

## Expamet Building Products

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Agrément Certificate  
**93/2915**  
Product Sheet 1

### EXPAMET PERMANENT FORMWORK

### EXPAMET HY-RIB PERMANENT FORMWORK

#### PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to Expamet Hy-Rib Permanent Formwork, sheets of zinc-coated or stainless steel formed into ribbed expanded mesh for use as permanent formwork for concrete construction joints, stopends, retaining walls and columns and for supporting horizontal slab flooring.

#### AGRÉMENT CERTIFICATION INCLUDES:

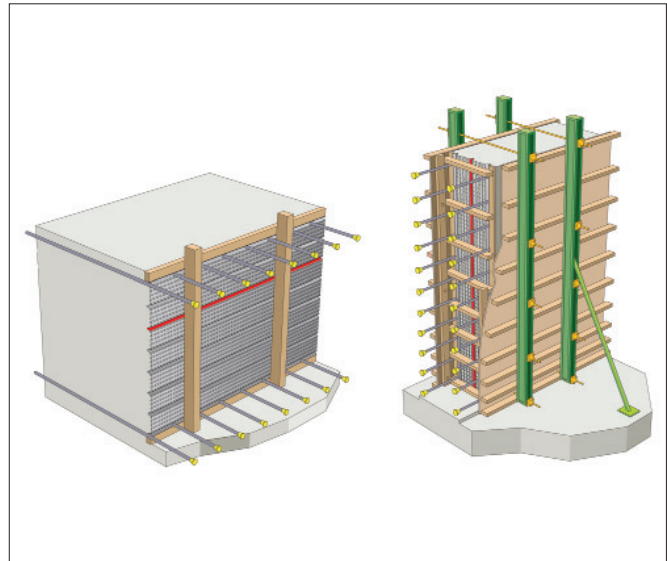
- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

#### KEY FACTORS ASSESSED

**Structural strength and stability** — when installed in accordance with the manufacturer's instructions, the product is resistant to the impact and pressure forces exerted by the discharge of pumped concrete (see section 5).

**Behaviour in relation to fire** — the product will not adversely affect the fire performance of the structures into which it is cast (see section 6).

**Durability** — the product will have the same durability as the structure into which it is cast (see section 8).



The BBA has awarded this Agrément Certificate to the company named above for the product described herein. This product 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: 23 September 2010

Brian Chamberlain  
Head of Approvals — Engineering

Greg Cooper  
Chief Executive

*The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at [www.bbacerts.co.uk](http://www.bbacerts.co.uk)*

*Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.*

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# Regulations

In the opinion of the BBA, Expamet Hy-Rib Permanent Formwork, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:



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

Requirement:	A1	Loading
Comment:		Elements constructed using the product will meet this requirement, in accordance with sections 3.1 to 3.5 and 5.1 to 5.4 of this Certificate.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The product is acceptable. See section 8 and the <i>Installation</i> part of this Certificate.



## The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Fitness and durability of materials and workmanship
Comment:		The use of the product satisfies the requirements of this Regulation. See sections 7 and 8 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building Standards – construction
Standard:	1.1	Structure
Comment:		Elements designed to the relevant codes and constructed using the product will satisfy the requirements of this Standard, in accordance with sections 3.1 to 3.5 and 5.1 to 5.4 of this Certificate. (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



## The Building Regulations (Northern Ireland) 2000 (as amended)

Regulation:	B2	Fitness of materials and workmanship
Comment:		The product is acceptable. See section 8 and the <i>Installation</i> part of this Certificate.
Regulation:	D1	Stability
Comment:		Elements constructed using the product will satisfy this Regulation, in accordance with sections 3.1 to 3.5 and 5.1 to 5.4 of this Certificate.

### Construction (Design and Management) Regulations 2007

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

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

See section: 1 *Description* (1.3) and 10 *Assembly of the formwork* (10.1) of this Certificate.

# Non-regulatory Information

## NHBC Standards 2010

NHBC accepts the use of Expamet Hy-Rib Permanent Formwork, when installed and used in accordance with this Certificate, in relation to *NHBC Standards, Part 2 Materials, Chapter 2.1 Concrete and its reinforcement*.

