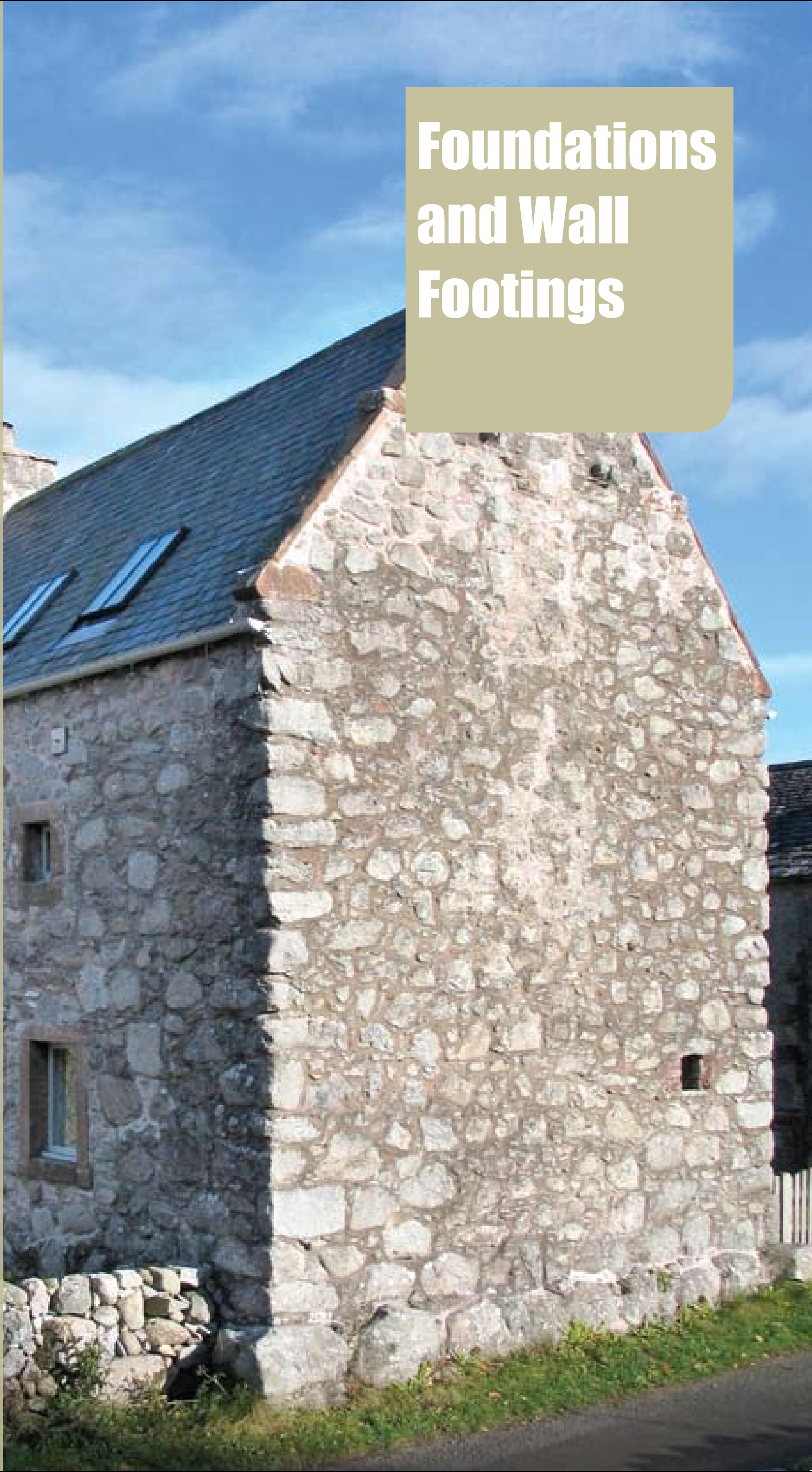
INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Foundations and Wall Footings

