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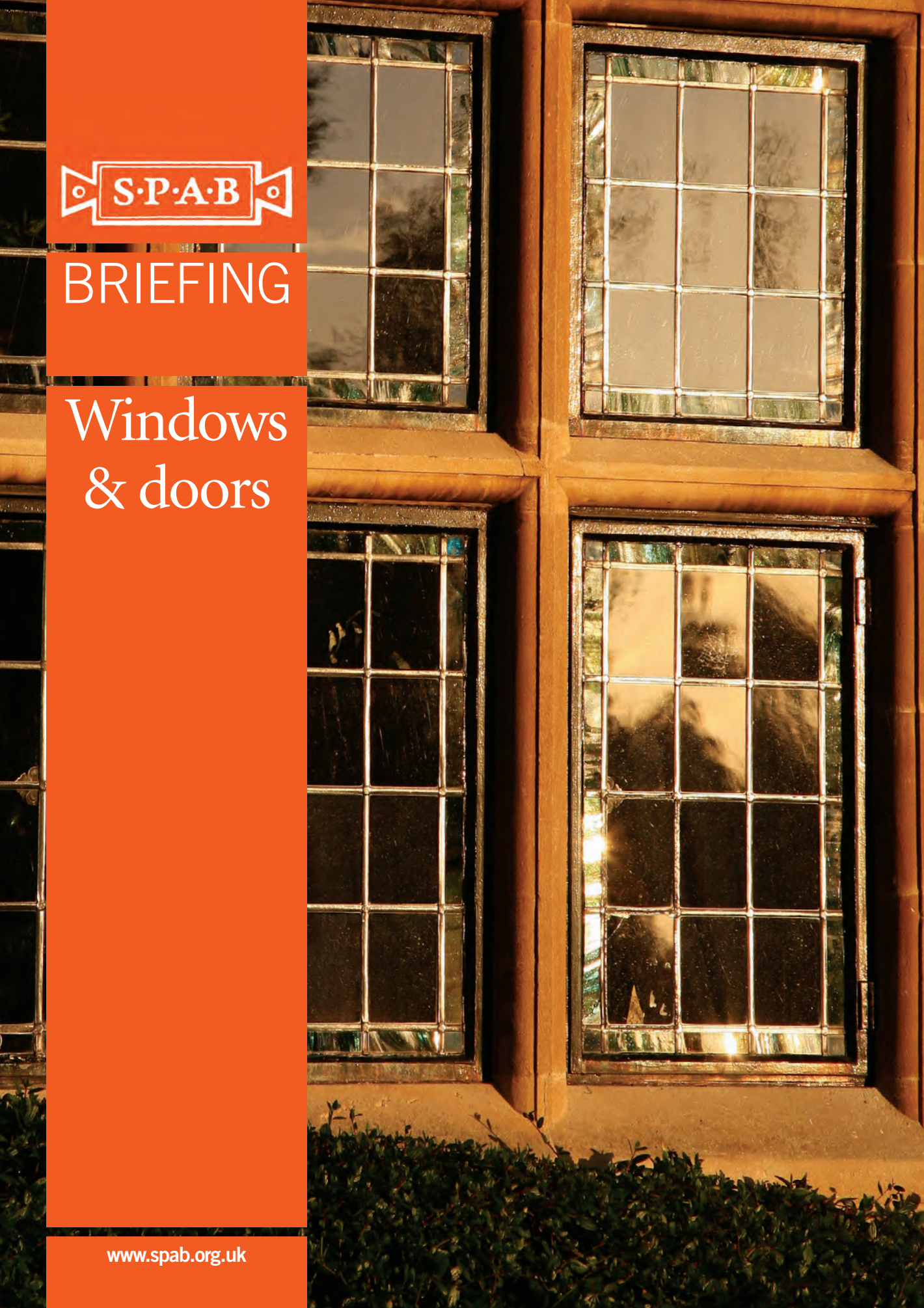

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Contents

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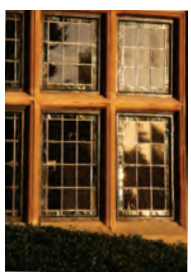

Cover: A Victorian window, the original glass is a vital component that adds to its beauty.
Image: Roger Hunt

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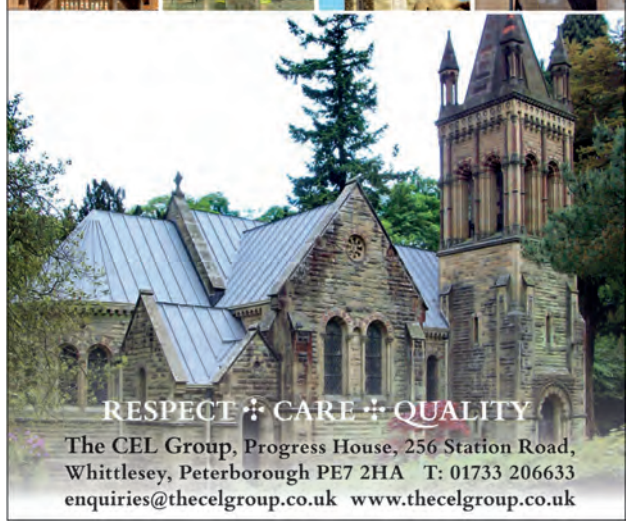

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Introduction

Douglas Kent, technical and research director, Society for the Protection of Ancient Buildings.

Old windows and doors are an intrinsic part of our heritage. They bring texture and life to many old buildings, helping to stir our spirits and perceptions. Even the plainest windows are more than a mere assembly of mouldings and fittings: their surfaces may be time-worn, sometimes there is handmade glass and forged ironmongery, with frames that have accommodated gentle distortion in the building. At a simpler level, they are rare, beautiful items, equivalent to an antique chair or table in historic, cultural and aesthetic value.

The SPAB has long championed these significant, irreplaceable features. Not everyone appreciates their attributes, some see old doors and windows as worthless, troublesome and replaceable. Others fail to realise that retention is viable through care, repair and a few, often straightforward, steps to enhance energy efficiency or security; and that this conservative approach frequently means lower long-term costs. Sadly, there is a rash of inappropriate replacement double-glazed windows that scar the faces of buildings across the UK, are emotionally cold and, however well executed, generally bland; the new but lifeless glass tending to stand out like a false eye.

So often, people are seduced to buy these replacement products by high-pressure sales techniques and remain blind to the reality of their decision because of limited knowledge and misguided efforts to 'do the right thing'. Outdated perceptions have not helped.

'Maintenance free' is among the claims made for PVC-U replacements. Yet, purpose-made paint is offered for PVC-U windows discoloured by sunlight. Weatherstripping and gaskets also require renewal. There are other issues. The plastic embrittles with age. It does not easily tolerate the gentle movement of older buildings and, unlike timber or metal, a slightly damaged plastic frame commonly requires total replacement. Additionally, PVC-U is one of the most environmentally hazardous construction materials made.

Whatever the material of a window frame, seals of double-glazed units regularly fail and fill with condensation. Consequently, companies now specialise in replacing misted-up double-glazed units. The replacement of sound old windows with modern substitutes that last no more than a single generation (or less) is hardly sustainable. The majority of old windows can be repaired. Replacement, then, really must be the last resort and, where absolutely necessary, should normally be like-for-like in terms of style and materials.

Legislation protects listed buildings, as well as some properties in conservation areas, from unnecessary window and door replacement. For example, the installation of double-glazed units in place of old single-glazed windows will often not be permitted. Exact controls vary locally for conservation areas, so it is best to check with the local planning authority to avoid the risk of legal sanctions.

Despite this protection and their many advantages, old windows and doors are threatened as never before. This SPAB Briefing aims, through the words of some of the leading practitioners in the field, to elaborate on these themes and encourage better understanding of the windows and doors that are so precious to the authenticity, history and beauty of our old buildings.

IMAGE: DOUGLAS KENT/DAVID GIBSONE

A valuable asset

Windows and doors form the 'face' of a building. Martin Ashley and Mandy Lorenz of Martin Ashley Architects make the case for retaining these important items.

