Surveying Historic Timber-Framed Buildings

The survey, identification of defects and specification of remedial work in timber-framed buildings is a specialised area and a trap for the unwary. Richard Oxley provides some initial guidance on this important subject.

Introduction

Some of the oldest and most interesting buildings in Britain are timber-framed. The number of timber-frame buildings that survive illustrates that they are both resilient and adaptable, with many of these buildings continuing to be in active every-day use.

The majority of historic timber-framed buildings are listed and therefore statutorily protected. Some historic timber-frame buildings survive from as early as the 13th and 14th centuries and will have been subject to varying degrees of alteration, repair and decay. The longevity of historic timber-frame buildings means that they are usually highly individual and complex structures.

Timber-frame buildings are vulnerable to decay, particularly where impervious materials have been introduced. It is not unknown for the structural integrity of timber-framed buildings to be put at risk as a result of the introduction of impervious materials.

Unfortunately, the importance, complexity and vulnerability of historic timber-frame buildings is not always understood or taken into consideration when their condition is being assessed. This can lead to inappropriate recommendations that result in unnecessary, damaging and irreversible work.

Historic timber-framed buildings are special and deserve to be surveyed in a manner that befits their age and historical value. This article outlines the principal factors that need to be taken into consideration when providing a report on a timber-frame building.

Understanding the Timber Frame

Assessment of the timber frame

The timber frame is the primary structural component, the skeleton, of a timber-framed building. Consequently, it is imperative that the inspecting surveyor appreciates that the structural performance of the building is dependent upon the inter-relationship between the timbers and their joints.

This is often overlooked or under-estimated, and it is not uncommon to encounter reports produced by surveyors and other professionals that do not assess the performance or the condition of the timber frame. In many cases the timber frame is inspected and reported upon as part of the roof, the walls and the floors, but not as the primary structural component of the building.

A survey that does not assess the performance and condition of the primary structural component of a building is at best misleading and in some cases will be negligent. It can therefore be argued that to achieve an understanding of the condition of a timber-framed building the frame and its joints need to be inspected and reported upon separately.

The assessment of a timber-frame will need to include:

- The identification of the frame type; eg box-frame, cruck, aisled
- Noting the constructional detailing of the primary timbers and joints
- Noting any alterations to the timber-frame
- Determining if the structural performance of the frame has changed. The questions that can be asked include:
    - Is the frame still performing as intended?

    - Are timbers missing, or have they been altered?
    - Have masonry walls superseded the structural role of the timber-frame? Is the building now a 'composite' structure? (For example, a combination of a timber-framed and masonry structure)
    - Are the masonry walls capable of performing a structural function? A common problem encountered is where single skin brick infill panels take on a structural function where the sill beam (sole plate) has decayed away. In many cases the infill panels are not capable of performing a structural load-bearing role.
- Determining whether the joints are still capable of performing their intended function
- Assessing the timber-frame as a three-dimensional structure, the relationship between the external and internal timbers
- The identification of areas that have suffered from decay
- The identification of past repairs and whether they have been successful
- The identification of areas at risk, or suffering from, active decay

Identifying the Timber

The age, type and quality of timber used in the construction of repair of a building will dictate its vulnerability to decay and its resistance to chemical treatment. The type of timber will also determine the performance characteristics of the timber frame and the types of decay that can attack the timbers.

Although it is difficult, and sometimes impossible, to identify the species of timber from a visual inspection every effort should be made to assess whether the timber is the sap or heartwood of a hard or softwood timber. It is also important to identify how the timber was converted (cut for use) in the building, for example, is the timber boxed heart or halved?

The sapwood of all timbers has little resistance to attack from wood-rotting fungi, whereas the natural durability and resistance to treatment with chemical preservatives of the heartwood of timbers varies with each different species. For example, two of the most common timbers in historic timber-framed buildings are oak and elm. The Building Research Establishment (BRE Digest 296. Timbers: Their Natural Durability and Resistance to Preservative Treatment) classifies the heart-wood of oak as being a naturally durable timber that is extremely resistant to treatment with chemical preservatives, whereas the heartwood of elm is classified as being non-durable and moderately resistant to treatment.

