TECHNICAL PAMPHLET 13

THE REPAIR OF WOOD WINDOWS

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S·P·A·B

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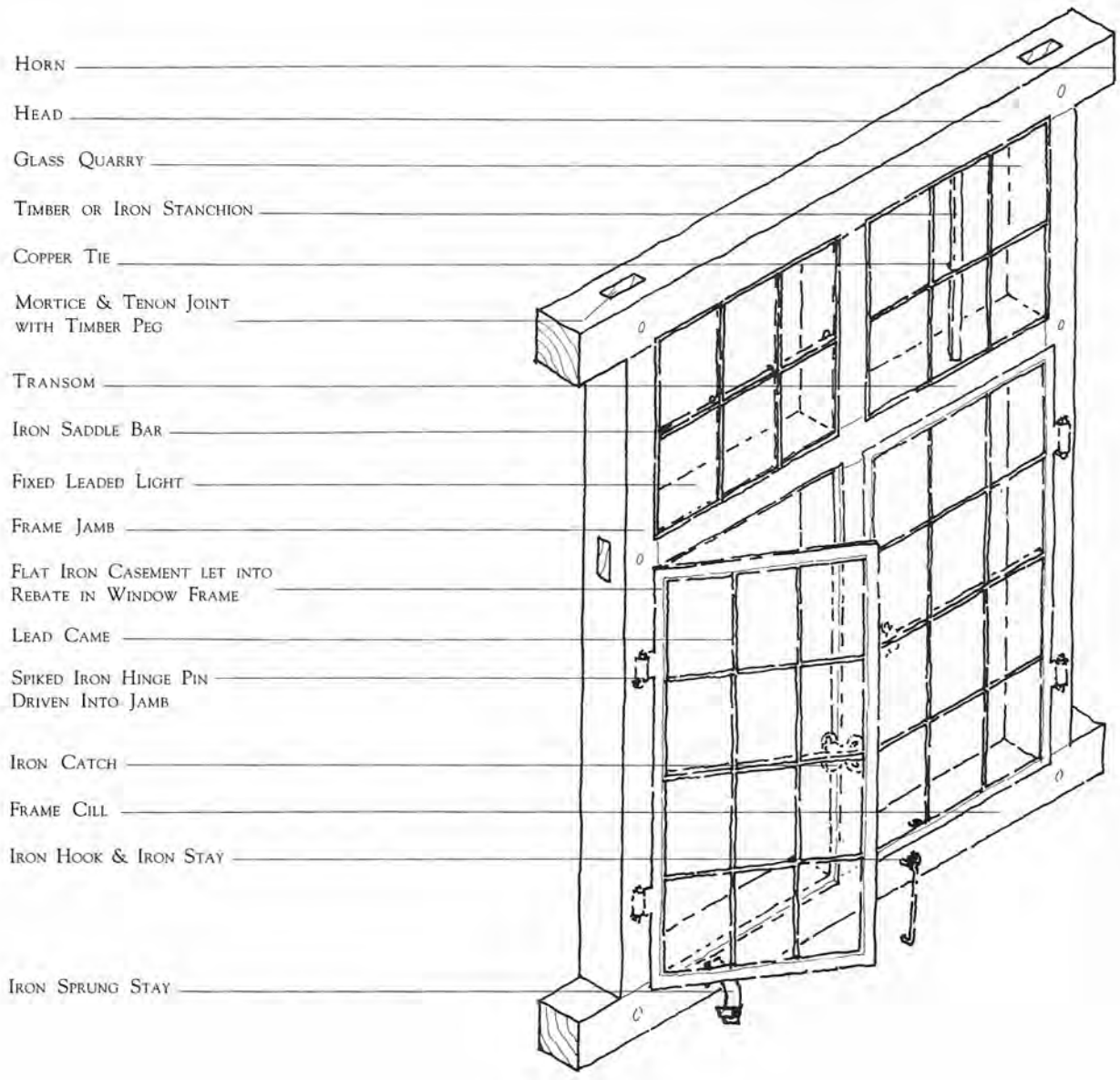
Needless destruction

Thousands of wood windows are destroyed every year because people believe they are beyond repair. As a result many old buildings suffer a profound deterioration 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, showing the compatible methods of construction and high quality of materials used in ancient buildings.

Repair methods

This pamphlet aims to demonstrate that limited decay can be tackled without total destruction, and that repair methods are to hand (both for the experienced joiner and the D.I.Y. enthusiast) which enable a decayed window to be brought back into a sound, functioning condition. Advice is included on the analysis of the causes of decay and general guidelines are set out for remedial work to windows, followed by specific examples of repair methods.

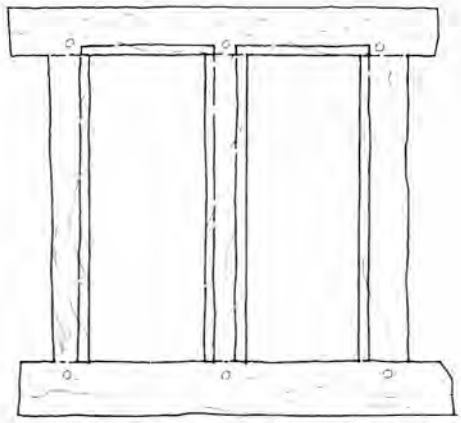


Typical Mullion and Transom Window

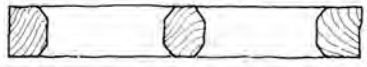
The earliest wood window frames known in the British Isles were simple openings formed as an integral part of timber-framed buildings (with cills, heads, jambs formed from frame members often with timber mullions) or as frames set within masonry. [1]

To reduce draughts, openings could be covered with oiled cloth, oiled paper, or sliding/folding timber shutters. In some cases, openings were filled with wattle or a timber lattice. [2]

From the 16th century, glass became more readily available (although not in general use until well into the 17th century) and the earlier form of chamfered mullions and jambs was adapted to take the small panes ('quarries') of glass set in lead 'cames'. 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.

