Industry Voices

EWI and off-site construction

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EWI and off-site construction – perfect partners when system selection, design and testing are key considerations

There can be little doubt that off-site construction is becoming increasingly popular in today's construction industry. Creating building modules and panellised through-walls in carefully controlled factory conditions, and then delivering them to site, helps increase quality standards and ultimately promotes better health and safety levels. It also saves time and reduces weather dependency by moving key elements of the traditional building programme to a factory and off the critical path of the project build.

The versatility and benefits of site applied External Wall Insulation (EWI) are well documented, and in this document we discuss how these advantages can be realised using modern off-site construction methods.

i. Alternative modular panel finish – Sto Resin Brick Slips

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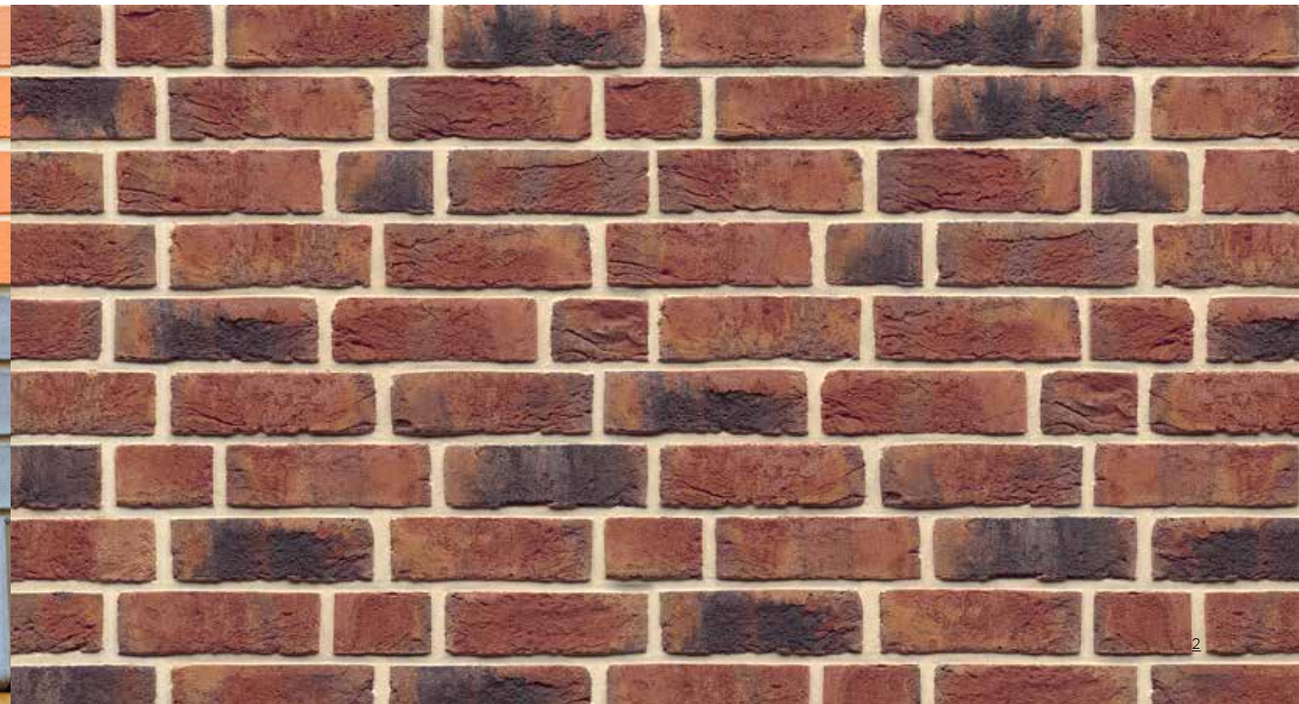
ii. Alternative modular panel finish – StoBrick Clay Brick Slips



2

"Off-site construction helps reduce the number of deliveries required to site and minimises the volume of waste materials".

Improving sustainability levels

As some might know, the use of EWI has many attractive features, particularly as it relates to the environment. Not least as a cost-effective way to improve energy efficiency. EWI essentially wraps the building in a bespoke thermal blanket, and it can also help remove many of the opportunities for cold-bridging which exist with more traditional alternatives. Site-applied EWI is a well-established technology that has been thoroughly tried, tested and proven to create significant reductions in heat loss, minimise energy usage and therefore reduce costs. It can also play a key role in the design of lightweight, modular façade elements and offers a range of high impact-resistance and attractive external options. Through factory application, EWI is therefore highly compatible with off-site construction techniques.

Given the increasingly urgent need to reduce the impact of construction activities on the environment, off-site construction helps reduce the number of deliveries required to site and minimises the volume of waste materials which must be disposed of. This is where the use of EWI in conjunction with off-site construction can make a great contribution.

