Introduction

This Technical Note describes the performance required of an externally rendered cladding system and ways in which it should be assessed.

CWCT TN59 shows the need for a single designer to assess the overall performance of a wall constructed from many components and several layers, possibly by several specialist contractors.

CWCT TN59 also describes the lessons learnt from building envelope failures in North America.

The scope of the performance is extensive and detailed assessment may be beyond the knowledge of an individual. It is likely therefore that separate individuals will consider different aspects of performance. However each should consider the wall as a whole and there should be a single person who ensures that all aspects of performance have been appropriately considered.

Performance of an externally rendered cladding system should always be assessed against the following aspects of performance:

- Structural behaviour
- Water penetration resistance
- Thermal performance
- Fire performance
- Maintenance
- Durability
- Detailing

The wall may also have to be assessed for other aspects of performance such as acoustics.

Structural performance

Building envelopes are required to carry all anticipated loads and meet serviceability and safety requirements, CWCT Standard for systemised building envelopes. They are also required to accommodate movement of the structure and the cladding. Finally cladding systems have to be robust.

Serviceability

Requirements for structural performance are given in CWCT Standard for systemised building envelopes. Deflections caused by the design wind load should be limited to prevent cracking of either the external render or any internal
air barriers and finishes such as a dry lining.

**Safety**
The wall should not become unsafe when it experiences a wind load fifty per cent greater than the design wind load. It is recognised that the render and system may require repair if this extreme wind event occurs. The render may crack but it should remain adhered to the wall.

**Movement accommodation**
Renders may expand and contract with changes in temperature or moisture. Some renders require the provision of expansion joints.

Primary and secondary structures move due to applied loads. The movements experienced by the cladding are likely to be less if the support wall is solid. However, framed support walls will follow the movements of the primary structural frame, CWCT TN55.

Movement of a structural bay such as that caused by wind sway will generally lead to low and uniform strains in the render. However, higher localised stresses may occur around window openings and many render coats require reinforcement at the corners of apertures such as windows.

Concentrated movements may occur where movement joints exist in the primary support structure. Renders, insulation and board should not be continuous past structural movement joints. A movement joint should be provided in the render coat at these locations.

**Impact**
Requirements for resistance to impact are given in CWCT TN 52.

Some render systems require stronger boards or render coats where the risk, or magnitude, of impact loading is greater.

Impact resistance is most important where people have access to the external surface of the wall. In particular the ground floor is more susceptible to impact damage. If adequate impact resistance cannot be provided by the render system then a different ground floor treatment should be adopted.

**Water penetration resistance**
Externally rendered cladding systems work on one of two principles:

- Face sealing
- Secondary defence

The method of providing resistance to water penetration should be identified at the outset. Assessment of the wall and detailing of all apertures and penetrations should recognise the requirements of the method of providing resistance to water penetration, CWCT TN17.

**Face sealed systems**
Face sealed systems rely on the render coat alone to prevent water penetrating into the wall construction. They contain no cavities or drainage system to drain away any water passing the external render coat.

Any cracking or other damage to the render may lead to water ingress past the render coat. This water will be unable to pass back out through the render coat and will be trapped within the wall with the effect that:

- It will eventually migrate inwards,
- It will promote corrosion and rot,
- It may reduce the effectiveness of the insulation,
- It may freeze and cause damage by expansion.

Water is likely to enter behind the render coat at windows, penetrations and other interfaces if they are detailed or constructed wrongly.

**Secondary defence systems**
Secondary defence systems contain cavities within the wall that are drained to
the outer surface through protected openings.

Limited damage to the render coat may not lead to gross water penetration as small quantities of water passing the render coat will be intercepted and drained back to the outer face.

The cavity has to be of adequate depth to allow free drainage. The CWCT standard for systemised building envelopes requires a minimum cavity width of 25 mm for a cavity in a rainscreen wall although this may be narrowed locally to 12.5 mm. The NHBC standard requires a minimum cavity width of 15 mm.

Where the insulation is applied to a board, it is possible to provide a cavity between the board and the face of the insulation. A cavity in this location does not significantly affect the design of the system except that the span of brackets supporting the boards will have to be increased.

Where the insulation is applied directly to the insulation, the cavity can only be provided between the back of the insulation and the back wall. Placing a cavity in this location may significantly change the design of the system as it is no longer possible to bond the insulation to the back wall and spacers must be introduced between the insulation and the back wall. The effectiveness of the insulation may be reduced by the existence of a cavity on the warm side of the insulation. If the cavity is designed as a ventilated cavity this effect will be significant but for a cavity than is only drained the effect will be small.

**U-values**

Framing systems create thermal bridges and they should be included in the calculation of U-values. Guidance on calculating U-values in accordance with AD L of the Building Regulations is given in CWCT The thermal assessment of window assemblies, curtain walling and non-traditional building envelopes. A calculation of the true U-value, including the effect of a metal frame and fixings will yield a U-value 40 to 100 per cent greater than that calculated assuming a purely layered system.

The U-value of an externally rendered cladding system supported by a back wall may be regarded as a simple layered construction provided that no cold bridges are formed by rails or fixings. However, thermal bridging will occur at apertures, penetrations and interfaces and should be included as a $\psi$-value or $\chi$-value in the calculation of an overall U-value.

**Thermal bridging**

Thermal bridges created by metal framing members and fixings not only increase the U-value, they also lead to colder or warmer patches on the surfaces of the wall. The risk of condensation forming is greater on areas of the wall surface that are cooler.

