## Meet the Team

### Oriola Davies

BEng, MSc BS, ProfGradIMM

Oriola is a qualified and experienced Mechanical Engineer (BEng) who joined the BBA in 2008 as a technical trainee in the Construction products unit of our Certification department, and since grown in her role to become Team Manager for the External Wall Insulation Systems (EWIS) team and is a BBA identified Technical Expert.
Oriola is an active member of the EOTA/ETICS working group and has considerable knowledge in construction product certification.

### Fernando Ferrarin

BEng, MEng

Fernando is a qualified Civil Engineer with a Master's degree in Civil and Urban Engineering. He worked as a Site Engineer and Quality and Sustainability manager before joining the BBA in 2017 as a Project Manager in the Engineering unit of our Certification department. He brings with him professional expertise in quality and sustainability certification and experience working in consultancies across America and Europe.

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# Resistance to wind load

## Technical case study

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PRODUCT CERTIFICATION | AUDIT & INSPECTION | TEST SERVICES

# Avoiding external insulation failures

**It is essential to assess external wall insulation systems for their ability to resist wind load and prevent installation failure.**

External wall insulation systems (EWIS) comprise insulation material that is mechanically or adhesively fixed to a substrate of a building's external wall. Various types of render, such as silicone, acrylic, mineral renders and decorated finishes including brick slips or dash finishes, are then bonded to the outer face of the insulation boards or slabs.

Installation improves the thermal performance of new and existing buildings and the aesthetics of facades, in addition to reducing condensation risks. Although thermal performance is the most important feature for users, the structural stability of the system is often overlooked by the non-technical community. This article therefore examines the potential issues and unintended consequences of EWIS design in relation to wind-load resistance.

To address the growing market for EWIS, the UK construction industry has been challenged to improve its design, detailing and installation, including the specification of ancillary components, pre-installation procedures, the quality of work on site, and site surveys. Furthermore, the construction industry needs to work alongside suppliers, installers and consumers to offer guidance and support on EWIS behaviours that might lead to unintended consequences from poor fittings.

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Recent reports of EWIS structural failures worldwide have raised technical bodies' awareness regarding systems' resistance to wind load. The collapse of EWIS's – which are often rendered with heavy finishes – from the external walls of high-rise buildings can cause property damage, serious injury and fatalities.

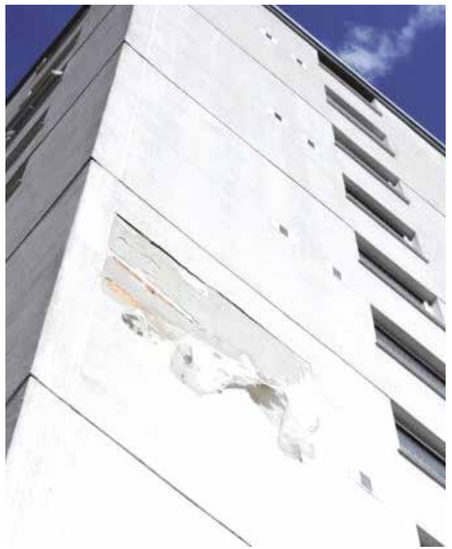
There have even been circumstances, albeit few and far between, where entire sections have detached from a building's facade after exposure to severe rain and wind loads.

Design and installation defects such as deficient structural calculations, specification of substandard ancillary components and weather exposure during installation also reduce the service life of the system. It is important when designing and specifying EWIS's to consider every mechanism by which they resist the applied static and dynamic loads.

**Negative wind load** – that is, wind suction on the external face of the system – is the most unfavourable lateral load. The design wind loads on the different zones of the building's elevation for the specific geographical location must be calculated, taking into account all relevant factors such as location and topography, in accordance with the Eurocodes BS EN 1991-1-4: 2–5 and its UK National Annex; the proposed fixing method must give a design resistance equal to or greater than the design load applied to the system.

Due to the complexity of building materials, tools, fixing and installation techniques, a comprehensive recommendation depends on a detailed understanding of the specific site conditions. Weather exposure and water ingress are major concerns during installation, for instance; water penetration results in saturation and increases the weight of the insulation, meaning both its thermal performance and its strength degrade.

Freeze – thaw action and high wind forces on the weakened system during winter can together result in excessive movement, cracking and finally delamination of the render or pull - through of the fixings. Failure to administer water exclusion details correctly also leads to hydraulic pressure on the render surface, which causes bursting and tensile



> "To emphasise the importance of structural integrity and safety during the system lifespan, the British Board of Agrément (BBA) has revised every current EWIS certificate regarding its strength and stability, and promoted a training course on wind-load resistance available to certificate holders, suppliers and architects."

stresses that contribute to the failure of the bond between the adhesive or basecoat and the insulation.

Design resistance of EWIS's to negative wind loads is determined either by a full-scale wind-suction test – such as the **dynamic wind uplift (DWU) test** – or by structural calculation defining the resistance of the contributing components. This is based on limit-state design principles, adopting design that is assisted by testing in accordance with the Eurocode (BS EN 1990).

The resistance to wind load depends on the system and fixing method. An excessive number of mechanical fixings can produce cold bridges, leading to reduced thermal performance. In turn, inadequate fixings placed in unsymmetrical patterns can induce structural failure where the load distribution on them does not match the assumptions made in the calculations.

To emphasise the importance of structural integrity and safety during the system lifespan, the British Board of Agrément (BBA) has revised every current EWIS certificate regarding its strength and stability, and promoted a training course on wind-load resistance available to certificate holders, suppliers and architects.

This training provides technical guidance on understanding and applying the design data in the certificate, thus helping to address the risks associated with the system's structural design. While there are no obligations to adopt the solutions proposed by the guidance on BBA certificates, following the principles does provide a mechanism for satisfying part A of the Building Regulations.

When assessing the stability of the system under negative wind pressures, the DWU test can be employed in accordance with European and BBA in-house guidelines. The system must adequately resist and safely transfer the calculated loads to the structure, accounting for all possible failure modes.

The supporting structure – that is, the external wall – should be able to resist any extra load that may be imposed as a result of installing the system.
The substrate and supporting structure must be able transfer all resultant additional loading to the ground in a satisfactory manner.

The adequacy of the substrate and supporting structure must be verified by the person or party responsible for the overall stability of the building to which the systems are fitted. **Only trained, competent professionals** can carry out the

design, specification and installation of EWIS in accordance with the particular requirements.

The DWU test determines the characteristic wind resistance of the EWIS through repeated changes in air pressure on a large sample area. This attained resistance cannot be extrapolated, and is only valid for the configuration of the system tested, resulting in the maximum pressure (Q) in the cycle preceding test specimen failure. This force is considered in a characteristic resistance formula Rk = Q x Cs x Ca, where R[k] is the characteristic design resistance, Ca is the geometrical factor to allow for deformation in test wall and real deformation on a complete wall, and Cs is a statistical correction factor.

A successful EWIS design must demonstrate an accurate understanding of material properties including thermal conductance, vapour resistivity, sorptivity – that is, its capacity to absorb and transmit liquid by capillarity – mechanical strength and fire performance, plus the installed environment, such as its existing structure and fabric, internal heat and moisture conditions, external solar gains, ventilation and wind environment, as well as considering the modelling capabilities in the design process.

If these elements are correctly certified, considered and assessed during the design phase and the system is properly installed, BBA-certified EWIS present solid, reliable and safe solutions to improve the thermal performance of buildings.

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**Competencies:** Building Pathology, Construction Technology, External Wall Insulation Systems and Environmental Services

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