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TECHNICAL BULLETIN

FOR RESIDENTIAL SURVEYORS

ENERGY PERFORMANCE CERTIFICATES AND HOME SURVEYS

EPCS AND HOME SURVEYS

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CONTINUING PROFESSIONAL DEVELOPMENT
60 Minutes

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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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EPCS AND HOME SURVEYS

HOW SURVEYORS CAN OFFER MEANINGFUL ADVICE

TIM KENNY ASSOCRICS, TIM KENNY SURVEYING LTD

In this article, residential surveyor and domestic energy assessor, Tim Kenny, considers the introduction of the RICS Home Survey Standard and the advice surveyors can give to clients in their home surveys in relation to the EPC.

Many years ago, I qualified as a domestic energy assessor (DEA) and produced some of the first energy performance certificates (EPCs) for the then compulsory Home Information Packs. When I started to develop my own reporting practices and templates for home surveys, it seemed obvious to include some information about the EPC in my reports.

EPCs and the Home Survey Standard

With the introduction of the mandatory RICS Home Survey Standard (Professional Statement), which came into effect on 1 March 2021, RICS members and regulated firms must include a commentary on energy matters in **all levels of reporting** (see section 4.7).

At **level 1**, if the EPC has not been made available by others, then the RICS member should obtain the most recent certificate from the appropriate central registry where practicable. The relevant energy and environmental rating should be reviewed and stated. This is the case at **level 2** as well, when checks should also be made for any obvious discrepancies between the EPC and the subject property, and the implications explained to the client. At **level 3**, requirements for the lower levels again apply, and the RICS member should also advise on the appropriateness of any energy improvements recommended in the EPC.

The requirement at level 1 simply involves restating factual information; however, the requirements for level 2 and 3 reports are more substantial, with guidance given within the Home Survey Standard and report templates. In this article, I want to share some of my thoughts and experience to help other surveyors meet these requirements in a way that adds value for clients.

The role of the EPC

In this context, it is worth considering the nature of EPCs and their purpose.

EPCs were introduced in 2007 as the UK's response to the EU's legislative framework to achieve its energy and environmental goals. The EU recognised that to address energy use and environmental goals, it was essential to address the energy usage in the built environment, and so the Energy Performance of Buildings Directive was introduced. The UK's response was the legislation that introduced the EPC.

EPCs for domestic properties have two outputs:-

- an energy efficiency rating based on estimated fuel costs and
- an environmental impact rating based on CO2 emissions.

Both measures are **estimated from the characteristics of the property**. The numerical ratings are then banded from A to G, with A being the most energy efficient and G the least. In general, the higher the EER or EIR rating, the lower the fuel bills and CO2 emissions are likely to be. (The A-G banding concept was introduced because of the success of a similar A-G banding on white goods, which had seen a significant shift in consumers choosing to buy more energy-efficient washing machines, for example.)

The legislation requires that an EPC is made available when a domestic dwelling is offered for sale or to rent. However, an EPC is valid for 10 years, and there is no requirement for the EPC available to be current and provide an up-to-date reflection of the energy efficiency of the property when it is marketed. To put it another way, an EPC could be 9 ½ years old when a property is offered for sale or to rent, and in the intervening years significant alterations could have been made to the property.

Domestic EPCs intend to provide the consumer with a guide to the relative energy efficiency of a property.

They are not designed to provide a comprehensive, accurate breakdown of the way a property will perform or the actual running costs. Instead, the software used to generate the EPC makes some standard assumptions about the performance of the fabric of the building and the way it will be occupied. Although limited, EPCs do enable consumers to make some form of comparison between properties based on their likely energy use.

The other key facts to understand about EPCs are:-

- the way the data is collected (the conventions that accredited energy assessors must adhere to). For the assessments to be comparable the interpretation of what is on site must also be consistent, so the conventions provide a mandatory framework for the collection and interpretation of what is on site
- the actual EPC can only be generated via a BRE-approved calculation engine.

The calculation engine will assume a standard occupancy based on the size of the dwelling to determine the number of occupants and therefore the hot water requirement. Similarly, it will assume a standard heating pattern based on the volume of the dwelling and following standard heating patterns of nine-hour heating a day during the week and sixteen hours a day at the weekend. These assumptions may not reflect the 'actual' way a building is occupied but again, are justified so that meaningful comparisons between buildings can be made.

In many ways, this is not ideal but given the variable nature of buildings, they are perhaps the best that can be offered. The most appropriate comparison is with the ranges given for electric vehicles – we all know they will not actually cover the distances stated in the manufacturer's glossy brochure, but because they are all tested to the same standard, we know a Smart will not travel as far as a Tesla on one charge, even if the comparative difference might vary depending on how the cars are driven. In much the same way, a buyer should be able to pick up an EPC and know that a property rated A should be cheaper to heat than one rated G. However, most properties will not be A-rated but instead will be a C or D.

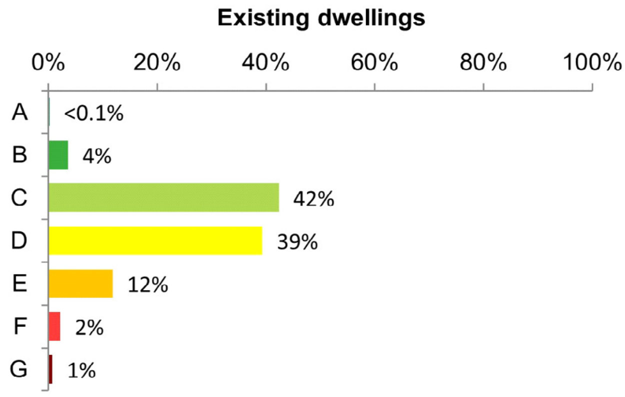


Figure 1: Energy efficiency ratings (EER): existing domestic properties, England, April to June 2022

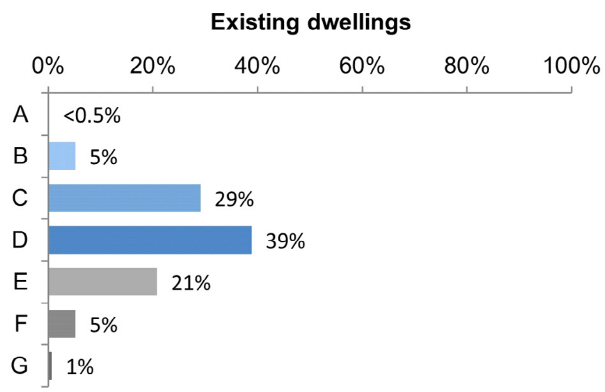


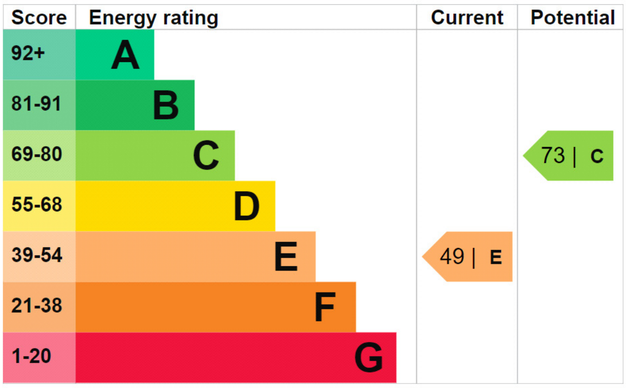
Figure 2: Environmental impact ratings (EIR): existing domestic properties, England, April to June 2022

Recommendations

An EPC itself includes recommendations generated by the software, which, in theory, improve the energy efficiency of the subject property. These recommendations are generated based on the data entry. For example, adding a thermal jacket to a hot water tank will only be recommended where the DEA has identified that an unlagged tank is present. With that said, the recommendations are not totally sophisticated, and DEAs are not trained to recognise 'show stoppers' – something that might prevent a recommendation from being carried out – or if they are (because they are also residential surveyors, for example), they simply cannot override the recommendations or add additional data fields to cover condition or legal constraints. In any event, there is no capacity in the software to capture the latter.

The recommendation must increase the EPC rating by at least 1 point (or 0.5 points for low-energy lighting) and the EPC gives an indicative cost and typical savings for the property, calculated by the approved RdSAP engine.

The EPC shows the current and potential energy efficiency. The potential energy efficiency is calculated by the software, assuming that a recommendation will increase the EPC rating by at least 1 SAP point and in a given order.



The graph shows this property's current and potential energy efficiency.

In some cases, the DEA can suppress recommendations, but **only if there is documentary evidence** showing that a specific recommendation is not appropriate. So, if a surveyor, who also happens to be an accredited DEA, were to judge that retrofitting cavity wall insulation would be inappropriate they cannot suppress that recommendation. It is perhaps for this reason – the fact that there are published EPCs with completely impractical recommendations – that EPCs have had bad press in certain quarters.

The role of the surveyor

The Home Survey Standard requires the surveyor to help the client make better use of the broad information and guidance given in the EPC. This creates an opportunity for surveyors. For a level 2 and 3 survey, the surveyor should identify any obvious discrepancies.

