windows

A GUIDE TO THE REPAIR OF HISTORIC WINDOWS

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Contents

Introduction

Owners generally want to do what is best for their old building. For windows to look good and work well, owners need to be informed of all the facts about window repair, restoration, and replacement. We rarely spend large quantities of money before finding out the cause of the problem and seeing what solutions might be available. It is no different with windows. To get a realistic idea of what can be done, look through this booklet and then assess your existing windows.

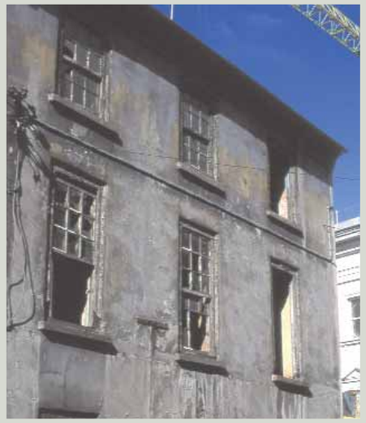
Why repair historic windows?

Very many old windows, made in the eighteenth and nineteenth centuries, have been successfully maintained and repaired using methods that have stood the test of time, and are still functioning. This common-sense 'mend and make do' approach to house maintenance has proven its worth over the centuries; only time will tell if windows made of modern materials last that long. If your windows are over a century old, doing works to them now is adding value to something that has proven it can withstand wear and weather.

This late Georgian building, formerly a hotel, had its original sash windows retained and refurbished in an office conversion project

It cannot be over-emphasised that historically windows were put together by skilled joiners and were made of high-quality timber that lasts for generations. This is why the repair and maintenance of your historic windows are strongly recommended.

If the accumulation of wear-and-tear is of concern, remember that most defects can be put right by a good joiner. If the windows need major repair and upgrading, the costs may be similar to replacement with new windows. However, the existing windows have proven their quality by surviving over decades and centuries. With care they should last many decades more, greatly outstripping the performance guarantees given with newly-manufactured windows.



In the 1880s, the Irish Builder *newspaper published an article on eighteenth-century house joinery, which said: 'The methods used in putting together work showed that the workmen were skilled, and that builders and workmen alike were interested in turning out well-finished and durable work'. This early eighteenth-century building was left derelict for many years, with the windows deteriorating until they were in extremely poor condition. However, as the timber was intrinsically of good quality, they were capable of being repaired, with missing elements fabricated to match*

Historic timber sash windows, in good condition and appropriately upgraded, should be as weather-tight as new windows, while the costs of repairing and upgrading should be lower than the price of off-the-shelf replacement windows.

It is a common mistake to confuse high quality historic timber with the poor 1960s and 70s timber windows that barely lasted a generation. The 30 or 40 year life span now often guaranteed with new windows is a small improvement, but it is a significant difference from the proven life span of at least several generations for historic timber windows. Bear in mind that there is no such thing as a 'maintenance free' product. Everything needs to be maintained. If you cannot maintain a window, you have to replace it, or its parts, when they wear out or break.

This window was photographed after being carefully cleaned and repainted by the householder

Well-maintained historic windows show off the character of your historic building to its best advantage. If you wish to sell the building, they increase its desirability to discerning buyers. If the original or early windows are gone, only the most accurately-designed and detailed replacement windows will make a similar positive impact but, even then, they can never replace the authentic historic windows. If replacement windows are not appropriate to the character of the building, this will be obvious and may reduce its attractiveness to future buyers. Replacing old windows is not always 'home improvement' after all.

The original sash windows in this house seemed to be cared for - like the house generally

Possibly with the best of intentions, they were taken out and top-hung uPVC casements fitted instead. When closed these appear flat and insubstantial, and when swung open the superficial likeness to traditional windows is lost

The power of advertising is often such that it makes us believe that new products must be better than the ones we already have. This is not necessarily true. Repairing windows reduces the pressure to produce new timber, metal, or plastic products, eliminates unnecessary waste, and is environmentally more sustainable. In many cases, the windows are replaced each time a dwelling is sold, generating thousands of tonnes of unnecessary waste.

While decay is commonly cited as a reason for replacing timber windows, in fact very few historic windows are deteriorated much, let alone beyond repair. Most likely the real reason for removing them is because of the mistaken perception that what is new must surely look and work better and will not require maintenance

Production of new timber windows is far less energy-consuming than plastic or metal but is sustainable only if the wood is sourced from an environmentally managed plantation. Some modern framing materials and patented catches, hinges and locks cannot be maintained or repaired. Recycled old timber is commonly used for low-grade uses such as woodchip; a poor end for high quality slow-grown pine from historic windows.

ARE MY WINDOWS 'HISTORIC'?

- Are they original?
- Are they later alterations of interest in themselves?
- Do they have old glass, arched heads, or decorative glazing?
- Are there shutters and other elements?
- Is there a balcony, guardrail, or Gothick hoodmould (a moulded 'eyebrow' above the window)?
- Do they add character to the building?

If the answer is yes, then you have historic windows that deserve the best treatment.

Conservation principles

In a sense we look after our historic buildings for those who come after us. Many of these buildings have been around for generations before us and it is our responsibility to hand them on in good condition to allow future generations to enjoy them too. It is important to understand some of the basic principles of good building conservation so that the works you undertake do not damage the special qualities of a historic building. Many of these principles are common-sense and all are based on an understanding of how old buildings work and how, with sensitive treatment, they can stay special.

Before you start, learn as much as you can about your particular building. What is its history? How has it changed over time? Remember that later alterations may be important additions to the history of the building. If the building has been cared for and adapted over the years, each generation of change has made its own contribution to its character. Find out what is special about the building, and how you can protect these special qualities when carrying out works.

CARRYING OUT MAINTENANCE OR REPAIR WORKS:

- Do use the experts - get independent advice from the right people
- Do repair the parts of the building that need it - do not replace them unless they can no longer do the job they were designed to do
- Do make sure that the right materials and repair techniques are used and that even the smallest changes you make to the building are done well
- Do use techniques that can be easily reversed or undone - this allows for any unforeseen problems to be corrected in future without damage to the special qualities of the building
- Don't overdo it - only do as much work to the building as is necessary, and as little as possible
- Don't look at problems in isolation - consider them in the context of the building as a whole
- Don't use architectural salvage from elsewhere unless you are certain that the taking of the materials hasn't caused the destruction of other old buildings or been the result of theft

Getting the right advice

When it comes to repairing a building, regardless of its age or size, it is important to know when specialist advice is needed and where to find the right help. It is a false economy not to get the best advice before having work carried out. Bad repair works can be difficult and expensive to undo. They can damage a building in the long-term and devalue your property.

You will need the right advice for the particular job. Sometimes you will require a craftsman, or an architect, a surveyor or a structural engineer. Sometimes you will need specialist advice from someone with a particular expertise such as a timber decay specialist or a stained glass expert. When undertaking a large or complex conservation and repair project, a multi-disciplinary team may be required. Most importantly, you should ensure that any adviser is independent and objective. Avoid taking advice from someone trying to sell you something, or someone with a vested interest in increasing the scale and expense of work. Many building professionals and contractors are only involved with modern construction and may not know how to deal sympathetically with an old building. You need someone who understands old buildings, has experience in dealing with them, and has trained to work with them. He or she should be knowledgeable and experienced in dealing with your type of building.

When employing a professional adviser or a building contractor, check their qualifications and status with the relevant bodies and institutes first. Ask for references, and for the locations and photographs of recent similar work undertaken. Do not be afraid to follow up the references and to visit other building projects. A good practitioner will not mind you doing this. If you see a good job successfully completed on a building similar to yours, find out who did the work, whether they would be suitable for the works you want to undertake, and if the building owner was satisfied.

Try to get at least three written estimates or quotations for the work from suitable contractors. Do not make your final choice based on cost alone. The cheapest quote you receive may be from a person who does not fully understand the complexity of the problem. Do not make payments for work until you are satisfied it has been correctly completed.

Be clear when briefing your adviser what you want him or her to do. A good adviser should be able to undertake an inspection of your property, give you a report identifying the causes of damage, make a careful diagnosis of the problem, recommend repairs, specify the work required, get a firm price from a suitable builder or craftsman, and oversee the work on site as it progresses. If your building is likely to need ongoing works over a number of years, your relationship with your adviser and builder will be important both to you and your building, and continuity will be a great advantage. They will be able to become familiar with the property, and to understand how it acts, and will build up expertise based on your particular building.

The Royal Institute of the Architects of Ireland keeps a register of architects accredited in building conservation and will be able to provide you with a list. The Irish Georgian Society maintains a register of practitioners with traditional building and conservation skills. The Construction Industry Federation has a register of heritage contractors. The conservation officer in the local authority may be able to recommend suitable professionals, craft workers, or suppliers in your area.

WINDOWS A GUIDE TO THE REPAIR OF HISTORIC WINDOWS

1. A short history of Irish windows

Old windows can tell us about the history and development of historic buildings. Over the centuries, window design was shaped by changing architectural fashions, but also by the need to gain more light inside buildings. Through the eighteenth and nineteenth centuries, window framing materials were gradually slimmed down and glass panes enlarged with every technological advance in joinery, metalworking, and glassmaking.

When this castle was built in the 1580s, the mullioned windows (on the right) were fashionably large and possibly even glazed (unlike most windows at the time), but by the mid eighteenth century they were seen as hopelessly mediaeval. The castle was thoroughly Georgianised and given large new sash windows, to let light in and view the landscape of the improved demesne

Lead-glazed fixed lights and casement windows of the seventeenth century are extremely rare in Ireland. Called 'quarry glazing', lead panels were still being made into the early eighteenth century, but were seen as inferior to timber-framed windows in every way

WINDOW TYPES

Most historic Irish windows date from the early eighteenth century and after. Extremely few earlier windows survive in use (some were later blocked up and may be uncovered during building works). Vertically-sliding sash windows originated in England in the late seventeenth century. The earliest known Irish sashes were fitted in Kilkenny Castle in 1680. By 1700 the use of sash windows had spread throughout the country; they were robust, required relatively little maintenance, allowed better control of ventilation and, as large windows with clear panes of glass, allowed more light indoors. Most surviving windows are sliding sashes, that is, sashes counterbalanced by hidden weights so they slide easily in the frames. Some sash windows, usually very early ones, have no weights and the sashes must be held open by pegs. Casement windows, hinged at the side, were also used, more often in the nineteenth and twentieth centuries.

Timber casement windows were cheaper to make than sashes, and so were often the choice of those housing workers. Here they are used in the bedrooms, letting the main living room have the more prestigious sash window

Other window types include top-hinged casements, common from the early twentieth century onwards, hopper windows - hinged at the bottom rail - and pivot windows, which were occasionally used in the nineteenth and, more so, in the twentieth century. Least common of all is the horizontally-sliding window.

The top light of this decoratively designed metal window is a pivot, which swings about its horizontal axis (the top swings inwards and the bottom outwards)

One side of a horizontal sliding window (sometimes called a Yorkshire sash) can be pushed open, while the other is fixed shut

Up to the middle of the eighteenth century, sashes had very blocky glazing bars and small panes. By the late 1750s styles were changing. Mrs Delany, a well-known socialite and diarist, wrote in 1759 that she 'had the sashes new made in the narrow way, which makes them much pleasanter'.

The substantial joinery seen here in a window of the 1720s had an aesthetic purpose as well as a practical one. The strong grid was thought to contribute to the character of the architecture

From then, until the mid nineteenth century, glazing bars were slimmed down until the profiles were very fine. Meanwhile the size of the panes got larger, typically using six panes per sash. In taller windows there were often nine panes in the upper sash and six in the lower.

The sash window shown here was installed in about the 1780s (it is now freshly glazed with new cylinder glass). Extremely thin glazing bars like these were made possible by using a metal core to strengthen the bars. Joinery standards improved generally towards the end of the eighteenth century to keep up with this new fashion for slimly profiled windows

Fitting plate glass was a fashion statement. Using a hierarchy of plate glass for the main rooms and small-paned sashes for basement and bedroom floors became commonplace in the late nineteenth century

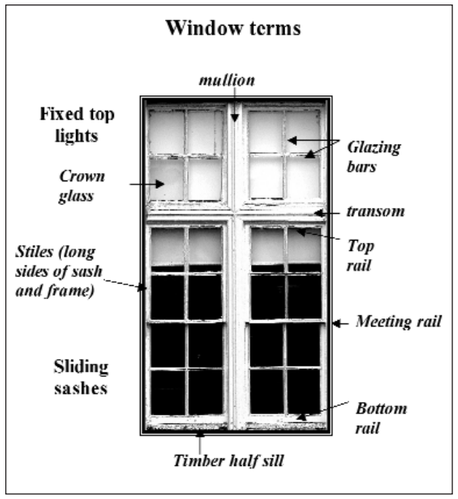
The introduction of mass-produced plate glass was a mid nineteenth-century development. It was often used in new and refurbished houses for the windows of the main reception rooms to allow views uninterrupted by glazing bars. Being expensive, the use of plate glass demonstrated the wealth, as well as the fashionable taste, of the owner. It was generally popular but a preference for the appearance of the smaller panes remained until the use of sash windows was more or less discontinued after the Second World War.