IMAGE: ROGER HUNT

The windows and doors of our historic buildings are a precious and vulnerable record of the history of craft skills, technical ability, architectural aspiration and cultural change in Britain from the earliest times to the present day.

Precious, because within their conception, detail and execution lies evidence of the craft techniques of the day, evolving materials technology, invention and innovation, attitudes to security, fire safety, increasing expectations of comfort, approaches to environmental control, and aspirations of wealth and significance.

Vulnerable, because windows and doors are working mechanisms. They are prone to weathering and decay and the vicissitudes of poor maintenance. They are also prone to wear and tear through use or abuse. They need to perform an essential function and, if windows or doors are not working well or do not meet current comfort standards, it is too often thought easier or cheaper to replace them, rather than to overhaul, repair or upgrade. Of course this has been the case through the centuries and there are many later replacement windows and doors in earlier buildings. However, the loss of early detail and history is always regrettable, and one should seek to retain and repair unless there is no conceivable alternative. In practice there is almost always a conceivable alternative – traditional windows and doors can be maintained, repaired and decorated using readily accessible trades and skills; fit can be adjusted, operation can be overhauled, draughts can be stopped; finishes can be redecorated; and neatly designed internal secondary glazing can be fitted to improve thermal and acoustic performance.

Old buildings have often structurally settled and moved to a greater or lesser degree. A common expression is that there are 'no right-angles in old buildings', which is part of the reason why modern replacement windows and doors within an existing elevation will often look visually uncomfortable. They have been precisely manufactured, whereas the apertures into which they are inserted are not precise. Self-finish PVC-U replacement window and door finishes will typically look visually harsh in the context of old elevations. In historic buildings, they can also create a sealed environment within properties which can lead to further problems such as mould and dampness.

There is nothing more upsetting than losing a beautifully designed, and elaborately built, timber window or door to a bland and cheaply constructed PVC-U replacement, that neither recognises the existing design or environment. PVC-U windows and doors are often marketed as maintenance-free and cheaper alternatives to their timber counterparts. Therefore WWF-UK

Above: Georgian door, doorcase and fanlight.
Below: PVC-U replacement windows (right) are bland and ill proportioned compared to original timber windows (left).

IMAGES: MANDY LORENZ

compiled an independent study, published as *Window of Opportunity*. After comparing both arguments, it came to the conclusion that timber windows perform better and that they are 14 - 25 per cent cheaper than PVC-U with the same specification, considering their overall life cycle. Pre-finished PVC-U products are initially cheaper but are very liable to damage and commonly come with a very chunky design. With their often bright white appearance they stand out rather than integrate. Instead of ageing gracefully, PVC degrades when exposed to sunlight. It becomes brittle and can develop hairline cracks requiring specialist repair or full replacement, resulting in internal and perhaps external decoration to adjacent walls.

The WWF study concludes that a typical lifespan of a PVC-U window is only 18 years, and that their toxicity level on combustion should be considered a major environmental impact. The study established that PVC-U products require eight times more energy to manufacture using non-renewable resources – of which only three per cent can be recycled; 82 per cent goes to landfill while 15 per cent is incinerated, releasing hazardous chemicals. This is expected to increase to 45 per cent by 2020 due to restrictions on EU landfill levels. By any estimation these figures are very worrying indeed.

In comparison, timber windows have strong environmental credentials, they are thermally more efficient and can easily be repaired. Today's paint manufacturers offer ten year lifespan on quality paints, and the timber can easily be re-decorated when faded or discoloured. As many examples around us prove, with periodic maintenance timber can last for centuries.

If there is no alternative to replacement, it is important for specifiers of new timber windows and doors to use timber certified by an independent body, such as the Forest Stewardship Council (FSC), so that materials used come from well managed forests and are a renewable resource. This does not have to cost more, and is an important carbon-awareness credential that should be attractive to informed homeowners.

Regarding existing windows and doors, it is not at all difficult to upgrade their thermal performance and soundproofing by using secondary internal glazing or shutters which, if carefully designed, are easy to fit. The installation of shutters can provide a multitude of benefits and is quite rightly back in fashion. Shutters can provide a very decorative option to reduce street noise and heat loss. They increase security and, especially when divided horizontally, create privacy whilst enabling ventilation and daylight. Carefully designed, they can be a stunning feature and ultimately reversible in the context of a historic building.

Maintenance enhances the appearance and extends the lifecycle of windows and doors but, if neglected, their condition can quickly progress from disrepair to a state beyond repair and regrettably requiring replacement. The physical and environmental cost of replacement is best avoided, and good maintenance is more environmentally- and cost-efficient by far. Careful maintenance, together with regular inspection provides early warning of hidden decay, which can often be caused by adjacent issues such as overflowing gutters and poor building detailing.

If replacement of windows and doors is unavoidable, quality workmanship and good design should always match and pay respect to the original design, the historical period, and the skills of the designers and craftspeople that came before us. With this approach we retain the craft, history, and financial value of our property – three very important issues. It is these essential qualities that make our properties the valuable assets of which we are the caretakers.

Careful repair is a key SPAB philosophy.

IMAGE: RALPH HODGSON

Join the SPAB

The Society for the Protection of Ancient Buildings was founded by William Morris in 1877 to counteract the highly destructive 'restoration' of medieval buildings practised by many Victorian architects. Today it is the largest, oldest and most technically expert group fighting to save old buildings from decay, demolition and damage. A firm set of principles, backed by practical knowledge accumulated over many decades, is at the heart of the Society's philosophy.

The SPAB is a charity representing the practical and positive side of conservation, not only campaigning but training, educating and offering advice through an expert telephone helpline and publications, including the Society's acclaimed quarterly magazine.

The SPAB runs specialist courses for building professionals, homeowners and those who care for churches and other public buildings. Members include many leading conservation practitioners as well as homeowners, living in houses spanning all historical periods, and those who simply care deeply about old buildings.

Thousands of structures survive which would have been lost, damaged or badly repaired without the SPAB's intervention. Indeed, many of the most famous buildings in Britain are cared for by some of the several thousand people who have received the Society's training.

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IMAGE: ROGER HUNT

Repair not replace

With good repair central to the SPAB conservation approach, Joe Bispham, a historic buildings adviser, carpenter and joiner, sets out the key considerations when working with old windows and doors.

Building owners – and in some cases professionals – mistakenly see rotten and damaged historic external joinery as a problem that can only be solved with complete replacement. Often this is because they are unsure about the final results of a repair and the longevity of the repaired item.

What professionals must offer the building owner is the confidence that a well repaired item will be successful in the long-term. This is made possible through having the knowledge to specify the correct quality materials for the repair and by recognising good craft practices in the execution of the repair, such as the scarfing and joining of new wood to old.

Minimal intervention is the principle of good conservation practice in repairs to historic fabric. That said, in the case of joinery repairs, it is essential to recognise that some of the sound wood of the item being repaired needs to be removed to allow the new wood to be fixed to a solid material. Attempted fixing to degraded wood will lead to failure of the joint between old and new.

Once a good repair is completed it will serve for as long as the original item is maintained and kept in working order because a sound repair becomes part of the original structure.

One of the many problems encountered is rot in softwood joinery, often caused through lack of maintenance and previous sub-standard repairs that have been poorly executed, frequently with poor quality materials.

Each repair will need to be assessed on its own merit. A close inspection of the original construction will be needed to understand not only the construction details but also the quality and species of wood used, the run of the grain and the wood growth pattern. A knowledge of all of these essential details is necessary for a successful, honest repair that conserves the appropriate style and avoids producing a pastiche.

Accurate measurements must be taken of damaged or rotten items and scale drawings should be made of sections that need to be replaced such as cills, bottom rails, mouldings and glazing bars.

All new replacement sections of wood used in a repair need to be like-for-like with the species, sizes and profiles matching the original. In joining a new section of wood to the original, a method of repair should be chosen so as to remove as little as possible of any mouldings. When undertaking the repair the new saw-cut line on the original joinery needs to be at the back of the moulding leaving the moulding intact on the joinery and conserving the historic detail.