A surveyor should identify how up-to-date an EPC is and advise whether or not there have been changes since it was created that may have impacted the rating. Most surveyors provide seller questionnaires to ask the seller about the property. Does the questionnaire prompt the seller to provide information about changes they have made that might impact the EPC? For instance, have they installed another boiler since the original EPC was created?
Identifying discrepancies does not mean that the surveyor should aim to audit the DEA. The surveyor should not attempt to recreate the measurement methodology of a DEA, but instead should note whether there is a significant discrepancy between their own measurement of the floor area or that provided by the agent and the one the DEA has provided. An error in floor area calculation can affect the energy rating since the software assumes occupancy based on the floor area. Comparing the two measurements can also be useful to identify whether the EPC has been produced before or after any major alterations or extensions to the property. Don't forget that how a DEA is required to calculate a floor area may be very different from the method a surveyor might use, so some difference should be expected. For example, garages, utility rooms, and porches may not be included in the floor area if they are not heated via the main heating system.

The surveyor should always flag any errors in the DEA's identification of the construction type. Occasionally, these are not in fact errors, but a result of the limited options available when certifying energy use. For instance, while most houses represent a small range of standard construction types, there are some that do not, such as historic, system build, or unique constructions. A surveyor with specialist knowledge may understand the energy performance of these structures, whereas the software used to produce EPCs does not. Instead, the DEA is obliged to include the property in the closest category available. In such cases, the surveyor should use their specialist knowledge and experience to help their client better understand the energy performance of a property. This is particularly key when considering older solid-walled properties; the data used to generate EPCs has assumed that they have a very poor thermal efficiency when actually, there are some good indicators that many older construction types perform much better than expected.

Another key issue to consider is the insulation in the property. EPCs are often generated using assumptions about the level of insulation, which are made without the full input of a DEA; instead, they are based on factors such as age and construction type. An inspection carried out by a surveyor will often provide more information about the true level of insulation in a property, and this should be conveyed to the client.

A good example is loft insulation. A surveyor is likely to spend more time in a roof space than a DEA, and is not required to follow RdSAP conventions, so they may find evidence of insulation which may be omitted from the EPC. For example, if the loft is fully boarded, the DEA must enter the insulation as 'unknown'. This will suppress a recommendation, and depending on the age, may assume no insulation is present. However, if a surveyor can see between the boards that there is in fact insulation present, they can advise the client of this and explain that removing the boards and increasing the loft insulation would improve the energy efficiency. Given this is one of the most cost-effective ways of improving energy efficiency in homes it is important that surveyors bring it to the attention of clients who might otherwise not have thought about it.

Insulation is also a key factor when considering the level 3 requirements. As retrofitting insulation to a property can be a cost-effective way to improve the energy efficiency, this often features among the recommendations made in an EPC. As I have already said, it should be noted that the recommendations within the report are automatically generated with very little scope for altering or suppressing them. It is, therefore, vital that the surveyor reviews these recommendations to ensure they are actually suitable for the property.

A classic example is cavity wall insulation. For some properties, this can be a definite benefit, but for many where a level 3 survey is likely to be instructed, it may be completely unsuitable such as in early cavity wall construction where the wall's external face may not be watertight, or in an exposed location etc. It may also be the case that there are defects that would render a recommendation ineffective or even detrimental. Examples may include worn pointing to an exposed wall, or issues with a roof structure that may make it unsuitable for PV panel installation. Where this is the case, the surveyor should always cross-reference relevant sections within the report.

It is also true than many level 3 surveys will be instructed for older or listed buildings where recommendations such as external solid wall insulation or insulation under a suspended timber floor may be completely inappropriate. Here, it is vital that the surveyor advise not only that the recommendation is inappropriate but also why, and detail the potential for harm to the property. Such advice may not take the place of a specialist report on energy efficiency related matters, but it could help a landlord client when considering issues such as the minimum energy efficiency standards (MEES).

The last way I look to add value to my surveys around the EPC is by linking any recommendations within the EPC to specific defects or repair works required at the property. We often think about the recommendations that cannot go ahead because of defects, but there are also some positive aspects. This could include highlighting that the works to resolve an issue you have identified with a solid floor could also provide an ideal opportunity to insulate the floor. The cost of insulating the floor may not be economic by itself but may make sense as part of the larger works required.

Another example is removing a textured coating ceiling to a loft room; this is a good time to check and, if applicable, improve the level of insulation.

Conclusion

As Surveyors, we do have to be mindful of liability, and it is important that we consider this aspect when reviewing changes to standards, but that does not mean we can't also look for opportunities to increase the value of what we offer to our clients. With increased energy prices and the move to carbon reduction, we can take a leading role in helping our clients.

A version of this article was originally published in the RICS Property Journal, however this version has been extended.

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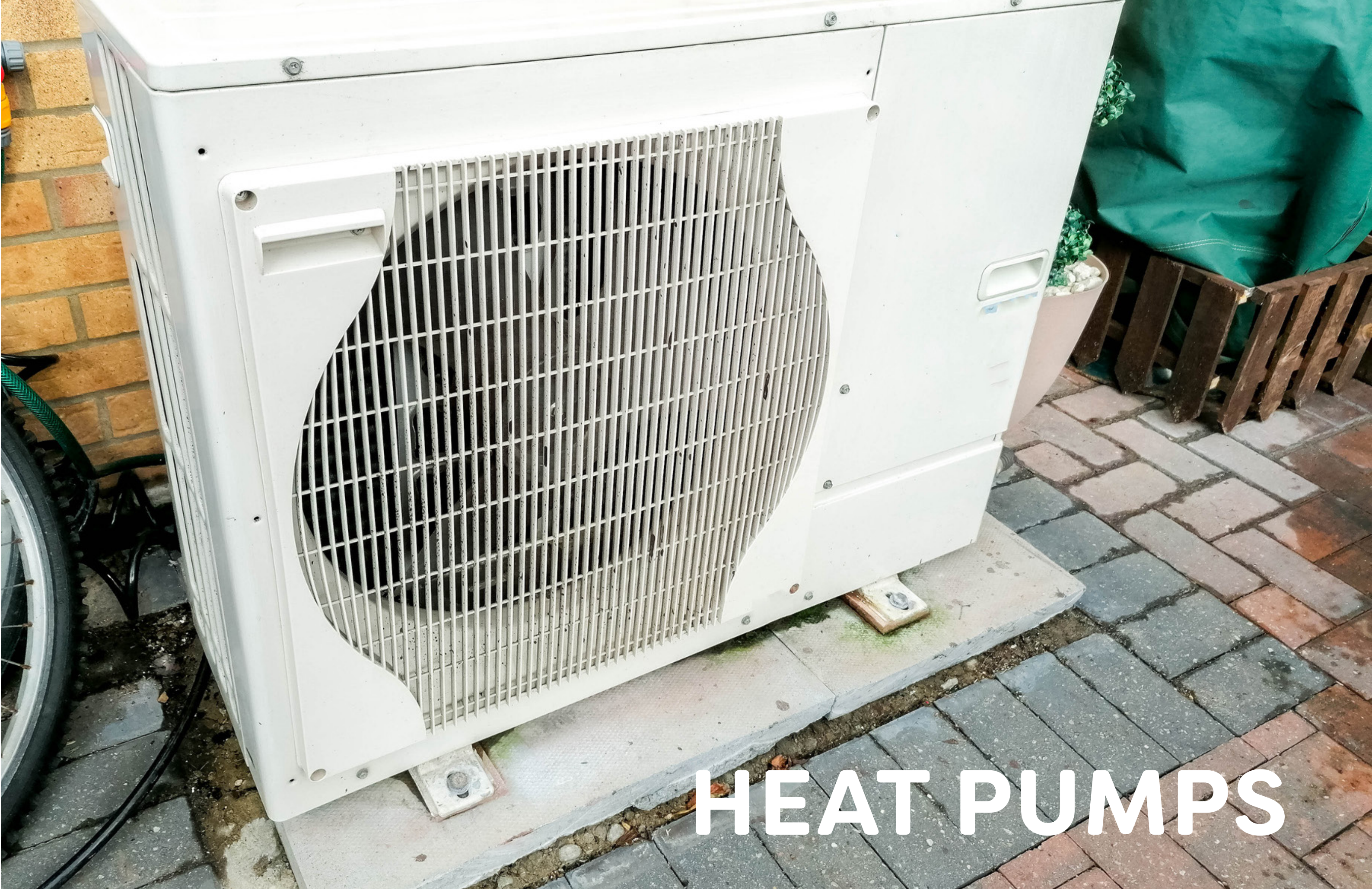

THE FUTURE FOR HOME HEATING?

DR N G CUTLAND, MINSTP, CONSULTANCY DIRECTOR, SAVA

In September 2020, the NHBC Foundation published a guide called "The Future for Home Heating – life without fossil fuels" [ref. NF87], which was researched and written by Dr Neil Cutland, then of Cutland Consulting Ltd. but now the Consultancy Director at Sava.

