

Repair of Wood Windows

SPAB Technical Advice Note

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Thousands of wood windows are destroyed every year because people believe they are beyond repair. As a result, many old buildings suffer a profound degradation in their character and historic interest. Only time will tell how durable modern replacements will be. Many replacement windows inserted in the last 30 years have now decayed beyond repair, whereas examples of original windows survive from the 18th century and earlier, demonstrating both the compatible methods of construction and the durability of materials used in ancient buildings.

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Cover image: A window at the King Edward VI Almshouses in Saffron Walden, Essex repaired with the aid of a grant from the SPAB's Newcombe Fund.
Photo: Joseph Bispham

1 Introduction

This Technical Advice Note aims to demonstrate that limited decay can be tackled without total destruction, and that repair methods are to hand that enable a decayed window to be brought back into a sound, functioning condition. Advice is included on the analysis of the causes of decay (section 3) and general guidelines (section 4) are set out for remedial work to windows, followed by specific examples of repair methods (section 5). The SPAB has a strong presumption in favour of repairing old single-glazed windows and, if necessary, introducing secondary glazing, as opposed to replacement double-glazed windows.¹

Figure 1 illustrates the main components of a typical mullion and transom window. Technical terms used in this guidance are defined in our online glossary.²

2 Window types

2.1 History

The earliest wood window frames known in the British Isles were simple openings formed as an integral part of timber-framed buildings (with cills, heads and jambs formed from members of the structural frame of the building, often with timber mullions as in figure 2) or as frames set within masonry.³

To reduce draughts, openings could be covered with oiled cloth, animal hide, bone or sliding/folding timber shutters. In some cases, openings were filled with wattle or a timber lattice.

From the 16th century, glass became more readily available (although was not in general use until well into the 17th century) and the

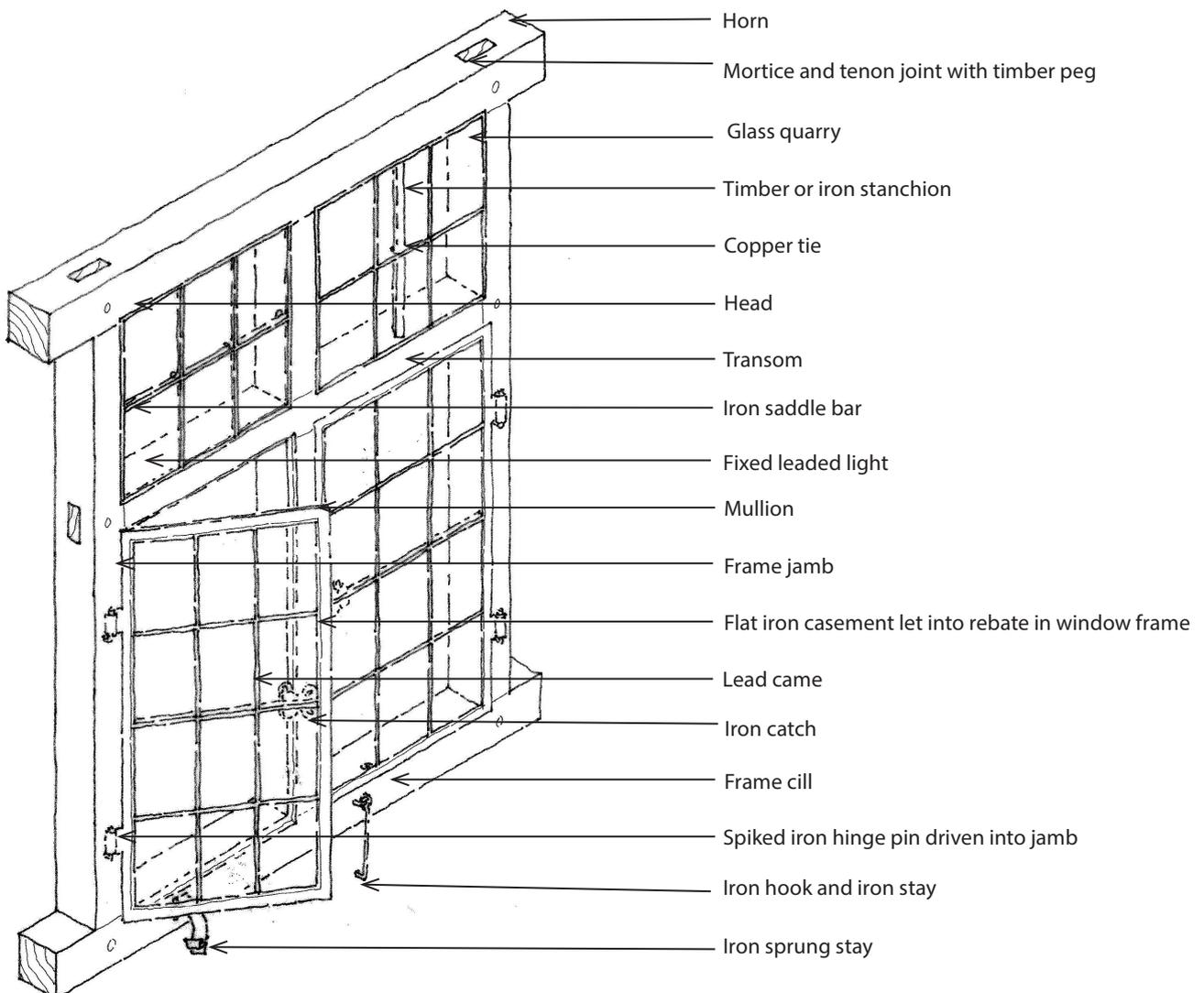


Figure 1: Typical mullion and transom window.

Illustration: SPAB

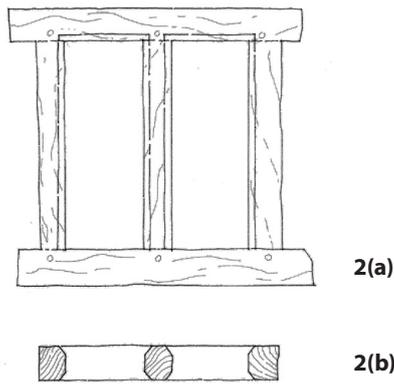


Figure 2: Example of an early unglazed window from a house in Fairford, Gloucestershire: (a) Elevation. (b) Plan.

Illustrations: SPAB

earlier form of chamfered mullions and jambs was adapted to take the small panes ('quarries') of glass set in lead 'comes'. Opening lights were rare in this form of early glazing. In the 17th century, mullion-and-transom windows became fashionable in the new, classically inspired, symmetrical facades, although leaded lights were still incorporated within this design of window, often with opening casements formed in a flat iron frame.

2.2 Sash windows

The earliest 'sash' windows were simple mechanisms where a single section of the window would slide vertically across a fixed section to form an opening, without the aid of weights and pulleys. Early vertical sliding sashes were held in position by a series of pegs and notches.

The modern sash window (with weights and pulleys) came into use in London in the latter half of the 17th century. Its introduction into the provinces occurred gradually throughout the first half of the 18th century. These early sash windows are distinguishable by their large section (for example, glazing bars up to 50 mm wide); they often incorporate a fixed sash (usually the top one) and may have frames worked out of solid timber.

Subsequently, sash window design evolved to produce a general lightening of glazing bars and frames, with sash boxes formed from separate sections of timber linings and pulley stiles (see figures 3(a) and 3(b)). With the advent of ever-cheaper and larger panes of glass (especially with the invention of drawn sheet glass), the number of panes per window decreased from twelve or sixteen throughout the 18th century to four or two towards the end of the 19th century. A 19th-century development was the introduction of 'horns'

(projections) at the base of the stile of the upper sash and at the head of the lower sash stile (see figure 3(c)). As fewer glazing bars were included in the design, horns were required to increase the strength of these joints.

