The risky business of covering up

EWI systems have emerged in recent years as a popular solution to the problem of thermal inefficiency in non-traditional housing. But a number of high-profile structural failures – typically followed by settlements and gagging orders – suggests that clients need to wake up to the risks. By **Joe Malone**

Green Lane/Wikimedia

The Park Hill council housing estate, Sheffield, England, undergoing renovation in 2010

My interest in external wall insulation (EWI) stems primarily from my expertise in damp investigation. I had seen EWI systems inappropriately applied to a number a buildings that have walls which are meant to breathe. It was inevitable that these installations would cause long term issues with damp but this was compounded by the fact that I was seeing a number of failed EWI systems with cracks or failed building joints that would allow water ingress. My specialism in damp investigation and the fact that I was a senior manager responsible for managing millions of pounds worth of EWI work led me to research EWI failures in detail, and I was genuinely alarmed by what I found.

Non-traditional housing stock normally presents three major problems for housing providers: 1) they are thermally inefficient, 2) they may have structural defects and 3) they can be unattractive and blight housing estates.

Whilst each problem presents unique challenges, none are insurmountable and life cycles can be cost effectively extended for a further 30 to 40 years so long as investment decisions are evidence-based.

EWI systems have emerged in recent years as a popular solution to the first of the above problems, but the risks and drawbacks need to be understood. Furthermore, designed and installed without proper care, EWI systems can actually exacerbate the second and third problems – structural integrity and aesthetics.

The most urgent message here is that most EWI systems are non-structural and therefore need to be fixed to load bearing fabric. There are times when a non-structural system is by no means appropriate for use, such as in Crosswall construction. A number of legal cases are currently pending in the courts or have already been settled following serious structural failures. It's essential to understand EWI systems, and to specify and design them appropriately, but even that is not enough. Adequate site management is needed to avoid shoddy or inappropriate workarounds by operatives.

But first, let's look more closely at EWI systems, their composition and uses.

Poor SAP Ratings

The Standard Assessment Procedure (SAP) is the methodology used by the Department of Energy & Climate Change (DECC) to assess and compare the energy and environmental performance of dwellings. Since all non-traditionally constructed properties require an improvement in their SAP rating it makes sense to discuss external wall insulation. There are a number of EWI systems in use but unless you are looking for a structural system then there is little variation apart from the choice of insulation material.

Phenolic boards (PF), PUR (Rigid polyurethane foam), PIR (Polyisocyanurate), EPS (Enhanced polystyrene board), or mineral wool are all frequently used as part of these EWI systems. Rigid phenolic insulation products offer best thermal performance when compared with rigid polyurethane or extruded polystyrene. Its low thermal conductivity allows minimal thickness of insulation, which allows for easier finishing around frame reveals, roof verges and soffits. For this reason it is one of the most widely used products. That said, phenolic board comes with a few known – and a few less well known – issues:

1. Demand for phenolic board has exceeded supply which has caused manufacturers to cut the 12 week curing period to six weeks in an attempt to keep the market supplied. There are some concerns with regard to the effect this decision will have on the quality of the product and there is some early anecdotal evidence regarding increased board shrinkage after system application. Phenolic boards were known to shrink, which can occasionally cause gaps to open up in the building envelope. Will we now see an increase in the severity of this problem? I believe we will.

2. Phenolic board has known acidic properties and should not be placed in direct contact with metal roof decks, wall cladding or stanchions. There are cases pending against manufacturers where phenolic boards have caused corrosion of steel roof decks.

3. Phenolic foam insulation has a significant environmental impact, exceeding that of other insulation materials. Significant amounts of petroleum and natural gas must be burnt during the manufacturing and refining processes, though the insulation industry has ceased to use chlorofluorocarbons (CFCs) in the manufacture of foam insulation products. Still it's nasty stuff and you should consider whether continued use of phenolic board is a responsible business decision for you or your client.

4. Phenolic foam insulation will deteriorate if it is exposed to moisture or sunlight. It is important to store phenolic boards correctly and apply render to walls within 48 hours of fixing external wall boards. I have managed millions of pounds worth of EWI work and site management of this issue has been a consistent and ongoing problem.

PUR board comes with similar known environmental problems but is also known to suffer a loss of U-value (thermal performance) with time. This is due to a combination of air infiltration and fluorocarbon gases diffusing out of the product (outgassing) over time. This rate of outgassing varies from product to product but in all likelihood a property that has a PUR insulation system installed will have a significantly reduced U Value 10 years on from the date of installation.

