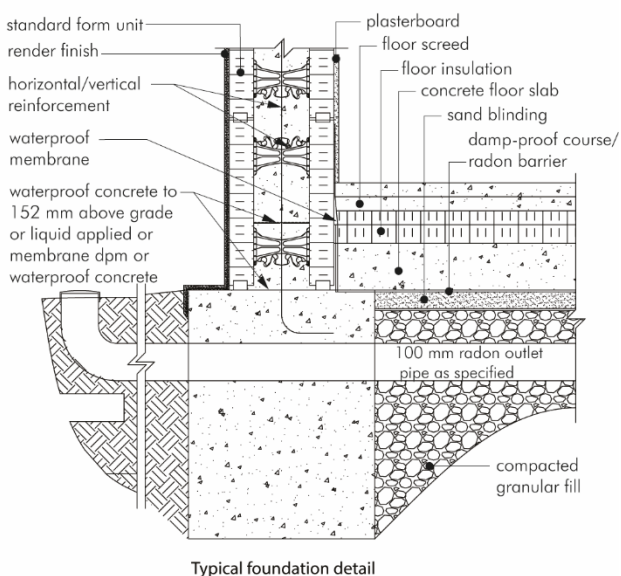
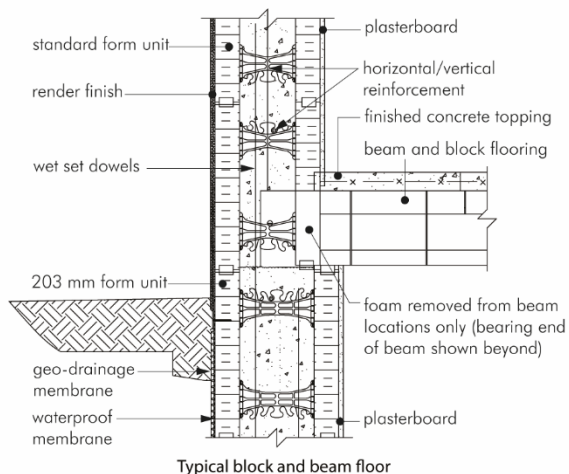
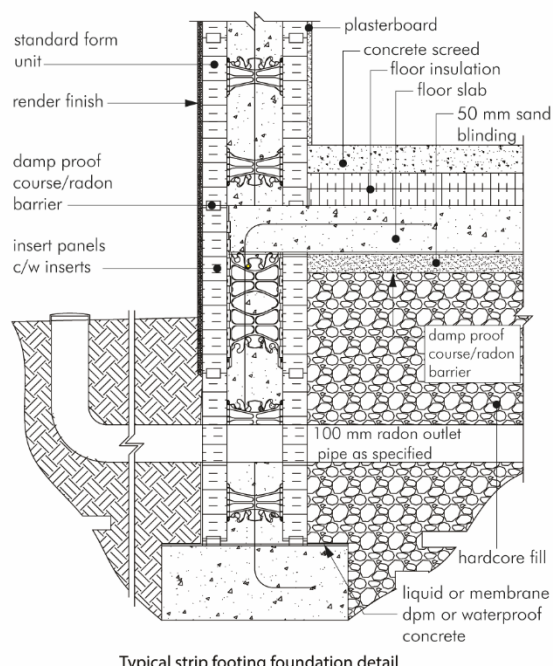
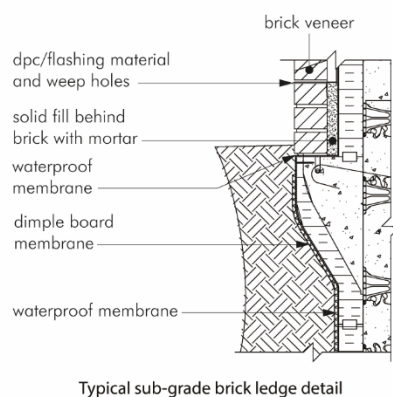
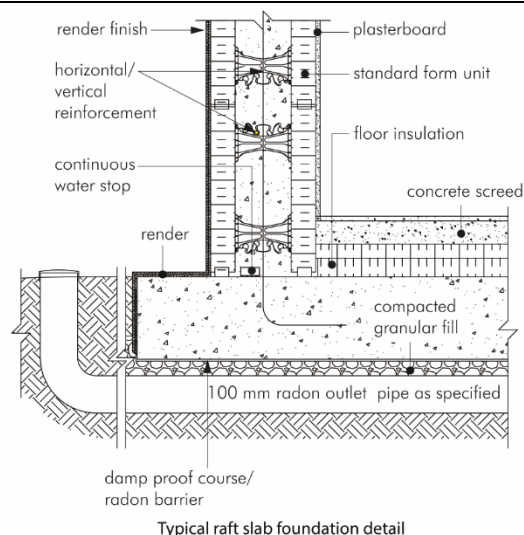
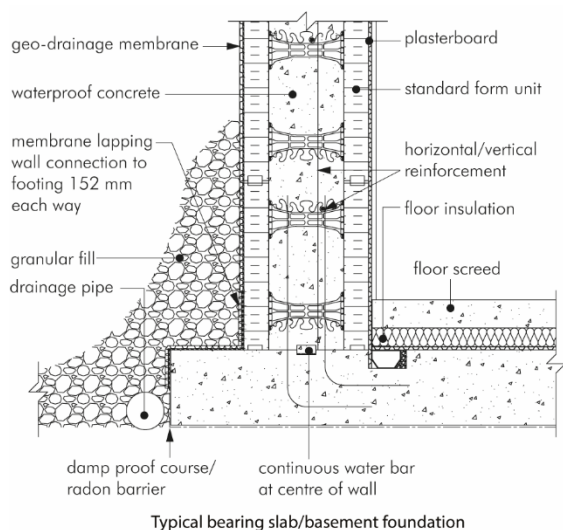
18.8 The forms may be readily cut or trimmed using a hot knife, fine-toothed handsaw or other appropriate saw as specified in the Certificate holder's *Installation Manual*.

