polarwall

insulating concrete formwork

Code for Sustainable Homes

A practical guide for using the Polarwall ICF system

About this guide

This guide is to help anyone using or wanting to specify Polarwall where a development has to meet various levels of the Code for Sustainable Homes.

It should be read in conjunction with the relevant technical guides and information produced by the Department for Communities and Local Government.

The information contained in this guide is not meant to provide actual evidence of Polarwall's ability to meet the various code levels but rather it should be used as a useful source of information for designing and using the Polarwall product.

As a consequence, each assessment under the code should be made on the site specific details for the project in question.

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Introduction 1

The Code for Sustainable Homes (CSH) was launched in December 2006, as a new national standard for sustainable design and construction of new homes. Since April 2007 the developer of any new home in England can choose to be assessed against this Code.

CSH was introduced by the Government as part of a package of measures towards zero carbon housing development. Consultation is already underway for the next change in the energy efficiency requirements for new dwellings, which is looking to increase Target Emission Rates (TER) from 2006 levels of 25% by 2010, 44% by 2013 and to be zero carbon in 2016.

From 2008, all housing funded by the Housing Corporation and development on English Partnership land must achieve a mandatory code level 3. Whilst it will remain voluntary for the private sector, some Local Authorities are encouraging its use through the planning system.

Using Polarwall

This guide has been produced by Polarwall Ltd to provide information that is relevant to it's product and each area of the code. It suggests the practical ways that Polarwall can be used to comply with the varying code levels and it's interaction with other product elements within the construction process.

Sections and weightings for CSH

Energy & CO_2 Emissions	36.4%
Potable Water*	9%
Surface water run-off	2.2%
Materials	7.2%
Waste	6.4%
Pollution	2.8%
Health & Well being	14%
Management	10%
Site Ecology	12%

* No direct impact from the Polarwall product

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Energy & CO_2

This is by far the most important area of the code, due mainly to the Government's drive in reducing CO_2 production from the way we use our homes. The main sections relevant to Polarwall are:

- Dwelling Emissions Rate as defined by 2006 Building Regulations (Ene1)
- Building Fabric (Ene2)
- Home office (Ene 9)

Dwelling Emissions Rate & Building Fabric (considered together) – The dwelling carbon dioxide emission rate (DER) has to has to improve by certain percentage levels to a corresponding target carbon dioxide emission rate (TER). Both the DER and TER are calculated using SAP 2005 - the Government's standard methodology for assessing the energy consumption in new dwellings.

The code sets target improvements over the TER 2006 levels that correspond to the appropriate code levels.

Code Level 1	10% improvement
Code Level 2	18% improvement
Code Level 3	25% improvement
Code Level 4	44% improvement
Code Level 5	100% improvement

Code level 6 provides for a true Carbon Zero construction but is not being considered here.

Using Polarwall

Polarwall is one element of a building, namely the external and party walls. Whilst it plays a vital role in reducing energy consumption it has to be used as part of a wider suite of products to achieve the requirement of each code level.

The main benefits of Polarwall are:

Air permeability – pre completion tests indicate the Polarwall building fabric to be extremely airtight, with results averaging around $2m^3/hm^2$ at 50Pa.

Thermal bridging – This is often poor at construction joints within the build. Polarwall allows construction joints and opening reveals to be wrapped ensuring insulation continuity and preventing cold bridging problems. Consequently an excellent 'Y value' can be used.

Energy & CO_2 contd…

The 'Y Value' is a measure of the heat loss from thermal bridging in the dwelling. To achieve the current standards a figure of 0.08 is required, which is equivalent of adding 8% to the total heat loss from the fabric of the building. Although Polarwall is not an Accredited Construction Detail (ACD), Polarwall Ltd will be able to supply its proprietary details for use by designers and contractors.

With insulation continuity and excellent air barrier continuity provided by Polarwall's concrete core, it is being assumed that the Y Value of a typical dwelling could be reduced to 0.02.

Wall U-Values – Polarwall's high levels of insulation provides excellent U Value performance, well in excess of the current levels used in standard wall construction. 4 main products are used:

Product	**GWP>5**	**GWP<5**
Standard	0.27W/m^2K	0.31W/m^2K
X25	0.22W/m^2K	0.25W/m^2K
X50	0.18W/m^2K	0.22W/m^2K
X100	0.14W/m^2K	0.16W/m^2K

Achieving good ratings in the above areas means that the buildings Heat Loss Parameter (HLP), (a measure in W/m2K, of the efficiency of the building fabric and ventilation systems) is also very good.

As the building envelope and in particular Polarwall will have the most significant long-term effect on the buildings thermal performance, then using the higher U Value performing products can offer acceptance for the higher rated code levels.

