

Timber cladding for building refurbishment

Refurbishment of buildings that are structurally sound is increasingly popular. Timber over-cladding is often chosen to refresh elevations, in order to:

- improve their appearance or weather resistance
- protect additional insulation applied to the exterior of a building.

This Wood Information Sheet (WIS) describes cladding over existing masonry-clad buildings (*Figures 1 and 2*) where the masonry will be retained. In the case of existing lightweight cladding (such as timber boards, shingles, render etc) it is preferable to remove the existing cladding and install a new insulated timber cladding system using these principles.

The choice of cladding material is just part of the solution. Designers must also consider various issues that arise when a new cladding system is installed, particularly insulation and weather protection standards that are certain to have increased since the building's original design.

This WIS is an overview of the subject with signposts to more detailed sources that are listed at the end.

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- Advantages of timber cladding
- Design principles
- Cladding to improve weather resistance or appearance
- Cladding to enclose external insulation
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Figure 2: Hatfield Library before refurbishment
Photo: Bryden Wood Associates



Figure 1: Iroko cladding on Hatfield Library in Hertfordshire
Photo: Bryden Wood Associates

Key points

- As a lightweight system, timber over-cladding imposes little increased loading.
- The cladding can be coated or left to weather naturally.
- Installation is an entirely 'dry' process.
- Timber, as a sustainable material, can improve the environmental rating of any building.
- Timber over-cladding can be designed as a 'rainscreen', with a drained and vented cavity.
- Cladding can improve weather resistance or appearance even if it does not involve insulation.
- There are three ways to install cladding required to enclose external insulation:
 - Method A fixed directly to the existing walls via cladding battens fixed through the insulation
 - Method B fixed to the existing wall via cladding battens over secondary battens
 - Method C self-supporting, that is fixed via cladding battens over secondary frames or I-beams that are independent of the existing wall.
- Self-supporting systems can be pre-fabricated.
- Detailing is similar to cladding for a new building.

Advantages of timber cladding

Using timber cladding for refurbishment has a number of advantages over other methods:

- It does not significantly increase the wall thickness because it requires little space. (Where insulation is to be added, the thickness of this will largely determine the total wall thickness.)
- As a lightweight form of construction, it imposes little increased loading on existing walls, intermediate floors, and foundations.
- It provides a wide range of visual options in the choice of layout, profile, and dimensions of boards.
- It can be coated or left to weather naturally.
- Installation is a totally 'dry process'.
- It may be advantageous to prefabricate self-supporting systems.
- Wood is a sustainable material that can improve the environmental rating of any building.
- All the woods typically used for cladding can be obtained from sustainably certified sources.

Design principles

Timber cladding should always be considered as a 'rainscreen' in that some moisture is likely to penetrate the cladding. For this reason a fully weatherproof membrane or wall surface should always be located behind a ventilated drained cavity.

The cavity is to allow drainage of any water that may enter and to allow a free flow of air behind the wood. This will prevent a high level of humidity developing in the cavity and ensure that the moisture content of the timber is similar on both internal and external faces. Limiting moisture variation between faces will prevent distortion across the thickness of the cladding boards. Allow for movement in the timber components due to seasonal variation in moisture content.

Additional construction on the outside of existing walls should not reduce the overall vapour permeability, particularly if the wall is to be highly insulated. It is therefore not advisable (and usually unnecessary) to add any sheathing boards behind timber over-cladding. If a sheathing is required for structural reasons, it should be of the vapour permeable type (such as bitumen impregnated softboard), which may take the place of a breather membrane, providing it has suitable horizontal joint protection.

When designing for over-cladding with timber it is important to determine how any additional vertical and lateral loading can be transferred to roof, floor, existing walls or foundations.

TRADA Technology's *External timber cladding* [1] explains how cladding should be specified, fixed and finished.

Battens in cladding systems may be of three types:

Cladding battens. These support the cladding and may be vertical or horizontal, depending on the orientation of the cladding.

Cladding counter battens. These vertical battens are needed to maintain cavity ventilation in vertical cladding systems. They support the horizontal cladding battens.

Secondary battens. Where specified, these support the cladding battens (or cladding counter battens) and are normally located behind a breather membrane in the insulation zone.

Cladding to improve weather resistance or appearance

Use this system when insulation is not required between the cladding and existing wall face.