# General

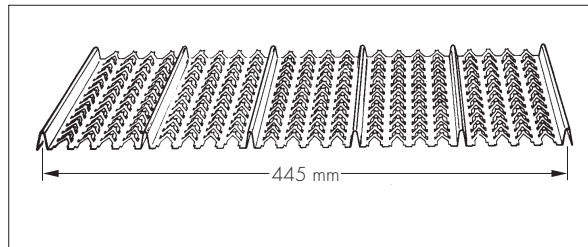
Expamet Hy-Rib Permanent Formwork comprises sheets of zinc-coated or stainless steel in the form of a ribbed expanded mesh for use as permanent formwork for concrete construction. The formwork allows poured concrete to exude through the open mesh and form nodules to provide a key for the next pour. This obviates the need for scabbling of the joint after the concrete has hardened. For retaining walls and columns, the Hy-Rib formwork facing surface can be conventionally rendered or clad. The surface of retaining walls receiving the infill should have a waterproof coating applied.

# Technical Specification

## 1 Description

1.1 Expamet Hy-Rib Permanent Formwork (see Figure 1) is manufactured from hot-dip, zinc-coated steel sheet to BS EN 10346 : 2009 and stainless steel sheet to BS EN 10088-1 : 2005(E). The steel sheet is cut, pressed and roll-formed to simultaneously form the ribs and stretch the material in between to form the exposed mesh.

Figure 1 Typical section



1.2 The formed sheet will retain poured concrete and produces a surface with the concrete which will bond to the next pour, or produce a surface to accept such finishes as render or tiles.

1.3 Three grades of formwork sheet are available, with the dimensions and density shown in Table 1.

Table 1 Grades, dimensions and weight of steel

	Zinc-coated grade			Stainless steel grade
	2811	2611	2411	2811 S 304 and 2811 S 316
Thickness (mm)	0.4	0.5	0.75	0.4
Weight (kg·m <sup>-2</sup> )	3.39	4.23	6.34	3.4
Length (m)	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5
Width (mm)	89, 178, 267, 356, 445	89, 178, 267, 356, 445	89, 178, 267, 356, 445	445

1.4 Concrete used with the formwork should be in accordance with BS 8500-1 : 2006, BS 8500-2 : 2006 and BS EN 206-1 : 2000. The range of concrete mixes used satisfactorily with the formwork during full-scale site trials is defined in section 14.1, Tables 3 and 4. Mixes outside this range should not be used in the context of this Certificate.

## 2 Delivery and site handling

2.1 The formwork is manufactured from light-gauge material and is supplied in sheet form. Good site practice should be observed to prevent damage due to weather or site traffic.


2.2 The sheets should be handled with care and stored under cover in dry conditions.

## Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Expamet Hy-Rib Permanent Formwork.

## Design Considerations

### 3 General

 3.1 Expamet Hy-Rib Permanent Formwork is satisfactory for use in forming construction joints, stopends, retaining walls or columns, and horizontal floor slabs.

3.2 The formwork for construction joints should be designed and constructed in accordance with the Certificate holder's *The Designers' Guide to the use of Expamet Hy-Rib*, and sections 10.1 to 10.4 of this Certificate. Guidance on loads to which the formwork may be subjected is given in the Concrete Society Report *Formwork — A Guide to Good Practice* (2nd Edition), and in the Construction Industry and Research Information Association (CIRIA) Data Sheet *Concrete Pressure on Formwork*.

3.3 Formwork for retaining walls and columns should be designed by a suitably qualified engineer in accordance with the recommendations of the Concrete Society Report *Formwork — A Guide to Good Practice* (2nd Edition).

3.4 The formwork for floor slabs should be designed and constructed in accordance with the manufacturer's recommendations.

3.5 Consideration should be given at the design stage to the positioning of services, such as pipework and rebars, and to the formation of any awkwardly shaped joints, which can be incorporated by following the manufacturer's recommendations.

### 4 Practicability of installation

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

## 5 Structural strength and stability



5.1 Site trials were conducted during which examinations were made of the effects of impact forces exerted on Hy-Rib formwork by the discharge of pumped concrete. It was concluded that the product would perform satisfactorily in all practical situations where the manufacturer's instructions for installation of the formwork had been followed. The amount of grout loss and the degree of deformation of the formwork would be minimal.

5.2 Data obtained from site trials also indicated that the pressure developed within the formwork was significantly lower than that developed using standard timber. Therefore, it would require less support than traditional formwork, with support centres similar to those used with 19 mm plywood being sufficient for most situations (see also sections 9 to 11.2).