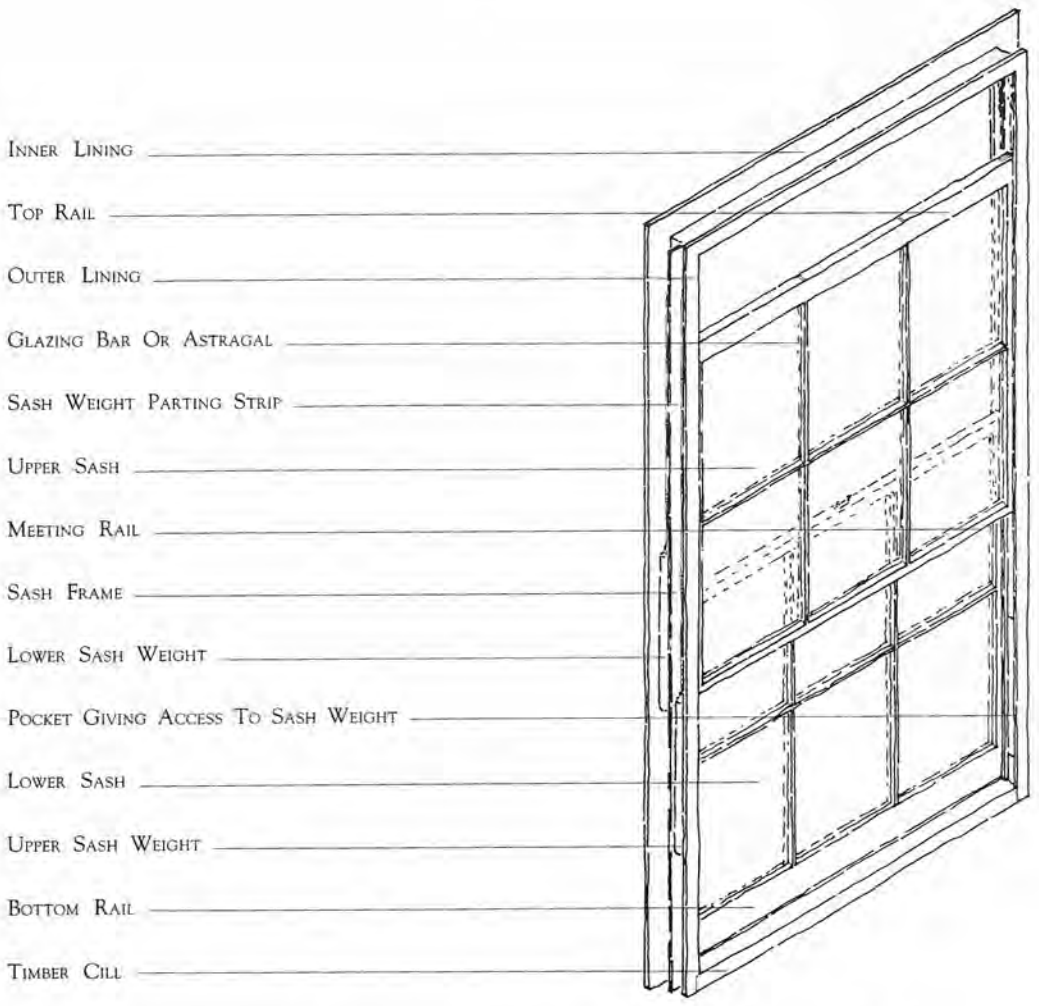


ELEVATION

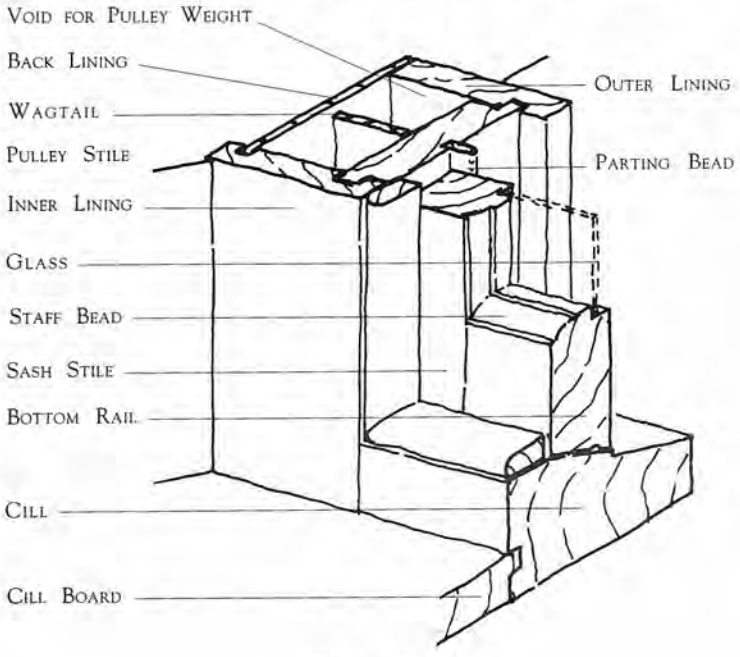


PLAN

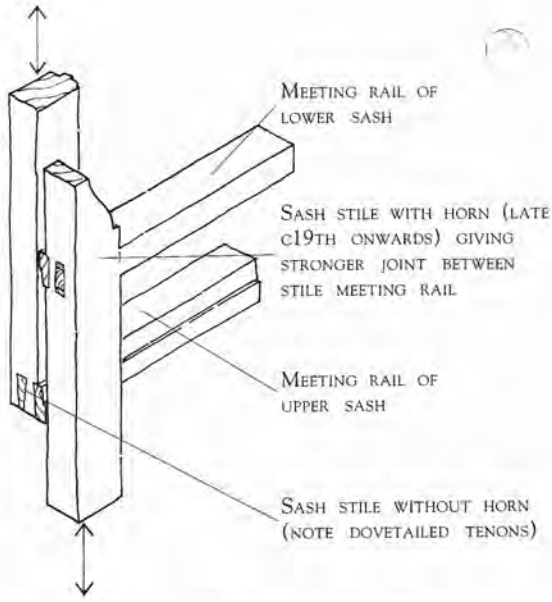
EXAMPLE OF AN EARLY, UNGLAZED WINDOW FROM A HOUSE IN FAIRFORD, GLOUCESTERSHIRE.



Typical Vertical Sliding Sash Window



Cill Detail



Detail of Junction of Upper / Lower Sash

Sash windows

The earliest 'sash' windows were simple mechanisms where a single section of the window would slide vertically or horizontally 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 sections (e.g. glazing bars up to 50mm wide), often incorporate a fixed sash (usually the top one) and may have frames worked out of the solid.

Subsequently, sash window design evolved to produce a general lightening of glazing bars and frame, with sash boxes being formed from separate sections of timber linings and pulley stiles. 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' at the base of the stile of the upper sash and at the head of the lower sash stile (see illustration) as fewer glazing bars were included in the design, horns were required to increase the strength of these joints.

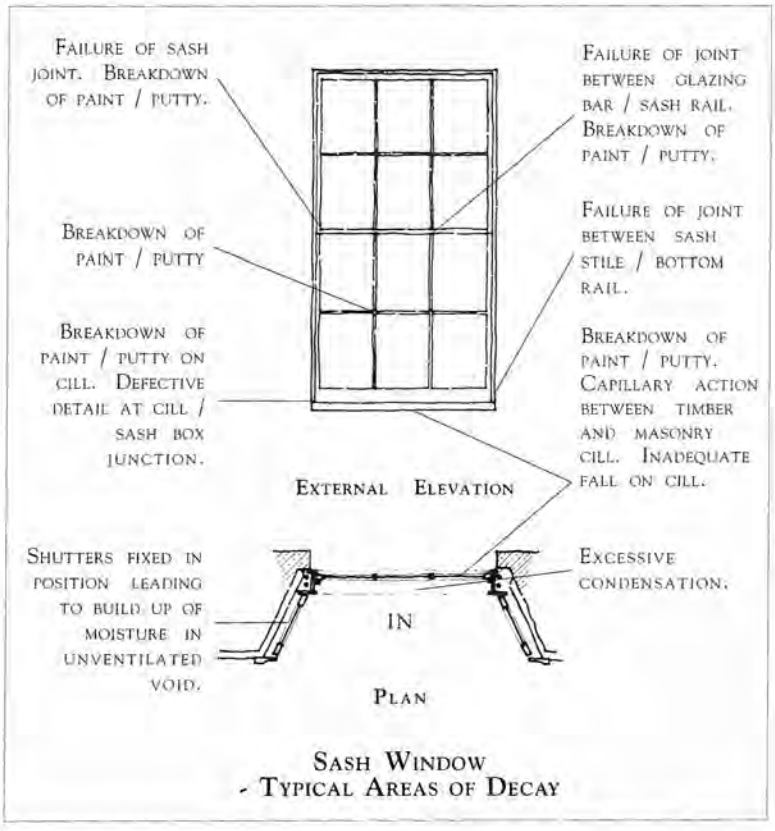
Smaller windows with leaded lights and metal casements continued to be used for humbler buildings, servants' quarters and rear elevations of grander buildings up to the middle of the 19th century. Wooden casement windows superseded those with iron casements and these windows have continued in use up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

A detailed inspection of windows for defects should ideally be made annually or at least as regularly as re-decoration. It is essential first to determine the precise nature and causes of decay.

