Under the skin

8 January 2018

Trevor Rushton scrutinises the performance of cladding systems and the factors that can lead to failure

---

The horrendous images of the Grenfell Tower fire will continue to haunt the profession for years to come; inevitably, attention is currently focused on the performance of cladding systems in fire, and until we have the results of the public inquiry it will be dangerous to speculate as to potential changes in regulations and standards.

However, the behaviour of cladding systems is not simply measured in terms of their behaviour in fire; there are numerous other factors that have the potential to affect their long-term performance.

Cladding is now dominated by lightweight systems of timber, aluminium, high-pressure laminate, stone or terracotta. Even brickwork is increasingly substituted by brick slips on a rigid-foam carrier system, as forms of construction become ever lighter. From a surveying perspective, the important components and elements are largely concealed from view and it is difficult to assess the quality of work.

Timber cladding

In a drive to establish a low-carbon, sustainable footprint, timber cladding has become a popular choice for buildings, but with mixed success. External timber cladding , 3rd edition, published by TRADA Technology , offers some helpful guidance as to the correct specification of such cladding, the most vital factor being durability.

Naturally durable trees such as cedar and Douglas fir can perform well, but a lack of consideration of detailing for rainwater run-off, fixing and moisture movement can result in reduced operating life, even when more expensive durable materials are used.

Alternative, less-durable species can be heat-treated, a process which involves heating the timber in a kiln to about 200?C to destroy the hemicellulose that typically enables fungal growth. An alternative to heat treatment is chemical modification ? acetylation ? which modifies the properties of the timber and reduces its ability to absorb moisture.

Being a hydroscopic material, timber expands and contracts according to moisture content. Typically, in-service moisture conditions of 12?18% are anticipated, although saturation can be expected periodically. Timber that has been installed too dry or too wet can suffer distortion, leading either to unacceptable gaps or buckling. Ideally, the installation?s moisture content needs to be maintained at about 16%.

High-pressure laminates

High-pressure laminates (HPLs) are increasingly versatile and are now commonly used on building exteriors. Usually a blend of natural fibres and thermosetting resins manufactured under high pressures and temperatures, the panels can incorporate a variety of decorative finishes. When installed correctly, HPLs are durable, but as with many products installation and fixing must be carried out strictly in accordance with the manufacturer?s instructions.

Figure 1: Distortions in an HPL cladding system resulting from incorrect fixing

A common method is to use rivet fixing, in which a central, fixed point carries gravitational loads while perimeter fixings restrict movement in the wind; the perimeter fixings must, however, permit the panel to move as a result of thermal and moisture changes, otherwise there is a risk of distortion, which will damage them or pull them out.

The fixing specification is critical, but of course once the panel has been installed it is difficult to establish whether the conditions have been satisfied, unless intrusive investigation is undertaken. A typical fixing specification is as follows:

- rivet shank diameter is 5mm;
- rivet head diameter is 16mm;
- fixed-point hole diameter is 5.1mm;
- hole diameter for sliding points in the panel is 10mm;
- the rivet head should be 0.3mm free from the panel surface;
- rivets must always be centred in the holes;
- to retain their position, each panel must have one fixed point in the centre; and
- all other fixing points are sliding points.

Poor fixing coupled with poor drainage and ventilation behind the panel is difficult to resolve without taking the cladding off ? an expensive and disruptive operation, and for which it will be difficult to recover costs in buildings under multiple ownership.

Factors in failure

According to the Construction Industry Research and Information Association report Cladding fixings: a guide to good practice , it is estimated that 80% of cladding failures are due to 3 principle factors: location, oversized holes, and fixings overloaded or losing load capability over time, otherwise known as creep.

While traditional, heavy claddings demanded heavyweight bespoke bracketry, light claddings including thin stone?aluminium composites are usually supported on T-bar cladding rails arranged vertically and held off the building by aluminium 'helping hand'-type bracket systems.

There are a variety of such systems, but common to their design is a simple L-shaped bracket with or without a thermal break strip, into which the leg of the T-bar can be pushed and adjusted to ensure vertical and horizontal alignment.

To simplify manufacturing, many brackets are supplied with round and slotted holes; these need to be used according to whether the bracket is taking gravitational loading ? when a fixed point is needed ? or restraint loading ? in which case a slotted fixing is needed.

If the incorrect holes are used, there remains a risk of distortions from thermal expansion or long-term creep of the building. Needless to say, the spacing and fixing of cladding systems need to be the product of careful consideration of wind-loading conditions, as per BS EN 1991-1-3: 2003 .

On 5 September, the Department for Communities and Local Government issued a circular to building control bodies and approved inspectors drawing attention to the need for competent and appropriate design of fixings.

This states that: 'Failure to properly take into account these factors can mean that the safety factors used during calculation and design to meet anticipated wind loads can be significantly eroded or, in some cases, reduced to zero. Where safety factors are marginalised, only a perfectly installed system will be likely to resist predictable peak wind loads'.

Figure 2: Cavity behind a timber rainscreen ? no provision for drainage resulted in significant water ingress internally

Water management

Another critical consideration with cladding is water management. If water penetrates a cavity, it can move down through the cladding system to infiltrate the building at interruptions such as window and door openings. Rigorous water management is essential: this is often achieved with the use of cavity trays, or ethylene propylene diene monomer (EDPM) rubber membranes, at appropriate positions.

Given the need to maintain ventilation, cavity tray details also need to be constructed in such a way as to permit effective ventilation and prevent insect and vermin entry. Unfortunately, drainage mechanisms are often neglected or left to the cladding installers to sort out on site, causing inevitable leakage problems later.

Cladding designers have long appreciated that it is impractical to confront the weather head-on and create a totally impervious outer barrier. It is far better to accept that leakage will take place, designing methods to accommodate it and ensure water drains away harmlessly.

Good ventilation is an essential mechanism in drying, and will permit the harmless diffusion of water vapour from the interior of the property. The provision of good ventilation, however, is contrary to the principles of fire management, as large, narrow voids enable flames to spread in an uncontrolled fashion behind cladding.

So the provision of fire barrier is essential, but these also need to accommodate ventilation, usually by means of intumescent materials. However, distortion of lightweight panels in the event of a fire can overcome the advantages of intumescent foam.

Where cladding is fixed in front of mineral wool insulation, it is usual to provide a breather membrane between the cavity and the insulation to prevent the passage of liquid water into the inner parts of the wall where it could cause harm. Breather membranes need to be detailed and fixed properly to be effective; incorrect lap detailing can result in water ingress.

Seamless finishes such as external wall insulation systems rarely prove totally watertight, and the National House Building Council insists on the provision of a drained cavity behind the cladding for tall buildings. Again, it is very important to note that adequate attention is given to the drainage of any water that penetrates this void: many manufacturers? standard detailing is prepared on the basis that a drained cavity does not exist, so you should treat it as you would treat a cavity wall.

In summary, while we await the result of further deliberation on the fire performance of cladding, as surveyors we need to be alive to the potential ways in which lightweight cladding systems fail ? especially since the components that are critical to the system are often concealed from view and require intrusive investigation. Collectively, surveyors need to be up to date when it comes to the inspection of cladding.

Trevor Rushton is a partner at Watts

Further information

- Images ? Trevor Rushton
- Related competencies: Building pathology , Construction technology and environmental services , Design and specification , Fire safety
- This feature is taken from the RICS Building surveying journal (December 2017/January 2018)
- Related categories: Defects , Dilapidations