Module: Construction principles, specification and design

Unit: Timber cladding – detail design

Level: Introductory

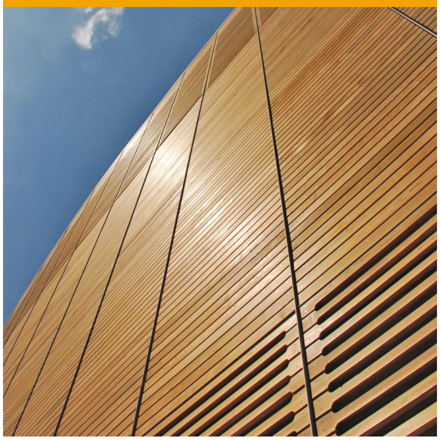

Figure 1: Western red cedar cladding, Olympic Velodrome, London

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This unit covers the following topics:

- **Timber selection**
- **Control of moisture**
- **Fixings**

Introduction

This unit builds on the information provided in *Introduction to timber cladding*, specifically expanding on detail design. The timber species used and the fixings chosen depend on the type of cladding required and the environmental conditions surrounding the cladding. Moisture-related movement and durability are the biggest considerations when designing timber cladding.

Timber selection

The choice of timber species for cladding on a project would normally be based on its ability to achieve the desired service life. Durability is probably the most important consideration in the choice of timber for cladding, and this can be achieved either by:

- the use of preservative treatment
- relying on the natural durability of various species, or
- using timber that has been modified in some way to enhance its durability.

Figure 2: Freshly cut logs showing the pale sapwood rim and the darker heartwood centre

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Natural durability

Natural durability of wood is a measure of the resistance of the heartwood to attack by wood-destroying organisms. In the case of wood-destroying fungi, a five-grade classification scale exists as follows:

Durability class	Level of durability
1	Very durable
2	Durable
3	Moderately durable
4	Slightly durable
5	Not durable

Table 1 – Five-grade classification scale for wood-destroying fungi

Sapwood of all wood species should be considered as durability class 5 (not durable).

BS EN 350-2 Durability of wood and wood-based products. Natural durability of solid wood. Guide to natural durability and treatability of selected wood species of importance in Europe[1] is the basic reference when checking the durability of a timber species. The durability of commonly used timber species can also be found in the TRADA species database (www.trada.co.uk/techinfo/tsg).

The expected service life of timber used as cladding will depend on a variety of factors such as:

- its in-service exposure conditions or use class
- whether it is protected with a paint finish or preservative treatment
- its natural durability rating, and
- the adequacy of detailing.

By adopting the guidance principles of *BS 8417 Preservation of wood. Code of practice* for an out-of-ground contact scenario for cladding, the following desired service-life expectations would be anticipated:

Condition	Desired service life		
	15 years	30 years	60 years
Coated	4	3	2
Uncoated	3	2	1

Table 2 – Recommended durability classes for out-of-ground contact use

Therefore a species with a durability class of 1 (very durable) would be selected in a circumstance that requires a desired service life of 60 years when used in an uncoated condition. Similarly, a species with a natural durability class of 4 (slightly durable) in a coated condition could be used in a situation where an anticipated service life of 15 years is required.

It should be stressed that *Table 2* presents the recommendations of *BS 8417* based on a generalised component classification system that, it may be argued, is non-specific to exterior cladding. The relationship between durability class and desired service life for external cladding situations may therefore differ in practice.

Figure 3: This softwood cladding coated with a stain finish after installation shows the effect of subsequent moisture movement

(© TRADA)

Figure 4: Home-grown larch cladding, Greenwich Millennium School

(© Cullinan Studio)

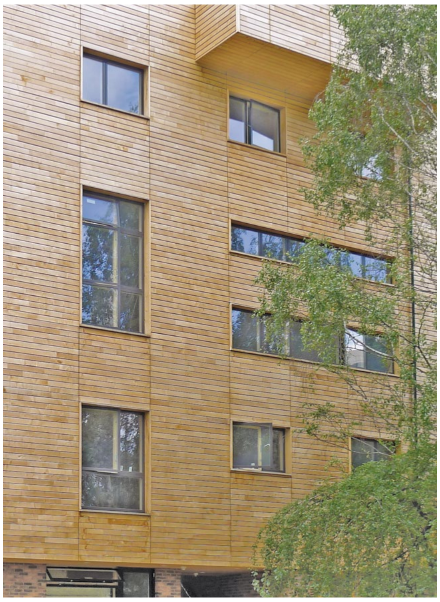

Figure 5: Sweet chestnut cladding, mixed-use building, Whitmore Road, London

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Movement

The 'movement' properties of timber are also important when selecting species for cladding, particularly for close-boarded types. Movement, being the dimensional change across width and thickness of boards, occurs when the moisture content of the wood changes in response to variations in atmospheric conditions. It is a relative term and species are classes as 'small', 'medium' or 'large' movement timbers. Large movement timbers are not generally recommended for use as cladding.