Fillers

The market today offers a wide range of DIY fix-it quick solutions to rotten wood, mainly in the form of fillers and hardeners. The most common fillers are two-part types; one being the filler, the other part the hardener that sets the filler once the two are mixed together. Generally, given the recommended temperature for application, these products set hard in a few hours so, on the face of it, they seem to solve lots of problems. These types of products are very useful in the small filling operations required in preparation for decorating and painting.

Using large amounts of filler to fill rotten or damaged sections of a window cill or door or window stile is only a short-term solution to the problem, as it will invariably eventually become loose and separate at the interface between the filler and degraded wood. Once a section of wood has rotted, the very best solution is to splice a new section on to sound wood as this will effect a lasting repair.

The junction between frame and wall needs to allow for seasonal movement of the wood but also, importantly, needs to be watertight so slightly flexible material is required. If a deep or wide gap is evident then pointing with a lime mortar and overfilling with burnt sand and boiled linseed oil mastic is a solution.

Quality of material

Much of our historic joinery was constructed from wood taken from trees grown in old stand forests of Northern Europe. The growth of these trees from the northern area of the Baltic and Scandinavia was slow and is seen in the tight growth rings of early and late wood produced yearly. This wood generally has a close grain fine texture and, as much of it was from old stands, the wood produced from these trees was fairly clear of knots and vertical grained, giving it much durability and stability.

Today the managed plantation softwood forests aim to produce timber as quickly and as economically as possible. This fast-grown timber is not as durable as that from mature trees that were more common up to the start of the 20th century. Much of the modern fast-grown softwood will be used in construction once it has been pressure impregnated with preservatives. Generally this type of timber is not suited to quality repairs of historic joinery.

The quality and closeness of grain of wood material used in a repair needs to match as near as possible that of the original. This will lessen the differential movement at the point of old and new. It is still possible to obtain quality timber from established timber merchants. European redwood (*Pinus sylvestris*) from Sweden, Finland or Russia graded 1-3 unsorted is a good choice for most joinery repairs; the timber should be selected piece by piece. Another option is Douglas fir (*Pseudotsuga menziesii*) graded from timber merchants as No 2 clear and better, again selection is essential. The moisture content of the wood used in the repair is very important. It is likely that the stocks sourced will have been kiln dried. At the inspection stage moisture readings should be taken of the historic joinery in the areas of sound wood, especially at the points where the splicing of new to old is to take place. The moisture content in the selected new wood used in the repair should be within one or two per cent of the old wood if subsequent movement is to be avoided.

Modified timber

A product name that has been known on the market for a number of years, and is gaining popularity from architects and manufacturers of new windows and doors in particular, is Accoya. Accoya is not wood from a species of tree but a trade name that has been given to modified wood. The most common species used for modification is radiata pine (*Pinus radiata*).

IMAGE: DOUGLAS KENT

IMAGE: MATTHEW SLOCOMBE

Opposite: Each window must be evaluated and repaired as necessary.
Top: Joe Bispham makes replacement casements.
Above: Repair to the base of a door.

Radiata pine is a softwood and the world's most widely planted softwood plantation tree – an abundant sustainable timber – with New Zealand being a major producer of the timber which is felled at 28 years from sapling to sawmill.

The first stage at the European processing factory is the reduction of the wood's moisture content to just three to four per cent. The wood modification process begins with acetylation, a chemical reaction between acetic anhydride and the wood molecules lignin and hemicelluloses. The wood is steeped in acetic anhydride which reacts with water-loving hydroxyl molecules in the cell walls, converting them into acetyl groups. These are also naturally present and will not attract or bond to water. By thus preventing almost all water ingress into the cell walls of the wood, acetylation makes it much less prone to movement with changes in humidity. At the same time acetylation significantly improves rot resistance since rot fungi need water molecules in the cell walls of the timber in order to break down the wood molecules.

The process is 100 per cent non-toxic and adds nothing chem-

IMAGE: ROGER HUNT

ically that does not already exist in the wood naturally. The manufacturers give a 50-year guarantee for the product above ground and a 25-year guarantee for use in contact with the ground, for example posts.

This product has been used on repair projects but has not, as yet, been fully explored and analysed. A section of modified wood used as a replacement for a damaged or rotten section of joinery, such as the cill of a window frame, would behave independently with regards to expansion and contraction to the other parts of the piece of joinery and, as such, would appear not to be problematic. However, more careful thought might be needed if modified wood is to be used in the repair of a historic item of joinery as a piece to scarf into a section of original unmodified wood, for instance a door stile. With the unmodified piece of wood acting naturally with seasonal movement and the modified piece having little or no seasonal movement, consideration must be given to how the two pieces behave at the interface of the scarf.

Craft practice

The success of any repair will rely on the joining of the two pieces of wood together as one. Splice/scarf joints are cut at a shallow angle running along the grain of the wood to give a larger surface area with the run of the grain to glue the two faces together. Fixings should, if possible, be to the inner faces or sides. If exterior fixing is required, stainless steel products should be used or wooden dowels for tenons.

A 45 degree angle-cut to join together two pieces of joinery, such as extending a stile of a frame, as illustrated in some literature, amounts to almost end grain fixing and has no life.

Treatment

Where European redwood is to be used in an external repair, new wood may be specified as preservative treated. This is less likely with Douglas fir as it has a higher classification for durability and is not as receptive as European redwood to treatment. Where treatment is necessary, all the sections of wood to be used in the repair will need to be cut and fitted and then sent for treatment. Before fixing, it is essential that the preservative carrying fluids have fully evaporated from the wood, making it ready to be glued. With or without preservative treatment, when the repair is complete all the wood must be primed and sealed, especially the end grain.

The painting of external joinery gives protection from the weather. The choice of colour used on joinery in an exposed, sunny location will affect its performance. The use of very dark colours will mean more thermal movement to wood and paint than the choice of lighter colours.

Cost and longevity

For repairs to be successful, good quality materials are essential. Repairs by their nature are labour intensive so, set against the labour cost, the extra over cost for quality materials is minimal.

Repairs undertaken with quality materials and good craft practices become part of the original structure and, as long as they are maintained, will continue to give service. There are many excellent carpenters and joiners that can, once shown the methods, complete an extensive repair to these historic joinery elements whilst drawing personal satisfaction from the process.

IMAGE: JOE BISPHAM

Top: Areas of rotten wood should be carefully repaired.
Above: A scarf repair to a French window.

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Thermal understanding

Paul Baker of Glasgow Caledonian University provides an insight into the research he has carried out into the thermal performance of timber windows.

Traditional windows are often considered to be draughty, prone to condensation and hard to maintain. At the same time, they can be very durable as illustrated by the many original Georgian and Victorian windows that are still in place. The problem is that the heat lost through a single glazed window is more than twice that of a modern window meeting the current UK building regulations.

Whilst secondary glazing may be an effective option to preserve existing traditional windows, there has been little information on the performance of more traditional methods of reducing heat loss, such as shutters, blinds and curtains. The research I was commissioned to undertake by Historic Environment Scotland and Historic England resulted from the concern that calculated U-values were not giving a true picture of actual thermal behaviour in relation to the performance of traditional windows.

The heat loss through the glazing of two typical timber sash windows – one a 2-over-2 pane from Historic England, the other a 6-over-6 pane from Historic Environment Scotland – was measured under laboratory conditions for various improvement measures and the whole window U-values calculated – the lower the U-value the better the window's insulation. The airtightness of the windows was also measured before and after draughtproofing. Condensation tests were carried out on one of the windows before and after installation of secondary glazing, since condensation can be a concern for occupants.

All the options tested reduced the conductive heat loss through the glazing. Shutters are the most effective option of the traditional methods. Modifying the shutters with insulation produced the best result. A low-emissivity secondary glazing system, a honeycomb blind and modern roller blind coated with a low emissivity film gave similar performances to the shutters. However, the secondary glazing system has the advantage that its benefits can be realised throughout the day. Combinations of options offer further improvements in performance.