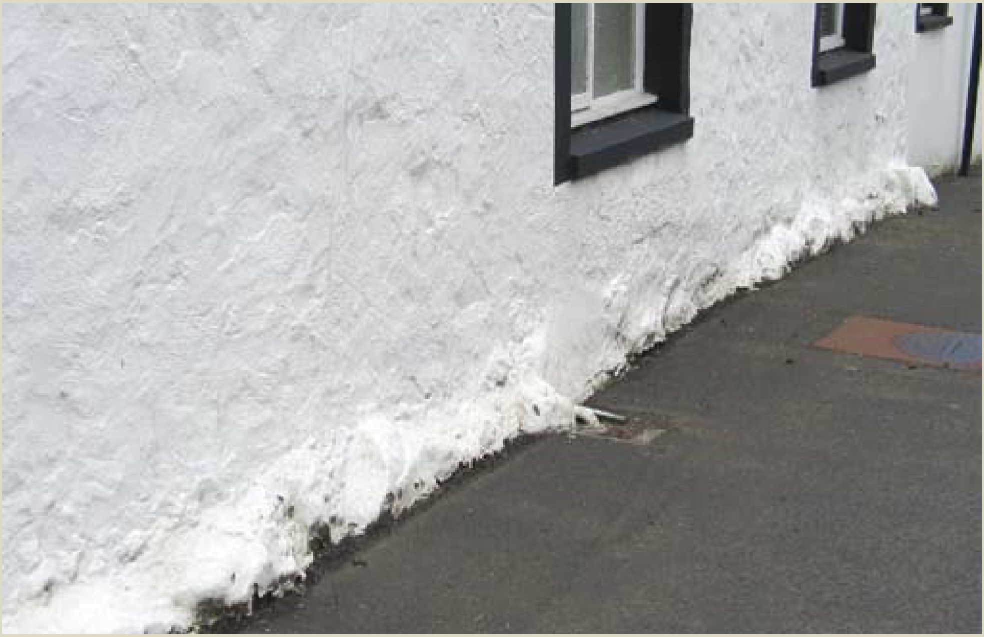


HISTORIC SCOTLAND

This INFORM offers a brief introduction to the topic of how foundations and wall footings might be affected by water and related circumstances. It also sets out to identify a range of issues that need to be borne in mind when dealing with the problems. Given the complexities that can exist with the topic, the information given can only be of the most superficial kind and any significant concerns regarding the structural stability of building foundations should be addressed by consulting an appropriately qualified professional.

Construction Background

Masonry buildings, from medieval times until the early 20th Century were generally built straight into the ground. For defensive reasons, castles tended to be built upon rocky promontories and, as a result, often had their walls constructed directly from the bedrock. Ecclesiastical structures however tended to be located in a wide range of situations, including river flood plains. Consequently, the walls of such buildings tended to be constructed on a broader foundational pad so that the structural load could be spread over a larger ground area. As the construction of masonry domestic buildings became more commonplace during the 18th Century, large rough boulders were laid in a shallow trenches to create rudimentary foundations. The dimensions of these stones tended to be larger than the width of the wall that was to be built on top; so many buildings of this period can still be found with exposed foundation stones, or with a distinct protrusion occurring at the wall footing.



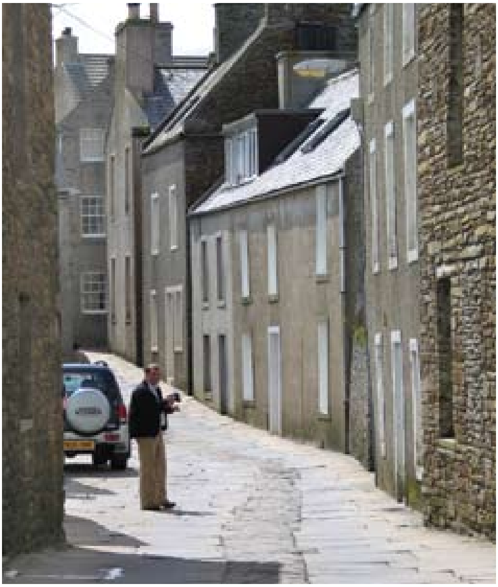
By Victorian times this protrusion had been regularised, and reduced in dimension, until only a minor thickening of the wall occurred at the footing. At the same time a more scientific approach emerged in designing foundations, resulting in the laying of proper load bearing strips upon which the building's walls were constructed.

