Review of the number of cavity walls in Great Britain

Methodology

DECC

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1 Introduction and Background

Wall insulation is a fundamental part of the Government's energy efficiency strategy with cavity wall insulation being capable of providing significant savings where it can be installed. It is therefore important that the Department of Energy and Climate Change (DECC) has a detailed understanding of the potential for its use.

There are many 'standard' cavity walls that can be filled with the confidence that filling the cavity will not lead to problems such as damp. However, for many types of cavity wall similar confidence doesn't exist. In some cases this lack of confidence may be because filling that type of cavity has been shown to lead to issues but it many cases it is simply because not enough testing has taken place.

The DECC report: "Study on hard to fill cavity walls in domestic dwellings in Great Britain" DECC ref: CESA EE0211 undertaken by Inbuilt and Davis Langdon in 2010 provided an overview of a number of different wall types but now a more detailed review, focusing on the number of each type of cavity, is required.

A detailed review has been undertaken and this report provides the background to the work, the methodology used in calculating the numbers and an explanation of the categorisation used. The revised numerical findings have been supplied separately but are also included in Appendix A of this report.

It is possible to categorise and group wall types in many different ways for technical, surveying and administrative purposes. The categorisation used in this report was defined following agreement by DECC and designed to support policy making and assist Government in targeting the most cost effective options in improving insulation standards in British homes.

1.1 Wall types

Several types of cavity wall were identified in the 2010 report as being hard to fill. That report provided initial estimates of the number of hard to fill cavities and the CO_2 savings from filling them. Since that report new information has become available that has allowed these numbers to be given to a better degree of accuracy, the definition of hard to fill cavity wall to be refined and categorisation of wall types to be revaluated.

Several studies, such as the 2010 DECC report, the English House Condition Survey and work by the Energy Saving Trust, have previously attempted to define and classify different types of cavity wall. The hard to fill category used in the 2010 DECC report is now considered inadequate, is often confused with "hard to treat" walls, non-traditional wall types and would benefit from refinement.

Consequently, after discussions with DECC, walls in GB can now be classified in the following 'high level' categories:

1. Unconventional to fill cavities
2. Filled cavity walls
3. Solid walls/other – unfillable
4. Solid walls/other – fillable
5. Standard cavities

Descriptions of the new and revised categories are given below:

Unconventional to fill cavities:

Unconventional to fill cavities are ones that are more difficult or more expensive to fill than standard cavities. British Board of Agrément (BBA) certified products typically have not been tested for these types of wall and guarantees from agencies such as Cavity Insulation Guarantee Agency (CIGA) are generally not available. This category comprises:

Type 1: Non-Standard cavities – fillable

- Narrow cavity – Masonry cavities that are less than 50mm wide.
- Concrete construction – Prefabricated concrete constructions systems with cavities.
- Metal frame construction – Metal frame construction systems with cavities.
- Random stone cavity – Uneven cavities formed in walls constructed of natural stone outer leaf and block/brick inner leaf.
- Timber frame uninsulated studwork (has masonry cavity) – A timber frame wall type with both a studwork cavity and a masonry cavity. In this wall type both cavities do not contain insulation.

Type 2: Standard cavities – some issues

- Standard cavity, with one or more of the following issues: too high, exposed, wall fault – A standard cavity construction which is either: more than four storeys tall, exposed to severe wind driven rain (exposure zone 4) or has a fault in its outer wall which would need to be remediated before filling. See section 1.2 for definitions of ‘issues’.

Type 3: Non-standard cavities – to be left unfilled

- Timber frame insulated studwork (has masonry cavity) – A timber frame wall type with both a studwork cavity and a masonry cavity. In this wall type the studwork cavity contains insulation and the masonry cavity does not contain insulation.

Filled cavity walls:

Filled cavity walls are cavity walls that have already been filled to some extent. Some could potentially be filled further however the potential savings are reduced compared to standard cavities. This category comprises:

- Fully filled – Masonry cavities that are already fully filled. These cavities cannot be filled further. This category covers walls that are fully insulated at the time of construction and those fully insulated post construction.
- Partial fill – Masonry cavities where insulation had previously been installed to a fraction of the cavity width at the time of construction. They have a residual cavity width of typically 30 – 50mm. Partial fill cavity walls can potentially be insulated further; however, savings are likely to be less than for a standard cavity wall.

Solid wall/other - unfillable:

These are walls that do not have a ‘conventional’ cavity and cannot be filled.

- Solid masonry wall – Typically a brick, stone or in-situ concrete wall with no significant cavities. These cannot be filled.
- Timber frame insulated studwork (no masonry cavity) – A timber frame wall type with only a studwork cavity. Generally these walls are clad in tile hanging, weather boarding or other similar finish. The studwork cavity has already been insulated and cannot be filled further.

Solid wall/other - fillable:

These walls are described in housing surveys are being solid walls but may have a unconventional cavity which could potentially be insulated further. This category comprises:

- Timber frame uninsulated studwork (no masonry cavity) – A timber frame wall type with only a studwork cavity. Generally these walls are clad in tile hanging, weather boarding or other similar finish. The studwork cavity is empty and could potentially be filled.
- Lath and plaster – A solid mass wall typically with a 40mm internal cavity between the wall and the internal lath and plaster finish. This internal cavity could potentially be filled. Generally only found in Scotland.