Waterproof membrane

If the existing wall is of cavity construction, it is usually unnecessary to install a waterproof membrane behind the cladding battens. However, if the wall is of solid masonry construction without a cavity (eg brickwork, concrete block, stone or concrete), waterproof the wall by either applying a liquid waterproofing agent or installing a waterproof membrane. The latter can be a conventional waterproof membrane or, preferably, a breather membrane that will allow any internally generated vapour in the wall to escape.

Fixing battens to flush faced, plumb masonry

Battens can be nailed, shot fired or screwed and plugged to the existing wall face. These battens should be at least 38mm thick to provide sufficient penetration for the cladding board nails or screws.

Fixing battens to irregular walls

If the existing wall surface is very irregular or out of plumb, pack out the battens at the fixings to ensure that the external faces of the battens are level and plumb.

If the wall is excessively uneven, out of plumb, or not offering secure fixings (eg drystone walling), it may be more economic to provide a separate timber frame wall spanning from ground floor to roof or upper floor independently of the existing wall. If this framing is adequately attached to the existing structure at

these levels, it is not usually necessary to have any intermediate connections to the existing wall. Boards can then be directly nailed either to the battens or the stud framing but, in the latter case, take care to ensure that any horizontal frame members do not obstruct ventilation of the cavity between the existing wall and back of the cladding.

Vertical boards

If the cladding boards are vertical (overlapping or interlocked), vertical counter battens will ensure there is a ventilated and drained cavity behind the horizontal batten.

Although the counter battens could theoretically be reduced in thickness in this arrangement, maintain a 38mm minimum thickness because these battens may be spanning between high points on the existing wall. It also avoids cladding batten fixings being driven into masonry.

If the vertical boards are to be used in a board-on-board arrangement, sufficient ventilation and drainage is usually available behind the outer boards, making vertical counter battens unnecessary. In this case, the horizontal battens may need to be packed off the existing wall to ensure that the outer faces are level and true.

Cladding to enclose external insulation

Insulation is frequently added to the exterior of existing buildings in order to improve the thermal performance. Such external insulation does not reduce internal space and causes less disruption to internal layouts, finishes, services and occupants than insulation added on the inside.

There are three basic methods of supporting timber cladding outside exterior wall insulation, and several variations. The choice of method will depend on the thickness and type of insulation required, the condition and regularity of the existing wall, and the number of storeys involved.

Method A: cladding battens only

In this method, cladding is fixed directly to the existing walls via cladding battens outside the insulation.

Fix non-compressible insulation (usually rigid foam boards) to the existing surface and then fix treated softwood vertical battens directly to the wall through the insulation (*Figure 3*). This is possible with long nails, but is more easily done with special fixings such as Helifix or bracket fixings designed for the purpose. Some dense mineral wool slabs may also provide sufficient compression resistance to allow the battens to be securely fixed

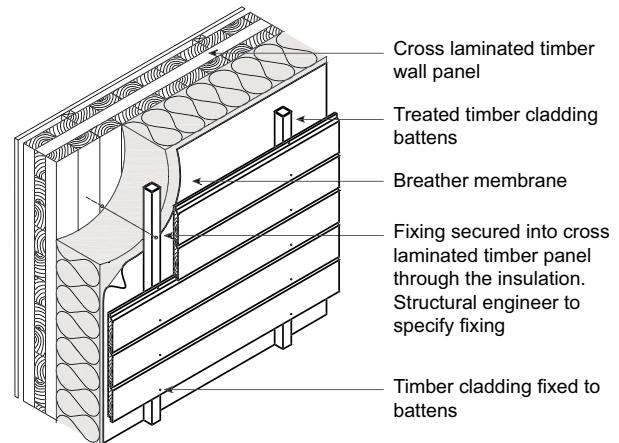


Figure 3: Method A: fixed directly to the existing walls via cladding battens



Figure 4: Coppiced sweet chestnut cladding on the Greenhouse in Ripe, East Sussex

Photo: BBM Sustainable Design

through to the existing wall. They have the advantage that they can absorb small surface irregularities more easily than foam boards.

Figure 4 shows a Method A system with rain screen cladding fixed over wax impregnated wood fibre insulation boards.

The advantage of Method A is that the thermal performance of the insulation extends across the whole existing wall uninterrupted by any wood supporting members.

The disadvantage is that, with an irregular wall surface, it is difficult to ensure that the insulation boards are flat and plumb, in which case the outer face of the cladding battens might not end up level or plumb.