18.9 Where the specified elevation height is not a multiple of the standard form height, adjustment may be made by cutting the bottom course of the forms, or trimming the top off the highest course of forms as described in the Certificate holder's *Installation Manual*.

18.10 The sequence of erection of the forms and recommendations on joints are given in the Certificate holder's *Installation Manual*.

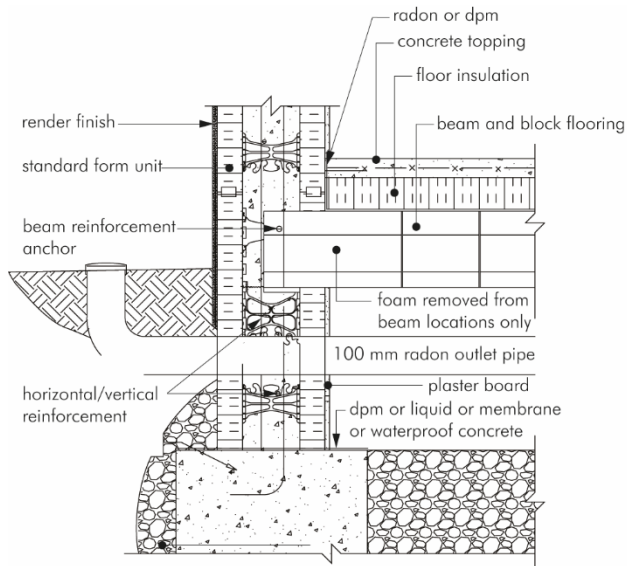
18.11 The forms must be suitably restrained and sealed on the footing/slab in accordance with the Certificate holder's *Installation Manual*.

