

CAVITY WALL INSULATION FAILURE

ENERGY REPORT

REQUESTED BY

PURE LEGAL TEST

PURE LEGAL OFFICES, POST CODE: M1 1AA

SOLICITOR REFERENCE

Pure-Legal-Test

IN RELATION TO

[Redacted]

[Redacted]

EXPERT REPORT OF MAX A. KRANGLE

Solicitors use only	
Court Name	
Case No.	

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REPORT

1 INTRODUCTION

1.1 Formal Details

My name is Max Alfred Krangle and I am Managing Director and Director of Research Intelligence at NRG Expert in London. NRG Expert is an independent energy market research and intelligence company with offices at 103 Latymer Court, Hammersmith Road, London, W6 7JF. NRG Expert is a trading name of NRG Smarts Limited, registered with Companies House in England & Wales with company number 7468718.

At NRG Expert I specialise in energy market pricing and costing analysis, as well as detailed financial analysis and market forecasts for domestic and global utilities and energy production, resource, and manufacturing markets. I provide market research reports and expert analysis to the world's leading companies, consultancies, and government bodies, giving them the data and statistics, they need to make difficult, cost-conscious decisions about their energy infrastructure, energy pricing, energy projects, and energy business development strategies.

I have been instructed by PURE LEGAL TEST at the following address PURE LEGAL OFFICES, Post Code: M1 1AA.

1.2 Synopsis

In this case, [REDACTED] (hereafter Claimant or Claimants) alleges faulty installation and erection of cavity wall insulation at Claimant's property at [REDACTED]. The main area of complaint I am asked to advise on relates to 'loss of promise' in financial terms on promised heating and energy savings and additional financial exposure in regard to extra energy costs where the claimant has used extra energy in relation to failed CWI since installation which took place in 2011. I am advising the Claimants.

1.3 Instructions

PURE LEGAL TEST have requested that I provide a written qualified CPR Part 35 compliant Expert's Report associated with the cavity wall insulation ("CWI") failure at Claimant's property at [REDACTED] and specifically assess 'loss of promise' in financial terms on promised heating and energy savings relating to Claimant's CWI install, and additionally:

- highlight potential extra energy costs incurred by Claimant in relation to the CWI failure.

1.4 Disclosure of Interests

I know of no actual or potential conflicts of interest or a connection with any of the parties, witnesses or Solicitors in respect of this matter which might be thought to influence the opinions expressed in this Expert's Report.

2 BACKGROUND TO THE DISPUTE AND THE ISSUES

2.1 The Relevant Parties

The present dispute of [REDACTED] ("Claimant") represented by PURE LEGAL TEST has arisen following the installation of Cavity Wall Insulation (CWI) by the respondent at the property of claimant located at [REDACTED]

2.2 The Assumed Facts

The following are the assumed facts relied upon in our reporting in this dispute.

Cavity wall insulation was installed in 2011.

Prior to 2011 there were no recorded problems with dampness or moisture in the property.

The type of cavity wall insulation that was installed was: Rockwool.

A 25 years guarantee on the installation of the Cavity Wall Insulation was given at the time of the install, and, as such, the installer was satisfied the property was suitable to have CWI installed and all necessary works that should have been carried out prior to install were completed and signed off by the installer. As such, no further (remedial) work should have been necessary for the CWI to offer energy savings to the client, i.e. the install should function as-is to offer energy savings.

The only recommended course of action to allow for the reparation of damages done and resulting from the cavity wall insulation would be a complete removal of the cavity wall insulation material.

Prior to 2011 there were no recorded problems with dampness or moisture in the property.

2.3 The Issues to be Addressed

This report will address the features and risks associated with the installation of Cavity Wall Insulation in properties in general, as well as specific to this case. Because of these issues, and at the core of this dispute, a loss of promise and additional costs were sustained by claimant, which will be addressed and substantiated with this report.

This report will also address issues as raised by claimant through their solicitors as instructed to me in Appendix II.

2.4 The Assumptions Adopted

This report assumes the facts as presented in the Chartered Surveyor's report as presented in Appendix III. Phil Hodgson is recognized and accredited to perform these tasks.

This report also assumes the facts and calculations as valid and accurate as presented in the draft Energy Performance Certificate as attached in Appendix IV to this report. The EPC was provided by solicitor for Claimant and it is assumed that it was accurately generated following the standards set for such documents by the relevant government and designated authorities. It is understood that the EPC was provided in draft form so as not to submit incorrect information to the Government Portal, and it was requested by Instructing Solicitors solely to support this report. It is assumed that all workings within are exactly to that which would be a standard published EPC. Additional information has been provided by Instructing Solicitors alongside the draft EPC to assist me in making bespoke and estimations for use within this report.

3 THE TECHNICAL INVESTIGATION

The Claimant's property at [REDACTED] was attended by an assessor employed and under instruction from Llewellyn Smith Chartered Surveyors on 08/08/2018. The results and findings of this technical investigation are attached at Appendix III.

I did not attend this inspection in person and am relying on the chartered surveyor's findings as presented.

4 THE FACTS ON WHICH THE EXPERT'S OPINION IS BASED

Facts relevant to my expert analysis and opinion are contained within documents as listed below. These documents are:

- The draft Energy Performance Certificate (hereinafter referred to as 'EPC' or 'Energy Performance Certificate'); Appendix IV
- Solicitor's Instructions and Client Lifestyle Information; Appendix II
- Chartered Surveyor's report; Appendix III Additionally, guidance, facts, and analysis have been taken from the following reports and publications; Appendix V
- Stirling, C. (2001) Insulating masonry cavity walls – Building Research Establishment Good Building Guide 44 Part 1
- Stirling, C. (2001) Insulating masonry cavity walls – Building Research Establishment Good Building Guide 44 Part 2
- Building Research Establishment (BRE Scotland) (2002) Thermal Insulation: Avoiding Risks
- International Energy Agency (2003) Integral Building Envelope Performance Assessment Building Research Establishment (2008) Thermal transmittance of walls of dwellings before and after application of cavity wall insulation – Energy Savings Trust
- Iwaszkiewicz, C.; Christofides, J.; Wright, W.; Et Al (2010) Study on hard to fill cavity walls in domestic dwellings in Great Britain – Department of Energy and Climate Change
- Thompson, R. (2012) Review of the number of Cavity Walls in Great Britain – Department of Energy and Climate Change
- Building Research Establishment (2012) Study on hard to fill cavity walls in domestic dwellings in Great Britain
- Stroma Certification (2015) RdSAP Manual Methodology
- Turner, C. (2015) Homes through the decades – NHBC Foundation
- Smith, M. (2016) Comparison of moisture survey and u-values for a UK 220mm solid brick wall – Leeds Metropolitan University
- Building Research Establishment (2017) Appendix S: Reduced Data SAP for Existing Dwellings – RdSAP 2012 version 9.93
- Constructing Excellence in Wales (nd) Post Installation Performance of Cavity Wall & External Wall Insulation – Building Research Establishment
- English Heritage (nd) Research of the Thermal Performance of Traditional Brick Walls

5 THE EXPERT'S OPINION

5.1 Introduction to Cavity Wall Insulation

With promised energy savings running into hundreds of pounds per year, cavity wall insulation (CWI) has been touted and promised by experts and politicians as one of the key ways of reducing the UK's energy consumption and lowering our collective carbon footprint.

Though there are variances, building regulations and commonly employed techniques have attributed many similar design features in homes that were built during the same time and a property's age is able to provide us with information about the likelihood of certain elements being present. Most of the houses built in Britain today were constructed in the 20th century with booms taking place after each of the two World Wars.