Smaller windows with leaded lights and metal casements continued to be used for humbler buildings, servants' quarters and the rear elevations of grander buildings up to the middle of the 19th century. Wooden casement windows superseded those with iron casements and these windows have continued in use up to the present day.

With the late 19th- and early 20th-century revivals in architectural styles, many of the earlier window forms were brought back into use with modifications to suit the increasing desire for comfort.

3 Defects and deterioration

3.1 Assessment

A detailed inspection of windows for defects should ideally be made annually or at least as regularly as redecoration. It is essential first to diagnose the precise nature and causes of decay (see figure 4).⁴

Although an inspection of the surfaces of a window may reveal much about its condition, probing vulnerable areas with a sharp instrument (for instance, bradawl or pen knife) is also necessary (see figure 5).

3.2 Wet rot

Wet rot comes in various forms and affects both softwoods and hardwoods, causing the timber to soften and lose strength. In windows, wet rot may be found where:

- Water is allowed to stand on horizontal planes (for example, cills).
- There is a breakdown of decorative surfaces (especially where paintwork cracks due to movement of joints).
- Moisture is attracted by capillary action and is subsequently trapped (for instance, between the timber window cill and the masonry sub-cill below).
- Adjoining masonry is damp for long periods.

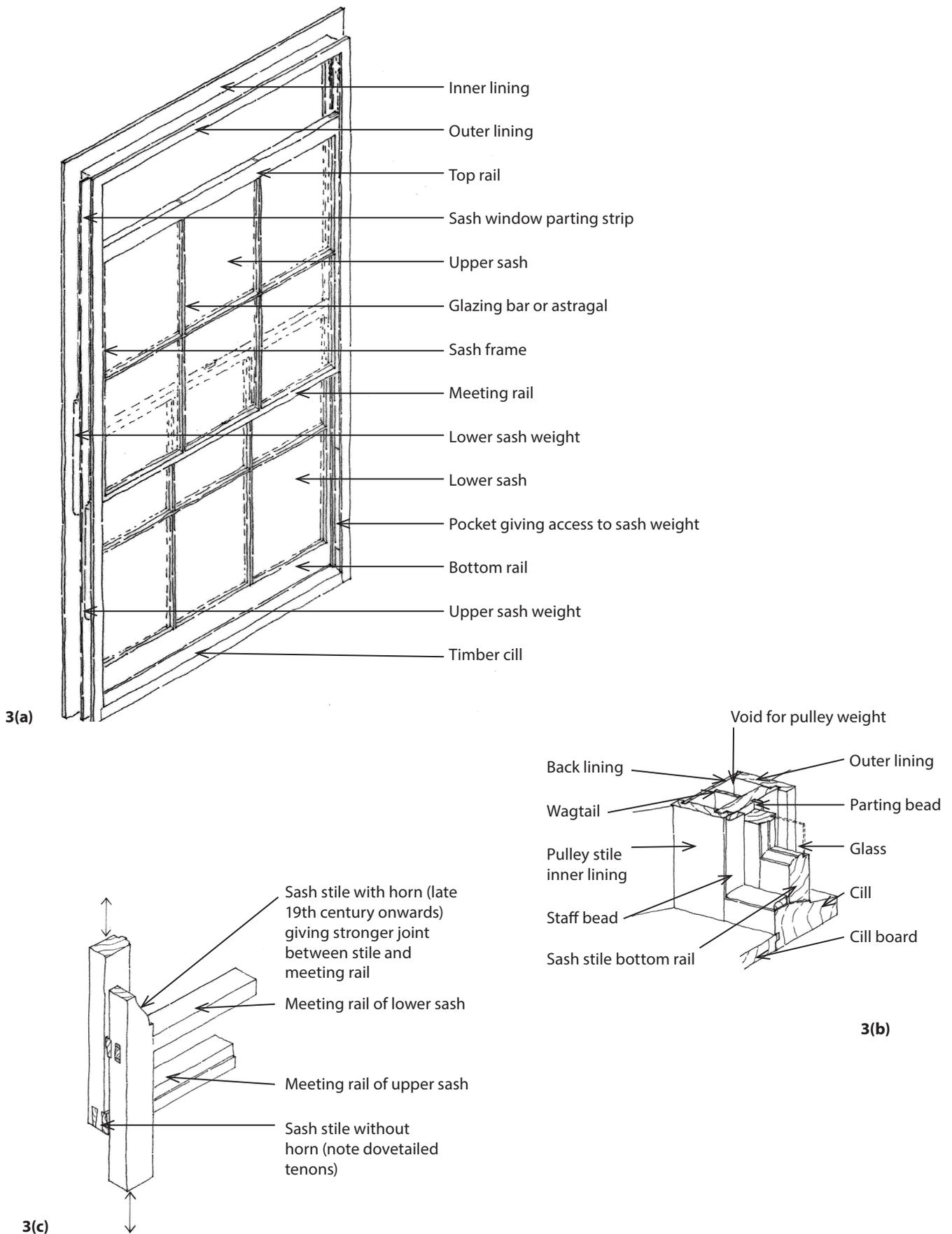


Figure 3: Typical vertical sliding sash window: **(a)** Main components. **(b)** Cill detail. **(c)** Detail of junction of upper/lower sash. Illustrations: SPAB

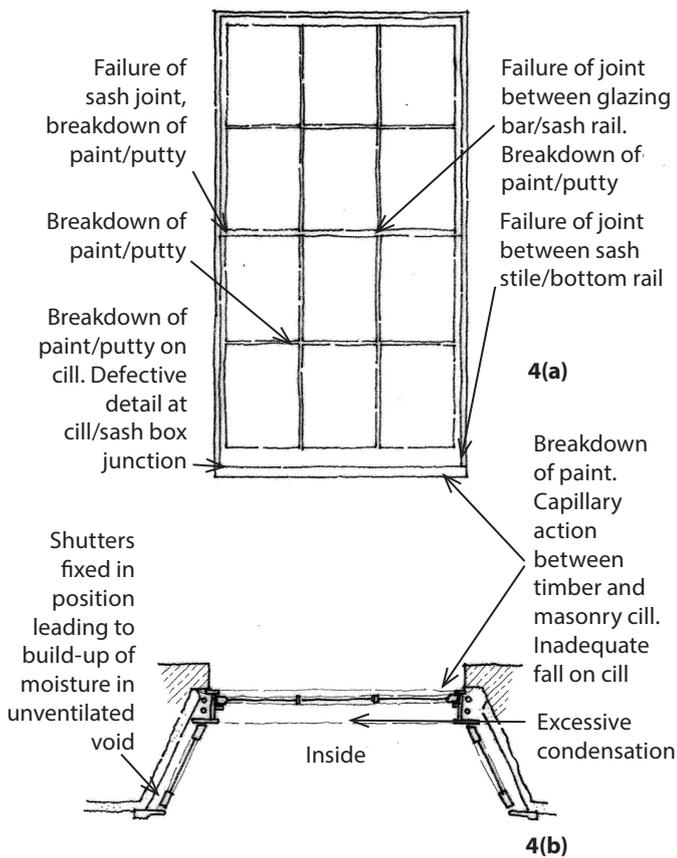


Figure 4: Sash window elevation (a) and plan (b) showing typical areas of decay. Illustrations: SPAB



Figure 5: A sharp instrument is essential for investigating the extent of decay in a window. In this case, rot has occurred following the use of poor quality timber for a past repair. Photo: Joseph Bispham

- Condensation persistently forms on the internal surface of the glass.