Standard cavities:

Standard cavity walls are ones that can be filled using conventional, approved insulation systems without additional expense or requirements. Standard cavities are typically of brick-brick construction or brick-block construction and have a cavity width of greater than 50mm. This category comprises:

- Standard cavity – Standard masonry construction
- Standard cavity with lower savings from filling – A dwelling with a standard cavity wall but complete dwellings cannot be filled due to it having mixed wall type or access issues. Definitions are given below in section 1.2.

1.2 Additional wall issues

Additional wall issues were identified in the 2010 DECC report that affect the uptake of cavity wall insulation. The numbers of these cavities were not calculated in the original report. The wall issues are:

- Too high – Above a certain height not all standard cavity wall insulation systems can be used and additional safety requirements must be put in place. The original 2010 DECC report used the terminology “Too tall”, this was deemed confusing.
- Exposure – All British Board of Agrément (BBA) certified insulation systems are certified for use in all exposure areas. Nonetheless in highly exposed areas there is a greater risk of water penetrating the cavity wall and it is advised that more rigorous and detailed surveys take place.
- Wall fault – Dwellings where the outer face of the wall is in disrepair. This can lead to water penetrating into the cavity and increases the likelihood of damp.

- Mixed wall type – In dwellings where the external wall is not of a single wall type. This category also includes dwellings where the outer face is completely or partially faced with tile hanging or some other form of cladding.
- Access issues – Dwellings with conservatories will require scaffolding to overcome the obstacle. Often installers will not insulate individual walls where there is an access issue.

For a standard cavity defined as “too high, exposed or wall fault” it is being categorised as a technically fillable wall Type 2 as filling this type of cavity is more expensive than filling a standard cavity and different methods are likely to be required.

A standard cavity that is defined as “mixed wall type” or as having “access issues” is likely to be fillable using standard techniques but it is likely that areas of the wall will not be filled.

2 Methodology

2.1 Calculating the numbers of each wall type

2.1.1 General

The main data sources for calculating the number of each type of wall in Great Britain were datasets from the following reports:

- English Housing Survey 2008 (EHS)
- Scottish House Condition Survey 2009 (SHCS)
- Living in Wales 2008 (LIW)

Each national housing survey covers several thousand dwellings in each country. The surveys cover a whole range of attributes from whether the dwelling has a cavity wall to the income of the homeowner. The surveys do not explicitly record the specific type of cavity wall. Information is acquired by qualified surveyors physically surveying a dwelling and interviewing the homeowner/occupier.

EHS contains data from around 16,000 dwellings, SHCS contains data from around 9,000 dwellings and the LIW contains data from around 3,000 dwellings. Each dwelling in each survey is considered to be a single data point for the purposes of this report.

The aim of this work was to acquire data for Great Britain and therefore datasets from each national survey had to be combined into a single British dataset. The attributes recorded for each surveyed dwelling covered in each survey are broadly the same but different terminology and methodologies are often used. Where there were differences in the recorded data, assumptions were made in order to standardise each dataset so that they could be combined together into a single GB dataset. The format chosen was the one used in the EHS because the EHS dataset was the largest.

For each type of wall, Inbuilt identified various dwelling attributes that were recorded in the housing surveys that indicate a particular type of wall. Using these attributes with appropriate factors and weightings each sample recorded in each survey was reviewed and its wall type determined and then categorised. The categories used are given in the background section of this report.

Each housing survey gives a weighting factor to each data point. This weighting factor was used to scale up from the dataset size (approximately 30,000 dwellings) to the total GB population (approximately 24 million dwellings).

We assumed that the surveys are broadly representative of the building population; however, due to the methodology used by the housing surveys they cannot be considered infallible and for this reason all results were sense checked against multiple sources to improve confidence. All sources are given in Appendix C. Where the sources disagree with the information acquired from the housing surveys, assumptions were made to align the data and the source.

Building regulations are a key driver for changes in building methods and can therefore be used to indicate when certain building methods were used. Typically building regulations do not have an immediate effect as dwellings can receive building control approval prior to changes in regulations but be constructed after the date of the change. This can be a period of several years. For this reason we assume that the effects of the new building regulations will first be seen in the building stock completed from the second year after the new building regulations have come into force. While this is a crude assumption it is only being used to understand u-value requirements and not features such as cavity width.

The walls of most dwellings are a single type of construction but some will have a mixed wall type. For the purposes of defining each wall type, a dwelling is classed by its most abundant construction method. For example if 60% of a dwelling's wall was concrete frame and 40% was standard masonry cavity the dwelling would be classed as concrete construction. With the exception of standard cavities, walls are purely classed by 'wall type' and not 'issue'. For example a narrow cavity wall is simply classed as a narrow cavity wall ignoring exposure, wall faults etc.

The majority of data in the three national surveys was collected between 2007 and 2009. We have not attempted to account for cavities that have been filled or homes constructed since the data was collected.

The criteria used to define each type of wall are given in the sections below. The definitions refer to the characteristics recorded in the national housing surveys and not the characteristics of actual properties.

2.1.2 Narrow cavities

Cavities became established in the interwar period of the 20th century between 1919 and 1939 with varying practices used during that time. In the 2010 report it was assumed that all cavities built between 1919 and 1939 were narrow. This assumption was made because cavity wall installers reported regularly rejecting cavities for being too narrow, particularly those built during the interwar period when cavity widths had not yet been standardised. This was a conservative value but no other data was available.

