

## Foreword

This series of booklets has been produced by the Department of the Environment to increase awareness of the value of our architectural heritage and to provide information on the basic principles and methods of conservation and restoration. The titles in the series are listed on the back of each booklet.

These texts are not intended to be comprehensive technical or legal guides. The main aim is to assist architects, builders, owners and others, in understanding the guiding principles of conservation and restoration. They will facilitate the identification of the most common problems encountered in heritage buildings, and indicate the best solutions. It should be appreciated that specialised aspects of conservation and restoration will require professional expertise and more detailed information.

The Department acknowledges, with appreciation, the efforts of the authors of the individual booklets, the Irish Georgian Society who coordinated their production, the Conservation Advisory Panel established under the Operational Programme for Local Urban and Rural Development and all others involved.

## Summary of Conservation

### Principles

- Research prior to planning work
- Minimum intervention - repair rather than replace
- Respect the setting.

## Summary of Conservation

### Procedure

- Research and analyse history of building
- Survey building and identify original material
- Plan work according to conservation principles
- Use experts where necessary
- Record all work
- Install maintenance procedures.

## Introduction

The roof of any building is in many ways its most important part as it has so many vital functions - to be watertight and windtight, to provide some heat insulation and to be condensation proof. The roof is the most exposed part of any building to the weather and if it fails in any way, allowing the rain and wind, ever present in Ireland, to enter, then everything beneath the roof and inside the structure is severely threatened.

Many historic buildings have roofs of great elaboration and complexity, with ornamental chimney stacks, towers, pinnacles, gables and parapets. There may be balustrades decorated with urns or sculptures, and decorative rain water spouts, hopper heads, gutters and downpipes. These all form part of the original design and outline/silhouette and their removal will result in very serious loss of interest and character. Removal of such items would not be acceptable in the context of a listed building. Any changes or removals would have to be agreed with the planning authority. When such features are so decayed that they are either dangerous or missing altogether they should be replaced with proper accurate copies.

## Brief History

The provision of adequate shelter from the weather has always been a basic need. From the very earliest days of civilisation, the protection of man, his possessions and his animals from rain, wind and cold has been vital, and this has been particularly important in the damp, temperate climate of Europe. The very earliest roofs were made of simple timbers, or even branches, covered with grasses or other vegetation.

Most ancient Greek, Roman, Saxon and medieval buildings had roof coverings of either simple clay tiles or thatch, and only the roofs of the most important structures would be covered with lead or stone slates.

Until the arrival of canals in the late 18th century, and the railways during the mid 19th century, the cost of moving building and roofing materials was very high so only materials easily available in any locality would be used. The reduction of transport costs over the last two centuries, combined with the vast increase of mechanisation and huge rise in the cost of labour, has resulted in the widespread replacement of many traditional types of roofing materials with a limited range of mundane and often mass-produced materials. Anyone who is responsible for any old building, either as owner, builder, architect, engineer or other, should discover the type of roof materials originally used on the building;



*Complex roof requiring repair and maintenance.*

if in any doubt about what to do, specialist advice can readily be obtained.

### Roof Structure

Almost all old buildings have triangulated pitched timber roofs which have a wide safety margin because of the large timber sizes used. Generally, the older roofs have steeper pitches with large adzed timbers and no ridge boards, whereas roofs of the late 18th century and 19th century are shallower, with sawn timbers and ridge boards. The roofs of Georgian and later terrace houses were often designed so that the roof itself

remained hidden from view at street level, the upper cornice, parapet or balustrade 'finishing off' the buildings.

### **Common problems**

#### **1. Central valley**

Many of these houses had double, or 'M' roofs parallel to the street front, to span the long depth of the house. The central valley gutters of these roofs are difficult to drain, and are all too easily choked with rubbish, leaves and even dead birds, resulting in rain water penetrating into the roof structure and the rooms below, with serious and expensive

consequences. It is possible to cover these by adding flat roofs spanning across from the outer ridges, but this should only be done where it is not visible and with any necessary approval of the relevant authorities.