Wet rot is recognised by slight ripples and discoloration in the paintwork, and the underlying timber is found to be soft and friable when probed. Although the breakdown of the decorative surface of a window is often associated with wet rot, this is not always the case, and a window (or part of a window) should never be condemned on surface appearance alone.

Treatment of wet rot in windows should broadly be as follows:⁵

1. Locate and eliminate the sources of moisture.
2. Promote rapid drying of the affected area.
3. Remove decayed timber only as far as is necessary to carry out repairs.
4. In repairs, make use of a species of timber which is known to be durable.

If timber remains in contact with damp masonry - during the period of drying out following removal of the moisture source - consider treating potentially vulnerable areas with a timber preservative; this approach will buy time but should not in most cases be considered as a permanent solution to the problem.

3.3 Dry rot

Dry rot (*Serpula lacrymans*) occurs mainly in softwoods and is characterised by the affected timber turning a dull brown colour and 'cubing' (deep cracks along and across the grain - also found in timber affected by some forms of wet rot). This type of fungus thrives in humid, stable conditions in poorly ventilated voids. As such, it rarely affects windows, but is sometimes found behind sealed shutters and in the pulley boxes of sash windows, especially where there has been an outbreak of the fungus elsewhere in the building.

Treatment of dry rot is more complex than for wet rot and usually should not be tackled without the advice of an independent timber decay consultant.⁶ In tackling dry rot, a primary aim normally is to dry out the structure which has led to the outbreak, and to remove the 'food' source, ie the affected timber. Great care must then be taken during reinstatement works to ensure that all new timbers introduced into the building are of

a durable type or are pre-treated; and they should be isolated from damp walls/floors, although placing impermeable barriers/coatings up against timber should be avoided, as this may lead to trapping of moisture in the window joinery.

3.4 Wood-boring insects

Damage caused by wood-boring insects is less common in windows than decay from fungal attack. Many species of wood-boring insects exist, but those chiefly affecting windows are furniture beetle and death watch beetle, with the latter usually only active in hardwoods, especially oak. Beetle activity is recognised by flight holes appearing in the surface of the timber, together with deposits of bore dust. The beetles leave the timber only between March and June, when inspections should take place.

Death watch beetle and furniture beetle are both encouraged by damp timber conditions and, therefore, are often found in association with wet rot. Where evidence of activity is found, treatment should be as for wet rot (see section 3.2); if a timber preservation treatment is used, this should be of a type appropriate to the control of wood-borers.

3.5 Settlement

Movement in masonry or timber-frame walls surrounding a window may lead to deformation of the window with jamming of working parts (sashes, casements) and even the breakage of window glass (see figure 6). Look for obvious signs of general movement within the fabric or more localised movement caused, for example, by the decay of a timber lintel above a window, or where differential movement in the cill and jambs (due to compression in the masonry below the latter) has occurred, giving a bowed appearance to the cill. Any structural movement may require remedial measures and could require the advice of a structural engineer experienced in dealing sensitively with old buildings.⁷ Windows which have become deformed by past movement in a surrounding wall have often been adjusted to suit their realignment, and continue to work effectively.

3.6 General wear and tear

All wood windows require regular maintenance to keep them in working order. Sticking sashes can be eased, although this should be avoided in buildings which have not been in use for some time – with the reintroduction of heat and ventilation, the sashes will often contract slightly, thus working themselves free. Where sashes or casements are loose and allow in excessive draughts, timber fillets may be added to fill gaps or draught strips may be used,⁸ although it is important not to seal windows completely. Windows which have been painted shut should be gently eased and excess paint removed.

Misalignment of sashes/casements may be due to missing or worn beads. If this is the case, the beads should be reworked/refitted or replaced, to allow the window to work properly.

The breakdown of paintwork or putty should be dealt with promptly as this may lead to decay of the timber below.



Figure 6: Structural movement.

Photo: Douglas Kent

4 Work in general

A number of principles should be followed when considering repairs to wood windows:

- Where decayed timber is to be removed to form a splice repair, the minimum amount of existing timber should be removed as is necessary to allow an effective repair to be formed.
- Always work new material to the line of the existing (rather than *vice versa*) and avoid unnecessary trimming of the original timber. Repairs should follow any existing deformities in the line of the window.
- Generally, avoid mixing timber species between the new and the existing in a repair, as the joint between the two is likely to fail due to differential expansion and contraction during alternating dry and damp conditions.
- When carrying out a repair, try to ensure that the structural integrity of the window is maintained and that the window continues to work as it was designed to do.
- Wherever possible, spliced repairs should be designed to ensure that moisture is directed towards the outer face of the timber and that moisture does not lie on the repair joint. The length of the splice is governed by the section of timber and the nature of the component being repaired, and should be designed to ensure an effective bond between the new and the existing sections of timber.
- Wherever possible, splice repairs should be designed which incorporate mechanical fixings (for example, timber pegs/dowels or non-ferrous screws/pins) as well as glue. Screw or pin fixings should ideally be inserted from the inner face of the window.
- Well-seasoned timber should be used in forming a repair, with the line and density of the grain (number of growth rings) of the new timber matching the existing as closely as possible. As with all joinery work, timber with shakes, fissures, warping, heartwood, sapwood or numerous/large knots should be avoided for use in repair.
- Avoid previous design faults when carrying out repairs. Consider modifying a method of construction (or a previous repair) where it is liable to lead to further decay.
- If possible, repairs to window frames should be formed *in situ*, especially where the frame is built in and cannot be removed

without damaging either the window or the surrounding wall. In general, casements/sashes can be easily removed without damage, to be repaired on site or in a joiner's workshop.

- Where windows are to be dismantled as part of the repair process, always mark and record the constituent parts before dismantling, especially where a significant number of windows are to be repaired. Similarly, always number glass panes/quarries before removal.

5 Repairs

5.1 Bottom rail of sash window

The method of repair illustrated in figure 7 allows for the work to be carried out without dismantling the sash. The same procedure for removal and replacement may be used where total renewal of the bottom rail is necessary, although removing the existing decayed rail is easier if a series of vertical cuts are made through the rail before removal.

5.2 Base of sash stile (outer face)

See figure 8.

5.3 Bottom rail/base of sash stile

A similar repair method may be used where the replacement of only the base of the sash stile is necessary, as shown in figure 9.

5.4 Tongue of glazing bar

For replacement of short sections of a glazing bar where only the outer tongue section is decayed, as illustrated in figure 10. If care is taken, this repair can be carried out without dismantling the sash or removing the glass. In most cases, hardwood (for strength and durability) should be used for the new tongue, even where the existing glazing bar is softwood.

5.5 Tongue of glazing bar at junction of bars

See figure 11.

5.6 Glazing bar

See figure 12.