For this report, Inbuilt has contacted a range of organisations and individuals with expertise in house construction and cavity wall insulation to gain a more detailed understanding of the prevalence of narrow cavities (see Appendix B for a list of contacted parties). Although some uncertainty still remains it is more likely that the variation in widths seen between 1919 and 1939 was skewed towards cavities wider than two inch cavities. Across all dwellings ages, narrow cavities that have been identified by cavity wall installers are likely to be the result of poor workmanship rather than being intentional. For this reason narrow cavities are likely to exist throughout the current housing stock in small numbers as opposed to simply in the interwar period. Nonetheless, the age of the dwellings, lack of standardisation of cavity walls, lack of regulation, lack of accurate measurement technology and reports by cavity wall installers suggest there are likely to be proportionally more narrow cavities built during the interwar period than later.

Due to improvements in site setting out tools, increases in the number of insulated cavities and stricter building regulation it is unlikely that the numbers of narrow masonry cavities built to the 1991 building regulations will be discernible

Our research also confirmed the existence of a number of early cavity wall types such as rat-trap bond and brick tied cavity walling. These cavities cannot be filled using standard insulation systems however their numbers are likely to be negligible and have therefore been ignored.

Traditionally Scottish buildings have used wider cavities than in England to mitigate against the higher prevalence of wind driven rain; because of this there are unlikely to be a significant number of narrow cavity dwellings in Scotland.

Each dwelling recorded in each housing survey was reviewed and the likelihood of being a narrow cavity was assigned using the following assumed values; these percentages were based upon the research as described above:

- Scotland – Zero narrow cavities
- Masonry cavity walls built in England or Wales between 1919 and 1944 – 20%
- Masonry cavities built in England or Wales between 1945 and 1993 – 5%

2.1.3 Concrete construction (system build)

The previous DECC report assumed that any form of concrete walled dwelling would fall into the hard to fill cavity concrete construction wall category. This assumption has been revised to exclude dwellings that are unlikely to have a fillable cavity.

A dwelling is assumed to be of concrete cavity construction when it is listed by a housing survey as having the following characteristics:

- Concrete construction
- Not in-situ concrete (such as no-fines) unless it has masonry pointing (the existence of masonry pointing implies that it has a masonry cavity)
- Not cross wall construction
- Not built post 1993 as these dwellings are likely to be insulated already
- Not identified as being previously insulated

2.1.4 Metal frame (System build)

A dwelling is assumed to be of Metal frame cavity construction when it is listed by a housing survey as having the following characteristics:

- Metal frame construction
- Not built post 1993 as these dwellings are likely to be insulated already.
- Not identified as being previously insulated

2.1.5 Random stone

Numbers of random stone cavities were estimated in the 2010 DECC report from contacting local authorities who gave estimates of the number of random stone build properties in their local authority area. This method has been revised because it had not been possible for a representative number of local authorities to be contacted and the accuracy of these estimates could not be quantified.

The new figures are based on information from the British Geological Survey (BGS) which identified areas that typically used stone for building. The areas identified are given in appendix C by local authority. The English Housing Survey does not record the local authority for each data point and this has had to be estimated. The method used for allocating local authorities to data points in the national housing surveys is given in appendix D. The BGS indicated that there will be some random stone properties in Wales but the numbers are likely imperceptible at this level of analysis and therefore the number of random stone properties in Wales has been taken to be zero.

Based on the above research, a dwelling is assumed to be of random stone construction when it is listed by a housing survey as having the following characteristics:

- Masonry construction in England
- In a local authority identified by the British Geological Survey (England only)
- Stone construction in Scotland (identified in the SHCS)
- Built prior to 1993
- The building type is not a flat
- Identified as not having solid walls
- Not identified as being previously insulated
- Not located in an urban location.

2.1.6 Timber frame (all forms)

Studwork cavities are common to almost all timber framed dwellings. Those built with brick outer leaf typically have a masonry cavity, those with tile hanging or weather boarding typically do not. The studwork cavity is commonly insulated during construction.

Currently, the masonry cavity is not intentionally filled with insulation because of concerns that it will increase the risk of decay in the timber frame structure. Nonetheless if the risk is proven to be low, filling the masonry cavity could potentially lead to additional savings.

Building regulations in 1976 were put in place in response to the 1973 oil crisis. These required U-values of 1.0 $W/(m^2K)$ for exposed walls. This requirement can be achieved using masonry brick and block construction without additional insulation but for a timber frame building some additional insulation is required.

Diagrams of the timber frame wall types are given in appendix E.