The social status of a structure could determine the style, material or type of the windows. For example, rectories were well-built with good quality joinery. The designs usually were fairly conservative, and used small-paned sash windows long after plate glass had become fashionable. Labourers' cottages, gatelodges or schoolhouses were fitted with fairly basic, small-paned casement, hopper lights or sashes in metal or timber frames, often with diamond pane (or quarry) glazing.

Often the most significant decorative feature of small buildings are the windows. Simple glazing or surrounding treatments give them great character

The houses of the gentry and nobility had windows of the highest specifications. The principal room windows, most likely sash windows, often had plate glass installed in them as soon as it became affordable in the mid-nineteenth century, in both Classical and Gothic Revival designs. Speculative housing developments in the later nineteenth century used mass-produced single- and two-pane sashes, chosen from catalogues. Early twentieth-century local authority houses often had sash windows, while private estates of the same period generally had steel or timber casements.

This terrace of thirteen houses was built in 1907. Almost all retain their original windows of stocky timber casements which contain decorative toplights



There are some details that help tell the age of a window. For example, the box frame which holds the sashes was originally fixed in place from the outside and remained fully visible. From the mid eighteenth-century, the frame was usually partly or fully hidden within the wall, a more sophisticated and expensive form of construction. However, many buildings of a hundred years later have exposed box frames, often constructed in this way to cut costs.

This restored terrace of early eighteenth-century houses retains the original appearance of the fully visible sash frames, which is quite different to the later house on the left

In 1883 The *Irish Builder* newspaper stated that 'a different method in framing a sash frame generally obtains in England to that in practice in Ireland'. One Irish detail was that the timber sill of the frame was narrow and set under the lower sash only. The British method, used at an early date in Ireland, was for the sill to extend the full depth of the frame.

Generally, from the 1750s onwards the narrow sill seen here on the right became the standard, although the earlier 'full' (as shown on the left) sill remained common in Munster and was also used in imported nineteenth-century joinery

Another particularly Irish detail is seen in the use of 'horns' (also known as lugs or joggles) on the corners of both upper and lower sash, whereas in Britain horns are only ever found on the upper sash, where they have a structural function. Sash horns were introduced in the early nineteenth century.

An early twentieth-century horn or joggle. The more slender the timber in a sash, the weaker the important joint at the meeting rail of the top sash, which bears all the weight of the sash as it hangs closed in position. Letting the 'horn' remain at this joint after construction, and decoratively shaping it, was a practical response to strengthen this vital joint. Generally, the smaller and plainer, the earlier the horn. More elongated and curvilinear shapes became common in the late nineteenth century

Some regional varieties of construction and detailing exist. For example, in Munster, especially Cork, the heads of many windows are slightly arched, while in Wexford one often sees windows with the top row of three panes being fixed to the frame.

Elegantly arched windows are a characteristic of late Georgian Cork. The timberwork is also arched, an expensive option, but one taken by most original designers or owners

It may be that making a separate top row of panes was a practical answer to reducing the weight of the upper sash. Whatever the reason, it is a feature unique to Wexford and should be appreciated and conserved where it survives

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WINDOW MATERIALS: GLASS, TIMBER AND METAL

Throughout the centuries glass was a valuable resource. It allowed light indoors while protecting the inhabitants from the weather, but it was expensive and fragile. Glass making was a specialised craft. In Ireland, window glass was first made in the late sixteenth century and was produced intermittently until the early nineteenth century in various places including the counties of Cork, Waterford, Offaly, Dublin, and Antrim.

Historic glass types have a different appearance to modern float glass. They are wavy, often tinted or speckled and have a softer sheen. The presence of historic glass gives an irreplaceable visual quality to the appearance of an old window

Crown glass was blown into a sphere and cut and spun by centrifugal force into a disc of very thin glass. Most panes have a characteristic curve and some are bowed or bellied. All have a soft polished appearance; some have a greenish tint like this one, while other panes can be quite purple

In Georgian times, crown glass, a blown disc, was considered superior quality glass. Crown was deemed better than cylinder glass, also a blown glass, which had a hammered surface.

Early cylinder glass has an extremely hammered looking surface and is quite speckled with bubbles or seeds, like the pane in this early eighteenth-century window

During the nineteenth century an improved cylinder glass, and its cousin patent plate glass (polished high quality cylinder glass), took over the market. They could be made more cheaply and in larger sheets than crown glass. From the late-nineteenth century the technology for drawing very large sheets of glass from vats of molten glass was developed. At all times glass manufacturers strove to make clear, flawless glass. Ironically, now that absolutely flat and clear float glass is universally available, we prize the qualities of handcrafted panes instead.

Stained glass or coloured glass panes became fashionable in domestic windows in the nineteenth century. Most usual are coloured panes used in the narrow edges of what are called 'margin' lights, with red, yellow and blue being popular colours.

Some coloured glasses can be cut or etched to give a decorative pattern, as is the case with this window, which still has most of its original decorative margin panes with 'sunburst' corners

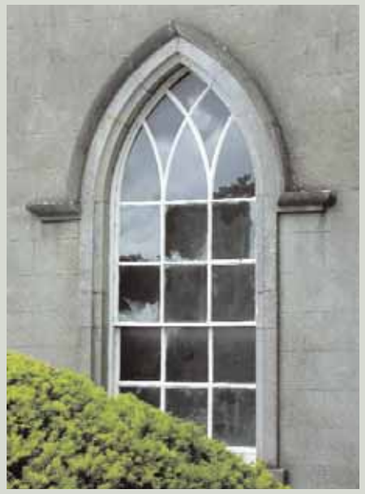
Taxes: myth and money

The window tax was levied in Ireland from 1799 to 1822, and glass tax from 1825 to 1845. The window tax was calculated on the number of windows in the house or workplace. The duty was far higher in Ireland than in England. Glass tax was levied according to the weight of the glass, which partly accounts for the use of very thin panes of crown glass - less duty was imposed on the manufacturer and passed on to the consumer.

Both taxes were strenuously resisted. In 1803 the members of Dublin Corporation petitioned the parliament in London to convey the message that the 'window tax is a very heavy burthen to the inhabitants of this country'. In 1816 the glaziers' guild called the window tax 'obnoxious, oppressive and extravagant'.

Most vertically-sliding sashes, horizontally-sliding windows, and casement windows were made of timber, usually pine or fir, sold as red deal (or, very rarely, pitch pine). Some few windows were made of oak or mahogany and fewer still have an iron core within a hardwood frame. Many nineteenth-century pivot and casement windows, and a few rare sash windows, are made of cast iron. Many twentieth-century windows are made of steel.

Most cast iron or steel windows contain timber sub-frames, or transoms as in this window. Sometimes the framing materials are not obvious until paint comes away and the material starts to deteriorate. It is vital to identify the framing materials when repairs are being planned



This window is 'blind' or false, a dummy window. It was made blind as the position of the window does not work with the layout of the rooms behind it, but the classical façade had to have regularly spaced windows, whatever the interior organisation. It is decades older than the introduction of the window tax, so it was not blocked up to reduce the tax charged on the building. It is hard to know exactly how many windows were 'stopped up' in response to the imposition of tax

2. Maintenance of timber windows

Window maintenance consists of keeping, or making, a window weathertight and functioning efficiently by ensuring that the paint, timber, putty, glass, and ironmongery (such as hinges, catches and locks) are in good order.

Windows, like all building elements, require routine maintenance. Nothing can continue giving service over decades or centuries unless it is maintained, especially if it is exposed to the weather externally and central heating internally, as well as suffering the constant demands of opening and closing. Owners would not neglect valuable paintings or furniture: your windows may well be older, more valuable, and set your house off better than any of the furnishings.

Maintenance works can be done by enthusiastic and skilled householders or handymen with knowledge of windows or joinery. Like most services, specialist joinery firms now address this area of work. Maintenance works can lead on to repair, if parts or joints need cutting out and new ones require fitting. Repair is generally a job for a joiner or cabinetmaker, although a skilled DIY enthusiast may be able to undertake many simple timber repairs.

The timber in this window appears to be in reasonable condition, although repainting is required. However, the cause of the defects seen in the render beside the window and moss build-up at the hoodmould above the arch should be investigated in case they affect the window, for example by trapping moisture which could damage the timber. Any project involving this window should take especial care of the historic glass panes

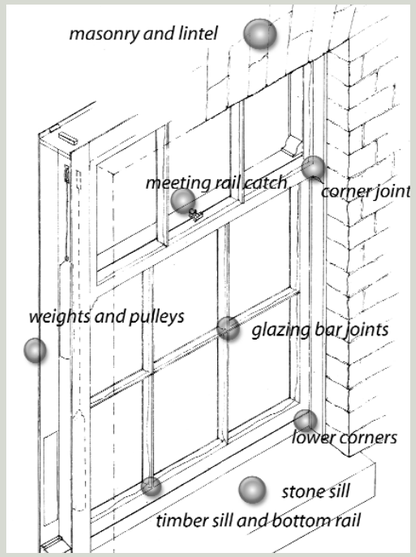
Inspection

Before deciding what should be done, the windows must be inspected. You can either do this yourself, if you are experienced at window maintenance, or it can be done by a joiner or contractor with practical experience in window maintenance and repair. You must alert the contractor to any other problems with the building that might affect the condition of the windows. This booklet can be used when agreeing the extent of the job with a contractor, to check that all the necessary work has been covered.

Plan to inspect your windows annually as part of a regular maintenance programme for the building. Start a maintenance cycle of routine work such as keeping paint and putty in good order and ensuring that the moving parts of the windows are working properly. While a five-year (quinquennial) cycle of repair work is recommended for historic buildings, external paintwork may need attention more frequently, particularly if the windows are exposed to harsh conditions or face south.

WHAT TO LOOK FOR

Check the condition of the putty, paint, timber, and ironmongery. Test vulnerable areas where water gathers, such as the junction of timber and stone sills, and the lower joints and rails.



Inspection diagram of vulnerable areas

Simple tools are needed for a condition survey: a pocket knife or awl to test the timber resistance, a wire brush for paintwork, and a scraper to check if metals are rusted. Test the vulnerable lower corners but don't cause damage; test the condition of each window both outside and inside. Ask the following questions and make notes for each window:

- Is the paint flaking - in some areas or everywhere?
- Are the joints loose?
- Is the timber spongy at the sill, bottom rail, and lower edges of the frame?
- Is the putty loose or missing?
- Are there cracked panes of glass?
- Are there faulty locks?
- Does condensation gather on the top sides of the meeting rails, bottom rails and sill, or on the glass?
- Does water pool on the surface of the masonry sill?
- Are any past repairs now needing attention?
- Do the sashes or casements open or close fully and easily?
- Are the shutters stuck?

TESTING THE TIMBER

It is normal for a knife or awl to penetrate up to about 3mm into timber. If it penetrates into the timber between 3-6mm, then the timber is sound but 'thirsty' and in need of conditioning with oil or pine resin. If the awl penetrates more than about 6mm, then there is a problem. Further probing will be needed to find the extent of the decayed area. If there is very little give in the vulnerable lower corners, rails and sills, then the windows are basically in good condition.

The loss of paint should not be the main guide as to the condition of the timber. Despite years of neglect, this window did not require substantial replacement of timbers. The ends of the box frame and its linings, as the most vulnerable areas, did require new scarfed repairs

Don't rely on moisture metre readings to judge the condition of window timbers, as they are not calibrated for this work. They may give a high moisture reading, leading you to believe that the window is past repair. Damp does not necessarily mean there is decay. Double-check the reading by testing the timber with an awl.

Some safety issues

GETTING READY

Wear the right clothes when carrying out maintenance or repair works. Wear shoes, or boots, with a good grip. Don't wear clothes with trailing pieces or cords as these may catch and cause you to fall.

WORKING AT A HEIGHT

Carrying out repair works or maintenance inspections at a height is hazardous. If you feel don't feel safe, or are nervous working at a height, then get professional help with the work.

Using ladders is a major safety issue. Avoid working on ladders in poor weather conditions such as windy, wet or icy conditions. It is always safest not to work alone. You should have someone competent with you to hold the ladder. Take care of people below when working at a height to avoid injuries caused by falling or thrown objects. Always use a ladder that is in good condition and of the correct height. Make sure it is secure, angled correctly with the top resting against a solid surface, not a gutter or a fascia. When climbing ladders make sure you have both hands free. Always work so you can have one hand on the ladder at all times, have a good handhold and don't overreach.

With many buildings that are larger or higher than an average dwelling, it may not be safe for an untrained person to carry out even the simplest maintenance or repair tasks. In fact, it is not advisable for any untrained person to work from ladders above one-storey high. You could consider hiring, or investing in, a properly-designed mobile scaffold tower or a mobile elevated working platform.

For further information on the safety issues of working at a height, see the Health & Safety Authority's publication: *Code of Practice for Safety in Roofwork*.

WORKING WITH LEAD PAINT

Lead paint was the traditional high-quality finish for timber and metalwork and is extremely long-lasting. Its use continued into the 1960s. These paints used linseed oil as the binder and white lead as the pigment. The appearance of the painted finish ages in a characteristic way which cannot be replicated by modern paints.