### 2. Woodworm/Dry rot

It is rare for insect or woodworm attack to be so severe in roof timbers that the structure is weakened in any way, so (expensive) spraying against this is thus usually unnecessary; it should only be done on the independent advice of an experienced conservation architect. The subject of dry rot in timber is covered in booklet *No. 11 Rising Damp & Timber Decay*.

### 3. Distortion

Distortion and possible collapse of a roof structure is usually caused only by movement of the wall structure below, or as the result of decay of timber bearing members, following water penetration. It is obviously wise to consult a conservation architect or engineer to ensure that the repairs are properly designed (so that no distortion of the splice or overstressing of the fixings occur), that proper temporary support is given to the structure while repairs are carried out, that all timber used in the repairs is properly specified, selected and treated, and that a minimum of existing fabric is removed and replaced by new.

Timber roof structures and all the different types of roof coverings are designed, and must be allowed to move following changes in climatic conditions and temperatures; any new techniques that prevent this, such as polyester reinforcement bars and epoxy resin mortar grout which fix the triangular structure rigidly, are not generally recommended.

### 4. Attic area

Pitched roofs provide useful space for water tanks and water pipes, as well as attic storage, but these uses can cause problems, such as internal leaks and a build-up of rubbish (a fire hazard) and vermin, and so should be regularly checked.

### 5. Flat roofs

Historic buildings often have elements with flat timber roofs, such as porches, and the areas in the centre of a pitched roof that have a central roof lantern, over a staircase or upper internal lobby, for instance, and these can suffer from all the same problems of pitched roofs, with the additional one of a lack of ventilation and the resulting condensation. This in itself is a frequent cause of timber decay in roof joists and other timbers, but it can be difficult to adequately ventilate an existing flat roof if the ceiling finish is applied directly to the underside of the joists, thus preventing cross ventilation.

## Chimneys

The chimney stacks of any old building, particularly Georgian and Victorian Gothic ones, are a very important element of the skyline, as well as of the building itself, and are of course an integral part of its original design. Mainly for removing smoke and gases from open fires, they also perform the important secondary function of permanently ventilating the building fabric and the rooms. They can often serve an important structural function, anchoring the walls and internal divisions. For all of these reasons, original chimneys should never be removed unless absolutely necessary, and never for merely external visual considerations.

Original chimney pots, especially on Victorian buildings should be carefully retained and repaired; also those on Georgian buildings that are of classical design. Several manufacturers are now making satisfactory replicas of these, which are easy to obtain. Chimneys that have to be rebuilt should exactly match the originals in colour, style and materials. This is important when the chimney is of ornamental brickwork, which is often found on Victorian buildings throughout the country.

### **Common Problems and Solutions**

**1. Damaged flashing, mortar or brickwork**  
Chimneys, the most exposed part of any building, are very susceptible to damage by

wind, rain and frost, and should be carefully inspected every year. Any damage, particularly which might result in water ingress, should be properly repaired by experts to avoid damage occurring below the chimney itself.

### **2. Blocked flues**

The blocking up of an original chimney, however tempting it may be, should be avoided because this can have serious physical consequences for the interior of the building. A blocked chimney means that essential ventilation is removed, which, for the good of the fabric and the occupants, must be replaced. In the past a flue would, generally, have been warm enough to evaporate immediately all rain that entered it, but in modern times a disused, open flue, is a source of water penetration.

If a flue is closed off, the acidic condensation that will subsequently form in it, because of lack of ventilation, will attack the chimney walls and also seep through the internal plaster in its efforts to evaporate, leaving large brown stains on the chimney breast. As there is little alternative to removing all the affected plaster, and probably rebuilding the chimney breast with clean material, it is better to avoid this by ensuring that any disused flue is adequately ventilated at both top and bottom with ventilator grilles, as well as closing the top of the stack with, for instance, a horizontal length of half round

ridge tile. This will prevent the downward access of rain, but still allow the vital cross ventilation at the top that will keep the air in the flue moving.

### 3. Poor construction

Chimneys added subsequently, for instance, when large rooms have been subdivided, were often added crudely and in a structurally unstable way, as well as compromising, and possibly damaging, the interiors. It may well be best for the building if these interventions are removed as part of the conservation works. In order to be able to distinguish between the original and the added stacks, the history and architectural development of the building should be properly investigated and analysed first.

