



Styro Stone UK Ltd

16a High Street
Tenterden
Kent TN30 6AP

Tel: +800 StyroStone or 01580 767707 Fax: 01580 767709
e-mail: infouk@styrostone.com

**Agrément
Certificate
No 03/4015**

Designated by Government
to issue
European Technical
Approvals

STYRO STONE PERMANENT INSULATING CONCRETE FORMWORK

Coffrage perdu
Betonschalung ortsfest

Product



• THIS CERTIFICATE RELATES TO STYRO STONE PERMANENT INSULATING CONCRETE FORMWORK (PIF), COMPRISING EXPANDED POLYSTYRENE PANELS WITH SOLID POLYSTYRENE SPACERS WHICH ACT AS CONNECTORS.

• The product is for use in loadbearing and non-loadbearing internal or external walls in dwellings and in buildings of similar occupancy.

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

continued

Regulations

1 The Building Regulations 2000 (as amended) (England and Wales)



The Secretary of State has agreed with the British Board of Agrément the requirements of the Building Regulations to which formwork can contribute in achieving compliance. In the opinion of the BBA, Styro Stone Permanent Insulating Concrete Formwork, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements.

Requirement: A1
Requirement: A2
Requirement: A3

Loading
Ground movement
Disproportionate collapse

Comment:

Walls constructed using the product in accordance with sections 7.2, 7.3 and 9.1 to 9.5 of this Certificate will satisfy the Requirements.

Requirement: B2(1)

Internal fire spread (linings)

Comment:

A plasterboard lining will meet the Requirement in buildings of every purpose group. See section 15.3 of this Certificate.

Requirement: B3(1)

Internal fire spread (structure)

Comment:

Walls constructed using the product with the specified finishes will meet the Requirement in buildings of every purpose group. See sections 15.1 and 15.4 of this Certificate.

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- It is for use with the internal and external finishes specified in this Certificate.
- Subject to design and supervision by a chartered engineer, the formwork may be used for constructing basement walls.

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Requirement:	B4(1)	External fire spread
Comment:		Finished walls incorporating the recommendations of sections 15.2 and 15.5 of this Certificate will meet the Requirement in buildings of every purpose group.
Requirement:	C4	Resistance to weather and ground moisture
Comment:		Walls constructed using the product in accordance with sections 7.2, 7.3, 13.1, 13.2 and 14 of this Certificate will meet the Requirement.
Requirement:	E1	Airborne sound (walls)
Comment:		The product and linings can be used with the appropriate flanking conditions to construct walls of the necessary equivalent mass to meet the Requirement. See section 12 of this Certificate.
Requirement:	L1	Dwellings
Requirement:	L2	Buildings other than dwellings
Comment:		Walls constructed using the product will meet the Elemental Requirement for limiting heat loss. See sections 10.1 and 10.2 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The product is acceptable. See sections 18.1 and 18.2 of this Certificate.

2 The Building Standards (Scotland) Regulations 1990 (as amended)



In the opinion of the BBA, Styro Stone Permanent Insulating Concrete Formwork, if used in accordance with the provisions of this Certificate, will satisfy or contribute to satisfying the various Regulations and related Technical Standards as listed below.

Regulation:	10	Fitness of materials and workmanship
Standards:	B2.1 and B2.2	Selection and use of materials, fittings, and components, and workmanship
Comment:		The product is acceptable. See sections 18.1 and 18.2 of this Certificate.
Regulation:	11	Structure
Standard:	C2.1	Stability
Standard:	C3.1	Disproportionate collapse
Comment:		Walls constructed using the product in accordance with sections 7.2, 7.3 and 9.1 to 9.5 of this Certificate will satisfy the requirements.
Regulation:	12	Structural fire precautions
Standard:	D2.1	Structural protection — Principles
Standard:	D2.2	Structural protection — Non-combustible materials
Standard:	D5.7	Separating walls and separating floors — Non-combustible materials
Standard:	D7.1	Fire spread on internal linings — Principles
Standard:	D8.2	Fire spread to adjoining buildings — Non-combustible materials
Standard:	D10.1	Fire spread on an external wall
Comment:		Walls constructed using the product with the specified finishes will satisfy the requirements in buildings of every purpose group; however in respect of separating walls the exceptions permitted with Standard D5.7 must be observed. See sections 15.1 to 15.5 of this Certificate.
Regulation:	16	Preparation of sites
Standards:	G2.1 to G2.4	Preparation of a site and resistance to moisture from the ground — Preparation of a site
Regulation:	17	Resistance to moisture
Standard:	G3.1	Resistance to precipitation — Resistance to precipitation
Regulation:	18	Resistance to condensation
Comment:		Walls constructed using the product in accordance with sections 7.2, 7.3, 13.1, 13.2 and 14 of this Certificate will satisfy the requirements.
Standard:	G4.1	Condensation — Interstitial condensation
Comment:		Generally, finished walls will satisfy the requirement but see also section 11.2 of this Certificate for methods of protection under certain conditions of temperature and humidity.
Standard:	G4.2	Condensation — Surface condensation
Comment:		Walls constructed with the specified finishes will satisfy the requirement. See section 11.1 of this Certificate.
Regulation:	19	Resistance to transmission of sound
Standard:	H2.1	Walls and floors to resist sound transmission — Airborne sound
Comment:		The product can be used with the appropriate lining and flanking conditions to construct walls of the necessary equivalent mass to satisfy the requirement. See section 12 of this Certificate.