There are serious health risks associated with lead paints where a painted surface is unsound or is disturbed. Test kits can be used which give an indication of the presence of lead paint. For absolute certainty as to the presence of lead paint, specialist laboratory testing should be carried out. The fumes created when applying lead paint or burning it off and the dust resulting from sanding it down are particularly hazardous. Sound lead paint should be left in place and, if necessary, can be sealed by over-painting with a modern paint. If the need arises, it should only be removed and/or reapplied in compliance with all relevant safety standards.

Lead paints are no longer readily available to buy in this country. Their importation can be licensed on application to the Health & Safety Authority for use in historic buildings.

Taking the sashes out of the frame

Work that involves taking sashes out of the frames needs care, particularly where there is historic glass or slender timberwork. This is can be awkward and heavy work and is best done by an experienced window contractor, joiner, or cabinetmaker, if you are unsure of what you are doing.

Use a wedge to jam the cords of the bottom sash at the pulley (taking care not to damage the pulley wheel) to hold the weights up as you detach them from the sash. Open the meeting rail catch. Prise off the staff beads with the bevelled face of a chisel so the sash can move inwards a little. Then detach the cords from either side of the sash, they are usually held with nails. Now the sash can be safely taken inside and laid on its side in a safe place. Never lay a sash flat.

Holding the jammed cord, remove the wedge from the pulley and run the cord up so that the weight falls gently to the bottom of the weight box. Tack the cord to the frame near the pulley or it will fall into the weight box.

To remove the top sash, first prise off the parting bead from one side with the chisel. Pull the sash downwards. Repeat the sequence: nail the cords to the frame; prise off the cord from the sides of the sash; carefully lift it into the building and lower the weights into the box.

Routine maintenance tasks

Many maintenance tasks require sashes to be taken out of the frames. Patented hinge fittings can be applied to make this easier and to make the job safer.

BALANCING AND EASING SASHES

Many sashes are heavy or difficult to open or close. This could be due to broken cords or pulleys, cords having stretched, sashes being overweight having been glazed with heavy modern glass or twisted cords and weights. There may be paint build-up that causes friction at the sides, the parts may need easing, or rubbish in the weight box may be stopping the weights from lowering fully. Often it is a combination of several of these factors.

Find and open the weight pocket piece on each side of the frame. This is an oblong door cut out of the frame and wedged in place. It is usually at low level on the inside lining of the frame or near the bottom of the pulley stile. The pocket pieces have to be located for all balancing and easing jobs. They might have chewed edges from long years of being forced open. The option of fitting piano hinges to the pocket piece could be considered. This would make access to the weight boxes easier in the future.

The pocket pieces are at a low height in the inner lining, sometimes behind the shutter. Occasionally they are cut out of the frame stile and are concealed by the closed lower sash

It is a good idea also to screw the staff beads back into place rather than nail them. This will reduce the chance of damage the next time they need to be removed.

REPLACING CORD

When replacing broken or stretched cords use non-stretch cord of cotton or hemp. Even so-called 'non-stretch cord' will stretch a little over time, so allow for this. Avoid the use of nylon cord as it can cut into brass pulleys. Choose a cord that matches the weight of the existing one (or fragments you may find attached to the weight, if nothing else survives). Cords for the top sash should be about 75mm shorter than the required length, and those for the bottom sash about 75mm longer. It is good practice to change all four lengths of cord if one has broken, as the others are likely to have a similar life span.

Some large windows are counterbalanced with chains. Chain link repair can be done by a competent metalworker or engineering workshop. If necessary, new chains can be fitted. As with cords, it is advisable to replace all at the same time to ensure that the set of chains performs to the same standard.

HANGING THE SASHES

Tack the cord onto the grooves at each side of the sash and pull the other end over the pulley wheel into the weight box using a 'mouse', a small piece of lead or iron with the cord tied around it. This will fall to the bottom of the cavity where you can catch it through the open pocket piece and then attach the cord to the weight. Patented screw fixtures are available to attach cord as an alternative.

Measure the cord length when the top sash is closed and the bottom one propped fully open. The cord should be tied at the point where the weight can swing clear of the bottom of the frame (sit it onto a block to tie it). If the cord is too long the sash will not operate properly. Ensure that the bottom sash can close fully and that the weight is not bumping against the pulley. Measure the other lengths off the sample.

MAKING SURE THE WEIGHTS ARE BALANCED

If the weights are lying loose in the box, weigh them to see which is heavier. The lighter weights should be attached to the lower sash; the heavier to the upper sash. The weights are usually chosen so that combined they are about 1 kilo (2lb) heavier than the top sash and 1 kilo lighter than the bottom sash to make it easier to keep the window closed. A domestic weighing scale should be sufficient to weigh the weights and sash to check if they are balanced. If you have to remove the sashes for painting or repair, mark the weights to show which is which. If modern glass has made the sashes heavier, fit iron washers or lead beads to the top of the weights to match the increase. Add a little for the top sash and go easy on the extra weight for the bottom sash.

TWISTED WEIGHTS

The cords and weights can swing around in their box when the sashes are operated and may get tangled if the cords are not separated by what is known as a waggle board. This is a length of timber that hangs from the top of the frame specifically to keep the cords and weights separated. If a major repair job is being planned, such as works to the frame or lintel, the opportunity should be taken to fit waggle boards, as they will stop the weights twisting in the future.

REPLACING PARTING BEADS OR STAFF BEADS

Broken, bowed, or missing parting or staff beads could prevent a window sliding easily. Previous maintenance works may have forced the parting beads out of their grooves and possibly snapped them. Historic beads should be retained where possible. If beads need replacing, prise them out gently with a chisel. Any new sections should have a matching profile. If a draught-proofing system is going to be used, it will often be necessary to fit new patented beads as a part of the system.

WHAT TO DO IF THE WINDOWS STILL DON'T OPEN OR CLOSE EASILY

Timber expands when damp, and this may be a factor in causing the windows to stick. Check the windows again when the building is heated and the timber has had a chance to dry out. The problem may resolve itself naturally.

Check if paint build-up has caused friction between the sashes and beads.

- Were the sashes or casements painted while in the frames?
- Is the hardware lubricated?
- Were the sashes in an unheated, unventilated building?

Check whether the sashes have been deliberately fixed shut. Look for blocks fitted to the frame at the meeting rail. Or perhaps the sash has no opening mechanism. In this case, there will be no ironmongery and there may be a solid frame, that is, with no weight box.

Settlement or subsidence of the building may have forced the windows to be off-square. If you suspect that structural damage is causing your windows to stick, get professional advice. Structural damage may be fixed while keeping the window off-square (structures are often repaired without resorting to straightening them up). In some cases the sashes can be made to slide again, but it could be intrusive work and may not be advisable if the sash contains historic glass. Stuck shutters can be eased while in place.

These sashes were overhauled recently, without compromising their character. It might be necessary in such cases to add timber to the stiles or rails of the sashes to line them up with the frame

SANDING TIGHT SASHES AND CASEMENTS

The parts of a window need to fit snugly together to work properly. Timber can be carefully sanded if the sashes and casements still jam despite trying other solutions. But it is important to bear in mind that this is not a reversible process and the window will rattle if too much timber is removed.

RATTLING WINDOWS

Check that the parting beads or staff beads are not loose or missing. If previous wear or sanding has left the sashes or casements loose within their frames, applying draught-proofing strips might be a solution.

Paintwork

Paint is a coating made of pigment, binder and usually additives, applied at regular intervals to protect the framing material. It is what is called a 'sacrificial' layer; its function is to keep rain out until it wears thin, cracks or flakes. Paint generally has a life span of three to seven years depending on its suitability for the purpose, its location, and the environmental conditions.

Flaking or peeling paint does not necessarily mean that the timber is damaged, however it is a sign that paintwork needs to be renewed. Paint removal often raises health and safety issues, especially if dust will be created and most particularly if the existing paint has lead in it. Assess the condition of the paintwork by asking the following questions:

- Is the paint peeling, coming off in large segments, or cracking like snakeskin? A snake skin pattern is a lead paint characteristic, while lifting and peeling indicate a modern paint
- Can bare timber or metal be seen? If so, the remaining paint needs to be removed
- Is the paint bubbling or lifting? It may be that the last coat went on over a greasy surface, an incompatible paint, or a wet surface
- Is the most recent layer flaking but the paint underneath sound? If so, the paint can be sanded down and new paint applied over the sound surface
- Is there mould or peeling of the paint inside the window? These problems are often related to condensation, so consider what other steps need to be taken to solve the problem together with repainting

REMOVING PAINT

Do you really need to remove all the coats of paint? Historic paint layers should not be removed if the paintwork is in good condition. If there is historic glass in the window, choose a careful paint removal method to avoid cracking it. All methods of removal have associated pros and cons, whether the frame is timber or metal.

Never use a blowtorch near glass. The fire risk associated with the use of blow torches to burn off paint is so high that it is recommended that they should not be used on any old building, except by trained specialists operating under strictly-controlled conditions. A hot air gun which has a setting of approximately 50-60º Celsius (much lower than available with many DIY models) can be used extremely carefully by someone expert in this work. Sweep the nozzle continually over the timber to avoid creating hot spots which can cause glass breakage. The aim is to warm the paint only enough that it expands to scrape off the loose layers more easily. Lift off the heated paint with a scraper, following the grain of the timber. Use a scratch stock (a shaped scraper) or blunt blade to get paint out of the crevices of mouldings, drips, and anti-capillary grooves. If shutters have been painted shut, carefully tap the paint seal with a sharp tool such as a chisel to break it.

A traditional way to remove paint, without using heat, is to brush it with cold linseed oil and leave this to soak in as the oil expands the paint. After about 15 minutes, the loose paint should lift off easily when scraped.

Chemical paint strippers (liquid or poultice) are widely used, but are not necessarily a good way to treat historic windows, as they require drenching the timber with chemicals and then rinsing with water. If the timber is not thoroughly rinsed and dried, chemical residues can lift off subsequent coats of paint.

Never dip historic windows in a caustic soda bath (often called 'acid dipping'). This action damages the joints, removes the natural resin in the timber, lifts putty, attacks the surface of old glass and ruins oak or metal. Timber needs to be thoroughly rinsed and dried afterwards or subsequent coats of paint may not hold. Chemical dipping will almost certainly require joints to be glued, new wedges to be fitted and complete re-puttying: repairs that might not have been needed otherwise.

This mid eighteenth-century oak sash was dipped before being repaired with new parts. The ultimate effect of the chemical on the oak is obvious and serious: the original fabric is now incapable of repair

RECONDITIONING OR OILING TIMBER

Timber which has been saturated by paint removal or dried out from long-term neglect may need reconditioning with raw linseed oil or Stockholm tar. Stockholm tar is a natural pine resin that has been used for centuries by shipbuilders for protecting timber from water and is still used in many countries for protecting window timber. It can be used on both pine and oak. The drying time for reconditioning should be factored in to any programme of works and, depending on environmental conditions, could require up to two days.

CHOOSING PAINT

Two main choices of paint type are available: water-based and solvent-based, both synthetic paints with a high liquid and additive content. These systems have primer, undercoat, and topcoat formulations. They are made to be easily applied, dry quickly, and last approximately five years before repainting. They cover the surface well but don't penetrate into the timber, providing protection for the timber as long as the paint is applied according to the manufacturer's instructions and is repainted before it starts to break down.

Water-based paint (acrylic type) is generally compatible over existing lead paint coats but solvent-based paints (alkyd type) are not. Alkyd paints can however be used on steel. Aluminium based primers are used with oak.

Paint that is made to traditional recipes using natural ingredients, called 'traditional' or 'natural' paint, is made of linseed oil and pigment with few or no additives. It soaks into the timber, actively protecting it. Linseed oil paint can be used for all coats, using different proportions of oil and pigment. Linseed oil paint an be used on metal as well as timber.

What is linseed oil paint?

Linseed oil paint, with lead oxide added to it, has been used for hundreds of years on joinery. It is made of high-quality linseed oil with crushed pigment. Some manufacturers use additives, for example citrus oil, to speed up drying time. While lead oxide is no longer permitted for general use, there are substitutes that can be used for a good white tint. Linseed oil paints are now often called 'natural' or 'traditional' paints.

Linseed oil paint soaks into the timber, conditioning it and, as the pigment is not diluted, it spreads very thinly without streaking. It also protects timber extremely well, including timber treated with fungicide. It can be used also on metal surfaces, including galvanised steel. Linseed paints are 'breathable' as they allow moisture to be released from the timber.

Three thin coats are applied, and are best painted on with a special 'spoon' type brush. Linseed oil paint takes longer than modern paint to dry. The length of drying time depends on the pigment used, but a day between coats would be usual, unless the paint contains a drying additive.

In terms of maintenance, linseed oil paintwork needs reconditioning every seven years or so, by cleaning, rubbing down and coating with boiled linseed oil. Seven years after that reconditioning, a coat of paint should be reapplied to clean surfaces. The reconditioning/painting cycle should be repeated every seven years. If some or all layers are crazed, wet-sandpaper back to sound paint or timber, or brush on cold boiled linseed oil to expand and assist the paint to loosen off, then wet-sandpaper it to a sound surface.

Important note: do <u>not</u> crumple rags soaked with linseed oil paint. Soaked rags can spontaneously combust if rolled or crumpled up. Instead, hang them on a line to dry or soak them in water.