2.1.7 Timber frame uninsulated studwork (has masonry cavity)

A dwelling is assumed to be of timber frame construction with a masonry cavity and an uninsulated studwork cavity when it is listed by a housing survey as having the following characteristics:

- Timber frame construction
- Built in 1978 or earlier and not identified as having insulation in the stud cavity.
- Identified as cavity wall construction (Scotland)
- Identified as having masonry pointing (England and Wales)

2.1.8 Timber frame insulated studwork (has masonry cavity)

A dwelling is assumed to be of timber frame construction with a masonry cavity and an insulated studwork cavity when it is listed by a housing survey as having the following characteristics:

- Timber frame construction
- Built post 1978 or identified as being insulated
- Identified as cavity wall construction (Scotland)
- Identified as having masonry pointing (England and Wales)

2.1.9 Timber frame uninsulated studwork (no masonry cavity)

A dwelling is assumed to be of timber frame construction with no masonry cavity and an uninsulated studwork cavity when it is listed by a housing survey as having the following characteristics:

- Timber frame construction
- Built in 1978 or earlier and not identified as having insulation in the stud cavity.
- Identified as solid wall construction (Scotland)
- Not identified as having masonry pointing (England and Wales)
- Not identified as being previously insulated

2.1.10 Timber frame insulated studwork (no masonry cavity)

A dwelling is assumed to be of timber frame construction with no masonry cavity and an insulated studwork cavity when it is listed by a housing survey as having the following characteristics:

- Timber frame construction
- Built post 1978 or identified as being insulated
- Not Identified as having masonry pointing (England and Wales)
- Not identified as being previously insulated

2.1.11 Partial cavity

The 2010 DECC report assumed that all cavities built post 1995 were partially filled. This assumption has been revised. The most common methods for meeting recent building regulations in masonry cavity construction are to use either full thickness cavity wall insulation or partial cavity wall insulation. In exposure zone 4 and in Scotland the National House-Building Council (NHBC) will not give warranties to new dwellings with full fill cavity wall insulation. For this reason properties built in exposed areas and in Scotland typically have partial insulation and in other areas buildings have either partial or full fill insulation.

Partial fill walls were constructed in small numbers the 1980s but grew in popularity in the 1990s. Building regulations in England and Wales in 1990 required U-values in walls to be 0.45W/(m^2K) however this requirement could be relaxed to 0.60W/(m^2K) where double glazing was installed. A U-value of 0.60W/(m^2K) will generally require additional insulation to masonry construction where lightweight blocks are not suitable – mainly 3+storey flats. Although flexibility in the regulations continued to allow uninsulated masonry cavities throughout the 1990s this was increasingly rare. Consequently, the majority of the uptake of partial cavity wall insulation has been assumed to be between 1990 and 1995.

A dwelling is assumed to be of partial cavity construction when it is listed by a housing survey as having the following characteristics:

In exposed areas and in Scotland

- Masonry cavity wall construction
- Not insulated
- Built post 1993

OR

In all other areas, 50% of all dwellings identified as:

- Masonry cavity wall construction
- Not insulated
- Built post 1993
- Not in an exposed local authority

2.1.12 Lath and plaster

The 2010 DECC report did not consider lath and plaster because that report used data for England, where lath and plaster cavities are very rare, and scaled the figures to total size of the housing stock in Great Britain. Walls with lath and plaster cavities are essentially the same as a solid walls but have lath and plaster applied to battens fixed internally to external walls. This creates a cavity of approximately 40mm. Research by Historic Scotland has shown that lath and plaster cavities exist in Scotland in far higher numbers than in the rest of Great Britain and could potentially be insulated.

Historic Scotland suggests that lath and plaster construction was the most common form of construction between 1850 and 1918.

A dwelling is assumed to be of lath and plaster construction when it is listed by a housing survey as having the following characteristics:

- Located in Scotland
- Identified in SHCS as being masonry solid wall
- Built between 1850 and 1918

2.1.13 Standard cavity

The 2010 DECC report does not give figures for the number of standard cavities in GB. Standard cavities are those cavities that have a standard masonry construction, are not filled in anyway, do not have any additional issue such as a wall fault and can be filled using standard certified insulation systems.

2.1.14 Standard cavity with any of: wall fault, too high, exposed location

This category considers dwellings that have a standard masonry cavity and one or more of the issues: wall fault, too high, exposed location. The criteria for each issue are described further in section 2.2.

2.1.15 Standard cavity with any of: access issues, mixed wall type

This category considers dwellings that have a standard masonry cavity and one or more of the issues: mixed wall type or access issues. The criteria for each issue are described further in section 2.2.

2.2 Calculation of number of cavity walls with issues

2.2.1 General

The 2010 DECC report considered cavity walls with issues but did not attempt to estimate their number.

For this report the number of cavity walls with issues was calculated from the national housing surveys using a similar methodology to calculating the number of hard to fill cavity walls.

2.2.2 Too high

A dwelling is assumed to be too high when it is listed by a housing survey as having the following characteristics:

- Dwelling is more than 4 storeys
- Part of a building that is more than 4 storeys

2.2.3 Wall fault

The dwelling attributes that indicate wall faults are not consistent between the three national surveys. For this reason different but broadly similar attributes have been used and assumed to indicate a wall fault.

A dwelling is assumed to have a wall fault when it is listed by a housing survey as having the following characteristics:

- Unfit or defective walls (Wales)
- Urgent repair required for wall finish or penetrative damp seen (Scotland)
- Unfit or defective walls (England)

2.2.4 Access issues

Access issues are considered to be something that requires the installer to use scaffolding to get over. The most common cause is the existence of a conservatory and is the only issue considered here.

A dwelling is assumed to have access issues when it is listed by a housing survey as having the following characteristics:

- A conservatory

2.2.5 Exposure

An exposed dwelling is assumed to be one that is severely exposed to wind driven rain. Whether a dwelling is severely exposed is based on two factors: its geographical location and surrounding topography. Complete definitions are given in BRE report BR 262[1]. The topography of each national housing survey sample is recorded in the surveys but the geographical location is not.