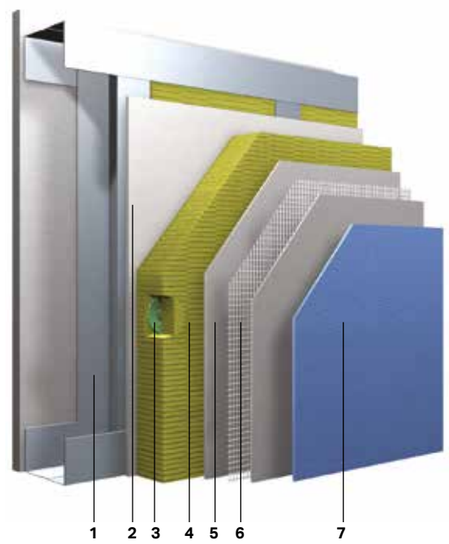
Meeting structural requirements

One of the key reasons for the compatibility of EWI with modular systems is that it can be applied to a wide range of off-site modular and panellised structures, including timber, SIPs, reinforced concrete and various steel-based options that are proving increasingly popular for large multi-storey buildings. Among the many considerations is the spacing of the structural elements within each modular unit, which requires a design that accommodates mechanical fixings.

EWI can also be factory-applied to many different infill panel types, where it can add an extra layer of insulation to the panels. If an adhesive fixing is being used, the strength of the panel structure is a key consideration. A strong surface is generally needed to create a secure and long-lasting adhesive bond, as a weaker substrate is likely to be affected by wind loadings[1] which can cause deflection and affect the bond with the EWI boards.

From a durability perspective, it is also important to ensure the watertightness of both the external faces of panels and joints. If ingress occurs, the bond strength within the layers of a system can be compromised over time, potentially resulting in failure.

iii. A typical build-up of a StoTherm Mineral external wall insulation system onto light steel frame



1. Light-steel frame substrate
2. CP board
3. Sto-Rotofix plus black/green spiral fixing
4. Mineral fibre board
5. StoArmat Classic cement-free reinforcing coat or StoArmat Novo mineralic reinforcing coat
6. Sto Glass Fibre Mesh / Sto-Armour Mesh embedded into reinforcing coat
7. Decorative render finish

The importance of product longevity

In recent years, the UK construction industry has seen an increasing drive for longer term durability of products, typically ranging from 25 to 60 years. This push is from both product manufacturers, who wish to make claims of superiority in the marketplace, and Warranty Providers and Insurers, who are looking for assurance that products will continue to perform over the long-term.

As the nature of the modular units' structure and substrate are clearly important, it is advisable to plan the use of EWI at the earliest possible stage.[2] By understanding the make-up early on, this affords the opportunity to determine the system's performance through structural and environmental testing.

1. Refers to BBA case study on resistance to windload.
2. Often, calculated performance yields more conservative values than those obtained via testing.

iv. StoPanel® prefabricated external wall insulation panels - these can be custom-designed to match project needs. StoPanel® Technology has been designed with partnerships forged between leading contractors and fabricators, and Sto Corp. in the USA. This technology is currently being developed for European markets.

v. StoSilco 1.5 Render can be applied to finish modular panels with an external wall insulation system

Determining the correct assessment processes

There are numerous types of EWI available, with common insulation types including Expanded Polystyrene (EPS), Extruded Polystyrene (XPS), Mineral Wool (MW), Phenolic Foam (PF), Polyisocyanurate Foam (PIR) and Polyurethane Foam (PUR).

Given the variation in material types and the ways in which they can be employed within systems, there is no 'one size fits all' method of test and assessment. However, careful consideration is needed to select from a number of test requirements, including but not limited to Fire, Thermal Performance, Watertightness, Resistance to Wind Loading and Structural testing.

Ultimately, it is important during the specification period for architects and contractors to work with the EWI provider to select a system which has been tested with the specific substrate build-up, and the project specific application conditions and performance requirements considered. Strict adherence to the manufacturers' application procedures is critical.

Effective protection with an attractive finish

It is also important to note that the durability, thermal performance and long-term aesthetics of systems incorporating EWI relies on the performance of the system as a whole. That is, the performance is achieved through multiple components working together. Therefore, when considering design changes or multiple external finishes, careful attention must be paid to the implications these alterations may have on performance.

When used with a modular system, EWI can allow the factory application of breather membranes, damp-proof membranes and internal cavities which add another layer of protection against water and damp. The off-site elements themselves can provide a good base level of insulation to which the EWI can add an extra thermal performance and attractive aesthetic finishing.

Once the EWI is installed, the building can be finished with either a render or a rainscreen solution. With external finishes such as brick-slips and glass also available for use, this opens up a wide range of possibilities in terms of design, colour and textures.

