



British Board of Agrément
Bucknalls Lane
Watford
Herts WD25 9BA
Tel: +44 (0) 1923 665300
Fax: +44 (0) 1923 665301
e-mail: clientservices@bba.star.co.uk
website: www.bbacerts.co.uk



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European Technical Assessment

ETA-07/0034 of 24/04/2017

Technical Assessment Body issuing the European Technical Assessment:

British Board of Agrément

Trade name of the construction product:

NUDURA Integrated Building Technology Insulated Concrete Form System

Product family to which the construction product belongs:

Product Area 34
Prefabricated Building Units

Manufacturer:

NUDURA Inc
27 Hooper Road
Unit No 10
Barrie
Ontario
Canada L4N 9S3

Manufacturing plant(s):

Polymax, Inc
870 Industrial Boulevard
Granby
Quebec J2G 1A4
Canada

This European Technical Assessment contains:

12 pages, including three annexes which form an integral part of the document

This European Technical Assessment is issued in accordance with Regulation (EU) No. 305/2011 on the basis of:

European Technical Assessment Guideline (ETAG) No. 009 *Non Load-Bearing Permanent Shuttering Kits/Systems Based on the Hollow Blocks or Panels of Insulating Materials and Sometimes Concrete*, Edition June 2002, used as the European Assessment Document (EAD)

This European Technical Assessment replaces:

European Technical Approval ETA 07/0034 valid from 7 March 2007 to 31 March 2017

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1 Technical description of the product

The NUDURA Integrated Building Technology Insulated Concrete Form System is formwork comprising factory assembled units consisting of two panels of green expanded polystyrene (EPS), each 67 mm thick, mechanically fixed together using an arrangement of hinged polypropylene webs moulded into each panel at production stage. Various forms are available within the range as described in this section, allowing overall wall widths of 235 mm, 286 mm, 337 mm, 387 mm and 438 mm to be formed. The characteristics of the formwork components are:

- EPS panels — moulded from expanded polystyrene beads. The panels have a nominal density of $21.6 \text{ kg}\cdot\text{m}^{-3}$ and a thermal conductivity of $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$. For nominal dimensions of the EPS panels, see Annex 1, Figure A1
- Polypropylene spacers — these are black in colour 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 100 mm, 150 mm, 200 mm, 250 mm and 300 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 finishes such as plasterboard and weatherproofing systems (subject to load limitations — see ETA holder's data sheets)

The upper and lower surfaces of the EPS forms incorporate small castellations so that adjoining forms effectively lock together 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 the floats 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 50 mm centres to aid cutting and trimming. The forms interlock, and build up horizontally and vertically into a tight rigid formwork. The wall is formed by filling the forms with concrete.

The system's components are available in the range given in Annex 1, Figure A1, and illustrated in Annex 2, Figure A2, and have the characteristics listed in Annex 3.

The formwork is used in conjunction with:

- concrete — typically grade C20 (to EN 206 : 2013 + A1 : 2016) for plain walls or C25 to C37 for reinforced concrete depending on above or below ground use
- aggregate — with a recommended maximum size of 10 mm to 13 mm aggregate used in concrete walls up to 150 mm nominal core thickness and 19 mm for 200 mm nominal core thickness and above. The concrete can contain an admixture complying with EN 934-2 : 2009 to allow placement by either rodding or free flow, and to allow adequate site time. Vibrating equipment can be used with care.

Components and finishes used in conjunction with the formwork, but not covered by this Certificate, are:

- steel reinforcement — where required, should comply with applicable national rules
- external render — either:
 - cement-based render of two or three coats of cement/sand/polymer rendering mix, with the basecoat reinforced with stainless steel or galvanized expanded steel lath, screw-fixed to the polypropylene flanges in the form, or
 - acrylic-based render of two coats of proprietary rendering mix, with glassfibre filament or nylon fibre mesh reinforcement within the basecoat applied directly to the surface of the EPS form
- external masonry — either brickwork or stonework fixed in accordance with the national Regulations. The type of masonry unit must be to the relevant part(s) of EN 771 and, where masonry tests are required, to the relevant part(s) of EN 1052. Other external finishes can be applied subject to fixing requirements and load limitations

- internal finish — typically 12.5 mm thick plasterboard fixed directly to the polypropylene flanges with a plaster skim coat or taped joints. Other lining systems can be applied (such as vinyl, steel, wood and cement particle board) subject to load limitations
- brickwork/stonework wall ties to EN 845-1 : 2003
- trestle supports — supplied by the ETA holder.

