

Cast your home in Concrete

Concrete housing is enjoying a revival in the UK, thanks to the introduction of permanent insulated formwork – a highly energy efficient construction system which is extremely simple to use, making it ideal for DIY self-builders. Mark Brinkley reports.

It is not often that the much-hyped word revolutionary can genuinely be applied to developments in the construction industry but the development of permanent insulated formwork (or PIF) is such a case. It turns an established practice on its head.

PIF houses are built out of concrete, poured on site, but that's not the innovation. Concrete housing is nothing new. Travel to the Mediterranean and you will see that it is one of the most common construction forms, especially where there is a danger of earthquakes. Normally, concrete houses are built with steel reinforced columns and, in order to pour the concrete, a timber mould (known as formwork) is built around the columns. The concrete is then poured inside this formwork. Making up formwork is a distinct branch of carpentry and people who can build forms for complex shapes, such as staircases, are always in demand. However, once the concrete is poured, the timber formwork is taken down and more often than not disposed of. Conventionally, formwork is temporary.

However, developments in plastics and, specifically, expanded polystyrene have begun to challenge the use of temporary timber formwork. Like timber, polystyrene is strong enough to act as a container for poured concrete. However, it doesn't degrade like timber and it is, of course, an excellent insulation material. Consequently, it becomes possible to design systems that leave the formwork in place throughout the lifespan of the building. This, then, is the revolutionary development.

Permanent insulated formwork was first developed around 1970 in Germany and there it is currently used for between 2000 and 3000 new homes a year. Many PIF homes have been built in France, Italy and Australia and PIFs have been particularly successful in

North America, where there are over a dozen substantial manufacturers building a combined total of around 15,000 homes a year. The first PIF houses appeared in the UK in the 1970s but it's only in the last few years that the technique has begun to be taken up in any number, largely due to the promotional work of one company, Beco. Their product, known as Beco Wallform, is based on one of the main German systems, Isorast, and their main customers are self-builders.



Pictures courtesy of Mark Welsh

"In comparison with conventional blockwork or timber frame, it is a frighteningly fast method of construction, requiring only modest skill levels..."



◀ Ray and Anne Price built this impressive chalet style house in Lincolnshire using permanent insulated formwork. The system is extremely flexible and highly energy efficient.

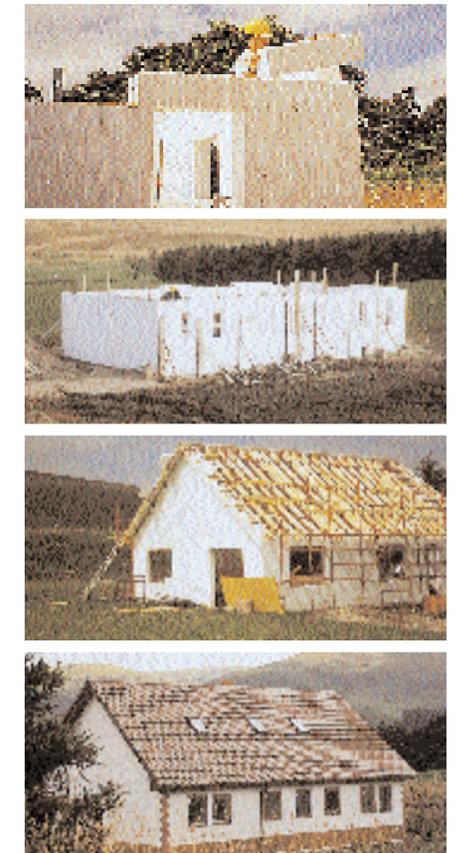
How does PIF work?: When people first encounter a PIF system such as Beco, the initial reaction is often one of scepticism. Walls being built out of hollow polystyrene blocks that just clip together like Lego – it's something a child could do in a matter of minutes. It does have the feeling of child's play to it.

