Technical Note No 59

Introduction to externally rendered cladding systems

This Technical Note is one of two describing the procurement design and assessment of externally rendered cladding systems. They are:

TN 59 Introduction to externally rendered cladding systems
TN 60 Performance of externally rendered cladding systems

This Technical Note should also be read in conjunction with:

TN17 Weathertightness and drainage
TN33 Breather membranes and vapour control layers in walls
TN47 Overall building envelope U-values

Introduction

External renders are used in many forms of wall construction and in some forms have been used successfully for many years.

However, the performance of external renders is highly dependent on site workmanship and the robustness of interface details. There is also some concern that renders may be used that are inappropriate for the particular substrate they are being applied to.

The use of externally rendered lightweight construction in North America has lead to large numbers of building envelope failures. There are over 65,000 properties needing major remedial work in British Columbia alone. These failures are well documented. The Barrett Committee of enquiry into building envelope failures in British Columbia found that failures occurred for a number of reasons including:

a) Use of face-sealed systems that rely on single water seals in the outer surface of joints and on the performance of the render.

b) Use of inappropriate design features for a wet climate. These included balconies, external walkways and reduced overhangs all of which provide greater opportunity for water penetration.

c) An increase in the number and complexity of joints in the building envelope.

d) Weaknesses in architectural and shop drawings.

e) Failure to understand and inspect construction at site.

f) Use of wall construction that was suitable for a drier mid-continent environment in a wetter sea-board environment.

Three clear conclusions were drawn from the experience in Vancouver:

a) Although many failures were associated with small builders there were also numerous failures of medium-rise buildings. It was clear that design had to be driven by engineering principles and not architecture alone.

b) Too great a reliance was placed on manufacturer's claims for the performance of their render whilst interfaces, quality of construction and performance of the wall as a whole were not well understood.

c) Face sealed systems are less reliable than secondary defence systems. Vancouver building regulations introduced a mandatory requirement for walls to contain a drained cavity. *(NHBC has introduced a similar requirement in the UK).*

Scope

This Technical Note deals with renders applied to:

- Boards mounted on support rails or brackets,
- Rigid insulation fixed to the outer face of a support wall,
- A metal carrier mesh fixed to the outer face of a support wall with insulation between the support wall and the metal carrier.

The support walls may be framed construction such as timber or steel stud or solid (brick, blockwork or concrete) construction.

The use of walling systems with external renders on new build projects has grown in popularity in the UK in recent years as constructors strive to construct more economical lighter weight well-insulated walls.

Traditional and new render systems

Externally rendered cladding systems have an established use in improving existing buildings. They may:

- Improve thermal insulation,
- Reduce condensation on internal surfaces,
- Stabilise deteriorating surfaces,
- Improve appearance.

Traditional renders applied to solid substrates undergo very fine cracking and remain adhered to the substrate. Modern renders applied to softer substrates tend to move more and any cracking will form as wider cracks at greater spacing. Reinforcement may be used to control such cracks.

Modern renders are also less permeable than many traditional renders.
The following acronyms are in use to describe rendered cladding systems:

ETICS
Exterior Thermal Insulation Composite System - This is the terminology that is widely used in Europe and in the European Technical Approval Guide, ETAG 004.

EWIS
Exterior Wall Insulation System
- This terminology is used by the British Board of Agrement (BBA) and is widely understood in the UK.

EIFS
Exterior Insulated Finish System
– This terminology is used in the USA and Canada and is used by some suppliers and contractors working in the UK.

Forms of construction

Render on insulation systems

In this form of construction a support wall is sheathed with insulation on its outer face. A render is then applied to the outer surface of the insulation.

The support wall may be either a framed wall comprising lightweight steel or timber studs and board, Figures 2 and 3, or a solid wall of blockwork or concrete, Figure 1. Windows will normally be fixed direct to an opening in the support wall.

With a solid support wall it is unlikely that movement of the support wall will lead to cracking of the render weather screen or inner air barrier.

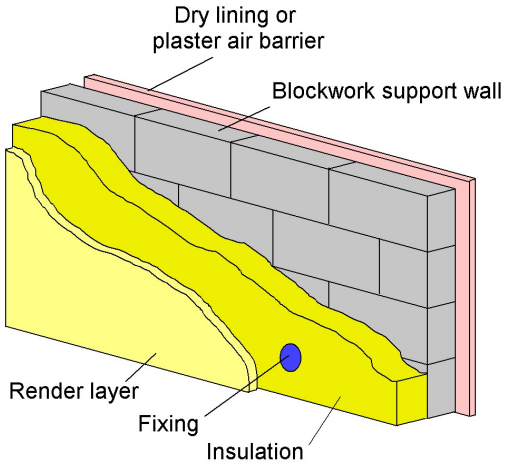

Figure 1 Render on insulation system on a solid support wall

The solid support wall will offer some resistance to moisture movement and a vapour barrier may not be needed, TN60.