5.3 Because it comprises porous open mesh, the formwork reduces the risk of voids and/or honeycombing occurring within the concrete.

5.4 A number of tests have been carried out by independent bodies on behalf of the Certificate holder to verify the effectiveness of Hy-Rib formwork as used to form construction joints in reinforced concrete structures. The tests were made to examine the shear resistance of the joints when formed with Hy-Rib formwork and to compare this with that of scabbled joints and monolithic specimens. The evidence of test results suggests that if there are differences, these favour the use of the Hy-Rib formwork. Details of specific tests may be obtained from the Certificate holder.

## 6 Behaviour in relation to fire

6.1 The formwork will not adversely affect the fire resistance of the structures into which it is cast.

6.2 A concrete floor, 150 mm thick, was subjected to a fire resistance test in accordance with the appropriate structural requirements of BS 476-8 : 1972. The test specimen was formed with Expamet Hy-Rib 2411 formwork and reinforced with 16 mm, 8 mm and 6 mm diameter steel bars. It was rendered on its underside with 13 mm of cement and sand and 3 mm of hardwall plaster.

6.3 The floor had a clear span of 4.0 metres and was loaded at 1.5 kN·m<sup>-2</sup>. A fire resistance of 111 minutes was achieved in terms of the specimen's stability, integrity and insulation.

## 7 Maintenance



As the product forms an integral part of a completed concrete structure and is permanently confined within the structure itself, maintenance is not required.

## 8 Durability



In the situations assessed, Expamet Hy-Rib Permanent Formwork will be fully protected and will remain intact for the lifetime of the structure into which it is cast.

# Installation

## 9 General

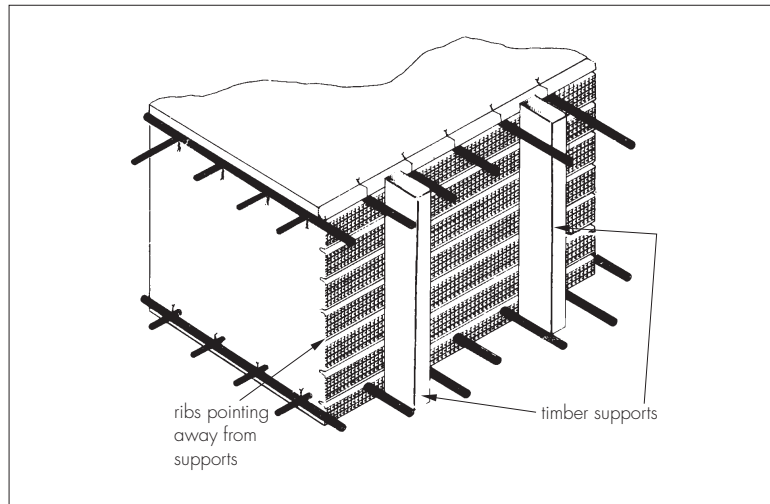
The installation and support of Expamet Hy-Rib Permanent Formwork must be in accordance with the current *Designers' Guide to the use of Expamet Hy-Rib* and the requirements of sections 3.1 to 3.5 of this Certificate.

## 10 Assembly of the formwork

10.1 The formwork can be cut on site with heavy duty shears or abrasive disc saws; all appropriate health and safety measures should be taken.

10.2 The formwork can be installed with the ribs placed horizontally or vertically. Support members should always be at right angles to the ribs and the ribs should always point away from the supports (see Figure 2).

Figure 2 Hy-Rib with timber supports



10.3 An indication of the typical spacing of supports is given in Table 2. This table is based on the use of the formwork over at least three spans.

Table 2 Indicative spacing of supports

Depth of joint (m)	Clear distance between supports (m)		
	Grade 2411	Grade 2611	Grade 2811
0.25	1.250	1.025	0.950
0.50	0.900	0.725	0.675
1.00	0.625	0.500	0.475
1.50	0.525	0.425	0.400
2.00	0.450	0.375	0.350
2.50	0.400	0.325	0.300
3.00	0.375	0.300	0.275

10.4 To reduce or eliminate stripping of supports, suitably formed rebar can be used instead of conventional timber studs. Fastening to the supports can be by nailing to timber or by wire tying to steel and rebar (see Figure 3).

10.5 Adjacent sheets of formwork are joined by overlapping the edge ribs and tying the ribs at 150 mm intervals. End sheets are overlapped by 150 mm over the supports (see Figure 4).