Tables 1, 2 and 3 offer an overview of various building fabric aspects needed to seek compliance for the energy and CO_2 emission targets for the various code levels. They have not considered the space heating requirements or inclusion of Zero or Low Carbon (ZLC) Energy Technologies, rather appropriate advice has been given on the use of these systems.

The tables have centred on achieving the standards for code levels 3, 4 and 5 only as these are seen as the benchmark for the coming years and Government reviews on Part L, in 2010, 2013 and 2016.

Home office – Polarwall construction offers an excellent way to create a room in the roof or provide basement construction that is ideally suited to accommodate a home office environment.

Level 3 Compliance 4

Table 1

Unit	House type 1	House type 2	House type 3
Air Permeability	2	2	2
Thermal bridging Y value	0.02	0.02	0.02
Roof U-value	0.13	0.13	0.13
Number of Open Fireplaces	None	None	None
Wall U-value	0.22	0.22	0.22
Floor U-value	0.20	0.20	0.20
Glazing U-value	1.2	1.2	1.2
Glazing as a percentage of floor area	25%	20%	17%

Polarwall Relevant

House type 1 - Detached two storeys, four bed house - total floor area 140 sq m
House type 2 - Semi detached three storey 3 bed houses with integral garage - total floor area 120 sq m
House type 3 - Mid terraced two storey, two bed house total floor area 64 sq m

Notes:

Whole House Mechanical Ventilation: Best practice guidance refers the use of these systems where low permeability levels are present. Use a 85% efficient, 1W/(l.s) specific fan power heat recovery system.

Space, Water Heating and Controls: Ideally a gas fired condensing boiler with 90-95% efficiency. Hot water from boiler with insulated cylinder, with programmer room thermostats and TRV's. Where gas is not available then oil fired systems can be sourced, however solar heating should be used to off-set the emission ratings.

Ground source heat pump: Where higher higher code levels are required, heating derived from GSHP is ideal.

Secondary Heating: No secondary heating would normally be used, however if required, wood burning stoves are ideal as they use renewable fuel in the from of wood.

Solar Water Heating: preferably 2-5 sq.m will be required however orientation is critical as well as tilt and no or little over-shading to maximise efficiency.

Photovoltaic Generation: When electricity rather than heat is required, PV is a robust technology. This is most likely to be used when achieving code levels 4 or 5. PV electrical output is assumed as 0.5KWp being a 5 sq.m panel. Costs can be prohibitive however.

Low energy lighting: these should be used as a proportion of the total internal lighting requirements. The benchmark figures are over 75%.

Level 4 Compliance 5

Table 2

Unit	House type 1	House type 2	House type 3
Air Permeability	2	2	2
Thermal bridging Y value	0.02	0.02	0.02
Roof U-value	0.13	0.13	0.13
Number of Open Fireplaces	None	None	None
Wall U-value	0.18	0.18	0.22
Floor U-value	0.20	0.20	0.20
Glazing U-value	0.8, g=0.50	0.8 g=0.50	0.8 g=0.50
Glazing as a percentage of floor area	25%	20%	17%

Polarwall Relevant

House type 1 - Detached two storeys, four bed house - total floor area 140 sq m
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Level 5 Compliance 6

Table 3

Unit	House type 1	House type 2	House type 3
Air Permeability	2	2	2
Thermal bridging Y value	0.02	0.02	0.02
Roof U-value	0.13	0.13	0.13
Number of Open Fireplaces	None	None	None
Wall U-value	0.14	0.14	0.14
Floor U-value	0.15	0.15	0.15
Glazing U-value	0.8	0.8	0.8
Glazing as a percentage of floor area	25%	20%	17%

Polarwall Relevant

House type 1 - Detached two storeys, four bed house - total floor area 140 sq m
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Surface water run off

In areas where there is a risk of flooding then appropriate measures should be taken to reduce the impact on the basic building elements of the home.

- Flood risk (Sur 2)

Flood Risk – Advice given by the Association of British Insurers requires development in medium to high flood risk areas to accommodate and replace timber and plasterboard sections with concrete materials.

Where this is the case the walls of the house are also susceptible to damage. The Polarwall product provides a robust concrete structure against water submersion. Foul water and sediment left behind by flooding can also be easily power washed once internal linings have been removed. In cases for traditional construction, jet washing can remove mortar between block joints thus impairing the structural performance of the wall and increasing cost of repair.

Polarwall's insulation also offers an excellent waterproofed material. Tests carried out by our XPS manufacturer for water immersion conclude that the material absorbs 0.7% of moisture over a 1-month period, making it an ideal material for flood protection.