Understanding the building's performance

It is important to appreciate how old buildings traditionally performed and how changes to the traditional 'breathing' performance can have a detrimental influence on their condition.

The introduction of impervious materials (such as modern paints, cement renders, fillets and patch repairs over joints etc) will reduce the areas from where moisture can readily evaporate and increase the likelihood of moisture becoming trapped within the fabric and against the timbers.

Where the fabric and, in particular timbers, are subjected to prolonged dampness the conditions conducive for active fungal decay and wood boring insect infestation will be present. It is therefore imperative that there is an appreciation that where impervious materials have been used to repair or maintain a timber-framed building that there is a strong risk that decay will be present.

Cladding and infill panels

The cladding and external finishes to timber-frame buildings are important as they play an integral part in the traditional performance of the building.

Answering the following questions will assist in understanding the traditional performance of the building, the condition of the timber-frame and the risks of decay:

- How was the building originally presented? (Was the timber-frame originally protected by rendering and/or limewash?)
- What alterations have been made? (Is the timber-frame now exposed when it was never intended to be?) (Has the historic cladding or finishes been removed or concealed?)
- What types of material have been used to repair and maintain the building? (Are they traditional porous and compatible materials, or are they modern hard and impervious materials?)

Assessment of decay

An inspection of the timbers most at risk, such as sill beams near ground level, timbers in contact with impervious materials and timbers below leaking roof coverings or rainwater goods, is an important part of the survey of a timber-framed building.

To appreciate the risks of decay to a timber-framed building, and to avoid the unnecessary treatment with chemical preservatives, it is essential that the inspecting surveyor can identify the principal agents of decay (fungal decay and wood boring insect infestation). For example:

- The most common types of decay mechanisms, such as the wet rots and wood boring beetles; common furniture beetle (*Anobium punctatum*), death watch beetle (*Xestobium rufovillosum*), lyctus powder post beetle (*Lyctus brunneus*), and forest long horn beetle;
- Whether the decay is active, and;
- Whether it is of a type that requires treatment. For example, lyctus powder post and forest long horn beetle can only attack the sapwood for a relatively short period of time after the timber has been felled. In a building that is four centuries old these infestations will be inactive and do not require treatment.

There is a large difference in the significance of an attack by common furniture beetle and an attack by death watch beetle. In a recent case (*Oswald v Countrywide Surveyors*, reported in Structural Survey Volume 12, No 5 The Death Watch Beetle Case & No 6 Do Women Like Beetles?, 1993/4) a surveyor did not make a clear distinction between common furniture beetle and death watch beetle, making only a reference to woodworm *a generic term usually associated with common furniture beetle). In this case the surveyor was found to be negligent in failing to warn the client of the severe structural damage that death watch beetle is capable of causing. This case highlights the importance of positively identifying the decay mechanisms and having an appreciation of the damage that they can cause.

Assessing the rate of decay suffered by the timber frame

An appreciation of the rates of decay being suffered will assist in deciding what recommendations need to be made. For example, if the frame is suffering from accelerating rates of decay that are putting the structural integrity of the building at risk then works to remove the causes of decay and repair the frame will need to be implemented as soon as possible, whereas if the rates of decay are at an acceptable level and there are no structural issues a more sensitive approach can be adopted.