The performance of slimline double glazing replacement panes was disappointing: thin conventional air- or gas-filled double glazed units are not optimised for thermal performance but to fit windows designed for single glazing. However, 8 mm thick vacuum glazed units tested in situ in listed Georgian apartments in Edinburgh easily fit traditional frames without compromising performance, achieving a U-value of 1.0 W/m^{2}K.

Improving the airtightness of traditional windows by reducing unwanted air leakage will decrease the ventilation heat load of a building. Draughtproofing reduced the air leakage of the windows by about 85 per cent compared to that of the original leaky windows. The airtightness of the draughtproofed window is comparable with that of a standard trickle vent.

The result of condensation tests on the Historic England window with secondary glazing added showed that, if warm moist air is allowed into the gap between the secondary glazing and the sash window, the temperature of the air will fall below its dew point as it cools. This results in condensation on the colder inside surface of the sash window and the condensation risk will be potentially higher than the risk for the window without secondary glazing. This is because the surface temperature of the glazing of the sash will be colder with the secondary glazing due to a higher temperature gradient. The situation is exacerbated if both the window and the secondary glazing are leaky (draughty): this may allow a continuous flow of warm air to the outside, resulting in a higher condensation rate. On the other hand, if the secondary glazing is firmly sealed, the risk of condensation appears to be negligible, whether the sash window is well-sealed (draughtproofed) or leaky. The general advice is not to draughtproof an existing window where secondary glazing is to be added, provided the secondary glazing is well-sealed.

Estimates of the whole window U-values and reduction in total heat loss through the windows with various options

	HISTORIC ENGLAND WINDOW		HISTORIC ENVIRONMENT SCOTLAND WINDOW	
	Whole window U-value W/m^{2}K	Reduction in total heat loss through window	Whole window U-value W/m^{2}K	Reduction in total heat loss through window
Window with single glazing only	4.3	-	4.5	-
Heavy curtains	2.5	41%	2.1	55%
Modern roller blind	2.7	38%	2.3	49%
Modern blind with DIY low-emissivity plastic film fixed to the window facing side of the blind	1.9	57%	1.9	58%
Honeycomb blind	2.1	51%	2.2	51%
Shutters	1.8	58%	1.9	58%
Insulated shutters	-	-	1.3	72%
Low-emissivity secondary glazing	1.8	58%	1.7	62%
Low-emissivity secondary glazing & shutters	1.6	62%	-	-
Slimline double glazing replacement panes	-	-	2.2	51%

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IMAGE: VERRERIE DE SAINT-JUST

Transparent beauty

The attributes of handmade glass make it special. Ben Sinclair of Norgrove Studios extols its virtues and emphasises its importance when considering window repairs.

An old building with original glazing visually 'sings' in a way that is incomparable with a building glazed with modern glass. This is because period glass has ethereal qualities that machine-made, perfectly flat glass does not possess and cannot aspire to. The effect is noticeable in two ways: from without, when looking at a facade, and from within, where incoming light is refracted and plays on internal surfaces, as well as subtly distorting and enhancing views to the outside.

Consequently, handmade glass, whether reused as retained original material or matched replacement glass, is critical to maintaining a building's historic character. When undertaking work, fine surviving glass should be identified, evaluated and kept, with consideration given to replacing lost material with good quality matching glass.

Glazing and window repairs

The majority of historic vernacular and ecclesiastical buildings would have been traditionally glazed with handmade glass up until at least the beginning of the 20th century. This would have been in the form of leaded lights, set to timber frames or directly to stone and brickwork, and later, as sheet glass to timber, or occasionally metal, sashes or casements.

Successful rebuilding of original glass in leaded glazing is a skilled craft, and it is sensible to use good craftspeople for this work. Diligence in commissioning is vitally important as much historic glass has been lost by poor quality operatives in this field. Leaded lights in handmade glass are very successful. The same in drawn sheet glass or float glass are flat and dull and, along with stick-on lead planted on sheet float glass, have no character or attractive qualities.

When repairing timber windows, the glass may be carefully removed with the help of an infrared heat lamp. This type of handheld machine is commonly used to strip paint from vulnerable timber surfaces and is effective when used on traditional putty that holds glass within a timber window rebate to a sash or casement. The timber repairs can then be effected and the window reglazed.

Where good glass has been lost and replaced with flat machine made glass earlier in the life of the window, there is an opportunity to recapture the original appearance with the use of new handmade glass to match the original. A good joiner who is interested in the repair and retention of original timber material is essential, as is a capable glazier who can source and supply glass to match existing surviving panes of good glass.

New handmade glass

Conventional glazing firms are unlikely to have stocks of good handmade glass but a simple web search for handmade cylinder mouth-blown glass reveals stockists of suitable glass throughout the UK, with glass of varying quality from different parts of Europe.

The cheapest will be from eastern Europe, and is usually coarser in surface and appearance. The finest is probably French, with the most amazingly subtle shimmer. It can also be sourced from Germany and the USA but issues of variation in visual appearance, coarse surface quality and clarity will be apparent. English

cylinder glass is available, although this tends to be an 'art' glass, noticeably different in appearance to surviving period plain glazing from the 18th and 19th centuries and sheet sizes are significantly smaller. English glass is useful for replicating heavy Arts and Crafts glasses, and glass types, like Norman slab.

Large sized samples of these handmade glass types, close to the size of pane required, should be requested and compared with the original glass, and each other. The differences can then be seen and a close match achieved to surviving originals.

Unlike other materials, such as timber, brick, stone and mortar, glass does not improve in appearance, or patinate with age. Handmade glass looks good from day one, whereas float or drawn sheet will never improve over time.

Glass to avoid

Drawn sheet glass: Unscrupulous or misinformed suppliers will sometimes offer machine-made drawn sheet as a 'heritage' glass; it is not. Drawn sheet is a mechanically made sheet glass drawn vertically (hence the name) from a molten bath of glass. It is a product for the horticultural glass market known either as 'greenhouse glass' or 'Dutch lights'. This glass is flat in one plane, and has minor creases or waves in the other, caused by the glass passing through rollers to give a constant thickness – usually 3 mm – as it is drawn upwards out of a molten reservoir.

This process was first started at the beginning of the 20th century when early drawn sheet had the appearance of good handmade glass. By the 1950s production was trying to be as flat as possible, competing with truly flat float glass invented by Alastair Pilkington in 1952. When used in glazing today, it has a very small amount of visual distortion and is mediocre in appearance, being a coarse glass that no longer exhibits the characteristics of handmade glass.

Float glass: Available at any merchant, this is truly flat, having been floated as a liquid on a bath of molten tin. It is thick – 4 mm and upwards – and has no character, shimmer or beauty. Windows so glazed have the external appearance of a soulless mirror. Leaded lights in float glass are particularly ugly and are almost indistinguishable from sheet float glass with applied stick on lead.

The only context in which float glass would be used today would be for a) the replacement of 19th century polished plate glass, a truly flat glass, that was achieved by mechanical grinding and polishing of glass cast as a slab; b) for secondary glazing; and c) the process of laminating handmade glass in order to conform to safety regulations.

Double-glazed units

Composed of float glass, double-glazed units of any thickness look terrible in a traditional context. Slender glazing bars are impossible as a wide rebate – the recess cut in the timber to accommodate the glass – is needed to cover the edges of the sealed unit.

Specially designed 'slim' double-glazed units which are targeted at the heritage sector usually have a poor insulation value so satisfy neither aesthetics nor insulation targets. They are also likely to have a short life as the gap between the panes is so small with very little, if any, moisture absorbing desiccant introduced to the minute spacer bar.

Any double-glazed unit needs to be dry-fitted so the sealant edge is not immersed in any material, and any water can drain through drainage channels in the frame, whether this is timber, plastic or metal. This means rebates have to be large – and by extension ugly – with heavy exterior beads. Slim double-glazed units fitted to timber windows may fail if putty comes into contact with the edge seals as the seals break down in the presence of such material. Non-setting butyl compounds can be used, but it is unlikely that such a method will be satisfactory in the long term.