Common in homes built from the 1920s onward, most of homes in the UK were constructed with cavity walls. Exceptions to this are the oldest homes still standing, however, throughout the post-war years and in the construction booms of the 20th century, cavity walls were the easiest and most efficient way to insulate a home, retaining heat and keeping out dampness from Britain's wet climate.

Cavity walls are exterior walls of the home (or, at times, also the walls between terraced homes) built with two independent layers of brickwork, or concrete blocks, tied together leaving an open space between the two. This gap, or cavity, allows air to flow between the two 'layers' that make up the wall and circulate, but also creates an insulating barrier to the outside hindering heat transfer from the inside of the building directly to the outside. However, more importantly, the cavity wall also specifically functions as an additional barrier to damp by providing a means for moisture which has penetrated the outer wall of a building to not reach the interior spaces. Where moisture has been able to saturate or seep through the outer wall because of driving rain, the air gap between the layers of the wall means that accumulated moisture will run down the inside of the outer layer. Accumulation of this moisture is prevented by allowing it to run out of the cavity again and away from the wall at the base.

Building techniques and building codes have changed, and are constantly evolving based on the available knowledge, materials, and legislation. New homes being built today feature some of the best insulation and waterproofing techniques available giving these homes enviable energy efficiency ratings when compared to older properties.

5.2 Function of Cavity Walls

In exposed coastal areas, and across the UK, cavity walls were the prime line of defence against the effects of wind driven rain and the ingress of moisture into the home because of Britain's climate. Many UK homes built after the first world war featured cavity walls as a means of keeping damp and moisture from penetrating through the outer layer of masonry into the home. Damp and moisture inside the home is a source of many problems relating not only to the energy efficiency of the home but also to the health of the occupants.

Homes built in England and Wales from the 1920s onwards have typically been built with cavity walls. Cavity walls became a feature of construction designed to prevent the transfer of rainwater falling or being blown onto the outer wall from crossing through to the inner walls of the dwelling. As time has passed and building standards have changed, the width of the cavity, and therefore the total size of walls has increased to allow for the addition of insulation at the construction stage while still leaving an air-gap to aid with the prevention of moisture ingress. The increased width offers further protection from rainwater penetrating to the inner walls of a dwelling. The cavity allows for drainage of any water or moisture that seeps in to the cavity wall, with air flow through the cavity ventilating the cavity space and ensuring that condensation had minimal chance of forming due to temperature variances and humidity.

Originally, the air gap formed by building a cavity wall was also thought to be an effective means of thermally insulating the home allowing heat to stay in during the winter, and out during the summer. This benefit, however,

On-Behalf of [REDACTED]

has been shown to be minor in its effectiveness. As building standards have changed, insulation materials have been incorporated in cavity wall design, often affixed in the cavity to the inner leaf, whilst maintaining an air gap to prevent the transference of moisture, as was the original design of cavity walls.

There are varying schools of thought on the amount of heat that can be lost through walls, with the typical figure being set at 35%. Effectively what this means is that the heating system is providing 35% more output relative to the space that it is designed to heat. With proper cavity wall insulation, the amount of heat lost can be brought back and indoor spaces can be heated more efficiently.

Homes with well-insulated cavity walls will be warmer in winter, cooler in summer, and not lose any of the damp-proofing qualities of cavity walls.

5.3 History of Cavity Walls

The Victorian-era expansion of railways in Britain facilitated mobility and led to the outward expansion of residential areas away from the city centres. This new construction was also aided by the railways' ability to transport not only people, but also building supplies and raw materials. Houses were being built in rapid tempo, and new concerns for health and wellbeing following disease outbreaks attributable to living conditions meant that new building standards were being considered and developed.

The link between poverty and poor health was made by Edwin Chadwick in 1842, and the effects of the 1848 Health Act have lingered in the psyche and in the public debate on housing and building standards to this day. Cold, dampness, and poor sanitation were among the first elements to be addressed in new buildings through various construction techniques that have developed over time.

Properties built before the end of the First World War typically did not feature cavity walls, though the properties were known to be draughty thanks to chimneys and poorly fitting windows. This had a twofold effect on the state of living inside the property. On the one hand, ventilation provided for less stale air and mould inside the properties; however, the drawback was that there was still considerable dampness and the properties were not easy to heat.

Builders and architects started to experiment with so-called hollow walls in the Victorian era, but the widespread use as a building technique didn't come about until the interwar years, though early 20th century homes were increasingly constructed with cavity walls. Where this was the case, the primary concern and the main reason for constructing the cavity wall was to create an air barrier to prevent driving rain from seeping through the walls to the interior of the home.

The walls of early cavity-walled buildings, especially those built with softer lime-based mortars, breathe. That is to say, moisture is readily exchanged between the exterior and interior environment of that leaf of the wall. Any installation of any form of insulation of these cavity walls must take this permeability of moisture into careful consideration. Typically, the outer leaf of a cavity wall will absorb moisture which then evaporates out again when dryer conditions prevail. However, where there is prolonged or consistent driving rain, the outer leaf of a cavity wall will continue to absorb the moisture and saturate the outer wall leading to the trickling down of moisture on the interior side of that wall thanks to the air gap.

If a home in this time was built with a cavity wall, the gap between the inner and outer leaves (the cavity) was typically very narrow. The primary concern was driving rain and moisture.

The thickness of a wall stands in direct relation to the insulating value or thermal efficiency of the wall. A thicker single wall, and thicker individual leaves of cavity walls have a very high thermal mass. This helps stabilize the internal environment through absorption of heat during the day, and radiance of the heat during colder nights. Moisture saturation of these walls will, however, diminish the wall's capacity to insulate and will allow greater amounts of heat loss through the building's fabric.

Products that are available for cavity-wall insulation are not in themselves high performance insulators. It is not normally cost-effective to install CWI in cavities of less than 50mm width.

5.4 Heat loss in Homes

A dwelling is only effective in retaining heat and therefore conserving energy if all the building's elements such as roof, walls, floor, windows, and doors are effective in preventing the largest amount of heat from transferring from the internal environment to the outside of the dwelling. Each of these building elements can be assessed and assigned a value indicative of its thermal transmittance, a so-called U-value. This number expresses the transfer of heat in watts per square meter (W/m^2) of area per degree difference in temperature between outside and inside.

Building elements, or rather the building fabric that is most effective in preventing the transfer of heat between the interior and exterior of the dwelling will have a low U-value. Current building regulations specify that houses should be constructed to provide an average weighted U-value for the following elements:

Element	Area-weighted average U-value ($W/m^2 K$)
Roof	0.20
Wal	0.30
Floor	0.25
Party wall	0.20
Windows and doors	2.00

Elements that provide the least amount of heat transference (i.e. those that are well-insulated) will have the lowest U-values. The calculation procedure described in BS EN ISO 6946 is the main standard for calculating U-values of walls and is largely based on ideal constructions. There is an allowance for small air gaps around the insulation, however, the standard does not account for structural irregularities.

Though the standard does account for heat losses related to the thermal conductivity of building materials, it does not account for moisture related heat loss, or increased costs of heating associated with damp or air-flow problems. These factors are greatly influenced by the quality of construction and the workmanship of the installers.

Allowing moisture to penetrate or build up through condensation in the cavity wall or transfer from the outside environment to the inside environment of a cavity wall or dwelling will have an impact on the heat conductivity and therefore the insulation value of the wall, or structural element of the building fabric. Cavity width, the type of insulation material, and the presence of moisture control barriers or moisture-proof rendering will have an impact on the overall U-value of the building. IEA Annex 32 research has shown that moisture will have an impact on heating costs along with increased risks of fungal growth and deterioration of the materials.