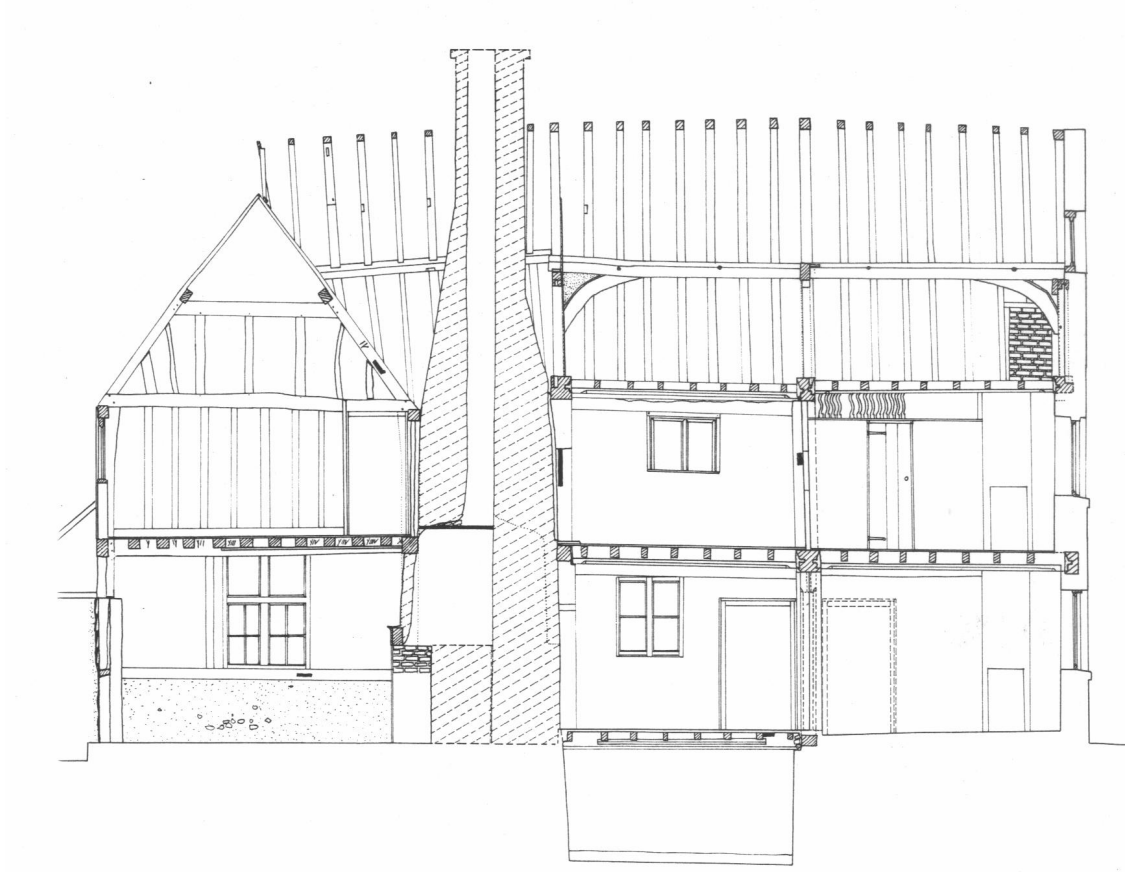

Figure 1: Brockley Hill Farm, Stanmore, Middlesex. Drawing by Mike Dunn, Beams, Hertford

Carrying out the Survey

The physical inspection of the timber frame of many buildings will be severely limited by the presence of masonry, renders, weatherboarding, plasters, internal floors and ceilings, as well as the contents of the building. In most cases it is difficult to determine the precise constructional detailing or condition of all of the timber frame.

The physical survey of timber-framed buildings is greatly assisted if a measured survey is available (*fig 1*). The availability of such information makes it easier for the surveyor to understand the building, and to identify alterations and any timbers that are missing. However detailed information of this nature will not normally be available and the surveyor will have to collate as much information as possible on site. This is usually best achieved by sketching and annotating the timber frame (*fig 2*).

To avoid becoming overawed at the number and complexity of timbers, the timber frame and the associated components of the building need to be broken down into achievable and manageable tasks. This can be achieved by inspecting the primary timbers first, starting with the cross-frames, gradually building up a picture of the timber frame until the secondary timbers (studs, rails and common rafters) can be inspected. From this inspection it will be possible to identify what timbers are present, what their condition is, and to form an overall impression of the condition of the frame.