Although an inspection of the surfaces of a window may reveal much about its condition, probing vulnerable areas with a sharp instrument (e.g. bradall or pen knife) is also necessary. The following notes should help to diagnose the most frequently occurring problems.

Wet rots affect both softwoods and hardwoods causing the timber to soften and lose strength. In windows wet rot may be found where:



SASH WINDOW
- TYPICAL AREAS OF DECAY

- *Water is allowed to stand on horizontal planes(e.g.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 (e.g. between the timber window cill and masonry sub-cill below)*
- *Adjoining masonry is damp for long periods*
- *Condensation persistently forms on the internal face of the glass.*

Wet rot is recognized 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 follow the guidelines set out by the BRE: [3]

a *Locate and eliminate the sources of moisture*
b *Promote rapid drying of the affected area*
c *Remove decayed timber as far as is necessary to carry out repairs*
d *Use preservative-treated timber in repairs*
e *Treat remaining timber which may be at risk with preservative*

Dry rot (*Serpula lacrymans*) occurs mainly in softwood [4] 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 wet rots). 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 when there has been an outbreak of the fungus elsewhere in the building.

Treatment of dry rot is more complex than for wet rot and should usually not be tackled without the advice of an independent specialist.

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 only usually active in hardwoods, especially oak.

A SHARP INSTRUMENT IS ESSENTIAL IN INVESTIGATING THE EXTENT OF DECAY IN A WINDOW. IN THIS CASE, DECAY HAS FOLLOWED THE BREAKDOWN OF PAINT AND GLAZING PUTTY ALLOWING THE INGRESS OF MOISTURE.

Beetle activity is recognized by flight holes appearing in the surface of the timber together with deposits of bore dust. The beetles only leave the timber during March - 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 above) using a type of timber treatment appropriate to the control of wood-borers. [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 to breakage of window glass. Look for obvious signs of general movement within the fabric or more localized movement caused, for example, by the decay of a timber lintel above a window, or where differential movement between 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. Often windows have become deformed by past movement in the walls, but have been adjusted to suit their realignment and continue to work effectively.

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 re-introduction of heat and ventilation they will often contract slightly thus working themselves free. Where sashes or casements are loose and allow excessive draughts, timber fillets may be added to fill gaps or draught strips may be used [6] 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 re-worked/re-fitted 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.

Guidelines to Repairing Wood Windows

- Where decayed timber is to be removed to form a splice repair, the minimum amount of existing timber should be removed to allow an effective repair to be formed.

- Always work new material to the line of the existing and avoid unnecessary trimming of the original timber. Repairs should follow any existing deformations in the line of the window.

- Avoid mixing timber species between new and existing in a repair as the joint between the two is likely to fail from different rates of expansion and contraction during 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.

- Where possible, spliced repairs should be designed to ensure that moisture is directed towards the outer face of the timber and that moisture does not lay 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 it should be designed to ensure an effective bond between the new and existing sections of timber.

- Wherever possible, splice repairs should be formed which include mechanical fixings (e.g. timber pegs/dowels or non-ferrous screws/pins) as well as glue. Screw or pin fixings should ideally be made from the inner face of the window.

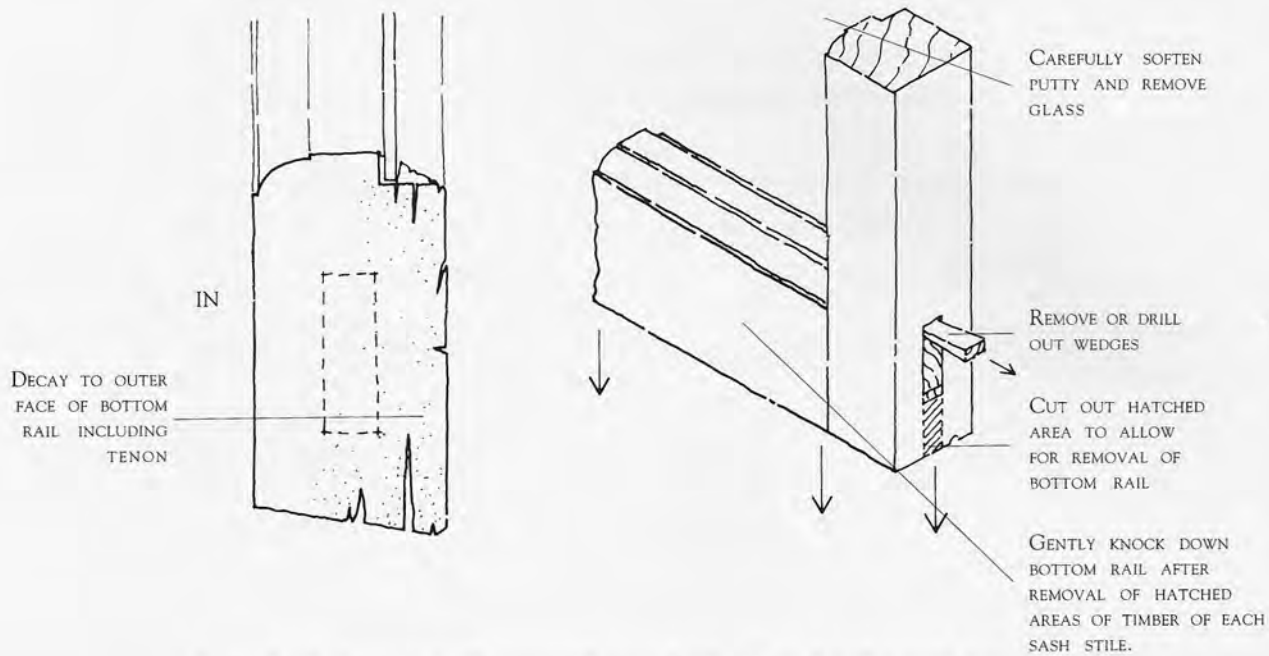
- Well-seasoned timber should be used in forming a repair with the line and density of the grain (number of growth rings) of the new timber matching the existing as closely as possible. As with all joinery work, timber with shakes, fissures, warping, heartwood, sapwood or numerous/large knots should 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.