Materials 8

The code looks at 2 main areas in relation to the Polarwall product:

- Environmental impact of materials (Mat1)
- Responsible sourcing of materials – Basic Building Elements (Mat 2)

Environmental impact of materials – Of the basic building elements, 3 of the following 5 areas must achieve a relevant Green Guide[1] rating of A-D

- Roof
- External walls
- Internal walls (including separating walls)
- Upper and ground floors
- Windows

The Green Guide produced by the BRE assesses the embodied impacts of materials used (those associated with the manufacture and disposal of construction products). It is vital that this is kept in perspective to the whole life performance of the building as the "in-use" impact is generally around 90% .

Buildings that last longer will tend to have a smaller embodied impact and it is widely accepted that concrete buildings will last far longer than the 60 year assessment, however the Green Guide ignores this fact.

Current guidance suggests that Polarwall would achieve a ***D classification rating***. Whilst this does not achieve a high score, it should be noted that the benefits of using Polarwall far outweigh the performance drop in this section, which does account for only 4.5% of the total score.

To enhance the rating for concrete the following can be looked at:

- Using concrete to include cement replacement materials such as Pulverised Fuel Ash (PFA) and Ground Granulated Blastfurnace Slag (GGBS), both of which are waste products from the power generation industry. These can replace between 30 and 50% of the cement content.
- Recycled aggregate use as long as the material source does not travel more than 30 miles to the manufacturing point
- Use of recycled water within the manufacturing process
- Using returned concrete loads by washing out the cement paste and re-using the aggregate

[1] The updated version of the Green Guide to Housing Specification is due for publication in 2008

Materials contd…

End of life recycling – It is more than likely that a Polarwall building will come to the end of its life because no further use can be found for it, rather than the concrete having failed due to age. If it is to be demolished it will provide a rich source of recycled aggregate for use in other construction applications.

To access more information on the environmental credentials of concrete see http://www.concretecentre.com/main.asp?page=728

Responsible Sourcing of Materials – 80% of all materials used in the following categories must be responsibly sourced:

- Frame
- Ground & upper floors
- Roof
- External walls
- Internal walls
- Foundations/substructure
- Staircase

Using Polarwall

Polarwall's construction brings together different product groups and there are a number of ways to maximise their suitability:

- Using materials supplied from companies with a valid Environmental Management System (EMS) to ISO 14001 or equivalent recognition.

There are a large number of concrete plants with an EMS designation and readymix suppliers with full EMS certification. Polarwall Ltd will work with the design team to secure the best placed producer.

- Using materials that have been recycled.

PVC is used in the production of Polarwall's rail system. These rails are produced from disused window frames, that would otherwise be land-filled.

Documentation to demonstrate the relevant recycling credentials of the product can be provided.

Waste

This is particularly relevant during the construction process where waste is produced as part of the assembly of the Polarwall products.

- Construction site waste management (Was2)

Construction site waste management – Polarwall Ltd will be able to produce an insert for the Site Waste Management Plan (SWMP) detailing the following areas:

Minimising the generation of waste – Polarwall materials are delivered to site in phases as agreed with site management personnel. Material levels can therefore be managed efficiently avoiding over stocking and ordering. Transport efficiency movements to site are also considered.

Construction operatives are trained to use the Polarwall product in it's most efficient manner thus avoiding excessive waste generation.

Relevant targets for waste generation will be set out in the plan. Past evidence assumes that the main area of waste will be with the insulation. Using a target factor of m3/100m2 floor area, the waste volume is around **4m3**. The average KPI for the residential sector using the BRE SMARTWaste tool is **17.7m3**.

Sorting, Re-Using & Recycling Waste – A significant proportion of the waste generated through the construction of Polarwall can be sorted for re-use or recycling. Waste materials will be stored at an agreed location on site and will be picked up as new material is delivered. The following material types can be recycled as:

- Plastic components can be re-chipped and used within the manufacturing process of PVC trade extrusion products.

- Insulation can be chipped and ground down for re-extrusion into park benches and other decorative outdoor features.

- The controlled nature of concrete placement into the wall means very little waste is produced from this activity

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Pollution

This section concentrates on the Global Warming Potential (GWP) emitted from the manufacture and installation of insulation used within the Polarwall product.

- Global Warming Potential (GWP) of Insulants (Pol1)

Other areas of pollutants contained within the code are not applicable to the Polarwall product.

Global Warming Potential of Insulants – Polarwall uses extruded polystyrene (XPS) as its main insulation material. XPS can be manufactured with a GWP of greater than 5 or less than 5.