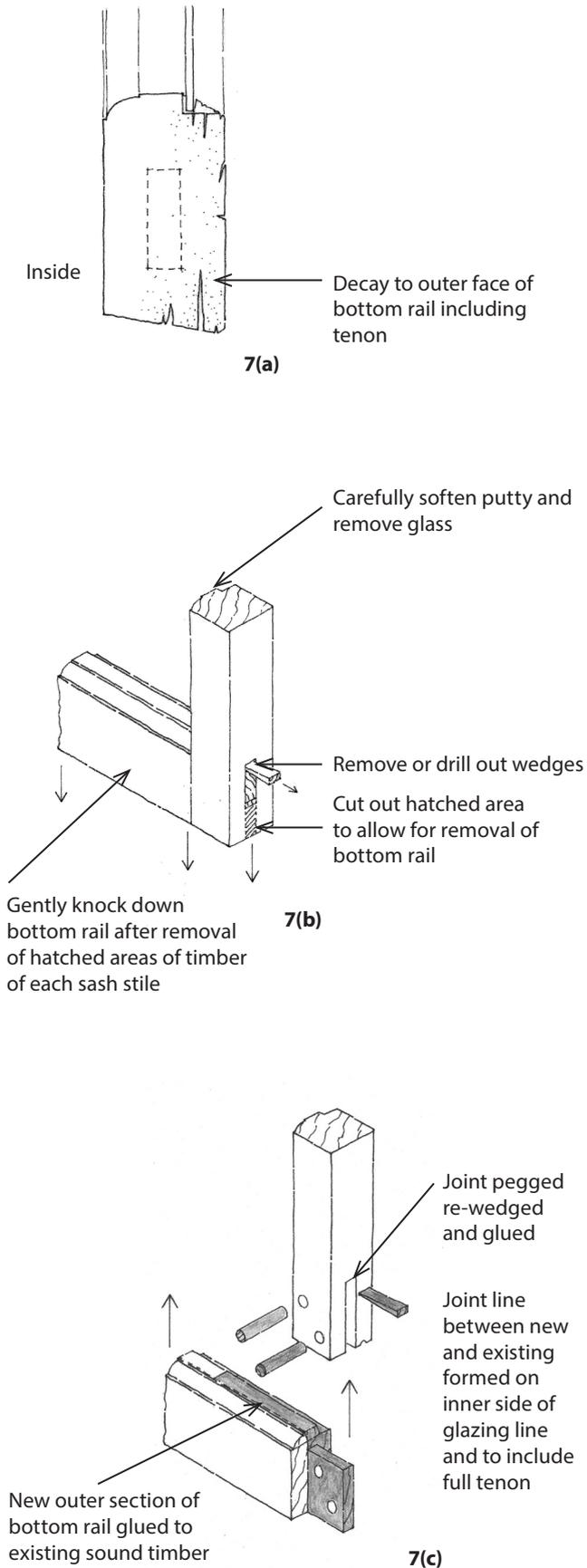


Figure 7: Bottom rail of sash: (a) Decay. (b) Dismantling. (c) Repair. Illustrations: SPAB

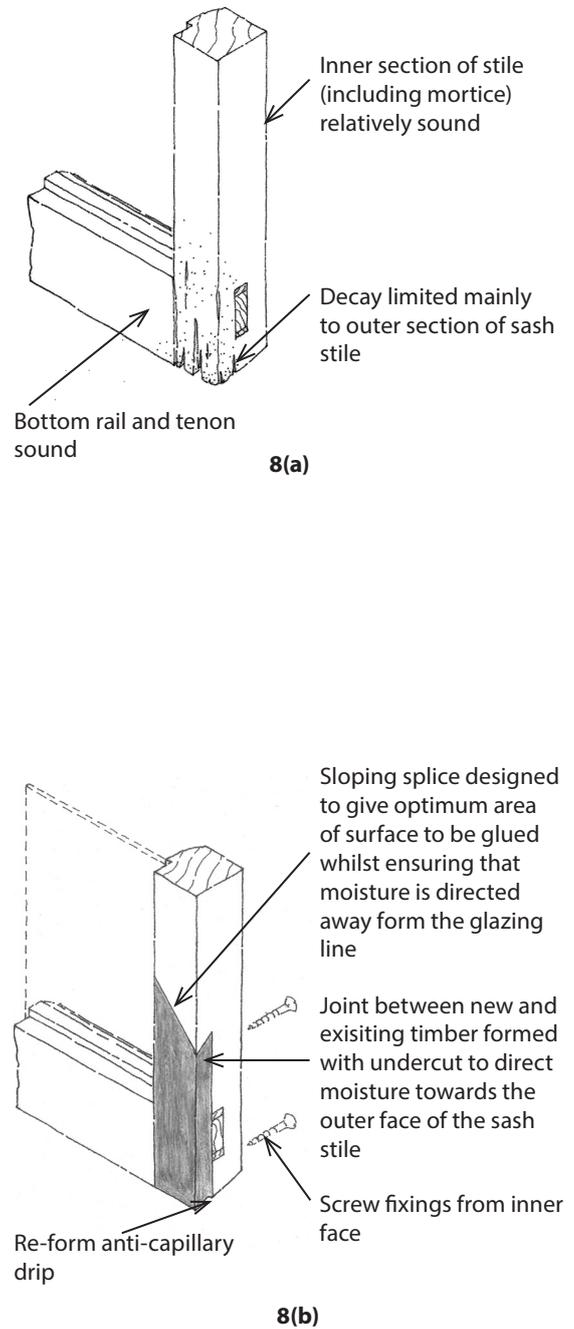


Figure 8: Sash stile (outer face): (a) Decay. (b) Repair. Illustrations: SPAB

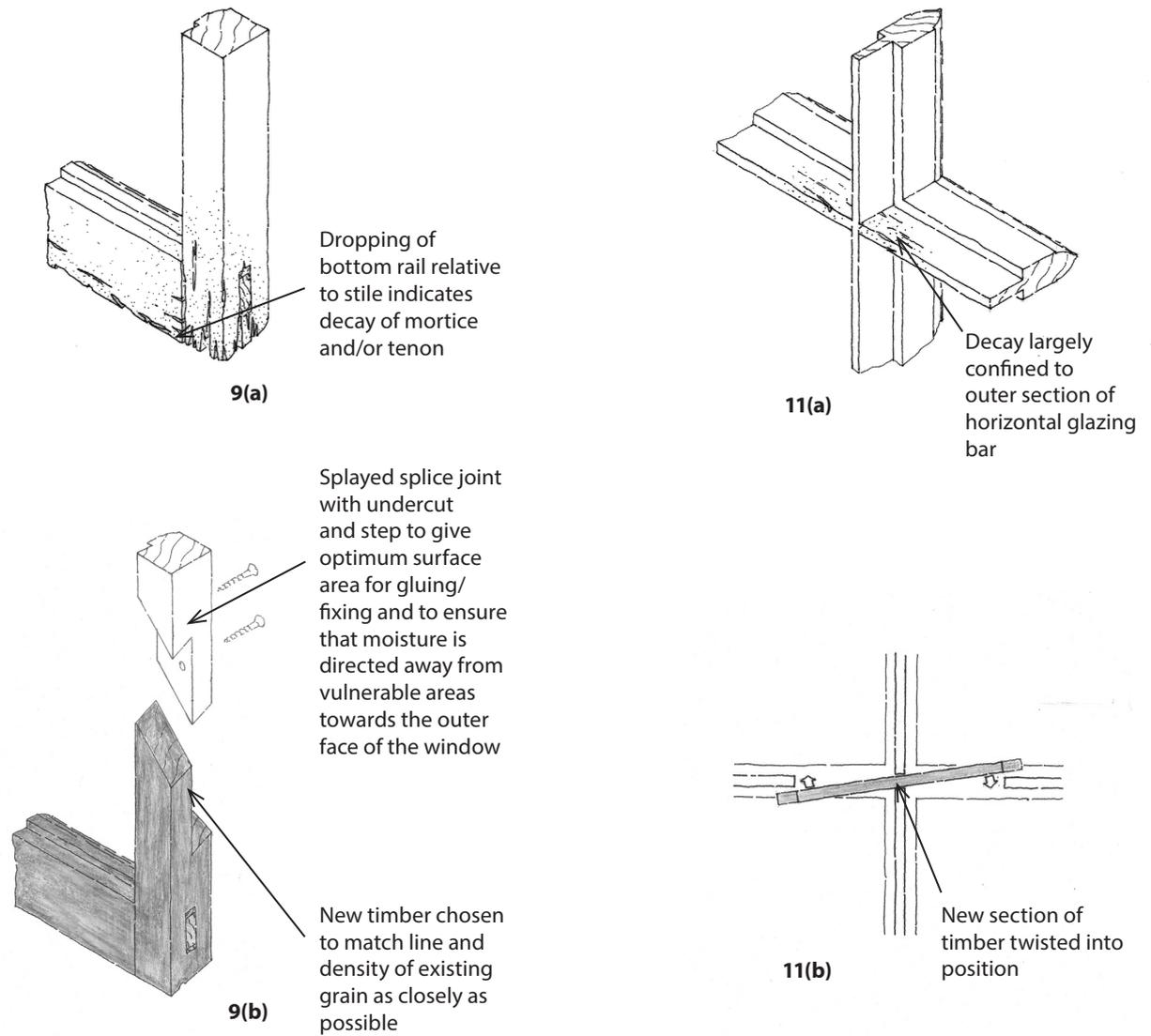


Figure 9: Bottom rail/base of sash stile: **(a)** Decay. **(b)** Repair. Illustrations: SPAB

