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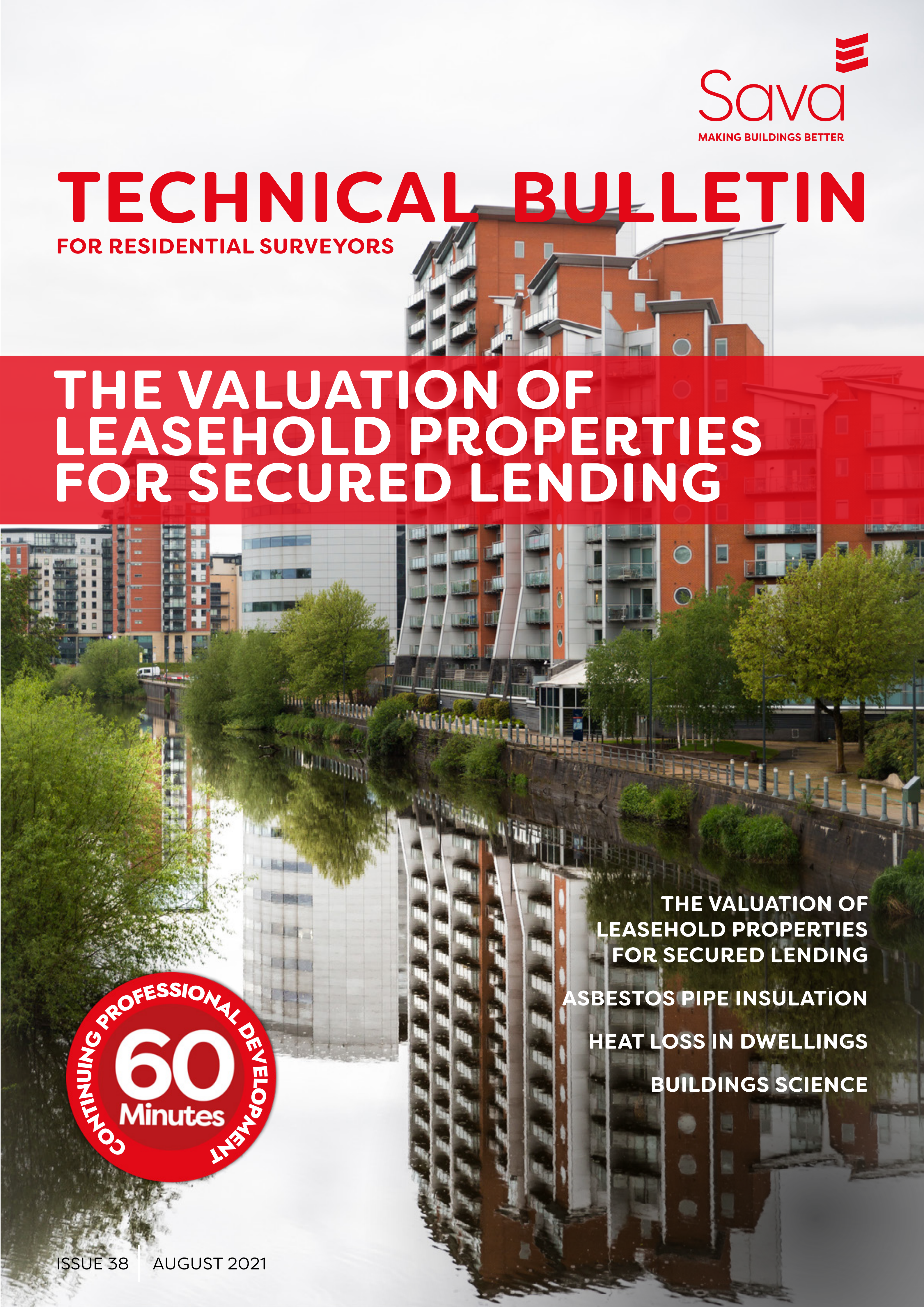
TECHNICAL BULLETIN

FOR RESIDENTIAL SURVEYORS



THE VALUATION OF LEASEHOLD PROPERTIES FOR SECURED LENDING

CONTINUING PROFESSIONAL DEVELOPMENT
60 Minutes

ISSUE 38 | AUGUST 2021

THE TECHNICAL BULLETIN

FOR RESIDENTIAL SURVEYORS

Welcome to the Technical Bulletin. This Bulletin is designed primarily for residential surveyors who are members of RICS and other professional bodies working across all housing sectors. Other professionals may also find the content useful.

Produced by Sava, you will find technical articles, regulation updates and interpretation and best practice. We hope you find this useful in your day-to-day work and we welcome any feedback you may have and suggestions for future publications.

Who we are

We are a team of building physicists and engineers, statisticians, software developers, residential surveyors, gas engineers and business management specialists.

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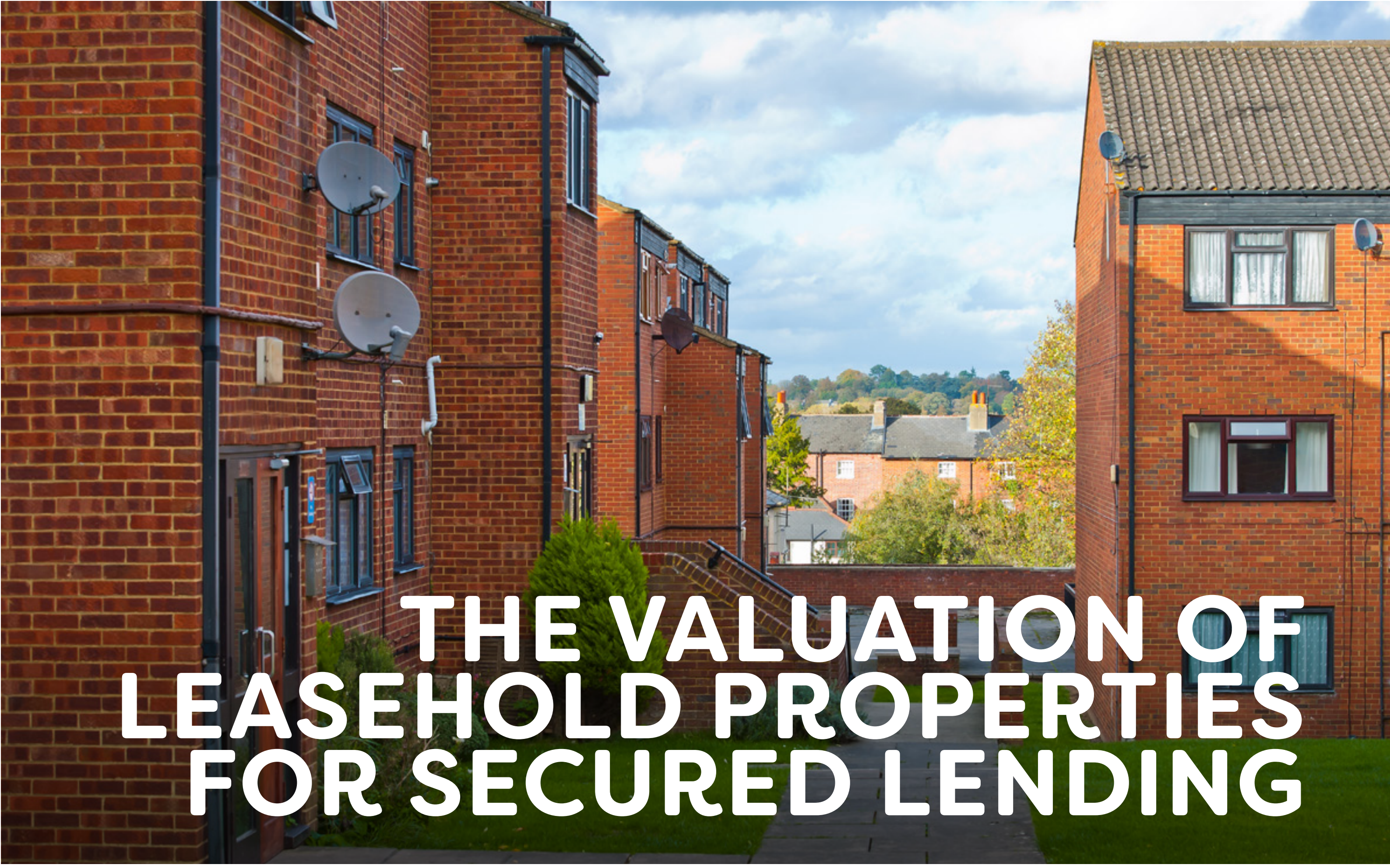

THE VALUATION OF LEASEHOLD PROPERTIES FOR SECURED LENDING

INTRODUCING THE LATEST RICS GUIDANCE NOTE ON VALUING LEASEHOLD RESIDENTIAL PROPERTY

HILARY GRAYSON BSC EST MAN (HONS) DIRECTOR OF SURVEYING SERVICES, SAVA
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The RICS recently published a new guidance note: "Valuation of Residential Leasehold Properties for Secured Lending Purposes". This guidance note, which covers England and Wales, is effective from 1 July 2021. In this article, we look at this new publication and discuss some of the implications for valuers undertaking secured lending valuations.

Why do we need a new guidance note?

The difficulty with leases is that they are, by definition, a depreciating asset. From the day that they are created the clock starts ticking, and at the end of the lease the subject property reverts to the freeholder leaving the leaseholder with nothing.

Of course, the length of many residential leases are for such a long period of time that they are treated in a very similar way to freeholds – a 999-year lease is as far into the future as the Battle of Hastings is in the past. Up until recently, we would not have given this a further thought, particularly as the ground rents on those leases were minimal and were often not required to be reviewed for the entire period of the lease. However, some developers saw a way of retaining an interest in sites and making additional profit by selling houses and flats on a relatively short leasehold basis. Many of the homeowners affected had little or no idea of the implications of being a leaseholder rather than a freeholder which has led to the recent bad press around leasehold properties. In addition, the leases, as well as being shorter, were set up with rapidly escalating ground rents together with other clauses that may have a material effect on value, meaning that lenders are more sensitive to the potential risks associated with leasehold property. Valuers can no longer rely on very general assumptions around lease clauses and must give 'proper consideration' to material matters that will have an impact on value. In answer to this, the RICS has launched a guidance note to assist valuers who are undertaking valuations of leasehold properties for secured lending purposes.

How is it structured?