Another possible disadvantage of this method, with either form of insulation, arises because the fixings may have to support the weight of the cladding above ground level. With thick insulation, the cladding weight has to be supported well away from the existing wall face and, because the insulation will provide little resistance to load, the support of the cladding will depend entirely on the bending resistance of the fixings. In this case, it is preferable that any vertical loads are transferred through the battens to supports at intermediate or ground floor levels. The batten fixings should then be capable of transferring only the wind loads to the existing walls.

A breather membrane may be necessary between the battens and insulation to protect the insulation from wetting and to seal exposed joints between the insulation boards and ensure airtightness.

Method B: secondary battens

In this method, cladding is fixed to the existing wall via cladding battens over secondary battens.

This method requires secondary vertical battens within the insulation and of the same depth as the insulation (Figure 5). Fix these battens directly to the existing wall surface and pack out to ensure that they are plumb and level. Then insert insulation batts or boards between these secondary battens. Add a breather membrane, if necessary, before fixing the cladding battens to the secondary battens.

An advantage of this method is that these secondary battens can transfer the weight of the cladding directly back to the existing walls. Also, the outer faces of these battens can be easily levelled

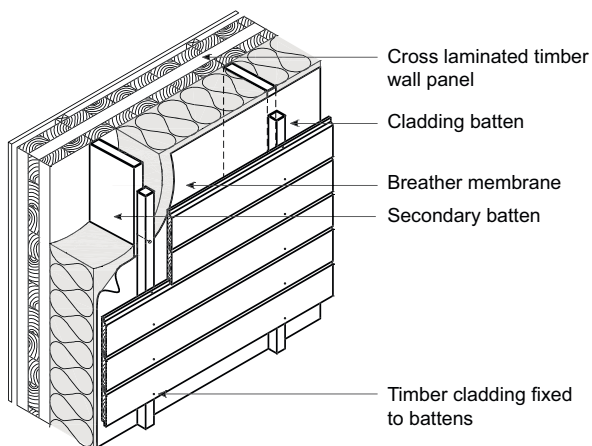


Figure 5: Method B1: fixed to the existing wall via deep secondary battens

and plumbed by packing between the battens and existing wall. A disadvantage is that the insulation is interrupted by the secondary battens, which will reduce the overall insulation value of the wall. In practice this can be made worse because it is difficult to ensure a tight fit between the insulation and the battens, particularly if the wood shrinks after drying-out. Flexible mineral wool batts are more tolerant in that, if suitably compressed, they will expand into these gaps. The introduction of the secondary battens removes the need to use non-compressible insulation. Another disadvantage is that, with increased thickness of insulation and consequent increase in the depth of the secondary batten, it becomes difficult to fix these deep sections back to the existing wall because it requires very long fixings through the wood or additional metal brackets. This can be avoided by installing the secondary battens and insulation in two separate layers (Figure 6).

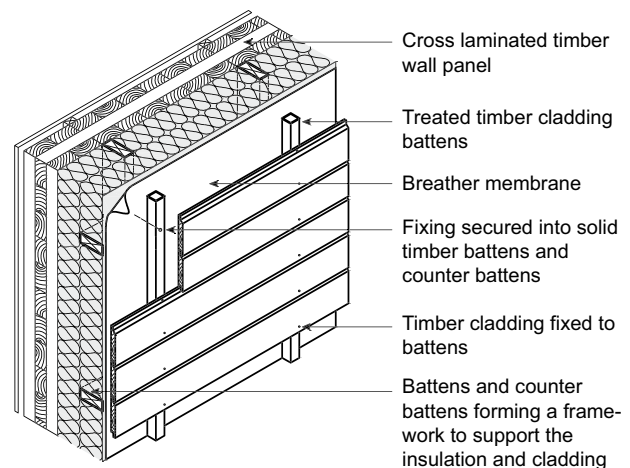


Figure 6: Method B2: fixed to the existing wall via layers of secondary battens

If the thickness of each layer of insulation is reduced to 50–75mm thickness, battens of this depth can still be nailed or screwed and plugged to the existing wall. Install the first layer of insulation between these battens, and fix the second layer of battens by simple nailing perpendicular to the first layer. Then install second layer of insulation between these battens, finishing flush with the outer face of the battens.

Besides simpler fixing, the main advantage of this method is that the only positions where the timber totally penetrates the insulation are at the crossovers of the battens. This considerably reduces thermal bridging. Any gaps that may occur between the insulation and framing will also be covered by at least one layer of insulation.

Both variants of Method B will allow the cladding battens to be fixed to the secondary battens, either in line or spanning between them. If a breather membrane is needed, install it across the outer face of the secondary battens before the cladding battens are fixed.