The effect of thermal bridging may be reduced by eliminating metal components that fully penetrate the insulation layer or using insulating components to separate metal components.

**Moisture and condensation**

Condensation will form if the combination of moisture and temperature is such that, either the moisture level is too high or the temperature is too low, CWCT TN33.

Condensation may form on the inner surface. The risk of surface condensation may be reduced by reducing the effect of any thermal bridges.

Interstitial condensation may form within the wall. The risk of interstitial
condensation may be reduced by reducing the effect of any thermal bridges or by using a vapour control layer.

An adequate vapour control layer may be provided by:

- A concrete support wall,
- A dense internal plaster finish,
- A foil backed plasterboard.

Alternatively a separate vapour control layer may be included in the construction.

The risk of condensation occurring can be assessed by calculating the temperatures and moisture levels within the wall. Particular attention should be given to high humidity rooms such as bathrooms.

A vapour control layer should always be provided on the warm side of the principal insulation unless a condensation assessment risk assessment shows that it is not necessary.

There should be only one vapour control layer. If there are two vapour control layers of similar impermeability moisture may be trapped between the two. Modern polymeric renders have low permeability to water vapour and may form an inadvertent vapour barrier.

Fire

Ignition
Exposed surfaces should resist ignition. Using only materials that meet Class 0, as defined in BS 476 parts 6 and 7, normally gives acceptable performance. However, resistance to ignition depends on the detailing of edges, particularly when materials within the wall do not meet Class 0. An alternative to Class 0 is Class B – s3, d2 or better in accordance with BS EN 13501-1.

Reaction to fire
Fire should not spread if part of the cladding system ignites. AD B requires cladding systems to have cavity fire stops at every floor level.

In externally rendered cladding systems the space occupied by the insulation should be regarded as a cavity when considering the placement of cavity barriers.

The reaction of cladding systems to fire may be assessed by testing in accordance with either BS8414 Part 1 or 2. This tests ignition at an aperture, and spread of fire.

There should be sufficient fire resistant fixings to prevent detachment of the outer layer of the cladding system from the building in the event of fire. There should normally be at least one fire resistant fixing per square metre and per insulation batt. If render is applied directly to the insulation then the fire resistant fixings should also retain the render layer. This is normally done by ensuring they engage with the mesh reinforcement.

Maintenance

All externally rendered cladding systems require regular inspection and rapid repair in the event of damage occurring. This requirement is stated on all BBA and EOTA certificates for external rendered cladding systems.

Adequate provision for maintenance access should be considered at the design stage.

Methods of inspection, maintenance and repair should be included in a maintenance manual. Piecemeal repairs may lead to colour inconsistency across the façade. This is a particular problem with some self-coloured renders.

Durability

The service life of a face-sealed externally rendered cladding system is dependent on regular inspection and repair of any damage that may allow water to pass the render.

Any water passing the external render of a face sealed system will be trapped behind
the render. It may then be some time before water leakage manifests itself at the inner surface of the wall. Considerable corrosion and rot can occur in the intervening period.

External rendered finishes may be susceptible to mould growth, particularly on north facing elevations. While this effect is not limited to this type of façade, the effect is more pronounced on highly insulated surfaces which are colder and likely to remain damp for longer. Where staining occurs, the textured surfaces produced with rendered finishes are more difficult to clean than metal surfaces.

**Detailing**

When assessing the performance of an externally rendered cladding system it is important to consider detailing at all penetrations, apertures, interfaces and perimeter features. These should not create any unacceptable weakness in the cladding system or otherwise impair the performance of the wall.

**Water penetration**

There should be an effective water barrier that is contiguous across the building envelope.

If there is a cavity behind the render layer then all cills, heads, jambs and penetrations should be flashed to limit water ingress.

In a face sealed system all windows, penetrations and perimeter details should be sealed to the render layer to prevent ingress of any water.

**Air barrier**

There should be an air barrier, normally at or near the inner surface. This should always be continuous.

The air barrier in the cladding system should be identified and it should be sealed to all windows, penetrations and the air barrier in adjacent construction at other interfaces.

**Vapour control layer**

If a vapour control layer is necessary in the wall then it should be coordinated with the vapour control layer in adjacent construction. If the vapour control layer is a polyethylene sheet then it should be lapped on to all adjacent vapour control layer.

**Thermal bridging**

Detailing of window openings and penetrations may cause unacceptable thermal bridges. Particular attention should be given to the assessment of window pods.

**References**

BS476-6:1989, Fire tests on building materials and structures. Method of test for fire propagation for products

BS476-7:1997, Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products

BS8414-1:2002, Fire performance of external cladding systems. Test methods for non-loadbearing external cladding systems applied to the face of a building

BS8414-2:2005, Fire performance of external cladding systems. Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

BS EN 13501-1:2007, Fire classification of construction products and building elements. Classification using data from reaction to fire tests

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Standard for systemised building envelopes.
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The thermal assessment of window assemblies, curtain walling and non-traditional building envelopes.

CWCT TN17
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CWCT 2000
Performance of externally rendered cladding systems

CWCT TN33
Breather membranes and vapour control layers in walls.
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CWCT TN47
Overall building envelope U-values.
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CWCT TN55
Movement accommodation in building envelopes.
CWCT 2007

ETAG 004
External thermal insulation composite systems with rendering.
EOTA 2000

NHBC
NHBC Standards, Part 6.9.
NHBC 2005