REPAINTING

Paint must be properly applied to protect the timber for a given period of time, over sound timber or sound and clean existing coats of paint. Paint applied by brush can be slightly undulating or streaked unlike a mechanically applied factory finish. It is vital to overlap the paint slightly onto the glazing to seal the putty. Protect the surroundings from splashes including other painted surfaces, masonry and glass, as well as the window furniture. Do not paint previously unpainted surfaces, for example tropical hardwood sashes and frames.

Over-cautious sealing of the putty by painting very far onto the glass can affect the appearance of the window, especially if it is not done consistently

It is best practice to take the sashes out of the frames for repainting and to allow the fresh paint to dry thoroughly before rehanging them. If the paint is not properly dry when the sashes are re-hung they can stick.

The lower sash has been removed for repainting and the opening is protected by fitting a lath across the frame and closing the shutters. It is important to prevent access to dangerous openings during a painting job

Friction from movement can also force the coagulating paint into bulges and tracks. Over time, these blemishes can cut into the moving parts, eventually digging into the timber and eroding it, or preventing the window operating. To avoid friction in the operation of the sashes, do not paint the sides of the sashes and the pulley stile where the two sashes meet. Wax these surfaces to seal the timber and ease the movement of the sash against the stile.

Historic paint colours

White and off-white were the most expensive paint colours in the eighteenth and nineteenth centuries, as white pigments were costlier than dark. Brown, purple-brown, dark green and black were popular and cheaper. This is still the case with linseed oil paints. Dark colours help to reduce the visibility of the frame, especially the glazing bars, while light colours accentuate the framework. White helps cut down thermal movement as it deflects some ultra-violet light, while black and dark colours absorb it, meaning that the paint may have a shorter life span. Woodstains were used only in upmarket Victorian or Edwardian work, such as large plate glass, tropical hardwood-framed windows. Wood-graining (also called scumbling) - using a stain to imitate the grain of oak or other high status timbers like mahogany - was popular on doors and might be found occasionally on shutters. The interior surfaces were sometimes painted a different colour to the exterior.

Paint layers can be scientifically analysed to discover the colour of historic coats of paint. Analysis is preferable to trying to match colours simply by scraping off the later layers of paint as the action of sunlight on those paints over the years will have changed them from the original tint and will result in colour errors.

Note: Many modern so-called 'historic' colour ranges are water- or solvent-based paints and are not made from linseed oil and pigment.

In Ulster, it was popular to paint the exposed box frames a dark colour and the sashes white

PAINTING OVER EXISTING COATS

Wash the painted surface with a non-alkaline soap, mild detergent in water, or sugar soap. Rinse it and run wet sandpaper over it. Do not paint over existing draught-proofing strips, as this will disable them. If existing coats have built up into tracks, sand the paint back to an even finish, checking that the sashes or parting beads are not damaged.

PAINTING OVER BARE TIMBER

If the paintwork has completely failed it should be removed and the surface prepared for new paint. Traditionally, bare timber was conditioned using raw linseed oil. Fill defects in the surface and sand it. Seal any knots by applying shellac, or similar, to seal in their resin. Don't sand over the shellac or the shellac seal will fail. Prime all surfaces including end grain. For a uniform colour, apply the undercoat and topcoats thinly and evenly.

Putty

Traditional putty is made of linseed oil and whiting, without added colourants. It has been used for centuries to glaze timber windows. Patented variations were later developed to glaze iron and steel windows. It is easy to apply, bonds chemically with the timber and, when maintained with a paint cover, seals the glass indefinitely. However, as putty gets very hard with age it is difficult to remove without breaking the glass or damaging the timber around it.

Putty should continue to do its job as long as the paintwork seals it. However, it can crack or lift if the existing putty has not been correctly applied. Putty must be applied to a damp surface and painted within a month of application; otherwise the oils will leach out.

If your glass is hand-blown and fragile, do not put it under stress by trying to remove the existing putty unless it must be removed to carry out timber repairs. If some putty has loosened, but the glass is still held strongly in place, it may be possible to keep the glass in place while achieving a weathertight job.

REMOVING PUTTY

There are some ways to soften putty in order to reglaze or to facilitate repairs. Unfortunately, there will almost always be some loss of glass, but the success rate can be up to 70-80% with experienced contractors. Always be aware that glazing sprigs may be buried in the putty. These are tiny nails that help keep glass in place.

Use a hot air gun only with extreme caution (following health and safety requirements). A carefully controlled low heat of 50-60º Celsius, swept continually over the length of the putty to be removed, can soften it sufficiently without heating the glass to cracking point, allowing the putty to be scooped out and the glass to be removed. Bear in mind that the heat could soften the surrounding paint, which you may not want to do.

Infra-red lamps (as used in animal husbandry) can also be used to heat the putty, evenly sweeping across the area to be tackled at a heat of no more than 50-60º Celsius. A patented Swedish putty lamp, which uses infra-red heat, was developed for softening putty. Infra-red heat permeates the putty quicker than it heats the glass.

If the putty is in poor condition or the glass is cracked, modern or missing, very carefully hack out the putty with a chisel, avoiding the glazing sprigs and being careful not to cut into the narrow glazing bar tongues.

APPLYING PUTTY

Clean out the rebate and apply a coat of shellac or boiled linseed oil to it to prevent the oil in the putty leaching into the wood. Some glaziers paint the rebate for this reason. Use small electro-galvanised steel pins or coppered sprigs for glazing sprigs, if they are needed. They should not touch the glass and must be fully covered by putty.

Use best quality, fresh traditional linseed oil putty, well kneaded and applied with a putty knife. The back, or bedding, putty should be continuous and the finishing putty should form a clean triangular bead, sealing the glass. Trim the putty so it does not overshoot the edge of the glazing bar. Putty must be painted after the surface has set but not more than a month after applying it.

When reputtying gaps in otherwise sound lengths of putty, clean the area and apply new back putty and/or finishing putty, smoothly sealing the junction with the old putty. Older putty which is all still sound but has some cracks can be refurbished by applying a slurry of putty onto it (that is, fresh putty thinned with boiled linseed oil). This could be an option if the glass is too fragile to be safely removed from the sash.

Remember to paint the putty within one month, sealing it completely.

REGLAZING USING TIMBER BEADS

Many hardwood plate glass windows are glazed with hardwood beads (narrow lengths of fillet or edging) backed by wash-leather or rubber gaskets, to cushion the edges of the pane. When reglazing, perished organic materials should be fully removed and the rebate cleaned and prepared as above. Neoprene-based gaskets manufactured for glazing purposes can be used behind the original or new beads. Use beads only on sashes where beads were originally fitted.

Repair and replacement of glass

Historic glass with corner cracks or scratches on the surface should not be replaced. If the glass is badly broken or the sash needs to be repaired, individual panes should be carefully removed. If historic glass can be salvaged it should be reused. Never break up reparable old windows just to retrieve the glass. It is common to end up with nothing more than broken panes of glass as well as broken sticks of timber.

IDENTIFYING GLASS LOCATION AND CONDITION

Survey the glass panes, noting in which window and what pane there is historic glass. Note the location of cracked corners or scratches and other superficial damage. Simple diagrams of each window will help. Each window, and each individual pane in the window, should be numbered so everyone involved in the work knows where the panes belong when they are ready to be glazed back in place. Panes should be reglazed in their original place as not all will be exactly the same size, and many might be slightly off-square. Do not put stickers or masking tape on historic glass, as glue is difficult to remove without abrasive cleaning, which can damage the surface.

ALTERNATIVES TO HISTORIC GLASS

If panes are missing and you would like to glaze with an alternative to float glass, several types of glass are commercially available that have some degree of imperfection. The economical option is to use horticultural glass, which has faint 'music lines' (parallel streaks), which imitate early twentieth-century drawn glass. However, it may be of a poorer quality than is desired. The expensive alternative is French cylinder glass, which is the modern version of nineteenth-century cylinder sheet glass.

This sash was glazed with modern cylinder sheet glass. Each sheet of this or any other substitute for historic glass should be carefully examined before using it, as some, especially those sold for stained glass work, contain exaggerated imperfections and will look out of place

There is no available substitute for crown glass and, in general, modern glass lacks the satin sheen of historic glass and its slight discoloration. If using float glass, order 2mm or 3mm thick glass in preference to 4mm or thicker. Using thicker glass than the original, which could be less than 2mm thick, will weigh down the sash and can strain the joints of delicate sashes. Many versions of old coloured, opaque or decorative glasses are available, but it may be difficult to match colours or patterns exactly. Stained glass suppliers should be able to help. If the windows are glazed with 'art glass', it is important to consult a stained-glass conservator rather than risk damage through inappropriate repair.

When cutting old glass, ensure that the surface is clean and not dusty or greasy. Clean it carefully with a soft cloth, mild detergent, and water. Use a sharp glasscutter, preferably one with an oil reservoir. Cut salvaged glass on a clean blanket or surface with some 'give', as old panes are rarely completely flat. Avoid cutting over bubbles or other imperfections, as the glass will crack. Don't cut the glass tight to the rebate, as the timber sash needs room to expand and contract. Check the fit against the sash after cutting each side, to make sure the pane matches any off-square angles in the timber. If there is a 'belly' or bow in the glass, it should face outwards.

REPAIR OF LEADED GLAZING (INCLUDING STAINED GLASS)

Stained glass windows are relatively rare and should be prized where they are found. Specialised expertise is necessary to repair leaded or stained glass windows. Common problems include the buckling of the leadwork, which can cause individual panes to crack. Causes could include inadequate restraints in the form of iron or brass bars supporting the panels; exhaustion of the lead itself (for example, failure from continuous expansion and contraction on a southerly aspect); cracking and failure of the joints (from poor soldering or weak joints). If the grouting which cements the panel has come out, panes may work loose. If the windows are an artist's work, it is very important to ensure that a specialist stained glass conservator is engaged so that the repair is appropriate and involves the least intervention. See *The Care of Stained Glass*, by David Lawrence.

There is a diagonal crack running through this hand-painted floral panel. Even a seemingly simple matter such as gluing a crack like this is a job for a stained glass conservator, as the wrong approach could irreversibly damage the artwork

Window furniture for both timber and metal windows

Pulleys, hinges, catches, latches and other fittings are vital to the smooth operation and security of the window. As a rule of thumb, up to the middle of the eighteenth century, sash windows had wooden pulleys and lead weights. There were no meeting rail catches. These are the catches that sit onto the flat surfaces on top of the meeting rails. They are in two parts, one on each rail, that lock to each other to secure the window closed. From the late eighteenth century onwards- brass pulleys, cast iron weights and catches and latches of brass or cast iron were used. Wrought iron

hinges were used for shutters and casement windows until near the end of the eighteenth century, when cast iron or brass hinges came into general use. Most surviving window furniture is nineteenth century in date but if your windows are older, bear in mind that the catches or pulleys may be there from the time they were made.

The original catches and stays survive on these metal casements. They should be retained and cared for whenever the window is undergoing maintenance, as they are an integral part of the original window

DEALING WITH HISTORIC IRONMONGERY

If the windows are being repaired and the fittings need to come off, it is important to ensure the individual pieces are identified and catalogued so that they go back on the correct window. Where historic ironmongery has become redundant it is preferable to leave it in place and fit appropriately specified and sited new items where possible.

Clean historic ironmongery gently with soft cloths or brass brushes, avoiding the use of abrasive creams or solvents. Lubricate the moving parts with a light penetrating spray. Lubricants for steel parts should contain an anti-corrosion agent.

MEETING RAIL CATCHES

It is advisable to leave the meeting rail catches in place when carrying out repairs. It can be difficult to line them up again if they are taken off, for example when draught-proofing is being fitted. Quadrant fasteners (illustrated) will not work if they cannot close tightly. The 'Brighton' type fastener has a moveable threaded screw arm attached to one meeting rail, which sits onto a clasp mounted on the other rail. The nut on the arm should not be fully tightened when the sash meeting rails are closed tightly against each other, to avoid straining the thread.

The meeting rails must line up accurately for quadrant fasteners to close properly, as was done when this window was repaired

PROBLEM PULLEYS

Pulleys that are not working should be taken apart, then cleaned and oiled to remove grime. New brass pins may be needed. Cracked pulley wheels should be replaced but the housing may be in good order and should be kept. Brass pulley wheels, designed for boats, can be used if they are of the correct dimensions and sufficiently strong for use in windows. When buying new pulleys, choose all-brass pulleys rather than those with a plastic wheel or housing. Plastic does not stand up to the wear-and-tear of decades of service and does not have the appropriate appearance for old windows. Even if they cannot be repaired, timber pulleys should be left in place with new pulleys located above or below them.

REPAIRS TO HINGES

Historic wrought iron and brass hinges must not be routinely replaced. If the mechanism is faulty, turn them upside down and fit new pins. Hinges should be cleaned to remove old paint and lubricated. Use brass screws rather than iron to repair existing or new ironmongery. If the hinges are historic but are beyond repair, leave them in place, and add good quality new ones of an appropriate size and metal.

Wrought iron is generally resistant to corrosion and is capable of repeated repair unless it has worn very thin. The hinges of this early nineteenth-century window are substantial and should continue to work for many years

NEW FITTINGS

If the existing ironmongery is beyond repair or missing, several ranges of brass and iron ironmongery, generally copies of nineteenth-century designs, are available from major suppliers. Choose best-quality cast brass pulleys and cast brass or cast iron meeting rail catches, for top performance and long life. Extra fittings, such as sash lifts, sash eyes, and sash handles are also available, although few such items were historically used in Ireland. On smaller windows they are not necessary and can result in visual clutter.