Figure 6 Typical construction details ⁽¹⁾

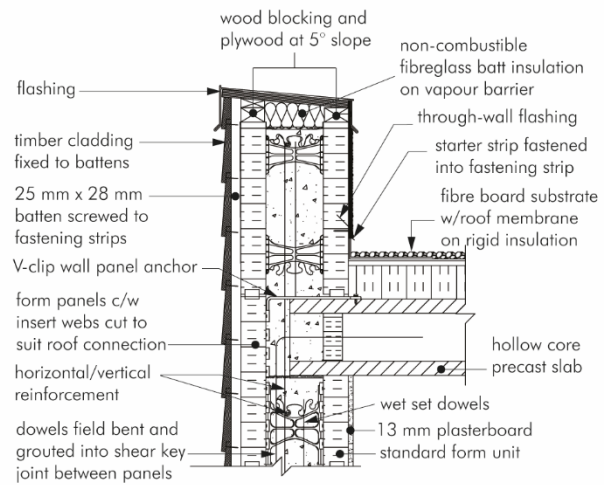


(1) Basement figures only for illustration, not assessed. The Certificate holder provides a complete set of construction details in their *Installation Manual*.

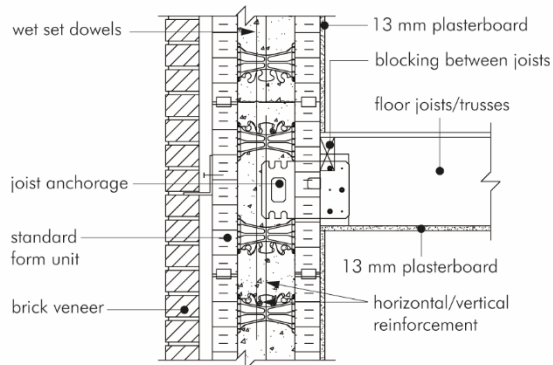
Figure 7 Typical construction details ⁽¹⁾