The new guidance is divided into 8 sections or chapters:

1. Introduction
2. Background
3. Legal responsibilities
4. Diminishing lease terms
5. Restrictive covenants and planning agreements
6. Other factors affecting value
7. Guidance for conducting a mortgage valuation of a leasehold property
8. Summary

The scope of the document is covered under section 1.1 and it makes the following clear:

- The document covers valuation for secured lending purposes only.
- It provides a supplement to the Red Book Global Standards and the UK national supplement.
- It is directed at properties that are likely to qualify for rights under the leasehold reform legislation (e.g., the Leasehold Reform Act 1967 and the Leasehold Reform, Housing and Urban Development Act 1993), but not at properties that this legislation does not cover.
- It is applicable where the term of the lease is 55 years or longer (usually for a term less than 55-years a lender will have specific instructions).

Changes to the regulatory framework

There is a lot currently going on in the world of leasehold property and you might question why the guidance was published now instead of postponing publication until there was more certainty. But in truth, it has been in preparation for some time, and though a lot is happening, there is the need for guidance now in response to the changes in lender expectations.

So, what is happening? In late 2017, in response to the extremely bad press around the issue, the government announced plans to tackle the growing problem of newly built houses sold as leasehold rather than freehold, and to limit ground rents on new lease agreements.

The Law Commission picked up the baton and looked at leasehold reform with the aim of finding ways to make buying a freehold or extending a lease "easier, faster, fairer and cheaper." In the two years between July 2018 and 2020 it went on to publish ten consultations and subsequent papers on this topic alone. This included recommendations on enfranchisement, commonhold and 'right to manage'. In January of this year, Robert Jenrick, the Secretary of State, announced that leasehold reform would be tackled through two pieces of legislation. The first of these is The Leasehold Reform (Ground Rent) Bill, introduced in the House of Lords on 12 May 2021. This Bill aims to fulfil the government commitment to "set future ground rents to zero." The provisions will apply to leasehold retirement properties, but not before 1 April 2023.

But future legislation is planned, and the government has announced that this will:

- Reform the process of enfranchisement valuation used to calculate the cost of extending a lease or buying the freehold.
- Abolish marriage value.
- Cap the treatment of ground rents at 0.1% of the freehold value and prescribe rates for the calculations at market value. An online calculator will simplify and standardise the process of enfranchisement.
- Keep existing discounts for improvements made by leaseholders and security of tenure.
- Introduce a separate valuation method for low-value properties.
- Give leaseholders of flats and houses the same right to extend their lease agreements "as often as they wish, at zero ground rent, for a term of 990 years".
- Allow for redevelopment breaks during the last 12 months of the original lease, or the last five years of each period of 90 years of the extension to continue, "subject to existing safeguards and compensation".
- Enable leaseholders, where they already have a long lease, to buy out the ground rent without having to extend the lease term.

In addition, the government has said that responses to the Law Commission's recommendations on enfranchisement, commonhold and right to manage will be issued "in due course" and translated into law "as soon as possible". This is likely to take at least another year with legislation not before the third session of this Parliament.

But that is just the legal framework around leases. Of course, the other major issue is the safety of buildings following the Grenfell Tower fire, and other legislation that will impact leasehold property are the Fire Safety Act 2021 (enacted in April 2021) and the Building Safety Bill.

It would be easy to dismiss these as irrelevant since they were both introduced in response to the Grenfell tragedy. However, while the Grenfell flats were predominantly social housing, these two bills are not aimed solely at social housing providers.

Prior to the Fire Safety Act, fire safety legislation was covered by the Regulatory Reform (Fire Safety) Order 2005 which brought together different pieces of fire legislation. It applied to all non-domestic premises, including communal areas of residential buildings with multiple homes. The Order designated those in control of premises as the responsible person for fire safety, and they had a duty to undertake assessments and manage risks and were enforced by Fire and Rescue Authorities.

The Fire Safety Act takes this further, clarifying that for any building containing two or more sets of domestic premises, the Order applies to the building's structure and external walls (which includes doors and windows in those walls, as well as things attached to them, such as balconies), and any common parts, including the front doors of residential areas.

The Building Safety Bill is a very meaty document and merits an article on its own (we will inevitably come back to this) but in essence, it will apply to "higher risk" buildings – that is all multi-occupancy residential buildings where the floor of the top storey exceeds 18 metres or the building has more than 6 storeys (ignoring any storeys below ground level) in England, including student accommodation. It also introduces a stricter safety regime with the introduction of a Building Safety Regulator, and new duty holders.

As these various pieces of legislation work their way through the parliamentary process it is likely that very quickly this first edition of the guidance note on valuing leasehold residential property will need revision.

The lenders

Time was you never heard anything about residential leases on the mainstream news channels, but now, for all the reasons discussed above, leasehold property is much more prominent. And with that come changes in lenders' sensitivity to risk that may be associated with leaseholds.

It may be stating the obvious, but we must remember that the lenders are businesses, obtaining the money they pass on to purchasers as mortgages either from customer deposits (typically building societies and credit unions), or from borrowing money themselves in the money market. The interest rates that they charge are usually linked to the underlying Bank of England rate or the London InterBank Offered Rate, or LIBOR (LIBOR is a benchmark interest rate by which major global banks lend money to one another in the international interbank market for short-term loans).

Whilst the mortgage market itself was deregulated, mortgage lending is not. Banks and building societies have always been closely regulated, but in 2004 mortgages as a product became the subject of statutory regulation (before that between 1997 and 2004 the Council for Mortgage Lenders [CML] operated the CML Mortgage Code as a voluntary system of regulation) when the Financial Services Authority, now known as the Financial Conduct Authority [FCA], implemented a regime established under the Financial Services and Markets Act 2000 for regulating mortgages to homeowners.

That said, different lenders will have a slightly different approach to 'risk'. For instance, a building society such as Nationwide that invests the savings of its individual customers is going to be more 'risk averse' than say a private limited company, such as Pepper Money, that is also authorised and regulated by the FCA but which has a business model that aims to fill different sectors of the market than Nationwide. Both are regulated and both have to manage the risks with their lending – and in order to do so they must have a greater understanding of the risks involved. Hence the new guidance note.

What does this mean in practice?

In essence, what the guidance note is saying, is that a 2-bedroom flat might not be a good comparable for another 2-bedroom flat just because it is a 2-bedroom flat with almost identical 'amenities'.

Instead, it is saying that although in the past we may have got away with making the sweeping assumption that both shared the same 'features' that have a material effect on value, now we cannot take that cavalier approach. Instead, the valuer must make 'reasonable efforts' to ensure that those features are also comparable (though the guidance note does make it clear that the valuer is not expected to go beyond the scope of the inspection as described in the Red Book Global Standards).

So, what are some of the features that might have a material effect on value?

The term of the lease

Since leases are depreciating assets, it is a fair working hypothesis to assume that the value of the leasehold interest will decrease as time moves on and the end of the lease gets closer. Therefore, and using the example of two (on the face of it) very similar 2-bedroom flats, the question has to be, do they have a similar unexpired lease term or are the unexpired lease terms for both properties such that the impacts on market value is comparable?

To answer that question, the valuer has to find out what the lease term of the subject property is (and indeed, whether it has been extended). The guidance makes it clear that the valuer should make 'reasonable efforts' to find out what the details of the lease are and only fall back on 'assumptions' when reasonable efforts have failed. While the guidance does not specifically say what 'reasonable efforts' are, it does state that the information should be 'readily accessible', and that the valuer does not have to make 'detailed legal enquiries' (See Note at the beginning of Section 2 of the guidance note and Section 2.6). This suggests that information provided by an agent, or the owner, would be deemed 'reasonable', though of course, that information may not be accurate. The implication of this is that valuers should be careful to record the source of such information and what, if any, actions were taken to check it. Rightmove have suggested that they will look to include this information in the surveyor comparable tool where it is available to them.

The guidance also says that dependence on assumptions is to be 'avoided'. This suggests that in some cases assumptions might be acceptable but again, if they are used, should be justified in the valuation rationale with a record made of why assumptions were used.

The ground rent and the provision in the lease for review of that ground rent

Historically, residential ground rents have been relatively modest, from a 'peppercorn' to a few hundred pounds per annum. However, the 'ground rent scandal' of a few years ago, when it emerged that some new flats and houses had been sold with clauses whereby ground rents would rise dramatically in later years along with the packaging and disposing of those ground rents by the original developer, changed that, and particularly changed the consumer's attitude to ground rents.

Some homeowners found themselves stuck in properties with escalating ground rents because, understandably, purchasers would opt for a freehold over such a financial burden. By definition, such ground rents had a detrimental effect on the value.

The guidance, therefore, makes clear that the valuer must determine if the ground rent (and in particular how and when it is reviewed) will have an adverse effect on value. This is not a 'one size fits all' issue – what might be deemed as having a particularly adverse effect in one area might be considerably different in another. The 'local market' will determine this.
Again, information relating to the ground rent will be sought from the agent or owner and again the valuer needs to record this. Local knowledge is likely to play a part as to whether the valuer deems the information provided as reliable or risky and in either case apply the appropriate assumptions (that the information is accurate or otherwise) pending legal advice. Sometimes the valuer may potentially withhold a valuation until the full details from a reliable source (such as legal advisers) can be determined.
This information is also relevant as lenders will refuse to lend on properties where the passing ground rent exceeds a certain percentage of the value of the property.

Any restrictive covenants in the lease that might impact what a person can or cannot do in the property

A restrictive covenant may impose significant restrictions on what can and cannot be done in a property. Often such covenants are sensible, preventing illegal activity, for example. After all, few people would want to be neighbours with a brothel, but sometimes the covenant might have a significant local impact. The example given in the guidance is where a property has a covenant restricting subletting. In an area popular with private landlords and with a dynamic private rented market, such a covenant could have an impact on the value. Elsewhere it might have no effect whatsoever.

Some modern leases restrict the erecting of say, a greenhouse, garden shed or conservatory without first seeking the consent of the freeholder and apply onerous charges to seeking such consents. Clearly, if a garden is small this is unlikely to impact the value since there would be nowhere to put such a structure, but for a family home with a good garden, this could impact the value. Again, the local market will determine this.

Compliance with regulation

As we have already seen, the safety of the buildings in which we live is no longer to be left to chance. Linked to increased regulation is the compliance with that regulation.

Once the Building Safety Bill becomes law, there will be a clear regulatory framework for those buildings in scope, with rights and obligations on various parties involved (from building owner to the occupier), a building safety regulator and rights of redress via the criminal justice system.