The physical inspection of the timber frame will need to include:

- Selective probing with an implement such as a blunt screwdriver to test the resistance of the timbers so that an assessment of the extent of surface decay can be made

- 'Sounding' the timbers with the handle of the screwdriver, or an implement that will not cause damage to the timbers, to gain an idea of the presence of decay below the surface
- The use of a hacksaw blade, to test if tenons are present in joints

None of these methods are 'scientific' or conclusive, but they are an important part of gaining an overall picture of the condition of the timbers.

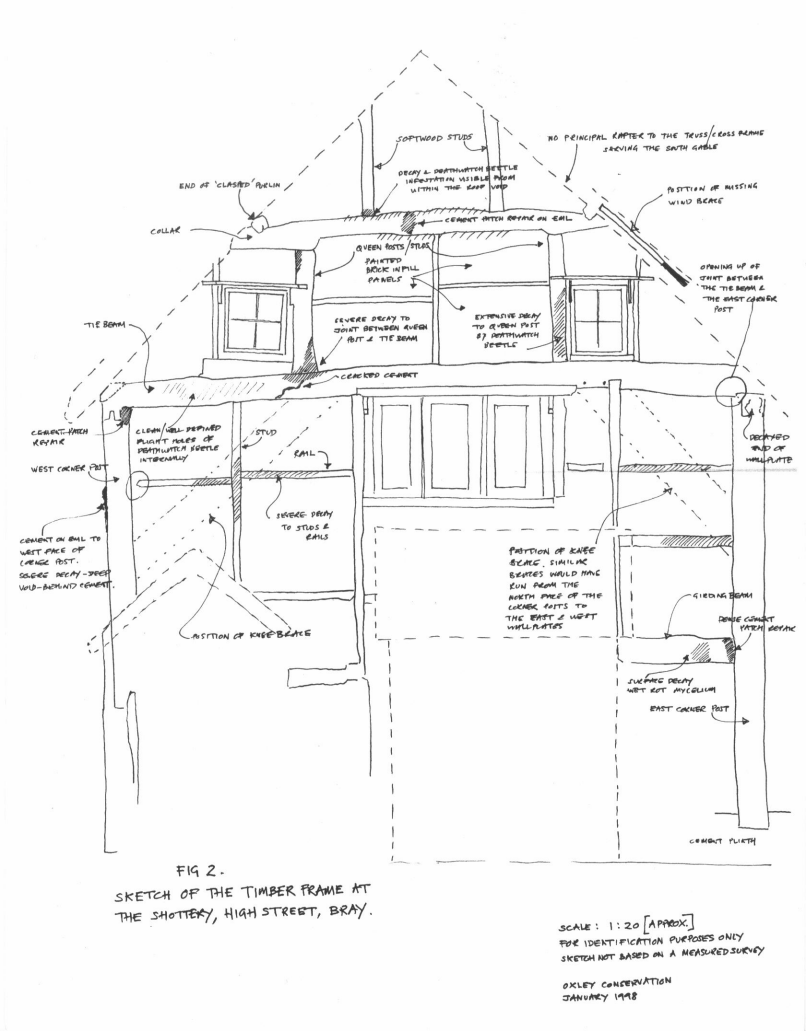

Figure 2: Sketch of the Timber Frame

Further Investigations

The limitations of the inspection will in many cases dictate that parts of the building will require a more in-depth investigation so that the precise constructional detailing and condition can be determined. To avoid unnecessary work it is essential that any further investigations are not carried out by anyone with a vested financial interest in work following their own recommendations.

Further investigation might include careful and limited opening-up, such as the removal of areas of external cladding (render, weather-boarding etc). Obviously, this requires the permission of the owner, and in the circumstances of a pre-purchase survey will not usually be permitted.