The most cost effective and pragmatic choice of material from those under discussion is EPS, in particular, graphite enhanced polystyrene (GEPS), which will give a significantly improved U-value over standard EPS.

Its long-term performance gives significantly less concern than that of phenolic or PUR and whilst it could never be considered a 'green' product it is in my opinion the more environmentally friendly and acceptable choice from among the main types of rigid insulation board in main use. Of course there are pros and cons with every material and whilst I would recommend GEPS for low rise stock, fire performance needs consideration in high rise stock.

Fire Safety Performance

A chemical called HBCD is often added to EPS or GEPS to improve fire performance and whilst you may not yet have heard about health concerns relating to the use of HBCD, it is on the verge of being banned or having its use restricted in Europe.

In general terms EPS or GEPS has poor fire performance but can achieve a class E rating under BS EN13501-1 ('Fire classification

of construction products and building elements') when enclosed with a laminated facing layer of the type seen in EWI systems. That being said, class E isn't really acceptable for high rise applications and you would need to build in external fire breaks. Stone or glass wool products offer the best performance being rated at A1 due to their non-combustible nature.

Whilst being the least environmentally friendly Phenolic foam can achieve a Euroclass B rating due to having a zero flashover reaction to fire.

EWI System Failures

There have been a number of EWI high rise system failures in Scotland, Birmingham, Wigan and the North West. One spectacular failure at Stanley House in Bootle, Merseyside, was captured on mobile phone can be viewed on YouTube. (Search for: "Cladding Falling Off Stanley House In Bootle".)

Several court cases are pending but in Birmingham the issue has turned into a dispute over whether the products or the standard of installation were the cause of these failures. What is clear is that insulation boards have moved or become partially detached from the external building façade.

I have some concerns that systems have not been adequately wind tested for installation at height. Another known problem is that mechanical fixings into no-fines concrete have been very poor or completely inappropriate for the circumstances. There have been a significant number of hammer fixing failures into concrete, particularly no-fines concrete.

There are three relatively recent high profile cases of EWI system failures: Stanley House in Bootle, Merseyside, owned by One Vision Housing; Glasgow Housing Association's 'Mini-Multi' Blocks, Glasgow; and Derby House, Scholes Village, owned by Wigan and Leigh Housing.

> ***"In researching these cases I have found one instance where the EWI system was not certificated by the British Board of Agrément – though it may have been sold as such"***

The Youtube video of Stanley House clearly shows that the render had detached from the underlying insulation board when it failed. A poor adhesive bond, failed building joints, loose insulation boards, differential expansion – or a combination of all these factors – will cause failures such as this. However, a spokesperson representing One Vision told me that they could not comment on the failure as a condition of the court settlement with the contractor.

Glasgow Housing Association also refused to comment on the failures, but there were early reports of extensive 'blistering' in a number of multi-storey blocks shortly after installation[1]. This would tend to indicate that moisture was present under the render coat, meaning that materials were installed wet or that moisture found its way into the system due to failed building joints.

A more recent failure occurred at Derby House in Scholes Village. The render coat detached from the underlying insulation boards in April this year. "Tenants demand action after slab near miss", said the headline in local media after a piece of cladding reportedly fell 60ft to the ground just feet from the building entrance[2]. The accompanying photograph clearly shows that the insulation boards are still in place. This case was recent so it is likely to be still under investigation.

In researching these cases I have found one instance where the EWI system was not certificated by the British Board of Agrément (BBA) – though it may have been sold as such – because the supplier had substituted one tested and approved system component for another untested system component. I have seen a number of occasions where installers are making these changes to system specifications, unaware that they have breached the BBA system approval, and clients need to be aware of this.

Again, settlements are cloaked in confidentiality. This is understandable, but worrying. Clients and contractors are very reluctant to share the details of these failures due to a perceived risk of reputation damage. One client was even bound by a gagging order linked to their court settlement. This veil of secrecy does nothing to promote good practice or continuous improvement.

I do believe that render failure will, more often than, not, be a sign that the underlying substrate has failed, and you should insist on opening up works extensively to seek more definitive proof of failure before accepting an over simplified explanation that moisture has crept past failed building joints. In my experience contractors prefer simpler explanations because they are cheaper to remedy.

Proper installation

In general terms, the majority of EWI system installers are satisfied with mechanical hammer fixings alone whilst a minority of installers believes this is a problem and adopt a belt and braces approach to installation by both gluing and mechanically fixing boards to the external façade. I agree with this approach for low rise stock but would still issue a note of caution with regard to specifying a standard non-structural system for medium- to high-rise stock.