2 Specification of the intended use in accordance with the applicable EAD

The system provides permanent formwork for the construction of in-situ dense aggregate concrete walls and contributes to the thermal insulation of the finished construction. The spacers incorporated during production connect the shuttering panels and resist the pressure of the concrete during filling, and can also support reinforcing bars when required.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

3.1.1 Resulting structural pattern

In end-use conditions, walls made with NUDURA ICF System shuttering elements are walls of continuous type according to ETAG 009, paragraph 2.2, and will have the mechanical characteristics shown in Table 1.

Table 1 Mechanical characteristics

Property	Performance
Structural pattern	Continuous
Filling efficiency (see section 3.1.2)	Free flowing concrete, as per concrete recommended design mix
Steel reinforcement (see section 3.1.3)	Possible

3.1.2 Efficiency of filling

Conformity with the requirements of ETAG 009, section 5.1.2, was assessed through on-site observation of the filling with concrete of a trial formwork constructed using the system. The efficient filling without bursting of the shuttering and without voids or any uncovered reinforcement in the concrete core is possible.

The resistance to filling pressure has been determined by observation of the finished shuttering elements, both during and on completion of filling. The requirements in respect of cracking and failure of the system elements and horizontal bowing of shuttering not exceeding 5 mm are also satisfactorily met.

3.1.3 Possibility of steel reinforcement

The instructions in the NUDURA ICF Installation Manual are appropriate to install steel reinforcement for walls according to EN 1992-1-1 : 2004 or corresponding national rules.

3.2 Safety in case of fire (BWR 2)

Table 2 Reaction to fire and fire resistance

Property	Method	Classification
Reaction to fire	EN ISO 11925-2 : 2002	Euroclass E to EN 13501-1
Fire resistance	—	According to ETAG 009, Annex C, Table 1, for walls with a minimum concrete strength C20 with a minimum continuous concrete core of 100 mm, the fire resistance class will be REI 30. Similarly, for walls with a minimum continuous concrete core of 150 mm, the fire resistance class will be REI 120.

3.3 Health, hygiene and the environment (BWR 3)

3.3.1 Dangerous substances

According to the manufacturer's declaration regarding the shuttering elements, taking account of the EU database 8, the NUDURA ICF System does not contain any dangerous substances.

3.3.2 Water vapour permeability

The product may be regarded as type EPS with a water vapour diffusion factor (μ) of 60 according to EN 12524 : 2000.

The values for the water vapour diffusion resistance of concrete depending on density and type of concrete are also tabulated in EN ISO 12524 : 2000.

3.3.3 Water absorption

No performance determined (NPD).

3.3.4 Watertightness

No performance determined (NPD).

3.4 Safety in use (BWR 4)

3.4.1 Bond strength and resistance to impact load

Bond strength

The expanded polystyrene is effectively bonded to the concrete core by mechanical interlocking of the internal vertical dovetail slots and the concrete. The bond strength (insulation to concrete) was based on visual observations during removal of pieces of shuttering in order to study filling efficiency, which was found to be acceptable.

Resistance to impact load

No effect was detected after soft body impact. When tested for hard body impact, a diameter of 50 mm was observed on the EPS panel. Care should be taken on site to avoid hard body impact.

During installation on site, damage to the system could result from striking by objects. After construction, the system will be covered with cladding and therefore will be protected from impact loads.

3.4.2 Resistance to filling pressure

The resistance to filling pressure has been determined by observation of the finished shuttering elements, both during and on completion of the filling, and is satisfactory for filling up to heights of approximately 4 m. The requirements in respect to cracking and failure of the system elements and horizontal bowing of shuttering are also satisfactorily met. The formwork needs vertical checks/adjustment during filling.

3.4.3 Safety against personal injuries by contact

As delivered to site, the shuttering elements do not have sharp or cutting edges. The soft surface of the shuttering means there is no risk of abrasion or personal injury. The requirements according to ETAG 009, chapter 6.4.3, are satisfactorily met.

3.5 Protection against noise (BWR 5)

3.5.1 Airborne sound insulation

No performance determined (NPD).

3.5.2 Sound absorption

No performance determined (NPD).

3.6 Energy economy and heat retention (BWR 6)

3.6.1 Thermal resistance

The nominal thermal conductivity (λ) of the Insulating Concrete Formwork (ICF) / Permanent Insulating Formwork (PIF) is $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$. The total wall resistance, and consequently its U-value, would depend on the construction.