Benefits of properly installed, and fully effective cavity wall insulation can be summed up as follows:

1. More comfortable indoor environments, reducing the risks of cold-related illnesses
2. Lower Energy costs due to reduced heating time to compensate for heat loss
3. Opportunity to install lower-rated or more efficient heating systems due to decreased heat demand of the property.

The above-mentioned factors are benefits that will be realized in ideal conditions, however, the full effectiveness of cavity wall insulation and therefore the benefits relating to decreased heat-loss in properties is also greatly influenced by factors such as:

1. The thickness of the insulation (mainly determined by the size of the cavity in which insulation material is injected)

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2. The type of material used for insulation
3. Air-gaps or cavities present post-installation of the cavity wall insulation
4. Areas of varying insulation density, i.e. less compact insulation in one section of a wall, versus surrounding areas
5. Air movement around the insulation, allowing for ventilation and prevention of moisture build up through condensation (air circulation is largely eliminated in instances of post-construction cavity wall insulation using filling techniques)
6. Thermal bridging caused by wall-ties or other elements linking the outer and inner leaves of a cavity wall.
7. Moisture transference and saturation of existing wall elements prior to the installation of cavity wall insulation.

5.5 Materials used in CWI installation for Claimant

A variety of insulation materials exist as options for post-construction cavity wall insulation installation. Each of these different materials have unique characteristics and specific installation instructions which should be followed as set by the manufacturer and applicable building regulations. Overall, the basic function of the insulation material remains the same, however, the selection of a material to be used in a project may be influenced by factors such as cost, suitability, and availability.

Theoretically, these materials should be superior to mineral-wool fibre boards as they are inherently water repellent. However, this claim relates to the material's properties in low-moisture conditions where there is potential for any moisture to be expelled or evaporated before saturation or transmittance of the moisture to the inner leaves of the wall. In driving rain conditions found in the highest exposure zone areas, the quantity of moisture and saturation of the exterior walls may overwhelm the water repellence of the insulation material. This leads to a risk of moisture transmittance across the cavity not only where imperfections or gaps exist in the insulation, but throughout the entire insulated area as well.

Filling the cavity with any material substantially reduces or eliminates the wall's designed function to prevent moisture from entering the dwelling. Furthermore, because the material is injected, and settles in the cavity wall, there may be air gaps within, or inconsistent densities of the material creating small capillaries and gaps in which moisture can collect, or seep through. The material itself may be water repellent, but the installed product may have sponge-like qualities in retaining moisture when the moisture present in large enough quantities.

In this case, the material that was used for the installation of cavity wall insulation at the Claimant's property was Rockwool. Below is a description of this material's features and qualities.

5.5.1 Rockwool

Rockwool or Stone wool is a molten rock product manufactured at 1600°C in which streams of high-pressure air is blown resulting in fine fibres ranging from 6 to 10 micrometres. For installation in cavity walls, granulated constituents are blown into the cavity to pre-determined density and volumes. Typically, this product is installed in sheets during new construction, though it cannot be compared directly, it has been adapted for use in cavity wall insulation retrofits. Rather than prefabricated sheets, rockwool granules are blown into the cavity whereby no glues or catalysts are used.

5.6 Insulation Practices

Any construction material should be approved and tested, fit for purpose, and suitable for the task for which it is intended to be used. Building regulations and codes see to the enforcement of this, though the same measure should be applied in any structural work including the installation of insulation in a cavity wall. In Britain, the British Board of Agrément (BBA) have produced the regulations to which CWI should have been installed.

It is assumed in this report that all materials used for the cavity wall insulation at the Claimant's property met the building and fire regulations at the time and were suitable for use as insulation material for the intended purposes. However, that does not detract from the fact that due to the nature of the location of the property and the specific circumstances relating to climatological factors, cavity wall insulation may not have been suitable.

On-Behalf of [REDACTED]

Insulation manufacturers, installers can set up best-practice guidelines and companies should ensure that their staff are properly trained and knowledgeable on the product, and its installation techniques. Guidelines that are established should address issues and anticipate problems realistically and allow for discretion to be taken on when to advise to not install insulation because of counter-indicated factors. Commercial pressures, and the ability to make a quick profit should not be the prime motivator to install cavity wall insulation. To an installer, once their work installing the insulation is done, and the client is happy, the matter is closed. The manufacturer of the insulation material is happy they have sold their product.

However, the client is relying and trusting the installer, and the insulation manufacturer to offer their knowledge and guidance on the suitability of the product for their home. Adverse effects of improper installation of the insulation can lead to serious energy losses, substantial damage to property and even potential health risks. The consumer cannot be expected to be an expert, their trust is reliant with those in-the-know and ultimately the installer.

5.7 Climate and meteorological factors

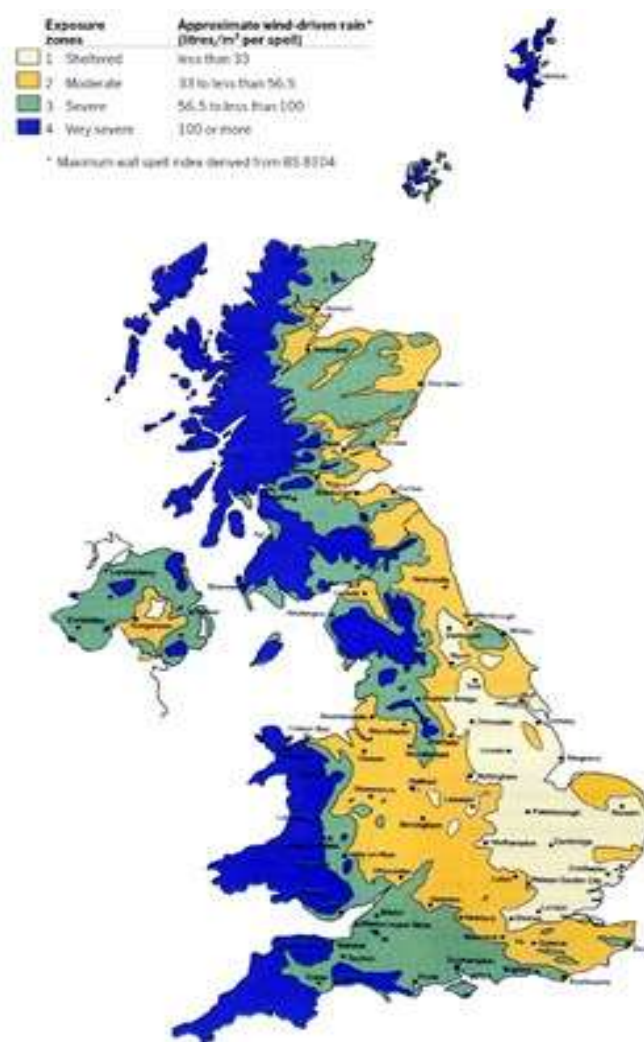
Wind driven rain is one of the prime meteorological factors to consider with any installation of cavity wall insulation in homes in the UK. To assess the level at which a home might encounter this phenomenon, the Building Research Establishment (BRE) conducted a study to determine and classify exposure zones. The BRE has further issued recommendations linking the suitability of cavity wall insulation to the exposure zone in which the property is located, the type of cavity wall insulation to be used, and the thickness of the cavity, among other factors.

