

INFORM

INFORMATION FOR HISTORIC BUILDING OWNERS

Structural Cracks



This INFORM offers a brief introduction on how to recognise and diagnose various types of settlement cracks that can be found in traditionally constructed buildings. Understanding the variety of cracks which can appear can also help assist in determining where there is either no need for concern, or where a more serious problem is in the process of emerging that might require professional guidance and support to resolve.

In traditionally constructed buildings movement occurs all the time. In the majority of cases, the extent of this is so small it goes unnoticed. But, it is not uncommon that only when distortions and cracks are noticed for the first time, the natural response is concern over the use or safety of the building and the problems that need to be addressed and resolved.

Traditionally built structures have emerged as a result of trial-and-error. Compared to modern buildings, very few structural calculations were involved in their construction. Successive generations of craftsmen knew intuitively what worked and avoided that which had



previously failed to perform effectively. This hard won experience meant that structural safety and security was automatically incorporated into the way in which they were built. It could be argued that many Georgian and Victorian buildings, which represent a large part of the domestic housing stock, have significantly outperformed the original builders' intentions. But, with their load-bearing walls constructed of stone and lime, the nature of lime mortar readily accommodates the day-to-day flexing and structural movement that buildings are subjected to. Recognising this point is key to understanding whether or not any observed structural movement, manifesting in the form of cracks, creates any real cause for concern to become the trigger for consequential remedial action. Such action only becomes a serious matter when structural movement and cracks occur to such an extent that the in-built safety margins become so jeopardised as to risk the possibility of significant structural failure.

Cracks are indicators

Cracks occur for all sorts of reasons. It is important to recognise that they are the visible symptom of possible problems, not the actual problem itself.

The great majority of cracks tend to be superficial and benign so it is necessary to understand the properties of cracks, and why they have happened. This offers the key to understanding what the level and extent of necessary repair works might amount to.

As a mechanism for releasing stresses that have built up within the structure, cracks will naturally exploit inherent weaknesses in the buildings' design. It is not uncommon therefore to see cracks running from the corners of window and door openings and to observe fractures in associated lintel and sill stones.

Structural cracks can be caused by a variety of problems. These might include:

- Broken drains and water pipes
- Crushed or decayed internal structural timber
- Mining subsidence
- Shrinkage of clay soils
- Tree root growth
- Unstable adjacent walls
- Washed out foundations

Size of cracks

Using the width of the crack is an indication of its severity, cracks might be categorised into five groupings.

Negligible

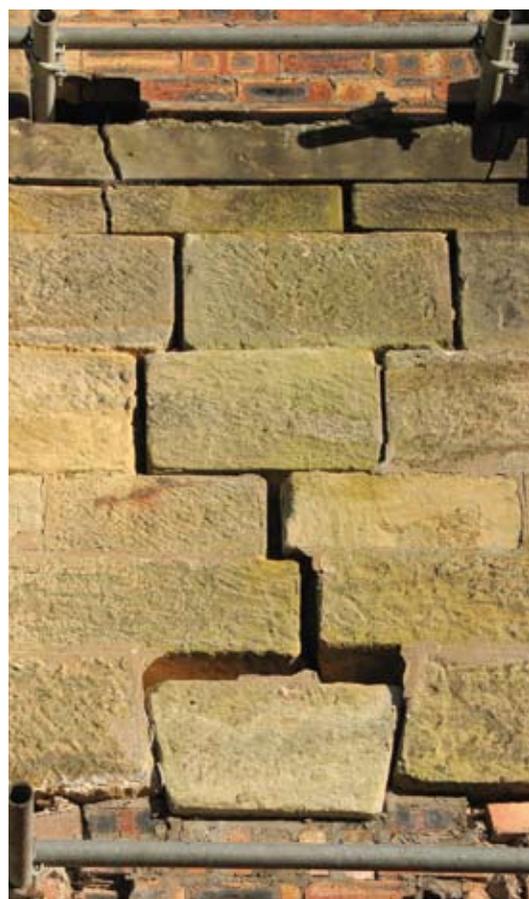
It can be generally assumed that hairline cracks, with a dimension of less than a millimetre in width, are of little concern apart from the aesthetic and nuisance consequences they create. Simple redecoration may be all that is required to deal with the problem.

Slight

Over a period of time, if the structural movement has stopped and stabilised, cracks that are between 1 and 5 mm in width can normally be dealt with through filling the open voids and carrying out redecoration on the interior of buildings, and repointing the affected area on the exterior.