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Regulation:	22	Conservation of fuel and power
Standard:	J3.1	Buildings in purpose group 1 — Building fabric
Standard:	J4.1	Buildings in purpose group 1 — Limiting thermal bridging at junctions and around openings
Standard:	J8.1	Buildings in purpose groups 2 to 7
Standard:	J9.1	Buildings in purpose groups 2 to 7 — Limiting thermal bridging at junctions and around openings
Comment:		External walls constructed using the product will satisfy the requirement. See sections 10.1 and 10.2 of this Certificate.

3 The Building Regulations (Northern Ireland) 2000



In the opinion of the BBA, Styro Stone Permanent Insulating Concrete Formwork, if used in accordance with the provisions of this Certificate, will satisfy or contribute to satisfying the various Building Regulations as listed below.

Regulation:	B2	Fitness of materials and workmanship
Comment:		The product is acceptable. See sections 18.1 and 18.2 of this Certificate.
Regulation:	C4	Resistance to ground moisture and weather
Comment:		Walls constructed using the product in accordance with sections 7.2, 7.3, 13.1, 13.2 and 14 of this Certificate will satisfy the Regulation.
Regulation:	C5	Condensation
Comment:		Generally, finished walls will satisfy the Regulation but see also sections 11.1 and 11.2 of this Certificate for methods of protection under certain conditions of temperature and humidity.
Regulation:	D1	Stability
Regulation:	D2	Disproportionate collapse
Comment:		Walls constructed using the product in accordance with sections 7.2, 7.3 and 9.1 to 9.5 of this Certificate will satisfy the Regulations.
Regulation:	E3	Internal fire spread — Linings
Regulation:	E4	Internal fire spread — Structure
Comment:		Walls constructed using the product with the specified finishes will satisfy the Regulations. See sections 15.1, 15.3 and 15.4 of this Certificate.
Regulation:	E5	External fire spread
Comment:		Finished walls incorporating the recommendations of sections 15.2 and 15.5 of this Certificate will satisfy the Regulation.
Regulation:	F2	Building fabric
Comment:		Walls constructed using the product will satisfy the Regulation. See sections 10.1 and 10.2 of this Certificate.
Regulation:	G2	Separating walls and separating floors
Comment:		the product can be used with the appropriate flanking conditions to construct walls that will satisfy the Regulation. See section 12 of this Certificate.

4 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See sections: *6 Site handling and storage (6.4) and 8 Practicability of installation (8.1 to 8.3).*

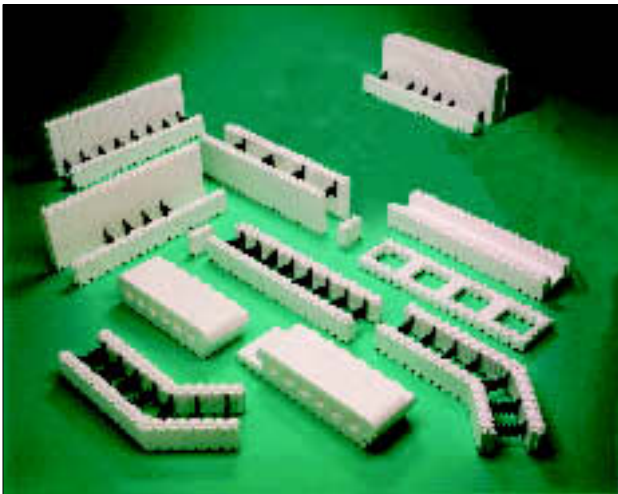
Technical Specification

5 Description

General

5.1 The Styro Stone Permanent Insulating Concrete Formwork (PIF) system comprises elements of two expanded polystyrene panels separated by moulded polystyrene spacers cast in during production (see Figure 1). The elements interlock and build up horizontally and vertically into a tight, rigid formwork. The wall is formed by placing or pouring concrete into the formwork.

Figure 1 Styro Stone PIF Elements



5.2 The elements are available either 125 mm or 250 mm high and in two grades: Standard PIF or RR. The two grades interlock together. The wall thicknesses achieved are given in Table 1.

Table 1 Wall thickness

Grade	Nominal thickness (mm)			
	Polystyrene internal	Concrete	Polystyrene external	Overall
Standard PIF	50	145	50	250
RR	50	145	150	350

5.3 The formwork components are:

- Expanded polystyrene panels — density of 25 kgm^{-3} and a thermal conductivity of $0.035 \text{ Wm}^{-1}\text{K}^{-1}$. Upper and lower surfaces are castellated and the vertical mating surfaces are tongue-and-groove to form a tight fit when joined together. The rigid formwork does not require supporting falsework. The inner surfaces have tapered grooves running vertically and are offset on opposite faces to ensure uniform concrete thickness. They also form locks for end stops. The outer surfaces are grooved vertically at 50 mm centres to aid cutting and trimming.
- Polystyrene spacers — nominally 2.5 mm thick, black or grey, spanning between the two leaves of the EPS panels and incorporated during manufacture. They are disposed vertically and

top edges are serrated giving support to reinforcing bars where required.