5.7.1 Exposure Zones

Parts of England and Wales are prone to severe or very severe amounts of wind driven rain. Britain's overall wet climate affects everyone; however, certain parts of England and Wales see more rain, and, wind-driven rain than other parts. It is these climatological factors that have influenced building techniques and styles over the years. Keeping moisture out of the home, as well as keeping heat in the home have been the driving force behind cavity wall construction.

The figure below has been published by the BRE and shows the different levels of exposure to wind driven rain for different parts of Great Britain. The 4-part scale is defined by the amount of wind-driven rain in litres/m² per spell. Each of the 4 zones is defined as follows:

- Zone 1 - Sheltered - Less than 33l/m² per spell**
- Zone 2 - Moderate - 33 to 56.5l/m² per spell**
- Zone 3 - Severe - 56.5 to 100l/m² per spell**
- Zone 4 - Very Severe - 100 or more litres/m² per spell**

Figure 1 Exposure Zones in UK

Source: Charles Sterling – Thermal Insulation: Avoiding Risks (2002) BRE Scotland

As can be seen from the figure above, western coastal areas of England and Wales are prone to the highest amounts of wind-driven rain, with many areas falling into the ‘Severe’ or ‘Very Severe’ zones.

Cavity Wall insulation manufacturers insist that rainwater will not cross the cavity when it is filled with insulation material, however, the BRE in its good building guide 44: Part 2 (Insulating masonry cavity walls – principle risks and guidance) has stated that moisture will be able to transfer across a filled cavity leading to “Reduced thermal performance and damage to internal finishes”.

The guidelines that the BRE has published and continues to update have provided a table outlining the conditions under which it is suitable to install cavity wall insulation, or not. This table is copied below.

Figure 2 Maximum recommended exposure zones for insulated masonry walls

Walls

Rain penetration through cavity and solid walls

Table 1 Maximum recommended exposure zones for insulated masonry walls. See guidance notes below

Wall construction		Maximum recommended exposure zone for each construction						
Insulation method	Min. width of filled cavity or clear cavity (mm)	Impervious cladding		Rendered finish		Facing masonry		
		Full height of wall	Above facing masonry	Full height of wall	Above facing masonry	Tooled flush joints	Recessed mortar joints	Flush sills and copings
Built-in full fill	50	4	3	3	3	2	1	1
	75	4	3	4	3	3	1	1
	100	4	4	4	3	3	1	2
	125	4	4	4	3	3	1	2
	150	4	4	4	4	4	1	2
Injected fill not UF foam	50	4	2	3	2	2	1	1
	75	4	3	4	3	3	1	1
	100	4	3	4	3	3	1	1
	125	4	4	4	3	3	1	2
	150	4	4	4	4	4	1	2
Injected fill UF foam	50	4	2	3	2	1	1	1
	75	4	2	3	2	2	1	1
	100	4	2	3	2	2	1	1
Partial fill								
Residual 50 mm cavity	50	4	4	4	4	3	1	1
Internal insulation								
Clear cavity 50 mm	50	4	3	4	3	3	1	1
Clear cavity 100 mm	100	4	4	4	4	4	2	2
Fully filled cavity 50 mm	50	4	3	3	3	2	1	1
Fully filled cavity 100 mm	100	4	4	4	3	3	1	2

Source: Charles Sterling – Thermal Insulation: Avoiding Risks (2002) BRE Scotland

From this table we can deduce that there are many different variables that must be considered to firstly, determine suitability of cavity wall insulation, and secondly, determine the material choice. Even if the insulation material does not transmit rainwater and moisture across the cavity and to the inner leaf, cavity wall insulation can still create dampness problems through increased condensation. As a rule of thumb, however, Cavity Wall Insulation should not be installed in homes in exposure zones 3 and 4, without meeting very strict criteria concerning the weatherproofing features of the walls. Most homes in the UK built without cavity wall insulation and located in these highest of exposure zones would not meet these criteria.

Additionally, when a cavity wall is filled with any insulation material and there is no longer an air-gap, one of the properties of the cavity wall, namely that of ventilation between the inner and outer leaves, is taken away. Imperfections and gaps in the insulation material therefore create cold-zones and areas of stagnant air which will allow condensation to form in and around those areas due to temperature differences and fluctuations. Increased localised heat loss may lead to the internal surface temperature of falling below the dew point. These localized cold-spots will, over time, cause and contribute to mould and dampness problems inside the dwelling. The effects of damp and more detail on the build-up of moisture will be discussed further on in this report.

5.8 Energy Performance Certificates

In efforts to increase awareness about a home's energy efficiency, and as a measure to encourage home-buyers and new renters to save on their energy costs by implementing energy efficiency improvements, the government has mandated that whenever a home is built, sold, or rented an Energy

Performance Certificate (EPC) is produced. This EPC contains information on the dwelling's energy

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footprint, and lists features that contribute to the dwelling's overall energy efficiency, and, the EPC will list improvements and potential savings based on standard calculation methods and averages as an indicator of potential energy efficiency.

EPCs are issued as standard for new builds, and currently, one is produced whenever a dwelling is sold or rented. Newly built homes will have been built to the highest energy efficiency standards that follow from the current building legislation. For existing dwellings, the EPCs will describe and list measures which can contribute to energy efficiency which may be available and feasible given available technology and construction techniques to adapt the structures and features of the dwelling. Examples may include changing elements such as replacing incandescent lightbulbs with energy efficient bulbs, replacement of a water heater, or more serious (and costly) structural changes such as installing loft insulation, replacing single-paned windows with multi-paned windows, or filling the cavity walls with insulation material.

The EPC is a standard document, with its conclusions and calculations based on established protocols and methodologies developed by the Building Research Establishment (BRE) for the former Department of the Environment. Using the Standard Assessment Procedure (SAP) developed for new builds and incorporated in Part L of the Building regulations, surveyors and inspectors can create the EPC and calculate potential savings using a standardised model. For existing dwellings, a lower cost (and simplified) method of calculating energy efficiency and creation of the EPC can be used; the so-called Reduced data SAP (RdSAP).

The anticipated savings figure referred to in section 5.9 below is extracted from the draft EPC as attached in Appendix IV of this report which has been provided to me by solicitors is a result of these calculations. Following the methodologies of the RdSAP, to have reached this figure, the assessor or surveyor will have used the tables contained in Appendix S of RdSAP 2012 which have been copied as Figure 4 below. The surveyor will have looked at the features of the property, and the software that generates the EPC will have used these features in determining the underlying U-value of the walls based on the input.

These U-values are then used in calculations to determine the effect that the proposed energy-saving measures such as cavity wall insulation will have on the overall energy consumption in the property. When determining the heating savings figures, a standard heating pattern of a 9-hour heating day during the week, and a 16-hour day during the weekend is used whereby the living area is heated to 21°C and the rest of the house to 18°C. Standard occupancy figures based on the size of the dwelling are also used in calculations.

Older homes will have been constructed to different standards which at the time of construction would have allowed for higher overall U-values of external walls. Therefore, the walls in older homes have an increased heat-loss potential. Retrofitting and injecting cavity wall insulation can potentially bring a wall's U-value down, approaching the targets set for new construction. This, however, is a best-case scenario, and typically would only apply to houses built most recently without any other form of cavity wall insulation and installed under perfect conditions with no damage to the walls.