Caulking or pointing the window frame

Small gaps between the frame and the masonry should be pointed or caulked with an appropriate mastic. The traditional solution is to use a compound of boiled linseed oil putty (the same as for glazing) with burnt sand. Proprietary mastics are now commercially available. Choose one that is durable, resilient, and appropriate for this use. Silicone should be avoided as it can lift off in damp conditions, allowing moisture to infiltrate the joint. It should be noted that some silicone mastics produce acetic acid, which can damage painted surfaces and corrode metalwork. Never use expandable foam to seal the gap with the masonry as it is visually intrusive and may lift if it becomes saturated, allowing damp into the timberwork.

The silicone-based mastic used here is starting to lift in places, just a few years after being applied. As it is black and applied thickly it is more visible than caulking or pointing should be

If there are voids behind the frame, they can be packed with a lime mortar (2:5, lime:sand or 1:2:9, cement:lime:sand, if a hard mix is appropriate for the wall type). Key it to receive the mastic and prime with a coat of boiled linseed oil. Lime mortar helps ventilate the void. Hemp fibres can also be mixed through traditional putty mastics to do the same job. A large gap can be packed with an appropriate mastic as a base for a lime mortar finish.

Maintenance: summary

- Look at the whole window and the surround before drawing conclusions. Is it a job you can tackle or should you get it done professionally? Do you need structural advice?
- Don't damage timber when testing it for soundness: probe gently with a small implement
- Always be extremely careful when using heat, including hot air, near historic (or any) glass. Unless glass is heated gently and over the full surface it may crack
- Remove only as much existing paint as needed to get back to sound layers. Take precautions against inhaling lead fumes or particles if you are stripping old paint
- Never dip windows in a caustic bath and be very careful about using and rinsing other chemical strippers
- Paint with the sashes out of the frames for best results. Always overlap the paint onto the glass to seal in the putty
- Don't salvage glass or fittings from windows that are capable of being repaired and reused - if a window is clearly beyond repair, it is appropriate to salvage historic glass from it

3. Repair of timber windows

This section is for owners looking for answers to the problems with their windows. It gives a summary of the types of timber repairs that can be done. Importantly, it should help you to ask the right questions of the person you are going to pay to repair your windows, so you get a good job done by a capable contractor. Repair work should generally not require planning permission. If in doubt contact the conservation officer in the local authority.

Preparation

WHO TO CHOOSE TO DO THE WORK?

Ask friends and acquaintances with old houses; consult your conservation officer, who should have a list of local contractors who have done similar work; call to houses where you have seen joiners at work, or look up local or national internet sites. Get references from potential architects, suppliers, or contractors and make sure to contact their previous customers. See also 'Getting the right advice', on p. 8.

A good builder, architect, joiner, or cabinetmaker will take the time to inspect your windows, to alert you if related elements of your building might be contributing to damage or decay, to survey each one and to individually specify work for it. They should explain clearly what is included in the price and forewarn you about any extras that may accumulate. An overall quotation without itemising specific repairs in respect of each individual window is not sufficient.

INSIST ON HIGH STANDARDS

Good work will help old windows last a long time; however poorly specified or badly carried out work will shorten their life span. Conservation contractors carry out only as much repair or replacement work as necessary and do the sort of repairs that will ensure a lasting job. Skilled joiners recognise the superior quality of old timber and know to obtain the best quality timber with matching characteristics for repairs. They should also be able to advise you of the types of upgrading measures that are available to improve sound and thermal insulation and give their opinion on appropriate security fixtures.

SURVEYING THE WINDOWS

Each window should be surveyed separately. Use an A4 sheet for each window. This is a convenient size to carry and file and is large enough to hold the necessary information on a single sheet. Everyone involved in the job should have a copy of the window survey. It should include:

- A numbering system for each window (sashes / casements and panes)
- A summary of the characteristics of each window (e.g. double-hung sash with arched head)
- A summary assessment (both interior and exterior) of the condition of paint, putty, timber and ironmongery (see also 'Inspection' on pages 15 and 16)
- Glass type and condition
- Masonry condition

There should be space on each page for related notes, for example to highlight matters of concern or details of interest. If needed, drawings or photographs can be attached to the relevant form. Each window should be given a unique number and all sashes (and individual panes) numbered unobtrusively to match the inventory form. The numbering system on the form should show exactly where sashes and individual panes of historic glass belong, if they have to be removed from the frames.

CHOOSING TIMBER FOR REPAIRS

Your contractor should specify high-quality softwood. Pine, known as red deal, was historically the timber used in most Irish windows. If using a different species for repairs, rather than matching the original timber, make sure it expands and contracts at a similar rate or the repair could be forced apart. Be sure that the timber type is not prone to twisting after seasoning or it could break the repaired joints.

If you are thinking of using salvaged timber, be careful that it has not been (or will not be) taken from a building that should be repaired rather than dismantled. Old timber can be used as long as it has the correct characteristics for window work. Timber from old beams and floorboards does not necessarily have the quality to make sashes. Avoid the use of timber with shakes, fissures, warps, knots and other imperfections.

Most timber sold these days is kiln-dried and pressure-treated with preservative prior to sale. Liquid preservative can be brushed onto the exposed end grain of new parts (always taking the appropriate health and safety precautions) but is not a substitute for good detailing. For example, quarter-sawn or radial cut sections of high-quality heartwood absorb little moisture, and so should be used in locations where the grain will be exposed, such as the bottom corners of sashes. Brushing on pine resin will help to protect the end grain.

USE GOOD TIMBER

Slow-grown pine, which is a resinous timber with eight to ten growth rings per centimetre, is ideal for most window repairs and new parts. Pine should be cut in winter when the sap is down. The planks should be air dried for two years and stored a further year in a workshop to season them properly. It is advisable to use heartwood only (without sapwood) as it gives the best performance over a long period.

Local oak was the timber of choice in past centuries, especially for windowsills, because of its superior weathering ability and resistance to fungal and insect attack. Irish oak is available from specialist suppliers for the repair of oak windows.

The use of tropical hardwoods may not be appropriate. Many species are prone to twist long after installation, even when seasoned. Some expand and contact at different rates to pine, while others are not hardy enough to withstand Irish weather conditions.

What might be living in my windows?

Rots (so-called 'wet' and 'dry' rots) are often blamed for decay in windows. Wet rot can take hold in very neglected, damp timbers. It is usually a localised infection at exposed and saturated end grains or where paint and putty have failed. The damaged timber can be cut out and new timber spliced to match. Not all saturated timber becomes infected with wet rot. Wet timber that dries firm is sound and should be reconditioned with linseed oil and kept in place.

Dry rot grows in humid conditions. It can occur in unventilated window linings, or very occasionally in sashes or casements if the fungus has spread from elsewhere in a very damp building. Timber damaged by dry rot has a distinctive cuboidal cracking pattern and may fall to dust when prodded. Individual timbers should be repaired, but first the cause of the attack must be addressed or it will return. Before starting repair work, air dry all the affected sashes.

Sometimes woodworm (furniture beetle) is found in sheltered areas. An attack can accompany wet rot but beetles alone are not likely to damage a window beyond repair. If timber strength is compromised, carry out a spliced repair.

AGREEING THE WORKS

Some decisions should be made jointly by the owner and contractor. If you are retaining an architect, instruct the architect, rather than the contractor, in order to avoid confusion and misunderstanding. If windows with panes of historic glass are in need of major repair, decide whether it is safer to salvage the glass and glaze it into a new sash or casement, or if the joiner is able to carry out the joinery work without breaking the glass. Decide in advance who takes responsibility for broken crown or cylinder glass. Consider the type of glass that will replace it if breakages do occur.

It is more efficient if repairs to the frame and shutter assemblage can be done in situ, that is without dismantling the frames or shutter joinery. Does your joiner anticipate any problems that might require removing the frames to a workshop?

The window frame assemblage should not be removed from the structural opening unless this is necessary. If it must be removed, this should be done immediately prior to repairs being carried out, as otherwise the assemblage could be left vulnerable to damage

Is the building going to be in use while the job is in progress? If it is, agree the organisation of the job with the contractor. Can the work take place entirely or mostly in or around your house? Is there space for the joiner to set up a temporary workshop? This means the glazed sashes do not have to be transported, which lessens the chance of damage, and helps you keep an eye on the progress of the job. Decide on the security measures needed if sashes or casements have to be taken off site. Answers to these questions should inform the programme of work.

GETTING A REALISTIC ESTIMATE

The contractor will specify and quote for work on a provisional basis based on the findings of the survey (as listed on the window survey sheets) and include contingencies, as it is difficult to foretell exactly what extent of work will be required. It often happens that some estimated repairs are not needed while other faults may only be discovered after starting the job. Types of repairs should be priced, with the numbers of each type of repair estimated. Both the householder and the joiner are working on trust when pricing and specifying a job: one to get the work done well and the other to get paid for it afterwards. Both sides should communicate clearly.

Types of timber repair

SPEAK YOUR JOINER'S LANGUAGE

Scribing, mitring, splicing and scarfing are methods of work that could appear on the schedule of works. Scribing and mitring describe ways of sawing to shape the small joints where moulded sections meet. Scarfing and splicing are types of repair that cut out damaged timber and fit a matching piece in a new joint.

HOW TO REPAIR

Joiners cut out the decayed timber, and a minimum amount of sound timber beside the decay, to obtain a strong spliced joint between the old and new timber. The joint is often reinforced by pegging or screwing using brass screws fixed from the interior. The joint should be angled to throw water to the outside edge of the timber rather than let it creep inwards. The greater the angle, the stronger the repair.

The new timber should match the grain density and direction of the existing. The profile of the old moulding should be carefully replicated. The new profile should be shaped to fit the existing one, rather than the other way around. A moulding cutter with the same profile should be used or a new one cut to match. For short sections, a moulding plane can be used. It may be necessary to remove paint from an unobtrusive area of the frame to get an accurate copy of the moulding.

Some repairs can be done with the glass in situ while others will require one or more panes to be taken out.

This oak sash has been repaired with new timber scarfed in, which matches the grain density and direction of the original. The repair is of high quality and should last indefinitely

THE LIMITS OF REPAIR

Some sashes, casements, or frames may be in such poor condition that repair would effectively mean rebuilding them. If the corner joints and several glazing bars need new timber scarfed in, the joiner should advise if there would be a substantial loss of strength as well as a loss of old fabric. Even with the best timber, joints are a potential point of weakness if the window is not maintained. In rare cases, it may be advisable to carefully remove the historic glass, make a new sash, and glaze the old glass into it.

Although this house has been left disused and the windows vandalised, it should not be presumed that what remains cannot be repaired. Each window should be assessed and tailored repair schedules made up for each. If it is found that the parts of a window are beyond repair, accurate profiles should be drawn up for the fabrication of new sashes or frames, and the historic glass should be salvaged for use in the new work

The timber may be damp, but this does not mean that it is irreparable and it should be re-assessed when it is dry. The sash members may have warped. If the meeting rails do not meet, repairs can be tailored to fit the distortion. However, if the timber has warped to the degree that significant amounts of new material would be needed to make it weathertight (if, for example, the sash cannot be made to fit into the frame), it may be necessary to make a new sash. If the old sash is of historical importance (due to age or rarity) it should be stored safely. If the glass is of more importance than the sash, it should be carefully de-glazed for reuse in the new sash.

Common types of sash and casement repair

LOOSE JOINTS

The wedges in the corner joints may fall out and the joints work themselves loose, typically at the lower edges which bear the strain. If the timber is sound, the stiles can be cramped together and the joints thoroughly re-glued and re-wedged. The glue has to withstand weathering. Powdered-resin glue is usually used for this work, as a modern alternative for traditional rabbit-skin glue. Some joints are also pegged or dowelled. Missing pegs should be replaced with a dense, impermeable timber dowel of a timber that does not twist.

REPAIRING RAILS OR STILES

Where a corner joint has failed and the timber is not in good enough condition to repair it, the corner can be cut out and a new corner spliced to fit and the joint repaired. This work may involve splicing either rail or stile, or if the joint is badly decayed new ends will be needed to both pieces. Sometimes a rail or stile can be damaged in several locations, in which case a new one should be made to a matching profile.

The cabinetmaker who made a new bottom rail and stile end (the sash is shown upside down) used a very strong mortice joint to fix the new stile end to the original. The moulding at the edge of the timber is accurate to the original

REPAIRING OR REPLACING THE BOTTOM RAIL

The bottom rail is the most vulnerable part of the sash or casement. Repairing a corner of it is straightforward work. If all of it has decayed, or if both corner joints are failing with loss of structural strength, then a new bottom rail should be fitted, to an accurate profile.

AUGMENTING SASH STILES OR RAILS

If the bottom rail and timber sill do not fit together properly, an extra piece can be glued and screwed with non-ferrous screws to the bottom face of the rail, matching the slope or steps to weather it against the sill. The joint must be very tightly done to help it last, without screw holes that would allow moisture in. Similarly, if the window rattles because the sashes or casements have worn, adding timber to the sides of the stiles may help. Equal sized sections should be added to each side of a sash so it does not sit unevenly in the frame. The screws should be countersunk to avoid interference with the window operating. Bear in mind that this sort of repair could eventually work loose due to damp ingress or friction.