Figure 3 Hy-Rib with rebar supports

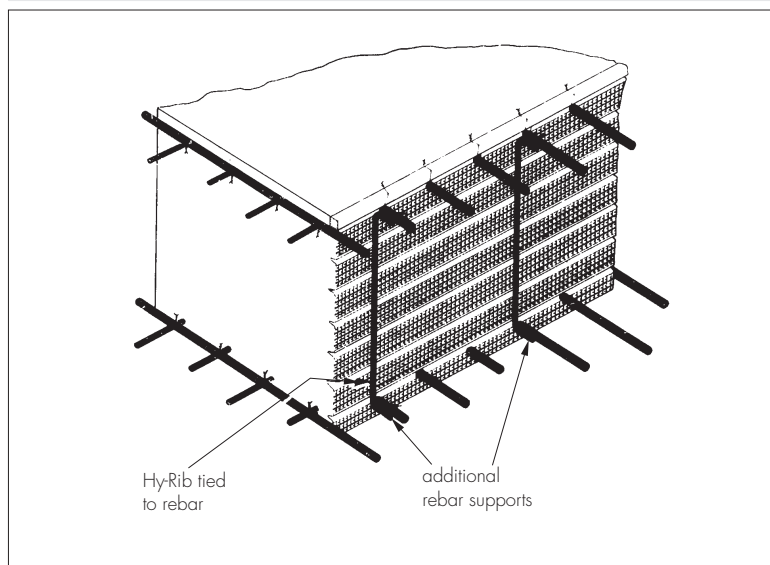
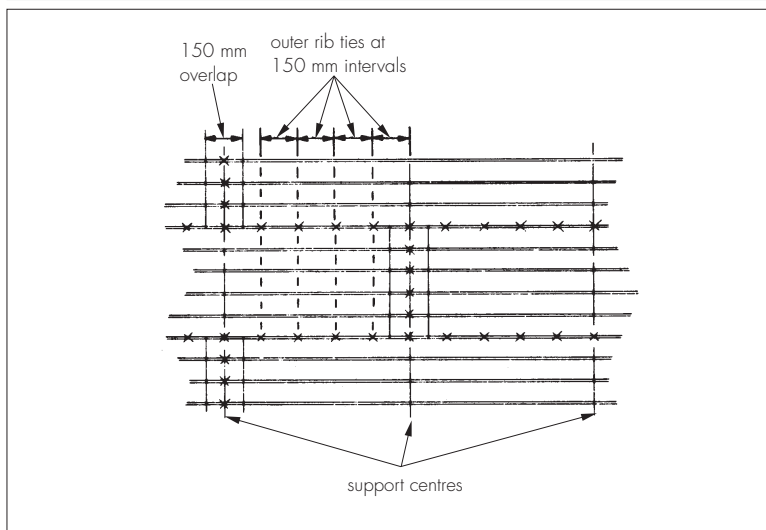


Figure 4 Typical sheet jointing detail



## 11 Concrete installation

11.1 Concrete can be either pumped or placed direct. The formwork is suitable for use with most grades of concrete to BS 8500-1 : 2006, BS 8500-2 : 2006 and BS EN 206-1 : 2000. The slump should be between 70 mm and 100 mm, although slumps up to 175 mm can be used (in this situation the use of concrete vibrators in proximity to the formwork should be limited to minimise grout loss).

11.2 The concrete should be placed at a distance of 500 mm from the formwork and allowed to flow up to it. Vibration of the concrete is carried out until nodules appear through the formwork mesh. The vibrators should be at least 450 mm away from the formwork when used in continuous vibration. If the layout of the formwork requires the vibrators to be closer than 450 mm, they should be used intermittently for periods of no more than 5 to 10 seconds until nodules are observed. This gives adequate compaction and keeps the loss of fines to a reasonable level.

## Technical Investigations

### 12 Tests

Tests were carried out to determine the material characteristics of Hy-Rib formwork including dimensional checks, the mass of the zinc coating and the weight per unit of area.

### 13 Investigations

13.1 Visits were made to trials and installation-in-progress sites to assess the practicability of installation of the formwork, the incorporation of reinforcement, the formation of unusually shaped joints, the spacing of support members and the placing of the concrete. The range of concrete mixes and related data used satisfactorily for trial installations is given in Tables 3 and 4.