5.9 Proposed energy savings

It is estimated that up to 35% of all heat loss from UK homes takes place through external walls¹. The link between uninsulated cavity walls and this heat loss is easily made and shown to consumers when touting the potential energy savings that cavity wall insulation may bring. For example, on the website: <http://www.government-grants.co.uk/cavity-wall-insulation> we find the statement that "uninsulated cavity walls lose 33% or more of the heat generated within the property. So, for an uninsulated house that's £1 of heat escaping for every £3 spent heating it." With statements such as these a consumer might be tempted to assume that their energy costs could decrease by up to a third, turning cavity-wall insulation into a money saver.

¹ <https://www.thegreenage.co.uk/where-am-i-losing-heat-home/>

Cavity wall insulation, however, does not eliminate the heat transfer and heat loss that takes place in homes, and other factors such as the number and size of windows, as well as other areas of the home that can be insulated will affect the overall energy efficiency, and thus cost of heating, of an individual home. When installed properly, and appropriately, cavity wall insulation will decrease the overall U-value of the property's walls, thus reducing the heat-transfer and heat losses to the outside. Incorrect installation, however, can lead to greater heat-loss.

For Claimant, the anticipated savings that cavity wall insulation would bring amounted to over a period of 3 years. However, as is evidenced in the surveyor's report, there were significant problems that occurred in the property relating to the overall effectiveness of the insulation after it was installed.

5.10 Disadvantages of cavity wall insulation installation

5.10.1 Effects of improper installation

Cavity wall installation must be performed to very high standards to gain the proposed benefits. Any imperfection or improper installation carries with it a great risk of heat loss, or moisture build up resulting in damp and mould. Considering that cavity walls were built as a means of keeping out wind driven rain, prevalent in coastal areas and high-numbered exposure zones, there is always a risk of moisture transfer between the outer and inner walls if the cavity is filled, regardless of the material used. The BRE Good Building Guide 44 Part 2 states that:

"There can be an increased risk of rain penetration if a cavity is fully filled with insulation, i.e. moisture is able to transfer from the outer to the inner leaves resulting in areas of dampness on internal finishes. Rainwater, under certain driving rain conditions, can penetrate the outer leaf of masonry leading to wetting of the cavity insulation, a reduced thermal performance and damage to internal finishes."

In new-build construction, many of the risks of improper installation are mitigated through diligence in construction, proper design, and correct use of materials during the build of the dwelling. Inherently, new construction allows the best access to the future cavity during the building phase and there is no need for retrofitting techniques. Material choice and construction methods are chosen based on design parameters and each is selected based on their individual characteristics as well as how well the materials perform together.

Building standards in place since the 1980s have mandated cavity wall insulation. Adherence to the standards set out does not affect the performance of the structure to withstand (driving) rain. Materials chosen include rigid foam boards which are intrinsically waterproof, or mineral-wool or glass-fibre panels with vertically aligned fibres allow for the downward flow of any moisture build up. Further, depending on the width of the cavity, there may only even be a partial fill with insulation (fitted to the internal cavity wall) leaving an air-cavity which would disallow the transference of moisture from rain seepage to the inner layers.

It should be clear that careful planning and consideration is to be undertaken during all stages of construction of new properties and retrofitting of existing properties when considering cavity wall insulation. As a part of the EPC issuance process and in accordance with the BRE training manuals, homes located in the highest exposure zones (zones 3 and 4, and in some cases zone 2) should have an addendum to the EPC signalling that further investigation would be required to determine whether and how the walls can be insulated (with the potential that higher costs would be incurred in installation).

Research performed by the BRE has shown that single-leaf brick walls leak when exposed to wind driven rain. Due to drying shrinkage, and cracks in the mortar (common in all brick structures), water can seep through from the exterior of the wall to the interior. Cavity walls are comprised of two leaves with an air gap in between. In newer construction, the cavity between the inner and outer layers of solid wall materials is wider, to allow insulation materials to be

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placed against the outside of the inner leaf, along with other materials to assist with moisture-proofing. However, an air gap remains as the primary line of defence against moisture ingress into the dwelling. When, as is the case with injected cavity wall insulation, post-construction of the dwelling, insulation material fills this void, there is no longer an air-gap between the two leaves of the cavity wall and moisture may seep through, reaching and ultimately saturating the inner leaf.

5.11 Increased U-values due to moisture penetration

A wall's insulation value is determined by its construction and the components that it is made up out of. A single leaf brick-wall will, for example, be less effective at insulating a house than a wall built to modern standards incorporating a cavity wall and constructed with insulation materials in addition to an air-gap cavity. Today's building standards are very much the result of energy-saving measures with U-value targets being set very low, meaning a very low rate of heat-loss.

As I stress in this report, the walls of a building can account for a large portion of the heat loss through its fabric. English Heritage has undertaken research to assess the heat transferability in brick walls when dry and compare them when saturated with moisture. It has found, that in many cases, single leaf brick walls may double their U-values when wet, when compared to the same wall being dry. Cavity wall construction relies on two layers of single-leaf wall construction with the cavity separating the two. Despite that, the overall effectiveness of the cavity wall is reliant on the effectiveness of its components and should one or more of the layers be compromised due to, for example, moisture saturation, the entire wall's effectiveness to prevent heat transfer will be reduced as a result.

Based on the draft EPC as attached in Appendix IV, cavity wall insulation at the property should have resulted in an overall savings of £178.00 per year and reduced the overall heating requirement of the dwelling by 2964 kWh/m²/year. Cavity wall insulation would normally achieve this by reducing the total overall U-value of the walls, resulting in less heat transference.

Based on the guidelines set by BRE in their RdSAP and as evidenced in the figures below, I determine following Figure 4 below that based on the age of the property, and its features that the total, overall average U-value of the walls would be considered at 1.5 W/m²K before the installation of cavity wall insulation. I base this approximation on the known building standards of the time, in combination with the rating of the walls as evidenced in the draft EPC which is attached in Appendix IV and the BRE's RdSAP guidelines considering the location and structure of the property.

Figure 3 below shows the age band classification used for the purposes of determining the energy efficiency of elements of the property. In this case, the claimant's property is in 1930-1949 and was built in 1930, therefore we must conclude that the property falls under age band C.

Figure 3 RdSAP 2012 Appendix S - Age Bands**Table S1 : Age bands**

	Years of construction			
Age band	England & Wales	Scotland	Northern Ireland	Park home (UK)
A	before 1900	before 1919	before 1919	-
B	1900-1929	1919-1929	1919-1929	-
C	1930-1949	1930-1949	1930-1949	-
D	1950-1966	1950-1964	1950-1973	-
E	1967-1975	1965-1975	1974-1977	-
F	1976-1982	1976-1983	1978-1985	before 1983
G	1983-1990	1984-1991	1986-1991	1983-1995
H	1991-1995	1992-1998	1992-1999	(not applicable)
I	1996-2002	1999-2002	2000-2006	1996-2005
J	2003-2006	2003-2007	(not applicable)	(not applicable)
K	2007-2011	2008-2011	2007-2013	2006 onwards
L	2012 onwards	2012 onwards	2014 onwards	(not applicable)

Source: RdSAP 2012 version 9.93 (19 November 2017), Table S1

Table S6 of Appendix S of RdSAP 2012 shows the anticipated U values associated with filled cavities as well as the assumed value of unfilled cavities in relation to the age band of the property. From this table we can conclude that the U-value of this property would be estimated at 0.7 W/m²K when looking at the “filled cavity” line of the table.