REPAIRING OR REPLACING PARTS OF GLAZING BARS

Sections or whole glazing bars can be replaced if they have broken, or split, or are missing. The new piece should have an accurate profile so the joints fit properly and the glass is not tight in the rebate. Stripping the paint off the old glazing bar to get a crisp sample will be important. A decayed, or badly damaged, tongue or bone of the glazing bar can be replaced with new timber. This repair does not need structural strength so long as the window remains glazed and the paint and putty maintained.

At some stage one of the glazing bars in this sash was repaired (vertical bar, top half of picture). While this kept the sash in use, a standard moulding was used instead of a profile matching the late eighteenth-century original. Small details like this should not be overlooked by those in charge of a repair job

Frame, architrave and shutter repair

It is rarely necessary to take out a frame. It should be an objective to repair frames without taking them apart. Frames are, or should be, bedded firmly into the window opening. They are not made to be easily removed. Standard repairs can be done on site, unless other factors make this impossible. As with sashes, the minimum amount of sound timber should be removed.

SCARFING NEW ENDS TO FRAME STILES

The ends of the stiles that sit on the sill or masonry are vulnerable to moisture creeping up from below as well as from rain draining off. New ends can be scarfed on to the outer lining and/or stile, taking care to make a tight joint, and angled to discourage moisture creeping inwards. Make the cut at least 150mm above the stone sill, above the level prone to splashback from rain on the sill.

The new ends on these recently repaired stiles were not cut at an angle and the paintwork is starting to flake. Both factors will make the new joints prone to moisture ingress, which could start to damage the joint and soften the timber

REPAIRING THE TIMBER SILL

Sills are made of solid timber, preferably oak, as they must take the most extreme weather conditions of any part of the window. Generally, it is best to leave the timber sill alone unless the outer surfaces are spongy, denoting decay, or it is badly cracked or split. If the timber tests sound at the outside surfaces and especially at the joints with the stile, then it should be adequate to ensure that the top surface is sloped so that water does not pool on it or onto the masonry sill below. Check also that the sill is adequately bedded to prevent rain being driven underneath. Bed the sill with putty and apply a sound paint finish, sealing the putty, to aid water run-off.

If a sill needs to be repaired or replaced, it is vital to choose the best quality timber to match. The sloped steps on the top surface may have eroded, resulting in water pooling and a poor fit with the bottom of the sash. Repairing the top surface of the sill by affixing new timber to the surface is unlikely to last, due to its exposure and the difficulty of siting screw fixings without introducing moisture. Draught-proofing the staff bead against the bottom rail of the sash may help. If failure at the bottom joints of the frame stile has resulted in the sill moving out of position, it should be propped with firring pieces (strips of timber) and secured in place with attention to ensuring there is adequate run off. The front face of the sill can be replaced with care. The new face should not twist away from the main part of the sill and the joint should be tight to prevent water getting in. Occasionally a sill will need complete replacement. A skilled joiner should be able to do this with the frame in situ, though other factors might complicate matters, requiring the frame to be removed.

REPAIRING TIMBER MULLIONS

The lower ends of mullions, the uprights between the lights of a window, are vulnerable to decay. If new timber is spliced to form a new joint with the sill, the joint should be tight and strong to secure a long-lasting repair. The cut should be angled towards the exterior, discouraging moisture from creeping inwards, and should be pegged and screwed from the interior.

Previous repairs to the ends of this mullion were uncovered during a refurbishment project. The repairs remained in good condition and did not need attention

REPAIRS TO SHUTTERS

Shutter panels, like door panels, are vulnerable to cracking as they are made of thin timbers glued together. Repairs may entail splicing new rail or stile ends, gluing split timbers in the panel, tightening and wedging the joints, replacing badly damaged timber behind the hinges and repairing or refitting the hinges. New panels can twist even if the timber is well seasoned, so care must be taken if new timber has to be worked into a panel. The panel should never be glued in position.

A cabinetmaker carried out some repairs to this shutter. The illustration shows new timber pieced in at the lower hinge, where decay had taken place, prior to repainting the timberwork

JACKING THE FRAME BACK INTO PLACE

If the frame is out of line with the wall, it might be necessary to move it back into place. This may be a symptom of structural settlement, which should be attended to by a professional. If the frame does not need to be removed for structural repairs, it may be possible to lever it back into place. Early frames were not fitted into a reveal in the wall. They were fixed internally with large wrought-iron straps. These fixings may have failed and allowed the frame to move in or outwards.

The sashes should be removed for safety and the frame propped internally to hold it square. The whole (which may include timber linings, or sides, and shutters) should be gently knocked back into place as one piece (having checked that the secondary parts are not fixed to the wall), causing as little movement as possible to the joints. Frames not held in a rebate should be fixed to the masonry internally using non-ferrous fixings.

Substitutes for timber repair

While it may be tempting to repair all dents or holes, do so only if it is necessary to keep the weather out and the window working. Almost all work can be done using timber in preference to fillers for better long-term performance, but it is a question of deciding what is necessary.

Epoxies and other resins, or metal corner brackets, are often used for DIY repairs. Some may be adequate if the timber is not exposed to weathering. They should not be used as quick fixes instead of joint repairs as they can worsen the underlying condition of the joint. The drawback of using fillers is that sooner or later condensation or rainwater will penetrate under the filler, causing it to lift, and soaking the timber. Such repairs could also be prone to condensation collecting at the joint between the timber and the synthetic material.

FILLERS

Two-part epoxy resins are more appropriate than ready-to-use fillers but bear in mind that some resins may make the joints too rigid. They also give off heat while hardening and so should not be used close to historic glass. The damaged area must be fully scraped back to sound timber, and the surface prepared in accordance with the manufacturer's instructions. Resin must be painted or it will discolour or decay if exposed to daylight over a long time.

A traditional filler or 'stopping' mix for flaws and small holes is putty mixed with white lead paste and chalk or sawdust. A variation on this is the addition of cellulose glue to putty. Traditional putty can be used. Oil the timber cavity with boiled linseed oil so that the oil in the putty does not seep out, drying and cracking the filled patch. Pine resin can also be used to strengthen wormy, flaky, or slightly substandard surfaces.

BRACKETS

Cast iron L-shaped angle brackets have often been used to strengthen a weak corner joint. The long-term benefit is questionable, however, as iron or steel can help to rot the joint by attracting condensation. If there are old brackets, check that the timber beneath the bracket is sound. Often the joint has been compromised by chiselling out the site for the bracket, so that it sits flush and does not interfere with the window functioning. If replacing existing brackets, use brass brackets and fit them onto the interior face. Drill screw holes on the inside only to avoid moisture seeping into the timber. If a weak sash contains historic glass, or funding is not available for proper timber repairs, brackets may be a temporary answer to strengthen the joints until a permanent repair can be carried out.

Associated repairs

DAMP OR DAMAGED MASONRY

Damaged rainwater goods, especially on bay windows, lost or cement-based pointing mortar around the window, rising damp, or structural settlement can cause the joint between the frame and the masonry to open and let in damp. This may result in the frame moving out of its rebate. Stone sills can settle at the wrong angle so that water drains into the building rather than being thrown off it. Tackle the window problem only after the major defects have been identified and remedied.

Sometimes windows which are out of square have settled without damage. Such windows should remain off-square, as to square them up would be intrusive, expensive and requires skill to successfully refit the frames, sashes, and internal joinery without loss of historic fabric. Get good conservation advice on the root cause of the problem and have the conservation works tailored to your actual situation.

REPLACING LINTELS

Timber lintels are usually concealed above the frame within the masonry. In some forms of construction the lintels are open to the exterior and are protected with render, while in other forms there is no lintel and the masonry rests on the head of the window frame itself.

A third form of construction is where the wallplate (the timber beam laid on the top of the wall which supports the roof structure) functions as a continuous lintel. In rare cases, bonding timbers act also as lintels. Old lintels are usually made of extremely hard-wearing oak, which should continue to function unless attacked by rot or infestation (but insect attack is rare in dense heartwood). Surface damage does not necessarily indicate that a lintel is structurally compromised and a thorough diagnosis needs to be made. As well as rot, lintels may be compromised by structural damage or inappropriate past repairs. Lintels that are sound should remain in place and the source of the damp diagnosed and treated. If there are very old oak lintels with notches or sockets in them, consult an archaeologist as these could be reused mediaeval timbers.

The lintel in this late nineteenth-century building needs urgent attention. The cracked brickwork and depressed head of the window indicate that it has failed. The brickwork appears to be saturated, which will worsen the structural problem

Many projects routinely specify the removal of existing timber lintels and their replacement with precast concrete ones. This approach should be justified by your architect or builder, as it could well be unnecessary. Pre-cast concrete lintels are rigid and they will not move with changes in moisture level in the same way that brickwork or rubble masonry will. If justification is given for specifying concrete lintels, they should be fixed with lime mortar rather than cement.

Many commercially-available timbers are not dense or resinous enough to withstand exposed and damp conditions. It is recommended to use best-quality, 100% heartwood, native or temperate timbers that have a good record as lintels. Timber is usually pressure-treated with preservative, but this should make little difference to the performance of best quality oak. Wrap the ends to protect the end grain from damp masonry and fit a damp-proof course above the lintel. To protect and condition the timber, coat it with pine resin.

4. Maintenance and repair of metal windows

Iron and steel windows are capable of maintenance by skilled owners or handymen, but repairs usually are a job for specialist metalworkers. It is vital to maintain the paint seal to keep metalwork in good order. As with timber windows, check the paint, metal, putty or mastic, glass and ironmongery. For help on preparing to do a survey, see pages 15, 16 and 29.

INSPECTION: TESTING METAL

Use a wire brush for testing paintwork and a scraper to check if metal is rusted. Test the condition of the frame both outside and inside. Check to see if the drain or weep holes at the base of steel frames are open or clogged. Check that the casement hinges, stays or catches or pivots work but do not force them if they are stuck or open only partially.

A number of signs of corrosion are visible on this window, especially on the casement (lower left of the window). This may require specialist repair. Elsewhere paint is failing, but the metal does not seem to be badly affected yet

Iron or steel expands when moisture attacks it. Paint may blister indicating the start of expansion, the putty may be lifting, the surface may distort, or jacked layers of rusted iron may be apparent if corrosion is advanced. The underside of lower rails should be probed, as the visible faces of the metal may be intact while moisture is eating out the metal from underneath.

REMOVING PAINT AND REPAINTING

Do not use a hot air gun to remove paint - metal conducts heat and increasing the temperature makes the historic glass vulnerable to cracking.

Mechanical or chemical methods of removing paint are better used where there is no historic glass present which might be damaged and no layers of lead paint present on the metal. Use a mini-grinder or rasp (coarse file) to remove built-up paint and a wire brush, or drill with brush attachment, for light rust. If lead paint is present, use wet methods of removal to prevent dust rising. Patented rust-removing gels or liquids (phosphoric acid-based compounds) are available for light to medium rust levels. Chemical removal should be carefully considered, as the residue must be fully neutralised and thoroughly dried off, but washing can soak the metal and could lead to further corrosion (chemicals may also damage glass). Low-pressure air or grit blasting techniques will take off large-scale rust products. These techniques may be appropriate if potentially toxic paint dust can be contained in a sealed blasting cabinet. Use a handheld pencil nozzle, so that the user can control the impact, and shield the glass with adhesive plastic film. Remove the film immediately afterwards very carefully so as not to damage the glass.

This work should be done in a properly fitted out workshop and in compliance with the relevant health and safety requirements. Where work is done in situ, care must be taken to prevent damage to nearby surfaces.

Immediately after cleaning and drying bare metal, apply rust-inhibiting, zinc-rich primer. Apply undercoat and topcoat to seal the surfaces, taking care to fully seal the putty. Paint should be applied in a dry atmosphere.

Chemical analysis and performance testing was carried out by the Office of Public Works prior to choosing new paint for the metalwork of the mid nineteenth-century glasshouses at the National Botanic Gardens. It was found that immediate sealing of the metal - within twenty minutes of drying the bare metal - increased the protection that the paint gives by a factor of five

REGLAZING

Flexible steel-window putty, putty mastic, and glazing compounds were developed for metal windows as traditional putty sets too hard for metal, which needs to flex. Putty based on fish oil should not be used on metal windows. A bed of siliconised latex (known as painter's caulk) can be used backing the glass and steel putty to the exterior, to give the necessary flexibility. Trim with a sharp knife when set. (Note that silicone can lift if it gets damp, so the paint seal must remain perfect.) There are some patented sealants on the market that claim to be very durable, flexible, paintable, and suitable for metals. For use on historic windows be sure (a) they will not peel off if damp penetrates the paint coats and (b) they can be removed safely for future reglazing. When reglazing, locate the spring clips for holding the panes and reuse them to secure the glass.

The mastic should be a smooth bead and must be fully sealed to prevent moisture attacking the steel, as was done in this maintenance project

REPAIR

The repair of iron and steel windows usually requires specialised experience. The extent of damage, specifically the degree of corrosion, has to be evaluated and particular repairs and future maintenance tasks appropriately specified. Iron and steel frames are often fixed directly into masonry. While opening parts can be removed for repair, the fixed elements should be repaired in situ where this can be done safely, to avoid causing further damage by removal.