However, not all multi occupational buildings will be in scope and it remains to be seen how the improved regulation of those buildings deemed high-risk (in terms of occupant safety) will impact other multi occupational buildings.

In the meantime, a well-managed building or estate is going to be a better place to live in theory, as there is a potential cost involved which we will look at next – and the guidance says that valuers should consider the impact on 'value and marketability' if it seems a freeholder is failing to fulfil their obligations.

Such obligations are likely to include fire risk and alarm maintenance, health and safety generally (which could include keeping means of escape clear, dealing with fly-tipping, vermin control etc.), control of asbestos etc.

How maintenance work is handled, the costs associated with those works, and service charges

Freeholders will usually charge leaseholders a service charge to recover their costs in providing services to the building or estate. The way in which the service charge is organised (for example, what it covers and how it is worked out) should be set out in the lease and you would usually expect it to cover things such as general maintenance and repairs, buildings insurance and, where relevant, central heating, lifts, porters or security staff, lighting, alarm systems and cleaning of the common areas etc.

A service charge may also include a contribution to the costs of management services provided by the freeholder (such as from the managing agent) and sometimes contributions to a 'reserve fund', sometimes called a 'sinking fund', which allows for future expenditure.

Service charges may be fixed – that is the exact amount payable, and any regular increase or review is set out at the beginning of the lease term – or variable where they may change from year to year depending on the expenditure the freeholder may have. Sometimes that expenditure may be capped, but sometimes it might be open-ended. Clearly, from a freeholder's perspective, a variable service charge is preferable since it enables them to recover unexpected or sharply rising costs. (That said, the amount a landlord can recover is limited to covering only the cost of works that it was reasonable for the landlord to undertake and that are completed to a reasonable standard. A leaseholder can challenge a service charge that it considers is unreasonable.) From a leaseholder's perspective a variable service charge is uncertain (even if the repair is reasonable) and, if the household budget is tight, can mean there are affordability issues. Despite rights to challenge onerous service charges, this will be time-consuming and likely to bring unwanted hassle.

If a block of flats, for example, is well managed with a transparent service charge policy and a well-managed reserve fund then, in theory, this will be an attractive proposition for any incoming leaseholder. However, if the opposite is true and there is the risk of the leaseholder having to share the burden of unforeseen maintenance, then this could have a seriously detrimental impact on future saleability and value.

This is well illustrated in the case *Cypress Place and Vallea Court, Manchester –v– Pemberstone Reversions*. The case involved a company, Pemberstone, which owned the freehold of two blocks of flats in Manchester which contained over 300 flats.

It turned out that these blocks were clad with a material that failed to meet fire safety regulations imposed after Grenfell. Pemberstone added a £3million cost of replacing the cladding to the leaseholders' annual service charge, meaning each flat owner had a bill of £10,000. Included in this was a "waking watch" charge, for 24-hour security in case there was a fire before the dangerous cladding was replaced.

The leaseholders challenged Pemberstone's right to recover the cost of replacing the cladding.

This went to the Land Tribunal which found that both the interim fire safety measures (including the "waking watch") and the costs of replacing the cladding were service charge items and therefore recoverable as a matter of contractual right by the landlord from the lessees.

If the lease states that the landlord had retained ownership of the property's common areas, including its exterior, structure and external parts then, if the replacement cladding falls within the definition of repair or maintenance of the building, the landlord will have a responsibility to replace any cladding on the exterior that is deemed a fire risk. If a landlord chooses not to act, then it could be found liable to the tenants and their visitors in the event a fire should occur. This is a problem encountered by many leaseholders and freeholders following Grenfell, whether a freeholder is able to recover the cost of repairs/improvements and the extent to which they are able to do so will always depend on the terms of each lease.

Since the valuer is not expected to scrutinise the lease in detail (and is probably not qualified to give an interpretation of such scrutiny) the exact details of the rights and obligations under the service charge are unlikely to be known unless through previous direct experience (such as being involved with another leasehold property in the same block) or good local knowledge (perhaps via a solicitor who acted for another leaseholder). Therefore, it is likely that the valuer will have to apply some assumptions to both the property being valued and any comparables being scrutinised.

Those assumptions should be appropriate and recorded. For instance, if a flat is within a 1930s block, it might be reasonable to assume that the block is likely to need roof repairs at some point in the foreseeable future, whereas a similar block only 10 years old might not. Could this have an impact on the value of that flat?

Valuers should also take care where the property concerned is a shared ownership property as the service charge may also include the rental element for the part retained by the Housing Association or other provider.

The valuation

As with all valuations, the best comparable is going to be most similar and require the least adjustment (in the type of construction, size, location, amenities, lease terms, length of lease etc.). In reality, the lease is going to add a level of complexity, variation and possible additional reasons for adjustment over freehold property.

The guidance takes the following approach: -

1. Start by considering comparables that have the same physical attributes as well as tenure.
2. Then consider properties with the same physical attributes but differing tenure (a recent sale with a shorter lease is a better comparable than making an 'artificial' adjustment to a lease term).
3. Next consider properties with similar tenure but different physical attributes.
4. Then consider 'less similar' properties.
5. Finally, the valuer should review the market to check that the valuation is 'logical in that context'.

The final tool is for the valuer to understand how, in their local market, the concept of 'leasehold relativity' works. This is the mechanism whereby it is possible to apply a multiplier to a lease to compare it to a hypothetical freehold. To do this you need to collate the value of leasehold valuations in a given market to determine the relativity to the theoretic freehold value. This is expressed as a percentage.

Below is the example from the RICS guidance note:

Note: The hypothetical freehold calculation can provide the valuer with an inflated virtual freehold value, which may need to be taken back to provide a realistic market value for a property with any given lease term. It also does not take into consideration other influences on value such as the level of ground rent, which may need to be factored in or considered separately, as in the following example. The subject property is a two-bed purpose-built flat with 70 years' unexpired lease term. The three comparable properties in Table 1 are of the same type, style, size and condition in the some location, and were all sold within the past month. They vary only in the unexpired lease term.

	Comparable 1	Comparable 2	Comparable 3
Unexpired lease term	65 years	55 years	72 years
Relativity	86%	80%	92%
Sale price	£172,000	£162,000	£186,000
Calculation	£172,000/86x100	£162,000/80x100	£186,000/92x100
Virtual freehold value	£200,000	£202,500	£202,200

1. Comparable calculations for virtual freehold value

It Is Important to analyse the market evidence objectively before adjusting the value of the subject property. Table 1 provides a valuation range of £200,000-£202,500, and on this basis the subject property is worth, say, £201,000 on a virtual freehold basis.
In this example, the unexpired lease term of 70 years has a relativity of 91%. To convert the valuation to reflect this, the following calculation is made:

£201,000 x 91/100 = £182,900

This points to a valuation for the subject property of say, £183,000.
It should be noted that the percentages and figures given are purely an example and do not relate to
an actual relativity graph. The valuer should source, test and monitor an appropriate graph. In addition, bearing in mind the simplicity of this approach, valuers should also always sense-check the outcome of such a valuation calculation against known market transactions and other information.

Conclusion and summary

The valuation of leasehold property for secured lending is getting more complex, a trend that we see lasting for the foreseeable future. It is also relatively volatile, being politically and socially sensitive following Grenfell and the leasehold scandal.

Valuers will have to make all reasonable efforts to find out more about the leases of the properties they are both valuing and using for comparables and, crucially, clearly recording the sources of information and assumptions derived from it.

Anne Hinds BSc (Hons) FRICS

Anne Hinds BSc (Hons) FRICS is a Chartered Surveyor dealing with technical advice and guidance on mortgage valuations, expert witness reports and other survey and valuation matters. Qualifying in 1986 she originally worked in the industrial and commercial sector followed by a period in the Valuation Office before moving into residential with Legal and General Surveying Services, eventually becoming National Quality Assurance Surveyor. She then went on to become Customer Care Director with the surveying division of the Spicerhaart Group and later esurv. For several years Anne has worked with a small firm carrying out mortgage valuations and residential surveys along with expert witness and other surveying related matters. She is now the Risk and Technical Manager for Kinleigh Folkard and Hayward Chartered Surveyors. With over 30 years' experience in surveying, primarily in the investigation, management, and handling of negligence claims against surveyors, she is particularly interested in the prevention of fraud involving surveyors. Given her experience with claims, Anne is well aware of the measures that should be taken to ensure good risk management within firms. Anne is chair of the RICS Assigned Risks Panel, she has sat on the RICS Residential Survey and Valuation Group, has been involved with several information papers including the valuation of individual new build homes and is a former chair of the RICS Disciplinary Panel. Anne has been involved with Sava since its inception and undertakes assessment for those wishing to qualify as AssocRICS surveyors.

Hilary Grayson BSc EST MAN (Hons)

Hilary is focused on developing new qualifications, as well as Sava's activities within residential surveying. Hilary has a wealth of experience within the built environment, including commercial property, local government and working at RICS. As well as her work at Sava, she is a Trustee at Westbury Arts Centre, a listed farmhouse dating from the Jacobean period, and has inadvertently become a custodian of a colony of bats.

ASBESTOS PIPE INSULATION

THE RISKS AND REQUIREMENTS

CALLUM SKENE BSC (HONS) ASBESTOS SURVEYOR/ANALYST, CASA ENVIRONMENTAL SERVICES

In this article, Asbestos Surveyor, Callum Skene, explains the main three types of asbestos-containing pipe insulation and reminds us of the requirements for safe removal. He then explores some of the legal implications of asbestos in the context of residential property.

As we know, asbestos was used as a material in building products in the past because it had many great properties for the building industry: it was cheap, strong, insulating, and resistant to chemicals, electricity and fire. However, we now know that it is not so great for human health. Inhaling asbestos fibres can cause cancers such as mesothelioma and lung cancer, and other serious lung diseases such as asbestosis and pleural thickening – a lung disease where there is scarring, calcification, and/or thickening of the lining surrounding the lungs. According to HSE[1] , in 2019 there were 2,369 mesothelioma deaths in Great Britain, and it is estimated that there were, in addition, a similar number of deaths due to asbestos-related lung cancer. There were also 490 asbestosis deaths due to past exposures to asbestos. So, it is a risk that should be taken seriously and considered at all stages of buying, selling or refurbishing a home.

1. https://www.hse.gov.uk/sTATIsTICs/causdis/asbestos-related-disease.pdf

What is asbestos?