IMAGE: BEN SINCLAIR

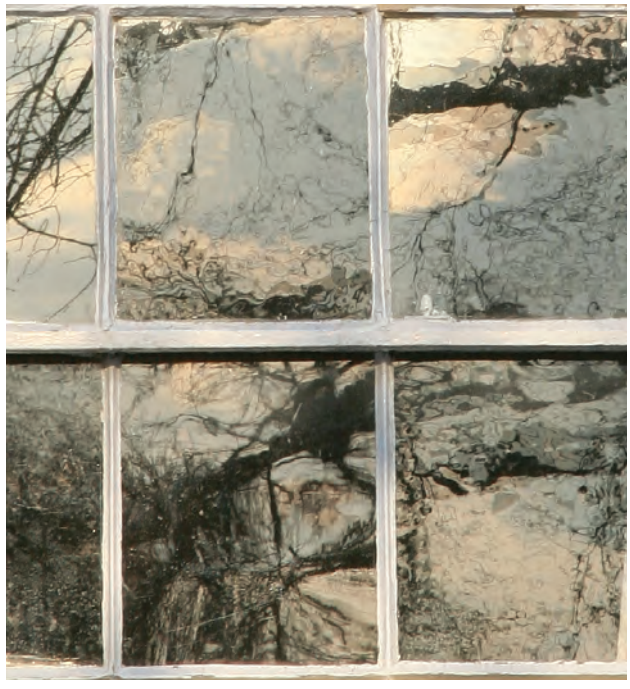

IMAGE: ROGER HUNT

Opposite: Cylinder glass is still produced.
Top: Late 17th- to early 18th-century 'broad' glass, a primitive cylinder glass.
Above: Handmade glass has ethereal qualities.

Double-glazed units may be made with a handmade glass outer face and a float inner face to give the unit the appearance of a single pane of handmade glass. This can be effective in a single paned casement or sash, although any glazing bar has to be thick and crude. Additionally, all the other limitations of double-glazing come into play.

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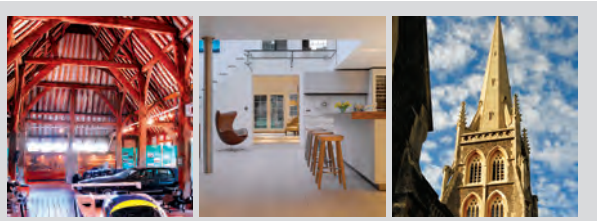

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IMAGE: ROGER HUNT

Fittings like this brass warded rimlock contribute to the history of doors and windows.

Fittings and furniture

Locksmith Richard Phillips examines ways of preventing unwanted intruders while retaining the character of windows and doors and the history of their fittings.

Many old doors show a history of locks, with a succession of three, four or even five locks still in situ. It is often easier simply to leave a superseded lock than to remove and make good. This is lucky because the practice of leaving old fittings is helpful to historians. Even screws and nails have their own development history and, in their small way, are worth preserving or, if that is not possible, at least recording for their dating information.

Where modern security measures need to be introduced they should be discreet and installation must be done so it causes minimum damage. It is worth remembering that any security fitting is only as good as the door or window to which it is attached so repairing weak or decayed sections of timber is a priority.

Doors should preferably be secured by locks with security at least equal to BS 3621 – identified by the British Kitemark – although certain locks not certified to BS 3621 have in the past and could in the future be accepted by insurers. Fixing methods vary and insurers prefer mortice locks, which are fixed in a pocket in the door edge, as their fixing is typically stronger than rim-fixing on the surface, although this can be strengthened. Some doors are unsuitable for mortice locks due to their construction or because the frame will be weakened significantly in the process.

Proper function and fit of doors is important. Most doors which fit snugly – normally on hinges, within a wood-cased opening – can be secured by modern locks. Large, thick, heavy doors – usually hung on pintles and often in stone openings – which do not fit snugly can be more of a problem, as the bolts of modern locks can be too small.

A variety of key mechanisms are employed in locks. Two are commonly used today: lever locks and pin-tumbler cylinder locks. Lever locks tend to be larger, more robust and secure, especially physically and have bigger keys. Yale type pin-tumbler cylinder locks were developed in the late 19th century. These allow the key mechanism to be separated from the bolt, so a conveniently small key can operate a lock on any thickness of door. They are less robust than lever locks and tend to be less secure. There are no commercially made picks for larger lever locks; and anyway, lock-picking is far from as easy as Hollywood portrays!

A further form of mechanism is used in warded locks, a type of lock that uses fixed obstructions (wards) to prevent it being opened unless the correct key is used. These are now generally not acceptable to insurers. Many of today's locksmiths are unfamiliar with them and do not have the kit for opening them non-destructively. The same is true of most burglars so, paradoxically, large rimlocks are perhaps more secure now than when made.

Wooden windows are generally easy to secure with today's wide range of locks. Although sash windows with only original fittings are particularly insecure, special, relatively inconspicuous bolts may be drilled into the meeting rail so the two sashes lock together. Alternatively, a special locking bolt allows sashes to be secure even while ajar. Pre-Second World War metal windows can require expert advice.

Shutters may be an effective deterrent to burglars. Where appropriate, thin ones can be lined with sheet steel. Not many shutters were originally fitted with a catch to prevent opening the securing bar from outside – something advised in 1851 by George Cruikshank in *Stop Thief*, the first published book on crime prevention.

Locks are not alone in being important. Latches, knobs, bolts, knockers, hinges and letter plates all contribute character and give vital clues to the history and status of a building, so should be repaired and maintained with the same care as would be given to other antiques.

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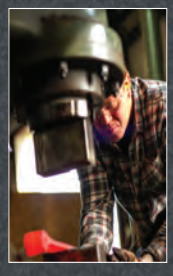


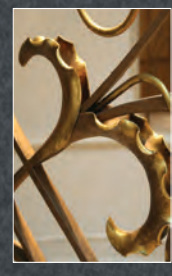

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IMAGE: ROGER HUNT

Where new is necessary

Mark Hines, a director of Mark Hines Architects, a practice specialising in conservation and new design, explores new window and door options for old buildings.

Introducing a new window, dormer or any other form of rooflight into an old property successfully can be particularly challenging. There are many decisions that need to be made: its precise location, size, proportions, frame material, glazing bar or type of glass. All these questions need careful consideration, as buildings can be easily spoilt by insensitive interventions.

A new window might be needed for all sorts of reasons, but as good conservation is often about minimum intervention, the first question we might ask is: 'Is it actually necessary?'. For instance, careful upgrading and repair of the existing window may well be a better option than wholesale replacement. Similarly, with clever design, areas such as bathrooms can be made perfectly usable without natural light. Both may prove to be satisfactory, economical and better conservation options.

If we decide to do something new, how can this be done whilst being sympathetic to the historic building fabric? Every project is different, but successful new interventions keep the feeling, character and atmosphere of the building. This is sometimes much harder to do than it sounds. As a rough guide, new windows should generally match the style of the other windows in the building – the more formal or classical the architecture the more important this is. Vernacular buildings, with less regularised openings, will perhaps allow us a little more leeway in our choices.

IMAGE: MATTHEW SLOCOMBE

Top: This extension's casement windows reflect the proportions of the sashes in the terrace, consciously but sympathetically distinguishing new from old. Above: Glass tiles in a clay tile roof.

Proportions

For hundreds of years, the structural capacity of a timber or stone lintel to span an opening set the horizontal width of the window. Its height was determined by functional requirements or, as glass was expensive, a window's vertical measurement was sometimes used to express the wealth of the owner. During the Georgian period, getting the classically correct proportion of openings in a facade became a mathematical or academic discipline, a sign of education and good taste. Windows gradually became taller and glazing bars thinner, giving us the elegant proportions many of us still value today.

In choosing the window frame material, it is important to consider how the new window will perform over time. All windows require maintenance but, provided they are well-installed and properly maintained, timber, stone or metal windows can last for many decades or even centuries. Ideally, the frame should weather gracefully at the same rate as the rest of the building.

