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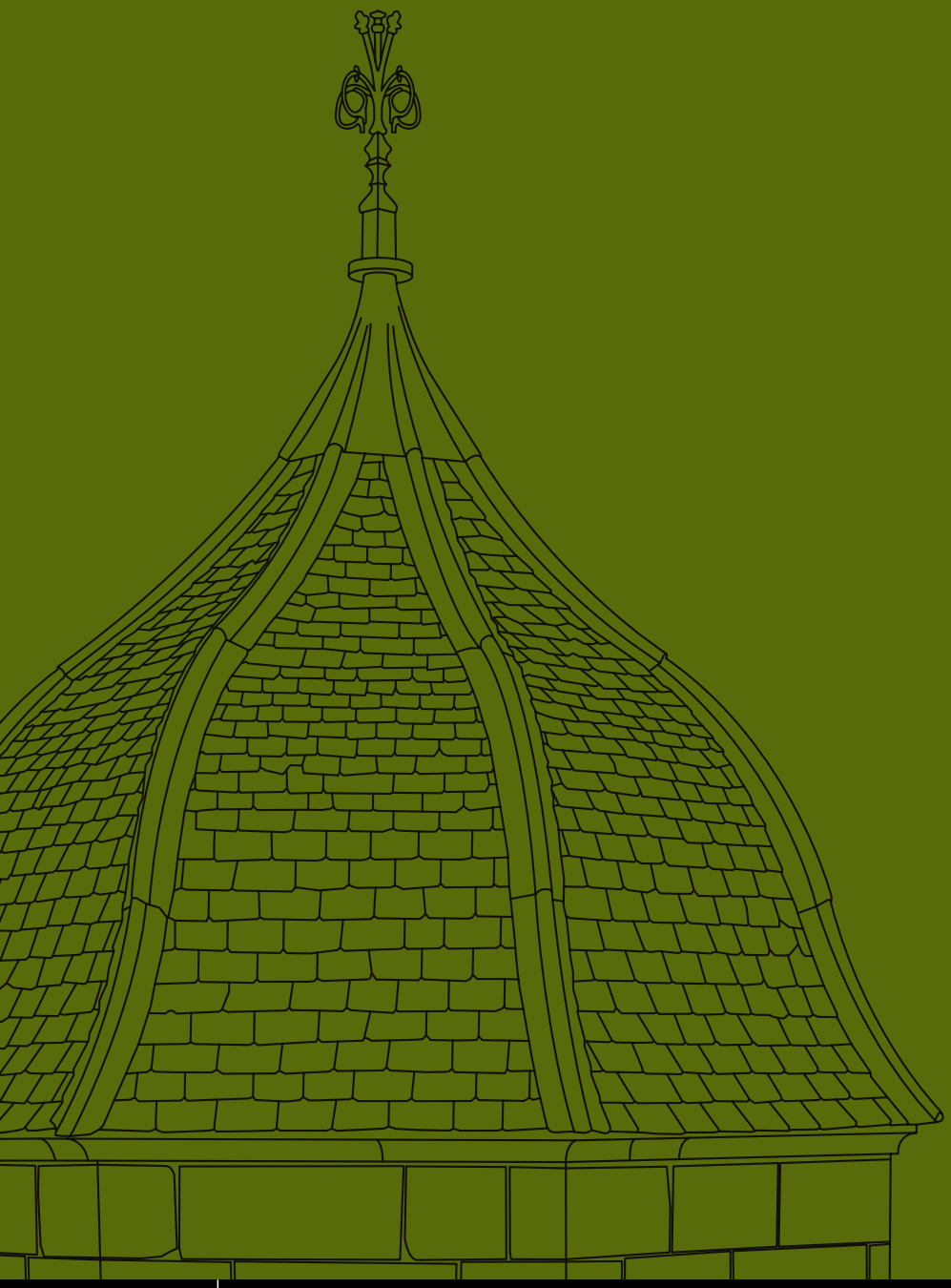
Short Guide

Lead Theft: Guidance on Protecting Traditional Buildings



Metals

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1. Introduction


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The theft of lead, and of other metals used for roofing, has become increasingly prevalent in recent years. Lead is a traditional material that is found commonly on the roofs of churches, houses, town halls and other public buildings, so the threat posed to the built heritage by lead theft is significant (Figs 1 to 4).

This short guide offers practical guidance on how to reduce the risk of lead theft and how to protect the lead on buildings. It also sets out Historic Scotland's policy on dealing with the loss of lead from a listed building, and the question of using alternative materials to replace lead.

Although metal theft can occur on many types of building, churches are particularly vulnerable; and although almost any metal is currently being targeted, lead is one of the most valuable and easily removed roof coverings, and is frequently stolen. Therefore this guidance refers primarily to lead theft, and has a particular focus on church buildings. However the content also applies to other building types and other types of sheet metal.


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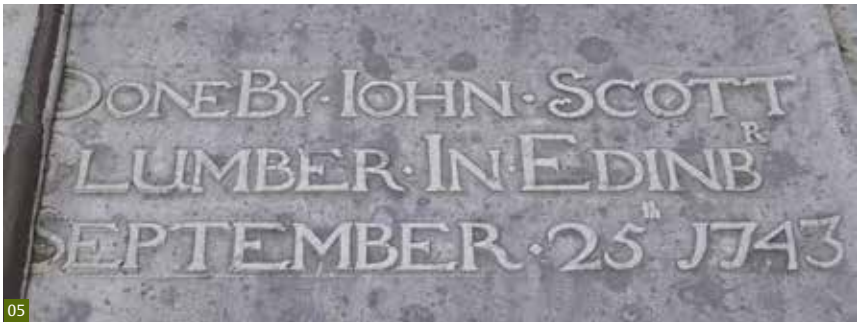
Figs 1 to 4: Lead is a common feature of historic buildings throughout Scotland, used for sheet roofing and other architectural elements.

2. Lead on roofs: a brief history

Lead is one of the oldest and most durable building materials known to man. Its use in Scotland has been documented as far back as the Roman occupation. Lead's longevity is due to its relative chemical inertness and corrosion resistance, together with its high flexibility. Other significant characteristics are its malleability and consequent ease of working, especially where 'dressing' on site is required. Lead sheet on roofs has been known to last for over two hundred years (Fig. 5). This is not matched by any comparable modern or synthetic product.