[1] Thermal insulation: avoiding risks, second edition, BRE 1994

The housing surveys also give each dwelling an “exposure rating” (unfortunately they use the same terminology as is used in this report but the meaning is different) these exposure rating are based on the surrounding topography and do not account for geographical location.

The geographical location of each dwelling in each housing survey was determined to local authority level using the methodology given in appendix C. Local authorities are rarely in just one exposure zone so each local authority was split between exposed areas and unexposed areas based on the exposure map in BRE report BR 262. The dwellings in the housing surveys were distributed between the exposed and unexposed depending on the size of those areas.

A dwelling is assumed to have access issues when it is listed by a housing survey as having the following characteristics:

- Located in exposure zone 3 but the local conditions accentuate wind affects (housing surveys describes the dwelling as being “very exposed”[2]).
- Located in exposure zone 4 when local conditions do not protect the dwelling from wind driven rain (housing surveys describe the dwelling as being “not exposed”).

2.2.6 Mixed wall type

A dwelling is assumed to have access issues when it is listed by a housing survey as having the following characteristics:

- More than 10% of its external wall being of a different type to the predominant wall type (England and Wales).
- An extension that was built with a different wall type to the main building (Scotland).

OR

- More than 10% of walls finish being tile hanging, weather boarding or other panel system (England and Wales).
- Predominant wall finish is not brick, stone or render (Scotland)

2.3 Calculation of CO_2 savings

The total CO_2 savings for filling each type of cavity was based upon:

- The type of each cavity
- The type of dwelling insulated
- The number of each type of cavity
- The number of each type of dwelling

To calculate CO_2 savings of each dwelling its characteristics, such as dimensions, are required. These details are not known for every property in GB so a “standard” dwelling was modelled for each dwelling type and assumed to be representative all dwellings of that type. The “standard” dwellings were originally developed for the 2010 DECC report; their characteristics were based upon data from a library of surveys undertaken by Davis Langdon.

The CO_2 savings attained from filling each dwelling was then predicted using SAP 2009 by first modelling each dwelling type with an uninsulated cavity wall, then modelling the same dwelling with an insulated cavity wall and taking the difference. This was undertaken for each

[2] Housing surveys use the term exposed to describe the local conditions not the exposure to wind driven rain.

type of dwelling and each wall type. The resultant figure was then scaled up to the entire GB population. The assumptions used for the “standard” dwellings in SAP 2009 are given in appendix H.

This methodology is similar to that used in the 2010 DECC report with the key difference being that the 2010 DECC report modelled the different dwellings using SAP 2005

The U-values of the filled and unfilled cavity walls were equal to those used in the original DECC report with the exception of narrow cavities which are now assumed to have a brick-brick construction as opposed to brick-block. These were calculated using the method outlined in BS EN ISO 6946. The U-values assumed for each type of cavity wall are given in Appendix F.

The report “Thermal Transmittance of walls of dwellings before and after application of cavity wall insulation” by the BRE suggests that U value improvements from insulating cavity walls are likely to be 38% less than suggested using BS EN ISO 6946. We have assumed that CO_2 savings will be similarly affected and have adjusted our estimates accordingly.

Additional assumptions used in SAP 2009:

- Installation of insulation would not reduce thermal bridging
- Party walls would not be insulated
- All dwellings would be fully filled with a substance with a thermal conductivity of 0.04 W/mK (such as EPS bead)
- SAP 2009 models accurately reflect real dwellings
- Walls are filled perfectly
- Comfort factors are not accounted for.

The carbon savings by dwelling and wall type are given in appendix G.

2.3.1 Additional CO_2 saving considerations

The correct installation of insulation is important in all forms of construction and there are multiple studies demonstrating that any air movement on the warm side of the insulation will degrade the thermal performance and lead to greater heat loss than calculations would imply. Correct installation of partial fill insulation, where rigid foam board is placed against the inner leaf within the cavity is particularly important. The nature of the blockwork construction means that it can be difficult to ensure that rigid partial fill board is held against the inner leaf of the cavity.

Work undertaken by BRE[3] investigated actual and calculated U-values for a number of new build wall types. Although the actual performance of most wall types was worse than calculated, the difference was particularly marked for partial fill with measured U-values being up to twice the calculated U-values. Large variations between one section and another on the same wall were observed in a number of cases, suggesting that the way in which each individual section of insulation is fixed may be a factor.

This work concluded that for full and partial fill cavities the differences between measured U-values and expected U-values were:

- For fully filled cavity walls, 0.05 W/m²K (approx.)

[3] Field investigations of the thermal performance of construction elements as built, Sean Doran, November 2000, BRE Client Report No. 78132.

- For partially filled cavity walls, 0.10 W/m²K (approx.)

Consequently for any given wall these values should be added to the calculated U-value. This will increase the savings to the filling of any residual cavity in a partially filled cavity wall.

Leeds Metropolitan University is currently undertaking a study involving monitoring the impact of filling partial fill residual cavities with blown insulation. Initial reports indicate an even greater energy and CO_2 saving that calculations would suggest, even with above adjustment. This is significant as it may increase the cost effectiveness of filling residual cavities although surveying costs are likely to be higher than for standards cavities.