Glass tiles

Probably the earliest form of rooflights, glass tiles are generally made from cast glass and are nailed directly to timber battens. They can be very beautiful and are seamlessly integrated into the surrounding roof finish. However, some tiles can be an inconsistent thickness and gaps between overlaps mean that rain may penetrate and condensation can form internally. Bonding the edges of the tiles with a silicon sealant but leaving a gap at the bottom of each tile can help allow any internal moisture build up to escape.

Dormer windows

The key to installing a new dormer is to create a satisfactory relationship with the windows below, and to avoid the temptation to make it too big. Generally, the width and height should be no greater than the dimensions of the openings of the windows below. In narrow houses, a single dormer placed in the centre of the facade may look much better than trying to align it with the other openings. The dormer cheeks should be faced in a sympathetic material to the rest of the building.

Roof windows and rooflights

Historically speaking, roof windows or rooflights are a more modern way of introducing light into an interior. They are often the only practical way of getting light into an area, especially where there is a planning requirement to keep within an existing roof profile or not to overlook an adjoining property.

Roof windows share all the characteristics of a normal window in terms of function, cleaning, maintenance and durability, but are installed within the pitch of the roof. In older houses, roof windows are sometimes added above stairs to bring in natural light and ventilation, or used to give access to the roof. Adding a roof window to a valley gutter gives useful access to clear leaves and help prevent blockages or leaking roofs. Where used on a pitched roof, they can be flush – which looks neater and more traditional – or slightly above the level of the roof finish.

Rooflights vary in form, and can range from being small single pieces of fixed glass, elaborate pyramidal or barrel vaulted structures or even horizontal units capable of being walked on. On flat roofs, rooflights are usually positioned above the level of the surrounding roof material.

Sun pipes

These are a comparatively modern invention. Unlike roof windows or rooflights, sun pipes do not offer a direct view of the sky but channel light through a mirror coated tube which provides a diffuse, soft light. They can be easier to weave through existing roof timbers and are therefore less physically intrusive than a rooflight or window. Some fittings terminate externally in crude looking plastic domes, but many now have glass lids so externally they have the appearance of a rooflight.

IMAGE: DOUGLAS KENT

IMAGES: ROGER HUNT

Top right: The characterless new 'Georgian' door (right) lacks the detail of the original door (left). Above: Temporary flood barriers protect an old building.

Ventilation

One of the main reasons for wanting to replacing a window is to reduce drafts and help retain heat. However, draughty windows also provide important background ventilation which is necessary to prevent moisture build up and to ensure a satisfactory and healthy internal environment. If windows are to be replaced to reduce drafts, it is very importantly to ensure there is still adequate internal ventilation.

Irregular openings

In order to preserve as much historic fabric as possible, new windows should be made to fit the existing building, rather than cutting surrounding historic structure to fit the window. If the opening is squarish, a new window may fit within standard constructional tolerances – generally plus or minus 5 mm. For more irregular shaped openings, a bespoke solution will be needed.

Flood barriers

In houses at risk of flooding, historic doors should be retained. As an additional line of defence, purpose-made barriers can be temporarily fixed in front of doors and removed once the risk has passed. Typically, a timber panel is located between guide channels formed by timber battens which are permanently fixed to reveals each side of the door opening. A slot in the paving can help secure the bottom edge of the side channels and barrier. Its effectiveness may be increased by applying waterproof sealant around its edges. Rather than a single panel, individual boards can also be slotted together with tongued hardwood top edges and grooves to the bottom edges to increase its height. A locating pin can be used to help prevent the boards from lifting.

Windows may be protected in a similar manner, and both existing doors and widows can be given additional protection by the fitting of draught and weather seals.

As an alternative to temporary flood barriers, permanent barriers can be discreetly incorporated into the immediate features surrounding the building such as a raised front door step, boundary walls, fences or gates. Other flood protection features may be incorporated into the wider landscape, such as raised earth bunding or additional drainage ditches, to prevent water reaching the building. These have the advantage of not requiring interventions within the historic structure itself.

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IMAGE: ROGER HUNT

Performance improvements

Much can be done to improve the thermal performance of old windows and doors without destroying their character, says historic buildings surveyor Catharine Bull.

When compared to the rest of the building envelope, windows are often the component which performs worst thermally. The thermal insulation properties of a window are largely determined by the glass but other elements also play a part: the frame, casement or sash, and installation detail.

Every window and door tends to need to be considered separately, with different solutions for different areas around the building depending on aesthetics, orientation and how the window or door is used. For example, is it an escape window in the event of fire or a window that is never opened in the winter months? Sometimes, alongside thermal performance, acoustic treatments may be required.

Shutters, curtains and blinds

Many of the most cost effective solutions for improving windows were historically commonplace. Internal shutters were used to retain heat, reduce solar gain and improve security and privacy. An important feature of many historic buildings, shutters remain an excellent way of reducing heat loss by both draughts and conduction through windows in unused rooms or from dusk in rooms used during the day.

Using minimal repair and replacement, existing shutters may be overhauled in situ to get them operating smoothly and fitting snugly. Improvement of the thermal performance of the timber can be made by insulating the panels of the shutters and fitting a brush strip or rubber seal to the edge. Where there is evidence of shutters having once existed, consider reinstating them. As a reversible intervention, shutters are worth installing even without clear evidence of their existence historically. Making the panels of glass offers a way of retaining the light transmission of a window.

Heavy curtains are also good at reducing heat loss but must be hung with no gaps around them through which draughts can flow. Thermal interlinings maximise their insulating effect. Well-designed blinds can be just as effective as curtains, and more so if they fit tightly against or within the window frame and are made of materials with a reflective surface facing outwards.

For particularly draughty doors, portiere rods are worth considering. These may either be ready-made or made by a blacksmith to fit the opening and are hung with a thick insulated curtain close to the door to trap cold air behind. The rods use a rising hinge so, when the door is opened, the curtain easily swings open with the door with minimal resistance. In summer, the curtain can either be tied back or removed.

Films

Research has found that the application of a proprietary film, claiming to reduce heat gain in summer and heat loss in winter, has a modest but measurable improvement in the thermal performance of glass. It is inappropriate for fragile, old glass.

Draughtproofing

Draughtproofing is one of the best and least intrusive ways of improving comfort and reducing heating energy use and causes little or no change to a building's appearance. It can also help to

IMAGE: ROGER HUNT

IMAGE: ANDY MARSHALL/SPAB

Opposite: Improving the energy performance of existing windows is preferable to the visual damage caused by inappropriate replacements.
Left: An escutcheon plate with cover stops draughts.
Above: Shutters help retain heat and provide added security.

reduce noise and dust ingress. Windows and doors may be a major source of air infiltration, especially if in poor repair and where there is much play or rattle when gently shaken. Draughtproofing reduces the gap between the window casement or sash and the frame, significantly lessening the air exchange via the gaps.

Many traditional timber windows are draughty and difficult to operate because of the effects of wear and tear and the accumulated impact of repainting over the years. However, traditional windows and doors can almost always be repaired, even if they are in bad condition so, before embarking on draughtproofing measures, decide what repairs are needed and do these first. In some cases, this work attains a good fit of the window within its frame.

When draughtproofing, choosing the right product to achieve an effective seal when the window is closed can be difficult as draught-strips come in many shapes and sizes. Windows and doors are often distorted and many products can only deal with a small range of crack widths. Some products are applied to the surface of a door or window frame but concealed solutions are often better for traditional buildings, and essential for most historic ones.

Draughtproofing seals are of two main types: compression seals and wiper seals. Compression seals are used where the moving part of the door or window closes against the frame and the seal compresses to fill the gap. Typical applications include around the sides and top of a door or around the entire edge of a casement and they can also be used along the bottom and top rails of sash windows.

Wiper seals are used when the moving parts slide by each other and are the only way of sealing the sides and meeting rails of sliding sash windows. They can also be fitted to the edges of casement windows and doors, particularly the base of doors. The most common wiper seals are brush pile held in a plastic carrier.