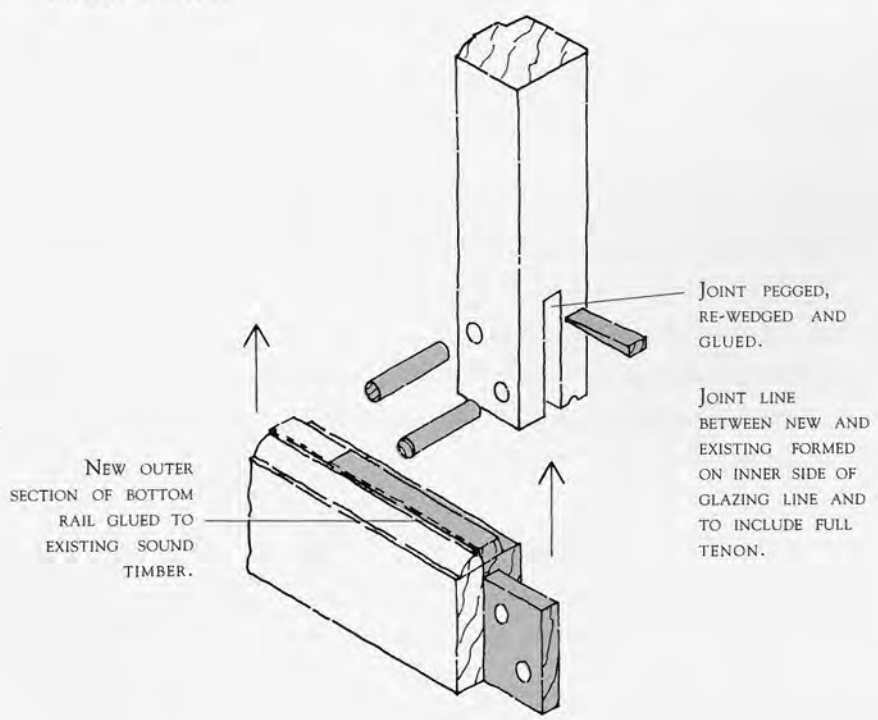
- If possible, repair to window frames should be formed in-situ especially where the frame is built-in and cannot be removed without damaging either the window or surrounding wall. In general, casements/sashes can be easily removed without damage to be repaired on site or in a joiner's workshop.

- 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.

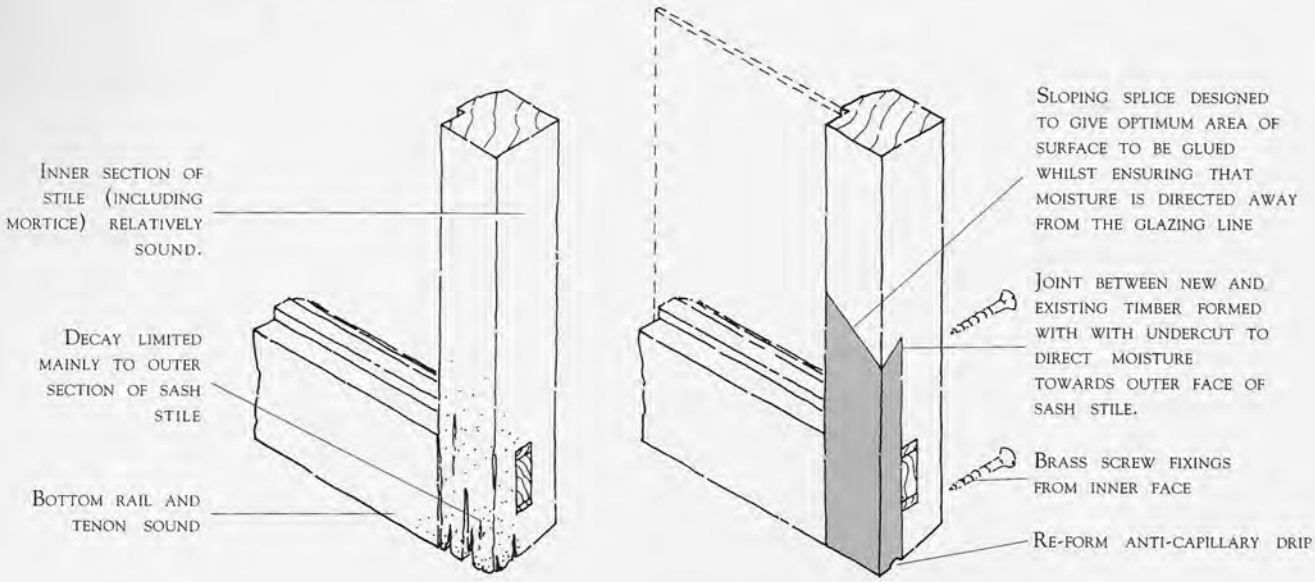
Bottom rail of sash window



A method of repair is illustrated here which 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.

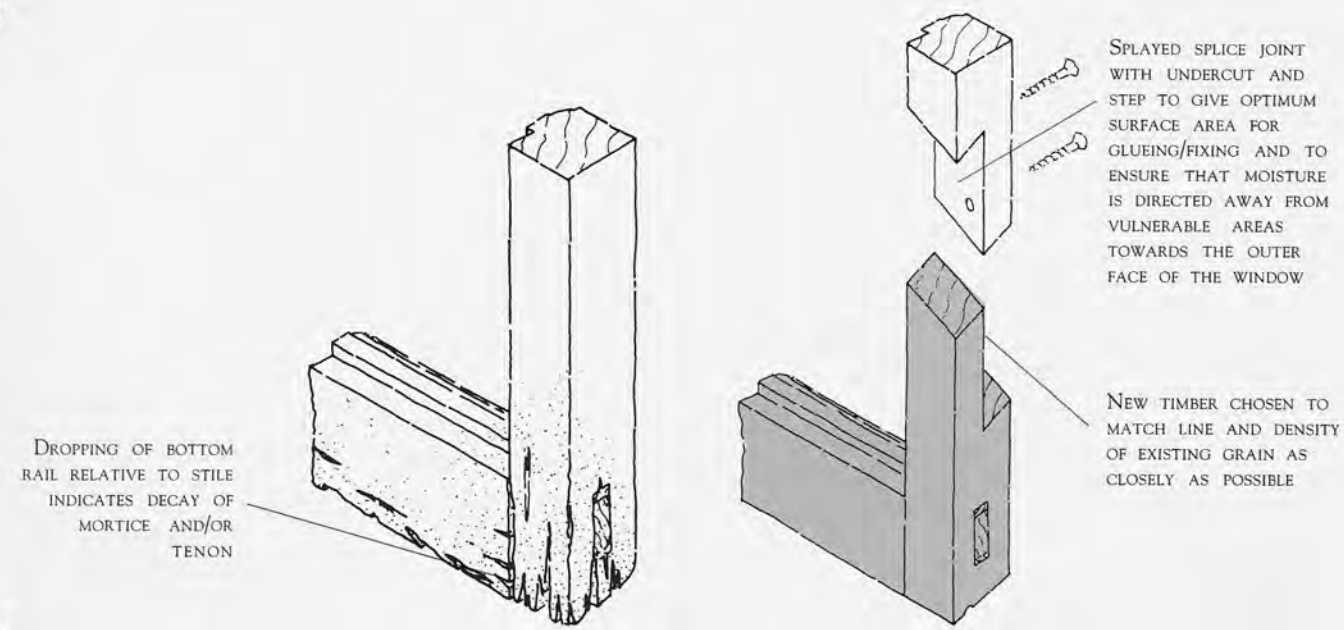


Base of sash stile (outer face)

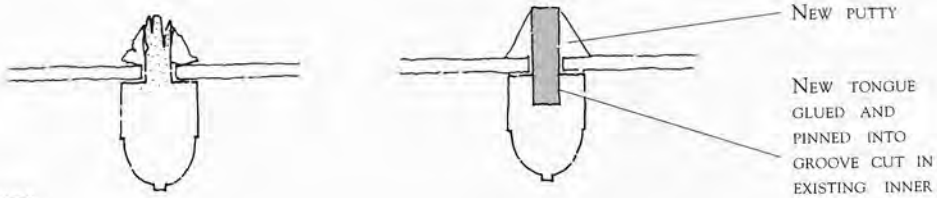


Bottom rail / base of sash stile

A similar repair method may be used where only the replacement of the base of the sash stile is necessary.