Method C: self-supporting

In this method, cladding is fixed via cladding battens over secondary frames or I-beams that are independent of the existing wall. These frames are deep enough to span between floors, or floor and roof.

If the required insulation is at least 100mm thick, vertical timber sections of this depth can span typical storey heights and resist any wind loading. Wind and cladding loads are then taken back to roof or floor structure via steel brackets, without the need to transfer these loads to the existing walls.

Essentially, install a separate timber frame outside and independent of the existing walls (Figure 7). This has the advantage of eliminating many fixings, although those at roof or floor level may need to be more substantial. It also means that location, accuracy and plumb of the supporting frame does not depend on the quality of the original wall.

Method C1 still has the disadvantage that the average thermal insulation of the wall will be reduced because the framing interrupts the insulation. For this reason, if there is sufficient space available, always insert insulation between the supporting framing and the existing wall to reduce any effects of thermal bridging. In this variant of Method C, a separate framework is still provided

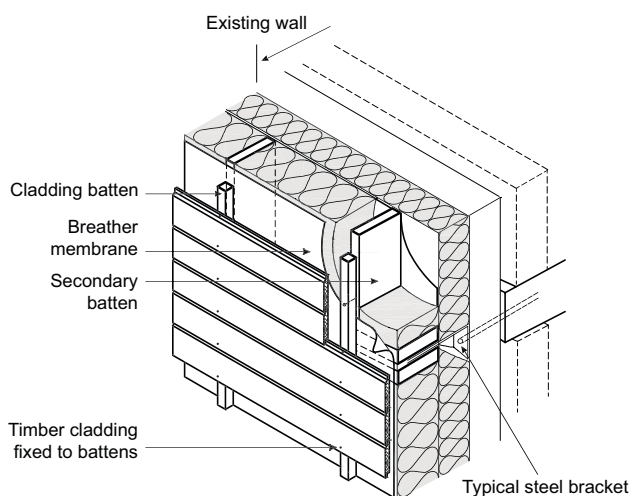


Figure 7: Method C1: self-supporting with independent secondary frames spanning floor to floor

independent of the existing wall, but may be capable of spanning one or more storeys without connections to the original structure (Figure 8).

This method uses timber I-beams, at least 150mm deep and at maximum 600mm horizontal centre to centre (c/c), securely held at top and bottom. The wind loads are then taken back to the roof structure and to ground floor level through these connections.

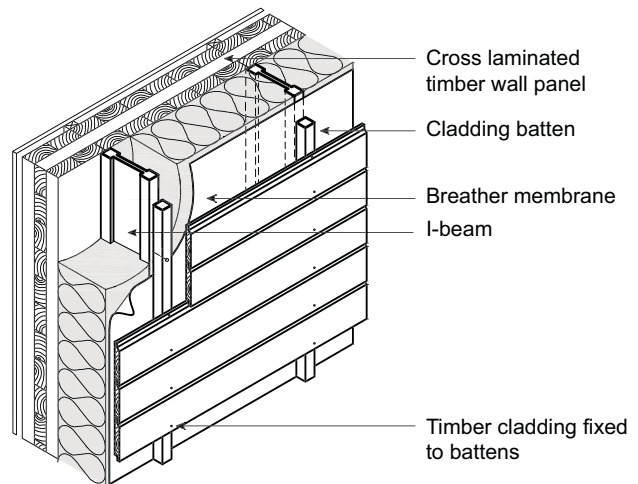


Figure 8: Method C2: self-supporting with I-beams spanning floor to floor

(Fixing at intermediate floor levels is usually not necessary because of the long spanning properties of these beams.) The I-beams carry cladding loads down to ground level.

Although the I-beams occupy the full thickness of the insulation, their thin webs transfer very little heat, so the overall insulation of the wall will only be marginally reduced by thermal bridging.

Scope for pre-assembly

A further advantage is that, particularly for multi-storey buildings, these frames can be prefabricated and erected as panels containing the insulation and faced with a breather membrane similar to conventional timber frame construction.

Unlike timber frame construction, they will not normally be required to provide any racking resistance and therefore there should be no need to add sheathing. However, if a sheathing is necessary to improve handling strength of these panels, this should be with a 'breathable' material such as bitumen impregnated board rather than plywood or oriented strand board. This type of board can add stiffness and provide some insulation outside the framing without reducing the vapour permeability of the wall.