Sand cast lead is the oldest form of lead sheet available. It is formed by pouring lead along a bed of pressed sand. The lead solidifies as it cools and forms a uniform flat sheet which can then be cut, rolled up for easy transport and laid (Figs 6 to 8). The skill of the caster and the rate of pouring the molten lead determine the thickness of the lead sheet, which is assigned a 'code' according to its thickness. Sand cast lead is an expensive and beautiful product, and is normally reserved nowadays for the most prestigious buildings, and for conservation work.



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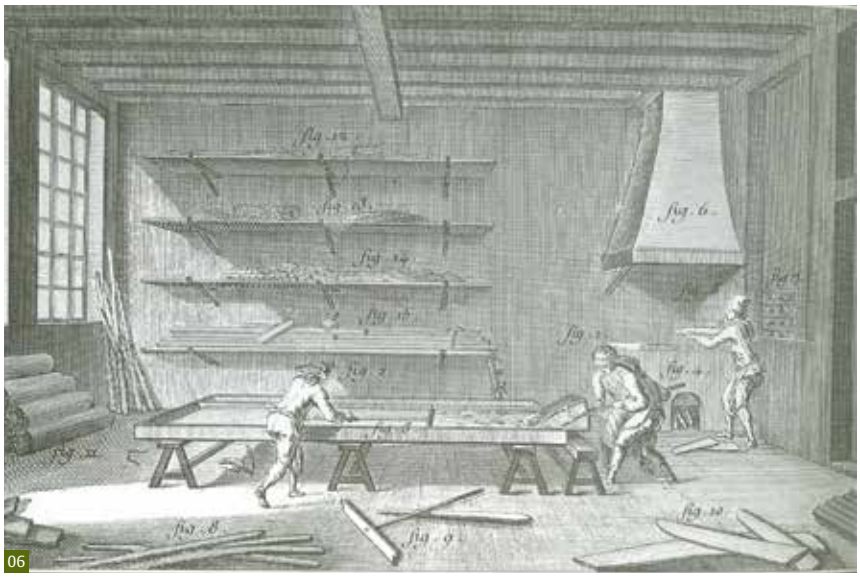
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Fig. 5 Lead sheet on roofs can last for well over 200 years.

Figs 6 and 7 The process of producing sand cast lead sheet has changed little over the centuries.

Fig. 8 Sand cast lead sheet.

Fig. 9 Milled lead sheet.

Milled lead sheet began to replace cast lead sheet at the beginning of the 19th century. It is rolled flat to a uniform thickness in rolling mills. Today, the majority of lead sheet used in building is in this form. Modern milled lead sheet is made to the specification laid down in British and European Standards and is supplied in different thicknesses, specified by 'codes' indicating its weight in pounds per square foot. It is laid in 'bays' to allow for thermal movement (Fig. 9).

As well as for sheet roofing, lead was also used for other architectural elements, often incorporating decorative details. This was particularly the case with prominent visible features such as down pipes or hopper heads (Fig. 10). It is common to find dates, initials, decorative scrolling or more intricate mouldings on such features. The value of these items far exceeds the value of the metal, as they are examples of early craftsmanship, which cannot be replaced (Fig. 11). On some buildings, lead sheet is laid in a decorative manner to form diamond or fish-scale details. This can be replicated in new work, but is expensive (Fig. 12). Original examples of this type of decorative lead work are rare, and should be protected against theft.

Lead is a relatively expensive material, and always has been, due to the labour-intensive extraction and smelting methods, transport costs and the skilled workmanship required for its use. Because of this, it is most often found on high status buildings such as cathedrals, churches, palaces and prestigious public buildings. The lead is often visible, and intended to be seen as a statement of the splendour of the building. In addition, lead's versatility has made it widely used for other weathering and drainage details that are less visible, but no less essential for the building's protection. Down pipes, hopper heads and flashings are all commonly formed from lead, as well as ridge cappings, valleys and skew details on slated or tiled roofs. Pediments, parapets and cornices are sometimes given a covering of lead to reduce weathering and help shed water. All of these lead elements have been, and continue to be, targeted by thieves.

From the early 19th century milled zinc sheet began to be produced industrially, and was used as a flat roof covering on factories and other flat roofed buildings, although lead was still used extensively on more prestigious buildings such as churches and country houses. Many details such as gutters and ridges on 19th century buildings are in fact of zinc, not lead (Fig. 13).

Fig. 10 Decorative lead downpipe and hopper head.

Fig. 11 The value of decorative leadwork goes far beyond the price of the metal.

Fig. 12 Decorative leadwork, such as this scalloped dome detail, can be replicated but is expensive.

Fig. 13 Zinc gutter.

3. Conservation principles

Scottish Historic Environment Policy (SHEP) sets out general principles to be applied in all conservation and maintenance work. This states that:
'to retain historic character and future performance of older buildings it is important to use appropriate and compatible materials and construction techniques.'
(para. 1.33 c, p.13)

The principles set out in SHEP are supplemented by detailed guidance offered in Historic Scotland's Managing Change in the Historic Environment Guidance Note: *Roofs:*

> *'The significance of an historic roof is derived from a number of factors including its age, functional performance, shape and pitch, profile, and the qualities of its supporting structure, covering materials and associated features.'*
> (Key issue 2, p.2)

> *'Wherever possible the repair and alteration of historic roofs should be carried out in traditional materials to match the existing. Replication of the type, dimensions, pattern and coursing of materials is important to maintaining the character of the roof. The use of slate, lead and other traditional materials not only protects the character and appearance of a building, but with regular maintenance they can also be extremely durable. Associated features, such as rainwater goods and chimneys, should also be repaired or renewed using appropriate traditional materials.'*
> (para. 4.4, p.6)

Local planning authorities may have their own polices in place and will assess whether the repair or replacement of lead or other material requires consent.

As with other building elements such as windows and wall finishes on traditional buildings, when specifying repairs or replacement it is not simply the appearance or utility of a material that matters, but also its authenticity. In other words, does it reflect the original design or aesthetic intent, and reflect the status and age of the building? This concept is established both in the international conservation charters, which have influenced the way historic buildings are assessed and protected, and in national legislation and policy relating to the historic built environment.