If the thermal solution is not given adequate consideration and fails then I have experienced first hand how extremely difficult it is to get contractors to resolve these failures, especially when high rise access alone (mast climbers or scaffolding) can cost them somewhere in the region of £100,000 to £250,000 per block.

[1] **'Contractors forced to repeat rendering work', Inside Housing, 22 October 2009, http://www.insidehousing.co.uk/news/housing-management/contractors-forced-to-repeat-rendering-work/6506801.article (retrieved 26 November 2013)**

EWI structural vs. non-structural systems

The majority of EWI systems are non-structural and therefore need to be fixed to load bearing fabric. There are times when a non-structural system is inappropriate for use such as in crosswall construction. Crosswall construction takes all the building loads from floors and roof on the gable walls. The front and rear facades of these properties are non-load bearing and therefore unsuitable for fixing a standard EWI system. In these cases you would choose a structural EWI system. Moreover, a structural EWI system has several other potential applications when considered for use on non-traditional stock.

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These include:

- Full cladding of defective buildings (reduces need for difficult remedial work);
- Fully designed structural cladding for non-traditional medium- to high-rise structures. Designed to account for wind loadings etc.;
- Full over-cladding of defective or inefficient system-built structures (improving structural safety and thermal continuity);
- Enclosing balconies and walkways (converting external space into usable internal floor area);
- Forming new or extending existing parapets (improving safety at roof level).

You should also note the failures of mechanical fixings into concrete (particularly no-fines) and ensure a system can bypass this issue. This is a note of warning that should apply to all system design but you should note that bad site management during any installation process will negate any effective design process. I have visited sites on many occasions and seen the wrong size hammer fixings used or, more commonly, operatives not using depth stops attached to their drills and often even punching straight through walls when drilling for hammer fixings. The length of hammer fixing is critical to the design process yet I am convinced that they often don't account for the depth of existing render applied to some non-traditional properties and therefore hammer fixings can be fixed to insufficient depth in the structural panel. It is all too easy to make assumptions about the depth of existing render and I often insist on having patches chiselled out to expose the substrate. This allows us to make a more informed decision about the required length for hammer fixings.

Pre-existing concrete defects

I previously discussed the defects relating to carbonation and chloride attack of concrete non-trads. The problem is of particular concern when dealing with high-rise stock because the repair of cracks and spalling can significantly add to your refurbishment cost. Each small localised repair can cost £30 to £40 to repair. There can be hundreds of such repairs on each high rise and this doesn't include access costs or the cost of an anti-carbonation coating.

Rusting is of course an expansive reaction and treating rusted rebar is a key part of the concrete repair process to prevent future spalling. There is an argument that says overcladding with an EWI system cuts off oxygen required for the rusting process and therefore prevents any further deterioration of the rebar. This could to a degree mitigate the requirement for concrete repairs but where structural engineers are involved in the design process then they are less likely to accept this argument.

Is EWI appropriate for all properties?

In short, no. There are concerns about the potential for EWI systems to cause damp and this stems from two issues:

Traditional properties built on the 'overcoat' principle and using traditional stone or lime mortars are meant to breathe. Adding EWI would affect the walls' breathability and so is completely inappropriate for use on these properties. An ex-colleague of mine has been trying to find a solution for improving SAP on single skin stone properties in Cumbria, and chose an internal wall insulation system. Whilst this raises less concern it will still affect the walls' breathability.

I've seen a number of EWI systems badly installed and bridging the DPC. The installers may well claim that their materials will not wick moisture but you'd be wise to judge for yourself.

Aesthetics

Well designed EWI systems have the ability to transform our estates, but if design is not given adequate consideration the estates will remain as bland as ever, or even be damaged in their aesthetics, particularly by the choice of gaudy colour schemes. Housing providers who give residents too much choice in the design of their estates often end up with a clashing patchwork of pink, green, violet, etc..

Colour choice of external render systems is one consideration, but all EWI systems offer a choice of architectural detailing as well. An effective one can be bricks slips. On the last scheme I was involved with we gave a great deal of consideration to all aspects of design, even to the extent of having illustrations done by artists so we could make better choices.

To many organisations, EWI is nothing more than a technical solution to deal with thermal efficiency but they are failing to protect the future of their estates and communities by not giving adequate consideration to the design process. ❑

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2 "Tenants demand action after slab near miss", WiganToday.net, 16 April 2013. http://www.wigantoday.net/news/local/tenants-demand-action-after-slab-near-miss-1-5587248 (Retrieved 26 November 2013)