3 Confidence Levels

As described in section 1 of this report, this work has combined the results of three separate limited surveys which used slightly different methodologies to capture their data. Consequently, due to the inherent uncertainty of this work we do not attempt to give a full statistical error analysis for this report's results however we are able to provide upper and lower bounds for the results based on estimations of confidence.

3.1 Error due to sampling method

EHS 2008 estimates that the majority of its outputs the standard error is less than 2% due to the limit sample size. To be on the safe side we have assumed a sampling error of 5% for all calculated values for reasonable confidence.

3.2 Error in surveyed construction type

Our work relies heavily on results recorded by the surveyors working for the national housing surveys.

Several construction types are infamously difficult to distinguish from a standard masonry cavity using an external survey.

To estimate the likely error due to misidentification made by surveyors we used EHS 2009[4] data. EHS 2009 records when the surveyor has been into the loft space to look for indications of cavity wall insulation, this would allow the surveyor to accurately determine the construction type. By comparing the proportions of each construction type identified using this method and the proportions identified directly we were able to get a sense of the number which were misidentified by surveyors.

For the majority of cases we suggest the surveyor correctly identifies the construction type 95% of the time however we suggest that the numbers of timber frame and metal frame dwellings may be under estimated by up to 10%.

3.3 Error in fully filled status

The method used to identify cavity wall insulation by the national housing surveys is based upon visible external signs of insulation and therefore will underestimate the actual number giving an absolute lower bound for the actual number of insulated cavities. EHS 2008 estimates that 33.4% of dwellings in England are insulated which would equate to around 8.7 million dwellings in GB.

For the upper bound the largest influential factor is the number of partial fill cavities, which could be confused with full fill. We assume that at its most extreme case 20% of partially filled cavities could in reality be fully filled. In addition, we assume that an additional 5% of unfilled dwellings built between 1981 and 1990 could have been fully filled.

3.4 Error in partial fill

There is a large amount of uncertainty in the numbers of partial fill cavities. Based on the accuracy of the base data we assume that our calculated value would be within 20% of the actual value.

[4] EHS 2009 this used the same surveying methodology as EHS 2008 but recorded additional data which allowed us to carry out this piece of analysis. While the figures may not correlate the error should from surveying will the same.

3.5 Error in narrow cavity

We calculated the number of narrow cavity walls from contacting a large range of stakeholders and basing our assumptions on their experience. There was a range of opinions from the stakeholders that we spoke to and therefore there is a high degree of uncertainty. We assume ±50%.

3.6 Error in CO_2 displaced

There is considerable error in the calculated CO_2 savings. The largest sources are:

- The “standard” dwellings modelled being different to real dwellings. The key difference would be the boiler type, wall area, wall thickness and wall U-value
- Householders preferring warmer houses instead of turning down heating systems
- Error in the estimated number of cavities (see above)
- Error in the affect of insulation in upon wall U-values.

Consequently, there is a high degree of uncertainty which we assume to be approximately 20% plus the uncertainty associated with the number of cavities.

Appendix A – Results tables

The following tables give the results for the analysis undertaken. There is potential for overlap between "Standard Cavity with one of Wall fault, Exposure, Too high" and" Standard cavity, One of more of: (Mixed wall type, Conservatory)", because of this overlap the sum of all cavities in the tables below may be greater than the total number of cavities in Great Britain.

Numbers of cavity walls by building type

Number of unconventional to fill cavities, Type 1: Non-Standard cavities – fillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Narrow cavity	6,100 - 18,000	62,000 - 190,000	26,000 - 77,000	32,000 - 96,000	-	32,000 - 96,000	110,000 - 330,000	270,000 - 800,000
Concrete construction	6,200 - 6,900	22,000 - 24,000	29,000 - 32,000	41,000 - 45,000	150,000 - 160,000	180,000 - 200,000	98,000 - 110,000	530,000 - 580,000
Random stone cavity	540 - 660	66,000 - 81,000	14,000 - 18,000	18,000 - 22,000	350 - 420	3,900 - 4,700	53,000 - 65,000	160,000 - 190,000
Metal construction	530 - 610	40,000 - 46,000	6,800 - 7,800	3,700 - 4,300	5,600 - 6,500	9,800 - 11,000	34,000 - 40,000	100,000 - 120,000
Timber uninsulated studwork (has masonry cavity)	980 - 1,100	24,000 - 27,000	17,000 - 20,000	14,000 - 16,000	800 - 930	10,000 - 12,000	29,000 - 34,000	96,000 - 110,000
Sub total	14,000 - 28,000	210,000 - 360,000	93,000 - 150,000	110,000 - 180,000	160,000 - 170,000	240,000 - 320,000	320,000 - 580,000	1,100,000 - 1,800,000

Number of unconventional to fill cavities, Type 2: Standard cavities – some issues[5]								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Standard cavity with a wall fault	36,000 - 40,000	230,000 - 250,000	140,000 - 150,000	220,000 - 250,000	2,400 - 2,600	220,000 - 240,000	470,000 - 520,000	1,300,000 - 1,400,000
Standard cavity in a building that is too high	4,600 - 5,000	10,000 - 11,000	2,900 - 3,200	6,100 - 6,700	10,000 - 11,000	22,000 - 24,000	7,400 - 8,200	63,000 - 70,000
Standard cavity in a exposed location	1,700 - 1,900	55,000 - 61,000	21,000 - 23,000	30,000 - 33,000	4,100 - 4,600	40,000 - 44,000	62,000 - 69,000	210,000 - 240,000
Standard Cavity with one of Wall fault, Exposure, too high	40,000 - 49,000	260,000 - 320,000	140,000 - 180,000	240,000 - 290,000	15,000 - 19,000	250,000 - 310,000	490,000 - 600,000	1,400,000 - 1,800,000