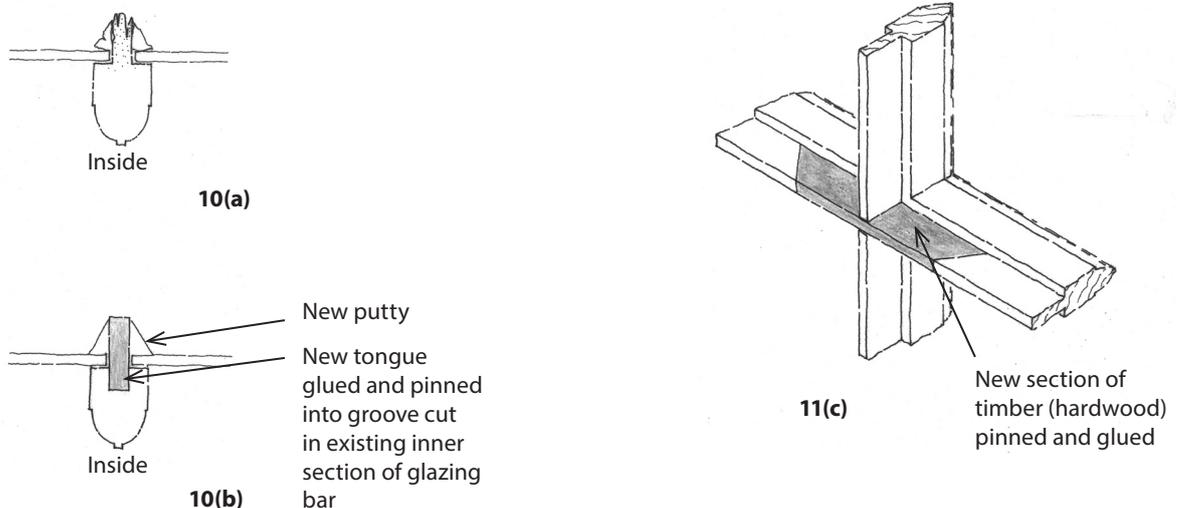


Figure 10: Tongue of glazing bar: **(a)** Decay. **(b)** Repair. Illustrations: SPAB

Figure 11: Tongue of glazing bar at junction of bars: **(a)** Decay. **(b)** and **(c)** Repair. Illustrations: SPAB

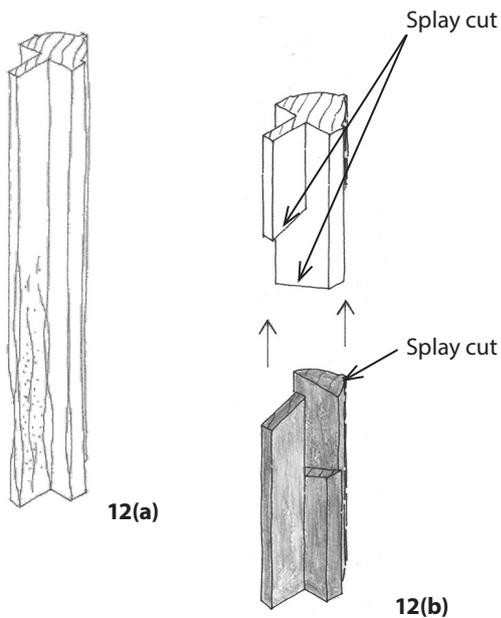


Figure 12: Glazing bar: (a) Decay. (b) Repair. Illustrations: SPAB

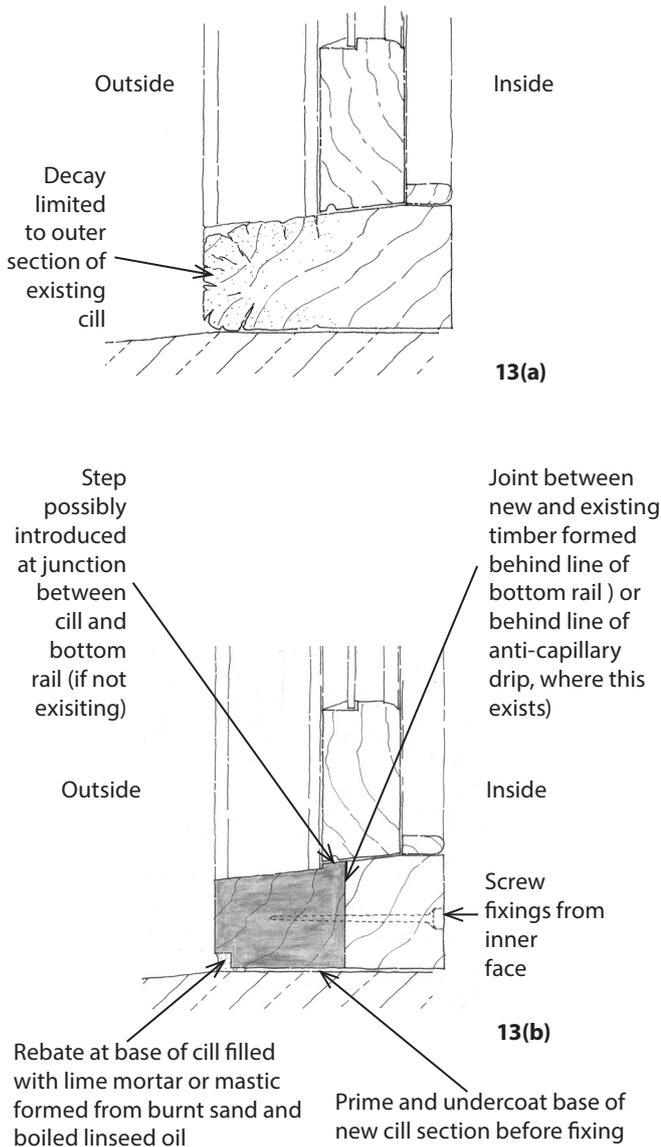
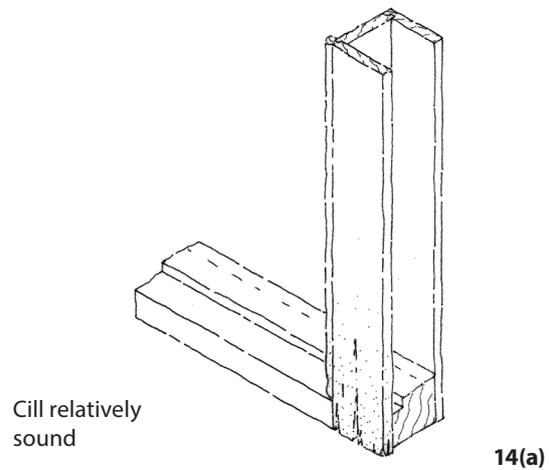


