

'A Day on the Tools' – An alternative way of learning about Cavity Wall Tie Failure

In this article, Sava student Christopher Moran discusses a recent practical day of mentoring when he shadowed a Property Care Association award winning company 'Bricktie Ltd' when they removed and replaced the cavity wall ties on a 3 bedroom semi detached house in Sheffield. He discusses his learning regarding cavity wall tie failure and alternative suggestions for mentoring during times when it has proven hard for many students to gain practical shadowing experience.

Introduction:

During a recent case study for my diploma in Surveying and Valuation I found a property that was suffering from suspected cavity wall tie failure.



It had many of the classic signs and warning signals of cavity wall tie failure; horizontal cracking high up on the exposed south westerly elevation, the property was built in the 1930's, it was made using black ash mortar and just visible within the cavity (which could be looked into through the cellar door entrance) was a wall tie with visible rusting.

I therefore recommended that the client instructed a specialist to have a cavity wall tie inspection conducted, to see if my suspicions were correct. After reflection, this experience also led me to wonder what happened after I had gone, how do the specialist companies conducted this survey? And how do they fix the issue of wall tie failure if it is found to be present?



What is cavity wall tie failure? What are the main causes of the problem?

Cavity Wall Tie failure is a failure of/ or corrosion to the ties used to hold the internal and external walls making up a cavity wall.

The main cause of failure is the rusting of metal ties, although there can be other causes, such as failure to properly bed the tie in the mortar joint, poor quality mortar reducing the bond between tie and mortar, or not installing the requisite number of ties.



Specifically, the following factors play a part:

- Rust leading to disintegration – possible wall collapse
- Rust Expansion (up to 600% the size of the original tie!)
- Cracking (normally horizontal) and structural distortion in the walls.
- Cracking leads to reduced weather resistance of the wall and an increase in corrosion.
- Corrosion of wire ties doesn't usually lead to cracking. This can cause total failure, without the warning tell-tale cracking, which is associated with thicker section 'fishtail' type ties.
- Generally, wall tie corrosion affects houses between 1920's (first cavity walls) and 1981 (zinc coating tripled).
- However, wall tie problems caused by poor embedment, low tie density and inadequate supervision can be found in all cavity wall buildings, even new ones.

Acceleration can be caused by:

- Aggressive chemicals: e.g. black ash in mortar.
- Chloride salts, e.g. from marine sands or added to mortar as an accelerator.
- Carbonation: as the mortar slowly carbonates the protective alkaline layer is destroyed.
- The aspect - increased water ingress, often South West facing walls.



Is cavity wall tie failure a national problem or geographically restricted to certain areas?

Cavity Wall Tie failure is a national problem. It was thought at one time to be localised as it was believed that it occurred mainly in areas where a catalyst, for example black ash mortar, increased the likelihood of breakdown. It was later appreciated that the problem was more widespread and the causes more complex.

However the geographical issues of adverse weather and salt in the air can lead to a more rapid breakdown of the wall ties. Likewise, the localised use of wall ties prone to failure could create pockets of increased failure.

What is the difference between cavity wall tie failure and sulphate attack in brick walls? How do you tell the difference between the two during a site inspection?

Cavity wall failure is identified by horizontal cracks that correspond to the mortar courses containing the ties. Often at 450mm intervals.

Sulphate attack in brick walls may occur in every joint. Often a white colouring is seen in the mortar as it deteriorates. It is also often accompanied by frost attack as a by-product of the large volume of water involved.



A 'day on the tools' with Bricktie:

I decided to act on my questions and found a local company with a very good reputation – Bricktie Limited. Seeing that they were the Property Care Association winners in 2014 and that their managing director, Bryan Hindle, was very enthusiastic with his own blog about property issues (<http://www.preservationexpert.co.uk>) I contacted them and asked to shadow a wall tie replacement job. I was over the moon when I received a call from Bryan, who in his positive manner arranged for me to shadow his team on an upcoming 3 bedroom semi-detached property in Sheffield.