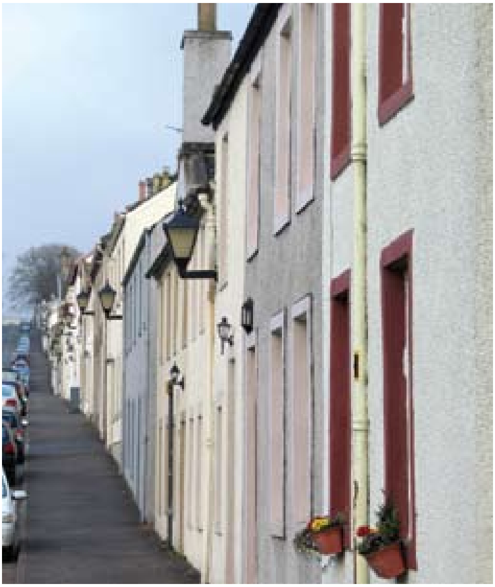
Traditionally built stone masonry foundations were usually constructed without any form of damp-proofing. They were designed to tolerate water in the surrounding ground and permit this to be drained away naturally. In this process, the use of traditional lime mortars played a key part as it allowed the free movement of moisture through the building.

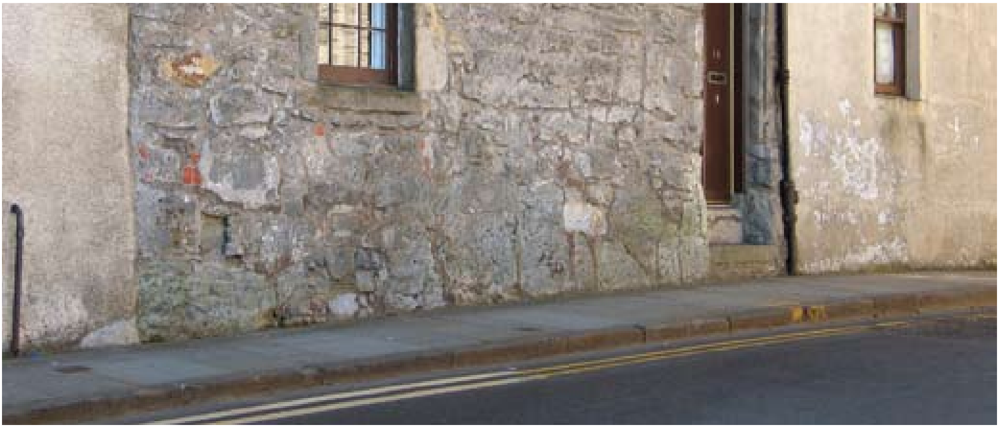
Sloping Ground

Where buildings, or groups of buildings, were constructed up the ground slope, stepped foundations had to be created, especially if the buildings were adjoining. Whilst this meant that internal ground floor levels had to be stepped, over the length of the building it was inevitable that some part of the foundation also acted as a part-retaining wall structure against the rise of the ground. Inevitably, this created more of a problem as the foundation and wall footing construction could lead directly to water penetration of the interior where the floor was lower than the external ground level.

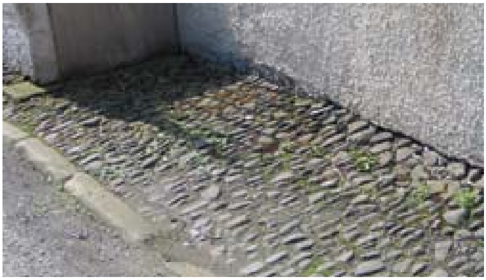
Occasionally, the entrance doorway was located in the highest part of the slope with the floor made up above the external ground level to avoid this problem. Access into the property was over a raised entrance platt or step as this prevented surface water from gaining direct access through the doorway. But, this arrangement still left the problem of dealing with any rainwater discharged from the building itself, and the need to control surface water discharging down the slope. On steeply sloping sites, complex original arrangements of gutters, slabs with channels cut in them, bridging entrance platts and applied skirting blocks helped, although later external road and pavement surfacing works can often add to the difficulties.