There are different types of asbestos fibres; the three most common types are 'blue asbestos' (crocidolite), 'brown asbestos' (amosite), and 'white asbestos' (chrysotile).

Blue asbestos is regarded the most dangerous. The fibres are akin to tiny needles (short and sharp) as small as fractions of a micron, so can cause significant damage to the lining of the lungs. The structure of the fibres makes them easier to breathe in than other types of asbestos fibres, but they are also difficult for the body's immune system to defend against due to their chemically-resistant nature. Blue asbestos was widely used as a spray-applied thermal insulating material and had many other heat resistant uses.

Brown asbestos is also highly dangerous, and is notably more common than blue asbestos. It can be found in insulating boards, as well as some less-considered items such as toilet cisterns and older bituminous products.

White asbestos has more flexible fibres and is considered slightly less harmful than brown and blue asbestos because it is more easily rejected by the immune system and exhaled. Before being banned, it was the most frequently used asbestos type in Britain. Due to the malleable nature of the fibre, it was woven into textiles and ropes, whilst also being a significant constituent in cement products such as corrugated sheets, flue pipes, and roof slates. Despite its weaker chemical resistance, it remains a dangerous material and was still responsible for many asbestos-related deaths. Any materials containing asbestos fibres, regardless of fibre type, are considered to be asbestos-containing materials (ACMs) in the UK and must be removed and disposed of as such.

Asbestos had numerous uses because it offers very effective heat, acoustic and chemical resistant properties. Although used in other sectors, notably marine engineering, it was very commonly used in the construction industry, for instance: in retardant coatings; insulation bricks; pipes and fireplace cement; heat, fire, and acid resistant gaskets; pipe and boiler insulation; ceiling insulation; firebreaks; decorative flooring; roofing and rainware; and even garden planters.

It is perhaps not fully recognised that the tragedy of the terrorist attack on the World Trade Centre on 11 September 2001 released a cloud containing approximately 400 tons of pulverized asbestos and other hazardous materials across lower Manhattan[2]. Tragically, there will inevitably continue to be deaths associated with the collapse of the twin towers for years after the actual event.

Although the dangers of asbestos had been known for some time beforehand (regulations were in place as an attempt to protect asbestos workers as far back as 1931[3]), effectively all asbestos usage was finally prohibited in the UK in 1999, providing the 'rule of thumb' of presuming any construction prior to the year 2000 to contain ACMs.

This article focuses primarily on pipe insulation which contains asbestos.

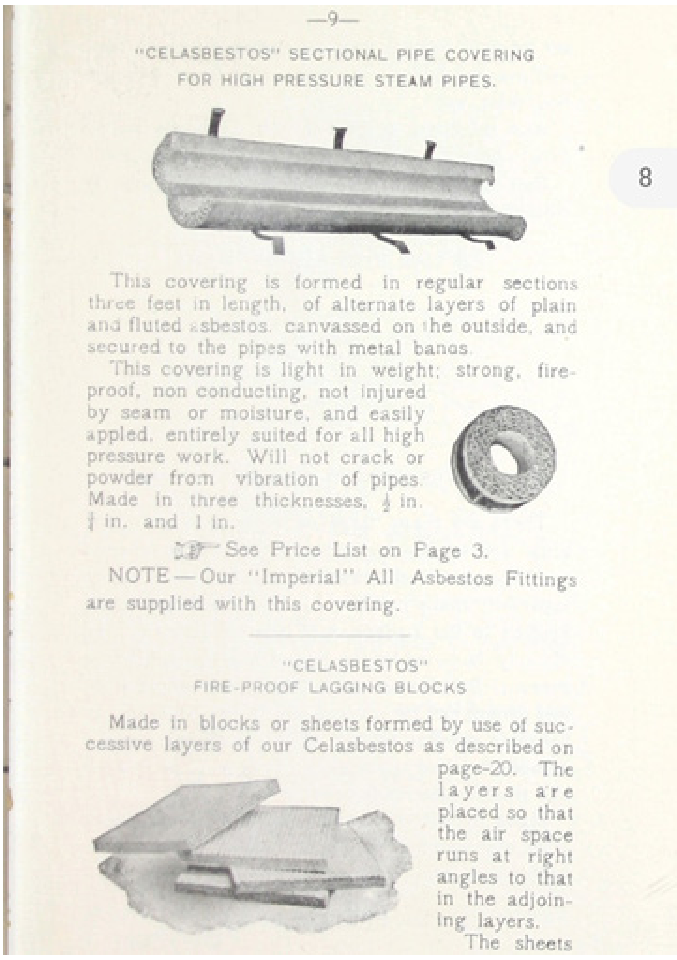
Types of asbestos-related pipe insulation

The peak of usage of asbestos-containing materials for pipe insulation was from the 1940s to the 1960s. Asbestos thermal pipe insulation (or 'lagging') products were officially prohibited in the UK in 1985[4], though generally their usage had declined in the decade or so prior to that, owing to voluntary bans leading up to the cut-off. This is useful to know because, if you come across pipe insulation you know to have been installed after 1985 it is likely that it will not contain asbestos. However, there still remains a risk of ACM remnants being present beneath newer insulation on older pipework.

There are in essence three forms of asbestos-containing pipe insulation, or 'lagging', these are:

- **Air Cell or Celasbestos insulation**

Usually installed in factory-moulded sections, this insulation is essentially composed of layers of corrugated asbestos cardboard clasped around a pipe and covered in foil. Although usually just containing white (chrysotile) asbestos, it is deemed to be 'thermal insulation' and is therefore a licensable material.



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"CELASBESTOS" SECTIONAL PIPE COVERING
FOR HIGH PRESSURE STEAM PIPES.

8

This covering is formed in regular sections three feet in length, of alternate layers of plain and fluted asbestos, canvassed on the outside, and secured to the pipes with metal bands.

This covering is light in weight; strong, fire-proof, non conducting, not injured by seam or moisture, and easily appled, entirely suited for all high pressure work. Will not crack or powder from vibration of pipes. Made in three thicknesses, ½ in. ¾ in. and 1 in.

See Price List on Page 3.

NOTE—Our "Imperial" All Asbestos Fittings are supplied with this covering.

"CELASBESTOS"
FIRE-PROOF LAGGING BLOCKS

Made in blocks or sheets formed by use of successive layers of our Celasbestos as described on page-20. The layers are placed so that the air space runs at right angles to that in the adjoining layers. The sheets

Figure 1: The above was taken from a very old brochure on asbestos materials by Bowen and Martin explaining the benefits of Celasbestos insulation.

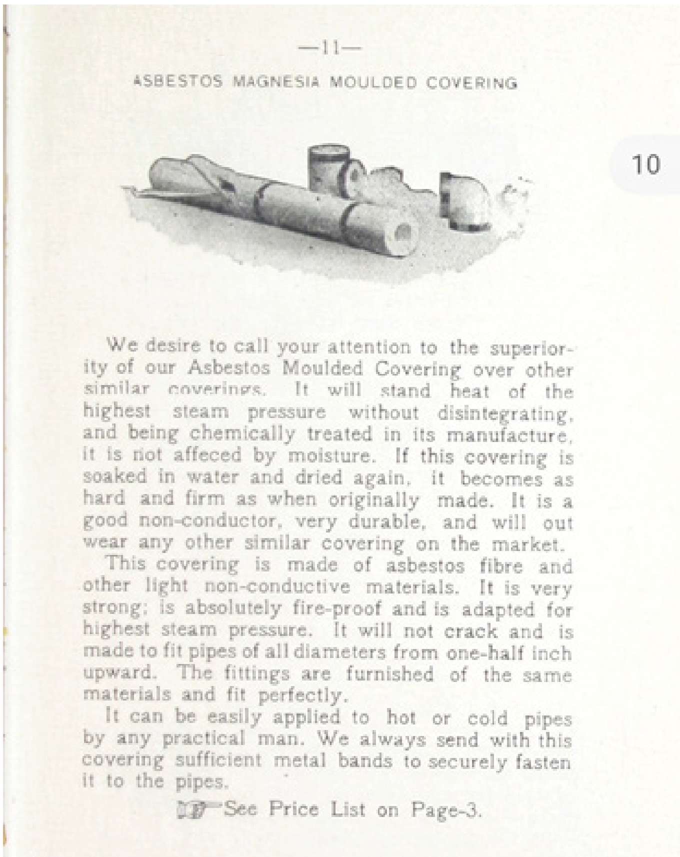
- **Magnesia moulded block insulation**

Again, pre-formed in factories, these sections of insulation are the closest relative to modern-day MMMF (man-made mineral fibre) sectional pipe insulation. Formed sections of magnesia and asbestos mixed blocks were clasped around pipework and often covered in a fabric wrap. Very rarely, boilers can also be found with brick-shaped asbestos magnesia insulation surrounding them.

2. https://www.asbestos.com/world-trade-center/

3. https://www.legislation.gov.uk/uksro/1931/344/contents/made

4 https://www.legislation.gov.uk/uksi/1985/910/contents/made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ASBESTOS MAGNESIA MOULDED COVERING

10

We desire to call your attention to the superiority of our Asbestos Moulded Covering over other similar coverings. It will stand heat of the highest steam pressure without disintegrating, and being chemically treated in its manufacture, it is not affeced by moisture. If this covering is soaked in water and dried again, it becomes as hard and firm as when originally made. It is a good non-conductor, very durable, and will out wear any other similar covering on the market.

This covering is made of asbestos fibre and other light non-conductive materials. It is very strong; is absolutely fire-proof and is adapted for highest steam pressure. It will not crack and is made to fit pipes of all diameters from one-half inch upward. The fittings are furnished of the same materials and fit perfectly.

It can be easily applied to hot or cold pipes by any practical man. We always send with this covering sufficient metal bands to securely fasten it to the pipes.

See Price List on Page-3.

Figure 2: Also taken from the Bowen and Martin brochure, explaining the benefits of asbestos magnesia moulded covering.

- **Hand-applied hard-set lagging**

This was usually mixed on-site and applied onto pipework and boilers. Whilst some lagging was applied in a highly skilled and tidy fashion, at other times it was done haphazardly. As a result, quite often where this insulation has been applied, overspray can be found on the walls, floor and ceiling behind the pipe run that has been insulated, or around pipe brackets and fixings. In the present day, it is quite commonly seen wrapped in a calico plaster cast if managed well, but the original finish was usually just a thin layer of paint. The photographs below show an old "Robin Hood" oil-fired boiler with this type of lagging, now fully wrapped and encapsulated. The plaster cast acts as a tough material protecting the friable ACM beneath – if sealed completely it will contain the fibres and provide protection against small bumps and scratches.