Moderate

Extending in a range between 5 and 15 mm in width, moderate cracks will generally require some builder work to remedy. The related circumstances could also require the involvement of a professional to establish the real cause of the cracks, and to help identify the associated remedial work that needs to be carried out. In



this width range, associated problems are also likely to emerge, perhaps requiring some localised replacement of fractured elements such as window sills, door lintels etc. Work may also be required to remedy any associated concerns regarding the weather-tightness of the building. This may have been compromised through disturbance to roof coverings or rainwater goods as a result of the movement.

Severe

Cracks extending in width up to 25 mm usually indicate that extensive structural repair works will be required. Involving the possible replacement of affected sections of the building, cracks of this dimension may also be accompanied by a variety of lesser dimensioned cracks. Professional advice should always be sought on the cause of the failures and the extent of remedial work. The installation of interim temporary support scaffolding or propping may also be necessary until the remedial works are carried out.

Very severe

Cracks in excess of 25 mm in width will generally indicate very severe structural damage. This will normally require major repair works that could well involve the partial or complete rebuilding of the affected area. Structural underpinning may also be necessary due to the danger of associated collapse and instability. Obtaining early professional advice will be essential in addressing the associated issues. The installation of interim temporary support work will most likely be necessary until the remedial works are carried out.

The shape of cracks

In addition to considering the dimension of cracks, their shape and profile can give a strong indication as to what has caused them to occur in the first place.

Fine hairline cracks running across the face of a wall could simply indicate that a small degree of shrinkage has occurred in the fabric. As most of the walls constructed in pre-1919 buildings used lime mortar, the structure can readily accommodate such fine defects without undue concern. Indeed, hairline cracks may be seasonally driven, appearing and disappearing dependent upon the prevailing climatic conditions.





A diagonally running stepped crack, with the appearance likened to that of a stair when viewed edge on, can indicate that structural settlement is happening, possibly due to upheaval at foundation level or some other form of slippage. Usually starting off as a hairline this pattern of crack tends to follow the alignments of the horizontal beds and vertical joints in the built structure. If foundational settlement continues the crack can consequently grow in width and individual stones or bricks can become loose and dislodged. The advice of a professional should be sought at an early stage.

Vertical, or near vertical, cracks can also be a sign of serious trouble. If the cracks are wide at the top and tight at the bottom this can mean that one or both ends of the buildings' foundation are dropping, or that the middle of the foundations are rising. Vertical cracks also usually mean that the stresses have been sufficiently severe to crack individual stones or bricks in the wall to such an extent that could make the broken pieces also unsafe. If the





failure, particularly if the wall is also acting in a retaining capacity. Such crack patterns might also be found on parapet walls. These should be investigated at an early stage due to the added risk and safety problems that would be created if the parapet became loose and dislodged as a result of the structural failure, and the real risk that the crack could be allowing rainwater to enter the building interior.

cracks are wider at the bottom and tighter at the top then the opposite effects could be occurring. Parallel sets of vertical or near vertical cracks can also display variations on these symptoms which indicate complex foundational movements are taking place. Again, professional advice should be sought at an early stage in the discovery of this form of movement, and temporary support work may also be required.

Continuous horizontal cracks which follow the masonry beds between the stones or brickwork should also to be treated with some concern. They could indicate that walls are in an early stage of

Monitoring cracks

As the majority of cracks develop imperceptibly slowly it is often prudent to set up a monitoring regime to check out what exactly is happening. Basic do-it-yourself methods of carrying out preliminary monitoring have, in the past, simply involved applying and securing a piece of glass or paper tape across the crack. These techniques aimed to register if further movement was taking place, as shown by either the glass breaking or the paper tearing. However, these methods are not accurate enough to give detailed results when compared to the more professional ways of monitoring movement which a competent





structural engineer, surveyor or architect will put in place. This is more likely to be achieved through the installation and monitoring of proprietary “tell-tales”, or the taking and recording of regular micrometer readings across the setting of three pins straddling the crack.

Conclusion

Whilst the majority of cracks in traditional buildings are of the hairline variety, requiring only cosmetic redecoration treatments to remedy, any complexity in the shape, orientation and continuous movement of a crack should be professionally investigated at the earliest possible opportunity. Structural movement is serious when the safety margins of strength, stability of integrity have been significantly reduced, or if movement is progressive and may lead to failure. In such circumstances, a holistic approach to surveying and analyzing the problem should be adopted so that all associated factors can be taken into account when determining the appropriate remedial action.

Further Reading

Cracking and Building Movement - Book and CD ROM: Peter Dickinson & Nigel Thornton
RICS Books ISBN: 978-1-8421-915-69

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

Cracks Caused By Foundation Movement: BRE Press: ISBN: 978-1-86081-097-8

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

Has your house got cracks: T J Freeman, R M C Driscoll and G S Littlejohn: ICE/BRE: Thomas Telbord Limited: ISBN 978-0-72773-089-3

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Published by Technical Conservation Group, October 2008

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