This does not mean that change can never happen. Indeed, it is recognised that the historic environment is constantly changing and adapting, and this adaptation is essential to safeguarding it in the long-term. For example, over time tiles and slate have replaced thatch as a common roof covering, as the harder wearing and more durable materials became more widely available. Likewise, improvements in heating and lighting have all been incorporated into traditional buildings as technology and lifestyles developed. Conversely, materials that are found to be toxic have been phased out, such as paint containing lead compounds or arsenic, despite their authenticity and proven performance. On the other hand, traditional practices in joinery and stonemasonry are maintained and required in conservation work, despite simpler and cheaper options being available, both because they ensure the continuation of the skills required for the repair and maintenance of traditional buildings, and because they result in workmanship that is authentic, fit for purpose and pleasing to the eye.

Conservation is the process of managing change, but part of this process means taking the long view rather than reacting to a transient need or short-term financial imperative, such as the increased incidence of lead theft at the present time. For this reason, the replacement of a traditional material such as lead with an alternative, less durable or less appropriate material is not an alteration to be taken lightly. The long-term result of such alterations would inevitably be the incremental loss of historic fabric and character, and a precedent for the replacement of other historic or valuable materials, regardless of risk. There is also the risk that ceasing to use lead on historic buildings might shift the focus of thieves to other materials and artefacts, rather than reduce the incidence of such crime overall. For this reason, Historic Scotland's view is that the focus should be on reducing the ease or likelihood of metal theft, rather than supporting alternatives to traditional roofing materials.

With this in mind, Historic Scotland's advice on alterations to lead sheet roofing on listed buildings is that *repairs or replacements should be carried out in a like-for-like manner wherever the lead features are significant to the building's character or appearance*. This includes visible roofs and flashings, cupolas and rainwater goods, where it is reasonable to expect that the risk to these of future thefts can be mitigated by improved security measures. In many cases, investment in security measures, such as more securely fixing the new lead to the roof, will be sufficient to protect the roof against repeated theft. Where lead is not visible, for example where it is hidden behind a parapet, or for features such as valley gutters, replacement with an alternative material will normally be acceptable if a theft has occurred and there is a likelihood of further thefts occurring, and where alternative security measures or deterrents are unsuitable or impractical (*see* decision tree Fig. 24, p 16).

Historic Scotland recognises the problems that many churches and building owners are experiencing with the current high levels of metal theft. Our advice is intended to provide practical guidance in preventing and tackling theft, and to reduce the physical and financial damage that lead theft causes.

4. Lead and metal theft

Increasing global demand for metals has caused the international price of metals to rise significantly. Metal roofing, flashings, rainwater pipes, garden ornaments, statuary, fencing, gates and even church bells and war memorials have been stolen in recent years as the price of scrap metal makes even small quantities attractive to thieves.

Various metals are targeted: copper is particularly valuable, and thefts of pipes, cabling and lightning conductors are all on the increase. Bronze plaques and war memorials have been stolen. Iron, zinc, aluminium and stainless steel may also be stolen, although these tend to be less of a risk as their value by weight is lower and they are much more difficult to remove from a roof.

The theft of lead and other metals from buildings, particularly those of architectural or historic significance, is without doubt causing serious problems for building owners. The financial cost of lead and other metal theft is not limited to the cost of replacing the metal alone. Damage to stonework and other building elements is a common complication (Figs 14 and 15), and water ingress caused by the loss of the roof covering can cause huge damage to the building fabric and significant harm to interior finishes and furnishings. If the theft is not immediately discovered, the saturated timber roof structure and linings can be susceptible to fungal and insect attack, leading to further degradation and sometimes structural damage (Fig. 16). Such crimes cause great distress and anxiety to those who care for historic buildings, and may increase insurance premiums, or cause difficulty in obtaining appropriate insurance. Repeated thefts may even result in buildings being sold or falling out of use.

However, the issue of metal theft cannot be seen in isolation as a problem that must be solved only by those who are responsible for protecting the historic environment. The wider issues are also relevant, notably those of reforming legislation relating to scrap metal dealing and enabling greater engagement with the police both to prevent crime and apprehend offenders. The Scottish Government have carried out a consultation on proposals to amend the scope of the Licensing Scheme for Metal Dealers (up-to-date details can be found at www.gov.scot) and a Ministerial commitment to action has been made.

The proposals would significantly increase the turnover threshold for exemption from licensing requirements for scrap metal dealers, meaning that many more dealers will require a licence to trade. Only the largest dealers would be eligible to apply for an exemption.

Regardless of legislation, there are a number of practical measures that building owners and managers can take to reduce the risk of losing lead and other metal by theft from their buildings, or to mitigate the damage where a theft has already occurred.


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Fig. 14 Damage to stonework and other building elements is a common complication where lead is stolen.

Fig. 15 Isolated structures are often targeted by thieves.

Fig. 16 Empty buildings are particularly vulnerable to lead theft, leading to water ingress, decay and eventual dereliction.

5. Preventing lead theft

There are a number of ways in which the risk of lead being stolen from a building can be reduced. Before expensive measures are considered it is worthwhile ensuring that other low cost measures that will help reduce the risk of crime are implemented as a priority.

Even where there is no history of metal theft or other crimes, security of the building should be regularly reviewed and crime prevention measures considered. Security can range from the low tech 'common sense' and inexpensive approach, which may be sufficient in some cases, to high tech and comprehensive security systems for the most valuable and vulnerable buildings. Police Crime Prevention Officers are able to give expert advice.

If no security assessment or management plan for the building exists, then a security review should be carried out as soon as possible, so that any areas of vulnerability can be identified and addressed before a theft occurs. The security measures should in any case be re-assessed regularly. For churches, the Quinquennial Inspection (QI) is a good time to do a thorough assessment of building security as well as condition, although this may not be frequent enough to keep up to date with security issues. An annual assessment during maintenance work would be a better option.

Community action

- Promote the protection of the building as a community issue; involving local people can help maintain security and can help reduce other crime and anti-social behaviour. It may be worthwhile conducting a door-to-door awareness-raising campaign, advising people living near the building of what to look out for and who to contact if they notice anything unusual, particularly the arrival of workmen on site unless they are expected as a result of a public notice or other announcement. People loitering near the building, or unusual vehicles parked nearby, should be reported to a responsible person (e.g. a church officer). Neighbourhood Watch schemes may provide a focus for community action where appropriate.
- It is advisable for church officers and other responsible persons to make frequent and irregular visits to the site. Caution should be exercised if intruders are noticed, as it may be inadvisable to confront them without support from the police.
- Involve local police and Community Support Officers and ask them to keep an eye on the site during their patrols, to note vehicles parked nearby and to question anyone seen on site at unusual times. Your local police Community Action website is a good place to start.