Alternatively, non-destructive techniques can be used, such as micro-drilling, ultrasound scanning and heat sensitive photography. These systems do have limitations and are dependent upon the knowledge, skill and interpretation of the operative.

It is essential that any further investigations, whether it is based upon physical opening-up work or non-destructive systems, is based upon independent advice; a knowledge and understanding of timber-framed buildings; the causes of decay; and the decay mechanisms themselves.

Remedial Work

Repair works, albeit well intentioned, can cause extensive and irreversible damage to both the timber-frame and the fabric and finishes of the building. The extent of damage caused by some repairs can be greater than that suffered by the building after centuries of 'gentle' decay.

Sensitive historic fabric, such as wattle and daub, earth and lime plasters and wall paintings, are all at risk where physical repair is required. Unfortunately many historic buildings have lost their historic finishes during programmes of repair. It is therefore essential that a greater emphasis is placed upon retaining these finishes and that stripping back to the skeleton is avoided at all costs.

An understanding of the types of repair options that are available, together with their advantages and disadvantages, is essential before recommending or specifying any repairs to a timber-framed building. The principal repair options that are available are traditional carpentry repairs; the use of metal straps, and resin repairs. Some of the factors that need to be taken into account when selecting a repair option include:

- Structural performance
- Consistency with the existing fabric and previous repairs
- Compatibility; for example, the risks of tannic acid from oak on metal, and the introduction of impervious resins where there is a risk of moisture causing a problem of decay
- The level of intervention required to the historic fabric
- Practicality
- Cost
- Proven history of success
- Interpretation; is it an 'honest repair'
- Reversibility
- Aesthetics

Surviving earth finish – infill. Every effort needs to be made for surviving historic finishes to be retained within any programme of repair

The Report

The information collated from the inspection needs to be reported to the client. The report needs to stress the importance and performance of the timber frame, which should be reflected in the frame being provided with a separate section in the report.

The report needs to provide positive recommendations on the condition of the timber frame, the type of defects identified, and where necessary the need for further investigations. The report would benefit from being supported with sketches and photographs that will assist in explaining the structure and any problems identified to the client.

Summary

Historic timber frame buildings differ from masonry structures. Those who inspect and report upon these buildings should adopt an approach that reflects the special characteristics of timber-framed buildings. This could be achieved by illustrating the following:

- That a conservation-minded approach has been adopted, that reflects the special architectural and historical value and importance of these buildings
- An ability to put building conservation philosophy and knowledge into practice, thereby ensuring that the importance of the historic fabric is fully respected and that the building or its fabric will not be adversely affected by any recommendations made
- An understanding of the protecting legislation and its implications
- That each building is approached in a manner that reflects its individual nature
- An understanding of how timber-framed buildings were traditionally constructed, repaired and maintained
- That the timber-frame is the primary structural component, and that this is reflected in the manner that the building is inspected and reported upon
- The age, type and quality of timber used
- The importance of the traditional performance
- The consequences of any detrimental changes in the traditional performance
- The ability to recognise the type and nature of defects that the building is likely to suffer from
- The available methods for appropriate and sympathetic repair

Adopting an approach similar to that outlined above will increase the chances of historic timber-framed buildings receiving reasoned and informed advice, which will contribute to prolonging the life of these special buildings and their fabric, both the timber-frame and the historic finishes.

Further Reading & References

SPAB "The Need for Old Buildings to 'Breathe'" Information Sheet 4. SPAB The Society for the Protection of Ancient Buildings "Is Timber Treatment Always Necessary? An Introduction for Homeowners" Information Sheet 14. RICS Building Conservation Group "Damp & Timber Treatment do's & Don'ts Guide 3" Building Conservation Journal No 18, Winter 1997. Bravery, Berry, Carey & Cooper "Recognising Wood Rot and Insect Damage in Buildings" BRE. "The Mortice & Tenon" available from: The Mortice & Tenon, 6 Orchard Cottages, Wick Lane, Camerton, Bath, North Somerset BA3 1PG (01249 716425)