3.6.2 Influence of moisture transfer on insulating capacity of wall

No performance determined (NPD).

3.6.3 Thermal inertia

No performance determined (NPD).

3.7 Aspects of durability and serviceability (BWR 7)

The provisions made in this ETA are based on an assumed working life for the system of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be used as a means for selecting the appropriate product in relation to the expected economically reasonable working life of the works.

3.7.1 Resistance to deterioration

Physical agents

No performance determined (NPD).

Chemical agents

No performance determined (NPD).

Biological agents

No performance determined (NPD).

3.7.2 Resistance to damage during normal use

Normal use impacts

No performance determined (NPD).

Incorporation of ducts

It is essential that any ducts in the walls are included at the design stage rather than drilled/cut after installation, as this could result in damage that has to be repaired.

Fixing of objects

No performance determined (NPD).

3.8 Identification of the product

The panels are wrapped in plastic bearing the manufacturer's name, product type, dimensions, quantity, date of fabrication and batch reference details.

In relation to transportation and storage, the panels should be treated as conventional insulation products.

4 Assessment and verification of constancy of performance (SAVCP) system applied, with reference to its legal base

According to the Decision 98/599/EC⁽¹⁾ of the European Commission⁽²⁾, amended by Decision 2001/596/EC, the system of assessment and verification of constancy of performance [see Annex V to Regulation (EU) No. 305/2011] is as shown in Table 3.

Table 3 System of assessment and verification of constancy of performance

Product	Intended use	Level or class	System
Permanent insulation shuttering kits/systems	Construction of external and internal walls in buildings subject to fire regulations	NPD	2+

(1) Official Journal of the European Communities L 287 of 24.10.1998

(2) Official Journal of the European Communities L 209 of 02.08.2001

5 Technical details necessary for the implementation of the AVCP system, as outlined in the applicable EAD

5.1 Tasks of the Assessment Holder

5.1.1 Factory Production Control

The manufacturer must ensure permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer must be documented in a systematic manner in the form of written

policies and procedures, including records of results achieved. This production control system ensures that the product is in conformity with the European Technical Assessment.

Manufacturers having a Factory Production Control (FPC) system which complies with the EN ISO 9000 series and which addresses the requirements of a European Technical Assessment are recognised as satisfying the FPC requirements of the Directive.

The results of factory production control must be recorded in a checklist signed by the person responsible and evaluated. The records must be presented to the notified product certification body involved in continuous surveillance. On request, the records must be presented to the British Board of Agrément.

5.1.2 Testing of samples taken at the factory

The manufacturer must only use raw materials supplied with the relevant inspection documents as laid down in the prescribed Control Plan⁽¹⁾. The raw materials must be subject to agreed controls and tests by the manufacturer before acceptance. Checks on incoming materials, such as polystyrene beads and spacers, must include control of the Certificates of Conformity presented by suppliers (comparison with nominal values) by verifying dimensions and determining material properties, eg chemical composition and physical properties.

The manufactured components are checked for dimensional compliance, and visually checked for surface and other defects.

The frequency of controls and tests conducted during production and on the finished panel must be laid down in the prescribed Control Plan, taking account of the manufacturing process. The results of factory production control must be recorded and evaluated. The records must include at least:

- the designation of the product
- the type of control or testing
- the date of manufacture of the product and dates of testing of the product or basic materials and components
- the results of control and testing and, if appropriate, comparison with requirements
- the signature of the person responsible for Factory Production Control.

The records must be presented to the inspection body involved in the continuous surveillance. Details of the extent, nature and frequency of testing and controls to be performed within the Factory Production Control must correspond to the prescribed Control Plan included in the technical documentation associated with this ETA.

5.2 Tasks of the Notified Body

5.2.1 Initial type-testing of the product

For initial type-testing⁽²⁾ the results of tests, assessments and calculations performed as part of the assessment for the European Technical Assessment must be used unless there are changes in the production line or plant. In such cases, the necessary type-testing has to be agreed between the British Board of Agrément and the Notified Body involved.

5.2.2 Initial inspection of factory and of Factory Production Control

The Notified Body must ascertain that, in accordance with the prescribed Control Plan, the factory, in particular the staff and equipment, and the Factory Production Control are suitable to ensure a continuous and orderly manufacturing of the system components with the specifications given in the Control Plan and this ETA.

5.2.3 Continuous surveillance

The Notified Body must visit the factory at least once per year for routine inspections. It must be verified that the system of Factory Production Control and the specified manufacturing processes are maintained, taking account of the prescribed Control Plan.