Number of unconventional to fill cavities, Type 3: Non-standard cavities – not fillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Sum of Timber insulated studwork (has masonry cavity)	3,300 - 3,800	180,000 - 210,000	56,000 - 65,000	94,000 - 110,000	4,900 - 5,700	100,000 - 120,000	95,000 - 110,000	540,000 - 620,000

[5] As cavities may have more than a single issue there may be some double counting

Number of Filled cavity walls								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Fully filled	26,000 - 27,000	2,400,000 - 2,600,000	810,000 - 860,000	990,000 - 1,100,000	54,000 - 58,000	1,200,000 - 1,200,000	2,700,000 - 2,900,000	8,100,000 - 8,700,000
Partial fill	980 - 1,500	210,000 - 310,000	53,000 - 80,000	55,000 - 82,000	5,800 - 8,700	130,000 - 190,000	110,000 - 160,000	560,000 - 840,000
Sub total	27,000 - 29,000	2,600,000 - 2,900,000	860,000 - 940,000	1,000,000 - 1,100,000	60,000 - 66,000	1,300,000 - 1,400,000	2,800,000 - 3,000,000	8,700,000 - 9,500,000

Number of Solid wall/other - unfillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Solid	690,000 - 760,000	870,000 - 960,000	800,000 - 890,000	2,200,000 - 2,500,000	110,000 - 130,000	550,000 - 610,000	1,500,000 - 1,700,000	6,800,000 - 7,500,000
Timber frame insulated (no masonry cavity)	-	25,000 - 29,000	1,300 - 1,500	9,700 - 11,000	35 - 41	2,200 - 2,600	4,700 - 5,500	43,000 - 50,000
Sub total	690,000 - 760,000	910,000 - 1,000,000	820,000 - 900,000	2,300,000 - 2,500,000	110,000 - 130,000	560,000 - 620,000	1,500,000 - 1,700,000	6,900,000 - 7,600,000

Number of Solid wall/other - fillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Timber frame uninsulated no masonry cavity	460 - 530	42,000 - 49,000	11,000 - 13,000	13,000 - 16,000	170 - 200	5,700 - 6,600	15,000 - 17,000	88,000 - 100,000
Lath and Plaster	4,600 - 5,100	91,000 - 100,000	33,000 - 37,000	49,000 - 54,000	8,500 - 9,400	95,000 - 110,000	64,000 - 70,000	350,000 - 380,000
Sub total	5,000 - 5,600	130,000 - 150,000	45,000 - 50,000	62,000 - 69,000	8,600 - 9,600	100,000 - 110,000	78,000 - 87,000	430,000 - 480,000

Number of Standard cavities								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Standard cavity, One of more of: (Mixed wall type, conservatory)	7,300 - 8,000	500,000 - 560,000	140,000 - 160,000	250,000 - 270,000	4,100 - 4,500	210,000 - 230,000	520,000 - 580,000	1,600,000 - 1,800,000
Standard cavity	43,000 - 47,000	840,000 - 920,000	400,000 - 440,000	630,000 - 700,000	9,300 - 10,000	770,000 - 850,000	1,200,000 - 1,300,000	3,900,000 - 4,300,000
Sub total	50,000 - 55,000	1,300,000 - 1,500,000	540,000 - 600,000	880,000 - 970,000	13,000 - 15,000	980,000 - 1,100,000	1,700,000 - 1,900,000	5,500,000 - 6,100,000

Numbers of cavity walls by age

The following tables give the number of cavities in GB by their type and their age.

Number of unconventional to fill cavities, Type 1: Non-Standard cavities – fillable

	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Narrow cavity	-	4,500 - 14,000	9,100 - 27,000	120,000 - 360,000	51,000 - 150,000	38,000 - 110,000	18,000 - 55,000	19,000 - 57,000	7,200 - 22,000	-	-	270,000 - 800,000
Concrete construction	-	-	-	14,000 - 16,000	240,000 - 260,000	210,000 - 240,000	46,000 - 50,000	16,000 - 18,000	-	-	-	530,000 - 580,000
Random stone cavity	1,900 - 2,300	560 - 690	1,000 - 1,200	20,000 - 25,000	46,000 - 57,000	49,000 - 60,000	17,000 - 21,000	17,000 - 21,000	3,800 - 4,600	-	-	160,000 - 190,000
Metal construction	-	-	-	7,800 - 9,000	45,000 - 52,000	11,000 - 13,000	6,900 - 8,000	12,000 - 14,000	7,900 - 9,100	6,300 - 7,300	4,300 - 4,900	100,000 - 120,000
Timber uninsulated studwork (has masonry cavity)	-	-	-	11,000 - 13,000	18,000 - 21,000	30,000 - 35,000	37,000 - 42,000	-	-	-	-	96,000 - 110,000
Sub total	1,900 - 2,300	5,100 - 14,000	10,000 - 29,000	170,000 - 420,000	400,000 - 540,000	340,000 - 460,000	120,000 - 180,000	64,000 - 110,000	19,000 - 35,000	6,300 - 7,300	4,300 - 4,900	1,100,000 - 1,800,000