Site security and housekeeping

Some ways to deter thieves by making physical access to the roof area difficult:

- Remove water butts or waste bins from locations close to the building.
- Consider the position of any lean-to or subsidiary buildings which may provide an access point on to the roof.
- Ensure any ladders kept on site are locked away and inaccessible when not in use.
- Ensure any scaffolding during building work is secured against climbers (*see* Security during building work p.14).
- Keep trees, hedges and undergrowth well trimmed and maintained, to maximise visibility of the building and avoid providing cover or hiding places for thieves, or for concealing stolen metal. Thieves often remove lead and hide it somewhere, and return later to collect it, as it may be too heavy to move in one go.
- Consider removing trees growing close to the building, but bear in mind that permission for this may be required from the local authority.
- Maintain perimeter fencing; keep gates locked, and be aware of vehicular access or parking areas near the site, which could provide an access for cars or vans.
- Remove or secure any wheelbarrows, bins or other containers that could facilitate the removal of metal from the site.
- Regularly check the roof, and note the condition of all lead elements, so that attempted thefts can be quickly identified and areas of weakness that might invite an opportunistic theft can be addressed. For example, loose tiles or guttering, torn or poorly fixed flashings, etc (Fig. 17). Sometimes thieves will steal small amounts of lead that can be easily removed, and then return for a larger haul.

Lighting and alarms

- Security lighting and movement sensors can be effective at detecting activity on the roof. This is likely to be more effective in residential or built-up areas, where the light can be seen by neighbours. If security lighting is installed, then local residents should be informed and told whom to contact if the lights are activated. Engaging local residents and neighbours can be valuable in improving site security and preventing thefts.


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Fig. 17 Damaged leadwork can invite opportunistic theft.

Fig. 18 Wireless motion sensors can be set to trigger an audible alarm and strobe lighting as well as alerting security services.

- Alarms – these can be either audible-on-site alarms, or remote alarms that will alert the police or a responsible person who can then raise the alarm with the police and others. Wireless alarm systems can be more reliable as they cannot easily be disabled by intruders (Fig. 18). Various systems are available including trip wires, point-to-point beam detectors or pressure sensors on the roof, motion or infrared sensors. These are suitably calibrated so that they are not readily activated by wildlife or passers-by, since false alarms would impact significantly on the system's efficacy. Alarms can be set to detect the presence of an intruder and immediately play a pre-recorded voice message. This can be a warning that the building is protected and that the intrusion is being recorded on CCTV, or that the alarm has been activated and the police have been alerted. Systems are also available that will detect vibration or vehicle movement.
- CCTV – this can be an expensive option and on its own may not be sufficiently effective as a deterrent. Advanced CCTV security systems include motion sensors and can alert a responsible person using a mobile phone text alert, allowing the alarm to be raised. CCTV may have limited value in identifying thieves, unless the image quality is very good.

Some of these elements may require consent, so the planning authority should be consulted.

Physical barriers to theft

- Anti-climb paint can be applied to parapets, boundary fences, down pipes, lamp posts and roofs, and can be effectively applied to most common building materials. It consists of a thick oily paint that is applied with a stiff brush or a trowel. It has an appearance similar to gloss paint but it remains slippery, making it difficult for a climber to maintain a grip. It will also leave marks on anyone who touches it, so can be helpful in identifying would-be thieves, if they can be apprehended. The use of anti-climb paint must be advertised with notices, to protect the owner's liability. Such signs may act as an additional disincentive to thieves. Anti-climb paint can be helpful in deterring opportunistic thieves but will not deter thieves who bring their own ladders. To prevent the general public being affected by the paint, it may only be applied above a certain height, normally about eight feet above the ground. The use of such paint is regulated in some areas so any further restrictions should be checked before it is applied. The paint should be applied in areas where intruders cannot reach it without climbing. The paint has the greatest deterrent effect when an intruder has to climb several feet before being stopped by a band of anti-climb paint.


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Fig. 19 Barbed wire can be attached to walls or parapets to deter thieves from gaining access to lead roofs, although the visual effect should be considered.

- Barbed wire or spikes can be attached to walls and parapets to deter thieves from gaining access to the lead. The presence of these should also be advertised with clear signage if there is any danger of injury to authorised or unauthorised persons (Fig. 19).
- Special mechanical fixings can be used to fix the lead more securely to the roof. One patented system fixes individual lead sheets to the roof, making it difficult and time consuming for thieves to remove. The process requires a small patch of lead to be removed, the lead sheet fixed down, and the patch re-welded (Fig. 20). This can be done neatly and has a low visual impact, while making the lead extremely difficult to remove. It has been used successfully on listed church buildings in England and is very effective at preventing theft.
- Where new lead roofing is being applied, it may be wise to use hollow rolled rather than wood core rolled sheet. Hollow rolled sheet has copper fixings, which make it more difficult to remove. If a theft cannot be carried out quickly, there is more likelihood of the perpetrators being interrupted and/or the attempted theft being abandoned.

Some of these elements may require consent, so the planning authority should be consulted.

Fig. 20 Mechanical fixings physically secure the lead to the roof, making it difficult for thieves to remove. © Chris Wood.


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Security or forensic marking

- Security marking of lead with a forensic coating is a low cost way of protecting the material. Such coatings can be applied to lead without altering its appearance, and are only visible under ultraviolet light. The security marking is specific to the building, so that recovered stolen metal can be traced back to its source. It can lead to successful convictions for metal theft crimes, and identifying individuals and dealers who have handled the stolen metal. Forensically marked materials need to be registered so that stolen metal can be traced back to its source. Forensic marking can act as a deterrent, if there is clear signage to advertise its use; however, it does not appear to discourage the most determined thieves (Fig. 21). Forensic marking is offered at a discounted rate via some insurance companies.
- Other types of security marking use a type of grease which is transferred to anyone who handles the metal. If there is a theft, or attempted theft, the forensic 'tagging' will mark the skin, clothes or tools of the thief. This allows stolen metal to be identified, and allows police to determine whether suspects have handled stolen metal.
- Some security companies offer a service specifically designed to deter lead theft, whereby the lead is embossed across its entire surface with a unique reference number. Associated signage warning that the lead is security marked is essential to act as a deterrent to thieves. Respectable scrap dealers will not accept security marked lead, so if the lead is offered for sale as scrap, the presence of identifying marks may be useful not only in apprehending the handler but also in enabling the return of the metal to the rightful owner. Security marking has limited value if the lead is targeted by organised gangs, as they often have systems in place for processing and distributing the stolen metal.
- Where lead is not a visually significant feature of the building, painting it to disguise the material can sometimes be an effective deterrent.