There is however a trade-off to be made with the insulation as the quoted thermal conductivity (λ value) of XPS increases as the GWP rating goes below 5. Therefore the U-Value performance of the product is reduced. The quoted U-Values obtained from both products can be seen below:

Product	**GWP>5**	**GWP<5**
Standard	0.27W/m^{2}K	0.31W/m^{2}K
X25	0.22W/m^{2}K	0.25W/m^{2}K
X50	0.18W/m^{2}K	0.22W/m^{2}K
X100	0.14W/m^{2}K	0.16W/m^{2}K

The benefit of using either product within the code calculations must therefore be made at the design stage to establish if the U-Value performance of the product can be reduced at the expense of using the insulation with a GWP of less than 5.

In both cases the insulation used is ODP, CFC and HCFC free.

Health & Well Being 12

Much of the compliance in this section is relevant to the design of the property and it's interaction with the way we live in the home. There are however sub-sections that are relevant to the use of the Polarwall product.

- Sound Insulation (Hea 2)
- Lifetime Homes (Hea 4)

Sound Insulation – This specifically relates to party or separating walls between dwellings. Current Regulations (Part E requirements of Approved Document E 2003 for England & Wales) require party walls to achieve an airborne rating of $D_{nT,w}$ + C_{tr}45 dB.

The acoustic wall provided by Polarwall has achieved pre completion test results of

- $D_{nT,w}$ + C_{tr}47 dB

To improve performance of the party wall by 5 to 6dB the following construction detail is suggested:

"line one side of the party wall with an independent lining of 48mm metal stud with 50mm Isowool APR suspended between frames with 12.5mm plasterboard. The independent lining frame should be offset from the wall by at least 15mm"

Lifetime Homes – This is primarily affected through the design process. However Polarwall offers benefits through it's robust concrete core to provide durable fixings for handrails, stair lifts etc… where these are fixed to external walls.

Adaptability of the home is also important, such as extending or modifying the house. Whilst this requires general building skills, it is generally far beyond the reach of most DIY enthusiasts.

Lighter framed buildings do not pose the same problems and as such are open to the removal of key structural elements that are not obvious to the DIY occupier. Costly maintenance to the housing provider can therefore be offset by using Polarwall.

Adaptability of a building from one use to another is also a consideration. A key factor in re-using a building is the durability of the original structure. Because Polarwall is long-lasting and durable it exhibits good credentials for re-use, rather than demolition and re-building, which ultimately will lead to greater environmental impacts.

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Management

There are 2 sections which are relevant to Polarwall:

- Construction Site Impacts (Man 3)
- Security (Man 4)

Construction Site Impacts (Sub-section b) – Procedures to record CO_2 emissions arising from commercial transport to and from site. This can be facilitated by Polarwall Limited to record the number of product deliveries made to site that would further extend to concrete pump and truck mixer visits.

The following vehicles are used for delivery:

Plastic goods – Light commercial vehicle up to 3.5tonnes generally being delivered from Exeter.

Insulation materials – Commercial vehicles with carrying capacity of over 3.5 tonnes up to 12 tonnes generally being delivered from Birmingham

Concrete mixer trucks and pumping vehicle - Commercial vehicles with carrying capacity of over 12 tonnes sourced from the locality of the development (average travel distance is less than 15 miles)

Security – Whilst Polarwall has not been assessed for Secure by Design, the durable nature of the building material denotes that entry into the property via the Polarwall product would be extremely difficult. Likewise fixings into the concrete core will also prove difficult to dislodge and remove.

Further security measures can be complied with where homes are being built for military purposes or where structures are required for military use. This centres on ICF's ability to withstand blast protection. The insulation plays a vital role in cushioning the initial impact of the blast and preventing the breaking of the internal concrete face.

Site Ecology 14

This section has one sub section relevant to Polarwall:

• Building Footprint – Eco 5

Building Footprint – This calls for the Net Internal Floor Area to Net Internal Ground Floor area to be a certain ratio for different house types.

Whilst this is very much design led, Polarwall can be used to great effect as habitable loft and basement space can be easily created using the Polarwall product.

For loft space the first floor walls should be extended past the ceiling by 600-900mm. Within this wall section, reinforcing steel can be placed to counter act the lateral forces imposed by the roof structure. Attic trusses can then be placed onto the wall-plate thus creating a habitable room space.

Basements are constructed by assembling the Polarwall product around a reinforced cage. The reinforcement provides the necessary structure to withstand the hydrostatic pressure exerted by the surrounding ground.

Basements can save up to 27% of land required to build the same volume of space in a house with two storeys above ground and that same volume house is automatically up to 10% more energy efficient with 1/3 of its volume below ground, increasing its thermal efficiency.

As with all habitable basements, the structure will require tanking to prevent ingress of moisture.