Iron or steel windows may be out of alignment, or there can be distortion from rust expanding the metal, with failure from corrosion in localised areas. In addition, steel frames may bow or dent. The ironmongery may be affected by corrosion on the frame, resulting in hinges breaking and catches not closing. A build-up of paint can distort the opening sections of slim steel frames and break hardware through forcing them to close. If this has already happened, collect the broken pieces for repair or replacement after the paint has been cleaned off.

Corrosion at the bottom rail of these casement windows is distorting the metal and damaging the leaded glass. The affected areas will have to be cleaned of rust and dents straightened. It will be necessary to cut out the badly affected metal and patch with accurately profiled new steel

Dent-straightening, stitching, welding, patching and splicing new material are types of repair that may be appropriate. It is important to ensure that new pieces match the section of the existing profiles. Minor dents can be straightened by applying manual pressure, using a wooden batten to brace the metal (as is done by panel beaters). Steel-based epoxy resins are available (as for car body repair) to fill small corrosion holes and surface imperfections, sanded smooth and painted. The bowing of steel, arising from corrosion, may require cutting out the corroded part and welding in a new section. Cast (and wrought) iron can be repaired using metal stitching or drop forging. These methods were successfully used by the Office of Public Works in the restoration of the iron conservatories at the National Botanic Gardens in Dublin. From the 1950s onwards steel was usually galvanised to protect it. Pre-1950s steel windows can be retrospectively galvanised, but hot-dip galvanising is a harsh process and may distort old frames.

5. Upgrading historic windows

Most owners would like to improve the thermal insulation of their building to stop heat escaping, and many would like to cut down on external noise getting into the house. Protected structures are exempt from having to comply with statutory requirements regarding the conservation of fuel and energy, but nonetheless it may be possible to improve the efficiency of a historic building without damaging its character. There are several solutions for upgrading existing windows, the pros and cons of which are outlined below. Security upgrading measures and a type of fitting to enable safer cleaning of sash windows are also outlined.

Complaints about draughts are nothing new. 'It is pitiful to see the extent to which women, and men too, allow themselves to be dominated by a little wind and a little weather… They must seal themselves up hermetically by weather-strips, and thus exclude the little sweetness that would make its way to them', reported the Irish Builder *in 1888. This bulky internal window must reduce indoor light a good deal as well as reducing natural air flow*

Be sure of what you want when looking at the available products. One system will rarely provide all the answers and you need to be certain that the product you would like to use is appropriate for your windows.

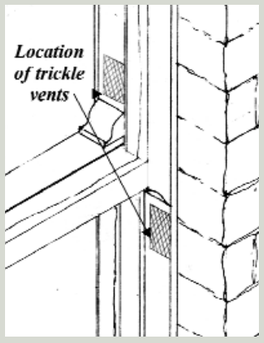
- Will it give you a worthwhile result for a reasonable cost with subsequent energy savings or more security?
- Could it compromise the character or long-term performance of the windows?

VENTILATION

People, buildings, and moisture-emitting or heat-generating appliances all need a constant supply of fresh air. Try to reduce the possibility of condensation damage occurring by avoiding, where possible, siting vapour-generating appliances such as cookers, gas heaters, washer-dryers, or shower units in rooms which have historic windows. If vents have to be fitted, make sure they are unobtrusive and effective, whether fixed into the windows or the walls. Ask your conservation officer if vents are acceptable to the planning authority.

In a historic building, vents should be sited in locations where they do not require invasive structural work and so that they are unobtrusive. They should never be placed in historic windows like this unusual eighteenth-century casement, whether or not historic glass would be affected

Purpose-made vents can be fitted in new windows, but it could compromise the strength of the timber to cut one into an existing sash or casement. If sash windows fit so well that ventilation is insufficient, it may be possible to fit a thin block to the top of the frame stile to prevent full closing of the upper sash. Sashes altered like this should be secured by locks at the sides instead of the meeting rails. This allows a permanent trickle of air at the top and meeting rail, which is usually over the head level of the occupants. If secondary glazing is used, the original window must be ventilated to the exterior. Permanent trickle vents can be fitted into box frames by a careful joiner. Cut two small oblong holes in the frame stiles near each other: one to take air directly from the outside into the weight box and the other to draw it from there into the room. Fit a grill or mesh over the holes, making sure that the sashes slide smoothly over them.



Suggested location of trickle vents in existing sash window

Improving thermal insulation

Insulation measures should cost less than the savings you expect to gain from them. Although windows are often the first target for home improvement, insulating water heaters, pipework and attics (in line with best conservation practice) should always be considered first as this will usually bring immediate and tangible energy savings. Check also that the windows are actually causing measurable heat loss. Windows in old buildings may take up a relatively small percentage of the overall external wall area. Remember that overhauling a window as part of general maintenance works, even without fitting draught-proofing, reduces inefficiencies in performance and helps improve insulation.

A number of relatively simple upgrading products can be retro-fitted to most historic windows by specialist joiners to reduce heat loss. Some types can be bought and fitted by DIY enthusiasts, though the quality of the work relates directly to the benefits gained. The best fit systems match the international standards for thermal insulation for windows in new buildings.

Simple solutions can help too. If there are shutters, use them at night to reduce heat loss. Remember that shutters can be draught-proofed too to reduce air filtration. If ordering curtains get a thermal interliner fitted.

DRAUGHT-PROOFING SYSTEMS

Generally, sash or casement windows will benefit from fitting a draught-stripping system (also known as weather sealing). They come as gap-fillers (sealants), nylon brushes, pile (dense fabric), polypropylene with foam filler, and silicone rubber tubes, typically bridging gaps of up to 6mm wide. Some systems are surface-mounted, but most seals or strips are fitted into grooves routed into the timber. Some products work on metal as well as timber windows.

Draught strips come in several varieties. Brushes were fitted to this meeting rail gap. It is recommended that the advantages and drawbacks of each type are investigated so you know how effective they are likely to be. You should be assured that they will not damage timber joints and that catches and hinges can still function. Be aware of the approximate lifespan they are likely to have and be sure that they can be removed without damage to your historic windows

There are advantages and disadvantages to all varieties. Routing out grooves in a timber frame to fit the draught strips is irreversible. It can cause damage to joints, especially in sashes with very thin frames. If there is a wide range of gaps in the windows, several solutions might be necessary. Gaps can be seasonal in timber windows, as timber expands when damp. Moulded mastic sealants can be used to draught proof metal windows. After application the mastic moulds itself to the shape of the gap. Steel windows may have distorted through paint build-up or corrosion and gaps created. It is important to treat the cause before specifying appropriate draught proofing. To prevent casements being distorted through forcing them to close, use the slimmest draught-strips adequate for the situation.

Many of the products require a patented plastic parting bead with inbuilt strips or seals to replace the timber bead. There is a visual impact from these proprietary fittings, especially those products only available in white, which limits the colours the window can be painted without drawing attention to them

Be aware also that if the strips are too effective, alternative forms of ventilation will be needed to ensure that fresh air can circulate. Ask the following questions of the supplier:

- Will the strips be damaged if paint sticks to them or can they be temporarily removed during redecoration?
- Could the strips be deformed if they are fitted in a too-small gap?
- Is the appearance of the white plastic parting bead acceptable to you (or the planning authority) or does the manufacturer offer different finishes?
- Will meeting rail catches still work when the strips are in place?
- Will the strips deflect to accommodate changes in the size of the gap?
- Will the window slide or shut easily?
- Will the product reduce air leakage around the edges of the sashes?
- What is the projected life span of the product? Is it hard wearing and made of materials that age well?
- Is the product fully reversible? Can it be fitted and removed without damage? This is a vital consideration if you have vulnerable, spindly sashes or those of extreme rarity or age

Be aware that the strips will not last as long as the sashes and will have to be replaced sometime between 10 and 20 years after installation. Make sure the product fulfils the objective of effectively reducing heat loss at a reasonable expense without affecting the character or integrity of the windows.

SECONDARY GLAZING (INTERNAL)

Secondary glazing is a full size window or panel fitted internally, usually directly behind the existing window, to reduce heat loss in a building. The internal panel may slide or open inwards. It can be a temporary or permanent fixture, for removal in summer or for year-round use. Choose a style and opening type that is visually appropriate to the character of the windows and the needs of the users. If there needs to be a division in the panel, site it behind the window's meeting rail or stile. Avoid fitting a duplicate small-paned window, as it magnifies the double reflection which is the drawback of all internal glazing. The panel must be sealed to the interior, with ventilation provided through the original window, to avoid condensation forming.

A double-glazed internal casement panel has been fitted to this sash window. The design is such that there is little or no visual impact from the exterior. Given the wide panel frame, this design would not be appropriate in a location which contains an authentic period interior. The opening in this case did not have any shutters or other internal joinery

It is never acceptable to fit external secondary glazing, such as storm windows or plastic sheeting, to historic Irish windows, whether for energy or security reasons.

SECONDARY GLAZING AND THERMAL INSULATION

For the best thermal insulation results, there should be a space of at least 20mm between the original window and the internal panel. A 20mm gap may be obtained if the staff bead (the bead holding in the lower sash) is removed and replaced with a bead provided with the panel. Where there are shutters set close to the sashes it might not be possible to achieve the 20mm gap without disabling the shutters. Invasive alterations should never be carried out to fit secondary glazing units. Historic shutters help with insulation as well as security and should be kept in working order.

DOUBLE-GLAZED UNITS

Fitting double glazing to historic windows is never recommended. It is not possible to fit a unit of sufficient quality to effectively improve thermal insulation without intrusive and damaging structural and visual consequences.

The impact of double glazing on historic windows

The recommended specification for sealed double-glazed units makes them too bulky for fitting to historic sashes or casements. International standards recommend that the sealed space between the two panes of glass in the sealed unit should be more than 12mm and preferably about 20mm, which is nearly the full depth of most sash and casement frames. Fitting thinner sealed units in a historic frame would compromise the strength and appearance of the historic window but would not result in effective thermal insulation. It should be remembered that sealed units do not stop air filtering through gaps around the unit or at the edge of the frame.

As sealed units are heavier than single panes, the timber joints of historic sashes and casements are put under strain and the pulleys, hinges and cords or chains jeopardised. Ultimately, sealed units are likely to shorten the life span of a historic window. The appearance of the window will be altered by the visible black or silver seals which are part of the double-glazed unit and by the rubber or plastic gaskets or timber beading used to seal the units within the frame (which should be substantial to comply with recommended standards).

Seals have a life span of perhaps two decades and, when they fail, the unit must be replaced. In that period it is unlikely that the cost of installation will have been recouped through savings on energy bills.

Improving sound insulation

Internal secondary glazing can reduce invasive high and low frequency noise. It should be fitted as best placed as possible without disabling the shutters, and glazed with 6mm or heavier glass. For greater benefit, the existing window can be draughtproofed. Sound insulation is most effective when the internal panel is placed between 50mm and 150mm (the greater the distance the better) inside the historic windows. Heavy curtains also help to deaden sound. Remember that sound also enters through air vents and chimneys as well as windows, but bear in mind that ventilation requirements mean that while noise can be reduced, adequate permanent ventilation is still needed.

Solar control and historic glass

Historic glass should never be removed to fit patented energy-conserving or solar control glasses. Where new glass is required special glass types are available, or where modern glass exists special film can be applied to the glass, to help channel energy into the house or keep it out as needed.

'LOW-E' GLASS

Energy-efficient glass ('low energy') was invented to minimise heat loss. It is available in single sheets (although it is most often sold in double-glazed units) and is useful if you are glazing new sashes or casements. Where historic glass survives, choose a different method of improving thermal insulation, such as fitting internal secondary units glazed with low-E glass.

ULTRA-VIOLET (UV) FILM

UV-inhibiting film can be applied to the interior face of the glass to filter out UV rays (the wavelengths that bleach out fabrics, timber furniture, and paintings). Never use it on historic glass, as the glass can crack when peeling off the film. Poor fitting also leaves air bubbles under the film and this reduces its effectiveness. The life span of the film is considerably shorter than that of glass, possibly about ten years or more if fitted properly and cleaned carefully. This means that over the years new film has to be applied at intervals, risking the glass each time. An alternative solution is to fit internal secondary glazing with glass that filters out visible light as well as UV-light. Bear in mind that filters often have a tint, which may be visually unacceptable. If you have furnishings that need protection from sunlight, fitting UV-inhibiting blinds may be a simpler solution.

This film contains many bubbles and in general reduces the clarity of the view through the glass

Security and safety considerations

From the mid-eighteenth century onwards all sashes and casements were fitted with catches. Old windows also may have some low-tech security safeguards that are effective, such as iron bars to lock the shutters closed. Some shutters have, or originally had, small bells, which acted as alarms if the shutters were disturbed when securing the window. Shutter bars should be lubricated or repaired so they work easily. Historic catches, latches, and bells should be left in place, even if they are now redundant. They can be augmented by fitting well-designed new locks and alarms.

Choose the fitting, and the means of fixing it, carefully. Do not attach fittings in locations that would compromise the strength of the timber. When installing wiring, never drill through sills. Generally avoid drilling holes that will allow damp into the timber. Drilling through timber, brick, or stone to attach fittings can result in unsightly flaking or chipping, or cracks and holes.