Choice of species

Softwood

The most common choice for cladding is softwood and there are a number of different species that are suitable, with home-grown species increasingly selected. Those widely used include:

- European redwood (durability class 4)
- European whitewood (durability class 4-5)
- European larch (durability class 3-4)
- Douglas fir, and (durability class 3-4)
- western red cedar (durability class 2).

The heartwood of western red cedar is naturally durable, but thanks to modern preservative methods, less durable species are also being used. Heat treatment and wood-modifying processes have introduced a new range of softwood products that achieve greater durability without the use of preservatives.

Some species of home-grown timber are now becoming readily available and are an attractive proposition for use as cladding in that this timber can reduce the transport energy otherwise required for imported wood.

Temperate hardwoods

The heartwood of durable temperate hardwoods, such as European Oak and Sweet Chestnut, are increasingly being used for cladding. European oak is readily available either home-grown or imported from other parts of Europe. It is rated as a durable timber and can be used untreated for cladding provided sapwood is excluded. It is likely to develop small surface checks due to variations in moisture content, but this will not affect its durability.

While kiln-dried temperate hardwoods can be used, there is a considerable economy if the wood is used 'green' as this saves the cost and energy of kiln drying. However, this saving may be offset by a possible increase in the cost of the fixings. Because boards used for cladding are relatively thin they will air dry quite rapidly after installation, but in the process the boards will shrink and tend to distort if not firmly restrained. It is important to make sufficient allowance for this movement by:

- using narrow boards, and
- keeping fixings close together along the length of the board.

The fixings must also be designed to absorb this shrinkage without the boards developing stresses that can lead to splitting. Since the boards will tend to distort as well as shrink, fixings should be installed at close enough centres along the length of the board to restrain these natural tendencies as the wood dries.

Another aspect of using European oak or sweet chestnut, particularly if used green, is that these woods contain extractives that may exude from the wood after installation. These will appear as a brown deposit on the face of the boards that will be gradually washed down by rainfall. This can be a particular problem if it is deposited on porous surfaces, such as brick or stone. Extractives may continue to leach for many months so it is advisable to protect surfaces below the cladding during this period.

Always specify corrosion-resistant fixings for acidic timbers such as oak and sweet chestnut to avoid staining the timber.

Tropical hardwoods

In the past, there has been a wide range of tropical hardwoods used for timber cladding, although less commonly used than softwood and generally limited to more prestigious buildings. Concern about the sustainability of many of these tropical hardwoods has also limited their use. However, there are now tropical timbers being imported with full certification of sustainable management, whether they are plantation grown or are a 'secondary' species. These secondary species are less well known but have characteristics of durability, strength and hardness similar to better-known timbers. Some of the traditional tropical hardwoods may be grown in plantations that are not in their indigenous countries, which may affect some of their basic properties of density, colour and durability. Confirmation may need to be sought that they are still suitable for use as cladding.

Figure 6: Iroko cladding before (left) and after (right) weathering, Temple Bar, Dublin

(© Patrick Hislop)

All tropical hardwoods, whatever their original colour, will eventually weather to a grey colour when exposed unfinished, although some will darken initially. If the bleached colour of weathered wood is acceptable, it is better left unfinished and should not then require maintenance for the lifetime of the building. For more information on tropical hardwoods, visit TRADA's wood species database at www.trada.co.uk/techinfo/tsg

Quality of timber

The appearance and strength of timber cladding will depend on specifying a suitable quality of material as well as the choice of species. The visual quality of timber is largely related to:

- the frequency and size of knots
- the slope of grain, and
- the surface finish, whether that is planed, fine or rough sawn.

If, for instance, a precise, smooth, flush face appearance is required, it is preferable to use boards with straight grain, precise edges and limits on the size and frequency of knots. However, if a more robust appearance is required, overlapping sawn boards, used vertically or horizontally, may be more appropriate and, in this case, larger and more frequent knots may be acceptable. However, loose or dead knots should always be excluded.

It is important to decide on the visual effect at an early stage of the design because this will determine the quality, profile and species that would be most suitable.