- End stops — lock into the internal-tapered grooves running vertically.

5.4 Components and finishes used in conjunction with the formwork are:

- Steel reinforcement — where required, should comply with BS 4449 : 1997.
- Concrete — usually of Grade C35 for basement work and C25 elsewhere, specified to BS EN 206-1 : 2000. The recommended aggregate size is 10 mm. It should contain an admixture complying with BS EN 934-2 : 2001 or BS 5075-3 : 1985 to allow placement either by rodding or by free flow. Vibrating equipment must not be used.
- External render — must be in accordance with BS 5262 : 1991 and is a mix of cement, sand and polymer, reinforced with coated polypropylene. Alternatively, it may be of an approved proprietary prepack. The base coat is reinforced with either a stainless steel lath or a polypropylene mesh.
- External masonry — may be of brickwork or stonework fixed in accordance with the provisions of BS 5628-3 : 1985 or BS 8298 : 1994 respectively.
- Internal finish — typically 12.5 mm thick plasterboard or a dry-lined finish with a plaster skim coat conforming to BS 8212 : 1995.

Ancillary equipment:

- brickwork/stonework ties to BS 1243 : 1978
- trestle support as supplied by the Certificate holder.

6 Site handling and storage

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

6.2 Styro Stone PIF is supplied shrunk-wrapped and wrapping should not be opened until the contents are required.

6.3 Packs should be stored on their sides to protect the castellations from damage.

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

Design Data

7 General

7.1 Styro Stone Permanent Insulating Concrete Formwork (PIF) is satisfactory for use in loadbearing and non-loadbearing walls as permanent formwork for in-situ dense aggregate concrete. It provides a

significant contribution to the thermal insulation of a wall.



7.2 Buildings subject to the national Building Regulations should be constructed in accordance with the relevant recommendations of BS 8110-1 : 1997, BS 8102 : 1990 and CP 102 : 1973.

7.3 Other buildings not subject to any of the Regulations defined in section 7.2 should also be built in accordance with BS 8110-1 : 1997, BS 8110-2 : 1985 and CP 102 : 1973.

7.4 The concrete is not easily examined after casting, hence, as specified in BS 8110-1 : 1997, Section 2, care must be taken to ensure full compaction. Compaction may be checked by removal of a section of PIF, observation, and then replacement. Voids are readily detected during the concrete placement, by hitting the PIF (eg with the palm of the hand or a wooden mallet) and listening for a 'hollow' sound. Suitable supervision during placing and compacting of the concrete must be provided.

7.5 Storey-height concrete walls are normally constructed in one or more lifts. Particular care is necessary to maintain alignment during concrete filling, and checking between lifts.

8 Practicability of installation

8.1 Installation of the formwork by trained operatives, including the forming of door and window openings, is practicable. The panels can be cut using conventional woodworking tools, thus carpentry skills are appropriate.

8.2 Concrete can be placed by hand, by skip with adapted neck or by pump. The requirements given in sections 20.20 to 20.24 of this Certificate must be observed during placing and compacting of the concrete.

8.3 Fixings, suitably durable and mechanically adequate, must be supported by the concrete and not by the polystyrene. Fixing to the concrete may be achieved by inserting appropriate fasteners into the formwork cavity before placing the concrete. Fixing to the concrete after it has hardened is also practicable. In specifying wall fixings carrying vertical loads, consideration should be given to the line of action of the load with respect to the face of the concrete wall and the effect on the strength of the fixing.

8.4 Consideration should be given at the design stage to the positioning of wall fixings, service pipes and joists, relative to the position of connecting assemblies. They can be incorporated by following the manufacturer's recommendations. Care must be taken not to damage the units and cold bridging effects must be considered.

8.5 Facing brickwork or stonework should be fixed to the concrete with stainless steel ties⁽¹⁾. Fixings should be applied to the depth recommended by the manufacturer.

(1) Available from the Certificate holder and can be customised to suit the application.

8.6 Timber weatherboarding and hung tiles should be fixed to treated battens secured to the in-situ concrete as described in section 8.5 and in accordance with the *Styro Stone Technical Manual*.

9 Structural strength and stability



9.1 Walls constructed using Styro Stone PIF may be treated as conventional concrete walls and should be designed and constructed in accordance with the recommendations of BS 8110-1 : 1997 and BS 8110-2 : 1985.

9.2 The nominal concrete cover to reinforcement should be that appropriate to 'mild' exposure in accordance with BS 8110-1 : 1997, Tables 3.2 and 3.4, or as required for fire resistance in accordance with BS 8110-2 : 1985, Section 4, whichever is the greater (see sections 20.16 to 20.19).

9.3 To achieve structurally-stable walls sufficiently plane for finishings, it might be necessary to brace the units during construction, check the plumb and alignment of the walls after each lift and make adjustments to the bracing as necessary. Attention to the accurate levelling of the foundation and initial setting out of the bracing (see sections 20.1 and 20.24) should prevent the need for significant adjustments to be made.