The guide was produced following the publication of the government's "Future Homes Standard" in 2019, which stated the intention that new homes will not be permitted to be connected to the gas grid from 2025 onwards. It considers what the non-gas home of 2025 might look like.

This article, written by Dr Neil Cutland, looks specifically at heat pumps as an alternative to gas central heating and the challenges we face if we are to replace gas boilers with electric heat pumps.

Introduction

In June 2022, Part L (conservation of heat and power) and Part F (ventilation) of the Building Regulations changed, meaning that carbon emissions in homes built to the new regulations will be 31% lower than the previous (2013) regulations. From 2025, when no new homes will be connected to the gas grid, the carbon emissions should be around 75-80% lower than the 2013 regulations. Efficiencies of heat pumps can exceed 300%, and government policies focus heavily on heat pumps as an alternative to gas central heating. The government's Heat and Building Strategy states:

"Heat pumps are already a predominant technology in some other countries, and have high levels of customer satisfaction; however, work needs to be done to build UK supply chains and drive down costs."

The UK is clearly not leading the way with this technology.

For example, Finland, a country with approximately 3 million households, has witnessed a move away from fossil fuels (they do use electricity, but 46.2 % of electricity generation in Finland comes from renewables [Statistics Finland, 2019]) and it has been estimated that 1,030,000 heat pumps have been sold since the year 2000. (Source)

What is a typical low-energy home?

Before looking at heat pumps in detail, we need to understand what a low-energy home looks like and why it is relevant when considering carbon emissions. In theory, the carbon emissions of a dwelling could be reduced solely by switching to low-carbon technologies for heating and lighting. However, the given thinking is that a 'fabric first' approach to the design of the building, to maximise the performance of the materials of the building fabric itself, should be implemented before considering the use of alternative building services.

A 'typical' low-energy home is likely to have the following characteristics:

- minimal space heating demand (e.g. floor, roof and wall U-values around 0.10 - 0.15 W/m^{2}K; triple-glazed windows; near-zero thermal bridges - which in practice means psi-values ≤ 0.01W/mK; air leakage ≤ 1.0m^3/m^{2}h @50Pa)
- mechanical ventilation with heat recovery (MVHR) with an efficiency of 85% or better
- good heating controls (ideally zoned and weather-compensated)
- LED fixed lighting
- efficient electrical appliances (A+ or better), if provided by the builder.
- To make this low-energy home a low-carbon home, a low-carbon heating and hot water system (such as a heat pump) must also be installed.

How does a heat pump work?

Heat pumps work by transferring thermal energy from outside (taken from the air or the ground) so that it can be used inside and distributed via emitters. There is heat available to be taken from outside in winter as well as summer.

A compressor (run by electricity) pumps a fluid around the loop. As it pumps through the compressor, it becomes hot and goes through a distribution system inside the house, where it gives up much of its heat. It is then cooled down further through an expansion valve, is pushed outside the building and through another heat exchanger where it picks up heat from outside and goes around the circuit again.

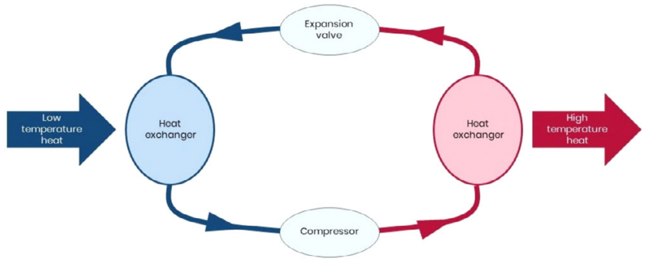

Figure 1: Diagram showing basic principles of how a heat pump works. Source: Energy Saving Trust

Fundamentally, there are two types of heat pump: air source heat pumps (ASHPs) and ground source heat pumps (GSHPs).

Air source heat pumps transfer heat from the outside air into the heat pump's fluid by using a fan, and then pumps it into the house. The image below shows a typical outside unit of an air source heat pump.

Figure 2: Air source heat pump unit

Ground source heat pumps collect heat from the ground. A separate fluid is pumped through a buried pipework loop and picks up the heat. There are two types of loop: a vertical loop in a borehole, and a horizontal loop laid in a shallow trench. (You may have heard of closed loop and open loop. It's rare to find open loops in homes - they are usually found in larger, mixed developments like holiday complexes where there is a stream or lake available as the heat source.)

A vertical bore can be expensive, but the bore can extend metres down into the ground where there is more heat. These are required for dwellings that do not have much ground.

Horizontal loops can be laid as a single loop around the perimeter of the available ground, or as coiled loops (informally called slinkies) where the perimeter of the ground is insufficient for a single loop.

Figure 3: Slinky horizontal loop in shallow trench. Source: Kensa Heat Pumps

In the UK, the temperature at just 1 metre below the ground tends to remain at around 10-12°C regardless of the time of year. This is ideal for heat pumps, which prefer the source temperature to be consistent. However, with air source heat pumps, the temperature of the outside air can vary greatly depending on the time of the year.

There is yet another form of heat pump technology–a water source heat pump (WSHP)–which work in a similar way to air or ground source heat pumps and use the heat energy from water to provide heating and hot water.

There are two main WSHP designs: a closed loop system or an open loop system. Closed loop systems are used in lakes, lochs, or large ponds. Open loop systems are used with boreholes near rivers or other areas where the geological conditions are suitable.

Water source heat pumps are very niche in a domestic setting since comparatively few dwellings have access to a suitable water source and no normal developer would consider them. However, there is the potential opportunity for community based WSHPs or for use in mixed developments such as holiday complexes. In 2014, the Government Department for Energy and Climate Change (DECC) introduced a water source heat map of England (see here).

The map was developed for local authorities, community groups and private developers, in order to highlight the opportunities for deploying innovative heat pump technology in the nation's rivers and water sources to produce energy from a low-carbon, cheap and reliable source. However, this map just identifies the potential opportunities. There would be many legal and practical factors to consider if the potential were to be harnessed.

Once the heat has been captured from the ground or air and passed through the heat pump's compressor, it needs to be distributed around the dwelling. This can be via the air or a wet circuit with radiators and/or underfloor heating.

Underfloor heating is ideal for heat pumps, as it requires a fairly low temperature compared to radiators (you wouldn't want to walk on floor as hot as a radiator), and the output temperature of a heat pump is well matched to this. It is common to mix underfloor heating downstairs with radiators upstairs. However, underfloor heating is expensive to retrofit into existing properties.

When installing heat pumps, it's strongly recommended that a qualified MCS-accredited heating system designer who specialises in heat pumps is consulted. If the heat pump and/or emitters are not correctly sized (i.e. are neither undersized nor oversized) then the property may not heat properly, risking excessive running costs, the heat pump breaking down, a cold house and very unhappy occupants. This will be outside the remit of most surveyors' reports, so if inspecting a property with a heat pump, you should advise your client to check with the vendor or installer who specified the system and if necessary, get a qualified heating designer to check the specification.

Suggested wording for a level 2 inspection and report:

"The property is heated by a ground/air **(delete as necessary)** source heat pump. Such installations must be designed and installed by qualified heating system specialists to ensure that the heat pump and emitters (fan units / radiators / underfloor pipework) are correctly sized, otherwise the temperature in the property may not be sufficient (especially in colder weather). Your legal adviser should request the vendor to provide documentation detailing the system and its specification.

You are strongly advised to instruct an MCS accredited specialist heat pump engineer to inspect the system to ensure that it is operating correctly and that both the heat pump and the emitters are of the correct size, prior to entering into a legal commitment to purchase the property."

Emitter sizing

Heat pump flow temperatures are lower than those of conventional central heating boilers. Although it won't feel like it when you touch a radiator, the water that comes from the gas boiler that feeds the radiator will be around 65-70°C. Although it has cooled down slightly by the time it reaches the radiator, it can still cause burns. However, a heat pump output temperature will be typically 45-55°C, so to get the air temperature inside the home up to a comfortable temperature, the radiators need to be physically larger.

There are now alternative low-temperature radiators, usually made of a less dense metal like aluminium and which may have highly efficient convection fins behind them, low water content, and possibly even a small fan that pushes the heat out more effectively. They are usually slightly deeper than a common radiator but otherwise are similar in area. They are more expensive than ordinary radiators.

Figure 4: Example of a radiator used with a heat pump. Source: Jaga UK

Domestic hot water

Domestic hot water can be challenging with heat pumps because water needs to be heated to 60°C or more to avoid legionella risk. Heat pumps generally work at lower temperatures than this - so how do you heat hot water with a heat pump adequately? There are several ways.

The heat pump output temperature can be boosted temporarily while heating the water. This is a common solution, although, heat pumps operate at much lower efficiencies while this happens, so it could be an expensive option.

Some systems will allow the heat pump to run at its normal temperature and then boost the hot water temperature using an immersion heater. Some heat pumps even contain a small integral hot water cylinder. The technology is always evolving, and better ways of heating water are likely to emerge, but domestic hot water will remain a challenge for many heat pump systems.