Choose carefully where you wish the alarm box to be placed, preferably somewhere unobtrusive on the elevation and not, as here, mounted on the window or with wires drilled through window timbers

LOCKS

Brass and steel locks and catches, sash stops, bolts and screws are available in appropriate sizes and styles, to secure meeting rails, casements or sliding parts of the frame. Barrel-shaped bolts, which are drilled through the meeting rails, are ideal to secure sashes, as long as they can be fitted without reducing the strength of the timber rails.

ALARMS

Sensors which electronically detect vibrations are the modern version of the bell on the shutter and can be very effective. Windows should be overhauled first to eliminate rattling, as this could set off the alarm.

GRILLES AND GUARDRAILS

The installation of security grilles or sheeting (external or internal) or safety guards to the window opening will almost certainly require planning permission. Plastic sheeting can interfere with the ventilation of the window. Grille designs should be judged on whether or not they affect the character of the structure and/or the window itself. Few are visually acceptable.

This metal grille altered the character of the sash window, and due to its prominence, affected the whole protected structure. It was removed shortly after being fitted

Guard rails that copy (in detail) historic railings may be appropriate, if you have evidence of such railings in your house or a similar house. If guard rails are to be fitted in place of lost originals, reuse the original drill holes. Never stop casement windows from opening or block a means of escape.

SAFETY GLASS

In some circumstances it may be necessary to fit laminated or toughened glass. These glass types are heavier than historic glass, so the weights must be readjusted. In complying with health and safety requirements, every effort should be made to retain historic glass. Solutions which allow the historic glass remain in place include fixing a brass rail inside the opening or fitting a framed, laminated glass screen in front of the lower pane of the sash. To do this, remove the lower half of the staff bead and screw the inner screen to the frame. Where there is no historic glass but the sash is made of thin, vulnerable, timber parts, glazing with heavy laminated glass would endanger the joints. In such cases, a solution would be to fit an inner screen.

HINGED SAFETY FITTINGS

Patented sash attachments are available that allow the lower sash to open inwards. They originated in Scotland as a safety fitting for cleaning windows above ground level. The fittings include small brass hinges, screws, clutches and grips, which can be retro-fitted to most sashes and frames. The system works by allowing the lower sash to be temporarily released from the weights and manoeuvred onto hinge fittings set on the frame that allow the sash to swing inwards like a casement. The fittings are now offered as part of the service of some window refurbishment companies.

6. Replacement windows

Conservation is about valuing the various changes over the centuries that contribute positively to the character of a historic building. Replacing the original or early windows of a historic building is misguided at best, will often adversely affect its character, and could be an expensive mistake.

Both of these buildings are early Georgian houses. One has early nineteenth-century windows, still well cared for. The other was fitted with uPVC top-hung windows in the 1990s and the façade was re-rendered, alterations that comprehensively affected its character

It is rare that an entire original or early timber window genuinely cannot be repaired. Cast iron and steel windows are usually also reparable, unless they have been badly damaged. If your building is a protected structure, the removal of historic windows without planning permission could lead to enforcement proceedings.

'PUTTING IT BACK TO THE ORIGINAL STATE' IF THE WINDOWS ARE GONE

If you do need new windows, first carry out some research. Manufacturers' brochures exist to sell products and it is usually necessary to look elsewhere for impartial advice, especially to find out the window details accurate to your building style and period. Generally, off-the-shelf replacement windows, even many so-called 'heritage style' products, do not match the architectural and material quality of historic windows. The details are different and many do not use best quality timber or traditional joinery methods.

Many steel window patterns are still in production by English manufacturers. No Irish maker is still in business. For cast iron windows, contact a metal fabricator who is experienced in doing off-standard work.

uPVC and timber double-glazed sliding sash windows may be bought by homeowners who want to fit appropriate replacements in their period house. But if the windows are to conform to international fabrication standards and contain the most effective double-glazed units, they will have a much stockier profile than traditional timber sash windows. The difference is obvious between the original (left) and replacement (right)

When the design of the replacement windows is agreed, the details should be accurately drawn and specified, so that everyone involved in the job knows exactly what the windows will look like, how they will operate and that they will be constructed to a high quality.

Two common errors are seen in this replacement timber sash window. It is glazed with timber beads, which result in a thicker, flatter profile to the glazing bars, and the sash has horns. The window is in an eighteenth-century building. At this period, glazing bars were very slim (and always glazed with putty), while horns were unknown until the early nineteenth century

If you want to 'reinstate' historically accurate new windows to a protected structure or a building in an architectural conservation area, first contact the conservation officer in the local authority to ask if the work will need planning permission.

Historic buildings and the law

Under Part IV of the Planning and Development Act 2000, buildings which form part of the architectural heritage can be protected either by being designated a protected structure or by being located within an architectural conservation area.

Where a building is a protected structure, or has been proposed for protection, or is located within an architectural conservation area, the usual exemptions from requirements for planning permission do not apply. In the case of a protected structure any works, whether internal or external, which would materially affect its character, will require planning permission. Legal protection also extends to other structures and features associated with a protected structure such as outbuildings, boundary walls, paving, and railings. In an architectural conservation area, any works to the exterior of a building which would affect the character of the area also require planning permission. Owners and occupiers of protected structures have a responsibility to maintain their buildings and not to damage them or allow them to fall into decay through neglect.

A notice was sent to every owner and occupier of a protected structure when the building first became protected but subsequent owners and occupiers will not have been notified. If you are not sure of the status of your building, check the Record of Protected Structures in the Development Plan for the area. If your building is a protected structure, or if it is located in an architectural conservation area, the planning authority will be able to tell you what this means for your particular property.

As an owner or occupier of a protected structure, you are entitled to ask the planning authority to issue a declaration which will guide you in identifying works that would, or would not, require planning permission. Maintenance and repair works, if carried out in line with good conservation practice and the guidance contained within this booklet, will generally not require planning permission. If you are in any doubt about particular proposed works, you should contact the conservation officer in the local authority for advice.

For general advice on planning issues relating to architectural heritage, a publication entitled *Architectural Heritage Protection Guidelines for Planning Authorities* (2004) is available from the Government Publications Sales Office or can be downloaded from www.environ.ie.

Historic windows and the law

WHAT DOES PLANNING LAW REQUIRE IF MY BUILDING IS A PROTECTED STRUCTURE OR IS LOCATED IN AN ARCHITECTURAL CONSERVATION AREA (ACA)?

Repair and maintenance works carried out in line with the guidance described in this booklet should not generally require planning permission. Certain upgrading measures will also be exempted development, providing they do not materially affect the character of the window. However, the fitting of double-glazed sealed units into historic windows cannot be considered exempted development because of the effect on the character of the historic building. In addition, such works are unlikely to be granted permission, unless it can be shown that the structure originally had double-glazed units. The replacement of original or early windows in a protected structure or within an ACA will usually require planning permission. But permission may not be granted where the existing historic windows are capable of repair, or where the proposed new windows would adversely affect the character of the protected structure or of the area.

Material alterations to the windows of a protected structure, even where they are proposed in order to comply with Building Regulations, are not exempted development if they affect the character of the protected structure or the character of the ACA. There is provision in the Regulations for the granting of a dispensation or relaxation in relation to specific works or materials by a building control authority.

It is recommended that you employ a qualified and experienced conservation professional for advice on how to proceed so as not to compromise the character of your historic windows.

WHAT IF I WANT TO REINSTATE 'PERIOD STYLE' WINDOWS?

The replacement of windows in a protected structure or an ACA will usually require planning permission, even where later windows are in place. If your building now has inappropriate modern windows, you may wish to restore its character by fitting historically-accurate windows. You should consult the conservation officer in the local authority for advice before proceeding.

HOW DO I KNOW WHAT DOES OR DOES NOT REQUIRE PERMISSION?

The owners and occupiers of a protected structure have a right to request a declaration from the planning authority. While it is most useful to get a declaration that relates to the full property, one can be issued specifically confined to window repair, upgrading or replacement. It is important that a declaration exempting the replacement of your windows from a requirement for planning permission states the material, style and details of windows that can be fitted without affecting the character of the structure.

WHAT IF MY BUILDING IS NOT PROTECTED?

If your building is not a protected structure, and not located within an ACA, the replacement of windows may still need planning permission. It is exempted development only where the new windows would not materially affect the external appearance of the structure so as to render the appearance inconsistent with the character of the structure or of neighbouring structures. Individual planning authorities may have specific policies on window repair and replacement.

Grant aid

Conservation grants are available for the conservation and repair of protected structures and are administered by the planning authorities. You should contact the relevant one for guidance on whether the works you are planning are eligible for a grant and, if so, how to apply. These grants are not available for routine maintenance works, alterations, or improvements. The type of works must fit within the schedule of priorities set out by the planning authority. In order for works to qualify for these grants, they must be carried out in line with good conservation practice. Repair work following the guidance set out in this booklet should be considered as satisfying this requirement.

Other bodies also provide grants for building conservation projects. These include the Heritage Council and the Irish Georgian Society. Their contact details are included below.

Tax incentives are available under Section 482 of the Taxes Consolidation Act 1997 for expenditure incurred on the repair, maintenance, or restoration of certain buildings or gardens determined to be of significant horticultural, scientific, historical, architectural, or aesthetic interest. The building or garden must receive a determination from the Revenue Commissioners who must be satisfied that there is reasonable public access to the property. Application forms can be obtained from the Department of the Environment, Heritage and Local Government, Dún Scéine, Harcourt Lane, Dublin 2.

Useful contacts

The conservation officer in the local authority should be the first person to contact with queries regarding a historic building. Other useful contacts include:

Architectural Heritage Advisory Unit, Department of the Environment, Heritage and Local Government,
Dún Scéine, Harcourt Lane, Dublin 2.
Telephone: (01) 888 3109
Web: www.environ.ie
www.buildingsofireland.ie

Construction Industry Federation, Construction House, Canal Road, Dublin 6
Telephone: (01) 406 6000
Web: www.heritageregistration.ie

Heritage Council, Rothe House, Kilkenny, Co. Kilkenny
Telephone: (056) 777 0777
Web: www.heritagecouncil.ie

Irish Architectural Archive, 45 Merrion Square, Dublin 2
Telephone: (01) 663 3040
Web: www.iarc.ie

Irish Georgian Society, 74 Merrion Square, Dublin 2
Telephone: (01) 676 7053
Web: www.igs.ie

Royal Institute of the Architects of Ireland, 8 Merrion Square, Dublin 2
Telephone: (01) 676 1703
Web: www.riai.ie

Useful publications

Architectural Heritage Protection Guidelines for Planning Authorities, Government of Ireland, 2004

Louise Harrington and John X. Miller, *Revelations of Style: Cork Windows*, Cork Civic Trust, n.d.

David Lawrence, *The Care of Stained Glass*, Heritage Council, 2004

Nessa Roche, *The Legacy of Light: a history of Irish windows*, Bray: Wordwell, 1999

Looking after your sash and case windows: a short guide for homeowners, Edinburgh: Historic Scotland, 2002

Conservation of Timber Sash and Case Windows, Edinburgh: Historic Scotland, 2002; Guide for Practitioners 3

Andrew Townsend and Martyn Clarke, *The Repair of Wood Windows*, London: Society for the Protection of Ancient Buildings Technical Pamphlet 13, n.d.

7. Checklist of common problems

PROBLEM:	POSSIBLE CAUSES:	GO TO (PAGE):
Stuck sashes or casements	> Broken pulley or cord	19, 26
	> Paint build-up	20, 22
	> Distortion of opening (settlement)	20, 36
	> Twisted weights	19
	> Warped timber	32
	> Deformed draught-proofing	41
	> Grimy, unlubricated or broken hardware	18, 26-27
Rattling or loose sashes	> Loose or split joints; lost wedges or glue failure	32
	> Worn parting beads or sash edges	20, 33
Failed paint cover	> Incompatible with underlying surface coats	20, 21, 37
	> Neglect	20, 21
	> Wet rot; surface fungi; condensation (interior poorly ventilated)	16, 20,30, 39-40
Putty cracking / lifting	> Dried out: oil absorbed by timber; not sealed by paint after applying	23, 38
Timber decay or damage	> Damp penetration; wet or dry rot; infestation	16, 30, 32
	> Joint problems, damage to timber	31-36
	> Poor quality previous repair/replacement work or materials); damage from cables	5, 35, 36, 44
Locks and catches not working	> Breakage from stress to materials during use	26, 38, 41
	> Meeting rail catches do not meet	26, 32, 41
Sashes very difficult to operate	> Weights wrongly calibrated	19
	> Broken pulleys or cords fraying	19, 26
	> Twisted weights	19
	> Parting bead / staff bead not correctly fitted	19, 20
Gaps between meeting faces	> At meeting rails and bottom rail/sill: rubbish at the bottom of the weight box; faulty sill; cords too long	18, 19, 33, 34
	> Materials forced apart by weather seals	41
	> Missing or defective mastic	27
	> Structural problems	20, 36
Stuck shutters	> Hinges broken	27, 35
	> Sealed by paint	21
	> Frame or architrave misaligned	35

WINDOWS A GUIDE TO THE REPAIR OF HISTORIC WINDOWS

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