(see below)

Figure 4 RdSAP 2012 Appendix S - Wall U-values England and Wales**Table S6: Wall U-values – England and Wales**

Age band	A	B	C	D	E	F	G	H	I	J	K	L
Wall type												
Stone: granite or whinstone as built	a	a	a	a	1.7 b	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Stone: sandstone or limestone as built	a	a	a	a	1.7 b	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Solid brick as built	1.7	1.7	1.7	1.7	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Stone/solid brick with 50 mm external or internal insulation	0.55	0.55	0.55	0.55	0.55	0.45*	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
Stone/solid brick with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
Stone/solid brick with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
Stone/solid brick with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*

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Cob (as built)	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.35	0.30	0.28
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.60	0.45	0.35	0.30	0.28
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.35	0.45 [†]	0.35 [†]	0.30 [†]	0.28 [†]
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.21*	0.21*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.17*	0.16*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.14*	0.14*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.12*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.35	0.30	0.28
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40 [†]	0.40 [†]	0.40 [†]	0.35 [†]	0.30 [†]	0.28 [†]
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*

See equations in S5.1.1 b or from equations in S5.1.1 if that is less.

* wall may have had internal or external insulation when originally built; this applies only if insulation is known to have been increased subsequently (otherwise 'as built' applies)

[†] assumed as built

Source: RdSAP 2012 version 9.93 (19 November 2017), Table S1

When comparing the U value of the walls, were they taken as built (row: Cavity as Built) and the filled cavity, we see an improvement of 0.8 W/m²K. The overall aim of Cavity Wall Insulation is to bring this number down to the lowest possible number to reduce heat transference as much as possible.

However, as English Heritage studies have shown the effects of moisture or saturation of a brick wall can, in many cases, double the heat transference of the wall than when it is dry. Figure 5 summarizes the reports conclusions in three specific cases where measurements were taken studying dry versus wet walls:

Figure 5 Summary of Test Results

TABLE 4: SUMMARY OF TEST RESULTS		
LOCATION	SAMPLE STATE	AVERAGE THERMAL CONDUCTIVITY AT 10°C W/mK
ENGLEFIELD	DRY	0.55
	WET	1.56
WALSALL	DRY	0.68
	WET	1.26
NEW BOLSOVER	DRY	0.63
	WET	0.98

Source: English Heritage Research Report: Research into the Thermal Performance of Traditional Brick Walls.

These figures apply to single leaf brick walls. Heat transference properties of other materials when dry or wet may not be as extreme, however, it is safe to assume based on these findings, and other statements made by the BRE, that moisture does reduce a material's ability to insulate and would therefore lead to a higher rate of heat transference to the outside.

The estimated savings calculations that cavity wall insulation would bring, do not consider the added heat transference that saturated walls bring. The BRE, the same body that has developed and set the calculation methods used for EPCs has also set out guidelines and issued the recommendations as referenced in this report that moisture will have an ill-effect on the energy efficiency of a dwelling. I am therefore of the opinion, that given these facts, Claimant was ill-advised on the risks of cavity wall insulation which have resulted in reduced energy efficiency of the property, particularly considering the penetration of moisture which took place as a result and are evidenced by the damp problems occurring as described by the chartered surveyors.

5.12 Damages and Losses Sustained

Considering the above, I believe that the claimant could not have benefitted fully from cavity wall insulation. Claimant's property is located in Zone4 which is known to feature severe or very severe driving rain. Filling the wall cavity with any material decreases the wall's ability to expel the moisture which penetrates the outer leaf and allows for the transference of the moisture to the inner leaf. Cavity wall insulation is not recommended for these exposure zones.

Claimant's Cavity wall insulation was installed in 2011. Based on the claimant's draft EPC, the average yearly space heating demand is 11239 kWh per year after the installation of cavity wall insulation. Prior to Cavity Wall Insulation, the property was expected to require 14203 kWh of energy to heat according to the typical use scenario set out in

On-Behalf of [REDACTED]

the RdSAP guidelines and as discussed in section 5.8 above. These figures in relation to the proposed savings that CWI would bring, however, use the assumption that the CWI is 100% effective, and the walls have remained dry, thus there being no impact on the thermal efficiency of the wall other than the positive effect that the cavity wall insulation should have. Overall, should the cavity wall insulation have been effective, claimant would have been expected to be able to save £178.00 per year on their heating costs, offsetting the cost of the installation.

²Smith, Melanie (2016) Comparison of Moisture Survey and U-values for a UK 220mm Solid Brick Walls – Leeds Metropolitan University.

I believe that this figure should, in fact not be considered as savings but rather as a component of the loss that claimant has sustained. Due to the failure of the cavity wall insulation to prevent moisture saturation of the wall, but rather the insulation causing and contributing to the moisture saturation, it is to be expected that the overall U-value of the wall, its thermal efficiency, would have been negatively affected rendering the cavity wall insulation useless.

Moisture, as evidenced with the properties of the brickwork as outlined in section 5.11 above, as well as research done at Leeds Metropolitan University², will affect the rate of heat transference of a brick wall. For the Claimant, as mentioned above, following the draft EPC values, cavity wall insulation should reduce the overall heating demand for the dwelling by 2964 kWh/m²/year. Instead, because of the properties of the walls as they contain moisture, we must consider an increase in the overall heating demand as proportionate to the impact that the walls have on heat loss.

The U-value of the walls has changed, and the walls have become less efficient due to their moisture content. Using the methodology of the EPC, whereby the total fabric heat loss of the dwelling is 285.24 W/K and 127.07 W/K is attributable to the exposed walls we determine that in ideal circumstances CWI would reduce the heat loss parameter of the exposed walls by 59.53 W/K. However, the increased heat transferability of the walls because of their moisture content would see the total fabric heat loss increase to 314.11 W/K for the property. Whereas CWI was estimated to save claimant **£178.00 per year** based on the EPC calculations, this increase in Heat Loss would see those savings be cancelled out and the heat demand of the property rise to 15640.54 kWh and utility bills being 88.4 more expensive than anticipated on average, per year.

As a result, if we were to take the typical heating scenario as used in the calculations for the EPC, the Claimant will have consumed 4401.54 kWh per year more than the Claimant was expecting, since the cavity wall insulation has been installed. This is attributable to the walls of the home not being as effective in insulating the property due to the CWI failure. Using the UK Government's indicative energy prices (as referenced in the tables below) for the years between 2011 and now this represents an increased heating cost for the claimant of £1655.20

Claimant has also lost the opportunity to recover the costs of the cavity wall insulation through energy savings, and benefit from increased energy efficiency of the home. Cavity wall insulation, according to the draft EPC should have decreased the energy consumption in a typical use scenario by 2964 kWh/m²/year. Using the same average gas prices as our calculation above, this represents a value of £1655.20

Table 1 Average Annual Gas Costs per kWh for Consumers in England and Wales

Year	Gas Costs pence/kWh		
	Standard Credit	Direct Debit	Prepayment
1998	1.7200	1.5800	1.8930
1999	1.7400	1.5270	1.8130

² Smith, Melanie (2016) Comparison of Moisture Survey and U-values for a UK 220mm Solid Brick Walls – Leeds Metropolitan University.