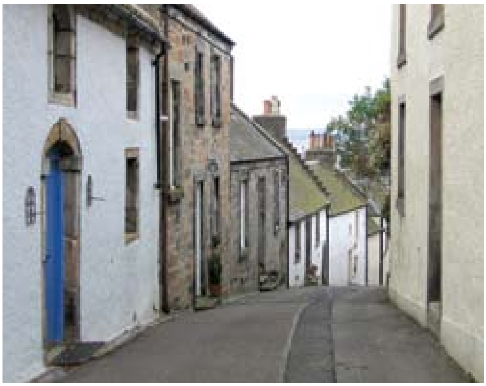






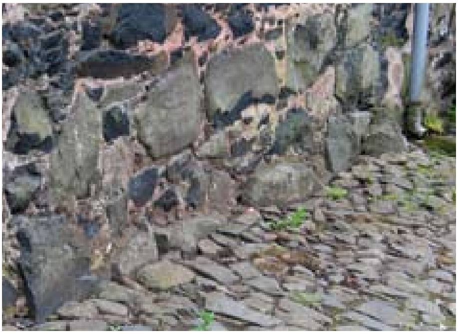
Pavements and Roads





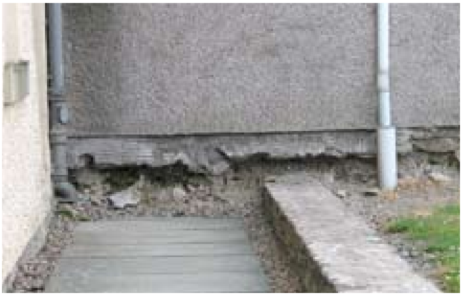
Pavements adjacent to buildings should, ideally, be laid on a slope that falls away from the wall as this helps direct rain water from the footing towards the road-side gutter. Prior to the introduction of tarmac or concrete slab pavements, traditional detailing could involve the construction of a pavement made up from rows of thin cobbles or split stones. To ensure that these discharged water properly the stones were laid at right angles to the building thereby allowing surface water to drain down the slope between the stones. Sometimes, such pavements also included the construction of an integrated cobble lined gutter which took the collected water away from the area. A further traditional detail that could be found is the use of a dimensioned kerb stone used to contain the cobbles and to provide a drop into the adjacent gutter.

Such traditional arrangements have often been lost where pavements and road improvements have been made resulting in the external ground level rising. Such later alterations make it all the more important to ensure that any sub-surface drains function effectively, and that pavement gullies are not blocked up by growth or other debris. Often, another problem created by the build up of pavements leads to creating a small well at the foot of the building into which rainwater is discharged. This arrangement can also encroach onto the external face of wall foot ventilators, allowing water access directly into the sub-surface of the building through the vent slots. Unfortunately, increases in modern road level surfacing sometimes also eliminates

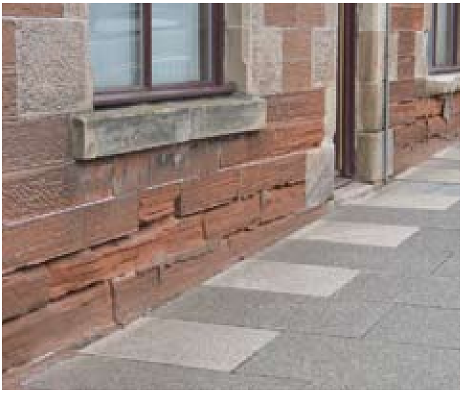


the gutter, running the risk of surface water flowing back towards the building's wall footing and foundations, especially if the surface slope away from the wall is slight, or non-existent. In addition, the impermeability of modern paving materials can trap underlying moisture adjacent to the wall footing.

Creating these circumstances should be avoided if at all possible. Whilst in an integrated community it is often impossible for individual owners to overcome these problems, a greater awareness of how resurfacing both pavements and roadways can affect water discharge back into buildings needs to be recognised by the appropriate authorities.