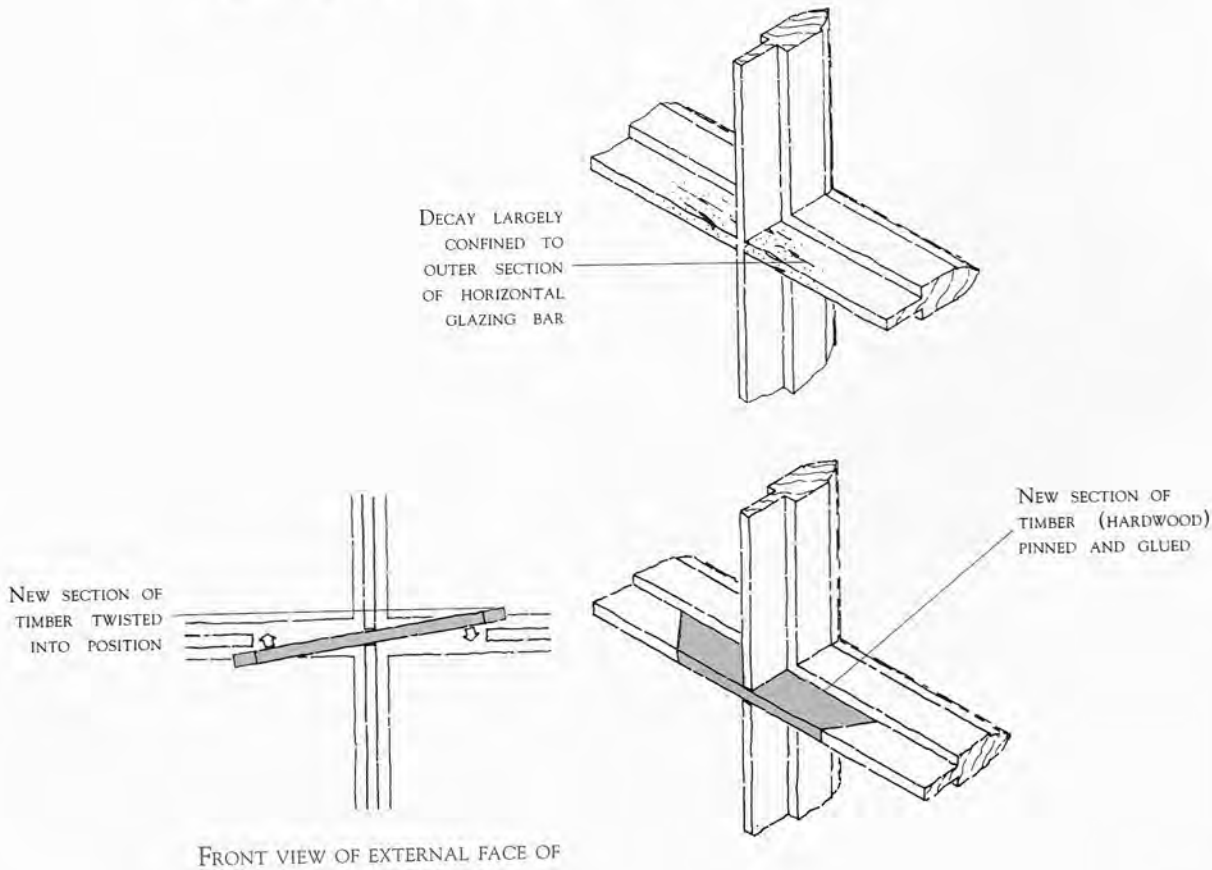
Tongue of glazing bar



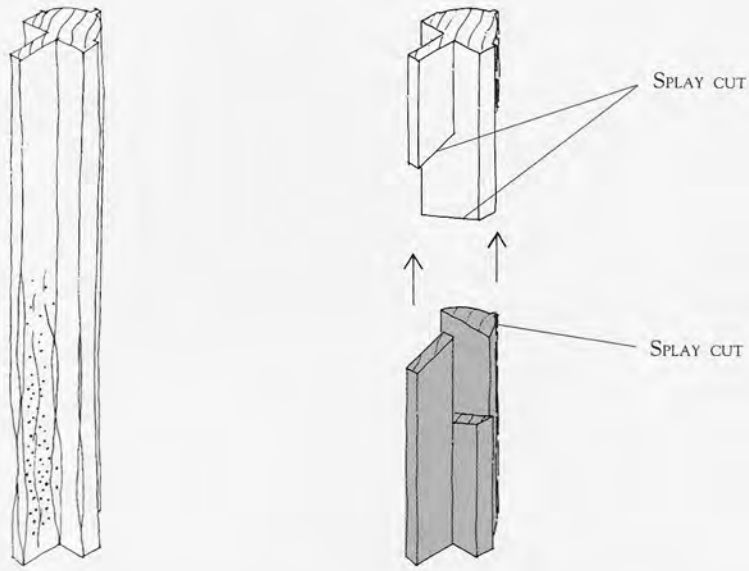
For replacement of short sections of glazing bar where only the outer tongue section is decayed. If care is taken, this repair can be carried out without dismantling the sash or removing the glass.

In most cases, hardwood (for strength and durability) should be used for the new tongue even where the existing glazing bar is softwood.

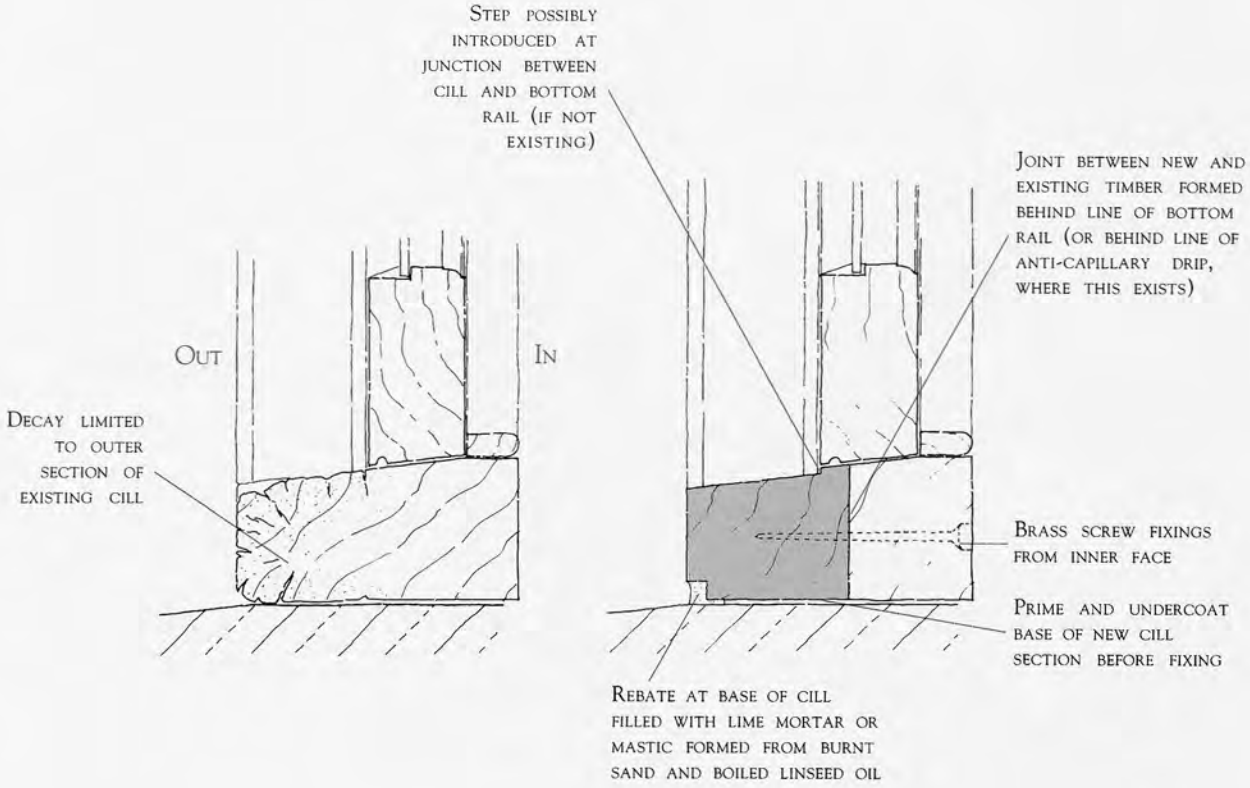
Tongue of glazing bar at junction of bars