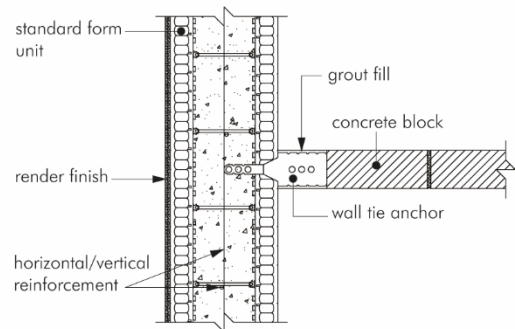
Typical block and beam floor connection



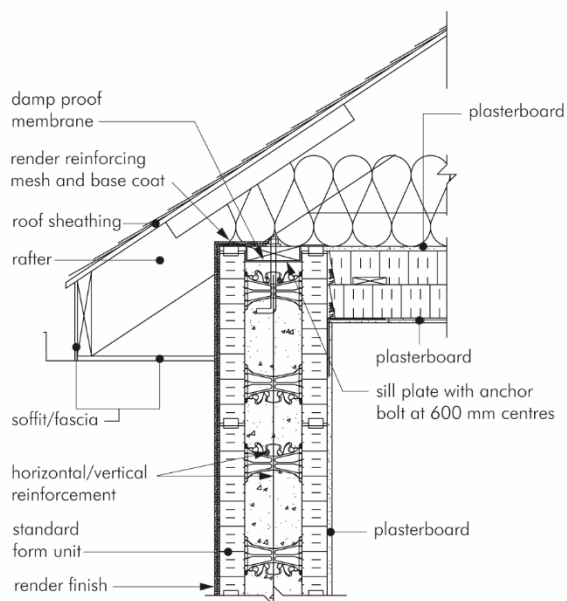
Typical flat roof connection



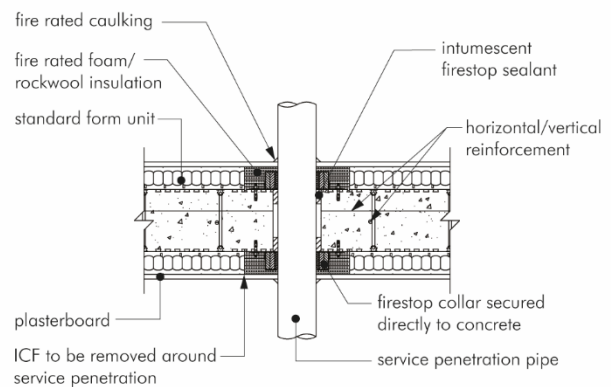
Typical intermediate floor connection



Typical block partition wall connection detail (plan view)



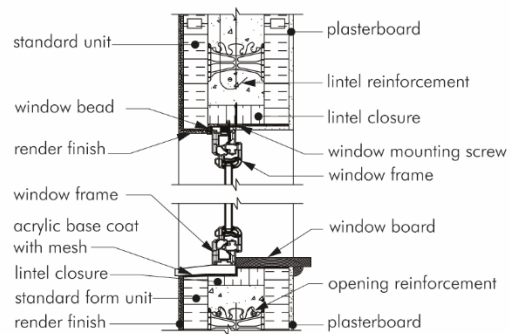
Typical roof rafter detail at top plate



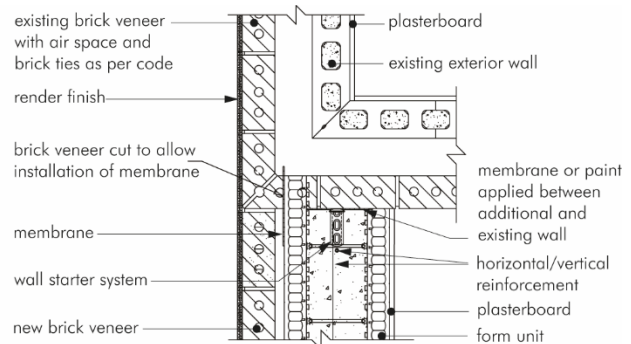
Typical firewall service penetration

(1) The Certificate holder provides a complete set of construction details in their *Installation Manual*.

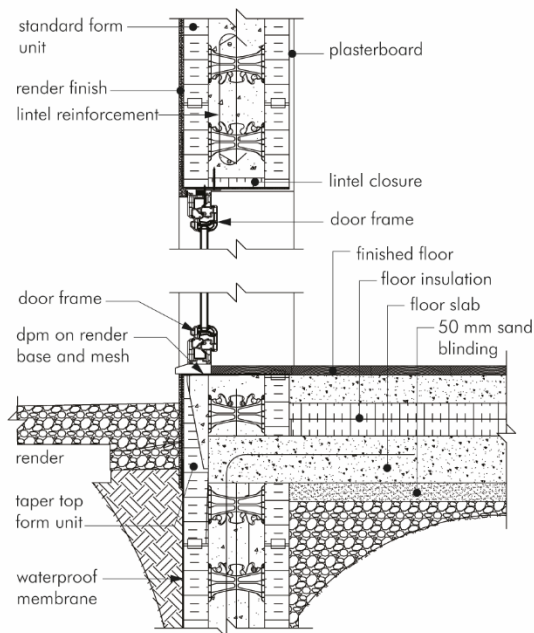
Figure 8 Typical construction details ⁽¹⁾