Small homes (i.e. flats) may have an instantaneous electric hot water system which is a cheap option and does not suffer the heat losses associated with storing hot water. However, this may not comply with the new Building Regulations which will require efficiencies higher than 100%. Builders should consult a contractor approved to MIS 3005 standards to ensure this would work. In larger homes, solar hot water heating may be a viable option, but again an approved contractor should advise if it might be more cost-effective to use the roof for photovoltaics (PV) to generate electricity.

The Challenges

The International Renewable Energy Agency has calculated that to meet global climate objectives, the number of heat pumps in global households needs to increase from 20 million in 2015 to 253 million by 2050, more than a tenfold increase.

"This is not simply a process of heat pump adoption, but in fact a transition to a new indoor domestic regime that requires many other regulatory, institutional, market, industry, and cultural changes in addition to the technological ones."
Credit: Mari Martiskainen, Johan Schot Benjamin K.Sovacool – User innovation, niche construction and regime destabilization in heat pump transitions.

So, what are some of the challenges?

Education

Switching from a gas boiler to a heat pump will require some adjustment of human behaviour. Because of the lower distribution temperature, the heating will need to be on for longer, which is likely to feel counter-intuitive. Care should be taken with this message because even though longer heating periods can mean higher bills, the possible rise in costs will be offset by the increased efficiency of the heat pump. Inevitably, heat pump systems will require some degree of education and commitment by consumers to change the way they do things. Inevitably, this will be a challenge.

And very simply, people need to become familiar with and trust the technology. Anecdotally, we have heard purchasers being put off properties with heat pumps simply because they are 'unknown'. We are all familiar with gas boilers – whereas heat pumps feel a bit like unknown territory.

Bad design, resulting in mistrust

Between 2011 and 2014, a scheme called the Renewable Heat Premium Payment (RHPP) Scheme provided grants for heat pumps, and many social housing providers replaced gas boilers with heat pumps. However, this created several anecdotal stories of the external units of air source heat pumps icing up. This meant they needed to run 'defrost cycles' which use a lot of electricity.

DECC (now BEIS – Department for Business, Energy and Industrial Strategy) commissioned research by UCL to analyse why this was happening. The conclusion of the final version of the report was that it was bad design, more than anything, that had caused the malfunction of the heat pumps. Once again, the lesson for builders and installers is to ensure that qualified and experienced heating engineers specify the system, or it may result in a less than ideal installation that costs money and effort to fix.

There is more information about this on these links:
FINAL REPORT ON ANALYSIS OF HEAT PUMP DATA FROM THE RENEWABLE HEAT PREMIUM PAYMENT (RHPP) SCHEME

Evaluation of the UK Government's Renewable Heat Premium Payment (RHPP) scheme

Noise

There have been some cases where the external fan units of air source heat pumps, and/or the indoor pumping system of heat pumps in general, have been found to be unacceptably noisy. The recommendation to builders installing heat pumps is to ask suppliers to demonstrate the proposed system in a real installation.

Planning Permission

At the time of writing, air source heat pumps are classed as permitted developments as long as certain requirements are met, such as compliance with the Microgeneration Certification Scheme Planning Standards (MCS 020), and that all parts are sited at least 1 metre from the property boundary. It must also be used solely for heating purposes (i.e. a cooling mode is not possible). If these requirements are not met, then a full planning application can be required. More information can be found on the planning portal website here.

Maintenance
The maintenance requirements for heat pumps are slightly different to gas boilers. For example, the external filters that pick up leaves, dirt etc. need to be maintained. However, it shouldn't cost much more to maintain a heat pump than a gas boiler. Manufacturers usually recommend an annual service, as is the case for gas boilers.

Cooling function
Heat pumps can theoretically function as cooling systems as well. Whilst this is great for the residents when there is a heat wave, it would increase the UK's carbon emissions if everyone were to use artificial cooling when it is hot.

Historically, grant schemes which subsidised heat pumps have forbidden supply of heat pumps that are capable of cooling. Similarly, under current planning law, heat pumps that can be run in cooling mode are not classed as permitted developments. The NHBC Foundation has advised builders to 'beware of marketing cooling' because the government could, in principle, tighten up policy and effectively make it illegal to cool with a heat pump.

Load on the national grid
Naturally, as we replace gas heating systems with electric ones, there will be an increased load on the national grid and our generation plant. This is in addition to the increase caused by the installation of electric vehicle chargepoints at a national level. As part of the solution, the country will need to implement complex software and hardware techniques to manage consumer demand.

Shortage of skills
It is widely recognised that there will be a skills shortage of people who can design, install and maintain heat pump systems. In the Future Homes Standard, the government states that it is currently engaging with the supply chain to ascertain the scale of the challenge and determine crucial roles to address the problem.

Performance gap
If homes are not built to the quality that the heating designer assumed, for example, the insulation isn't as efficient as originally specified or the building's air leakage rate is greater than was assumed, the heating system may turn out to be undersized. The government is working to address this 'performance gap' by progressively tightening up the quality control aspects of Part L of the Building Regulations.

Heat pumps in flats

Installing heat pumps in blocks of flats is a somewhat different challenge.

A company called Kensa has designed a solution they call a 'Shoebox' ground source heat pump, described on their website as 'small but mighty'. In 'shoebox-type' ground source heat pump systems the ground loop is shared between many apartments, and the loop water is pumped around the building at around 10-12°C. A small heat pump in each apartment then upgrades the heat to the 50-60°C that is needed for space heating.

The benefit of this system over a system with a large, central heat pump is that corridors will be less likely to overheat due to distribution pipework losses.

Conclusions

In summary, the key learning points are:

- The choice of which type of heat pump and distribution system to install depends on the built form, size, tenure and physical location of the home
- In order to ensure that the home is warm enough and that the provision of domestic hot water is adequate, it is vital that specialist advice is sought from a suitably qualified and experienced heating designer
- Proposed heat pumps should be checked prior to specifying a system, to determine noise levels and surveyors might want to advise purchasers to check the noise levels of any system already installed
- House builders (and early adopters) will need to consider the marketing messages for all-electric homes, which are heated by heat pumps and may not have gas cookers
- Be aware that some installations which also promise cooling may not be compliant with planning law or other standards and local policies
- The heating system that was designed and installed will only perform correctly if the environment for which it was planned has also been built or installed correctly
- The shortage of appropriately skilled designers, installers and service engineers may impact the uptake and ongoing management of heat pump systems.

This article is based upon the guide NF87 published by the NHBC Foundation. You can download the full guide free of charge here.

Dr N G Cutland, MInstP, Consultancy Director, Sava
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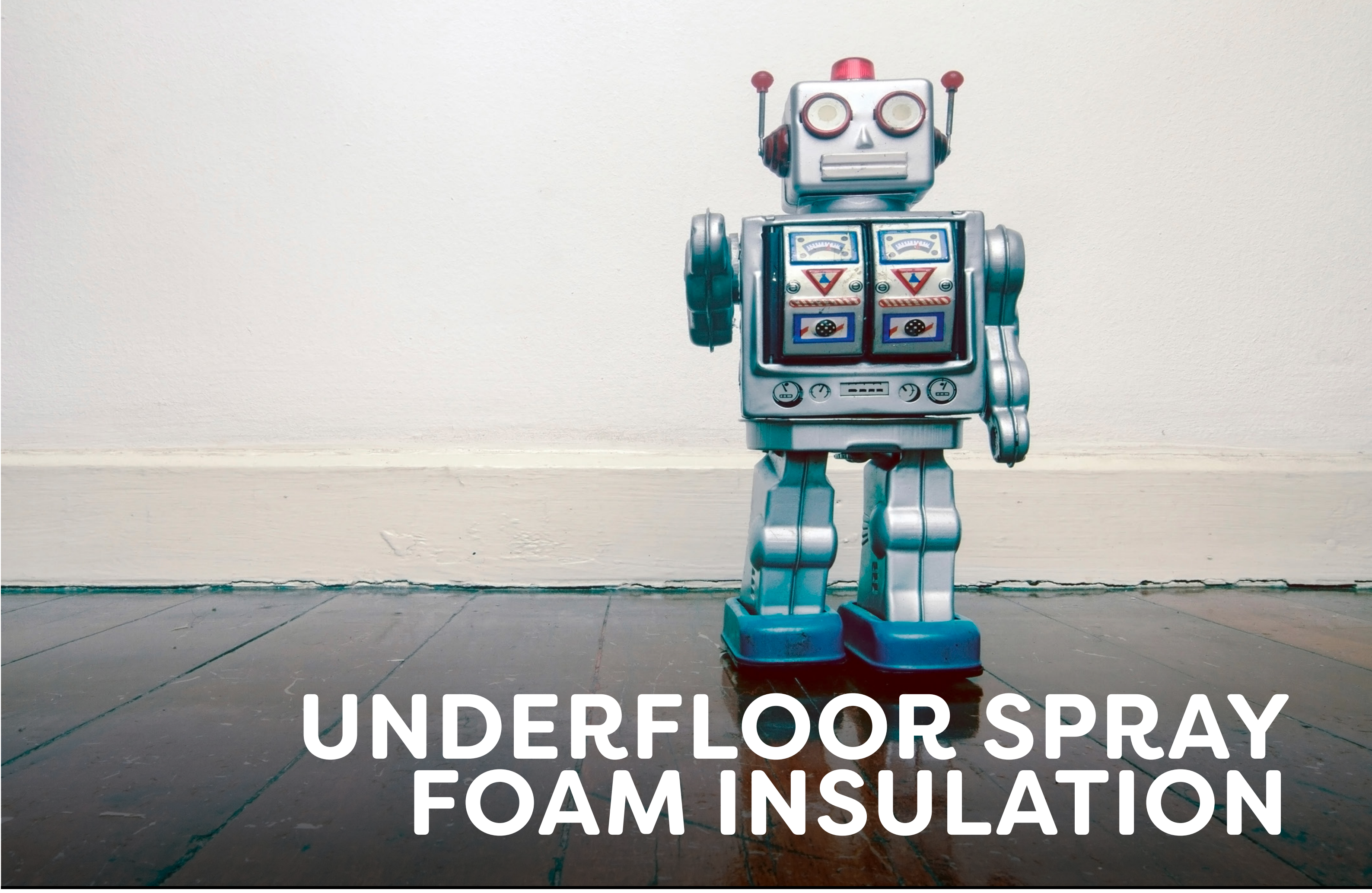
Neil also set up his own company, Cutland Consulting Ltd, in 2010, where his clients included the energy regulator Ofgem, the NHBC Foundation, Hastoe Housing, Knauf Insulation, BEIS, DLUHC and many others. Neil is one of the authors of the BREDEM-8 and BREDEM-12 models and has contributed extensively to the development of the SAP since its inception.