2000	1.6870	1.5070	1.7730
2001	1.6730	1.5130	1.7670
2002	1.7730	1.6000	1.8670
2003	1.8270	1.6670	1.9200
2004	2.1570	1.7600	2.1478
2005	2.7130	2.4200	2.8470
2006	3.0670	2.7730	3.2730
2007	3.5730	3.3130	3.7130
2008	4.0470	3.7130	4.2400
2009	3.9070	3.6470	3.8930
2010	4.2930	3.9870	4.2530
2011	4.8000	4.4130	4.7400
2012	5.1200	4.6800	5.0600
2013	5.3130	4.8070	5.2930
2014	5.0670	4.5330	5.0800

Source: Average annual domestic electricity bills for UK countries (QEP 2.2.2) – Department for Business, Energy & Industrial Strategy

Table 2 Average Annual Electricity Costs per kWh for Consumers in England and Wales

Year	Electricity Costs Pence/kWh		
	Standard Credit	Direct Debit	Prepayment
1998	7.9210	7.6580	8.4470
1999	7.7370	7.5000	8.3160
2000	7.5260	7.2630	8.1050
2001	7.3160	7.0530	7.8420
2002	7.2630	7.0000	7.7890
2003	7.2890	7.0260	7.7890
2004	7.4740	7.1580	7.9740
2005	8.3680	7.9210	8.9740
2006	9.9740	9.2630	10.6050
2007	11.2110	10.3680	11.7370
2008	12.8950	11.9210	13.5000
2009	13.2110	12.1580	13.4740
2010	12.8420	11.8160	13.1320
2011	13.9210	12.8950	14.1320

2016	14.7630	13.6580	14.8160
2017	15.7630	14.6050	15.9210
2018	16.2110	14.9470	16.3420

Source: Average annual domestic gas bills for UK countries (QEP 2.3.2) – Department for Business, Energy & Industrial Strategy

Finally, the increased demand that is placed on the heating system, and the added costs of dehumidification are also losses that have been sustained by Claimant to which a value can be attributed for which I include the figures in the total loss calculation below. In conclusion, the losses and damages sustained by Claimant in this are as follows:

Additional Heating Costs	£1655.20
0Unrealized savings	£1114.61
Dehumidifier Costs	£ 550.00
Boiler Depreciation	£ 225.22
Total Loss	£3545.03

We have set dehumidification costs at £50/year which is the average cost of running a dehumidifier in England and Wales based on the device's energy consumption and does not include the purchase price of the device. We have also estimated that the boiler used in the home will depreciate at an increased rate proportionate to the increased energy consumption, thereby shortening its lifespan. Our calculation assumes the average cost and replacement value of £2,000 and a normal lifespan of 10 years. As the cost of energy for 2018 is not yet known, 2017 rates were used to calculate 2018 energy costs.

5.13 Further negative effects on health by damp-related issues

To conclude, this report has focused largely on the energy-related effects of cavity-wall-installation and the detrimental effects it can have relating to this aspect when there are faults, or (moisture-related) problems. However, there are also health risks and problems that should be considered when addressing problems with cavity wall insulation and increased moisture and dampness penetrating into the home in areas where cavity-wall-insulation may not be suitable.

Visible damp or mould can contribute to the development or worsen the effects of respiratory tract illnesses, and persons with compromised immune systems or chronic lung diseases are at a risk for complications in the treatment and care of these issues. The United States Centers for Disease Control (CDC), the Institute of Medicine, and the World Health Organization have all performed studies, or published research and guidelines outlining a direct link between mould and dampness and these illnesses and health problems.³

Insufficient heating capability or significant heat-loss not only affects the comfort of an individual in a dwelling but can also affect that person's ability to cope with the cold, compounding their reactions to the effects of other issues such as damp and mould.

³ See: https://www.cdc.gov/mold/dampness_facts.htm/

6 EXPERT'S DECLARATION

I MAX ALFRED KRANGLE DECLARE THAT:

I understand that my duty in providing written reports and giving evidence is to help the Court, and that this duty overrides any obligation to the party by whom I am engaged or the person who has paid or is liable to pay me. I confirm that I have complied and will continue to comply with my duty.

I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of the case.

I know of no conflict of interest of any kind, other than any which I have disclosed in my report

I do not consider that any interest which I have disclosed affects my suitability as an expert witness on any issues on which I have given evidence

I will advise the party by whom I am instructed if, between the date of my report and the trial, there is any change in circumstances which affect my answers to points 7.3 and 7.4 above.

I have shown the sources of all information I have used.

I have exercised reasonable care and skill in order to be accurate and complete in preparing this report.

I have endeavoured to include in my report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.

I have not, without forming an independent view, included or excluded anything which has been suggested to me by others, including my instructing lawyers.

I will notify those instructing me immediately and confirm in writing if, for any reason, my existing report requires any correction or qualification.

I understand that;

1. my report will form the evidence to be given under oath or affirmation;
2. questions may be put to me in writing for the purposes of clarifying my report and that my answers shall be treated as part of my report and covered by my statement of truth;
3. the court may at any stage direct a discussion to take place between experts for the purpose of identifying and discussing the expert issues in the proceedings, where possible reaching an agreed opinion on those issues and identifying what action, if any, may be taken to resolve any of the outstanding issues between the parties;
4. the court may direct that following a discussion between the experts that a statement should be prepared showing those issues which are agreed, and those issues which are not agreed, together with a summary of the reasons for disagreeing;
5. I may be required to attend court to be cross-examined on my report by a cross-examiner assisted by an expert;

On-Behalf of [REDACTED]

6. I am likely to be the subject of public adverse criticism by the judge if the Court concludes that I have not taken reasonable care in trying to meet the standards set out above.

I have read Part 35 of the Civil Procedure Rules, the accompanying practice direction and the Guidance for the instruction of experts in civil claims and I have complied with their requirements.

I am aware of the practice direction on pre-action conduct. I have acted in accordance with the Code of Practice for Experts.

STATEMENT OF TRUTH

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

Signature *Max Krangle*

Date 28 August 2018

APPENDICES

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1. APPENDIX I – CURRICULUM VITAE

7.1 Curriculum Vitae of Max Krangle

Mr. Max Alfred Krangle

Qualifications, training, accreditation

Bachelor of Science (BSc Hons) 1996, University of Bristol

Graduate Diploma in Law 1997, University of Westminster

Postgraduate Diploma in Legal Practice 1998, The College of Law (London)

Legum Baccalaureus (LLB Hons) 2000, University of Wolverhampton

Solicitor of the Supreme Court of England & Wales 2000 (non-practicing, Roll Number 228223)

Past and present positions

Present position: Managing Director and Director of Research Intelligence at NRG Expert (2011 – Present)

Past Position: Managing Director, ABS Energy Research (2009-2011)

Principal professional specialisms

NRG Expert is an independent energy market research and intelligence company based in London, England. I specialise in energy market pricing and costing analysis, as well as detailed financial analysis and market forecasts for domestic and global utilities and energy production, resource, and manufacturing markets. I provide market research reports and expert analysis to the world's leading companies, consultancies, and government bodies, giving them the data and statistics they need to make difficult, cost-conscious decisions about their energy infrastructure, energy pricing, energy projects, and energy business development strategies. NRG Expert also distributes its research and market intelligence products directly to a global customer base through the company's website and via leading information providers, such as Bloomberg, EBSCO Information Services, MarketResearch.com, and over 30 other national and international market intelligence and research providers.

Awards, accolades, and other professional responsibilities

I am the course director and curriculum author of the Global Energy Certification program.