Figure 3: Example of hand-applied hard-set lagging wrapped in a calico plaster cast. The walls behind have been encapsulated due to the presence of minor lagging residues or 'snots'

Figure 4: This Robin Hood cast iron sectional boiler dates back to the 1960s. It serviced a large warehouse before eventually being put out of commission. Beneath the galvanised steel casings are residues of more hard-set insulation, remnants of historic removal attempts.

Figure 5: An example of asbestos magnesia sectional block insulation wrapped in a non-asbestos textile.

Figure 6: A long run of redundant pipe covered in highly damaged 'air cell' thermal insulation, found in the undercroft behind the boiler room in Figures 3 and 4.

Figure 7: A close-up showing a cross section of this form of insulation. It is visually similar to cardboard, but the 'corrugations' are formed of paper containing high volumes of white asbestos.

The risks associated with pipe insulation

Asbestos pipe insulation is very friable in any form and often has a very high asbestos content. Unless fully encapsulated, this ACM poses a significant risk to building occupiers and therefore, remediation should be advised. Under CAR 2012, non-domestic properties must have an asbestos management plan compiled by the dutyholder of the premises – based on the management plan and the condition of the ACM, the insulation may be encapsulated if mostly structurally sound, or removed if encapsulation is not possible. Whilst domestic properties are not legislated under CAR 2012, best practice is to apply the regulations as though it were a commercial premise.

A comprehensive asbestos 'refurbishment and demolition' (R&D) survey will also identify if there are residues of this type of lagging to pipework where the insulation has been removed in the past. It is worth noting that asbestos removals 20+ years ago were nowhere near as comprehensive as they are today due to stricter regulations.

The regulations

Regulation 2 of the Control of Asbestos Regulations 2012 states that asbestos-containing pipe insulation (no matter what form or volume/fibre type of asbestos it contains) is a 'licensable' material, and must always be removed under full enclosure by a licensed asbestos removal contractor, following a 14-day notification period to the Health and Safety Executive (with very few exceptions).

It is an offence to carry out work on an ACM that must be carried out by a licensed contractor. The HSE has comprehensive information on this here: https://www.hse.gov.uk/asbestos/licensing/licensed-contractor.htm
Because of the high risks involved and the use of a licensed contractor, removals of these ACMs can be extremely costly for residential properties.

It is worth noting that not all asbestos removal **has** to be carried out by a licensed contractor. While most **higher risk work with asbestos must only be done by a licensed contractor,** there are some instances where a non-licensed, but competent contractor can carry out work on ACMs so long as the correct procedures are followed and appropriate equipment used. These are listed in full on the HSE website at https://www.hse.gov.uk/asbestos/licensing/non-licensed-work.htm and includes things such as:

- Cleaning up small quantities of loose/fine debris containing ACM dust (where the work is sporadic and of low intensity, the control limit will not be exceeded, and it is short-duration work)
- Drilling of textured decorative coatings for installation of fixtures/fittings
- Maintenance of asbestos cement products (e.g. on roof sheeting, tiles and rainwater goods) and asbestos in ropes, yarns and woven cloth
- Painting/repainting AIB (asbestos insulating board) that is in good condition.

Any decision on whether particular work is licensable is based on the risk associated with the material.

Table 1 Examples of licensable and non-licensable work

Work which requires a licence from HSE	Work which does not usually require a licence from HSE
Removing sprayed coatings (limpet asbestos) Removal or other work which may disturb pipe lagging Any work involving loose fill insulation Work on millboard Cleaning up significant quantities of loose/fine debris containing ACM dust (where the work is not sporadic and of low intensity, the control limit will be exceeded or it is not short duration work) Work on AIB, where the risk assessment indicates that it will not be of short duration	Small, short duration maintenance tasks where the control limits will not be exceeded Removing textured decorative coatings by any suitable dust-reducing method Cleaning up small quantities of loose/fine debris containing ACM dust (where the work is sporadic and of low intensity, the control limit will not be exceeded and it is short duration work) Work on asbestos cement products or other materials containing asbestos (such as paints, bitumen, resins, rubber, etc) where the fibres are bound in a matrix which prevents most of them being released (this includes, typically, aged/weathered AC) Work associated with collecting and analysing samples to identify the presence of asbestos

Figure 8: Examples of licensable and non-licensable work from the HSE "Managing and working with asbestos – Control of Asbestos Regulations 2012"

Legal duty of care

The Control of Asbestos at Work Regulations 2002 (updated most recently by CAR 2012) are very clear regarding non-domestic premises. There is a legal duty to manage asbestos in non-domestic premises, whatever business activity is carried out in them. In this instance, non-domestic premises include the common areas of residential properties, including halls, stairwells, lift shafts, and roof spaces in blocks of flats.

Therefore, since May 2004, every duty holder has to:

- find out whether your building contains asbestos, and what condition the asbestos is in
- assess the risk, for example, if the asbestos is likely to release fibres
- make a plan to manage that risk

The duty holder will be the person in control of maintenance activities. This could be the occupier, the landlord, the sublessor, or the managing agent. Sometimes no maintenance obligation exists, for example where there is no tenancy agreement or contract or where the premises are unoccupied and then the duty falls on the person 'in control' of the premises.

The duty holder should either label the asbestos, seal it, or remove it. The appropriate course of action will depend on the particular circumstances of the situation. If the asbestos is in good condition, the HSE recommends that a record of the existence of the asbestos is made on building plans or other records, that this information is kept up to date, and a register is set up of the location of the asbestos. Any contractors or building occupants likely to come into contact with the ACM should be made aware of its location.

Note, if a landlord is registered as a provider of social housing, then from 1 April 2013, fails or delays to act on an occupier's report of asbestos in the premises, the occupier can also complain to the Housing Ombudsman Service following the appropriate complaint procedure.

Obligations to repair

Most people, once they know asbestos may be present in a building, are not happy, but the presence of asbestos itself does not constitute disrepair. It is only if it is damaged or deteriorates, leading to the risk of asbestos dust, that a duty holder should act to prevent disrepair from arising.
There are no specific laws or regulations regarding asbestos and housing. Landlords' obligations arise under the legislation relating to:

- hazards under Part 1 of the Housing Act 2004
- statutory nuisance under the Environmental Protection Act 1990
- implied contractual rights under the Landlord and Tenant Act 1985 and
- defective premises under the Defective Premises Act 1972

A landlord may also be compelled to act regardless of any legal obligation.

Asbestos and the Home Survey Standard

The new Home Survey Standard references health and safety on several occasions throughout the document and clearly, asbestos comes under this heading. But this is a complex area, particularly in the context of evaluating the risk and what it means for the client. So, we will return to this in another article.

Callum Skene BSc (Hons)

Callum Skene is a fully qualified Asbestos Surveyor and Analyst in possession of BOHS P402, P403, and P404 qualifications with nearly four years of experience across a range of property types. Working for Casa Environmental Services, based in Bristol, and with recent experience of asbestos work in the public sector, he has surveyed all manner of properties from social housing to schools to industrial warehouses.
Callum is currently studying MSc Building Surveying at the University College of Estate Management.

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HEAT LOSS IN DWELLINGS

WHAT YOU SHOULD KNOW

JULIE VIDAL, TECHNICAL TRAINING & LEARNING COORDINATOR, SAVA

With the effects of climate change becoming more prevalent and legislation adapting to reflect it, we thought it would be useful to cover the key principles of heat loss in dwellings, and how quality can impact performance.

Why this matters

In section 4.7 of the RICS Home Survey Standard 1st Edition 2019, it states at paragraph 4.7:

"Concerns over climate change and legislative and commercial changes in the energy sector have created a demand for clear and objective guidance on energy matters."

The standard goes on to say that at all levels of service (as defined by the standard) RICS members and regulated firms must be able to identify and advise on defects and deficiencies caused by inappropriate energy efficiency measures implemented at the subject property. But the RICS is not the only organisation moving climate change rapidly up the agenda. In recent years, the Bank of England has also addressed the issue of climate change. Motivated by its statutory objectives, it is:

1. promoting safety and soundness by enhancing the PRA's approach to supervising the financial risks from climate change
2. enhancing the resilience of the UK financial system by supporting an orderly market transition to a low-carbon economy

The Bank completed a review of the impact of climate change on the UK banking sector. This was published in September 2018, and it emphasised that a transition in thinking is taking place across the sector from viewing climate change as a potential reputational risk to a core financial and strategic risk.

Early in 2021, the Department of Business, Energy and Industrial Strategy published a consultation called "Improving home energy performance through lenders - Consultation on setting requirements for lenders to help householders improve the energy performance of their homes". This consultation was introduced as follows:

"In June 2019, the UK became the first major economy to pass a net zero emissions target into law. The target requires the UK to bring all greenhouse gas emissions to net zero by 2050. Homes in the UK made up 15% of greenhouse gas emissions in 2018, or 22% if electricity consumption is included. The government recognises that, in order to achieve net zero, we need to have largely eliminated emissions from our housing stock by 2050.

The government's Green Finance Strategy, published in July 2019, set out its intention to grow the market for green finance products to support home energy performance improvements. It included a commitment to consult on the merits of setting requirements for lenders to help households to which they lend to improve the energy performance of their homes. Building on feedback from the government's Call for Evidence on 'Building a Market for Energy Efficiency', published in 2017 this consultation seeks views on the principles of how best to improve the energy performance of domestic properties with a mortgage through obligations on lenders. The mandatory proposals contained in this document will be subject to further consultation and analysis."

At the time of writing this article, the findings of the consultation have not been published but taken with the position that the Bank of England has already adopted, we think it is fair to say that this whole area is going to be much more important for surveyors and housing professionals in general.

Climate change is an enormous subject, but we can start with the basics and that is to fully understand what is recorded on an EPC and why and how the ratings are based on assumed U-values for particular elements of the property, such as walls, floors, windows, and roof etc. To give energy advice it will be important to understand how the building performs, occupant behaviour and what energy improvements may, or may not be appropriate taking into consideration elements such as damp, exposure, defects, and planning.

This article starts with the basics of building physics, looking at heat loss from residential buildings.

Why is heat loss important?

Clearly, if houses consume no energy, we will well be on the way to net-zero carbon, but they do, and they also leak energy. Understanding heat loss will help understand how improvement measures could be implemented.