For sash or casement timber windows, the most effective way of draughtproofing is to rout a small channel into the frame of the window and insert a brush pile, which can act as either a compression or wiper seal, along with new parting and staff beads fitted with brush pile seals. Building owners should seek an experienced carpenter or joiner to do this work and possibly consent too. On sash windows, a fitch catch helps to hold the sashes together to create an effective seal when the window is closed.

Secondary glazing

Secondary glazing is highly effective at improving the thermal performance of traditional windows. It can match the performance of double glazing and provide far better noise insulation. The advantage with secondary glazing is that it retains the original window, keeping the exterior appearance intact, as well as the original materials and the technical knowledge embodied in the construction of the window.

Appropriate secondary glazing can have minimal visual impact if carefully planned, and meticulously designed: the sightlines through the window must not be obscured and the only line visible on the frame of the secondary glazing should be where the frame meets the glass. There are many different ways of installing secondary glazing to a window opening. The designs and specifications should be considered as early as possible in a project to ensure a successful result.

An important aspect to consider is how the window is used. On windows never opened, or permanently closed during the winter months, a seasonal approach to dealing with draughty windows is to apply a special proprietary film, similar to cling film, that is stretched across the window architrave and made taut by heating with a hairdryer. Another removable option is a piece of plastic, cut to size and held in place by self-adhesive magnetic strips around the edge of the plastic and window frame, which is easily removed if need be. Secondary glazing of this type can be almost invisible if installed with care and is entirely reversible. Also, as the carrying strips sit within the window

IMAGE: MATTHEW SLOCOMBE

IMAGE: ROGER HUNT

architraves, there are no conflicts with shutters allowing their continuing use.

A more durable and effective way of cutting back on heat losses from windows is to install fixed, made-to-measure secondary glazing units set at a little distance from the main glazing. Various companies now specialise in designing, manufacturing and installing glass secondary glazing for traditional buildings. Most of these proprietary systems have painted aluminium frames. The slim, neat lines of some of these modern secondary glazing systems mean that they work within the dimensions of the window so avoid intruding on shutters and window cills. The more substantial framing sections are stronger and can accommodate seals, fixings and counterbalance systems. Aluminium has a very low thermal inertia, and the fitting of the aluminium outer frame of these systems in a timber surround creates a 'warm edge' reducing conductive heat losses. The use of a wooden frame for a secondary glazing unit offers even greater thermal improvement and using low-emissivity glass also significantly improves performance.

The design and usage of the original window should inform the style of the secondary glazing. For example, where windows are never opened, or permanently closed during the winter months, single fixed or lift-out panels are an option, though they can be difficult to handle and store. Openable secondary glazing designed as sliding panels to access the original window are available and achieved by dividing the window into two panels. Where to locate the unit in the window reveal is frequently a problem when designing secondary glazing and the design of traditional shutters suggests ways to overcome this. For example, having the glazed panels fold back into architraves or along the wall, or slide into pockets alongside or below the window. Where secondary glazing is being installed, the advice is to not draughtproof the windows as this helps ventilate the cavity, thus minimising condensation.

Above left: Glass secondary glazing panel.
Above right: Plastic secondary glazing held in place with magnetic strips.

Glass replacement

Most traditional windows have a glazing bar with a shallow rebate designed to take the thickness of a single sheet of, typically 3 mm, handmade glass and a thin fillet of linseed oil putty. If the windows have lost their original glass and the rebates are deep enough, it may be possible to consider reglazing to cut heat transmission with low-emissivity coated glass.

Alternatively, slim-profile doubled glazed units that are 6-12 mm thick might be an option. Whilst the rebates of a traditional window may accommodate these units, their weight can still pose a problem as they are inevitably much heavier than the single panes of thin glass they are replacing. This leads to difficulties in counterbalancing vertical sliding sashes and is likely to put strain on the hinges of casements.

A hybrid form of double glazing in development is precision-cut acrylic fitted within each pane. It does not deal with heat transfer through the frame but tests have confirmed that it can cut thermal transfer by more than 40 per cent.

Doors

It is good practice to have all external doors carefully inspected by a good joiner to identify the larger gaps. These gaps can then be filled with timber fillets of the same timber species and grain direction and may be stained or painted to match the colour of the original door if required. A good craftsman should be able to make timber fillets less than 0.5 mm thick providing very precise gap control, although such fine tolerances can be problematic if the door is constantly exposed to rain causing it to swell.

Doors have a variety of apertures that allow draughts to enter: keyholes, letter plates, cat flaps and the gap at the bottom of the door. These are often overlooked and, when attended to, can make a vast improvement to the situation.

Professional draughtproofing is a good solution and, depending on the design of an old door, it may be possible to add a thin insulation product to the inner face covered with plywood or within the sunken panels to the inner face.

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Warmer

Double glazing is a well-known way to cut down on heat loss but this is often not possible with traditional single glazed windows. However; purpose designed secondary glazing introduces an extra pane of insulating glass which reduces heat loss by more than half and using advanced seals almost eliminates draughts.

Quieter

High noise levels can be very disturbing leading to problems with sleep,concentration and wellbeing, as well as raising stress-levels. WHO provides guidelines on optimum noise levels for the home and work. Secondary glazing provides the most effective way of eradicating noise, as the separation between the inner and outer glass decouples the panes to markedly reduce sound transmission. Well-designed secondary glazing set 150mm apart from the outer window can achieve a 45dB reduction.

Safer

Improved security provides peace of mind and simple secondary glazing with locks and strengthened glass offers an unobtrusive second barrier to entry, deterring the opportunist thief. However, many buildings will need much higher levels of protection both for people and for high value artefacts or sensitive data. In these cases secondary glazing provides certified levels of protection against the most determined intruder.

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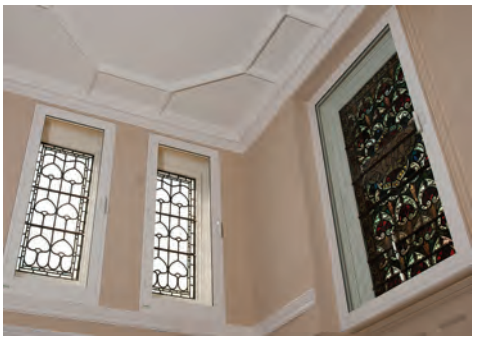

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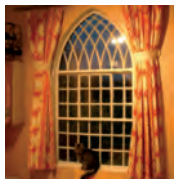

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Iron framed casements with leaded lights are often a principal feature of vernacular buildings.

IMAGE: ROGER HUNT

Iron and steel

Metal windows and doors are present in a vast number of buildings. Geoff Wallis, of Geoff Wallis Conservation, provides an insight into their history, care and repair.

Simple wrought iron frames and casements with glass held in lead cames have been used in Britain since at least the 16th century, but in the 18th century improved methods of manufacturing and shaping metal and the rise of large manufacturing works facilitated the much wider use of metal. The quality of metals and the accuracy of shaping them further improved in the 19th century and the cost fell. Consequently, the tonnage of metal used in architecture increased dramatically, particularly in industrial and public buildings where, by the end of Queen Victoria's reign, great quantities were in use.

Then technical advances in making steel reduced the cost of this material to below that of wrought and cast iron. Powerful, accurate rolling mills enabled complex precise sections to be formed, allowing the manufacture of stiffer and better-sealing casements. Thus, by the early 20th century, vast quantities of steel windows were being manufactured, notably by the Crittall Manufacturing Company which dominated the world market for many decades.

Steel frames, casements and doors are still manufactured, but the industry is now dominated by aluminium products generally having wider frame-sections. These offer good thermal and weathering properties, but can change the appearance of window and door openings dramatically. Repair of existing metal fixtures is therefore preferable to renewal on historic buildings.