Figure 13: Cill to sash window: (a) Decay. (b) *In situ* repair. Illustrations: SPAB

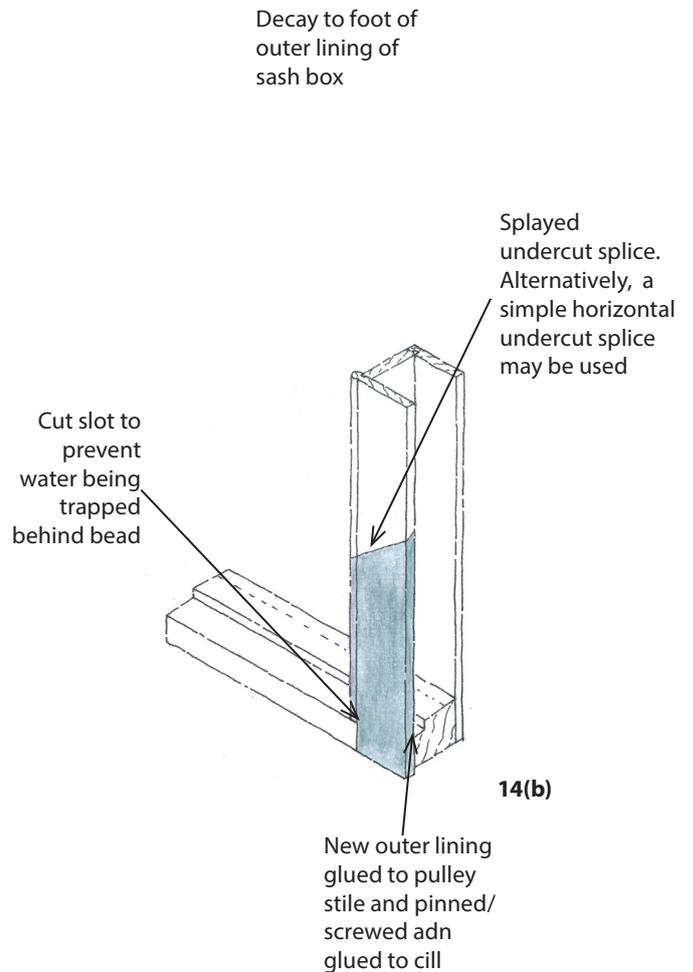


Figure 14: Outer lining of sash box: (a) Decay. (b) Repair. Illustrations: SPAB

5.7 *In situ* repair of cill to sash window

See figure 13.

5.8 Outer lining of sash box

The type of repair depicted in figure 14 can be carried out *in situ* where the sash box is not situated behind a reveal.

5.9 Base of pulley stile

See figure 15.

5.10 Casement window – general repairs

See figure 16.

5.11 Casement Window – alternative repair to base of jamb or mullion

The type of repair shown in figure 17 is appropriate where the window is performing a load-bearing role and a simple splice repair may not be strong enough. It also ensures that more of the internal face (including mouldings) of the existing mullion is retained than would be the case if the splice illustrated in figure 16 were to be employed.

5.12 Sash and casement mouldings

When replacing a moulded section of timber from an old window, it is very unlikely that a matching size and shape of moulding will be available from a timber merchant. A small section of the original moulding should be carefully stripped of any paint, revealing crisp, clean edges for an accurate mould to be taken. If the end section of the moulding cannot be drawn around, then an accurate moulding section can be obtained using a template former.

Where only small quantities of moulded section are required, it may be uneconomical for a cutter to be made for a spindle moulding machine. If this is the case, a combination of special purpose planes (moulding planes) and a steel scraper shaped to the required finished section can be used. New moulded sections should always be made very slightly over-sized, to allow for working back to the precise line of the existing timber in a repair, so avoiding the need to work the original material.

5.13 Loose joints

Casements or sashes are often in sound condition but the joints have become loose due to the breakdown of glue and loose wedges. The wedges will often be easily removable and will probably be unsuitable for reuse. It may be necessary to remove some panes of glass for the joints to be pulled together successfully.

It should be possible to apply glue to the shoulders of the tenon. This can be achieved by working the glue down to the base of the tenon with a hacksaw blade or piece of card. Glue can then be applied to the voids left by the removal of the wedges from the mortice. The joint should then be pulled together and re-wedged.

Where opening of joints is combined with minor decay such that regluing alone will be inadequate, reinforcement of the timber at the joint can be achieved with a non-ferrous bracket (see figure 18).

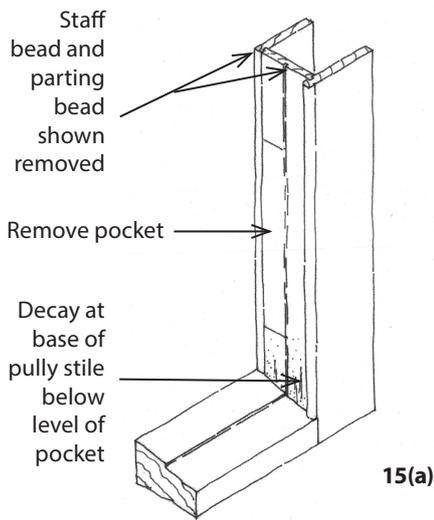
5.14 Small areas of decay

If localised pockets of decay are detected in their early stages and the structural integrity of the window remains sound, the defective areas can be scraped out and the remaining, sound, timber treated, filled and, where appropriate, painted.

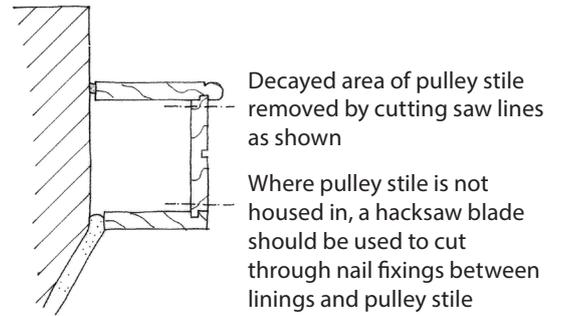
The treatment can take the form of a timber preservative when using standard modern paints but this is not suitable with all paint types. It is advisable to impregnate timber with raw linseed oil, for example, if using a linseed oil paint.

Larger voids should be filled with a combination of a timber patch (shaped to fill the void) and filler.

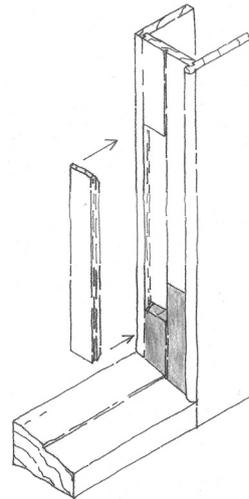
Traditional fillers (or 'stopping') were formed from a combination of white lead paste and ordinary linseed oil putty sometimes with the addition of chalk, sawdust etc, to give extra volume.⁹ Where linseed putty is used as a filler today, the lead is omitted to overcome toxicity concerns. Of the modern filler types, two-pack systems (for example, epoxy resin or polyurethane type) are generally more durable than ready-to-use fillers.