9.4 When used in situations where walls are exposed but have some protection, eg walls of private dwellings and walls of communal dwellings above ground-floor level, the render finish of the Styro Stone PIF system has adequate resistance to possible damage. Guidance may be obtained from BRE Current Paper CP 6/81 *Assessment of external walls, Hard body impact resistance*.

9.5 The render finish, incorporating the fixing methods and movement joints specified in this Certificate, will withstand the thermal stresses and wind pressures normally experienced in the United Kingdom. In special circumstances (ie in conditions of severe exposure, as defined in Clause 18 of BS 5262 : 1991) consideration should be given, at the corners of buildings and other special risk positions, to increasing the number of fixings. Typical pull-out strength for a stainless steel fixing in sound substrate is taken as 1000 N and the standard fixing rate is defined as one per square metre.

10 Thermal transmittance



10.1 The thermal transmittance (U value) of external walls can be taken as $0.30 \text{ Wm}^{-2}\text{K}^{-1}$, for Standard and $0.16 \text{ Wm}^{-2}\text{K}^{-1}$ for RR Grade, or better, depending on the contribution of the internal and external finishes.

10.2 The level of insulation around openings in external walls and at junctions between elements will adequately limit the risk of local condensation problems and excessive additional heat loss.

11 Condensation



11.1 Styro Stone PIF will limit the passage of moisture vapour into the concrete wall. In domestic or similar situations with an external finish of 16 mm thick cement/sand render to BS 5262 : 1991 and an internal 12.5 mm thick plasterboard lining, condensation is unlikely to occur on the inside face of the wall.

11.2 Significant interstitial condensation would occur at the internal concrete, expanded polystyrene interface in rooms where the internal conditions rose above 65% RH (at 25°C) with external temperatures below zero for periods longer than 36 hours. Such conditions could be possible in kitchens and bathrooms. In such rooms a vapour check plasterboard should be applied in accordance with the board manufacturer's instructions regarding fixings and joints. As an alternative to using a vapour check, forced ventilation could be incorporated into the design in these rooms.

12 Sound insulation



Concrete walls of density 2200 kgm^{-3} or greater, constructed using the formwork, can provide an equivalent mass of 300 kgm^{-2} . When used in conjunction with appropriate framing, lining and flanking details, a wall can meet the requirements for Wall Type 3 as described in the provisions deemed to satisfy the regulations.

13 Weathertightness



13.1 External walls constructed using Styro Stone PIF with an external finish of cement/sand render or masonry, when applied and maintained in accordance with sections 20.25 and 20.26, of this Certificate, will be weathertight for the life of the building.

13.2 The render finish will have a resistance to moisture penetration comparable to that of traditional rendered finishes. Styro Stone PIF has a low absorption of liquid water. The exposure of the face of the concrete walls constructed using Styro Stone PIF and finished in render, therefore,

may be considered as 'sheltered'. The system is suitable for exposure conditions up to and including 'severe'. The actual exposure conditions should be considered in detailing the specification for the render in accordance with BS 5262 : 1991, Clause 18.

14 Damp-proofing



Styro Stone PIF will not transmit moisture by capillary action. The concrete wall formed with the system is constructed using the specified concrete in accordance with Type B structures — structures without membrane in BS 8102 : 1990 (see also sections 5.3 and 7.2).

15 Behaviour in relation to fire



15.1 Concrete walls with 0.4% to 1% reinforcement and a minimum cover to the reinforcement of 25 mm are assessed as having a fire resistance of 1.5 hours (longer duration in Scotland) in accordance with Table 4.6 of BS 8110-2 : 1985. Concrete walls without reinforcement are assessed as having a fire resistance in excess of one hour. This assessment does not take account of any additional protection provided by the internal and external finishes. The use of the formwork with the specified finishes will not reduce the fire resistance of the concrete wall.

15.2 Where the application of the system is completed by rendering to BS 5262 : 1991, the completed application is designated Class 0 or low risk as defined in the national Building Regulations. If additional surface finishes are applied, these may alter the surface spread of flame rating and/or fire propagation indexes and consideration should be given to the appropriate building regulations which apply to the building being treated.

15.3 The internal lining of plasterboard, fastened as described in this Certificate, will have a Class 0 or low risk as defined in the national Building Regulations surface rating. The means of fastening would not adversely affect the rating.

15.4 Although the expanded polystyrene of Styro Stone PIF would be classified as combustible, when used with the internal and external finishes described in this Certificate, it can comply with the relevant parts of the national Building Regulations:

England and Wales

Part B

Scotland

Technical Standards D5.7 and D8.2

Northern Ireland

Regulation E5.

15.5 The behaviour in fire of external wall insulation systems incorporating combustible insulants is the subject of recommendations by the

Building Research Establishment. In accordance with these recommendations, there would be no restriction on the height of buildings provided that in multi-storey buildings, fire barriers are included at alternate floor levels.

16 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 J

Scotland

Technical Standards, Part F

Northern Ireland

Technical Booklet L.

17 Maintenance and repair

17.1 Regular checks should be carried out on render finishes to ensure that any damage is detected and repaired as soon as possible. Depending on the type and extent of damage caused action should be taken as appropriate (see sections 17.2 to 17.4). The general recommendations given in Section 6 of BS 5262 : 1991 should also be followed.