If the framed panels are to be prefabricated, this solution has further benefit in that different types of insulation may be used to their best advantage. Foamed plastic panels, possibly with interlocking joints, can be pinned to the walls and temporarily exposed to the weather without risk of damage. In the framed part of the wall, mineral wood batts can be included in the framed panels where they can be protected from the weather by a breather membrane. Compressed mineral wool will close up any gaps that may develop as the secondary frame members shrink. Cladding battens can then be fixed to the outside of the secondary frames.

Timber cladding details

For any of these methods of supporting timber cladding, whether external insulation is required in the refurbishment or not, detailing should be similar to cladding for a new building.

Boards

The face width of boards, whether horizontal or vertical, should not exceed 150mm in order to limit moisture movement across the board that would cause cupping or splitting. Boards with tongue and groove profiles should be no more than 125mm wide because of the risk of disengagement of the tongues if the boards shrink due to variation in moisture content. For boards over 100mm face width, use two fixings in order to keep the boards flat to the supports.

Alternatives to boards

Shingles or shakes can be used as an alternative to board cladding, but follow the supplier's advice for specification and fixing details.

Battens

Cladding battens should be at least 38mm x 38mm and spaced at maximum 600mm c/c.

For horizontal cladding, the cladding battens could be reduced to 38mm x 25mm if they are coincident with secondary members behind and the fixing nails can be driven partially into these.

For vertical cladding the battens should be at maximum 600mm c/c and be at least 38mm x 38mm if they are spanning between supports. If counter battens are coincident with secondary vertical framing, they can be reduced to 38mm x 25mm. (Where any vertical battens are fixed to masonry through non-compressible insulation, they should remain a minimum of 38mm x 38mm in size.)

Fixings

Softwood boards are usually nailed with ring-shank nails. As a rule of thumb, use ring-shank nails that are long enough to penetrate the equivalent of twice the board thickness into the supporting battens. Fix hardwood boards to the battens with screws through pre-drilled oversize holes.

BM TRADA recommends stainless steel for all cladding fixing because of the risk of damage to coated fixings caused by driving, which may lead to corrosion staining of the wood. This is particularly true of wood with a high tannin content such as oak, or Western red cedar because the tannin will corrode mild steel.

Durability

Moderately durable woods are adequate for use as external cladding, providing sapwood is excluded. For non-durable species, or where the sapwood is not excluded, boards should be pressure treated with preservative.

Alternatively, chemically- or heat-treated wood can be used provided it is rated at least moderately durable.

Cladding battens and cladding counter battens should be pressure treated with preservative. It is not necessary to treat secondary battens and framing within the insulation layer unless there is no breather membrane.

Finish

Many woods can be left unfinished to weather to a natural grey without affecting their durability, but, if colour is required, this should be either a translucent or opaque penetrating vapour-permeable stain or paint, rather than a film-forming type such as oil paint or varnish. Apply coatings to the wood as soon as possible before ultraviolet exposure affects the surface of the wood. Finish all faces of cladding boards with at least one coat before installation.

Moisture content

To limit moisture movement in use, install boards at a mean moisture content of $16\% \pm 2\%$.

Detailed advice

Refer to *External timber cladding* for choice of species, preservative treatment, appropriate profiles, dimensions, fixing and finishing cladding boards.

References

1. External timber cladding, 3rd edition, ISBN 978-1909594005, BM TRADA, 2013

Further reading

- WIS 1-35: Breather membranes for timber frame walls, TRADA Technology, 2013
- WIS 1-49: Cladding for timber frame buildings, BM TRADA, 2014
- WIS 2/3-1: Finishes for external timber, TRADA Technology, 2012
- WIS 2/3-16: Preservative treatment for timber – a guide to specification, TRADA Technology, 2012
- WIS 2/3-58: Sustainable timber sourcing, TRADA Technology, 2013
- WIS 2/3-60: Specifying timber exposed to weathering, BM TRADA, 2015
- WIS 4-28: Durability by design, TRADA Technology, 2012

About TRADA

The Timber Research and Development Association (TRADA) is an internationally recognised centre of excellence on the specification and use of timber and wood products.

TRADA is a company limited by guarantee and not-for-profit membership-based organisation. TRADA's origins go back over 75 years and its name is synonymous with independence and authority. Its position in the industry is unique with a diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users.

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Chiltern House, Stocking Lane, Hughenden Valley

High Wycombe, Buckinghamshire, HP14 4ND UK

t: +44 (0)1494 569600 **f:** +44 (0)1494 565487

e: publications@bmtrada.com **w:** bmtrada.com