Fig. 21 Forensic marking can act as a deterrent, if there is clear signage to advertise its use.

Security during building work

Buildings and sites are often targeted by thieves during building or renovation work. Scaffolding, materials left on site, and access for personnel and works vehicles all increase the risk of theft occurring.

- Barrier fencing around a site can prevent unauthorised personnel from entering, and having a single, secure, manned entry point will help to control all those coming and going from the site.
- Ensure that scaffolding on site is secure. Fix timber boarding around the base of the scaffold to a height of 3.5m to deter climbers, and install an alarm system on the scaffold itself.
- Ensure that ladders are removed at the end of each day and stored securely.
- Do not leave tools or materials such as rolled lead sheet on site unless stored securely, as they may well be stolen (Figs 22 and 23). Display notices stating that no tools or materials are kept on site overnight.
- Always advise your insurance company when you are planning to undertake work, and check whether your insurance policy will cover theft during building work or if scaffolding is in place. Some policies will not pay out if lead is stolen where scaffolding has been erected without consulting the insurer (*see* Insurance section below).
- Check whether the contractor is insured against theft during building works.

Insurance

Ensuring that the building is adequately insured is an essential aspect of protecting the building against the consequences of lead theft. Many insurance companies now require security measures to be implemented as a condition of the policy. The leading insurer of places of worship requires policyholders to have external lead work marked with forensic water and the unique code registered on a national database. As a reflection of the increased incidence and financial cost of such crimes, some insurers have also implemented a limit on claims for lead theft and associated damage. This is normally enough to cover the cost of most claims, but where buildings are repeatedly targeted, the building owners may find themselves struggling to pay the premiums to insure their buildings adequately.


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Figs 22 and 23 Materials left on site during building or renovation work may be targeted by thieves.

6. Dealing with theft or attempted theft

Unfortunately, it is not possible to protect all buildings against theft. Where buildings are particularly vulnerable or very remote, or where the funds cannot be raised to install security measures, it is much more likely that thieves will on occasion be successful in removing lead or other sheet metals from the roof. Where this occurs it is important to act quickly, both to apprehend the perpetrators where possible, and to protect the building from any further damage or deterioration that may result from the theft of the material.

Call the police

If a theft has occurred, or you suspect that an attempt has been made to gain access to the building unlawfully you should contact the police immediately either through the local crime prevention scheme or by calling Crimestoppers (0800 555 111).

Notify your insurer

You will need to advise the building insurance providers or broker as soon as possible that a theft or attempted theft has occurred. Your insurance company will advise you on the claims process and may arrange for an independent inspection to be made.

Contact an architect or surveyor

The architect or surveyor will need to visit the building to assess the damage that has occurred and advise on suitable temporary or longer-term protection options. They may advise that you arrange for a competent local contractor to implement emergency repairs or temporary protection. You can find an architect through RIAS, or a surveyor through RICS, but consider asking for one that is 'conservation accredited' and so has particular skills relating to historic or older buildings.

www.rias.org.uk
www.rics.org/scotland

Contact the local authority

If your building is listed, contact the planning department of your local authority to advise it of the theft and seek advice.

Temporary roof protection

A building should never be left exposed to the elements, as even one incidence of rain can cause water ingress, which could have serious consequences for the fabric of the building and may compound the costs of repair. A tarpaulin or other temporary covering should be fitted to protect the building from water ingress, while arrangements are made for a longer-term solution. In many cases, resolving issues with the police, insurance companies and local authorities can take time, and it may be some weeks before permanent re-roofing works can be scheduled. In the meantime, the most practical solution may be to re-roof the structure with bituminous roofing felt. This is relatively cheap to buy, easy to install and will allow the building to be made weather-tight while permanent solutions are agreed.

Emergency repairs such as this do not require listed building consent. But if they are still in place after a long period (perhaps six months or so) it may be that the planning authority will consider that a change has been made to the character of the building, and will ask that it should either be rectified or regularised by listed building consent and/or planning permission.