### Parapets

Many older buildings have parapet walls at roof level which are very exposed to the weather and are often difficult to inspect.

#### **Common Problems and Solutions**

##### 1. Damaged and unstable parapets

Due to exposure and their relative thinness, parapet walls can become very badly decayed and possibly insecure. They should never be removed just to get rid of the problems as this will totally change the appearance of the building. They should be made stable and waterproof, and this work, which may involve rebuilding, should be

carried out by competent personnel. Any new brick or stone used should be matched to the existing work, and original coping stones and other details retained.

##### 2. Render on inside face

Problems can be caused when the inside face of a parapet is plastered unnecessarily, preventing evaporation of moisture. Such plaster, particularly if over dense, should be removed, as moisture in the parapet can then evaporate far more easily.

##### 3. Balustrades

Balustrades are important features of old buildings of high quality, but they can have complicated problems which are quite difficult to repair properly. Expert advice should be sought as to how to stabilise and maintain balustrades and their decorative features, which can include urns, carvings etc..

## ROOF COVERINGS

### Slate

Natural slate has been used as a roofing material since the mid-18th century, and most buildings of consequence in Ireland are covered with slates or sheet metal. Where they have been used to replace thatch and other humbler materials on cottages and farm buildings, slates have become the traditional material although not the original one.

### **Common Problems and Solutions**

#### **1. Slipped or damaged slates**

Slates tend to delaminate in polluted atmospheres, and this delamination is also caused by frost action on poor quality slates. If water is retained between slates, the slate around the nail holes disintegrates and enlarges the holes; if the nails are iron, they rust and disintegrate and thus the slates are no longer adequately fixed; the roof is then 'nail-sick'.

If slates are single head nailed, they can be replaced by carefully swinging the surrounding ones aside and inserting the new slates. This can not be done when the slates are double-nailed, either at the head or the centre, and the replacement slates have to be individually supported by a strip of copper or zinc, that is nailed between the slates below and has the end turned up to take the weight of the slate. This is not a satisfactory repair in the long term and if more than a quarter of the slates have been refixed then it is probably better to strip and recover the whole roof.

Nails of cut copper, aluminium alloy and stainless steel are all suitable and it is important that they have large heads - the specification of slates and nails should comply with the relevant Standards. Galvanised nails are widely used by many, but are not generally recommended.

#### **2. Reslating the roof**

It is, of course, best to follow the original coursing of the slates which may be either in uniform courses, or in diminishing courses so that the large heavy slates are nearer the outer walls and the smaller lighter slates are near to the fragile roof apex. This is a very attractive arrangement and should be followed when the roof is re-covered: slates that are cracked or broken but otherwise sound could be re-dressed to smaller sizes for such roofs rather than being thrown away. Any colour patterns in the slating (a 19th century feature occasionally found) should also be repeated. Second hand slates can obviously be used to repair a slate roof if they are sound, but they must be professionally examined. If they are not an exact match to the existing ones, they should be positioned where they are not easily visible. Great care should be shown when moving them and stacking them before use as they can be broken easily. Slates should always be laid on new treated timber battens, but the 'intervention' of roofing felt can cause problems so it is not always recommended.

Imported natural slates are becoming increasingly common and, while they are infinitely preferable to the very short-lived artificial slates which are characterless and lose their colour, they may well weather in a different manner and have a significantly shorter life span than the traditional slates.

Galvanised iron, roofing felt, asbestos cement sheets or slates, or artificial slates are inappropriate for the repair or replacement of natural slates.



*Inappropriate artificial slates and obtrusive rooflights in historic building.*

### 3. Sealing slates

There are a number of modern proprietary methods that claim to seal faulty slates, some from the outside and others from the inside, but these are rarely effective. Also, these treatments cannot be repeated, so when they fail, the slates have to be completely stripped and replaced. Such treatments for historic buildings should be avoided.