The results of continuous surveillance must be made available on demand from the Notified Body to the British Board of Agrément. Where the provisions of the European Technical Assessment and the prescribed Control Plan are no longer fulfilled, the Certificate of Conformity will be withdrawn by the Certification body.

- (1) The prescribed Control Plan is deposited with the British Board of Agrément and is made available to the Notified Bodies involved in the conformity attestation process.
- (2) In the context of ETAG 009, initial type-testing may be by testing and/or calculation.



On behalf of the British Board of Agrément

BChamberlain

Brian Chamberlain
Head of Technical Excellence

Claire

Claire Curtis-Thomas
Chief Executive

Date of Fourth issue: 24 April 2017

ANNEX 1 PRODUCT RANGE

Figure A1 Standard component details (all dimensions in mm)

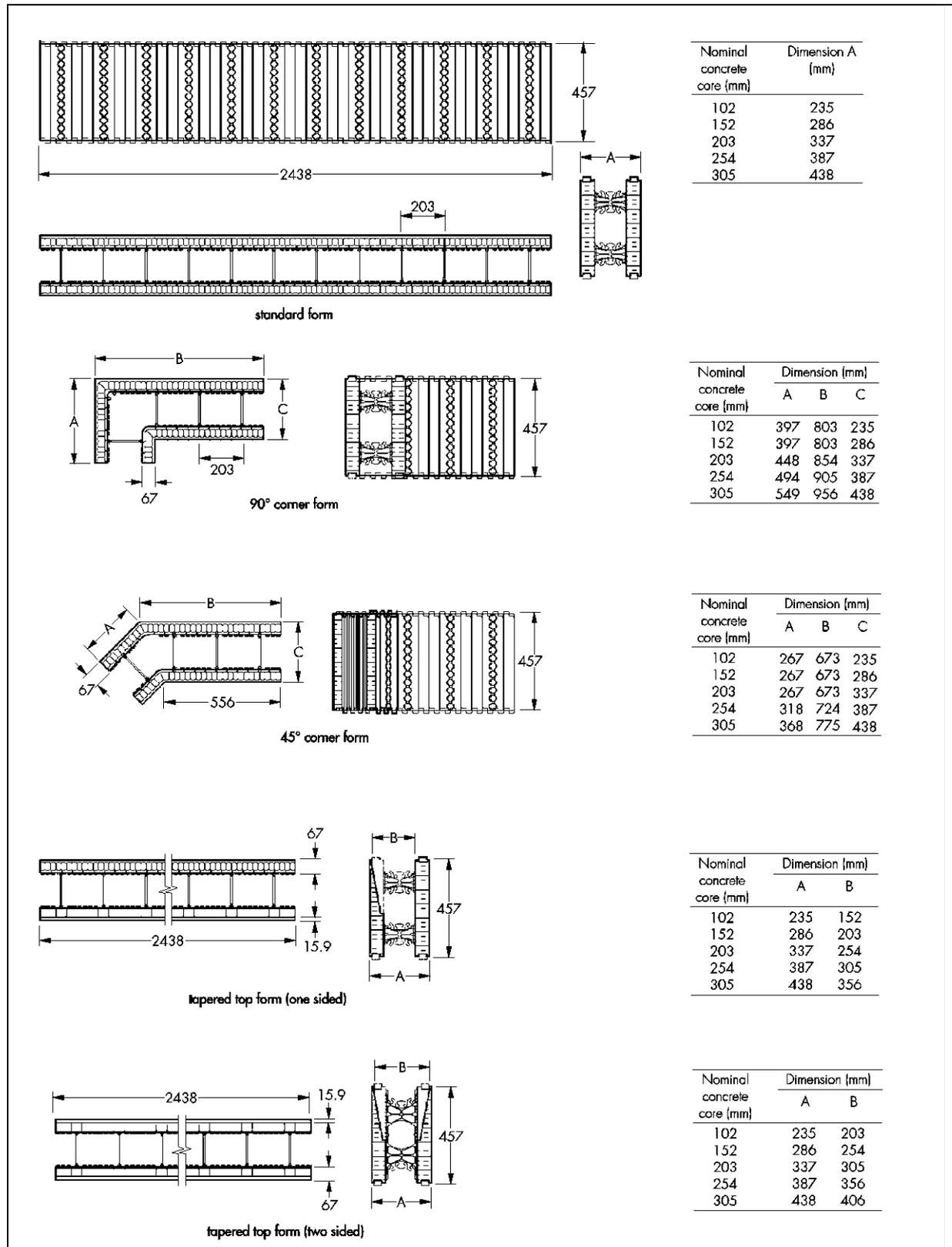
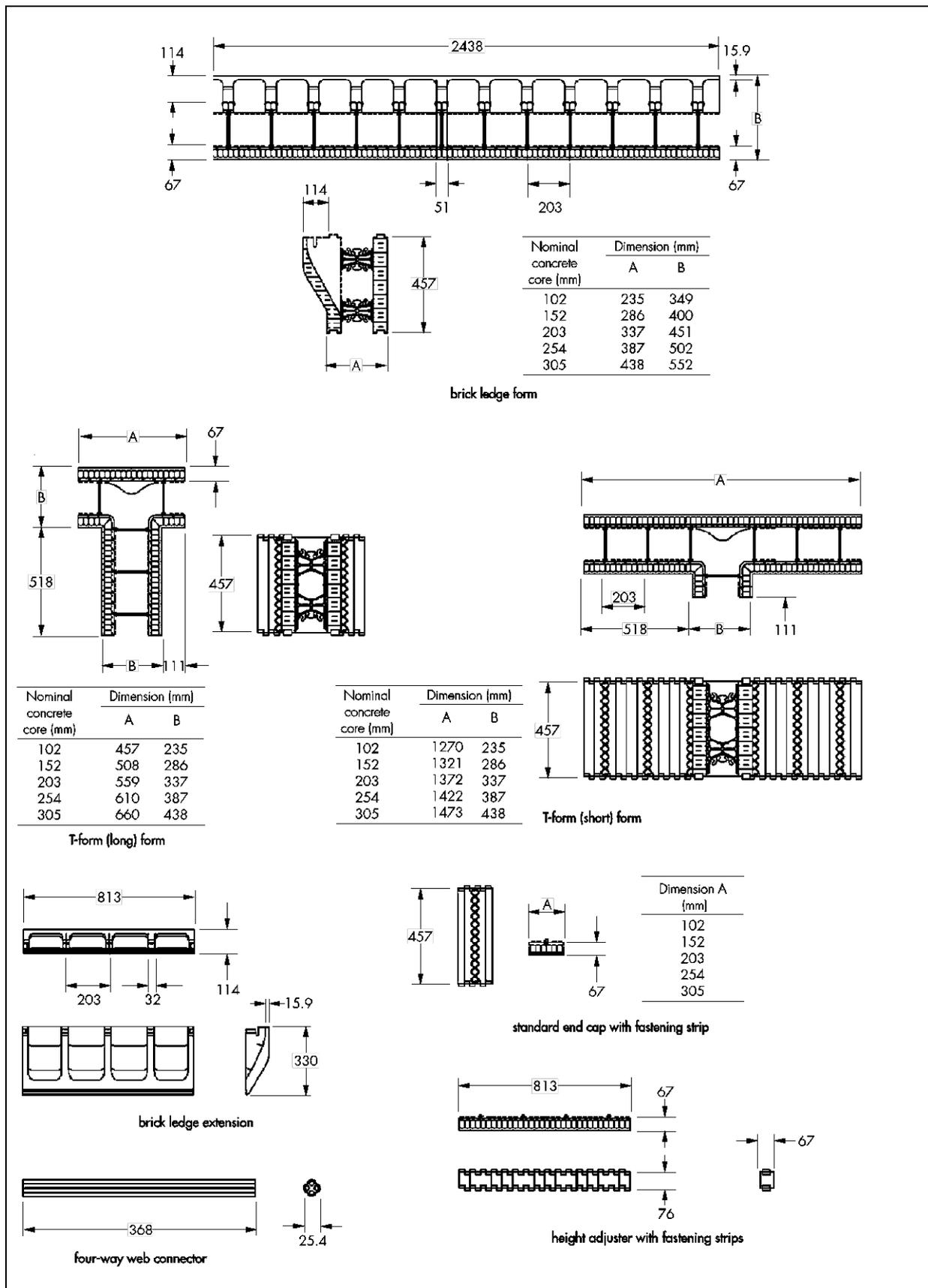
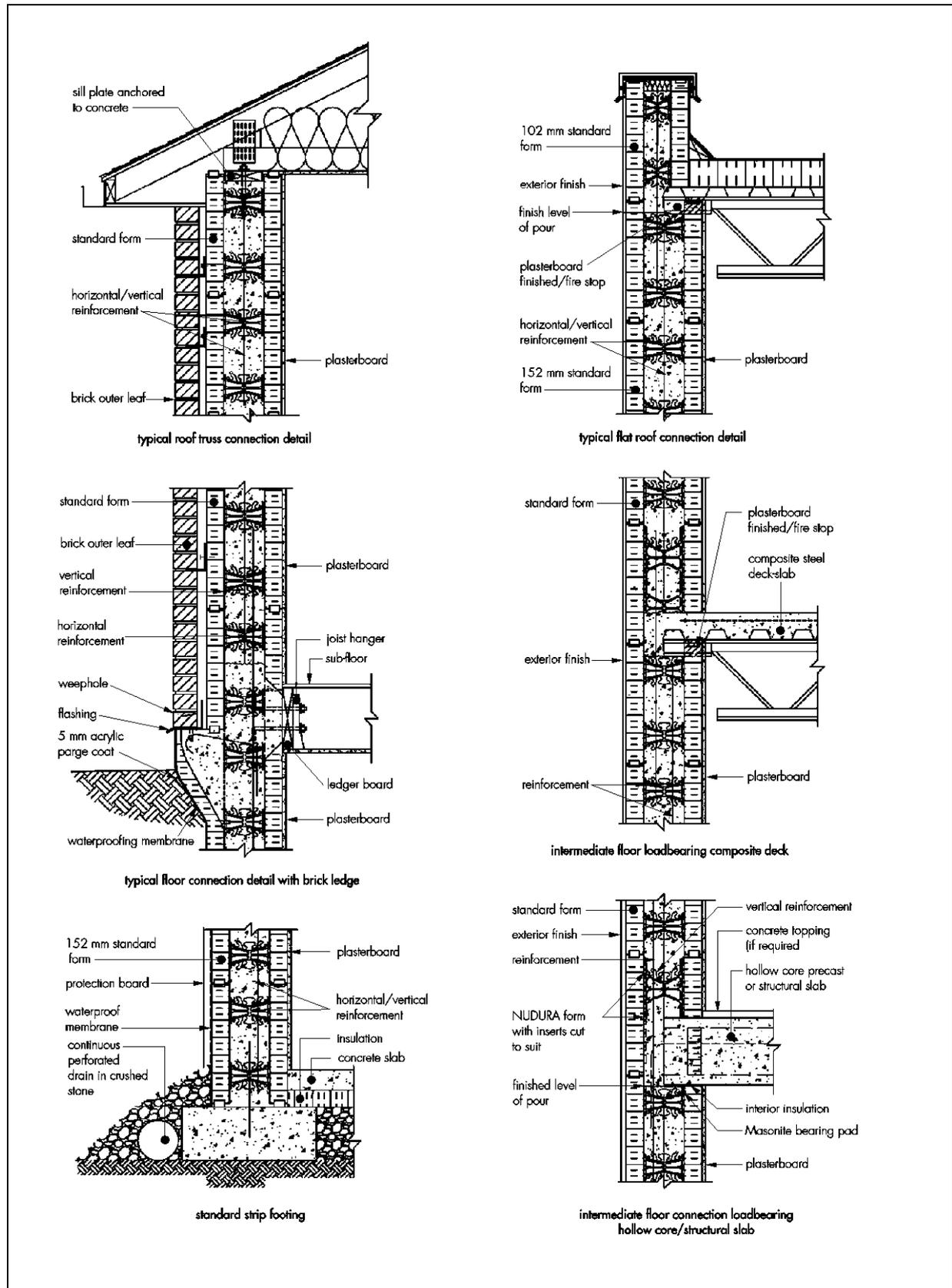


Figure A1 Standard component details (continued) (all dimensions in mm)



ANNEX 2 CONSTRUCTION DETAILS

Figure A2 Typical construction details



ANNEX 3 PRODUCT PERFORMANCE

Table A3 Product performance and characteristics

Property	Performance
Structural pattern	Continuous
Filling efficiency	Satisfactory
Steel reinforcement	Possible
Reaction to fire (Insulation)	Class E to EN 13501-1 : 2003
Dangerous substances	None
Water vapour permeability	A μ design value of 60 for the EPS based on EN 12524 : 2000
Filling pressure resistance	Slight joint leakage. Formwork needs verticality adjustment/checks during filling
Thermal properties	Thermal conductivity for EPS based on BBA test data to EN 12667 : 2001 is $\lambda_{90/90} = 0.036 \text{ Wm}^{-1}\text{K}^{-1}$



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