15(a)



15(b)

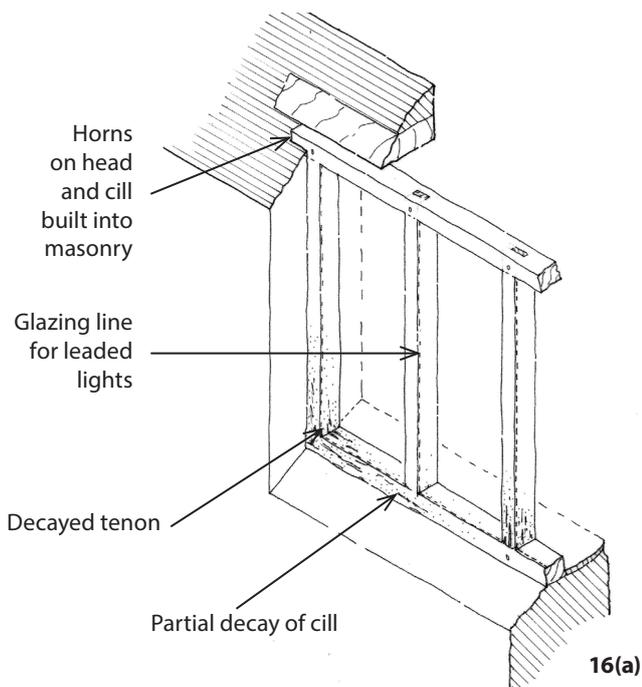


Refix pocket
New section of pulley stile glued and re-wedged to rebate in cill. Outer and inner linings screwed or pinned (non-ferrous) to pulley site

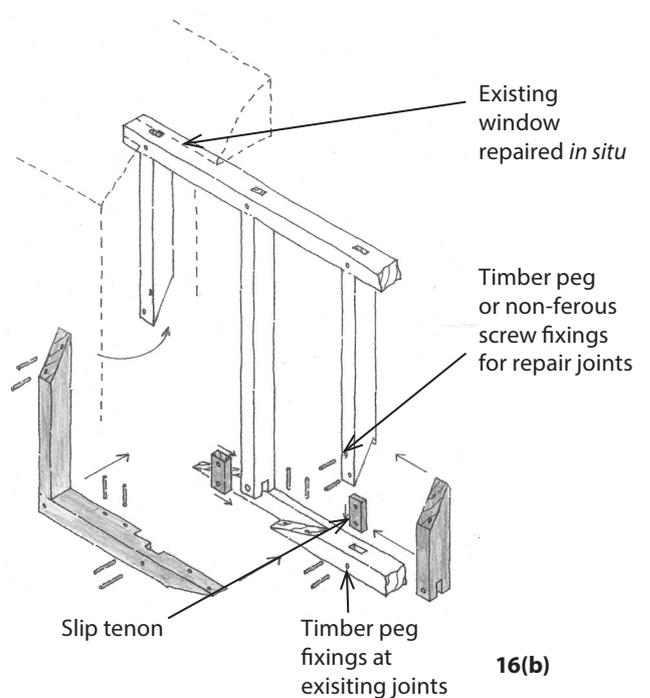
15(c)

Figure 15: Base of pulley stile: (a) Dismantling. (b) Cutting back shown on plan of sash box. (c) Repair.

Illustrations: SPAB



16(a)



16(b)

Figure 16: Mullion window: (a) Decay. (b) General repairs.

Illustrations: SPAB

6 Glass

6.1 Old glass

The inherent irregularities in handmade crown and cylinder glass found in windows dating from the mid-19th century and earlier contribute much to the liveliness and character of historic buildings. With the invention of drawn sheet glass and later float glass, glazing became much more uniform and dull in appearance.

Crown glass is irreplaceable (it is no longer manufactured in large sheets in this country) and is thin and easily broken. Therefore, extreme care should be taken to avoid damage both during general building works (especially involving the erection of scaffolding) and in the repair of individual windows. When considering the method of repair, an assessment must be made beforehand as to the quality of the glass, whether or not it can be easily removed and whether the repairs can be carried out with the glass in situ.

If it is necessary to remove the glass for timber repairs, the putty may have deteriorated to such an extent that it can be removed by hand. Otherwise, an organic solvent paint stripper, soldering iron or bespoke infrared lamp can be used to soften the putty. Other methods of softening include the application of household bleach or a mixture of potassium carbonate and quicklime in a 1:3 ratio (by weight). In all cases, extreme care and patience are needed as numerous applications may be required to soften the putty adequately.

6.2 Replacement glass

Replacement glass should be carefully chosen to be compatible with the original glass, but avoiding material which is too reamy (contains noticeable inclusions or inhomogenous glass strings or layers) or over-distorted. In sash windows, replacement glass should be of a thickness (and, hence, a weight) to ensure that the sash is correctly counterbalanced by its weights.

Few sources of new glass are satisfactory for replacement in historic windows. Handmade glass is, however, available from specialist suppliers. Original glass, taken from a window which is decayed beyond repair, should always be kept for reuse in repair work elsewhere within the same building.

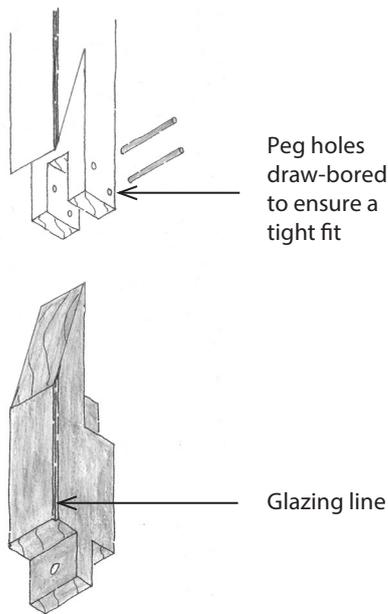


Figure 17: Mullion window – alternative repair to base of jamb or mullion
Illustrations: SPAB

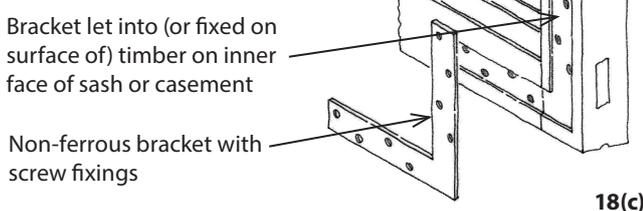
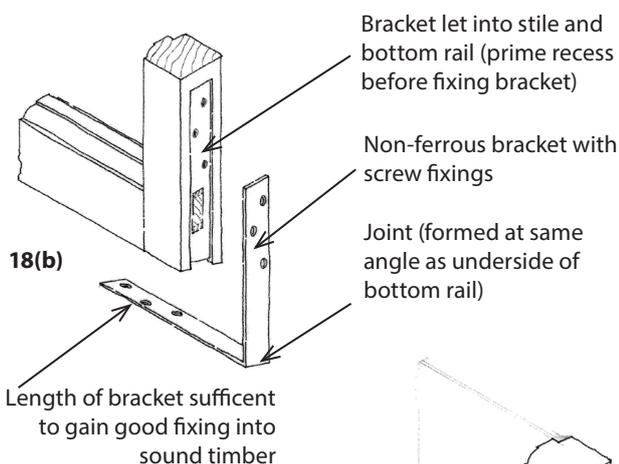
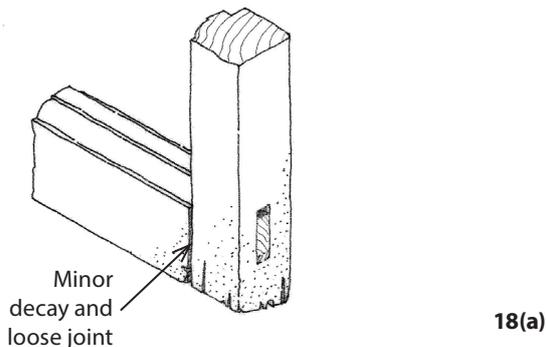


Figure 18: Dealing with loose joints. Illustrations: SPAB

6.3 Putty

Reglazing in timber sashes/casements should be carried out in linseed oil putty. The glazing rebates should be primed before applying putty to the appropriate thickness and angle. Where metal fixing sprigs or pins are necessary, these should be fixed with a small gap between sprig and glass to avoid fracturing the thin, delicate glass. Putty should be decorated within a day or two after application to avoid it drying out/shrinking. The paint should be taken slightly over the border, between glass and putty covering about 1 mm of the glass, to form an effective seal against moisture penetration.