But heat loss is not just about climate change and zero carbon. A well-performing and energy-efficient home is going to benefit from lower running costs towards household fuel and is less likely to suffer the effects of damp and condensation (so long as it is appropriately ventilated and heated).

Heat loss in dwellings

Heat losses in a property arise from various sources. The fabric of the built elements, infiltration losses through gaps or construction joints, and ventilation losses through 'holes' in the property such as flues or chimneys. Heat losses in a property affect the running costs and energy efficiency, by reducing the heat losses, the heating requirement will be reduced. In this article, we will be looking at the fabric and thermal bridging losses.

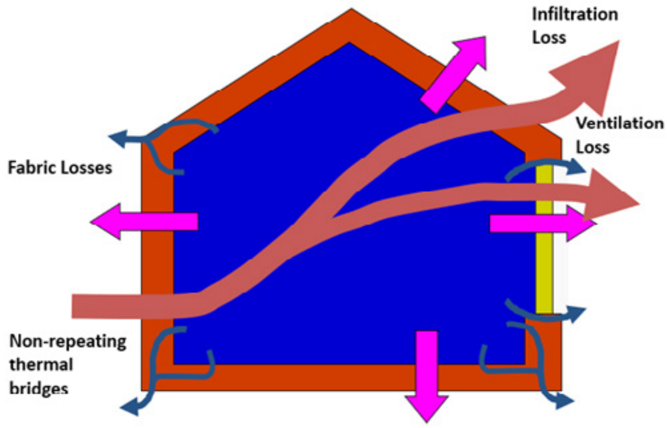


Figure 1: Possible sources of heat loss in a building

U-values

U-values tell us the rate at which heat is lost through a building element such as a wall, window, and floor, etc. A larger U-value will have a higher rate of heat loss, so the built element will 'leak' heat more quickly. The lower the U-value, the more effective the material is as an insulator, i.e., it is better at preventing the loss of heat from inside the property.

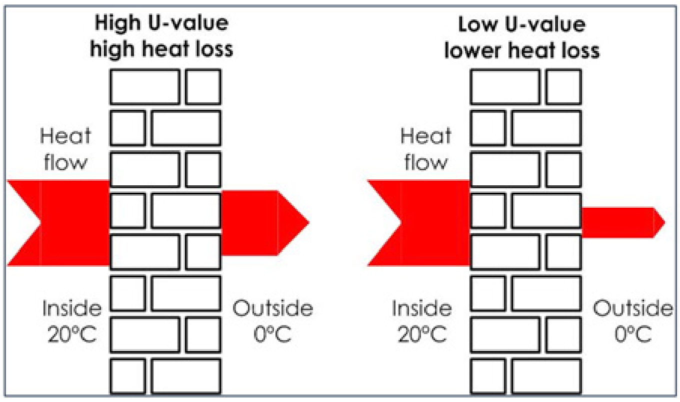


Figure 2: High U-value loses more heat compared to low U-value

U-values measure how much heat is lost through a square metre of that material for every degree difference in temperature between the inside and the outside. The units of U-value are Watts per square metre per Kelvin - W/m^2K:

- the method for measuring energy transfer is in Watts (W)
- the temperature is measured in degrees Celsius or Kelvin (K)
- the area is measured per square metre (m^2)

The U-value of a building element depends upon:

- the materials used and their thickness and
- where there are layers consisting of more than one material, the proportion of each material and how they align with materials in other layers.

A given building element will be made up of a number of layers of different materials (or in the case of windows, different materials for the glazing and frames), so the U-value effectively combines the thermal properties of all these different materials, taking into account the effects of repeating thermal bridges, such as cavity wall ties, and surface effects.

Thermal conductivity (λ)
Thermal conductivity is a measure of how easily heat flows through a specific material, independent of the thickness of the material in question. The lower the thermal conductivity of a material, the better its thermal performance i.e., the slower heat will move across a material. The thermal conductivity of the constituent materials is used in the calculation of the U-value. You may see the resistance (R) value advertised for insulation materials. R is the inverse of the thermal conductivity:

$R1 = 1/\lambda 1,\ R2 = 1/\lambda 2\ ...$

$U=1(R1 + R2 + ...)$

Example of a basic U-value calculation
A basic U-Value calculation for a cavity wall may look like this:

Material	Thickness	Conductivity (k-value)	Resistance = Thickness ÷ conductivity (R-value)
Outside surface	-	-	0.040 K m²/W
Clay bricks	0.100 m	0.77 W/m·K	0.130 K m²/W
Glasswool	0.100 m	0.04 W/m·K	2.500 K m²/W
Concrete blocks	0.100 m	1.13 W/m·K	0.090 K m²/W
Plaster	0.013 m	0.50 W/m·K	0.026 K m²/W
Inside surface	-	-	0.130 K m²/W
Total			**2.916 K m²/W**
U-value =		1 ÷ 2.916 =	0.343 W/m²K

This calculation takes into account the various elements of material in a cavity wall, however, it doesn't account for cold bridging caused by wall ties, for example, air gaps around insulation, or the different thermal properties of mortar joints.

Thermal bridges (cold bridges)
Thermal bridging occurs wherever the continuity of insulation in a structure is interrupted.

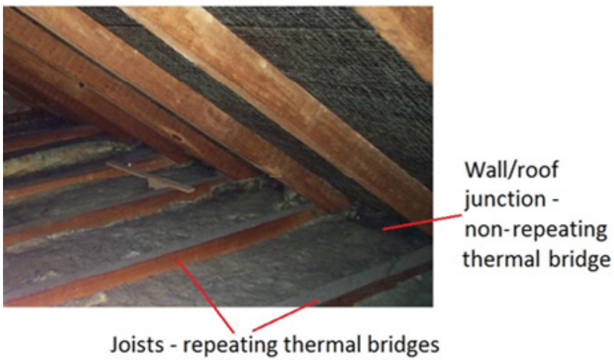


Figure 3: Example of thermal bridges in roof space

Heat will flow by conduction at a greater rate through a material with a higher thermal conductivity. Building elements are generally made up of several different materials, and where part of a structure has a higher thermal conductivity, such as steel wall ties, the heat loss will be greater, leading to a higher overall U-value. Such areas of higher conductivity are known as thermal bridges (or cold bridges). Non-repeating thermal bridges are where materials of a different thermal conductivity meet, such as the junction between a wall and window frame.

As well as repeating and non-repeating thermal bridges, there are also geometric thermal bridges. These are predominantly corners within the structure where the heat loss will be higher. This is one of the reasons mould growth due to condensation is often located in the corners.

Thermal bridging can result in:
- increased heat loss
- increased solar gains in summer
- reduction in indoor air quality
- cold spots
- increased risk of condensation and mould growth

Look at this example of mould growth resulting from moisture in cold spots.

Figure 4 and 5: mould growth from moisture in cold spots.
Photo credit: Robert Vaughan, Harlow Council

This property had no insulation between the timber joists, and it looks like the timbers themselves have an insulating effect. Left untreated in the long-term, this can cause structural damage and be harmful to the health of the occupants.

An example of Assumed U-values

This table shows assumed U-values of walls in England & Wales based on the U-value of the wall when it was constructed, and how that can be improved with retro-

	1900-1929	1950-1966	1983-1990	2012 onwards
Cavity as built	1.5	1.5	0.6	0.28
Filled cavity	0.7	0.7	0.35	0.28
Filled cavity with 150mm internal or external insulation	0.19	0.19	0.15	0.14

fitted insulation measures:

Figure 6: Data from RdSAP 2012 version 9.94

This demonstrates how the thermal performance of a wall can be improved with retrofitted measures and it is why such measures are likely to appear as a recommendation on an EPC. It also shows that there is no difference in U-values for cavity walls between 1900 and 1966 and how, after this, the introduction of the Building Regulations in 1965 has improved standards over time.

Why are U-values important?

To get an understanding of the importance of U-values, have a look at the Building Regulations 2010 Approved Document L1B Conservation of fuel and power in existing dwellings. This Approved Document sets out standards for building elements in existing dwellings that are newly constructed i.e., for extensions and for the replacement of existing elements, which for example, might include renovations. These standards 'comprise a general strengthening of efficiency standards that are considered reasonable for work on thermal elements, controlled fittings and controlled services in existing dwellings.'

Thermal imaging

Isothermal images are a spectrum with red generally indicating warmth and dark blue/purple indicating cold. Colour scales can vary with different thermal imaging devices. In the image below, the areas of heat loss from the house are shown in red. Here, the windows, eaves and roof ridge have high heat loss, but the sloping roof has low heat loss.

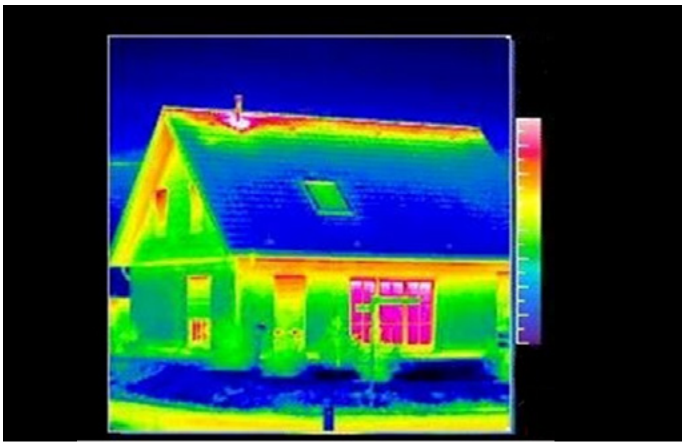


Figure 7: Thermal image example

Thermal imaging can be a very useful tool in understanding how buildings perform. However, although there are some readily accessible thermal imaging cameras and apps, interpretation is key. For more information on thermal imaging, you might find this site useful: https://ired.co.uk/thermal-imaging-surveys/buildings/. This blog article explains the science behind thermal imaging: https://ired.co.uk/what-is-emissivity/.

How quality impacts performance

The quality of the build or installation can have a significant impact on thermal transmittance. If the workmanship is poor, with gaps and poor thermal bridges, the thermal transmittance can be much higher than was originally intended.

What about retrofitted installations? For example, filling a cavity wall will improve the U-value and reduce heat loss, but what if the brickwork was in poor condition and allowed the insulation to constantly get wet? What about installing cavity wall insulation in a high flood-risk area? Wet insulation will fail to perform and can have a significant detrimental effect on the heat losses of the property.