UNDERFLOOR SPRAY FOAM INSULATION

NIGHTMARE SCENARIO OR DREAM SOLUTION?

HILARY GRAYSON BSC EST MAN (HONS), DIRECTOR OF SURVEYING SERVICES, SAVA

Waltham Forest Borough Council has recently undertaken a comprehensive retrofit of energy efficiency measures on a property at 47 Greenleaf Road, a typical Victorian end terrace property in Walthamstow, east London.

Built in 1902, the property was typical of its age with poor energy performance, an EPC energy rating of E, and an annual heat demand of 17,219kWh.

This article looks briefly at the measures installed, and in particular, at the underfloor insulation solution employed at the property.

Background

In 2019, the London Borough of Waltham Forest published a report indicating that 51% of its carbon emissions came from the residential homes within the borough. The borough is representative of many urban areas with 70% of the housing dating from before the second world war. In Waltham Forest's case, this amounts to 107,216 homes.

Waltham Forest also wanted to address the issue of fuel poverty. At the time of the report, 14.6% of households in the borough were in fuel poverty (in 2019, across England as a whole it was 13.4% or 3.18 million households in total).

Fuel poverty in England is measured using the Low-

Income Low Energy Efficiency (LILEE) indicator. Under this indicator, a household is considered to be fuel poor if:

- they are living in a property with a fuel poverty energy efficiency rating of band D or below

and

- when they spend the required amount to heat their home, they are left with a residual income below the official poverty line

There are 3 important elements in determining whether a household is fuel poor:

- household income
- household energy requirements
- fuel prices

Source: UK Government

Consequently, Waltham Forest challenged contractor Aston Group to reduce the annual heat demand of 47 Greenleaf Road from 17,219kWh to 7,995kWh per year, and increase the EPC from an E to A.

Fabric First

Approximately 25% of the heat generated in the home will be lost through the roof, 35% through the walls and draughty windows and doors, and about 10% through the floor. Consequently, Aston started with the building heat loss envelope.

Walls - External wall insulation (EWI) was installed to the side and rear elevations of the property, using 90mm Rockwool insulation slabs (non-combustible) with a top-coat of render. EWI was not feasible on the street elevation in order to avoid loss of character to the property, therefore, internal wall insulation (IWI) was installed to this façade using a Celotex 57.5mm insulated plasterboard. To avoid cold bridging, the EWI and IWI were overlapped by one metre at the corners.

Roof - The roof was upgraded to 300mm of mineral wool insulation (between and above joists).

Underfloor - Floor insulation was installed to the main suspended floor via a 'Q-Bot' insulation system.

Underfloor insulation

The loft space is an established insulation method, and EWI and IWI are becoming more commonplace. The property, typical of its type and age, had wooden suspended timber flooring and the method chosen for the underfloor insulation is a new technology called the Q-Bot insulation system.

In fact, Q-Bot technology is not so new as it is a spray foam insulation system. What makes it new, and a potentially exciting innovation is that it uses small robots to access the floor void without disrupting the whole floor, thereby causing the minimum amount of occupier disruption.

And this is where the alarm bells will start ringing for many surveyors – spray foam insulation on timber.

What is not clear from the literature available is the condition of the floor prior to the work being undertaken, but as part of the installation process, AirEx smart air bricks were also installed into the walls to regulate airflow.

The AirEx 'brick' is a smart ventilation system that replaces existing air bricks at a sub-floor level. AirEx bricks have in-built sensors to measure the environmental conditions (such as temperature and relative humidity) and use smart software to automatically regulate airflow enabling the bricks to open to reduce humidity and prevent damp and associated problems such as mould, but to close to reduce heat loss and improve thermal comfort. The bricks are battery powered, the batteries need to be changed approximately every two years, and they link to a central 'hub' via the wifi system. More information can be found at https://www.airex.tech/

The Q-Bot system can apply insulation to a typical house in 1-2 days resulting in a SAP improvement of 2 to 12 points (which Q-Bot says has been verified by the Energy Saving Trust). The company claims the installation reduces the risk of damp and mould because the layer of foam creates a hydrophobic barrier between the floor and void, and by increasing insulation raises the temperature of the floor, thereby reducing the risk of condensation.

Several Local Authorities and Housing Associations have worked with Q-Bot to install underfloor insulation in a range of case study properties to demonstrate the improvement in energy and environmental impact and enhancement of residents' comfort. These case studies have demonstrated improved U-values and high levels of occupants' satisfaction. However, it is not clear if any long-term monitoring of the properties is being undertaken to establish any other side effects from the technology.

Lenders and spray foam insulation

We understand that a recent meeting involving several lenders and leading valuation firms reacted to the news of underfloor spray foam insulation with a "collective horror". However, we approached two lenders for more detailed comments and the response was not completely negative.

While the general consensus is that any concerns relating to ventilation and dampness in roof spaces were magnified for under floor areas, one leading high street lender did tell us that for roofs, they would consider open cell foam when installed by an approved installer with all of the certificates and guarantees, but not where it has been used to rectify pre-existing roof defects. To the best of our knowledge, they have not yet had to address underfloor spray foam.

Nationwide also gave us the following statement:

"Regarding Spray Foam in roofs – we have reviewed our position and will accept this form of 'insulation' but only after the homeowner can demonstrate that the installation has been completed entirely in accordance with the manufacturer's specifications (and that includes pre-instal survey, inclusion of barriers etc.). Otherwise, we would need a report form a Building Surveyor and

will be guided by their recommendations. We would also require confirmation that the project was being implemented/designed to address energy efficiency as opposed to a short term roof repair/deficiency.

We are aware of robot technology for Spray Foam in under-floor voids – and we are currently looking at our guidance in this respect. The initial thinking is that our position will be similar to roof spaces i.e. 'if' it can be demonstrated that the 'insulation' has been installed correctly and in 'full' compliance with recommendations (inc pre-instal surveys etc), then we would accept it.

For example, the BBA specification states that services/ wiring needs to be re-routed/protected and not covered with the foam, but we have seen photographic evidence that suggests this is not always achieved and indeed would be difficult to achieve without expensive and disruptive work, thereby, negating the benefit of the robot method of installation."

The retrofit home

The Waltham Forest house refit is claiming an 82% improvement in energy use, 81% improvement in carbon emissions, and 64% improvement in running costs (calculated before the recent energy cost crisis).

Service upgrades

Mechanical ventilation - to reduce heat loss and improve internal indoor air quality, a mechanical ventilation system with heat recovery was installed

Heating system replacement - the existing gas boiler was replaced with an air source heat pump, associated hot water cylinder and new radiators

Photovoltaic array - A 3.9 kWp solar photovoltaic array has been installed with associated battery storage

A waste water heat recovery system (WWHRS) was fitted beneath the bath to recover a percentage of the heat lost down the drain.

While this article has only touched on the insulation and in particular the underfloor insulation, it will be interesting to see how this house performs over time and whether challenges such as the way the occupants live in and 'manage' the house, together with the efficacy of the new technologies and any unforeseen consequences (particularly the underfloor insulation and the AirEx bricks), impact on the fabric of the property.

However, the energy efficiency and property running costs are no longer side shows; they have become mainstream issues. As so much of the UK housing stock is pre-war, innovative technologies are going to be essential if we are to address the issues of climate change and energy costs. Watch this space.