Framed support walls comprise metal or timber studs supporting a dry lining system on the inside. The outer face normally comprises cement particle boards to which the insulation is fixed.

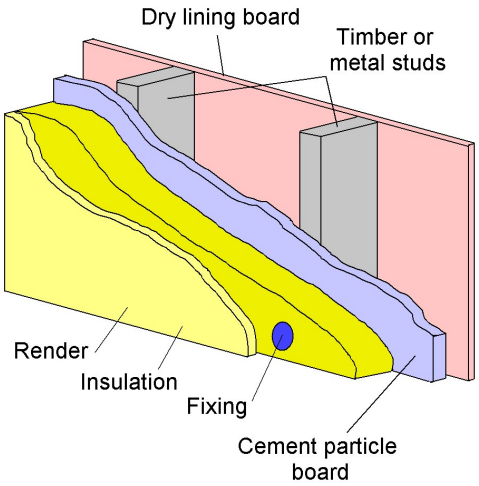

Figure 2 Externally rendered cladding system on a framed support wall

With framed support walls there will be greater out-of-plane deflection of the wall. There may also be in-plane movement. If the deflections are too great the render, the air barrier or both may be cracked.

With framed support walls it is important to consider whether a vapour control layer is necessary, and if so where it is positioned, TN60.

Render on board systems

In this form of construction the render is applied to boards fastened to the support wall or to rails on it.

If the support wall comprises only lightweight studs the out-of-plane and in-plane defections may be too great and cause cracking of the render, air barrier or both.

If the support wall comprises support rails fixed to a brick or blockwork wall the deflections will be much smaller.

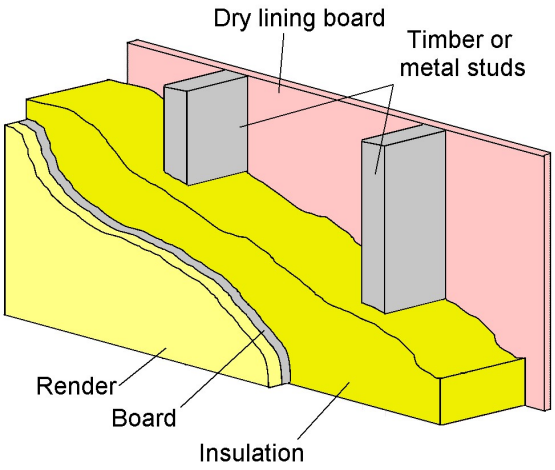

Figure 3 Render on board cladding system

With walls of this type the studs penetrate the insulation causing thermal bridges and it is more likely that a vapour control layer will be required. It is important to consider whether a vapour control layer is necessary, and if so where it is positioned, TN60.

Render materials

Render materials used for external insulation are generally proprietary materials which may be cement based, polymer modified cementitious materials or polymer based materials. Many manufacturers offer a range of renders each formulated differently. This is done to offer greater resistance to crack formation where necessary, and more economical

solutions where possible. Materials are generally supplied as pre-bagged mixes with selected aggregates.

Polymer and polymer modified cementitious renders are used in thicknesses from a few millimetres up to 15 mm. Some are reinforced by the inclusion of random fibres in the render while others incorporate a mesh of reinforcing fibres. Many render systems require additional reinforcement at corners such as the corners of window openings.

Conventional cementitious renders are used with a metal lathing in thicknesses of 25 mm or more. The reinforcement is intended to control cracking and is used to support the render.

The surface finish may be achieved by using a smooth finish coat of the polymeric render. Alternatively the surface may be painted or a roughcast appearance achieved by the embedment of stone or similar chippings in the finish coat.

Robust construction

Render on insulation or board walls are not as tolerant of design or workmanship errors as most other forms of construction.

While a render may perform well under test most render systems are susceptible to water leakage around their edges where they interface with windows and other penetrations or with other forms of construction.

The performance of rendered walls is highly dependent of good detailing of interfaces and good construction.

The most robust forms of construction are those with a secondary defence against water penetration. This is referred to as drained and ventilated construction. It is difficult to arrange drainage in render on insulation systems and many externally rendered cladding systems do not provide a secondary defence against water penetration.