Advantages and disadvantages

Windows made entirely from wrought and cast iron offered the advantages of being stronger and more durable than wood, allowing more slender sections which were elegant, and provided less obstruction to the passage of light. Ironwork was fire-resistant, and could be curved for shop-fronts, conservatories, and glasshouses. For doors, cast and wrought iron found application in factories, mills, banks and military establishments where fire-resistance and security were paramount.

Disadvantages lay in the cost of fabricating wrought iron frames and casements, the brittleness of cast iron, the flexibility of wrought iron, and the high thermal conductivity of both, with the attendant risk of condensation forming on indoor surfaces.

Assessment

Careful inspection is necessary before any work is carried out to metal windows and doors. Often frames and casements are corroded locally, particularly at the bottom where moisture collects. Rust expands by a factor of at least five so a build-up of rust does not necessarily mean that a section has inadequate residual strength. Usually the loads on a frame are spread, so that the weakening or loss of a localised area is often not significant structurally.

Weathersealing

By modern standards traditional metal windows and doors are often relatively pervious to wind and water. Moderate air leakage is often beneficial to the room's environment and its impact can best be reduced by fitting secondary glazing or heavy curtains.

Three factors influence the weather-tightness of casements and doors:

- Frame sections: Early wrought iron frames and casements were usually made of flat sections with face-contact offering little resistance to wind-driven rain. In the 18th century rolled wrought iron, steel and cast iron casements incorporated 'webs'

IMAGE: MATTHEW SLOCOMBE

Fittings are an integral part of metal windows. Below: Early ungalvanised steel windows should be cleaned off in situ and repainted.

IMAGE: DOROTHEA RESTORATIONS

which stiffened the section and formed rebates to receive glazing and to restrict leakage. In the 19th century the introduction of rolled steel sections, with improved stiffness, rebating, capillary-breaking and water management, which were popularised by the Crittall Manufacturing Company, brought further improvements.

- Flexibility: Traditional metal doors and window casements are often more flexible than modern equivalents. Rust, paint, and debris cause deflection and leaks, so simple cleaning and mechanical repairs may reduce seepage. Central catches on large doors and casements allow the top and bottom corners to deflect, so leakage can sometimes be reduced by fitting espagnolette or tower bolts.
- Fit: Corroded and heavily painted surfaces, worn hinges and catches, distortion and structural movement can cause gaps to develop between sealing faces. Distortion is often difficult to correct and is best treated by weathersealing (see below). Where the edges of doors and casements catch, the wear in hinges should be remedied and, if necessary, edges dressed away and protected by a suitable coating system.

Gaps can be filled by use of a soft, flexible mastic bead run onto the frame and squashed to shape by closing the casement onto it, using a bond-breaker such as cling film to ensure it releases after curing. Fine brush seals or thin soft rubber tubing bonded to faces or edges are effective in some situations.

Whilst filling gaps between frames and opening lights can result in improved weather-resistance, the flexibility of casements and the fine tolerances required to exclude wind and water make the long-term results variable, so secondary glazing may be advisable.

Repairs

The whole frame should not be removed from its opening if a localised repair can be carried out in situ.

Historic glass is as important as metalwork so is best removed before repairs and refitted on completion. Infrared putty-softening lamps do not work effectively on metal frames due to their high conductivity. Instead, facing putties must be carefully scraped away and glass gently eased from its bedding layer, with a sharp knife used to remove sufficient putty around edges to release the glass without stressing it, perhaps assisted by a thin lubricating oil.

Wrought iron and steel frame repairs

New sections can be rolled, forged, machined or fabricated from steel or recycled wrought iron and welded in place by arc welding or, if the frame has been removed from site, by gas welding. Worn or damaged hinges, catches, stays and bolts should be repaired using traditional materials and techniques where possible, and missing items replaced with accurate replicas.

Cast iron frame repairs

Localised cracking due to the expansion of rust or movement in surrounding masonry is common in cast iron frames and can often be addressed with the frame in situ. Defective sections may be eased out, rust or protruding masonry dressed off, surfaces cleaned and painted, and original sections secured by arc welding or by cold repairs such as pins, plates or stitches. Cold repairs are preferable to hot techniques which cause damaging stresses in brittle cast iron.

Spheroidal graphite (SG) cast iron is useful for replacement sections. It is cast in sand moulds in the traditional way but with an additive that makes the resulting casting ductile. Thus, new sections or complete new casements and frames are strong and durable, can be bent to shape and fittings, such as catch plates and hinges, can be welded to them.

Security

Traditional locks and catches on metal windows may often be upgraded by the addition of locking bolts or pins, and unused casements can be immobilised by small brass headless bolts (set screws) inserted into corners. Where casements or glazed panels are weak, additional security bars or secondary glazing may be required.

Preparation and painting

Early coatings should be retained where possible. Coatings such as hot-dip galvanising and paint are historically important and can contain evidence of past finish colours. Samples should be checked under a microscope and analysed chemically, if necessary, to determine early finish colours, and these used for repainting where possible.

Modern single and two-pack paints can usually be applied to traditional coatings, subject to trials. Specialist advice should be sought on the best method of surface preparation and the optimum choice of paint system.

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Finishing first

Laura Stevens, of specialist decorators L V Stevens & Co and chair of the Traditional Paint Forum, emphasises the need to select the right finish.

Since 2010, when the EU required the solvent levels of paints to be reduced dramatically, manufacturers have reformulated their paints or ceased producing solvent-based paints altogether and turned to water-based alternatives. This leaves the specifier or decorator with some difficult choices when choosing an exterior paint system:

- To stay with an existing solvent-based product range, even though it behaves very differently from the way that it used to
- To change to a new water-based range – this may involve totally removing existing coatings
- To consider traditional linseed oil-based paints

Best decorating practice involves removing all flaking and unsound paint before filling, abrading and cleaning prior to repainting, but changing paint systems from a pre-2010 gloss paint to a water-based system may require all the existing paint layers to be stripped off. As well as a potentially large amount of work, this will lead to loss of patina and evidence of historic paint schemes as well as the protective effects of any remaining historic lead paints. Sadly, it is no longer possible to obtain linseed oil-based paints containing lead – a mixture which has contributed to the longevity of many a historic window frame or door.

Where water-based paint strippers are employed there may be issues with totally neutralising products which have been used on porous softwoods. If such products are not completely neutralised, any future paint layers may be softened (saponification) by the remaining alkaline chemicals and rapidly break down.

There are also questions about the long-term environmental impacts of plasticisers which are used to make some water-based paints flexible, in time these effects may prove to be just as damaging as the lead and solvent-based paints which they were designed to replace.

Using traditional linseed oil-based paints is probably the best way forward. In some cases sound existing paint layers can be painted over if properly prepared. However, linseed oil paints behave differently to solvent-based paints and take some getting used to as they are applied in thinner layers and dry more slowly. If they are applied too thickly they form a 'skin' which appears dry but covers a tacky under layer. When using linseed oil paints it is extremely important to work within the correct temperature and humidity conditions and allow plenty of time for drying. It is vital to maintain linseed oil paints properly with a regular top-up coat or coat of plain linseed oil.

When choosing paint or other exterior finishes it is also important to consider colour, for practicality as well as aesthetics and historical accuracy. It is unwise to use a dark colour on areas of exterior joinery which are subject to intense sunlight as this can cause blistering and cracking due to heat absorption. This may be mitigated by using the traditional solution of hanging a canvas curtain on a metal rail in place over the door during the hottest parts of the year.

It is possible to leave robust exterior oak joinery unprotected and let the wood weather to a pleasant 'silvery' colour. Alternatively, the wood can be protected with several coats of linseed oil mixed with turpentine, then topped up as necessary with a coat of linseed oil on a regular basis depending on the prevailing weather conditions.

Where woodwork repairs have been carried out and will be left unpainted – for example on an oak door – the effect of new wood against old can be discordant leading to the temptation to stain the new timber to match the old. However, this would be going against the principle of an 'honest repair' and the stained areas may change over time and eventually look unsatisfactory.

Above: Choice of paint type and colour can make a significant difference to the character and fabric of old buildings.

www.decorworks.co.uk www.traditionalpaintforum.org.uk













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