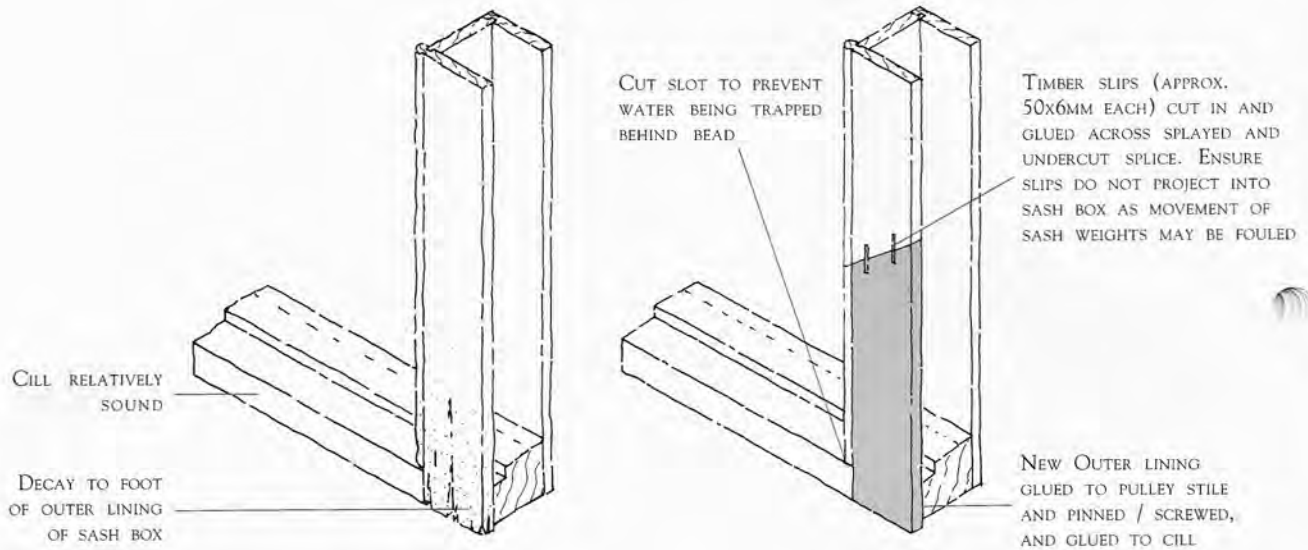
Glazing bar



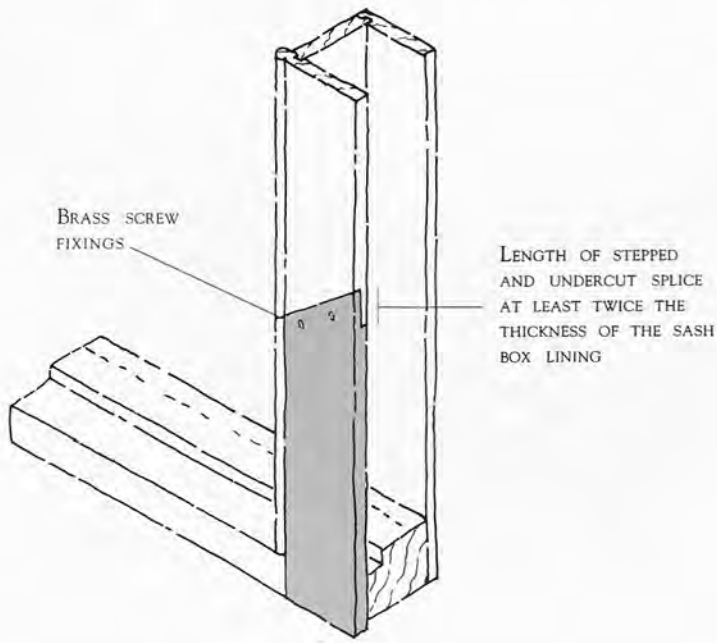
In situ repair of cill to sash window



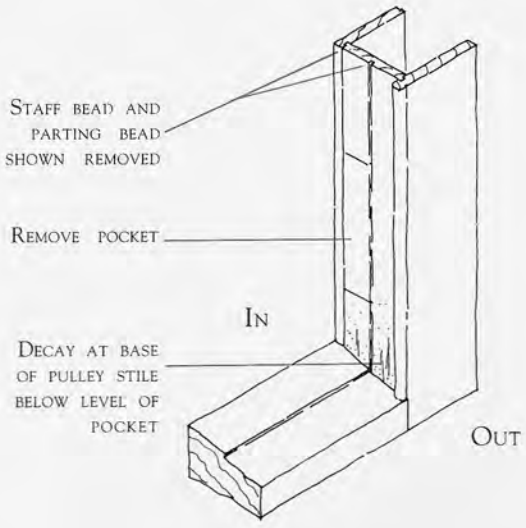
Outer lining of sash box

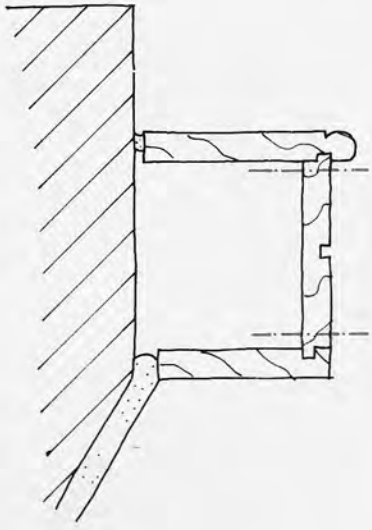


This type of repair can be carried out in-situ where the sash box is not situated behind a reveal. An alternative repair is shown below.