### 4. Slate hung walls

External walls that are hung with slates or clay tiles should be carefully repaired and preserved, not only for their insulating properties, but as part of the historic fabric. Often the slates are of decorative shapes, and some may carry dates. Slipped or damaged slates or tiles should be carefully refixed, or replaced, as outlined above.



*Slate-hung walls in need of repair.*

### 5. Mortar-bedded slates

Slates were sometimes used to cap and protect parts of parapet walls, chimney shoulders and other exposed surfaces at roof level. These slates were usually bedded in mortar. Lime-rich mortar should be used if such slates have to be replaced or rebedded.

Stone slates, that is, thin slabs of sandstone or limestone simply dressed to approximately rectangular shapes, are very rare indeed in Ireland and should be preserved.

### Tiles

Handmade clay tiles, although always commonly used throughout Europe, were rarely used in Ireland until recently, because of the lack of indigenous suitable clays and the high cost of importing them. They can be up to 12 times the weight of slates. Until the mid 19th century, these clay tiles - plain, flat, cambered, pantiles, single and double Roman, for instance - were handmade in small local workshops. They were fixed to the wooden roof battens either with wooden pegs or iron nails, or by nibs formed out of the clay as part of the tile itself. Such tiles have a very special character and patina.

Machine made tiles, mass produced since Victorian times, have regular crisp edges, are inexpensive and readily available but, due to the manufacturing process, are often prone to delaminating by the action of frost. These and coloured concrete tiles, are now widely used on modern domestic buildings in Ireland but their use in historic buildings would be visually incorrect and pose technical difficulties.

Decorative ridge cresting in iron or red terracotta was used extensively on Victorian

buildings, and is part of their historic character and should be repaired and preserved.

### Lead and Copper

Lead has always been the best metal material for flat roofs and gutters, closely followed by copper. They are also best for flashings at the junctions of roofs and walls, cover flashings for projecting cornices, and for roof ridges and ends.

#### **Common Problems and Solutions**

##### **1. Failure of roof covering or flashings**

The failure of these elements usually stems from simple problems - the incorrect fixing of the original sheets which were often too large, exacerbated by the contraction and expansion of the metal as the result of variations in temperature between day and night, and between summer and winter. If lead is cracked as a result of the use of oversized sheets or inadequate allowance for movement, "mending" the crack will not solve the problem and another will soon appear nearby; the only solution is to redetail the leadwork to correct the design fault. If lead is correctly detailed and specified, in accordance with the standards laid down by the relevant authority, then it should last for a very long period indeed - several hundred years in many cases - and is only vulnerable to human damage and maltreatment.



*Plant growth and damage, indicating presence of water, due to lack of flashing between roof and wall.*

## 2. Damaged lead and copper

Lead is easily damaged by feet (heavy hob-nailed boots can puncture lead, as can walking on loose nails lying on the lead), and falling slates and other heavy items have the same effect. Any lead sheeting that is likely to be walked on should be protected with hard-wood duck boarding (fixed with screws, rather than nails) and regularly swept clean. Different thicknesses of lead are required for the various features, and the choice of these, and their proper detailing, are all matters for experienced specialists only. The repair and/or replacement of lead work is expensive but it is important, for the protection of the building, and to avoid major expenditure later, that all defects are corrected immediately and properly. No work should be done on a D.I.Y. basis, or by an inexperienced or unreliable contractor.

Whatever is done, bitumen and other sealants should never be used to try to solve the problem; they are difficult to remove subsequently. Nor should cracks be repaired with solder, which is commonly attempted, as it has a different coefficient of expansion to the lead and will result in further cracking, and thus water entry. Lead, in certain cases only, can be patched by burning in new sections but if done incorrectly will result in a new defect in a short time.

Similarly, the repair of any other sheet metals, such as copper or zinc, is essentially work for the expert.

## Thatch

Thatch was the most common roof covering until the 16th and 17th centuries and it remained the usual roofing material in rural areas until the end of the last century. Thatching has enjoyed a revival in recent years and, in the design or repair of thatched roofs, regional differences should always be maintained. For instance, there are many different types of thatch - wheat straw, water reed, wheat reed, sedge, heather, flax and rye - used in different areas where they were found readily at hand, and there are also differences in the regional treatment of ridges, eaves and gables.