Shrinkage cracking

17.2 Where hairline cracks are aesthetically unacceptable and the render is firmly bonded to the lath or mesh reinforcement and the Styro Stone PIF panel, they can be filled using a colour-compatible mineral filler paste.

Larger cracks

17.3 Larger cracks should be cut out to approximately 5 mm wide and to the depth of the render. The edges should be square. The cracks are filled with a flexible sealant, using suitable primers as directed by the manufacturers.

Impact damage

17.4 Where the render has been damaged through impact it is necessary to cut away the damaged area back to a sound base. This may require the removal of a section of mesh reinforcement and Styro Stone PIF panel. The render is cut around the damaged area in a regular shape, with straight edges. Care should be taken when removing the render not to damage the reinforcement.


17.5 If the mesh reinforcement or the Styro Stone PIF panel are damaged they should be cut back at approximately 100 mm inside the line where the render has been removed.

17.6 The damaged area of a panel must be replaced using Styro Stone PIF panelling or

polystyrene of flame retardant (FR) grade and of a density of 25 kgm⁻³. Any gaps between the inserted section and the existing panel are filled with expandable foam. Reinforcement of the same type as the original is fixed to overlap the existing reinforcement by about 100 mm. The reinforcement and the replaced section of panel are secured to the concrete core using non-corrosive fixings at not more than 250 mm centres.

17.7 Base coat and finishing topcoat render to the original specification are applied to match the existing finish.

18 Durability

 18.1 Walls constructed with Styro Stone PIF will be rot-proof and have a service life of not less than 60 years, provided that proper maintenance is carried out in accordance with section 17 of this Certificate.

18.2 The injection-moulded, solid polystyrene spacers, polypropylene mesh, steel fixing pins, movement joint beads and profile trims are conventional building materials and will have a durability compatible with the expanded polystyrene.

Installation

19 General

The preparation, installation and support of the panels and application of the specified finishes must be in accordance with the *Styro Stone Technical Manual*. Particular attention must be given to the requirements given in sections 8.1 to 8.6 of this Certificate.

20 Procedure

20.1 The foundation should be flat and level to within ±10 mm. Normally, four courses are laid around the perimeter, aligned and the trestle support, or similar, bolted into position. These are precisely levelled and adjustments made to the panels with slate shims or dry mortar where necessary. The base blocks should be supported to maintain panel stability before concrete to a maximum depth of third-storey height or one metre (whichever is the least) is poured into the PIF to anchor the formwork base.

20.2 The panels are laid in courses with the castellations uppermost, in broken bond to ensure the vertical joints are staggered by quarter of a panel length. This creates a rigid assembly and a void where reinforcement can be fixed and concrete placed or poured. Typical construction details are shown in Figures 2 to 4.