Hilary Grayson BSc EST MAN (Hons),

Hilary Grayson BSc EST MAN (Hons) is Director of Surveying Services at Sava and 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.

HISTORY WITH CASE STUDIES

BERNIE SMITH MCABE, C.BUILD E, FCIOB, SMITH BUILDING SERVICES

In this article, Bernie Smith MCABE, C.Build E, FCIOB reviews the past use of lime mortar and explains the different types available and their benefits. He also shares two interesting case studies where he was appointed a consultant and his company, Smith Building Services, carried out repairs using lime render on historic buildings.

History
Limestone or calcium carbonate ($CaCO_3$) is a naturally produced stone found extensively throughout the world.

The earliest documentation of the use of lime in construction was around 4000BC. It is documented that the Egyptians used lime in the construction of the Pyramids. There is also some evidence of the use of lime when looking at buildings by the Romans and ancient Indians, and confirmation that lime was used when building the Welzmann Institute in Israel, 12000BC.

All these years ago, it was discovered that if you burnt limestone and then combined it with water, pliable material that hardened with age was produced. There is no definite date affirming when regular use of lime in construction began, but it is documented that the Roman architect Vitruvius provided basic guides for using lime when building. The Romans were keen advocates for using lime mixed with baked clay or volcanic ash, which when water was added, they found would harden considerably, producing a very reliable building component.

Lime continued to be used as a reliable construction material through time, however, in the 18th century, it was discovered that if you fired a limestone that contained clays, this would result in a hydraulic lime. In 1756 a gentleman named James Smeaton developed probably the first commercial hydraulic lime product available on the open market. His method was to combine pozzolans and Blue Lias limestone which contained clay, and he discovered that this produced a strong lime mortar that was very good in harsh environments and had good resistance to severe weather and even salt water. This was what was used to build the Eddystone lighthouse, Eddystone lighthouse, a structure that a structure that has certainly stood the test of time in very harsh conditions.

Benefits of lime mortar

It is the flexibility of lime mortar that makes it so successful for building. Whereas more modern cement-based mortars tend to be much more rigid and unforgiving, lime mortars allow movement within the structure without stress or cracking. Lime mortars also help with the ingress of moisture within a building. Acting with a wick-like ability, this may seem like a disadvantage, but by drawing moisture in it also allows the structure to easily dry out. The fact that the majority of the moisture is taken in and expelled through the joints means there is less chance of spalling of the masonry or a saturated building. The fact that lime mortars allow moisture to enter but also evaporate is very important to buildings that have been constructed without moisture barriers and techniques to allow flexibility, such as damp-proof courses or movement joints. Sometimes when talking about the permeability of a building, you very often hear the expression "the building needs to breathe". Personally, I prefer the expression "a building needs to dry"; this is simply saying that the structure does not trap moisture within itself, the moisture enters, but it also evaporates. Therefore, there is less likelihood of damp, mould growth or infestation of the fabric of the building.

Lime seemed to go out of fashion during the nineteen sixties, seventies and eighties, with the use of Portland cement being the favourable product used. Although Portland cement has been around since the first half of the eighteenth century, lime mortars and renders were still quite widely used up to this time. During the sixties, seventies and eighties, Portland cement was considered by many to be the right product to use on almost all types of construction projects including, unfortunately, sometimes historic restoration and repair works. Although the process of listing buildings of historical importance came into place during the Second World War, the care and repair of them were not always carried out most sympathetically. Over the last forty or so years, it has been realised that using the right materials for repairing and renovating old buildings is of the utmost importance. It is not just buildings of historic interest but also thousands of other buildings that benefit from the use of lime mortars and renders in their repair and construction.

Lime v cement-based

So, why is it important to use a lime mortar or render, rather than a cement-based product, when working on older buildings?

The first thing to remember is that the material binding or covering the stone or brickwork should not be stronger than the stone or brickwork itself. If the mortar or render is stronger, the building will not be able to flex or move, and damage may occur to its structure.

Secondly, cement-based materials are very dense and not very porous, therefore, any ingress of moisture could become trapped within the fabric and cause damp or structural issues.

Thirdly, when working on old buildings, especially ones of importance, it is important to ensure that the repair or building work does not look out of place and matches the original the best it can. It is easy to spot a repair that has been previously carried out using cement, as it stands out like the proverbial sore thumb.

Different types of lime

Hydraulic lime

When building with lime, the first thing is to decide which lime mortar or render will be most suited to the project that you are carrying out. For historic work, the most popular used is hydraulic lime, in simple terms, hydraulic means operated, moved or affected by water. Hydraulic lime is produced using limestone which hardens when water is added, known as slaked, and once it starts to set, it absorbs carbon dioxide from the atmosphere. The more hydraulic the lime used is, the faster it sets and the stronger it becomes. Hydraulic lime is categorised as follows: NHL2, NHL3.5, and NHL5. The number relates to compressive strength in megapascals (MPa) or newtons per millimetre (N/mm2).

NHL2 is the gentlest and most flexible of the hydraulic limes, it contains less than 12% clay which creates a slower setting time, normally around 20 days in water. NHL2 is normally used for internal works and for making lime plaster.

NHL3.5 is the more general-purpose and moderate lime; it contains between 12% and 18% clay and sets in water around 15 to 20 days. NHL3.5 is suitable for most day-to-day use of lime in construction.

NHL5 is the strongest and most fast setting of the three limes. It contains 25% clay and sets very quickly. If the conditions are right, it can set within hours. NHL5 is suitable for use in more exposed environments. Recently there seems to be a little controversy over the use of NHL5, one school of thought is that over long periods, it is setting too hard and not being as forgiving as predicted. It has been reported that, in some instances, the use of NHL5 has resulted in problems with the build or repair that is taking place. As stated above, this is just one theory and not a common opinion.

Hot lime

Hot lime, sometimes called hot mixed or hot mixed mortar, is another part of the lime construction family. Hot lime is the process of mixing quick lime, aggregate (usually sand) and then slaked. This process creates a powerful exothermic reaction and produces temperatures up to and exceeding 250 degrees Celsius. However, this high temperature only occurs in a low percentage of the mix and the majority of the mix should remain around 100 degrees Celsius. This is obviously where the term 'hot lime' is derived. This is the ideal temperature to produce a workable and productive mix.

The advantage of using a hot lime mix mortar over a hydraulic or hydrated lime mortar, is that the hot mix mortar is, to use that word again, more breathable, anything up to twice as much. It will adhere to the subject being constructed a lot more easily. Compared to the other limes, it is usually cheaper to purchase. It is also often specified because of its authenticity and ability to match existing lime-built structures. This is because it is a similar process of producing lime mortar as in historic times, however, modern hot mortar limes are a purer version than previously used.

One disadvantage is that in some situations, the setting times can cause problems to the user. Operatives may have to keep returning to their work over a period of several hours to keep working the mortar to prevent shrinkage and cracking occurring. When using hot lime, as with most types of construction, the weather plays a large part in the final result. It is imperative that the temperature is controlled and the mortar is not exposed to cold or too hot weather conditions. Although the term 'hot lime' is used, the hot lime can be used when cold; the term only relates to the mixing process. When the mix has recently been mixed and still retains its heat, it produces a stickier and more pliable mix. The disadvantage is that the batching plant needs to be in close proximity of the work being carried out. The advantage of using the hot mix cold, is that it can be mixed in bulk and transported as required to the area of need.

Quicklime

Quicklime is a limestone that has gone through a chemical reaction in a kiln. The heating of this limestone removes the carbon and moisture, producing the material quicklime. When choosing the aggregate/sand it is imperative to ensure that it comes from a suitable source. It must be free from an excessive number of impurities that could possibly contaminate the mix, resulting in future failure of the hot mix. It is not always possible to obtain a sand that is completely free from impurities, so care must be taken to ensure that the aggregate is suitable to be used. For example, a sand with too high a clay content will result in a necessity to over-slake, which in turn will create a mortar that is prone to excessive shrinkage. There is evidence, however, that a sand containing a small amount of grit and dirt will deliver a mortar of a softer and forgiving nature. But it must be said that the ratio of contaminants must not be excessive. There are two types of quicklime: a finely powdered version and a granular version. The second, known as 'kibbled', needs a different mix ratio than the powdered quicklime, as the kibbled is denser before mixing, therefore a different ratio of water and quicklime is required. The kibbled quicklime will also mix and set at a slower rate than the powdered quicklime. This can be an advantage as it is then easier to mix and use. Kibbled lime mortar does not produce as much plume and dust during mixing as the powdered product, therefore the mixing process is not so hazardous to the operative's health. A disadvantage of using kibbled quicklime is that the granules can sometimes be too disparate, resulting in discrepancies in the heating process during slaking. This can result in contrasting areas of heat within the mix and delayed areas of expansion of the mortar when used.

Case Studies

In the two following case studies, I was appointed as consultant and my company were appointed to carry out the work.