On the day of the survey I must admit, as well as the snow and the minus 2° temperature, I was a little concerned about how the Bricktie team might take to a fresh faced student in his obviously brand new Screwfix steel toe caps and helmet, but... they couldn't have been friendlier!

I spent the day with the team as they located and isolated all the corroding ties, replacing them with new stainless steel ties with a 25 year warranty. I was shown their process and had really interesting discussions about how surveyors might benefit from their knowledge when conducting inspections.

How they fixed the wall tie issues:

A wall tie surveyor is instructed to attend at the property and drills an access hole into the cavity. They then use a borescope to view the wall ties and make a professional judgement on their condition. Boroscopes are the tool of choice for wall tie surveys, however the prevalence of cavity wall insulation has increased the need to remove bricks or chase-out bed joints so that a surveyor can clearly see the extent of corrosion (if any). They produce a report and if required, issue a detailed specification, with a quote for remedial work. If appointed, technicians come back to the property with appropriate scaffolding and set about the job.

1 - A metal detector is used to locate all the ties within the cavity, marking their position with a **builder's crayon** (see the yellow line on the image on the right). Interestingly, some wall ties may be so corroded that the metal detector gives only the faintest of signals. The metal detectors have adjustable sensitivity, and the skill of technician comes into play to locate the ties.



2 – Once all the old ties are marked, the technician uses a **heavy-duty angle grinder** to grind through the mortar and then into the head of the tie itself, in essence chopping the tie down to about two thirds of its original length. A **vacuum attachment** is of vital importance at this stage, as it removes the debris created by the grinding, rather than having it fall into the bottom of the cavity and potentially cause damp bridging issues in the future. This process leaves a wall with a very pronounced series of horizontal chases in the outer leaf wall, as can be seen on the right.

3 - The new remedial wall **tie holes are drilled** into the mortar where the new ties will be installed. (Seen on the right also). The technician drills the holes into both the outer and inner leaf at a **slight upward angle**, meaning in the future that any water that gets onto the new ties will be pulled by gravity towards the outer leaf. Brick-Tie used a ‘Helifix’ remedial tie with a helical twist along its full length. This helix acts as a repeating drip-feature, as well as providing an excellent key for the resin.

The holes are drilled into the mortar (rather than as many text books state – the centre of each brick) for a number of interesting reasons; by drilling the mortar, the rear of the brick does not shatter (such spalling commonly happens when drilling through brick and blocks). This approach prevents a build-up of debris in the cavity and associated damp/bridging issues (a significant issue when a house has existing cavity fill insulation installed). When the wall is repointed, if repointed well (Bricktie technicians use careful colour matching dyes in their mortar) the visual aesthetic of the house is maintained and the property doesn’t have the polka dot appearance that some properties have after wall tie replacement. Finally, the mortar is softer and therefore it reduces the amount of vibration exposure produced during drilling, leading to safer long term health outcomes for Brick-Tie’s technicians, helping avoid Hand Arm Vibration (HAV) related injuries, like vibration white finger.



4. Isolation explained – The remaining old wall ties are **'isolated'** to prevent future issues. This is essential because there may be a small wafer of old tie left in the outer leaf, which will corrode and expand in the future. The chases (horizontal holes left by the angle grinder) need to be re-pointed without re-encapsulating the remaining tie section in mortar, where its continuing corrosion would otherwise cause new cracking. Although the new wall ties would hold the inner and outer walls together, the rusting old ties could still cause issues with expansion and cracking. As such they are **'isolated'**. There are many methods of doing this, but a common and efficient method is



cutting pieces of plastic DPC and creating an isolator hood that is pushed into the gap to encase the old tie and prevent new mortar from touching the tie. In effect the remaining section is left in a void – an expansion pocket, into which the slight growth of the thin section can expand, without being constrained. This is then over-pointed. The correct and diligent treatment of the old ties is the most frequently neglected part of wall tie corrosion projects. However, the basic methodology is proven to work and has been used for over 35 years.