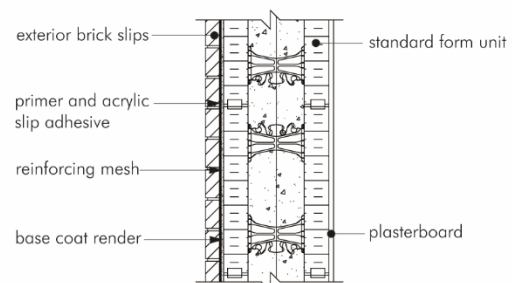
Typical window head and sill detail



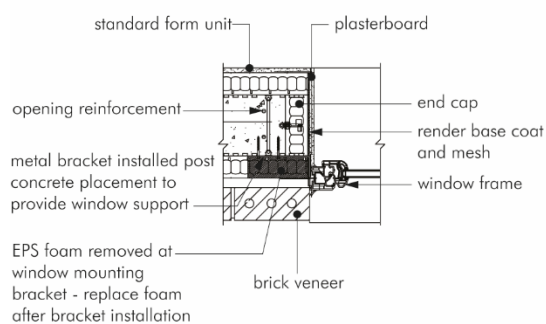
Typical addition to existing building detail (plan view)



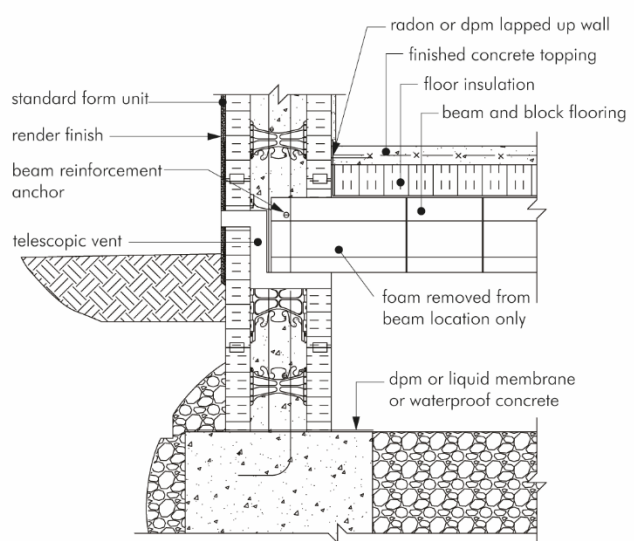
Typical door head and sill detail



Typical brick slip exterior finish detail



Typical window jamb detail (plan view)



Typical block and beam connection

(1) The Certificate holder provides a complete set of construction details in their *Installation Manual*.

Restraint and propping

18.12 It is essential that effective bracing and propping of walls takes place during construction to ensure stability, level, straightness and plumb of walls. The Certificate holder recommends the use of the NUDURA Propping System (information available in the Certificate holder's *Installation Manual*). The system uses adjustable pull-push bracing to easily make minor adjustment during concrete pour.

18.13 Temporary bracing and propping must be installed following erection of the fourth course of forms and prior to pouring of the concrete core. Typically, the bracing and alignment systems are placed on one side of the formwork (usually the inside face) during construction. However, for longer walls or walls greater than one storey in height, bracing on two sides is recommended. When using the Certificate holder's bracing system (not covered by this Certificate), the system must be supported at a maximum horizontal distance of 700 mm from any corner and then at a maximum of 1800 mm centres. On exposed sites or in adverse weather conditions, additional temporary support should be provided.

Reinforcement

18.14 All reinforcement should be accurately positioned to ensure that the minimum required cover to the concrete is provided. Starter, dowel bars and bar lapping lengths, where required, must be to the engineer's design and in accordance with BS EN 1992-1-1 : 2004. Polyethylene spacers should not be cut or modified when locating reinforcement.

18.15 The quantities of reinforcement placed within the system are dependent on design and detail requirements (see section 4 of this Certificate). Horizontal reinforcement can be placed in different locations across the concrete fill void using the spacer toothed slots. Vertical reinforcement should be placed against the horizontal reinforcement and secured using standard fixing methods. In plain walls, appropriate horizontal reinforcement should be provided at lintels in accordance with engineering requirements and the reinforcing bars must extend an anchorage length past the opening to suit the bar diameter.