Improving a property needs careful consideration about how the building and the occupant behaves, installing new windows may stop heat loss, but could it result in condensation problems if there is insufficient ventilation or heat?

To conclude

There is an obvious urgency in tackling climate change; surveyors and property professionals are in the unique position to be able to explain to homeowners the importance of energy efficiency and the implications of inappropriate measures, poor workmanship etc. Having a clear understanding of heat loss in dwellings and being able to identify these factors and pass on this knowledge to the UK public could help towards improving the quality of the UK housing stock, the health of the occupier, and the future of the planet.

Free CPD

The Open University offer free online learning via their Open Learn website and, they have a useful course on Energy in Buildings (link here). They have estimated it as 10 hours of study and offer a free statement of participation on completion, you just need to create a free account to complete the course. You may find the course to be a useful refresher on energy in buildings and it covers U-values too.

BUILDINGS SCIENCE

HOW MATERIALS RECOVER AFTER A FLOOD OR OTHER WATER DAMAGE

RUSSELL RAFTON, DIRECTOR, DRYFIX PRESERVATION LTD

People often assume that the recovery time of buildings affected by an escape of water or flood is mainly dependent upon the duration of the flood event. The reality is, however, that the duration of the event often has less influence on the recovery and the main factors are related to the method of construction, material composition, barriers to drying and chosen drying techniques. In this article, Russell Rafton shares with us the results of an experiment he carried out to demonstrate how materials recover after a flood or water damage.

Consider a hypothetical scenario of two properties affected by a flood.

The first property is affected by a flash flood caused by a failure of the roadside storm drain with the ingress of water through the building up to 600mm high. The incident lasted no more than 16 hours before the flood water was pumped out.

Property number two is affected by a fluvial flood event where water entered the building from a nearby river that burst its banks. Water entered the building also up to 600mm high, and the whole event lasted around four days before the water subsided.

Assuming both properties were constructed from the same materials and exposed to the same drying conditions, which property has the quickest recovery time: the flash flood or the fluvial flood?

Most would assume the flash flood as the event had the shortest duration. But is this assumption correct?

When a building is flooded or suffers water ingress, the water migrates into the capillary pores of the construction material. The longer the water is in contact with the material, the more time water molecules have to climb (rise) and bond to the capillary walls. This water loading, however, can only occur until the capillaries are full, once full the material is saturated and can take up no more additional water. The quantity of water loading (uptake) a material can absorb depends upon its mass, density, and capillary pore structure. A soft, porous brick, for example, will likely absorb more water than say a dense engineering brick, because it has more capillaries and unlike the engineering brick, it is not designed resilient to water and frost. Most masonry materials, however, irrespective of their design, mass or density will saturate in a relatively short period, usually within 10-12 hours.

So, to demonstrate how materials recover after a flood or water damage event, I set up an experiment.

The experiment

I sourced two samples each of several building materials, including:

- LBC facing bricks
- Solid farmhouse bricks
- Engineering bricks
- A cured sample of render (this would be my equivalent of the brick mortar).

The samples were weighed upon purchase using scientific scales which measure down to 0.5 grams and then stored in our laboratory for just over a month. The samples were repeatedly weighed until their weight or weight loss became static over a period of 48 hours. This allowed any free/excess moisture within the samples to evaporate and the material to become equilibrium dry with the environment in our lab.

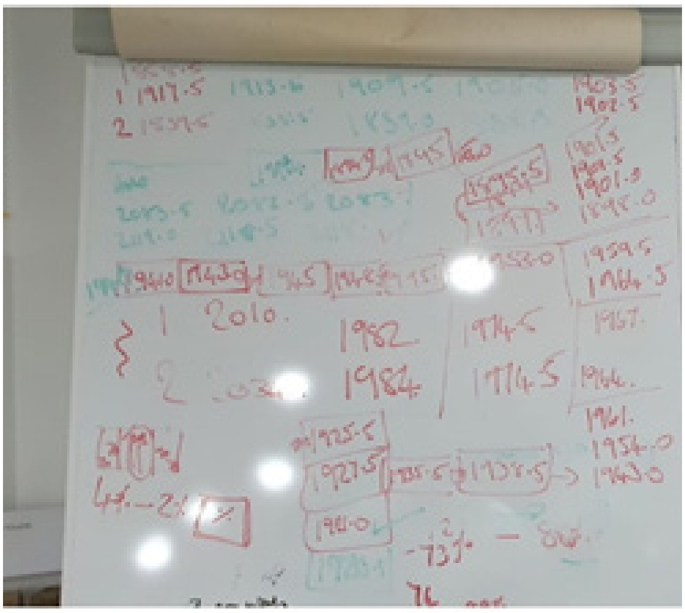
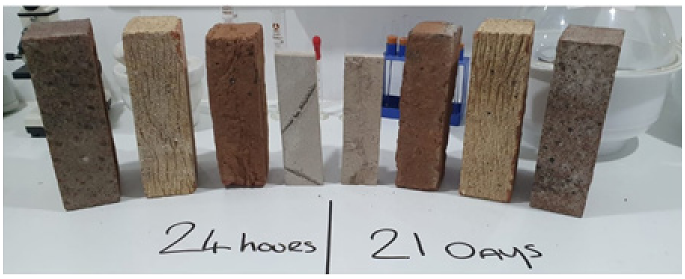


Figure 1: Record of measurements taken during the initial drying phase

Figure 2: Sample materials used for the experiment.



Once I was able to determine all the samples were dry, I recorded their dry weight, and the experiment began.

Figure 3: Weight of farmhouse brick before experiment

Firstly, I submerged one of each sample into a bucket of water. The samples were left to soak in the water for a total of 21 days. On day 20, I put the remaining other samples in another bucket of water and left them for just 24 hours.

Finally, I removed all samples, reweighed them to measure their capillary water uptake and simply left them aside in the lab to dry naturally. I reweighed each sample daily to monitor their drying/recovery time.

Figure 5: Samples submerged in water

For the following two months, I reweighed each sample on almost a daily basis recording the new weight as a measurement of water loss through evaporation. I would consider the material once again dry when it finally achieved its prior-to submersion equilibrium dry weight.

Since all the materials were subjected to the same drying conditions, i.e., the atmospheric conditions in the lab, I consider the demonstration fair as each material's drying rate is therefore dependent upon its physical structure. (Disclosure – at the very end of the experiment, the very last sample was subjected to more favourable conditions for a short period to speed up its drying/recovery which was taking an unprecedented amount of time).

So, between the engineering brick, farmhouse, LBC, and mortar sample, which had the greatest water uptake?

The results

The image below demonstrates the uptake of water in each sample submerged for 21 days.

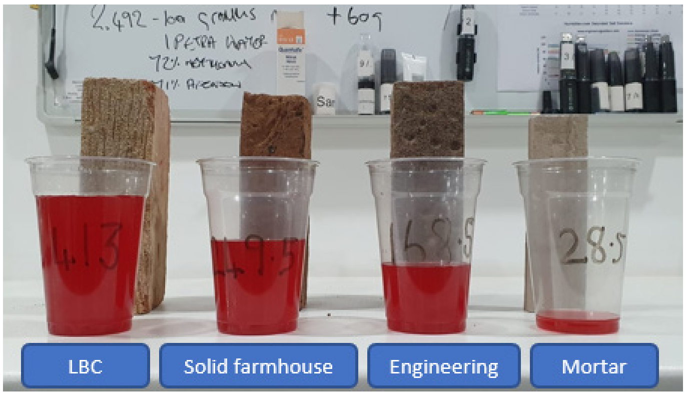


Figure 6: equivalent water uptake of each sample

The brick which had the largest water uptake in both samples was the LBC brick. The LBC is a rather lightweight common facing brick with a large frog in the middle to reduce its mass and inevitably production cost. The frog also improves brick bonding as a physical key. The LBC bricks had a water uptake of 413 grams for the 21-day submersion and a similar 404 grams for the 24-hour submersion. This results in a staggering weight increase the equivalent of 21.1% and 21.4% of the bricks total weight.

Figure 7 and 8: Results of LBC brick water uptake

The second-largest water uptake was by the solid farmhouse brick. The 21-day sample increased in weight by 249.5. The farmhouse brick is more of a common facing brick, being solid with no frog or indentations, and interestingly was the only brick that showed a slight difference between the long and short submersed samples. The 24-hour sample increased in weight by 165 grams.

However, this is not quite as straight forward as it first seems since the percentage weight increase was similar in both samples (they were not identical bricks, and each had a different starting weight). The 21-day sample increased in weight by 13% and the 24-hour sample increased in weight by 10 %. This would suggest that irrespective of the weight uptake difference that the 24-hour sample was likely saturated and the difference in gram uptake was probably due to the clay composition and capillary pore structure.

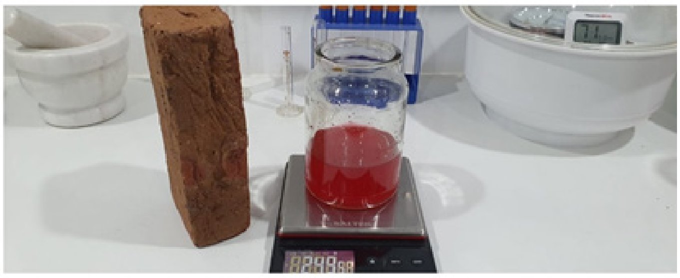


Figure 9 and 10: Solid farmhouse brick water uptake

The third-largest uptake (as expected) was the engineering brick. The 21-day sample increased in weight by just 168.5 grams vs 165.5 grams for the 24-hour sample indicating that irrespective of the submersion period, both samples were again saturated. The percentage weight increase, however, only equated to 8.1% for the 21-day sample and 7.8% for the 24-hour sample. Irrespective of their moderate weight increase as a percentage weight, the engineers absorbed less than 10% of their total weight. The reduced porosity of these bricks is the reason they are often specified below ground or below DPC level due to their moisture and frost resistant capabilities. Engineering bricks are fired at higher temperatures, so the clay matrix and aggregates start to melt together so there is less connected porosity, they are less permeable and hence they absorb less water.