Case Study One

In West Norfolk, there used to be a small village called Appleton, it is believed that this small village could have been a victim of the plague, but no one is really sure why this village disappeared. Where once there was a small community of homes, all that remains is a derelict church. If you were to stand at the top of the church tower on a frosty day, you can see the imprints of where the village buildings stood. The church itself is believed to be a little over 1000 years old, dating back to the time of the Saxons. It also contains reused building materials of Roman origin. Although all that remains is the tower and a few tumbled down walls, this building is still a consecrated church. The church had been left to take on the worst of the Norfolk weather for many years, with very little protection or repairs being carried out. Because of the importance of this church and its association with the royal family, it was decided that this church, with financial help from English Heritage, would be repaired to such a condition that it would be able to withstand any further deterioration.

Figure 1: Appleton Church before restoration

A well-respected local architect, with very good experience in working with this type of building, was appointed with the task of saving what was left of Appleton Church. The architect was very keen to repair the building using as many original materials and methods as possible. As much stone as possible was collected from where it had fallen around the building. It was discovered that some of the original stone had been put in storage at a local farm, so this was collected and made ready to be reused.

Several sands were considered to try and match the original sand used during the church's construction and, after much deliberation, a sand from a local pit a few miles away was chosen. This was a sensible option because when the church was originally built the sand would have been collected locally.

Discussions on the correct lime mortar were had, and the builder was asked to create several small sample batches for inspection. The architect decided on two different types of lime mortar.

An NHL5 mix comprising of 6 of the chosen sand to 1 of hydraulic lime was chosen for any areas that were to be repointed and also for the areas chosen for rough racking, which are exposed areas on top of walls, where stone is bedded to create a top protection of the exposed upper sections of the derelict walls.

For areas of rebuild, a hot lime mixture was chosen, a mixture of quicklime and the chosen sand at a ratio of 5 sand to 1 quicklime. This was to be batched on site and used in its hot state. I believe the reason for the two different mixes was because the architect believed that the NHL5 mix would give better weather resistance to the very exposed tops of the walls. The hot lime would be more suited for the bulk of the rebuilding and repairs, providing a lime mortar that was aesthetically superior, felicitous and more in keeping with the existing structure.

Some areas of the stone building were in such a state of disrepair they had to be photographed, documented carefully, dismantled, and set aside. The idea was (as far as practicable) to rebuild with the removed stones being re-laid in their original positions. The work to the areas of rough racking, using the NHL5 mix, was carried out with little or no problems.

As the majority of this work was carried out in the early part of the year, it was important to ensure that after construction and before the lime mortar set, the tops of the walls were protected from any late frosts, therefore, hessian sacking was used to cover the walls until the lime mortar had set. The rebuilding and repointing element using the hot lime mix was carried out when the weather was a little warmer. This created its own problems; the builders' operatives had to repeatedly return to their endeavours to rework and repoint the hot lime mix because if it was left, the mortar developed cracks during the drying process. However, the effort put into this process proved to be worth it, as the finished job was very satisfactory.

Now completed, the renovation and repairs to this church should extend its life for many more years. Using carefully chosen materials and original methods has provided a satisfactory outcome, both structurally and aesthetically. The use of lime in the repairs and reconstruction was essential to ensure that the ultimate conclusion met the client's and English Heritages' expectations.

Figure 2: Appleton Church after restoration work

Case Study Two

For 600 years, one of the main roads to enter King's Lynn in Norfolk has been through the historic South Gate. Where once this narrow arch-like entrance only experienced the traffic of horse carriages and carts, nowadays a high volume of motor vehicles including lorries, pass through this narrow entrance into the town. The interior sides of this magnificent structure are predominantly brickwork. This brickwork and the lime mortar holding it together, has over the last 100 years, seen a huge increase in the amount of pollution and contaminants distributed on to it, affecting its appearance and structural performance.

During the past years, there have been numerous attempts to repair the damage caused by this occurrence. In 2020 it was decided to (once again) carry out a repointing of the worst affected areas. It was discovered that some of the previous repairs had been poorly carried out and even small areas had been repointed using cement mortar. It was believed that the majority of the previous repairs had been executed using an NHL3.5 lime mortar mix. It was considered that perhaps an NHL5 lime mortar mix may be a better solution to resist the attack from traffic pollution. The works needed to be carried out at the quietest times to lessen the disruption to traffic through this busy thoroughfare. Therefore, it was decided to carry out the works during late night and early mornings to reduce the problem.

Figure 3: The South Gate, areas showing deterioration before repointing works

The worst areas of affected mortar joints were carefully cut out to a depth of around 25mm, however, some areas had already deteriorated to this depth and beyond, and the joints only required cleaning. A gritty sand was chosen and an NHL5 lime. The joints were then carefully repointed and finished with a wooden pointer.

On revisiting this project nearly two years later, it can be seen that even the repointed mortar joints are beginning to show, once again, the effects of the traffic pollution, with some areas almost back to their 2020 condition. Although repointing in cement mortar, was not an option for obvious reasons, this may have fared better than the lime mortar, with more resistance to traffic pollution. But even if allowed, the use of cement would have created its own problems with this historic building. There are now discussions taking place considering an alternative road layout, to avoid traffic passing through this ancient gateway. If this comes to fruition, then I believe that this could be the best solution to preserve The South Gate for the future.

Figure 4: The South Gate, same areas showing partial deterioration, two years after repointing

Conclusion

I have discussed the use of lime mortars and their use from an early date and how they have contributed to so many historic buildings. The material allowed bigger and stronger buildings to be constructed, even in some of the most extreme conditions, such as the Eddystone Lighthouse. Lime mortars have been continually used to some degree for hundreds of years, being basically the only reliable medium for bonding building materials together. With the introduction of cement mortars, the use of lime mortars became relegated mostly to the repair and reconstruction of older buildings. However, lime mortars seem to be gaining popularity again, with some designers and builders preferring their use over cement mortars. Mainstream builders of large developments still mainly use cement mortars, mainly for cost and convenience, but many new construction projects are taking place with the use of lime mortar. More control is required with the mixing and conditions of use, therefore, it takes a greater degree of supervision and care, something that is not always possible or provided on large development projects. There is a place in construction for both lime mortars and cement mortars, and designers and architects will decide on what is the most suitable for their projects. In my view, the use of lime mortars will always be part of future construction, either with new projects or repairing the old.

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Bernie Smith MCABE, C.Build E, FCIOB

Bernie Smith MCABE, C.Build E, FCIOB, started his career within the construction industry at trade level and quickly progressed into management. A few years later, he moved into training and spent a short time helping set up and running the Prince's Trust construction school in West Norfolk, before working for the local authority as a Clerk of Works. Bernie became regional surveyor for a leading high street electrical company, then set up his own company, Smith Building Services Ltd, specialising in maintenance and remedial repairs and employing 20 people. The company carries out specialist repairs on both historic and modern buildings throughout East Anglia and beyond.

WORKING FROM HOME AND PLANNING PERMISSION

SAGE V SECRETARY OF STATE FOR HOUSING, LOCAL GOVERNMENT AND COMMUNITIES [2021]

HILARY GRAYSON BSC EST MAN (HONS), DIRECTOR OF SURVEYING SERVICES, SAVA
LUCY BAGGETT, LAW AND BUSINESS UNDERGRADUATE, UNIVERSITY OF BIRMINGHAM

In 2021, the High court case *Ricki Sage v Secretary of State for Housing, Communities and Local Government & London Borough of Bromley [2021]* dismissed all grounds for appeal presented by a personal trainer who was running a gym in his garden shed/studio. This was a planning dispute with the Secretary of State for Housing, Local Government and Communities. This article looks at the case from the perspective of residential surveyors.

The claimant (Mr Sage) was a personal trainer who had a timber outbuilding with windows in his garden that he used partly as a garden shed and partly as a gym, kitted out with gym equipment including a treadmill, cross-trainer and punch bag. The garden and the shed were accessible via a passage at the side of the house, which is shared with the neighbouring property.

It is interesting to note in the judgement that the term "shed" was used. There is now a myriad of garden timber constructions available, often being marketed as suitable for home offices etc. and usually described as 'cabins' or 'garden offices' etc. While described as a 'shed', the judgement also noted that it had windows, but no toilet or showering facilities.

Mr Sage used the gym himself and also allowed family and friends to use it. However, since 2016 he also used the gym part of the shed for his business as a personal trainer, with paying clients attending the premises. He did not seek planning permission for this. Instead, he applied twice under s191 of the Town and Country Planning Act 1990 for a Certificate of Lawful Use (CLU) for this aspect of his use of the residential property.

s191 of the Town and Country Planning Act 1990 states:-

If any person wishes to ascertain whether—
(a)any existing use of buildings or other land is lawful;
b)any operations which have been carried out in, on, over or under land are lawful; or
(c)any other matter constituting a failure to comply with any condition or limitation subject to which planning permission has been granted is lawful,
he may make an application for the purpose to the local planning authority specifying the land and describing the use, operations or other matter.

In other words, a Certificate of Lawful Existing Use or Development (CLEUD) is legally granted by a Local Planning Authority to retrospectively legalise a previously unauthorised development or activity. Alternatively, it can be used to confirm that a development was carried out in accordance with a planning permission that has been granted. Because a CLEUD certifies that an existing building/use is lawful, it means the Local Planning Authority cannot take any enforcement action.