Multiple product testing for better-informed decisions

Where factors around product viability can result in differential performance, test assessments can be employed to confirm fitness-for-purpose. For manufacturers of modular and panellised systems, development costs and time-to-market are of critical concern. Therefore, when assessing each system on its own, which can be expensive and time consuming, the testing facility that conducts the testing can often assist in finding the most economical way to assess multiple configurations/finishes within the same programme - reducing both costs and time to market.

vi. Hygrothermal test rig

When testing EWI systems, manufacturers can also take the opportunity to trial multiple product types. This can be for value engineering purposes, where performance data can be weighed against costs to allow for informed decisions to be made on design modifications for increased function or for cost reduction.

Alternatively, product variants can be tested to allow benchmarking against competing alternatives in the marketplace, providing data for marketing purposes and valuable information for research and development.

Making way for change

Applying EWI to an off-site construction brings many advantages, but it must be considered early in the design process, as a factory-applied EWI system may require the application of some, or even all of the EWI layers, such as render or brick slip, to be completed off-site.

Although campaigns have previously been mounted to promote the factory-application of EWI in modular construction, and it has been seen as suitable for some buildings such as schools and hospitals, widespread adoption in the UK has been slow. This option, however, is now being embraced by more progressive off-site manufacturers who are benefiting from applying the EWI in a controlled factory environment.

Overcoming the burden of proof

The reluctance of some to embrace new ideas is not unusual in the construction industry, indeed, for innovative products there is often a 'burden of proof' on the manufacturer as specifiers and end-users expect, as a minimum, equivalent performance to that offered by traditional methods.

To traverse this, testing can provide suppliers and manufacturers of innovative products with the performance data required to educate specifiers and end-users in a straightforward manner - offering direct comparisons to existing methods and increased marketability of new products.

The industry often looks to smart architectural and façade finish designs which reduce both the number and the visibility of joints. Great progress is already being made in this area with the introduction of architectural profiles that allow joints to be hidden behind architectural detailing, but more can be done with creative designs which embrace panellised and modular construction systems.

The challenges ahead

With all new methods comes a learning curve and aligning modules and pre-finished wall panels on the façade can be a challenging task. Typically craned into position and then fixed from inside the building, thus often removing the need for scaffolding, correct panel and modular alignment, and effective weatherproofing detailing is extremely important.

Additional challenges come during transit and in the loading and off-loading methods used.[3] For each of these areas, the magnitude and effect on performance can be monitored and determined via transportability assessments. These studies can incorporate desktop reviews, monitoring of strains, video analysis and testing of site-installed products to allow benchmarking against pre-transit performance.

Overlooking this can cause stresses and strains within units that can be detrimental to the final performance.

Working together to invest in the future

While EWI brings many benefits to modular constructions, there is still much to be done to increase its use. Manufacturers must work with off-site constructors to ensure that their EWI products and systems can meet their specific needs; and that means investing in the best machines, technology and skilled labour force, ably supported with robust testing through the supply chain by a UKAS accredited testing facility.

This is where the BBA comes in. The BBA is a market-leading UKAS accredited certification body [No.17065:2012], within the UK, setting the standard for excellence within the construction industry for products and systems and offers technical expertise and independent 3rd party certification. Products that look to achieve BBA Certification, are subjected to rigorous testing and auditing before they are certified. This helps manufacturers show that their products not only meet industry standards and are accepted, but that they are also covered by NHBC warranties, based on independent 3rd party testing and certification.

3. It is important for safe and secure loading and transit that correct lifting techniques, product storage and in-transit differential movement are observed.

Meet the authors

George Bailey

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George Bailey has recently joined the British Board of Agrément as a Product Manager for BBA Test Services. He is a trained engineer with a BEng in Mechanical Engineering and MSc in Financial Risk Management. Having spent most of his career at Lucideon, George has substantial knowledge in construction testing – both technical and commercial. As such, he has helped the BBA to develop its product portfolio and expand its client base.

David Tyndall

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Following an early career in consulting and marketing, David has spent the last 15 years working in the construction industry with a particular focus on off-site construction. In 2004, he founded a prefabricated wall panel company which developed a unitised wall panel system based on LGS and glass reinforced concrete. David subsequently joined the Off-Site division of Kingspan Group Plc for a number of years before moving to Sto Group in 2011 as Managing Director for South East Asia, based in Singapore. Since early 2019, he has been based in Ireland and is focused on developing products and solutions for Sto's modular, off-site and pre-fabricated panel construction markets in Western Europe. David is also a member of the board of Skyrise Prefab Building Solutions Inc. in Toronto, Canada's leading provider of panelised, light gauge steel building solutions using StoPanel Technology

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