It also needs to be recognised that the regular application of winter road salt on pavement and road surfaces can be particularly damaging. Some stones, especially sandstone, are at a considerable risk of induced decay where the salt splashes against the building as salt contamination can lead to the accelerated degradation of the stone. The first signs of this happening usually occur in the vicinity of the masonry joints and beds where there is an easy route for salty moisture movement through the lime mortar. Here, it is best to try to prevent winter road salts to coming into direct contact with the masonry.



Gardens

Gardening can also create problems for wall footings and foundations by either increasing the external ground level above the original floor level, or by reducing the level to such an extent that the foundations become exposed through a drop in the adjacent ground. Both situations should be avoided, ensuring that the original ground levels, commensurate with original floor levels, remain.

Air Drains

In the late 18th and early 19th Centuries the beneficial use of air drains around buildings was well recognised. The air drain allowed evaporation of moisture from exposed wall faces into the constructed trench as a method of dealing with rising damp in wall footings and foundations. Used on a small scale in mansion houses, the same principle was applied to urban developments where basements were constructed to either a half or full level below the public pavement. By aligning and constructing the building in from the pavement edge, a combined air-well and light-well was created with the open space readily allowing moisture to evaporate from the lower wall into the free air. As part of the arrangement, care needs to be taken to ensure that water does not build up and flood into the bottom of the air drain or well by ensuring any drains flow freely.

Surface and Rainwater Discharge

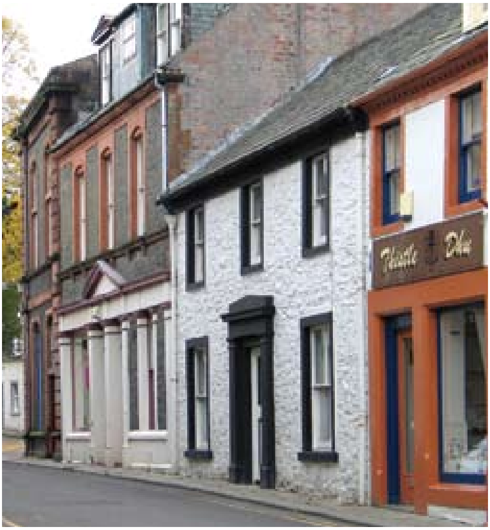
Where water is allowed to concentrate and pool adjacent to walls, associated decay mechanisms will inevitably be triggered over time. The need to maintain an effective rainwater discharge and collection system, combined with the control of surface run off water, is critical for the well-being of the wall foot and foundations. Although many circumstances do exist where rainwater down pipes discharge directly onto the cobbled or tarmac pavement surface this is not ideal as water can readily penetrate from there into the foundations with consequential damaging effects.

A better, but still not ideal arrangement, is where the rainwater down-pipes discharge into an open gully which, in turn, connects with a sub-surface drain to take the water completely away from the building. This arrangement requires regular maintenance to be carried out to ensure that the gully does not become blocked with debris or plant growth, and that the drains function at all times.