A development can become lawful and exempt from enforcement if it has been in situ for a specified period of time. In most cases, development becomes immune if no action is taken between 4-10 years, depending on the development.

What is not clear is what prompted Mr Sage to make these applications. Planning House, the independent town planning consultancy based in the North East and Midlands, advise that a CLEUD is likely to be required in the following circumstances:

- If planning enforcement action is threatened by a local council and you think the time for action has passed (as per the below timescales).
- If you are planning on selling or mortgaging your property and planning permission was never granted and you need to show a prospective buyer that no enforcement action can be taken.
- If you wish to confirm that a development was commenced within the relevant timeframe and complied with conditions, to confirm your permission is extant and can still be implemented.

In this case, it must be that Bromley Council initiated the action by threatening enforcement, perhaps as the result of a complaint made by a neighbour. But we can only speculate on this point.

Bromley Council refused both applications and Mr Sage appealed both times, but the appointed inspectors dismissed the appeals. Following the second appeal, Mr Sage appealed under s288 of the 1990 Act to the High Court.

The issue, in this case, was not if the building itself was inappropriate, but if the way it was being used was. As a rule of thumb, garden sheds and outbuildings do not need planning permission if they are only one storey with a maximum eaves height of 2.5 metres and if they do not cover more than half (50%) of the area that surrounds the original home and in the back garden of the house. However, this does not apply if the property is in a conservation area, a national park, or if it is listed.

So, why did Bromley Council refuse to grant the Certificate, and why did the appeal against this fail?

Material Change of Use

Since there was no discussion about the lawfulness of the shed itself, the issue in question, in this case, was whether the use of the shed was lawful, or in other words, did it constitute "development" for which consent was required.

In considering the facts of the case, the judge, Sir Duncan Ouseley, stated:
"The use of any buildings or other land within the curtilage of a dwelling house for any purpose incidental to the enjoyment of the dwelling house as such..." was not considered to be "development".

So, then the question was if the purpose, in this case, was "incidental to the enjoyment of the house", or was, in fact, something different.

Government Guidance

Prior to this judgement, the government website contained the following published guidelines:

> "Do I need planning permission to home work or run a business from home?
>
> Planning permission will not normally be required to home work or run a business from home, provided that a dwelling house remains a private residence first and business second (or in planning terms, provided that a business does not result in a material change of use of a property so that it is no longer a single dwelling house). A local planning authority is responsible for deciding whether planning permission is required and will determine this on the basis of individual facts. Issues which they may consider include whether home working or a business leads to notable increases in traffic, disturbance to neighbours, abnormal noise or smells or the need for any major structural changes or major renovations."

It was this guidance "Do I need planning permission to home work or run a business from home?" which the judge found to be problematic for two main reasons:-

- *"...is what use is being made of the land, including its ancillary uses, and, in the case of a dwelling house, whether any purposes to which it is put are reasonably incidental to its use as a dwelling house. The passage in brackets at the end of the first sentence of this guidance is correct but too readily capable of leading to the concept, of a material change of use or a purpose incidental to the use of dwellinghouse as such, being* *misunderstood. This is because a business use in a dwellinghouse may well be secondary to the primary residential use of the dwellinghouse; but may still create a material change of use, be for a non-incidental purpose. A secondary use will involve a material change of use of the dwellinghouse to a mixed or composite use, as was found to have occurred here, unless it is so secondary that it is merely ancillary to the residential use as a dwelling house such that there is still just that one use; or in the case of a dwelling house, the purpose at issue is reasonably incidental to the enjoyment of the dwelling house as such. This is a crucial point which the Guidance ignores or blurs badly.*

- *... a material change of use can be made without any adverse environmental impact at all. Treating environmental impact as the seemingly crucial issue for the judgment as to whether a material change of use has occurred, or a purpose is reasonably incidental is not consistent with clearly established law. The crucial test is whether there has been change in the character of the use. Environmental impact can be relevant as evidence that a material change has occurred because a use of the new character may be capable of yielding environmental impacts or have done so already. The Guidance as written is apt to mislead as to what the real question is, and as to the true but limited relevance of environmental impact.*

However, this is jumping ahead a bit because the judge had to ask the fundamental questions:

- Had there been a material change of use?
- And if so, was it for a purpose incidental to the use of the property as a dwelling?

When considering the matter, the judge did consider previous cases including *Wallington v Secretary of State for Wales: CA 12 Nov 1990.*

In this case, a property owner appealed against an enforcement notice. The case was that she kept a large number of dogs (44), and she claimed this was for domestic pleasure purposes, in other words, a hobby, and as such was incidental to the use as a private domestic dwelling.

The appeal failed based on having consideration as to what would be normal activities in a dwelling house. In the judgement, Lord Justice Slade considered the phrase "of and incidental to the enjoyment of the dwellinghouse" and said:

"As drafted, however, the phrase must mean 'of and incidental to the enjoyment of the dwellinghouse as a dwellinghouse'. The mere fact that an occupier may genuinely regard the relevant activity as a hobby cannot possibly suffice to prove by itself that the purpose is incidental to the enjoyment of the dwellinghouse as a dwellinghouse."

Lord Justice Farquharson added that it was acceptable to include an element of objective reasonableness when considering the concept of what is incidental to the enjoyment of the dwelling house and that it could not rest solely on the unchecked desires of the occupier of the house. But he also added that the use of a room in the house as a study or office, even with commercial aspects (such as working from home,) could still be regarded as incidental to the enjoyment of the house as a dwelling house.

On considering this point, Sir Duncan did say that a hobby was more likely to be "incidental to the enjoyment of the house" than a commercial activity.

So, was the activity here incidental to the enjoyment or not?

The issue of noise was considered, and it was found that, even with the doors open, the activities in the garden gym were no noisier than the background noise in the area and surveys found them to be hardly audible.

So, then the issue was the "comings and goings" and the level of commercial activity. Bromley Council refused to grant the certificate on the grounds that the level of activity as described in the application and the supporting documentation would amount to a material change and consequently need planning permission.

The gym was used six days a week, some days starting at 6am and finishing at 8pm. Having considered all the facts and case law, the judge concluded that this level of activity in a residential area could not be considered ancillary to the residential use of the dwelling and that Bromley Council was correct to refuse to grant the certificate.

Where does this leave working from home?

The judge did acknowledge that *"... there are many forms of service offered within a dwelling house, from private tuition, including in music or singing, child minding, medical services. I accept that what is normal or reasonably incidental now may have shifted with changes in work habits as a result of Covid."*

However, he was critical of the government's guidance, saying that it was worded in such a way that it was too readily capable of being misunderstood when dealing with the concept of a material change of use or a purpose incidental to the use of dwelling house. As in this case, **a business use in a dwelling house may well be secondary to its primary use, that of a residential dwelling, but by virtue of its intensity, for example, still create a material change of use.**

The judge said, *"This is a crucial point which the Guidance ignores or blurs badly".*

Consequently, the guidance has been removed from the government's website and at the time of writing, has not been replaced.

The important points regarding the future to working from home are the two issues the judge had with the guidance. The first, explained in paragraph 81 of the judgement, is that just because the dwelling has a primary use of a home and a secondary use of a business, this does not mean that the business use will be incidental to the use of a home as a home. There is confusion between material change and incidental use, and these can be blurred.

And the second, explained in paragraph 83, that the focus is on environmental impact and that this may be one of many factors and not the only factor (it is not an exhaustive list).

The judge said that the *"crucial test is whether there has been a change in the character of the use".* This change in the character of the use may be measured by disturbance produced, but it is not limited to that.

Someone who was 'working from home' would infer that they wouldn't need to require planning permission to work from home according to the government guidance. However, the decision made in this case and the removal of that guidance from the government website now casts some doubt on this. It will be interesting to see what replacement wording is published, if any.

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Hilary Grayson BSc EST MAN (Hons) is Director of Surveying Services at Sava and 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.

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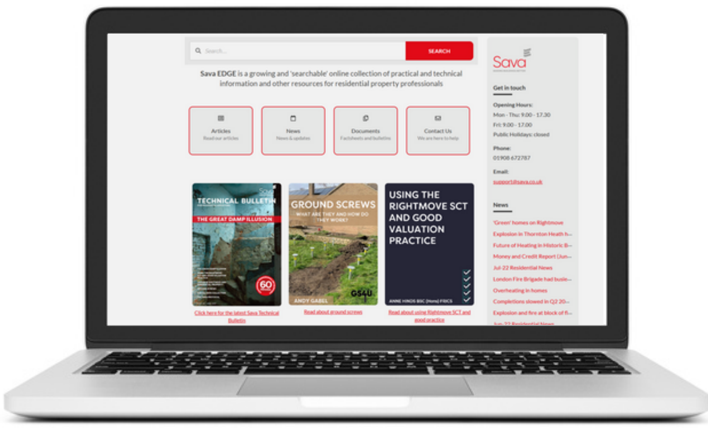

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