Windows and doors

18.16 Window and door openings are formed at the desired locations during construction of the formwork. EPS inserts are used to reduce thermal bridging at these openings (not covered by this Certificate). All openings and lintels formed as part of the erection works should be adequately braced / propped in accordance with the Certificate holder's *Installation Manual*.

Concrete placement

18.17 Prior to concrete pouring, a check is carried out on the system to ensure conformity to design and layout, correct alignment and plumb, and that bracings and props are secured. Reinforcement should be checked for correct cover distance and rigidity.

18.18 Concrete is placed using a line pump or overhead boom from a concrete pump lorry. Small volumes of concrete can be placed by hand, eg to make up small deficiencies at the end of each pour or to the sill of window openings. For concrete pumping, a 75 mm reducer and hose should be used. The concrete pump should be set at a pumping rate such that excessive pressure is not allowed on the sides of the formwork. The stream of concrete should be aimed directly into the void and away from corners. For the initial and subsequent traverses of the pump nozzle, the concrete pour height should be restricted to pour heights from 1 to 1.2 m, with a total daily concrete pour height not exceeding 3 m (ie one storey height).

18.19 The formwork should be checked for alignment and plumb before proceeding with the next traverse. This will also allow the first pour to stiffen. The next traverse proceeds in the same manner until the first storey-height has been reached. At window and door openings, concrete should be poured either side of each opening up to sill level and the concrete allowed to stiffen before the next pour is commenced.

Backfilling

18.20 Backfilling around the bottom layers of formwork to the ground floor should not take place until the concrete has reached sufficient design strength.

Electrical and plumbing installation

18.21 Electrical and plumbing services can be fixed within the formwork or into the concrete core by cutting chases into the EPS using a router or hot knife. 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.

Wall penetrations

18.22 Openings or ducts for service penetrations can be positioned within the formwork prior to concrete pouring.

Internal finishes

18.23 A range of internal finishes can be applied or fixed directly to the system. These should be screw-fixed into the spacer flanges or glued to the EPS using compatible adhesive.

18.24 Penetrations through the concrete, such as pipe entries or formwork ties, must also be securely sealed to maintain watertightness. The advice of the Certificate holder should be sought on suitable details.

External finishes

18.25 External cladding systems are outside the scope of this Certificate. Further details of suitable systems can be obtained from the Certificate holder. The use of Dryvit ICF 500 render system is detailed in Product Sheet 2 of this Certificate.

Heavy wall loads

18.26 All structural point loads should be supported by the concrete core and not the form spacer flanges. This can be achieved by the use of timber blocks screwed or bolted into the concrete core or cast-in anchor bolts and metal plates. Further guidance can be obtained from the Certificate holder's *Installation Manual*.

Technical Investigations

19 Tests

Tests and assessments on the Nudura Solid Insulated Wall System were carried out generally in accordance with the requirements of ETAG 009 : 2002 as part of normal construction under site conditions. Observations were made on the possibility of steel reinforcement within the form, resistance to filling pressure and efficiency of filling using pumped concrete. The overall stability of formwork due to the head of wet concrete was also observed.

20 Investigations

20.1 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.

20.2 An assessment was made on existing technical data relating to thermal performance, fire and airtightness.

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

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BS EN 1991-1-3 : 2003 + A1 : 2014 *Eurocode 1 : Actions on structures — General actions — Snow loads*

BS EN 1991-1-4 : 2005 + A1 : 2010 *Eurocode 1 : Actions on structures — General actions — Wind actions*

BS EN 1991-1-5 : 2003 *Eurocode 1 : Actions on structures — General actions — Thermal actions*

BS EN 1991-1-6 : 2005 *Eurocode 1 : Actions on structures — General actions — Actions during execution*

BS EN 1991-1-7 : 2006 + A1 : 2014 *Eurocode 1 : Actions on structures — General actions — Accidental actions*

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21 Conditions

21.1 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.

21.2 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.

21.3 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.

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

21.5 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.

21.6 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.