The replacement of one type of thatch with another may require stripping back to the



*Newly thatched cottage.*

roof structure, destroying early and original fabric, as well as altering the appearance and character of the building. The layers of a thatched roof may have remained intact and undisturbed for several centuries, new layers having merely been added on top if the structure and fixings were always adequate. Proposed extensions to thatched buildings, and the addition of extra roof features, such as windows and chimneys, can be problematic, and these and all repairs are a matter for an experienced thatcher whose advice should be sought at the beginning of any works.

### Dormer Windows, Rooflights, Mansard Roofs

Dormer windows, mansard roofs, glazed cupolas and roof lights have been widely used on many types of buildings for centuries, particularly Georgian and Victorian houses of every size and, when part of the original design, are a very important part of the building. Their replacement with simpler forms, or removal, should not be contemplated. Although access is often extremely difficult, it is especially important that these features are regularly inspected and repaired as they are very exposed and vulnerable to wind, rain and frost.

## Conservation Guidelines

### Roofs & Rainwater Goods

They should always be repaired using the correct and appropriate materials, details etc.

The addition of new dormers or mansards, as a way of increasing the accommodation in/of a building (particularly terraced houses) is widespread and can cause irreparable damage both physically, historically and visually. This should only be done with extreme care, and with all the appropriate approvals, and must be to the advice of the conservation specialist; any new items must reflect the style of the building as a whole, and mirror the size, disposition and spacing of the windows of the building.

The use of modern sloping roof lights should be kept to rear or hidden roofs wherever possible, where their visual effects are minimised. Roof access hatches and skylights should also be restricted to inner or hidden slopes, be maintained regularly, and designed so that no damage is caused to the roof coverings by their use.

It is often better if dormers and mansard windows are not painted white, but instead are painted grey, especially when the roof itself is covered with slates.

#### Rainwater Goods

Gutters collect rainwater from the roof, directing it to points where it is discharged, often by hopper heads, into rainwater down

pipes and hence into the drainage system at ground level. It is vital that these, known collectively as rainwater goods, are kept free of leaks and clear of obstruction; failure to do this will inevitably soon lead to water penetration and thus structural and internal damage, dry rot, and other major problems.

#### Common Problems

##### 1. Plant growth

A very common sight is grass and other plants freely growing in gutters, and buddleia and other bushes growing rampantly out of hopper heads and holes in walls. All these are potentially highly dangerous to the building because, as every plant needs moisture to grow, this is the clearest sign that water is already present in an unacceptably large amount. All plant growth should be removed as soon as possible and, most importantly, the hole, leak or crack properly filled; if this is not done, the water will continue to be present and new plants will continue to grow.

##### 2. Leaks

A careful check should be made of the rainflow, to see that it is flowing safely into and along gutters, and down the pipes. If it is discovered that any water is flowing into and through a roof, it must be carefully followed. Water falls by gravity and will flow to the lowest point before appearing inside, and this can be a considerable way from the leak

itself. All valley gutters,parapet gutters,eaves gutters and hopper heads must be cleaned out regularly, and always checked after the autumn leaves have fallen. Visible leaks in pipes can be seen during heavy rain, but hidden leaks,especially those in valley and parapet gutters,cannot. However,huge amounts of water can quickly enter the timber substructure through them and cause serious problems.

### 3. Old drainpipes and gutters

Most old buildings have cast-iron gutters and downpipes,and failed sections should always be replaced with new sections of the same material and shape. Some specialist companies are beginning to make new cast iron gutters,hopper heads and downpipes of various sizes and types in response to increasing demand. A few very important buildings have lead rainwater goods and as these are particularly important, any decisions about their repair must be made by conservation specialists. It should be the aim to preserve original rainwater goods,if practicable and possible, particularly any decorative features.



Lead pipe with decorative fixing.

When blocked and full of water in the winter, cast iron downpipes can be susceptible to vertical cracking as the water freezes;on thawing,this water will enter the building. To avoid this happening,it is strongly recommended that any pipe be as far out from the wall face, and internal corners,as possible, so that the rear of the pipe is not in contact with the wall. This will also facilitate the necessary repainting. Pipes should never be half-buried in external plaster, as leaks are then totally invisible.