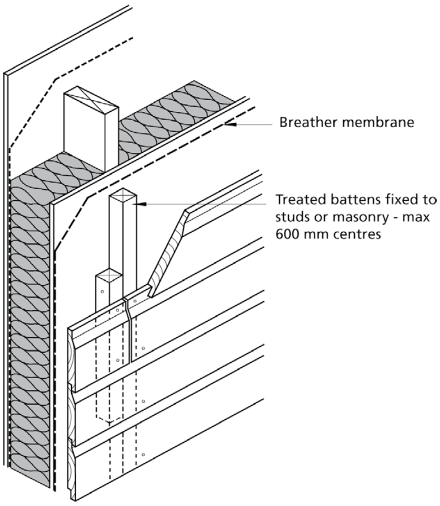

Figure 7: Cavity diagram from *Choose and Use* sheet[2]

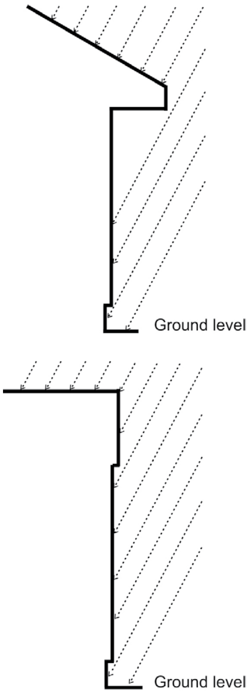

Figure 8: Protection from projecting roofs

Control of moisture

All timber cladding should be designed as a rainscreen in principle. This assumes that the cladding will always be subject to some penetration of moisture, and therefore a separate weatherproof membrane would normally be necessary behind the cladding. If there is a masonry wall behind the cladding, a separate membrane is not usually needed. The amount of moisture that penetrates will depend on the design of the cladding; an open-jointed system will allow more moisture penetration than an overlapping design. Whatever system is used, an open cavity allowing ventilation at the top and bottom should always be provided behind the cladding. Ventilating the cavity also means that both external and internal faces of the cladding are exposed to the same ambient humidity and consequently will have a similar moisture content. This will reduce any natural tendency of the wood to distort due to a variation of the moisture content on opposite faces.

In the UK, the typical ambient humidity, and even direct exposure to rain, will rarely raise the average moisture content of timber above 20% for any length of time. Avoiding direct contact with porous surfaces or wetted non-porous surfaces will prevent wood absorbing moisture from these surfaces. This is particularly important if the end grain of wood is exposed as it is very absorbent. Either a damp proof membrane or a sufficient gap will provide this protection by preventing contact with wetted surfaces. Guidelines include:

- Vertical boards should always be kept clear of any flashings below by at least 15mm and also have the top edges well protected to avoid wetting and discolouration.
- Cutting the bottom of vertical boards at an angle forming a drip to the outside will prevent water hanging on the underside where it could be absorbed by the end grain.
- Horizontal boards should also stop short of any vertical members by 8mm–10mm to allow ventilation to the end grain of the boards.

Preventing direct wetting by projecting roofs may largely protect wall surfaces, but even with large projections wind is likely to drive water against lower surfaces. Any protection of this sort is likely to extend the life of surface finishes rather than affect the overall durability of the wood.

The projection created by overhangs will slow, or even prevent, the natural weathering and bleaching of the wood compared to exposed areas of the wall. It is therefore advisable to protect the cladding to avoid any uneven colouring.

Figure 9: Overhanging roof has protected the wood from weathering

(© TRADA)

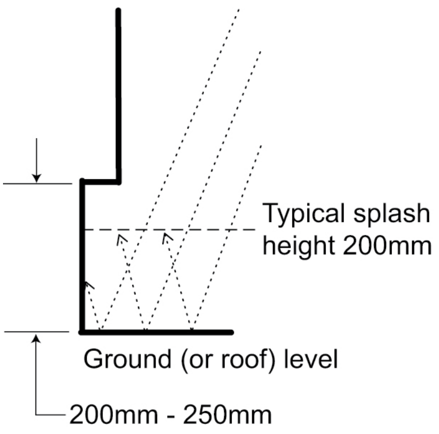

Figure 10: Splash zones

Indirect wetting, as a result of splashing off the ground or other horizontal surfaces, such as roofs, below the cladding, may result in regular wetting of the lower boards, which can lead to deterioration of surface finishes and possible algal growth. It is therefore advisable to stop any wood cladding 200mm–250mm above ground level, or abutting roofs, to prevent this form of wetting.

Allowing for moisture movement

As an organic material, the moisture content of wood will always vary with changes in environmental conditions. In the UK, the moisture content of external cladding may vary between:

- a maximum of 22% on northern faces in winter, and
- a minimum of 10% on southern faces exposed to summer sun.