I am the principle economist for the NRG Expert Tracker – Electricity and Natural Gas Price Forecasting and Advisory Services

Memberships of professional organisations

Practicing Associate Member of the Academy of Experts specialising in energy pricing (AMAE) 2018

Member, Law Society of England & Wales, 2000

Relevant published works

I am the principal author of the following published market research reports and databases:

NRG Expert. Electricity Transmission and Distribution Report and Database (NRG Smarts Limited, 2017)

On-Behalf of [REDACTED]

NRG Expert. The Global High-Tech Power Market Report and Database (NRG Smarts Limited, 2017)

NRG Expert. The Global Power Infrastructure Market (Transformers, Switchgear & Substations) (NRG Smarts Limited, 2017)

NRG Expert. The Global Market for Cables, Towers & Insulators Report and Database (NRG Smarts Limited, 2017)

NRG Expert. Smart Energy Technology Report (NRG Smarts Limited, 2017)

NRG Expert. Electrical Supply Industry World Guidebook (NRG Smarts Limited, 2017)

NRG Expert. Wind Energy Report (NRG Smarts Limited, 2017)

NRG Expert. The Global Solar PV Industry, Historical, Present, and Future Generation Statistics to 2030 (NRG Smarts Limited, 2016)

NRG Expert. Power Generator Database and Market Intelligence (NRG Smarts Limited, 2016)

NRG Expert. The Global Natural Gas Industry (NRG Smarts Limited, 2016)

NRG Expert. The Global Hydro Industry (NRG Smarts Limited, 2015)

NRG Expert. Global Power Plant Database (NRG Smarts Limited, 2014)

NRG Expert. Global Deployment of Utility Meters Forecasting Database and Industry Overview (NRG Smarts Limited, 2014)

NRG Expert. The Global Nuclear Industry (NRG Smarts Limited, 2014)

NRG Expert. The Global Coal Industry (2014)

NRG Expert. Renewable Energy & The Global Recession (NRG Smarts Limited, 2013)

NRG Expert. New Global Power Generation Projects Database (NRG Smarts Limited, 2012)

NRG Expert. Energy Efficiency Report (NRG Smarts Limited, 2012)

NRG Expert. Global Guide to Natural Gas Utilities Report (NRG Smarts Limited, 2012)

NRG Expert. Global Guide to Water and Waste Water Utilities Report (NRG Smarts Limited, 2012)

NRG Expert. Electrical Supply Industry Database (NRG Smarts Limited, 2012)

NRG Expert. Global Oil Reserves and Shale Oil Report (NRG Smarts Limited, 2012)

NRG Expert. World Biofuels Report (NRG Smarts Limited, 2012)

NRG Expert. World Biomass Report (NRG Smarts Limited, 2012)

NRG Expert. Global Ocean Energy Report (NRG Smarts Limited, 2012)

NRG Expert. Global Renewables Report (NRG Smarts Limited, 2012)

NRG Expert. Electricity Deregulation Report (NRG Smarts Limited, 2012)

NRG Expert. Water Deregulation Report (NRG Smarts Limited, 2012)

NRG Expert. Gas Deregulation Report (NRG Smarts Limited, 2012)

NRG Expert. Global Energy Almanac – 200 Countries (NRG Smarts Limited, 2012)

NRG Expert. Energy Storage Report (NRG Smarts Limited, 2011)

NRG Expert. Energy Security Report (NRG Smarts Limited, 2011)

NRG Expert. Global Smart Grid Report (NRG Smarts Limited, 2011)

NRG Expert. Shale Gas Report (NRG Smarts Limited, 2011)

NRG Expert. Oil Sands Report (NRG Smarts Limited, 2011)

NRG Expert. Geothermal Report (NRG Smarts Limited, 2011)

NRG Expert. NRG Statistical Review of World Energy (NRG Smarts Limited, 2011-2017)

Research publications

I have published over 100 energy research titles under both the ABS Energy Research and NRG Expert brands on energy topics generally, most of which relate to the pricing and market forecasting of raw energy resources, gas, electricity, and water utilities for both commercial and residential use, and energy equipment manufacturing, sales, and infrastructure deployment. My publications are available directly from NRG Expert and also distributed globally via leading information providers, such as Bloomberg, EBSCO Information Services, MarketResearch.com, and over 30 other national and international market intelligence and research providers. Many NRG Expert and ABS titles are also available from the British Library.

Training, qualifications and accreditation as an expert witness

I became an Associate Practicing Member of the Academy of Experts in February 2018.

I have attended the Academy of Experts “Expert Foundation Course” (2018), as well as the College of Law’s “Legal Practice Course” and “Professional Skills Course” (both in 1998). These courses cover, amongst other skills, aspects of acting as an expert from expert’s duties to conduct and procedure in Court.

I regularly attend research and update conferences on all aspects of economics and pricing in the global energy industry

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2. APPENDIX II – SOLICITOR’S INSTRUCTIONS

PURE LEGAL TEST, PURE LEGAL OFFICES, Post Code: M1 1AA

Mr. Max Krangle
NRG Expert
103 Latymer Court
Hammersmith Road London,
W6 7JF

Date: 2018-08-28
Our Ref: Pure-Legal-Test
Email: office@claimslegalexpert.co.uk

Dear Sir,

PART 35 COMPLIANT ENERGY REPORT relating to CAVITY WALL INSULATION FAILURE

Our client: [REDACTED]

Client address: [REDACTED]

Client telephone:

We act on behalf of our above-named client in respect of a Wall Cavity Insulation Failure Claim.

We enclose the Part 35 Chartered Surveyors report indicating Cavity Wall Insulation failure at our clients’ property.

Please instruct a draft EPC if and as required and gather any additional required property and client lifestyle information from our client which may be required as part of your assessment and report.

Please could you provide us with a CPR Part 35 compliant report and advise us as to whether you feel that our client has been exposed to:

A Loss of Promise – Where energy savings were promised and if the Wall Cavity Insulation failure has compromised this?

B Financial Liability - If you believe our client has been financially burdened and suffered a financial loss related to Wall Cavity Insulation failure?

If you require further information, then please advise.

If you feel that our client does not have a claim regarding the exposure listed above, please advise as we would not require a report in this case.

Yours sincerely

Solicitor: PURE LEGAL TEST

3. APPENDIX III – Part 35 Report

4. APPENDIX IV – DRAFT EPC

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5. APPENDIX V – DOCUMENTS CONSIDERED

Facts relevant to my expert analysis and opinion are contained within documents appended to this report. These documents are:

- Stirling, C. (2001) Insulating masonry cavity walls – Building Research Establishment Good Building Guide 44 Part 1
- Stirling, C. (2001) Insulating masonry cavity walls – Building Research Establishment Good Building Guide 44 Part 2
- Building Research Establishment (BRE Scotland) (2002) Thermal Insulation: Avoiding Risks
- International Energy Agency (2003) Integral Building Envelope Performance Assessment Building Research Establishment (2008) Thermal transmittance of walls of dwellings before and after application of cavity wall insulation – Energy Savings Trust
- Iwaszkiewicz, C.; Christofides, J.; Wright, W.; Et Al (2010) Study on hard to fill cavity walls in domestic dwellings in Great Britain – Department of Energy and Climate Change
- Thompson, R. (2012) Review of the number of Cavity Walls in Great Britain – Department of Energy and Climate Change
- Building Research Establishment (2012) Study on hard to fill cavity walls in domestic dwellings in Great Britain
- Stroma Certification (2015) RdSAP Manual Methodology
- Turner, C. (2015) Homes through the decades – NHBC Foundation
- Smith, M. (2016) Comparison of moisture survey and u-values for a UK 220mm solid brick wall – Leeds Metropolitan University
- Building Research Establishment (2017) Appendix S: Reduced Data SAP for Existing Dwellings – RdSAP 2012 version 9.93
- Constructing Excellence in Wales (nd) Post Installation Performance of Cavity Wall & External Wall Insulation – Building Research Establishment
- English Heritage (nd) Research of the Thermal Performance of Traditional Brick Walls