Figure 2 Typical corbel detail

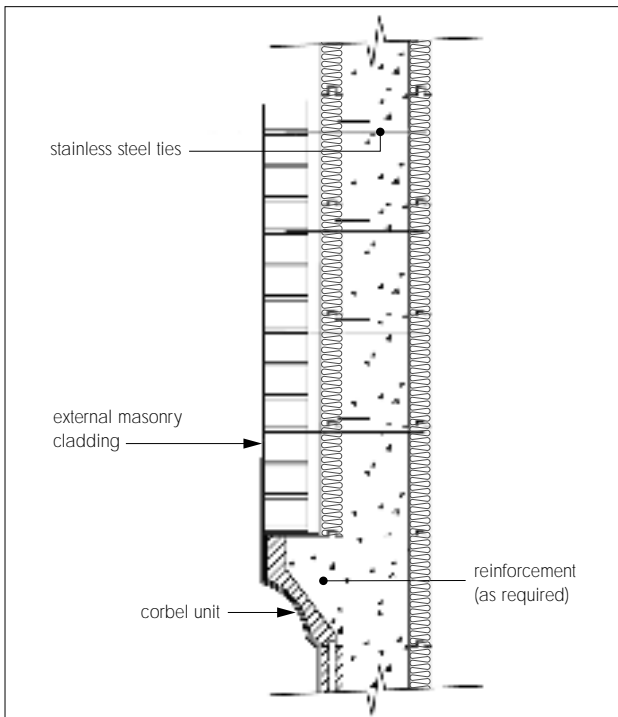


Figure 3 Typical ground-floor detail

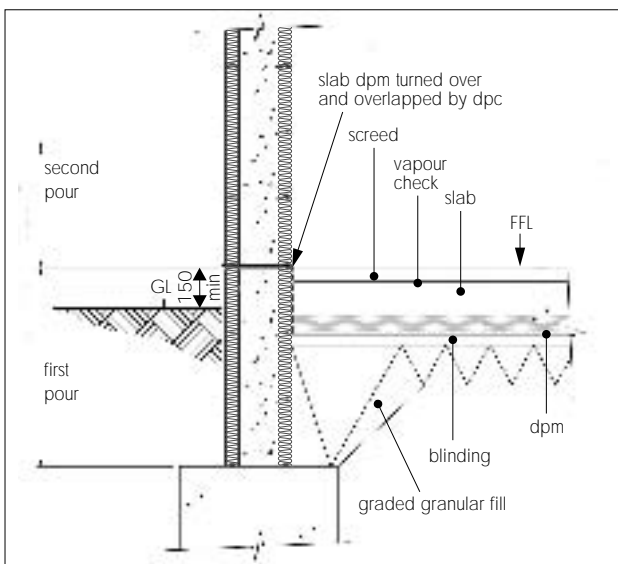
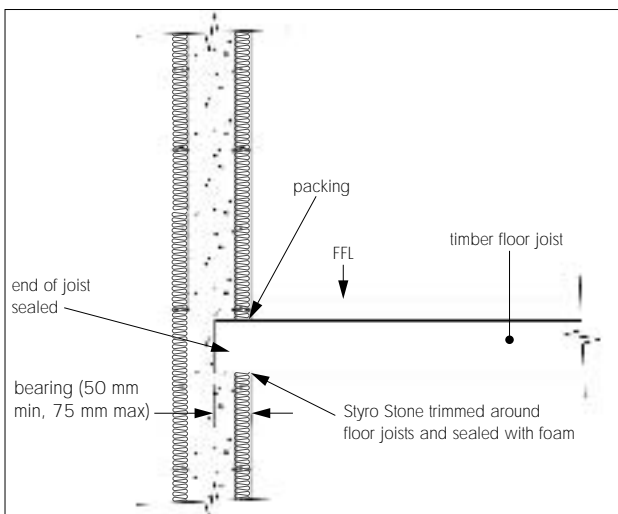


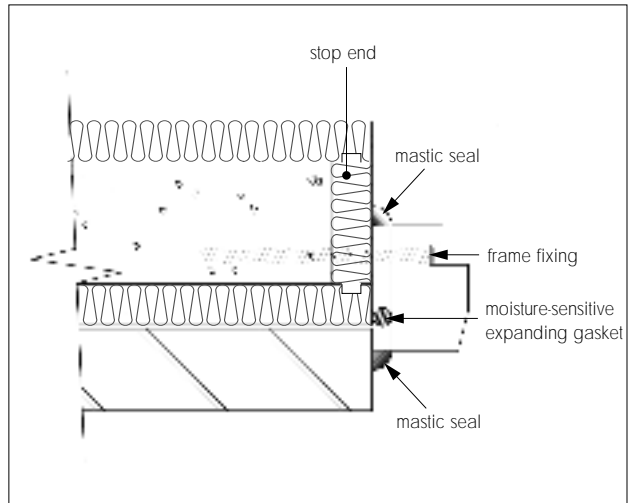
Figure 4 Typical first-floor detail



Openings

20.3 Where an opening is required, eg for a door or window, this is formed by fitting reveal closures to both sides and soffit closures at the top of the opening. The *Styro Stone Technical Manual* illustrates alternative fixing and weatherproofing details at doors and windows with various cladding systems. Details of design at typical window and door openings are shown in Figure 5.

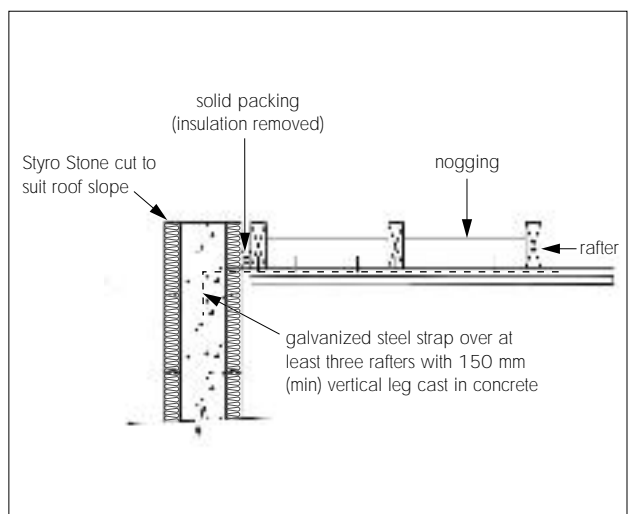
Figure 5 Typical opening details



20.4 Lintel formwork should be temporarily supported over openings during concreting and left in place until the concrete is sufficiently strong. This can be achieved by building up vertical struts within the opening using expanded polystyrene offcuts or by using steel or timber props.

20.5 Both concrete and timber floor types can be used. Any depth of floor can be accommodated by cutting the inner panels at floor level. When a wall is to be raised past a suspended floor, concrete should only be poured to the top level of the floor to minimise the outward pressure of wet concrete. Placing of the concrete can continue after the initial concrete has achieved sufficient strength. A typical wall/roof junction is illustrated in Figure 6.

Figure 6 Typical wall/roof junction detail



Concrete floors

20.6 Three types of concrete floor construction can be accommodated by the Styro Stone PIF, ie in-situ concrete; composite pre-cast with in-situ screed; and pre-cast concrete units. Each type has different requirements with regard to wall/floor location and propping arrangements. Details are given in the *Styro Stone Technical Manual*.

Timber floors

20.7 The Styro Stone PIF panels for the inner face of the walls can be cut to fit around the joists. Any gaps greater than 3 mm should be sealed with expandable foam.