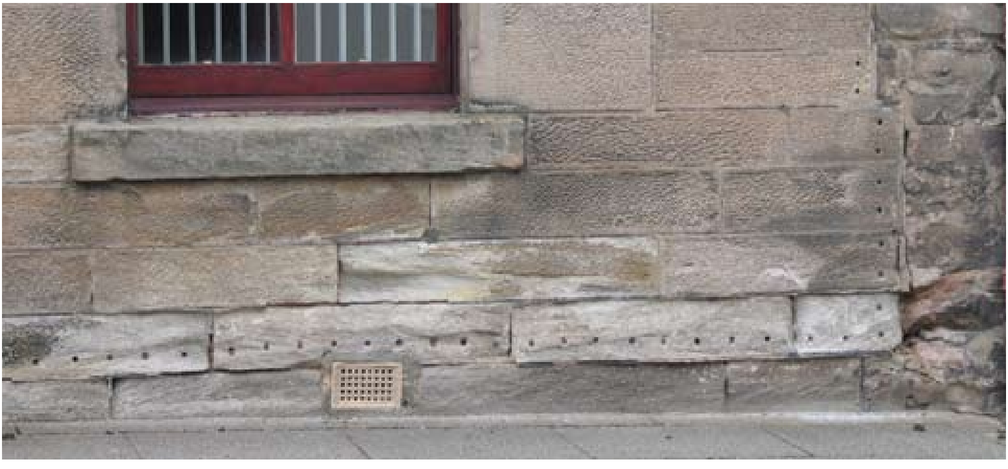
Damp-Proofing

Traditionally constructed lime mortared foundation walls were generally built with no damp-proof membrane. They relied upon their ability to naturally cope with the amount of water that exists in their immediate vicinity. Occasionally, the use of slate may be found in an attempt to provide rudimentary damp-proofing.

In Victorian times the application of a layer of asphalt through the wall thickness above the foundations created the first serious attempt to put a damp-proof membrane in traditional construction. Unfortunately, due to the thickness of the layer of the asphalt, over time this seal can be squeezed out, thinned and broken due to the imposed load of the building constructed on top of it, to become less effective.



Attempts are often made to inject chemicals into a course of wall foot masonry above foundation level to try to prevent water from rising up through the structure. This creates a chemical barrier within the structure of the stone. The technique is only likely to be effective in sandstone and is not so successful in less porous stones like granite or whin. Where used, the technique leaves the disfiguring tell-tale signs of a series of horizontal (and sometimes vertical) holes into which the chemical injection process was carried out. Other proprietary methods involving cutting



into the wall might include active and passive electro-osmotic techniques where electric currents are passed through the installed system in an attempt to control dampness.

More recently, a variety of proprietary paint systems have been marketed that promote the view that if they are applied to the exterior of a building they will protect it from the weather. Whilst this may be true in a homogenously built surface, the claims may be challenged whenever water finds its way behind the painted surface. If the paint is truly impervious this will inevitably drive the dampness more to the interior of the building than allowing it to escape to the exterior. Care should be exercised when considering the application of impervious paint to deal with wall footing and foundational problems.

Conclusion

Whilst many problems can befall building wall footings and foundations, the most fundamental remedy is to try to ensure that they have the minimal amount of water to contend with in performing their function of supporting the building.

The most effective approach is to try to understand how the building works, assess what the surrounding evidence of failure is indicating and to find an answer that takes into account all of the uncovered evidence. Quality specialist advice may be required at times to obtain such a full picture.

Further Reading

Cracking and Building Movement - Book and CD ROM: Peter Dickinson & Nigel Thornton RICS Books ISBN: 9781842191569

Why Do Buildings Crack? BRE Press: ISBN: 978-0-8512-547-60

Cracks Caused By Foundation Movement: BRE Press: ISBN: 978-1-8608-109-78

Structural Movement: is it really a problem?: Clive Richardson: <www.buildingconservation.com> The Building Conservation Directory, 1996 article

The Damp House: A Guide to the Causes and Treatment of Dampness; Jonathan Hetreed; The Crowood Press: ISBN: 978-1-8612-696-69

Rising Damp in Walls, Diagnosis and Treatment: BRE Digest DG 245: BRE Press: ISBN 977-1-8406-012-8

Contacts

Historic Scotland
Technical Conservation Group
0131 668 8668
hs.technicalconservationgroup@scotland.gsi.gov.uk

Historic Scotland Investments and Projects Team:
0131 668 8801
hs.grants@scotland.gsi.gov.uk

Historic Scotland Inspectorate:
0131 668 8716
hs.inspectorate@scotland.gsi.gov.uk

HISTORIC SCOTLAND

Principal author: Ingval Maxwell
Published by Technical Conservation, October 2008
Historic Scotland, Longmore House, Salisbury Place, Edinburgh EH91SH
Tel: 0131 668 8638 Fax: 0131 668 8669
www.historic-scotland.gov.uk email: hs.technicalconservationgroup@scotland.gsi.gov.uk

The House10/08 Produced from sustainable material