1.8

Summary of First Principles and Process

By following the principles explained in this chapter most cracks can be diagnosed relatively quickly and with a reasonable degree of confidence. It is essential that the process is followed; even where at first sight the cause and effect might seem obvious. Going through the process methodically will help avoid jumping to conclusions.

There will always be a few cracks and causes of movement that cannot be diagnosed from a single visual inspection. In such cases, further investigation will be required. This might involve opening up part of the construction, excavating trial pits to inspect the foundations, taking samples or monitoring over a period of time.

The absolute fundamental principle is that cracking is caused by tension in the material.

The first stage of diagnosis involves sketching the building and the crack pattern in simple line form, just as in the diagrams shown in the examples given already. Then sketch in imaginary lines of tension at right angles to the cracks. The imaginary lines of tension will point in the direction of the movement, which is usually where the cause of the movement and defect actually is. In most cases the upward arrow can be ignored. Once the risk of upward movement has been considered and ruled out, look to the other direction. This is usually down, with gravity.

Practical Guide to Diagnosing Structural Movement in Buildings, First Edition.
Malcolm Holland.

In most cases this process will immediately point to the cause of the defect which will be obvious.

If the overall crack pattern is a little ambiguous, look at the crack itself. Also take into account the factors that can distort the shape.

Rotational movement and short cuts through weak routes are the most significant factors. Load distribution is also a factor, but to a lesser degree.

By looking at the actual displacement of the crack, and by adjusting the angle of the imaginary lines of tension to take these distorting factors into account, the diagnosis success rate can be improved further.

With a reasonable knowledge of building construction and with reference to the 'swatches' and key features of types of movement described in Part Two and Three of this book, there will be very few cracks that cannot be diagnosed relatively quickly.

There are however, always some defects that cannot be diagnosed immediately. There will always be a few where the cause is unusual. In some cases a combination of factors can make a conclusive diagnosis difficult, or impossible.

Diagnosing cracks is not always easy. The movement in a building may have to be monitored for a time before a diagnosis can be made. Some uncovering work may be required, for example, taking out bricks from a wall or excavating trial pits to inspect foundations underground. This may be inconvenient but is sometimes unavoidable.

Always go through the process from start to finish. Do not jump to a conclusion and then find the evidence to fit.

In my experience, many people start from the point of assuming foundation movement, when there are so many more likely causes of cracking than this. With this in mind, it is not an unreasonable practice to consider all other causes, before looking at whether it is potentially foundation movement. Until one gains a reasonable amount of experience my advice would be to consider and exhaust all other possible causes first. Only when all other causes have been considered and discounted, move on to whether it could be foundation movement.

Before moving on to Part Two of the book, please look at the example below (Figure 1.8.1).

The elevation of this building shows a stepped crack approximately 0.5 mm wide running diagonally between the first floor window and the patio door opening below. To the left there is a tree within influencing distance. It would be possible to jump to the conclusion that the crack was caused by the tree, which in this example would not be correct.

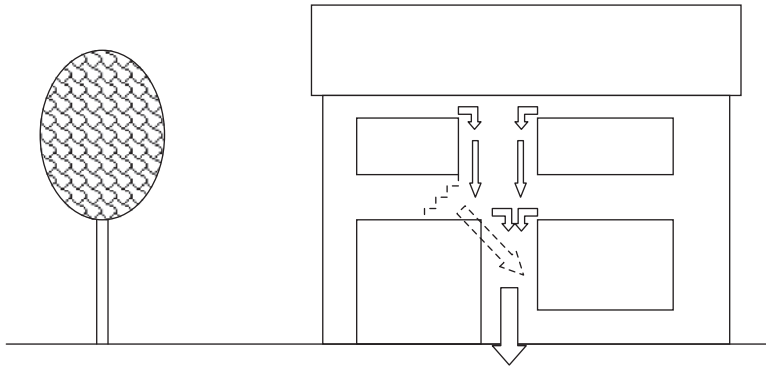

Figure 1.8.1 Arrows of tension point away from the tree.

By going through the process of sketching the elevation and the crack; and then applying an imaginary arrow of tension, it is possible to see that the tension line points down to the right, away from the tree. The movement is down to the right of the patio door opening not down to the left.

The solid arrows on the diagram show the route of the load, around and down the side of the window. The load path goes around the right hand side of the patio door opening. The load becomes very concentrated in this narrow section of brickwork, at the right hand side of the patio door. The load concentration here has probably resulted in long term settlement in this area of the building over a number of years or decades.

The triangle of brickwork under the first floor left hand window is virtually unloaded, other than its self weight. The crack has formed at the junction of the unloaded brickwork and the heavily loaded brickwork.

The crack is therefore due to some long term creep settlement. The movement has exploited the difference in weight distribution in the brickwork and caused a crack along this line. The movement would not be progressive to any significant amount, but if it is re-pointed, it is likely to crack again due to normal seasonal movement.

This demonstrates the importance of not jumping to conclusions. By using this methodology, a logical step by step process can be demonstrated. In addition a more reliable and accurate diagnosis can be made.