The seasonal variation on any one face of the building does not normally vary by more than 8%. However, this change in moisture content is sufficient to cause swelling or shrinkage of the wood. This will not in itself affect the strength or durability of the wood, unless the movement is restrained by fixings or tight jointing, in which case there is a risk of the wood splitting, cupping or bowing. Excessive moisture movement can reduce the overlap between boards or result in tongues becoming disengaged from grooves, reducing the weather resistance. This may compromise the fixing of the boards to the building. Sufficient allowance for moisture movement must therefore be provided in the detail design of any timber cladding.

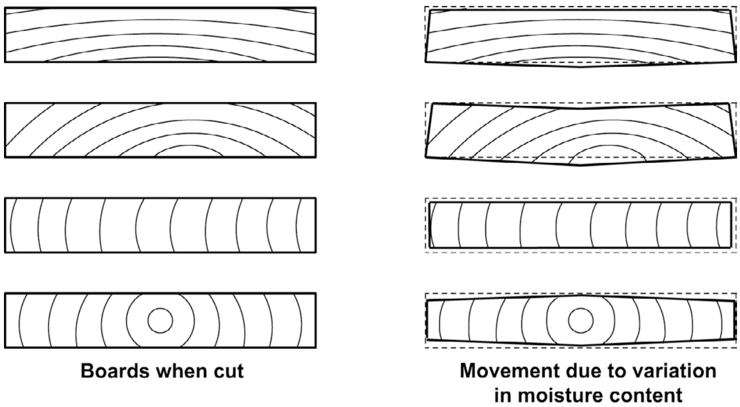

Figure 11: Changes in shape of boards cut from different parts of a log with changes in moisture content

The best way to reduce any problems of movement is to ensure that the moisture content of the boards at the time of installation is as close as possible to the likely 'in use' moisture content. In the UK, as the normal range of moisture content of timber cladding in use is likely to be between 12% and 20%[3], a mean variation of about 16% should be the aim. As this can still represent a significant variation in size, the scale of the expected movement can be reduced by limiting the width of the boards to 150mm, particularly if the wood is to be used green. The profile and joints between boards should be designed to accommodate this shrinkage and swelling while also ensuring that the joints between them remain weatherproof. The design of fixings must also take into account the possible moisture movement of the board.

Fixings

Softwood

Softwood boards are normally nailed to treated softwood battens. Standard wire nails can be used, but annular ring shank nails are preferred for their improved holding power. Small head nails are suitable for most softwoods, but larger heads are recommended for western red cedar because small heads can tend to pull through this softwood. Some pneumatically driven nails have D-shaped heads, rather than round heads, which affects the appearance of the fixing and may not be acceptable visually. Pneumatically driven lost head or T-shaped pins or brad nails are not recommended for fixing cladding boards as they offer little resistance to withdrawal. If fixings are pneumatically driven, pressures should be closely controlled to ensure that fixings are not over driven and do not damage the face of the cladding board.

Hardwood

Hardwood boards are normally fixed by screwing to treated softwood fixing battens. Even for boards installed at a moisture content close to their in-use range, it is advisable to pre-drill holes in the boards to provide a clearance around the shank of the screw to allow for seasonal variations in moisture content. The head of the countersunk screw will normally provide sufficient retention but using larger diameter screws with bigger heads is preferred for this reason. Restricting the board width to a maximum 150mm and locating the screws at the quarter points of the board width will limit the width of wood that will swell or shrink between the screws. A 2mm clearance between the shank of the screw and the hole in the board should be adequate for woods rated as small or medium movement if the boards are installed at about the recommended 16% moisture content.

Summary of key points

Timber cladding depends on detailed design to fulfil its brief. The key factors to consider include:

- the timber species
- moisture-related movement, and
- fixings required.

Durability is one of the most important aspects when designing timber cladding and the three factors above must be designed in detail to achieve the level of durability required.

References

1. *BS EN 350-2:1994 Durability of wood and wood-based products. Natural durability of solid wood. Guide to natural durability and treatability of selected wood species of importance in Europe*, BSI
2. *External wood cladding*, Choose & Use series, TRADA Technology, 2012
3. *BS EN 942:2007 Timber in joinery. General requirements*, BSI

Learning Resources

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

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To provide members with the highest quality information on timber and wood products to enable them to maximise the benefits that timber can provide.

What we do

We seek to achieve this aim through active and on-going programmes of information and research. Information is provided through our website, an extensive collection of printed materials and our training courses.

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