In drained and ventilated construction there is a cavity behind the outer weather barrier. Any leakage water passing the outer barrier is intercepted by the cavity and is allowed to drain out through drainage openings in the outer layer (CWCT TN17).

Waterproof render is as good at sealing water in the wall as it is at preventing entry of water. Rendered cladding systems without a cavity and drainage openings will become water logged if any water gets behind the render finish.

It is for this reason that the NHBC specification specifically requires the provision of a drained cavity within a rendered cladding system.

Design responsibility

Robust design requires a robust design process. Increasingly Architects and Main Contractors assign responsibility for design of each interface to a particular specialist contractor.

It is often forgotten that in layered constructions, such as rendered cladding systems, there are interfaces between the separate layers. For instance a drawing of rendered board construction may carry the note ‘lightweight structural frame to be provided by others’.

It is important that responsibility for the design of different layers of the wall is appropriately assigned and coordinated.

Single design body

Most performance aspects of the wall will depend on more than one layer of the construction. These include:

- Water penetration resistance,
- U-value,
- Moisture movement and interstitial condensation,
- Reaction to fire.

The only way to ensure that the wall is designed to meet the required performance levels is to appoint a single design body with responsibility to assess or calculate as appropriate the performance of the wall on the basis of established principles of building science.

The single design body should also be responsible for assessing the design of interfaces with windows and other penetrations. Aspects of performance that may be compromised at interfaces include:

- Water penetration resistance,
- Air permeability,
- Creation of cold bridges,
- Buildability,
- Maintenance and repair.

Render systems on a large number of buildings in Vancouver, Canada have failed prematurely. One cause of these failures was identified to be the over reliance on inadequate architectural experience rather than engineering knowledge.

Responsibility for construction

All layers of the wall contribute to its overall performance and they should all be constructed as designed. Similarly interfaces and other details should be constructed as designed.

Several specialist contractors are normally involved in the construction of a layered wall, the installation of windows and sealing of interfaces. It is essential that construction work is correctly coordinated.

A particular feature of layered walls is that construction details are often concealed within the wall as construction progresses. For instance:

- Fixings attaching the insulation,
- Reinforcement of renders around openings,
- Primers required for adhesives or renders.

Main Contractors need to assign responsibilities to specialist contractors and put in place robust quality schemes to check all aspects of a rendered cladding system while they are still accessible for inspection.

Workmanship

The performance of an externally rendered cladding system is totally reliant on:

- Proper fixing of any mesh and local reinforcement,
- Proper application of the render,
- Proper construction and sealing of interfaces.

It is important that operatives employed to install externally rendered cladding systems should be skilled and familiar with the particular system being used.

Specification

The CWCT Standard for Systemised Building Envelopes gives performance criteria applicable to all building envelope systems. It also sets construction requirements for rainscreen walls. One of these is for a cavity of minimum depth 25 mm behind a ventilated rainscreen.

The NHBC Standards require rendered cladding systems to have a minimum cavity depth of 15 mm.

If a specification requires a ‘drained and ventilated’ or ‘secondary defence’ approach to construction many rendered cladding systems available in the market will not be compliant.

Standards and certification

BBA

The British Board of Agrement has a certification scheme for external render systems. These certificates apply only to

renders applied to brick or blockwork support walls. The same render systems may not perform adequately when supported on a lightweight frame.

Agrement certificates recommend that a design review be undertaken on a project-by-project basis to check for:

- Interstitial condensation
- U-values
- Appropriateness of the system for the particular wind-driven rain climate

ETAG 004
The European Organisation for Technical Approvals (EOTA) has published ETAG 004 as a method of approving external render systems.

ETAG 004 is applicable to render systems supported by a brick or blockwork walls. Render systems will perform differently if supported on a lightweight frame.

It should be noted that the ETAG only establishes methods of test and assessment. It states quite clearly that the suitability of a system should be assessed on a project-by-project basis.

Maintenance and durability

The BBA agreement certificates always state that the render system will only meet its service life if it is regularly inspected and maintained.

In particular any cracking of the render or water ingress through the render has to be addressed immediately. Specifiers have to be sure that such an inspection and maintenance regime will be implemented. This may not be a realistic expectation for private dwellings and for blocks of apartments with many individual owners.

The consequences of not undertaking prompt repairs are costly and extensive remedial work. A whole life cost plan for the building should be established and an adequate maintenance budget allocated.

Canadian practice now requires, for buildings in co-ownership, that a sinking fund for repairs is established and that regular condition surveys are undertaken.

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