5. The resin-bonded tie system - Brick-Tie have their own styrene free, self-mixing resin, **which is injected** through the new drill holes first into the inner leaf. The **new wall ties are then inserted**, before resin is injected into the outer leaf and left to set. (The image on the right shows a Helifix remedial cavity wall tie used in this job).

A random selection of ties are only resined into the inner leaf and when all the resin is set, they are tension tested to ensure that they are of sufficient strength to hold the two walls together. The test results are recorded. The work can only be signed-off and guaranteed if the ties have passed all tests.

**There are very many different types of remedial wall tie. Mechanical, friction fix, grouted and chemical fixings all have a place. I asked Bryan about this and he states that most available systems are acceptable, "The surveyor or specifying specialist should consider each project on merit and use the most appropriate tie for that situation. There is no such thing as one-size-fits-all. The most important issue is not the wall tie, brand or model – the technician is the crucial element – skill, knowledge, on site testing and most of all engagement in the success of the work is what makes or breaks any remedial work."*



Stage 6 – The final part of the process is repointing all the holes and gaps left by the ground out mortar. A skilled technician brings a variety of mortar dyes and aggregates with them to colour match the mortar between bricks and the pattern of any render that may be on the property.

However, this is a challenging process, especially in render (see image on right from www.designingbuildings.co.uk - not the work of Bricktie) and as such repainting or repointing is common.



My explanation of the process is a simplified version of a very common method which the technicians explained to me they have been using regularly for over 10 years, but there are many other methods available. If the topic interests you, I highly recommend Bryan Hindle's blog,

(<http://www.preservationexpert.co.uk>), that goes into significantly more detail. Alternatively, a good place to look at the different kinds of remedial wall ties and their advantages and disadvantages is the Building Research Establishment Digest number 329.

My learning points when conducting surveys and when wall tie failure may be an issue:

- I've often read that evidence of drill holes through brick indicate cavity wall tie replacement and drill holes through mortar indicate cavity wall insulation has been added. However, as I've described, I was advised by the technicians that cavity wall ties are now more commonly resin fixed in through the mortar and not mechanically fixed through the bricks.

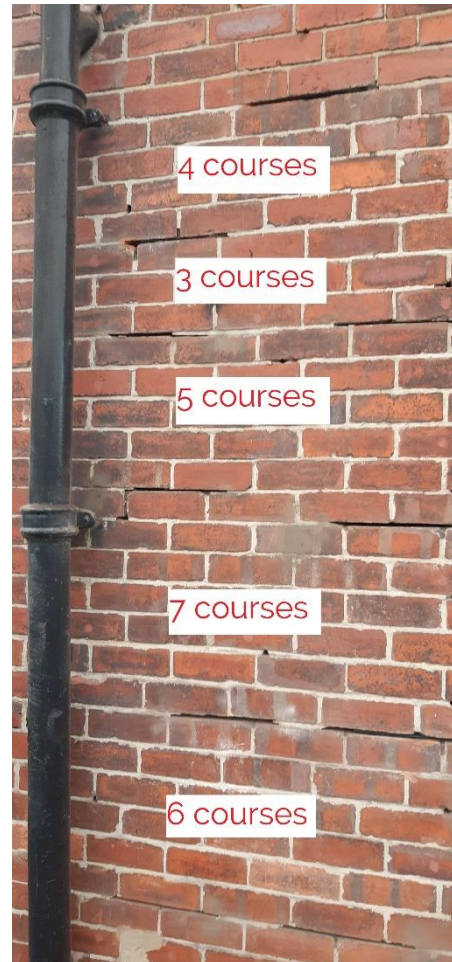
As such when evidence of drill holes is found in external walls, although general principles can be followed, assumptions shouldn't be made too soon. Drill holes in mortar, at around 900mm x 450mm centres could be evidence of wall ties.

Further research may be required to fully clarify what work has been conducted to the property.



- It's really important to focus on the part of the text books that state wall ties are **OFTEN** at 450mm/6 brick course vertical intervals, **not ALWAYS**. As I found (image to the right) this really is not always the case, with one small section of wall having wall ties at intervals of **3,4,5,6 and 7 course intervals**! The original builder of the property may have miscounted, forgotten to add a tie, or maybe even dropped one down the cavity and not been bothered to climb down their ladder to get another!