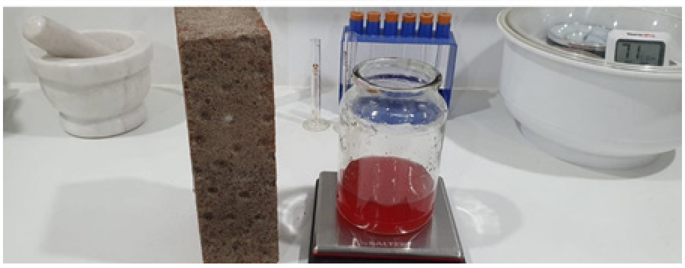


Figure 11 and 12: Engineering brick water uptake

Finally: the mortar sample. Each mortar sample had an uptake of just 28.5 grams per sample. However, the mortar samples had inevitably less mass than the bricks, therefore, a direct comparison in the grams of water uptake is unfair. As a percentage of their weight, the mortar samples increased in weight by 9.4% for the 21-day sample and 8.2% for the 24-hour sample. As such, the mortar samples had a similar percentage weight increase equivalent to the engineering bricks.

Figure 13 and 14: Mortar sample uptake

1 day Submersion

	LBC	Engineering	Farmhouse	Mortar
Initial weight	1916	2119.5	1859.5	348.5
Weight after submersion	2320	2285	2045	377
Weight increase	404	165.5	185.5	28.5
Percentage weight increase	21.1	7.8	10	8.2

21 day Submersion

	LBC	Engineering	Farmhouse	Mortar
Initial weight	1930	2085	1894	303
Weight after submersion	2343	2253.5	2143.5	331.5
Weight increase	413	168.5	249.5	28.5
Percentage weight increase	21.4	8.1	13.2	9.4

Figure 15: Water intake results for all samples

The drying process

Going back to the initial question, which of the brick samples would dry first: those submerged for just 24 hours, or those submerged for 21 days?

Over the following 63 days, I weighed, watched, and patiently waited as the samples slowly dried within the mild ambient conditions in the lab.

Following are the results and a plotted graph that shows the drying curve for each sample during the drying regime.

As expected, the first sample to dry was the mortar sample with both samples drying on day 10. The mortar sample had a water uptake considerably less than the bricks, however, its mass is also considerably less. Had I been able to source a sample of mortar the same mass as the bricks, then I would have expected its drying rate to have been similar to the engineering brick due to the similar percentage weight increases.

The second sample to dry was the engineering brick, with both samples drying in just 14 days. The similarities in the recovery duration highlight that irrespective of the submersion period, both bricks were equally saturated and dried at a similar rate (see drying curve below).

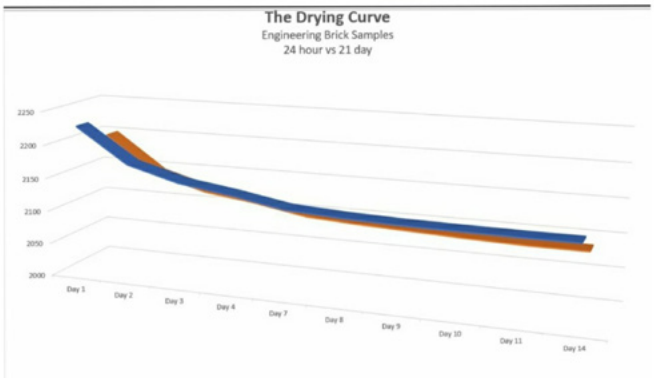


Figure 16: Drying curve of engineering brick

Surprisingly, the third brick to dry was the LBC facing brick. The LBC brick samples had the greatest water uptake of all materials in the test, however, they performed surprisingly well during the drying phase in their ability to release moisture quickly. The LBC brick submerged for 24 hours dried first within 25 days, followed closely by the 21-day submersion which dried within 26 days.

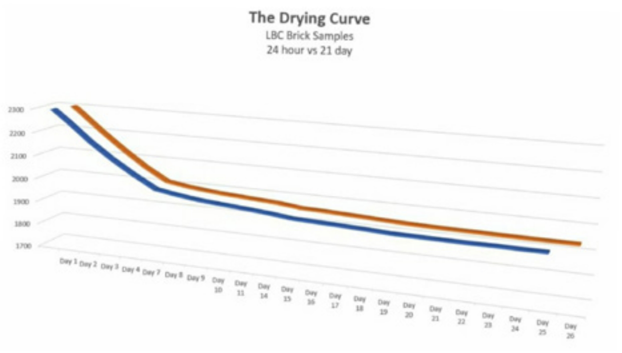


Figure 17: Drying curve of LBC brick

The poorest recovery was from the solid farmhouse brick. Although the farmhouse brick had a water uptake of almost 50% less than the LBC brick (10% vs 21.1%), it had a considerably slower drying rate. The first farmhouse sample to dry was actually the 21-day sample which dried within 47 days, that's an additional 21 days of natural drying than the LBC and 33 days longer than the engineering brick.

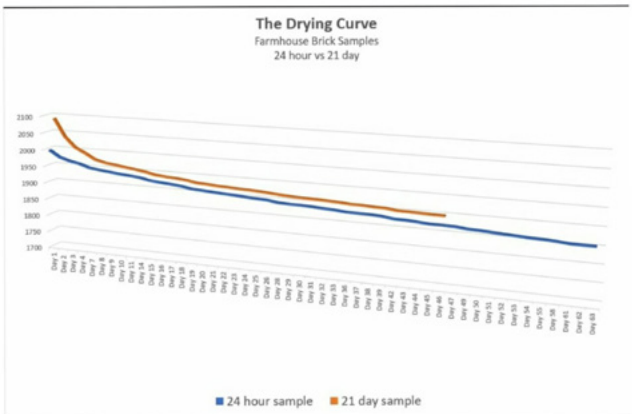


Figure 18: Drying curve of farmhouse brick

The recovery of the 24-hour sample was even slower. After 48 days the sample still hadn't reached its drying goal and its weight loss halted 28 grams higher than its initial dry weight. I considered this was likely the ambient conditions in the lab which had changed due to a heatwave prior to the experiment. As such, to complete the experiment I introduced the final sample into an electronically controlled desiccant chamber. I set the conditions within the chamber to 35% RH at 20 degrees C and waited patiently as the sample slowly continued drying for another 15 days losing around 0.5-1 gram per day. Finally, after a staggering 63 days, the sample reached its drying goal.

Figure 19: Farmhouse sample in electronically controlled desiccant chamber

So, why did the farmhouse brick have such a slow natural drying rate compared with LBC which had a far greater water uptake?

Well, I suspect this is probably due to multiple reasons. Firstly, the LBC brick, due to its incorporation of a frog, has less mass but a larger surface area exposed to the atmosphere. The larger surface area allows a greater rate of evaporation. Secondly, the pore structure and size are likely to have a big influence and inevitably appear much larger in the LBC, allowing for a faster evaporation rate.

This experiment was conducted predominantly without drying aids to highlight the natural drying/recovery of masonry materials affected by water. The aim was also to demonstrate that most masonry materials will saturate quickly, therefore, often the duration of the event has less influence on the drying and recovery of a water-damaged building. Factors such as construction methods, material selection, barriers to drying and a materials pore size and structure are of far greater importance.

Of course, in most water-damage/flood events, specialists will intervene and aim to recover the building at the earliest available opportunity to ensure damage limitation, allowing it to be restored and reoccupied as quickly as possible. This process is undertaken using forced drying systems and accelerated drying techniques. Drying professionals use their specialist knowledge and equipment which allows them to carefully balance temperature, humidity and airflow, which directly affects the state in which water exists, purposefully controlling the conditions for water-damaged materials to release their moisture in a controlled economical manner.

Figure 20: professional water removal following a flood

For evaporation to occur, a material must have sufficient energy to convert the liquid water to a gas resulting in a net loss of water from the material to the atmosphere. It sounds simple, however, these conditions have to be carefully managed as an imbalance in the system could lead to excessive evaporation resulting in a saturated environment and a failed drying regime. To do this effectively, drying specialists monitor and measure the reduction in specific humidity, often referred to as grain depression rather than other psychometric parameters that can be variable.

Clearly, in my experiment, the conditions in the lab during the final drying stage were different to those during the initial drying phase as I was unable to remove those last few grams of moisture from the 24-hour farmhouse brick without forcefully creating better ambient conditions. On reflection, the initial drying phase was during a lockdown, a period of prolonged and excessive heat and if I were to repeat the experiment, I would have monitored the conditions during the before and after phases. Although it doesn't change anything, in hindsight, it would have been useful to have that data.

According to the data, the 24-hour farmhouse sample slowed under the natural conditions to 1887.5 grams in weight when its target drying goal was 1859.5 grams, a 28-gram difference. To meet its target drying goal, I needed to introduce energy to convert those last few remaining water molecules into a gas for evaporation to occur. Energy is required for this process, and to change just a pound of liquid water into vapour requires 940 BTUs (British Thermal Units). There are 453 grams per pound, thus 2.075 BTUs per gram. In total, the sample needed to lose 28 grams, therefore, an additional 58 BTUs of energy was required for the sample to reach its drying goal.

Scale it up

So, consider this. Let us briefly imagine we scale this scenario up. Think about the average semi-detached property with three external walls, a total of 21 linear metres of wall. The property is subject to an external flood up to the height of 600mm and is constructed from the LBC brick. The LBC brick in this experiment had a water uptake of 413 grams and 1 kilo of mortar is estimated for the laying of each brick.

LBC brick water uptake 413 grams
303g grams of mortar = 28.5 grams uptake / 1kg of mortar = 94.05g potential water uptake
21 linear metres of wall x 600mm high = 12.6 m^2 wall
12.6 m^2 x 60 bricks per m^2 = 756 bricks which is also 756 kilos of mortar.
756 LBC bricks x 413 grams (water uptake) = 312,228g
756KG mortar x 94.05 grams (water uptake) = 71,102g
Total = 383,330g / 383.22 kilos or .383 tonnes

For some context, you could expect an average semi-detached property, when subject to a flood of water 600mm high, to have a water uptake of .383 tonnes within just the external leaf brickwork. That is the equivalent of a grand piano or two domestic pigs, and also doesn't take into account the inner leaf of the cavity wall, wall insulation or the floor structure - that's incredible!

Hopefully, this article has demonstrated and aided your understanding of what it really takes to dry down a water-damaged/flooded building and the length of time it can take for some materials to recover after a flood event.

Russell Rafton

Russell is the owner, director, and senior surveyor for Dryfix Preservation Ltd. Dryfix specialise in the diagnosis and repair of damp and timber-related problems, also including trace and locate of leaking water pipes and water damage repairs. Established for over 10 years, Dryfix are a PCA (Property Care Association) Accredited firm. Russell has been in the industry for over 20 years and completed extensive training with the PCA, IICRC and National Flood School.

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