Base of pulley stile

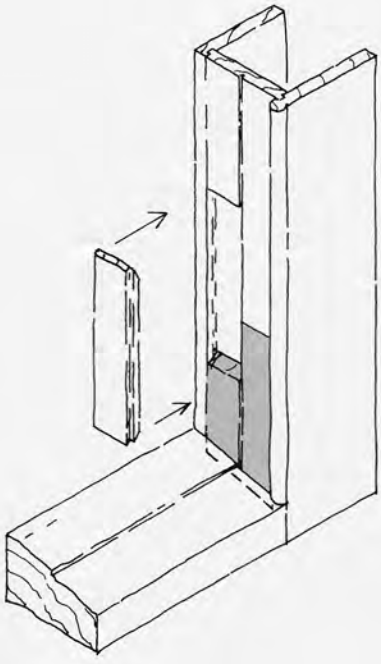




DECAYED AREA OF PULLEY STILE REMOVED BY CUTTING SAW LINES AS SHOWN

WHERE PULLEY STILE IS NOT HOUSED IN, A HACKSAW BLADE SHOULD BE USED TO CUT THROUGH NAIL FIXINGS BETWEEN LININGS AND PULLEY STILE

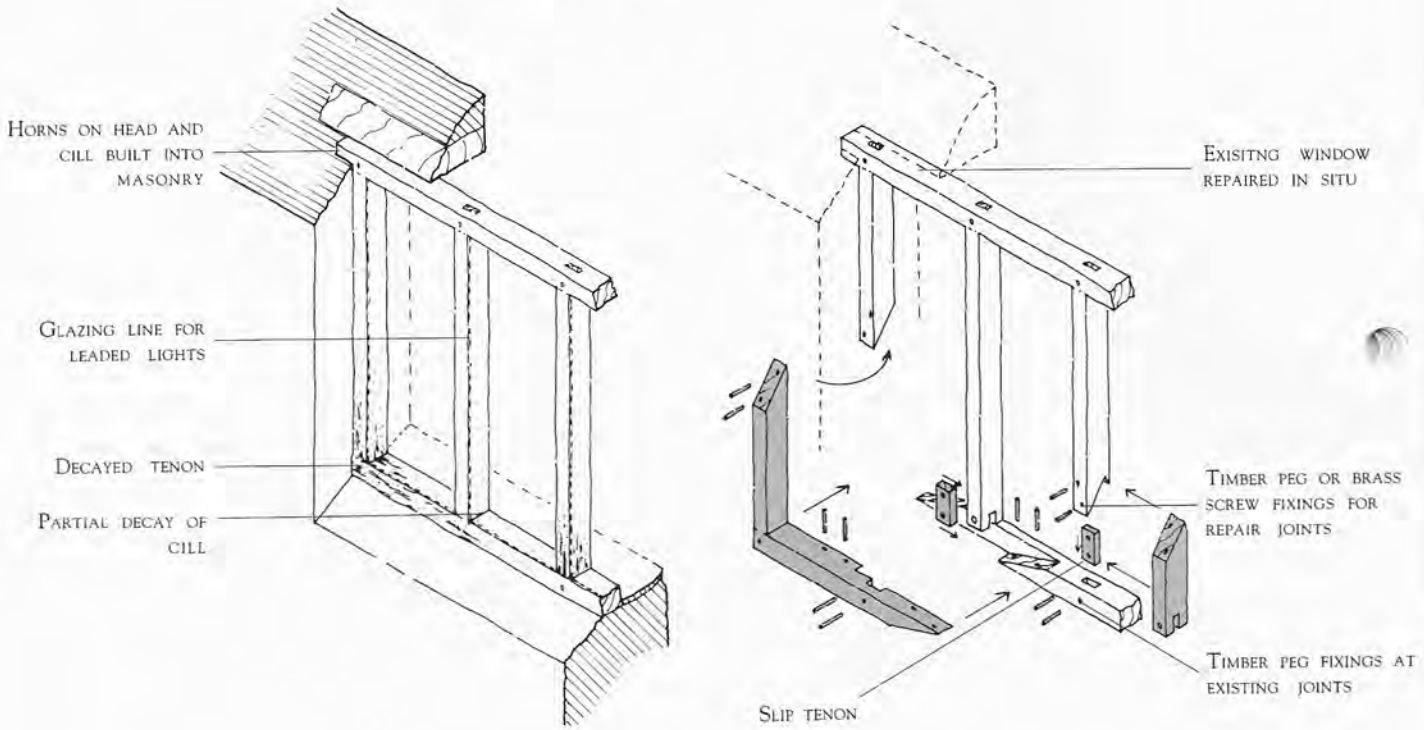
PLAN OF SASH BOX



RE-FIX POCKET

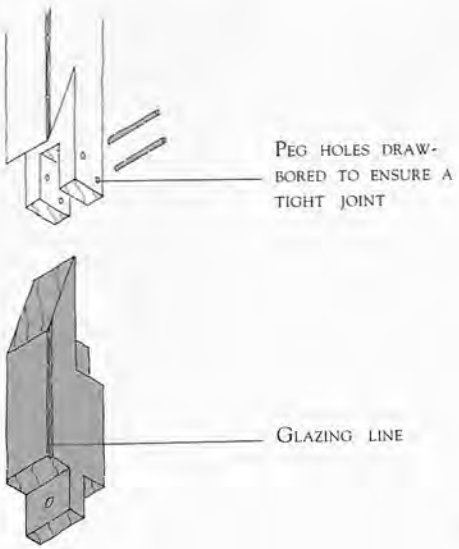
NEW SECTION OF PULLEY STILE GLUED AND RE-WEDGED TO REBATE IN CILL. OUTER AND INNER LININGS SCREWED OR PINNED (NON-FERROUS) TO PULLEY STILE

Mullion window - general repairs



Mullion window - alternative repair to base of jamb or mullion

This type of repair 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 for the splice illustrated above.



Sash and casement mouldings

When replacing a moulded section of timber from an old window, it is very unlikely that a matching moulding size and shape is available from a timber merchant today. 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 round then an accurate moulding section can be obtained using a template former.

Where only small quantities of moulded sections 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 (mouldings 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.