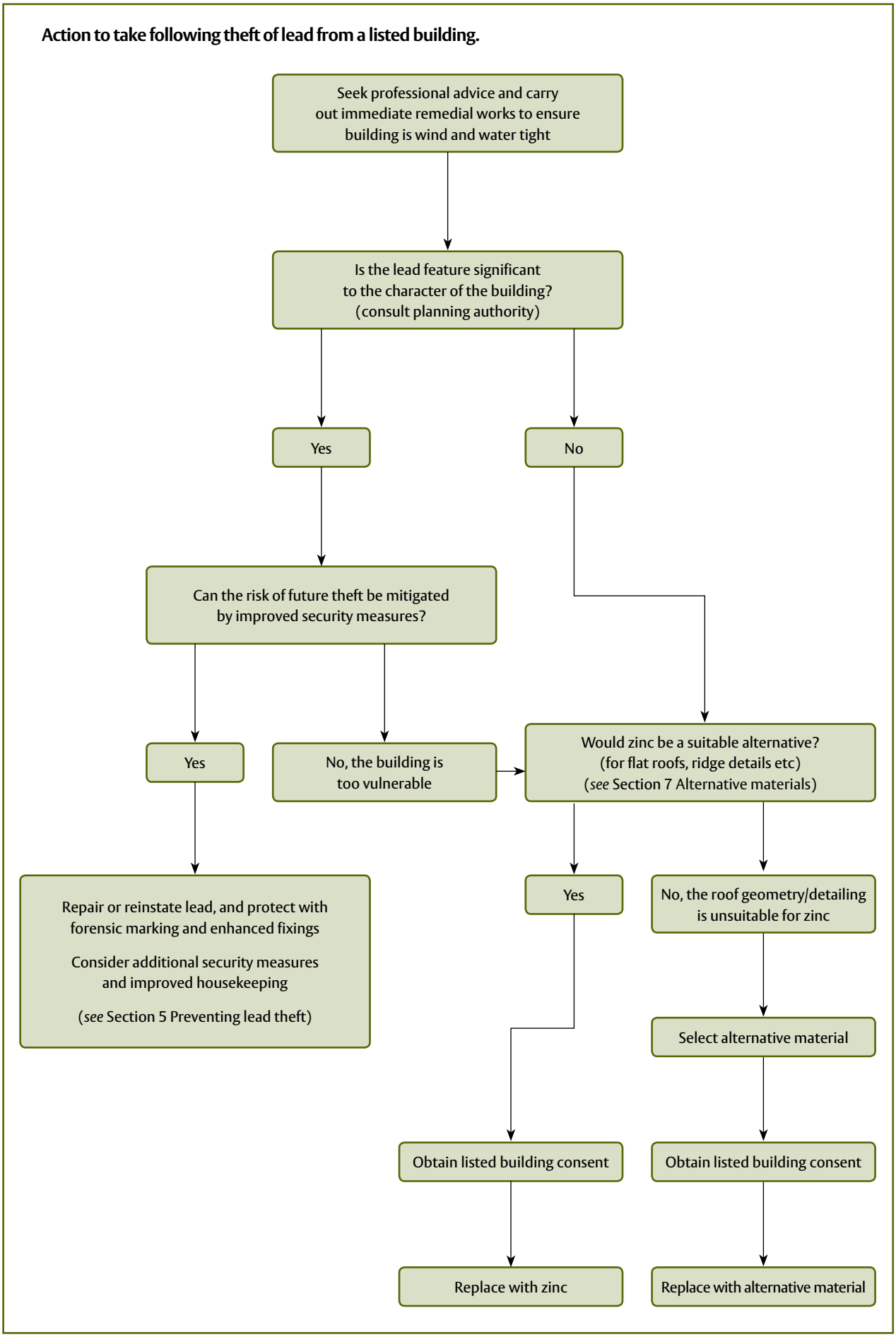

Fig. 24 Decision tree

7. Alternative materials

In some cases it is recognised that it will not be desirable to reinstate lead after theft, as the risk of repeated theft is too high, or the investment required to secure the lead is not available. Where the lead is not a significant element of the building's character or special interest or is in an unobtrusive area where the lead is not visible, such as valley guttering, parapets or flat roofs, the use of an alternative roofing material may be acceptable. Changing the roof covering will sometimes require alterations to the roof structure or substrate to accommodate the new material (*see* decision tree Fig. 24).

There is no material that can mimic the combined physical performance and aesthetic qualities of lead (Fig. 25), so when selecting an alternative there are a number of questions that need to be considered:

- What is the expected life span of the material?
- Will its visual appearance be compatible with the building's age and status?
- Will alterations be required to the roof to accommodate the new material?
- Will the new material be attractive to thieves?
- Are skilled contractors available who can supply and fit the material?

Both metal and non-metallic materials are used as alternatives to lead sheet. Some of the most commonly specified are described below.

Fig. 25 No material can mimic the combined physical performance and aesthetic qualities of lead.

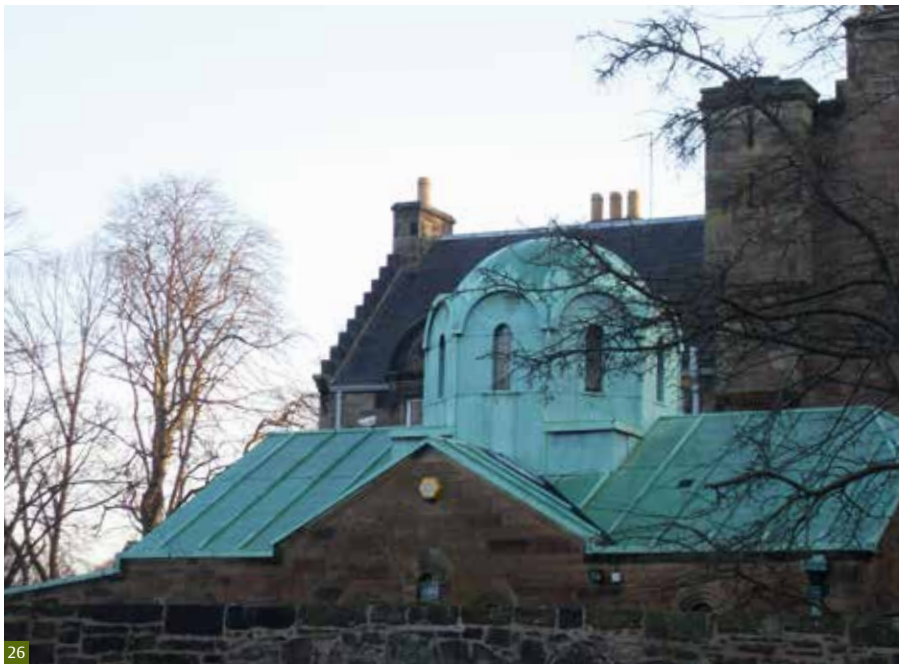

Fig. 26 Copper roofs are often a distinctive feature of a building.

Metal roof coverings

Zinc

Zinc is a silvery grey metal which is a suitable alternative to lead for many roofing applications, although it is not as soft or workable. In some situations, particularly where roof details have a complex geometry or intricate detailing, only lead will do, but in many cases zinc is a good alternative. Like lead, zinc is supplied in rolled sheets that are laid in bays, of size limited by the weight of a roll. Having higher tensile strength and lower density, zinc can be provided in thinner, larger sheets and still be easily handled. It is a durable material and can be moulded or shaped to architectural or weathering details. Zinc is highly recyclable and has a significant scrap value, but is not as attractive to thieves as it is more difficult to remove and not as valuable as lead. Being lighter and less 'crushable' than stripped lead sheet, a greater volume of stripped zinc would be required to provide enough weight to compare with the value of lead. Initially bright, zinc weathers to a matt grey tone not unlike lead. Zinc cannot be used in conjunction with some other metals such as stainless steel or copper as corrosion will occur where they touch. Ridges and flashings on roofs from c.1820 onwards will sometimes be of zinc, not lead, and if damaged or stolen should be replaced in zinc where appropriate.