Copper and cast aluminium rainwater goods have been used sometimes on old buildings and any replacements should be in the same materials. Modern plastic gutters and pipes, and extruded aluminium goods,are cheaper, but they are far more susceptible to impact damage, and have much shorter lives. Their use in old buildings is a false economy, and should be rigorously avoided.

### 4. Parapet and valley gutters

Parapet and valley gutters are in reality narrow widths of flat metal covered roofs and should always be treated as such - their repair is a matter for experienced specialists only. The timber boards underneath can become decayed and uneven,and this will seriously damage the metal surfaces. It is absolutely vital that these allow water to flow away easily and without leaks. Repairs or replacements can be expensive, so it is

## Conservation Guidelines

### Roofs & Rainwater Goods

foolish not to do this work properly. Repairs with cheap or unsuitable materials are only short-term at the very best, and are usually ineffective, and can be an absolute waste of money.

#### Maintenance

Roofs, roof coverings and all that are associated with them, such as chimneys, parapets, valleys, gutters, dormer windows and other rooflights, are usually awkward, and therefore expensive, to regularly inspect, with the result that they are often ignored - out of sight, out of mind - until a major disaster occurs. Maintenance is of vital importance, both for the well-being and survival of the building and to avoid major expensive repairs.

Roof structures and coverings should be inspected both internally and externally at least once a year, preferably in the winter, so that all fallen leaves and other vegetation can be removed before causing problems. Any holes and gaps will be immediately shown up by rain entering, and can be dealt with before major problems occur. This annual inspection of structure and coverings should be done by an experienced and reliable architect, surveyor or roofing contractor; if the roof is part of a terrace for instance, it may well be sensible to have all the roofs inspected on a shared basis thus reducing individual costs. It is recommended that a full professional

survey be carried out every five years by an experienced and impartial architect or surveyor, who can advise, on a long-term basis, on the necessary future works.

#### Dos and Don'ts

- Do*
- promptly investigate any leaks, floodings and other sources of water entry.
  - repair promptly any slates, tiles, gutters, pipes, flashings, etc., that have moved in any way.
  - inspect all gutters, hopper heads, parapets, dormer windows and chimneys every year.
  - keep all gutters, hopper heads, ventilator pipes and gulleys clear of leaves and other debris.
  - ensure that all repair work is carried out to the highest standard and to relevant requirements by experienced and sympathetic advisors and workmen.
- Don't*
- try to seal faulty roof slates
  - allow any plants to grow in gutters, hopper heads etc.
  - use cheap or artificial roofing materials on heritage buildings; real slates, clay tiles, lead, etc. are always the best.
  - remove original chimney stacks, decorative ridge crestings, dormer windows etc.

### Select Bibliography

Brockett, Peter and Wright, Adela. *The Care and Repair of Thatched Roofs* (Society for the Protection of Ancient Buildings Technical Pamphlet No. 10). London, 1989.

Davey, Heath et al. (eds.). *The Care and Conservation of Georgian Houses* (Architectural Press). Oxford, 1986.

English Heritage.

*Dormer Windows* (English Heritage Listed Building Guidance Leaflet). London, 1991.

*London Terrace Houses 1660-1860* (A Guide to Alterations and Extensions). London, 1996.

*Mansard Roofs* (English Heritage Listed Buildings Guidance Leaflet). London, 1989.

(The) Georgian Group. *Roofs* (The Georgian Group Guides, No. 10). London, 1991.

Lead Sheet Association.

*Lead Sheet Flashings*

(The Lead Sheet Manual, Vol.1). 1990.

*Lead Sheet Roofing*

(The Lead Sheet Manual, Vol.2). 1992.

*Lead Sheet Weatherings*

(The Lead Sheet Manual, Vol.3). 1993.

Williams, G.B.A.. *Chimneys in Old Buildings*

(Society for the Protection of Ancient Buildings Technical Pamphlet No. 3). London, 1976.