It seems such a simple idea, yet you feel that there are bound to be hidden problems. How do you fix doors and windows? How do you create lintels over the openings? How do you run the wiring? How do you finish the walls? How do you put up shelves? Only as you become more familiar with the product do you realise that all these questions have been asked thousands of times before and over twenty five years of development has gone into working out the answers. Wall junctions, floor junctions, cabling and shelving all have simple solutions. In fact, what stands out is just how much flexibility the systems

offer. For instance, should you want a curved wall, Beco Wallform produce curved blocks – a much easier way to do it than by using conventional blockwork or timber frame.

Some people are also worried that because the systems are modular, the layout options will be restricted. In Beco's case, however, the modular grid is as small as 62.5mm, less than a third of one brick, so the reality is that such a building system offers rather more layout flexibility than conventional brick and blockwork. It may be simple in its conception but it is also extremely capable in what it can handle.

However, there are things to watch out for. When you actually come to build a PIF wall, it helps to have someone around who has worked with such a system before. In particular, it is important to have a level foundation to work off, as it's difficult to adjust the course height once started.



Permanent insulated formwork is extremely simple to use, so is very popular with DIY self-builders. John Pool built his own home in Lanarkshire, Scotland three years ago, aged 87, using the Beco Wallform system.

It can also be possible for walls to get out of plumb during the pour – occasionally a wall section will burst open and a little concrete will spill out onto the floor. Rectifying these mishaps is a simple matter as long as they are attended to immediately. In comparison with conventional blockwork or timber frame, it is a frighteningly fast method of construction, requiring only modest skill levels. It is suitable for both above and below ground work and, consequently, PIFs are widely used for basement walls, although here there is usually a need for additional steel reinforcement.

Having erected the wall sections, closed off the corners and the openings and placed the lintel sections across the openings, it is usual to organise the pour using a concrete pump. These can be hired for around £250 per day or a little less for the half day during which they will be required. The readymix supplier

needs to know how the mix is going to be used and the quantity needed. It usually works out at around one cubic metre for every 7.5m² of walling and so the single storey of a detached house typically takes two or three truckloads of readymix. With the aid of a pump, the entire pour for a storey need only take a couple of hours.

“Beco blocks can give a U-value of 0.19, a level the UK regs might get to in about 2020!”

The most common way of finishing the walls is to use a render. It is advisable to use a specialist product such as those made by Marmorit – these contain certain polymer additives which give a good stable surface directly on top of the polystyrene. However, there is nothing to stop you using a more traditional finish such as brickwork. The inner face of the external walls is usually lined with plasterboard, whilst the internal room dividing walls can be built using your PIF walling system or the more conventional block or studwork. Service cables and pipes can be cut into the polystyrene walls and anything that needs to be hung off these walls can either be screwed into the concrete or hung off special rawlplugs.

Despite their use all over the world, PIFs have yet to take off anywhere in a really big way. It would be fair to say that for most of the construction industry, the whole concept remains just too radical. Yet, slowly but surely, interest continues to grow. Feedback from people who build with PIF systems is generally very positive and many go on to build that way again. In fact, the growing success of PIF building systems has been largely due to word of mouth recommendation.

Another significant factor behind the PIF story is the requirement for seemingly ever-increasing levels of insulation demanded by governments throughout the western world, anxious to reduce global emissions of carbon dioxide. You don't need to add insulation to a PIF house – it is built of insulation. PIF homes tend to be amongst the most energy efficient structures being built today.

New U-values: The UK Government has recently announced a further revision of the minimum U-values required in order to improve energy efficiency. U-values are a measurement of heat loss through a wall or roof – the lower the U-value, the less the

amount of heat loss is. The current accepted U-value for walls is 0.45, a figure which can be easily met by adding around 75mm of regular insulation to your wall construction. Conventional masonry and timber frame walls have no difficulty accommodating such insulation levels. However, by 2003 the wall U-value figure is expected to fall to 0.3. It is a dramatic improvement and one which most conventional wall building techniques struggle to cope with. For instance, cavity walls will need to have 100mm cavities – as wide as the facing bricks themselves. This not only eats up precious internal space but makes it awkward tying the walls together and building in joinery. Timber frame fares no better: the standard 90mm timber stud will

no longer provide enough space for insulation, so these walls will also have to be wider.