Table 3 Concrete mix for trials

Trial	Water (kg·m <sup>-3</sup> )	Cormix (litres)		OPC (kg·m <sup>-3</sup> )	Mix ground granulated blastfurnace slag	Sand (kg·m <sup>-3</sup> )	Aggregate (kg·m <sup>-3</sup> )		Measured air (kg·m <sup>-3</sup> )
		P4	P10				10 mm	20 mm	
1	179	1.0	–	205	145	782	262	775	2.25
2	179	–	0.68	205	135	813	260	768	2.80
3	163	–	0.68	205	135	813	260	768	3.00
4	163	–	0.68	205	135	813	260	768	–
5	163	–	0.68	205	135	813	260	768	–

Table 4 Concrete mix for trials — related data

Trial	Total density (kN·m <sup>-3</sup> )			Temperature (°C)				Slump (mm)	
	Aimed	Measured		Air		Concrete		Initial	Final
		Fresh	Demoulded	Start	End	Start	End		
1	2364	2327	2361	7.6	7.4	12.6	12.8	105	155
2	2345	2315	2329	4.0	4.8	8.6	8.6	60	100
3	2345	2307	2359	4.6	5.0	10.1	10.1	55	80
4	–	–	–	14.2	15.0	16.9	–	–	70
5	–	–	–	15.3	18.0	19.4	–	–	60

13.2 An assessment was made of existing data relating to the formwork with regard to:

- shear resistance of construction joints compared to that of conventional scabbled joints and monolithic specimens
- porewater pressure
- degree of deflection developed by the impact loading of poured concrete
- behaviour under load of a formed floor slab
- fire resistance of a formed floor slab.

13.3 The following documents were consulted:

#### Summary report

- *Shear resistance of construction joints formed by Hy-Rib* (P E Regan: April 1985)

#### Reports

- *Shear resistance of construction joints; comparisons of Hy-Rib and scabbled joints* (P E Regan: September 1979)
- *Test of Hy-Rib construction joints with various reinforcement ratios* (P E Regan)
- *Hy-Rib construction joints in beams without stirrups* (P E Regan: November 1979)
- *Additional tests of beams with construction joints* (P E Regan: April 1980)
- *Examination of concrete cast against Hy-Rib permanent formwork* (D A Cullen, Taywood Engineering, Technical Report 231S/99/10705: April 1999)
- John Laing tests on R C beams with Hy-Rib joints (April 1974 and June 1974)
- John Laing casting trial (April 1977)
- John Laing loading tests on Hy-Rib reinforced concrete slab (June 1975)
- Technical review of metallic sheathing used in bulkhead formwork (August 1984)
- Fire tests — Warrington/Firto (July 1977)
- Hy-Rib Permanent Formwork Trials — British Cement Association (February 1992 and July 1992)

#### German reports

- *Shear strength of construction joints in reinforced concrete structures shuttered with Hy-Rib* (English translation: September 1988)

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

## Additional Information

The management systems of Expamet Building Products have been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by British Standards Institution Quality Assurance (Certificate No FM 36694).

## Bibliography

- BS 476-8 : 1972 *Fire tests on building materials and structures — Test methods and criteria for the fire resistance of elements of building construction*
- BS 8500-1 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Method of specifying and guidance for the specifier*
- BS 8500-2 : 2006 *Concrete — Complementary British Standard to BS EN 206-1 — Specification for constituent materials and concrete*
- BS EN 206-1 : 2000 *Concrete — Specification, performance, production and conformity*
- BS EN 10088-2 : 2005 *Stainless steels — Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*
- BS EN 10346 : 2009 *Continuously hot-dip coated steel flat products — Technical delivery conditions*
- BS EN ISO 9001 : 2008 *Quality management systems — Requirements*

## 14 Conditions

14.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- 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.

14.2 Publications and documents referred to in this Certificate are those that the BBA deems to be relevant at the date of issue or re-issue of this Certificate and include any: Act of Parliament; Statutory Instrument; Directive; Regulation; British, European or International Standard; Code of Practice; manufacturers' instructions; or any other publication or document similar or related to the aforementioned.

14.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant 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.

14.4 In granting this Certificate, the BBA is not responsible for:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

14.5 Any information relating to the manufacture, supply, installation, use and maintenance 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 and maintained. It does 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; 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. 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 manufacture, supply, installation, use and maintenance of this product/system.