Terne-coated stainless steel

Terne-coated steel is stainless steel that has been hot-dip coated in an alloy of lead and tin. This gives it a surface finish that has a similar appearance to the patina of a lead roof. The material itself is much lighter, much harder and less malleable than lead. It can be supplied and fitted in sheets with standing or batten-roll joints to replicate a lead roof, although the appearance tends to be angular, and it lacks the softness and pliable quality of lead sheet. Roofs covered in terne-coated stainless steel can be noisy, as the material is very stiff and does not absorb the impact from rain and hail, which can lead to a 'drumming' effect. Terne-coated steel is a stable material, is not vulnerable to creep and can be laid in longer strips than lead sheet, although the fixings and detailing need to allow for thermal expansion. It has a good scrap value, limited by higher re-processing costs, but being more difficult to remove than lead it is less attractive to thieves.

Copper

Copper is a versatile and malleable roofing material, shiny orange when new, and acquiring a characteristic green patina, known as verdigris, over time. It can be supplied pre-patinated. Copper is a durable roof covering, and is often chosen by architects where a particular aesthetic is desired (Fig. 26). Like lead roofs, copper roofs are often a distinctive feature of a building, and replacing one with the other will dramatically alter the building's appearance. For this reason it is not normally considered a suitable alternative to lead. Furthermore, in terms of its scrap value, copper is currently comparable to lead, and may be targeted by thieves, although it is more difficult to remove from roofs in worthwhile quantities than lead sheet is. Copper is incompatible with some metals, such as aluminium, iron and zinc, unless it can be physically separated and electrically insulated from them to prevent corrosion, and should not be used in conjunction with oak as the acid from the sap will corrode the metal. Copper is unlikely to be suitable as a replacement material on most churches. It is less durable than lead, with a lifespan of around fifty years.

Stainless steel

Stainless steel sheet naturally has a silvery, highly reflective finish, although patination finishes can be applied to give it a dull, matt appearance. Some grades are relatively malleable, although not nearly as easily workable as lead sheet. Of itself it is generally corrosion resistant, but in conjunction with other metals it can be prone to technical defects from bi-metallic corrosion of fixings. Like terne-coated steel, it has a much harder, more angular appearance than lead or zinc, and can be noisy during rain or hail.

Aluminium

Aluminium is an extremely durable metal, but is expensive compared to steel products. Aluminium roofs are very lightweight and corrosion-resistant, and have lifespans of up to fifty years if well maintained. Aluminium can be anodized to improve corrosion resistance and provide a better surface for painting or other coatings. Aluminium does not solder readily, and so it is not ideal for roofs that have complex detailing or penetrations, although in-situ welding of joints and detailing can be carried out on site by specialist contractors. Aluminium-based products such as flashings have been developed recently with an appearance intended to imitate lead. These consist of a layer of fibre mesh between two coil-coated, corrosion-resistant layers of aluminium. Such products are extremely durable; however, they are not fixed in the same way as lead and visually do not have the look of heaviness or the lustre of lead sheet.

Non-metallic roof coverings

In some cases replacing a lead roof with an alternative metal sheet may not be practical or desirable (*see*, decision tree Fig. 24, p.16). There are a number of other materials available for use on flat or shallow pitched roofs, including the following:

Single ply membranes

There is a range of single ply roofing membranes sold under various trade names. These are generally manufactured from polymers and have a polyester fleece backing. Most of them have a maximum life span of around twenty to thirty years, which is very short compared to that of lead sheet. Failure can be caused by blistering, puncturing and wind-lift. Some single ply membranes are designed to mimic the matt-grey colour of lead, but they cannot successfully replicate the distinctive characteristics of lead sheet, in particular the lustre of the material, nor the way in which lead is fitted to the roof. However, the appearance of such membranes can be less visually distinctive than some of the sheet metal solutions, and as they have no resale value they are not prone to theft.


27

Fig. 27 Lead detailing.


28

Fig. 28 Felt replacement.


29

Fig. 29 'Tile-effect' felt.

Ethylene Propylene Diene Monomer (EPDM)

EPDM is a synthetic rubber sheet membrane that has been specifically developed for flat roofing applications. It is durable, water resistant and resistant to cracking, heat, oxidation, ozone and UV radiation. Manufacturers of EPDM have developed roof coverings that are intended to mimic the colour or appearance of lead sheet roofing. However EPDM is generally laid as a single long sheet, whereas lead is always laid in shorter bays. EPDM can be cut smaller and fitted in a way that can mimic lead bays, but this will affect its performance and is not recommended as it creates weakness within the overall roof covering. Where failures occur in EPDM it is generally in laps, flashings and around roof penetrations. EPDM can also be prone to linear shrinkage of between 1% and 2%. On a large roof this can be a significant factor in failure.

Bituminous felt

Bituminous felt is a serviceable roofing material, one that is used widely on utilitarian buildings and temporary structures. It is relatively cheap, and while it gives good weather protection, it is generally not a long-term solution for roofing buildings as it has a limited lifespan (between five and thirty years). It is not normally an appropriate replacement for lead sheet (Figs 27 to 29). However, where lead has been stolen and a provisional covering is urgently required to prevent water ingress and protect the structure, bituminous felt is a suitable temporary roofing material.

Asphalt

Asphalt is a bitumen-based roofing material, normally laid in bays as a hot poured and trowelled 'wet' layer to form a continuous 'sheet', and when set, covered with fine stone chippings, gravel or shingle. Asphalt is not suitable for pitched roofs but can be a cheaper option for flat roofs. It is unlikely to be suitable for historic or traditionally constructed buildings where lead was previously used.

Glass Reinforced Plastic (GRP)

GRP, also known as fibreglass, is a lightweight, strong, and robust material used for sheet roofing. It compares well with metal roofing in terms of strength and weight, and it can be readily moulded to different profiles. Manufacturers of GRP have developed products which are intended to mimic the colour and appearance of lead sheet roofing, but like single ply membranes, they cannot successfully replicate the distinctive characteristics of lead sheet, the lustre of the material, nor the way in which lead is fitted to the roof. Such materials may be an alternative to lead in areas which are inconspicuous, but vulnerable to theft, or where the principle of removing the lead has been agreed (Figs 30 and 31). GRP roofs can degrade by eroding over time with exposure to sunlight, and can fade. They are typically guaranteed for no more than twenty years.

Fig. 30 Original lead detail, in poor condition and vulnerable.