Contrast this with the performance of PIF walls. The Beco system is available in four thicknesses and the thinnest section, which is 250mm wide, gives a U-value of 0.3 – low enough to meet the new regs already, despite the wall thickness being 50mm less than the new standards for masonry and timber frame. Step up to the next thickness, 313mm, and the U-value falls to 0.19, a level the UK building regs might hope to get to in about 2020! Other PIF building systems offer similarly low U-values; the KEPS system provides a standard U-value as low as 0.27.

The reason for these superior performances is obvious. The walls are all formed from a

composition of expanded polystyrene and concrete. All other wall building systems have to have insulation added to them.

There are other ways that PIF wall building systems contribute to energy efficiency. They make inherently airtight structures – in heavily insulated homes, the amount of heat lost through the actual building fabric reduces to remarkably low levels. As it does, the significance of heat loss through unwanted ventilation becomes greater and, in many homes, may actually become greater than the fabric heat loss. Therefore, attention to air tightness becomes more important as insulation levels increase. Some building systems cope better with air tightness issues than others but arguably none is better than a PIF system.

Competing systems: Beco has been making much of the running in the UK but there are other systems available – although none tend to be geared quite so closely to the needs of the hands on self-builder. As well as block systems, there are panel systems, where the two polystyrene walls are erected separately and tied together across the cavity using a series of steel wall ties. In the UK, the best known example of this system is KEPS. The block systems also vary quite a bit in their design – Beco is bridged with polystyrene, other blocks use steel ties. In both Germany and North America there are a number of active PIF manufacturers. It seems inevitable that several of these will soon become more active in Britain. ■

Useful Contacts

Beco Wallform:	01652 651641
Springvale's KEPS:	02893 340203
Rhodipor Ecobuild:	01372 740738
Styrostone:	01580 767700
Marmorit Plastering Systems:	0800 731 3076

Blue Maxx: North America's largest PIF manufacturer, soon to start a UK agency www.bluemaxxaab.com – note that in America, PIFs are referred to as ICFs (Insulating Concrete Forms)

CASE STUDY: Len and Kath Roberts

The Roberts' are building their own part earth sheltered home in Oxfordshire using the Beco system. They chose permanent insulated formwork because Len wanted to do most of the work himself.

Len and Kath Roberts are currently building an earth sheltered house near Banbury. They have a five acre fish farm and have endured a five year battle with their planners to be allowed to build a house with an agricultural tie to the land. To do this, they had to prove that they had a viable business and needed to live on site in order to manage it effectively. “Initially we had no intention of building an unconventional house,” said Len. “However, as the planners became more and more obstructive, we hit on the idea of burying the house into a slope to lessen the impact. We then came across David Woods, an architect specialising in this type of building, and it all went forward from there.”

The decision to use Beco Wallform came about after the Roberts saw it on Channel 4's Grand Designs. “I was immediately taken with it. I wanted to do a lot of the work myself and saw this as a way of taking control over the operation.”

The concrete pour, using ready mixed concrete from Pioneer, took place on a Saturday morning in April. It wasn't just the concrete that poured – it was the wettest day of the year. Despite atrocious conditions, during which almost any other form of outside building work would have been suspended, the concrete pour went ahead. There isn't very much that will stop a Beco pour and everything went ahead as planned. Being an underground house, the walls needed to be reinforced, requiring the addition of some steel bars. Added to this, the Roberts' have chosen a fairly complex design with a number of curved walls – the Beco system was easily able to cope with the extra demands made on it.

Despite the rain dripping down his face and his hands being numb with cold, Len was elated at how it had all gone. His verdict was straight from the heart – “It's brilliant.”