Putty thinned with a few drops of raw linseed oil or natural turpentine can be used to seal minor cracks in old putty, thereby extending its life for a few years.

7 Preservatives

7.1 Use

All preservatives have a limited lifespan. They are not a long-term solution to bad detailing or poor quality modern timber, nor are they an alternative to regular maintenance. Some types of timber, such as Douglas fir, do not take preservatives particularly well. Preservatives are also incompatible with certain paints, such as linseed oil paint. If deemed to be useful/necessary, preservative systems should be carefully selected to ensure compatibility with paints, primers, glues and putty. An applied preservative should be allowed to dry before carrying out repairs, reglazing and re-painting.

Chemically modified timber is available that claims good durability. Its use for repairs is best confined to where the adjacent, existing timber can move independently; for example, for a new cill rather than scarfing in to an old one.

7.1 Methods of treatment

When used in repairs, new timber without a high natural resistance to decay should be pre-treated by the supplier with a double-vacuum treatment using an organic solvent preservative.¹⁰ Existing timber components removed from the window for repair can be immersed in a preservative (also organic solvent type), after all the repair cuts have been made. Where window components suffering from decay are to be repaired *in situ*, removal of the decayed areas of timber can be followed by brushing preservative in multiple applications

or by smothering temporarily the affected area with an absorbent material (for instance, cotton wool) soaked in preservative and covered with polythene sheeting. In all cases, particular attention should be given to treating the end grain of timber.

The use of boron rods (which work by emitting anti-fungal boron when damp) should generally be avoided. Considerable damage (including possible weakening of the joints) is inflicted on the window by the insertion of the rods and they provide protection to only a small area of the wood for a limited period.

8 Pointing

8.1 Lime and burnt sand mastic

The existing pointing material that fills the joint between a frame and the surrounding masonry should normally be matched (taking care not to inadvertently copy inappropriate repair work). The use of haired lime mortar and/or burnt sand mastic (baked sand and boiled linseed oil) is the traditional method for closing the window-to-wall gap. The void behind can be packed with rolled up newspaper, soaked with water before use.

8.2 Modern sealants

Modern mastic sealants and foam fillers should be avoided. They can trap moisture and are disfiguring.

9 Painting

9.1 Deterioration of paintwork

With the exception of some early oak windows, timber windows were usually painted from construction both for aesthetic reasons and to give the timber a protective coating (see figure 19). However, a poor paint specification or badly maintained paint will lead to deterioration in the paint surface, allowing water to penetrate into the body of the timber. This will lead to swelling of the timber, causing further deterioration of the paint finish and a continuation of the cycle of decay.

This problem is best avoided by regular inspection and maintenance of the paint surfaces. Complete stripping of a window is seldom necessary; only loose and defective

areas of paint, putty, filler etc should be removed. Essential stripping of paint can be achieved successfully using an organic solvent stripper, although much patience is required and care should be taken to clean the timber down thoroughly after stripping. Defective paint can also be burnt (flame or hot air stripper) but this method should be avoided on windows *in situ* (because of the dangers to the general building fabric) or where glass is still in place. Precautions should also be taken when burning off lead-based paint because of the toxic fumes. For the same reason, only wet abrasive paper should be used when rubbing down old paintwork.

9.2 Avoid stripping

Under no circumstances should windows (or any other joinery) be stripped by immersion in caustic soda or similar 'acid bath' treatments, as this will deform the timber and weaken the joints.

Drips and anti-capillary grooves with accumulated paint layers should be cleared, and any further repairs carried out before priming. Any reglazing should be carried out after



Figure 19: Windows post-dating the 18th century are commonly made of softwood and require regular redecoration for protection. Photo: Douglas Kent

painting, to minimise the risk of absorption by the timber of the binding oil from the window putty.

Following the removal of paint, all accessible surfaces of the window should be rubbed down (wet abrasive paper) with priming of exposed timber surfaces and application of a minimum of one undercoat and one finish coat. Concealed surfaces of timber (for example, underside of cill, interior of sash boxes) may be coated with primer and undercoat where they are made accessible during the course of repair. Some timber components are left unpainted, to allow the window to function properly (for instance, the junction of the sash window pulley stile/sash stile, which should be waxed to ensure an easy sliding action).

9.3 Choice of paint

Choice of paint is critical to the protection of softwood windows from decay. Lead-based paint systems (including primers) offer excellent durability on most types of wood and are particularly effective for use on partially degraded timber surfaces. However, their use is banned except on exempted buildings.¹¹ Alkyd paint systems are those most generally in use on external joinery. The elasticity required in paints applied to timber surfaces is initially good in alkyd-based paints, but this property deteriorates with age and generally results in the need for repainting much more frequently than with lead-based systems. Alkyd-based primers are not suitable for use on most hardwoods, where a metal-based primer should be used. Some of the linseed oil paints now on the market appear to provide good alternatives to alkyd-based systems.

10 References

For full details of sources cited, see bibliography in Section 11.2.

- 1 Further guidance on adding secondary glazing is given in Historic England, 2016b, pp50-53
- 2 See <https://www.spab.org.uk/advice/glossary>
- 3 Innocent, 1916, chapter XV
- 4 Further guidance on recognising the types of fungal decay and wood-boring insect damage encountered in buildings is given in Bravery *et al*, 2003
- 5 A leading source of advice on dealing with wood-boring insects and timber-decaying fungi is Brian Ridout's *Timber Decay in Buildings*. The approach he sets out is summarised in sections 3.2 to 3.4 of this Technical Advice Note

6 The SPAB may be able to suggest the names of timber decay consultants who might be contacted

7 The SPAB may be able to suggest the names of structural engineers.

8 See Historic England, 2016a for advice on draught-proofing windows

9 *Painting and Decorating*, 1947

10 For more on preservative treatment, see Bravery *et al*, 2003

11 Toxicity concerns mean the supply of lead paint is now restricted by law for use on certain listed buildings (Grades I and II*, or in Scotland Grade A), scheduled monuments and works of art. For more on dealing with lead in painted surfaces, see British Coatings Federation, 2014

11 Other advice

11.1 Contacts

Where work to old windows is being considered, the SPAB may be able to suggest suitable craftspeople, contractors and professionals.

11.2 Further reading

Bravery, A F, Berry, R W, Carey, J K and Cooper, D E (2003) *Recognising Wood Rot and Insect Damage in Buildings*, 3rd edition, BR 453, Garston: BRE Press

Briggs, M S (1925) *A Short History of the Building Crafts*, Oxford: Clarendon Press

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Wood, C, Bordass, B and Baker, P (2009) *Research into the Thermal Performance of Traditional Windows: Timber Sash Windows*, Research Report 109/2009, London: English Heritage. Available at:

<https://research.historicengland.org.uk/Report.aspx?i=16035> (Accessed 20 June 2019)

11.3 Other organisations

Brooking Museum of Architectural Detail
www.thebrooking.org.uk

The museum displays items from the Brooking National Collection. This is an unrivalled assemblage of British windows and other architectural elements spanning many centuries

11.4 Use of timber preservatives

Information on currently approved timber preservatives can be obtained from the Health and Safety Executive at www.hse.gov.uk. Before using any timber preservative, carry out an assessment in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended). You are strongly advised to consult the following publication before specifying and using timber preservatives:

Department for Environment, Food and Rural Affairs, the Health and Safety Commission and the National Assembly for Wales Environment, Planning and Countryside Department (2006) *Pesticides: Code of Practice for Using Plant Protection Products*, London: Department for Environment, Food and Rural Affairs

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