20.8 Where the wall is to continue above joist level, the joist ends are temporarily supported to stay level and concrete poured up to and above the joists. However, when the pour or placement of concrete is not continuous, it is essential that the distance from the top of the previous pour to the bottom of the joists is greater than 100 mm. Where the joists are wider than 100 mm, a small inspection hole is made in the inner face of the panels below each joist to check the concrete completely fills the spaces.

20.9 Where the wall is to stop at joist level, concrete is poured and levelled at the top of the panels. When it has hardened the joists can be placed directly on the concrete or a levelling mortar bed.

Timber treatment

20.10 All timber components, particularly frames and joists, in contact with the wall should be treated with an organic solvent preservative in accordance with BS 5268-5 : 1989.

Stability ties

20.11 As with any loadbearing wall and floor assembly, ties may be necessary at the junctions of walls and floors to provide stability. These may be either galvanized straps as used in traditional masonry walls or internal and peripheral tie reinforcement at slab level complying with Clause 3.12 of BS 8110-1 : 1997.

Incorporation of services and fittings

20.12 Horizontal ducts can be run through the Styro Stone PIF before the concrete is poured. Holes of the appropriate size are cut in the panels to take the PVC-U pipes. Gaps over 3 mm between the pipe and panel should be filled with expandable foam.

20.13 Pipes and conduits up to 50 mm diameter can be installed in the inner Styro Stone PIF panel by cutting the panel and spacer with a fine-tooth saw.

20.14 Plasticised PVC cables should be run in a rigid PVC-U or metal conduit to avoid contact with the polystyrene panels and potential plasticiser

migration. Electrical cables surrounded by insulation will need to be derated in accordance with current regulations.

20.15 Lightweight fittings, eg mirrors, can be fixed through the plasterboard lining. Heavy items such as door frames, cupboards and sanitary ware require timber supports to be fixed to the concrete core.

Installation of reinforcement bars

20.16 The advice of a Chartered Engineer will be required on the position and size of any reinforcement bars. In most applications, reinforcement is not necessary.

20.17 Horizontal bars are fitted to the upper or lower surface of the spacers as formwork construction proceeds. At corners, the horizontal steel is overlapped to provide continuity and support for any vertical reinforcement.

20.18 Vertical bars are secured to the horizontal bars using springwire clips.

20.19 Concrete cover to the expanded polystyrene will be at least 25 mm.

Concrete and filling

20.20 Concrete of Grade C35 should be used for basement work and Grade C25 elsewhere.

20.21 Ready-mixed concrete should be obtained from a plant approved by the Quality Scheme for Ready Mixed Concrete.

Concreting procedures

20.22 The concrete can be placed by pumping, by skip or by hand using a bucket and should be placed as soon as possible after mixing. A pour of concrete can be comprised of several loads or batches provided that a period of less than three hours elapses between the completion of the placement of one load or batch and the commencement of the next. This minimises the number of construction joints.

20.23 The distance of free fall of the concrete must be kept to a minimum to avoid segregation of the aggregates within the formwork. Planks or similar can be laid along the panel tops during concreting to protect the top edges and keep them free from concrete.

20.24 The following sequence of operations should be adopted:

(1) The concrete is placed into the lower part of the formwork using the window openings, where appropriate, and pouring continued until the concrete level is up to the bottom of the sill height. Light rodding at the sides of the openings ensures that the concrete flows the maximum distance away from the opening.

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(2) All wall sections are filled to a level of 1.5 m before proceeding to plain areas between windows. When the formwork has been built to one-storey height and there are no window openings it is recommended that it is supported at the bottom where the pour commences, and that the starting position is close to a corner. The concrete drops into the formwork and forms a heap to a maximum depth of approximately 1.5 m which flows sideways into the unfilled areas. The pouring position follows the flow of concrete until the remaining areas are filled to this depth.

(3) Timber bearers are fitted and props secured at openings. This allows concrete to be placed in the formwork between openings above sill height without loss at the sill position.

(4) Areas between windows are filled by pouring close to the lintel ends until the concrete reaches lintel level. The pour should then follow the flow of concrete until the whole section between lintels is full to lintel height. Voids below sills should be filled before the concrete has reached its initial set.

(5) The lintel course and areas between lintels should be filled as a 'continuous beam' from a single pour.

(6) The PIF panels are continually checked for alignment during the pour/placement and before an initial set has occurred. If an interruption in the pour takes place or the time to complete the pour exceeds three hours, further checks on alignment and plumb should be made before proceeding.

(7) Precautions must be taken between lifts to prevent the accumulation of water or debris within the formwork and to ensure the formation of sound construction joints. Two methods may be used, as described in (8) and (9).

(8) Where a construction joint can be prepared two to four hours after completion of placing the concrete it may be done by spraying with a high pressure jet of water. This should break up the surface layer and expose the fine aggregate and sand. All loose material is washed away and removed from the formwork by using an industrial wet vacuum cleaner or small sludge pump.

(9) When the concrete has set, and it is not possible to use the above method, the surface layer will require to be broken up using mechanical devices to chip it away. All loose material must be removed using an industrial vacuum cleaner to leave the surface of the concrete clean and free from loose material.

(10) Before a further pour of concrete commences, the formwork is checked to ensure it has remained clear of debris. When pouring recommences, a shallow layer (not more than 250 mm) of concrete

should be placed and well compacted at the horizontal joint before continuing.