Fig. 31 GRP cannot replicate the way lead looks, but may be an option for vulnerable and isolated structures.

8. Other lead features

While lead is used most extensively as a roof covering, it has also been commonly used in the past for other architectural and decorative features. Downpipes, hopper heads, gutters, water tanks and statuary can be made from lead, and can be even more vulnerable to theft than roofing materials as they are often more accessible and less easy to secure.

In exceptional cases it may be considered acceptable to reinstate lead rainwater goods in cast iron or powder-coated aluminium to replace stolen lead fittings. However, plastic rainwater goods are not a suitable replacement for lead on historic buildings. Lead is the most appropriate material for buildings pre-dating the mid-18th century.

Freestanding lead elements such as statuary are very vulnerable to theft. Security marking and photography can help to recover stolen items that are put into the art market, but are often insufficient to deter opportunistic theft. It may be prudent to add security measures such as CCTV, motion sensors and security lighting. Where the lead features are not integral to a particular garden or park design, it may be wise to relocate them to a more secure place. However, freestanding features may be listed in their own right or lie in the curtilage of a listed building, and therefore carry the same protection, so it would be advisable to consult the planning authority first.

9. Statutory consents

Many buildings with lead roofs are listed or within a conservation area. A few are scheduled ancient monuments. In such cases consent may be required for alterations to the roof covering, boundary details, architectural details or for the addition of fixed security measures such as CCTV or lighting. It is wise to speak to the local authority at an early stage to discuss where consents may be required and to come to a broad agreement about what would be most suitable.

Listed building consent

Listed building consent must be obtained where proposals will alter the character of a listed building. This applies regardless of the category of listing (A, B or C) and to work affecting both the interior and exterior. The planning authority (in most cases the local authority) will advise whether work is likely to affect the character of a listed building and therefore require consent. All applications for consent are made through the local authority rather than Historic Scotland and they are decided by the local authority (except when a local authority is itself the owner of a listed building and wishes to make alterations).

Ecclesiastical exemption

Buildings that are in use as places of worship do not require listed building consent, except for total demolition. There is a voluntary scheme for listed building control for work to the exterior of places of worship belonging to some denominations. This allows a local authority, often with guidance from Historic Scotland, to make recommendations, while leaving the final decision to the Diocese. This scheme would cover alterations to the roof such as replacing lead with a different material. Several church denominations have Decision Making Bodies (DMBs) which have responsibility for regulating alterations to churches. Where changes are being considered to church roofs, the planning authority should be consulted in the first instance. Planning permission is not covered by ecclesiastical exemption and may still be required for some external works.

Scheduled monument consent

If a monument is scheduled, the prior written consent of Scottish Ministers is required for most works, including repairs, and certainly for alterations. This is called Scheduled Monument Consent (SMC). The presumption is that works will be the minimum necessary consistent with the preservation of the monument.

If your building is scheduled then you should speak to Historic Scotland at an early stage, whether or not a theft has occurred, to discuss security measures or alterations. Churches that are in ecclesiastical use are not scheduled.

Planning permission

Planning permission may sometimes be required for alterations or additions to the building. The planning authority will advise whether permission is required and what is likely to be granted consent.

10. Summary

Many traditional buildings have lead features, both functional and decorative, that may be targeted by thieves. Incidences of theft and the associated damage to buildings are unfortunately not uncommon, but there are ways to reduce the risk of lead and other metal elements being stolen. Improved security measures, better fixings and other deterrents can substantially reduce the risk of metal theft and can also be effective at preventing other types of vandalism. Good maintenance is the starting point, as a building that appears vulnerable is often a target for thieves.

Wherever lead features are significant to a building's character or appearance, repairs or replacements should be carried out in a like-for-like manner. This includes visible lead roofs, ridges, flashings, cupolas and rainwater goods. Where lead is not visible, for example where it is hidden behind a parapet, or in a valley gutter, replacement with an alternative material will normally only be appropriate if a theft has already occurred; there is a likelihood of further theft occurring; and alternative security measures or deterrents are impractical. Implementing improved site security and protecting the existing lead features should be a priority. This will help ensure that valuable metal roofing materials can continue be specified, so that buildings can benefit from their superior performance whilst retaining the character and appearance of traditional metal roofs.

11. Contacts and further reading

Contacts

War Memorials Trust
Conservation advice/grants: *020 7233 7356*
www.warmemorials.org/links-scotland

Lead Sheet Association
www.leadsheet.co.uk

Church Buildings Maintenance in Scotland
www.maintainyourchurch.org.uk

Faith in Maintenance
www.spabfim.org.uk

The Society for the Protection of Ancient Buildings (SPAB)
www.spab.org.uk

Historic Scotland and Heritage Lottery Fund Repair Grants for Places of Worship
www.historic-scotland.gov.uk/repair-grants-for-places-of-worship

Funds for Historic Buildings
www.ffhb.org.uk

Historic Scotland
Longmore House
Salisbury Place
Edinburgh
EH9 1SH
Tel: 0131 668 8600
www.historic-scotland.gov.uk

Historic Scotland Technical Research Unit
(Technical enquiries)
Telephone: 0131 668 8668
hs.conservationgroup@scotland.gsi.gov.uk

Historic Scotland Heritage Management Team
(Planning/listed building matters)
Tel: 0131 668 8600
hs.listingsandconsents@scotland.gsi.gov.uk

Historic Scotland Grants Team
(Funding options)
Tel: 0131 668 8801
Fax: 0131 668 8788
hs.grants@scotland.gsi.gov.uk

Further reading

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English Heritage (2011) Theft of metal from church buildings. Available online at *www.english-heritage.org.uk/publications/theft-metal-church-buildings*

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Livesey, J., (2010) Protecting lead roofs from theft. Historic Churches, Cathedral Communications. Available online at *www.buildingconservation.com/articles/lead-theft/lead-theft.htm*

Maxwell, I. (2008) INFORM Guide: roofing leadwork. Edinburgh: Historic Scotland. Available at *www.conservation.historic-scotland.gov.uk/inform-roofing-leadwork.pdf*

All links accessed October 2014.

For more information about the conservation and maintenance of the built heritage including access to guidance documents such as INFORM and other Short Guide titles, please visit *http://conservation.historic-scotland.gov.uk/informguides* *http://conservation.historic-scotland.gov.uk/shortguides*

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