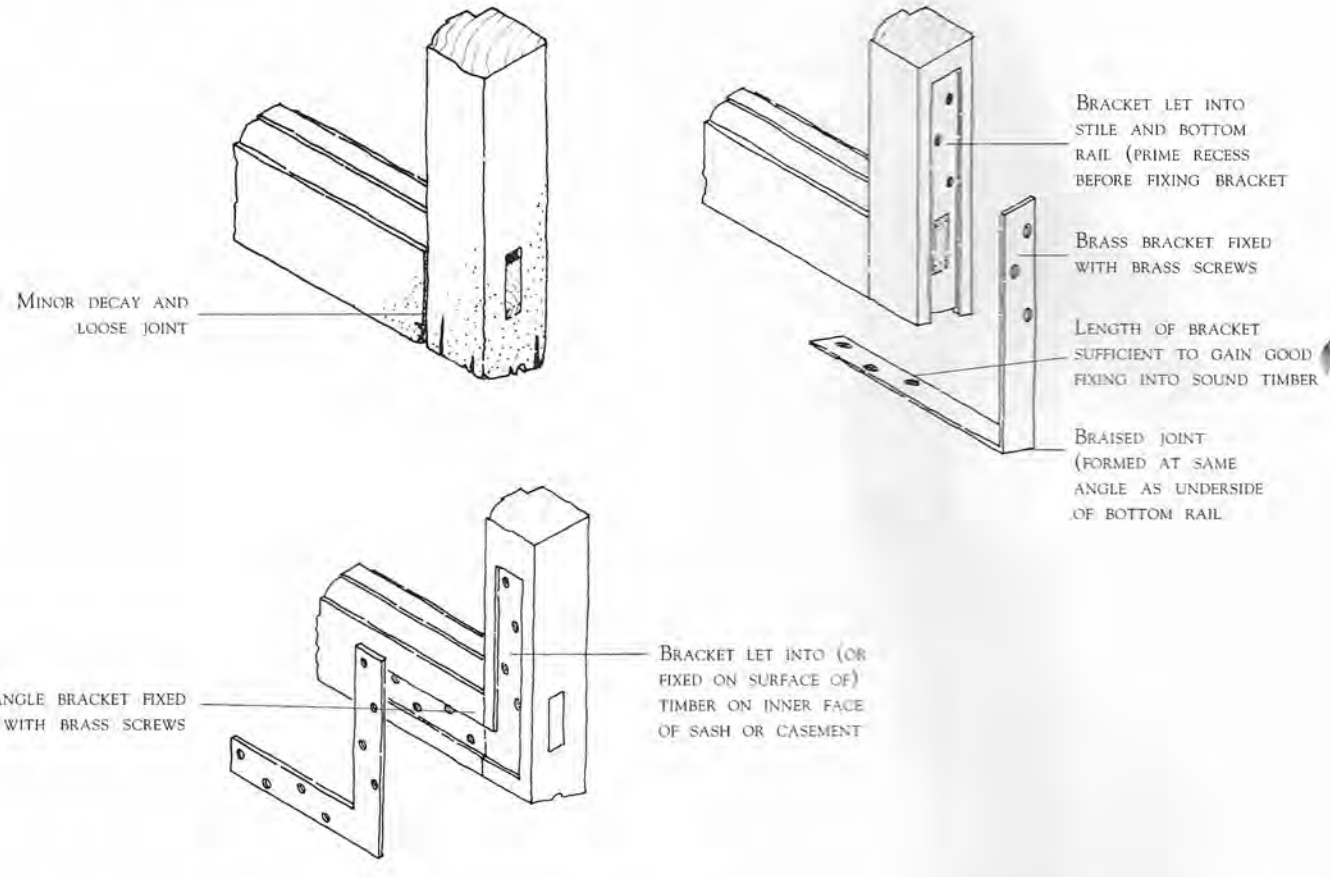
Loose joints

Casements or sashes are often in sound condition but the joints have become loose due to the break down of glue and loose wedges. The wedges will often be easily removable and will probably be unsuitable for re-use. 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 re-glueing only will be inadequate, re-inforcement of the timber at the joint can be achieved with a non-ferrous bracket (overleaf).

Loose joints



Small areas of decay

If localized 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 with a timber preservative that permits over-painting. Once the preservative has dried out, the decayed area should be primed and built up with a filler. 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. [7] Of the modern filler types, two-pack systems (e.g. epoxy resin or polyurethane type) are generally more durable than ready-to-use fillers.

The inherent irregularities in hand-made Crown and Cylinder glass found in windows of 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 of 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 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 or soldering iron can be used to soften the putty. Other methods of softening include the application of household bleach or a mixture of potassium carbonate and quick lime 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.

Replacement glass

Replacement glass should be carefully chosen to simulate the effect of the original glass but avoid material which is too reamy 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. Horticultural-grade glass can be suitable and some ordinary-grade glass manufactured in Eastern Europe has the correct qualities, although the supply and fluctuation in quality are erratic.

Original glass, taken from a window which is decayed beyond repair, should always be kept for re-use in repair work elsewhere within the same building.

Putty

Re-glazing in timber sashes/casements should be carried out in linseed oil putty. 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.

All preservatives have a limited effective life-span. They are not a long term solution to bad detailing, nor are they an alternative to regular maintenance. 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.

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.[8] 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 the affected area with an absorbent material (e.g. 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.

Windows are painted both for aesthetic reasons and to give the timber a protective coating. 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 off (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 toxic fumes. For the same reason, only wet abrasive paper should be used when rubbing down old paintwork.

Avoid stripping

Under no circumstances should windows (or any other joinery) be stripped by immersion in caustic soda or other 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 priming 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 (e.g. 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 (e.g. the junction of the sash window pulley stile/sash stile, which should be waxed to ensure an easy sliding action).

Choice of paint

Choice of paint is critical to the protection of the window 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.[9]

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 re-painting 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.

1 *Chapter XV,* **The Development of English Building Construction**, *by C.F. Innocent. CVP 1916.*

2 *Ibid.*

3 *P 35,* **Recognizing Wood Rot and Insect Damage in Buildings**, *Bravery, etc. BRE Report 98, 1987.*

4 *Ibid, p 16.*

5 *Ibid, pp 59 & 60.*

6 *A draught-proofing system can be obtained from Ventrolla Ltd, 51 Tower Street, Harrogate HGl lHS.*

7 *P. 136,* **Painting & Decorating**, *Home Mechanic Series. C. Arthur Pearson Ltd. London l947.*

8 *For more information on preservative treatment see BRE Digest 304,* **Preventing Decay in External Joinery**.

9 **The Environmental Protection (Controls on Injurious Substances) Regulations 1992** - *SI, 1992 Number 31.*

WARNING NOTE:
The use of pesticides

This pamphlet refers to the use of pesticides. The reader is strongly advised to read **Remedial Timber Treatment in Buildings: A Guide to Good Practice and the Safe Use of Wood Preservatives**, *before specifying and using pesticides.*

It is published by the HMSO for the Health and Safety Executive (ISBN O 11 885987) 1991.

Further reading

The Care and Conservation of Georgian Houses - a Maintenance Manual, *Davey etc. Architectural Press, London and Edinburgh New Town Conservation Committee, 1979.*

The Repair of Historic Buildings - Advice on Principles and Methods, *Christopher Brereton. English Heritage, 1991.*

A Short History of the Building Crafts, *M.S. Briggs. Oxford, 1925.*

The Georgian Group Guide No. 1: Windows, *Georgian Group, London.*

Sash Windows - Listed Building Guidance Leaflet. *English Heritage, London Division.*

Wood Windows: Arresting Decay. *Defect Action Sheets No. 13 & 14 BRE, 1983.*

Painting Woodwork, *BRE Digest 261. May 1982.*

Sash Windows, *Curtis & Fidler. Articles in Traditional Homes, October and November 1984.*

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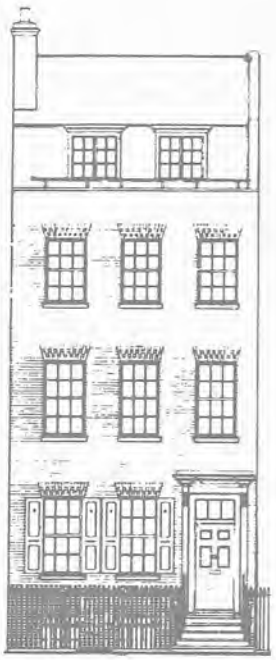

The Society for the Protection of Ancient Buildings was founded by William Morris in 1877 to oppose the destructive restoration of old buildings. Today the SPAB occupies a leading role in advising on all aspects of repair and maintenance of old buildings, large and small.

Please write or telephone for further details of the Society and membership.

S·P·A·B

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