As such, when inspecting a property, don't be tricked into thinking that if the horizontal cracking you are seeing doesn't correlate perfectly to 6 brick courses, it therefore can't be cavity wall tie failure.



- Cracking is not always horizontal.** Although the wall tie may be the cause, the ensuing cracking pattern may follow lines of weakness. Stepped cracks will often propagate where the stresses associated with tie expansion resisted by returns at corners, placing the masonry in tension. This is especially prevalent near weakly loaded areas such as at eaves level, below low parapet walls and around and under openings.



- Recommending a wall tie survey** (inspection) needn't be too concerning a decision for a surveyor. With inspections costing (through my research) a similar amount to a drain CCTV survey, the outlay is minimal compared to the potential cost and disruption to the client to

replace wall ties throughout a property. However, not all vendors will allow such intrusive inspection and appropriate negotiation with the agent may be required.

- **Wall tie failure can often be subtle** and easily missed. The property that I have been discussing throughout this article had only minor horizontal cracking and slight bowing to the side wall that could be easily missed. It really highlighted the importance of considering the **other evidence available**, such as the age of the property (and therefore it's likelihood of suffering from wall tie issues), the finding of black ash mortar, and any evidence obtained from neighbouring properties – that may be suffering from wall tie issues, or have had their wall ties replaced.



It also brought to mind the relevance of part 11.3 (2f) of the RICS Valuation - Global Standards 2017:

UK national supplement, which states (with reference to valuation inspections) “Where there are locational factors that may impact value, they should be recorded and reported, with some comment where appropriate. Certain problems, such as flooding, mining settlement, subsidence, woodworm, invasive vegetation, radon gas, mundic and other issues are particularly prevalent in certain districts. If appropriate, the valuer should make some reference to these defects, **even if the subject property does not appear to be affected** at the time of the inspection.”

My general advice for Sava students looking for mentoring:

It's been a very difficult time for students, with the coronavirus pandemic preventing conventional surveyor shadowing. The day with Bricktie led me to think about alternative methods of gaining experience. I've found some success with the following approaches, that my fellow students may wish to consider:

- Approach non-conventional mentors or shadowing experiences. As I've detailed above, being on site for a day during a wall tie replacement taught me a huge amount. Perhaps a day with other professionals who work outside may benefit you? I've no doubt that a day with a roofer, a builder or a drainage company would be of great benefit.
- If a prospective mentor is unable to meet you, due to their health vulnerabilities, or their organisational policies, perhaps they might consider 'online mentoring'? An hour a week/fortnight/month on zoom to talk through a pre-arranged topic area, or discuss issues you've found with your work? I've found that if you choose a pre-arranged topic, it really makes you focus on reading up on that topic area prior to the zoom call.
- Approaching mentors and requesting for them to 'be your mentor' can be quite a lot of pressure and off putting for prospective mentors. They don't know you, and may not wish to commit to such a long-term arrangement. I've found that asking if they mind if you come out with them for a day or two is far less pressuring and has a higher success rate. Then, if you

both enjoy each other's company, it can easily lead to longer term mentoring. A try before you buy for both of you!

- Create a professional LinkedIn account and a good CV. Add the hyperlink and the CV in your emails. It helps prospective mentors get to know more about you.
- Approach a second year SAVA student! They know what you are going through and should have good knowledge of surveying, construction and valuation, being able to assist you with any areas of weakness you may have. Also, they can answer specific questions you might have about the assessment requirements of the second year. You'll often find them on LinkedIn.

About Chris Moran:

Chris is a Sava student studying the Diploma in Residential Surveying and Valuation who is currently being mentored by Phil Parnham. He is currently half way through his final assessment year and is very interested to hear from any employers in the Sheffield area. To get in touch with Chris, please email: chrismoransurvey@gmail.com or view his LinkedIn profile at: <https://www.linkedin.com/in/christopher-moran-068569194/>

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