(11) Vertical contraction joints can be introduced where necessary in long, straight walls, by using crack inducers.

(12) After placing the concrete it should be protected from heavy rain for the first two hours.

External render finish

20.25 External finish render is normally applied in two coats. The first is a base coat over the mesh reinforcement and the second is a decorative finish topcoat. The reinforcing mesh is fixed with adhesive onto the Styro Stone PIF. The render is applied in accordance with BS 5262 : 1991 and the following requirements:

- At the top of walls the render and Styro Stone PIF panels should be protected by an adequate overhang or by an adequately sealed, purpose-made flashing profile.
- Areas of render should not exceed 5 metres in length or height and where necessary movement joints must be formed by cutting the reinforcement and using metal beading to provide support for the rendering.
- At windows and doors the design must allow for the insulation to be continued around the reveals.
- Care must be taken to achieve complete covering of the lath or mesh reinforcement and to butt the rendering against details such as the underside of window sills. The rendering may be finished by either dry dashing or by application of a suitable proprietary decorative finish. Attention should be paid to ensuring that finishes such as paints do not adversely affect the vapour transmission characteristics and surface spread of flame and/or fire propagation indexes of the render.
- Certain sands commercially available in Scotland are themselves prone to shrinkage and, therefore, are unsuitable for use in renderings as they can cause cracking. When in doubt, the Scottish Laboratory of the Building Research Establishment, East Kilbride, will advise, on a fee-paying basis, as to the suitability of specific sands. High chloride sands should also be avoided as they may reduce the life of the system.

Brickwork or stonework finishes

20.26 Ties, suitable for the desired cavity width (typically 5 mm), should be pierced through the PIF prior to concreting, to match the specified mortar joint positions.

Internal plasterboard finish

20.27 A lining of 12.5 mm thick, tapered edge plasterboard is fixed to the internal surface of the Styro Stone PIF wall. The plasterboard is first

secured using an approved bonding agent applied in dabs according to the Certificate holder's instructions.

20.28 Secondary non-combustible mechanical fixings may be installed into the concrete after the bonding agent has cured. A 2.4 m by 1.2 m sheet of plasterboard requires nine mechanical fixings. Steel fixings should be non-corrosive. The penetration into the concrete is in accordance with the manufacturer's instructions. If wall plugs are used these should have a high softening temperature.

20.29 A coat of plaster skim can be applied to the plasterboard or a dry-lined finish provided as required.

Technical Investigations

The following is a summary of the technical investigations carried out on Styro Stone Permanent Insulating Concrete Formwork.

21 Tests

21.1 Tests were undertaken to measure dimensions of the formwork.

21.2 The characteristics of the solid polystyrene spacers were assessed.

22 Investigations

22.1 A completed site was visited and the efficiency of concrete compaction was observed.

22.2 A site in progress and after completion was observed.

22.3 An assessment was made of data relating to fire performance.

22.4 Condensation and thermal assessments were made to the requirements of BS 5250 : 2002 and Building Regulation L1 of England and Wales.

Bibliography

BS 1243 : 1978 *Specification for metal ties for cavity wall construction*

BS 4449 : 1997 *Specification for carbon steel bars for the reinforcement of concrete*

BS 5075-3 : 1985 *Concrete admixtures — Specification for superplasticizing admixtures*

BS 5250 : 2002 *Code of practice for control of condensation in buildings*

BS 5262 : 1991 *Code of practice for external renderings*

BS 5268-5 : 1989 *Structural use of timber — Code of practice for the preservative treatment of structural timber*

BS 5628-3 : 1985 *Code of practice for use of masonry — Materials and components, design and workmanship*

BS 8102 : 1990 *Code of practice for protection of structures against water from the ground*

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 the design and installation of natural stone cladding and lining*

BS EN 206-1 : 2000 *Concrete — Specification, performance, production and conformity*

BS EN 934-2 : 2001 *Admixtures for concrete, mortar and grout — Concrete admixtures — Definitions, requirements, conformity, marking and labelling*

CP 102 : 1973 *Code of practice for protection of buildings against water from the ground*

23 Conditions

23.1 This Certificate:

- (a) relates only to the product that is described, installed, used and maintained as set out in this Certificate;
- (b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;
- (c) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;
- (d) is copyright of the BBA.

23.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, shall be construed as references to such publication in the form in which it was current at the date of this Certificate.

23.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and/or fabricating process(es) thereof:

- (a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked by the BBA or its agents; and

(c) are reviewed by the BBA as and when it considers appropriate.

23.4 In granting this Certificate, the BBA makes no representation as to:

- (a) the presence or absence of any patent or similar rights subsisting in the product or any other product;
- (b) the right of the Certificate holder to market, supply, install or maintain the product; and
- (c) the nature of individual installations of the product, including methods and workmanship.

23.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.



In the opinion of the British Board of Agrément, Styro Stone Permanent Insulating Concrete Formwork is fit for its intended use provided it is installed, used and maintained as set out in this Certificate. Certificate No 03/4015 is accordingly awarded to Styro Stone UK Ltd.

On behalf of the British Board of Agrément

Chief Executive

Date of issue: 4th June 2003