Number of unconventional to fill cavities, Type 2: Standard cavities – some issues												
	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Standard cavity with a wall fault	4,300 - 4,700	57,000 - 63,000	110,000 - 120,000	310,000 - 350,000	390,000 - 430,000	260,000 - 290,000	96,000 - 110,000	74,000 - 82,000	7,200 - 8,000	230 - 250	-	1,300,000 - 1,400,000
Standard cavity in a building that is too high	-	630 - 700	-	5,500 - 6,100	14,000 - 16,000	22,000 - 25,000	6,200 - 6,800	13,000 - 14,000	1,300 - 1,500	-	-	63,000 - 70,000
Standard cavity in a exposed location	1,200 - 1,300	1,600 - 1,700	2,800 - 3,100	28,000 - 31,000	47,000 - 52,000	55,000 - 61,000	28,000 - 31,000	45,000 - 50,000	3,700 - 4,100	610 - 670	320 - 360	210,000 - 240,000
Standard Cavity with one of Wall fault, Exposure, too high	5,200 - 6,300	54,000 - 66,000	100,000 - 120,000	320,000 - 390,000	420,000 - 510,000	310,000 - 370,000	120,000 - 150,000	110,000 - 140,000	12,000 - 14,000	570 - 700	310 - 370	1,400,000 - 1,800,000

Number of unconventional to fill cavities, Type 3: Non-standard cavities – not fillable												
	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Timber insulated studwork (has masonry cavity)	-	77 - 90	-	1,000 - 1,200	5,800 - 6,700	14,000 - 17,000	23,000 - 27,000	130,000 - 150,000	91,000 - 100,000	160,000 - 180,000	110,000 - 130,000	540,000 - 620,000

Number of filled cavity walls												
	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Fully filled	16,000 - 17,000	53,000 - 56,000	110,000 - 110,000	940,000 - 1,000,000	2,200,000 - 2,400,000	1,600,000 - 1,700,000	640,000 - 690,000	860,000 - 920,000	480,000 - 510,000	820,000 - 880,000	430,000 - 460,000	8,100,000 - 8,700,000
Partial fill	-	-	-	-	-	-	-	-	94,000 - 140,000	320,000 - 480,000	150,000 - 220,000	560,000 - 840,000
Sub total	16,000 - 17,000	53,000 - 56,000	110,000 - 110,000	940,000 - 1,000,000	2,200,000 - 2,400,000	1,600,000 - 1,700,000	640,000 - 690,000	860,000 - 920,000	570,000 - 650,000	1,100,000 - 1,400,000	580,000 - 680,000	8,700,000 - 9,500,000

Number of solid wall/other - unfillable												
	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Solid	790,000 - 870,000	2,000,000 - 2,200,000	1,600,000 - 1,700,000	1,600,000 - 1,800,000	490,000 - 540,000	260,000 - 290,000	58,000 - 64,000	35,000 - 39,000	3,300 - 3,700	2,100 - 2,400	1,700 - 1,900	6,800,000 - 7,500,000
Timber frame insulated (no masonry cavity)	-	-	-	-	2,300 - 2,700	1,700 - 2,000	3,700 - 4,300	11,000 - 13,000	4,500 - 5,300	11,000 - 12,000	8,900 - 10,000	43,000 - 50,000
Sub total	790,000 - 870,000	2,000,000 - 2,200,000	1,600,000 - 1,700,000	1,600,000 - 1,800,000	490,000 - 540,000	260,000 - 290,000	62,000 - 68,000	46,000 - 52,000	7,900 - 8,900	13,000 - 15,000	11,000 - 12,000	6,800,000 - 7,500,000

Number of solid wall/other - fillable

	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Timber frame uninsulated no masonry cavity	-	77 - 90	-	6,100 - 7,100	27,000 - 31,000	19,000 - 23,000	9,100 - 11,000	5,500 - 6,400	4,800 - 5,600	5,500 - 6,300	10,000 - 12,000	88,000 - 100,000
Lath and Plaster	-	180,000 - 200,000	160,000 - 180,000	-	-	-	-	-	-	-	-	350,000 - 380,000
Sub total	-	180,000 - 200,000	160,000 - 180,000	6,100 - 7,100	27,000 - 31,000	19,000 - 23,000	9,100 - 11,000	5,500 - 6,400	4,800 - 5,600	5,500 - 6,300	10,000 - 12,000	430,000 - 480,000

Number of standard cavities												
	Pre 1850	1850-1899	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	1981-1990	1991-1995	1996-2002	Post 2002	Grand Total
Standard cavity, One of more of: (Mixed wall type, Conservatory)	8,900 - 9,800	19,000 - 21,000	34,000 - 37,000	190,000 - 210,000	390,000 - 430,000	510,000 - 560,000	210,000 - 240,000	230,000 - 250,000	45,000 - 50,000	-	-	1,600,000 - 1,800,000
Standard cavity	3,200 - 3,600	75,000 - 83,000	130,000 - 140,000	610,000 - 680,000	1,000,000 - 1,100,000	710,000 - 780,000	450,000 - 500,000	690,000 - 770,000	190,000 - 210,000	-	220 - 250	3,900,000 - 4,300,000
Sub total	12,000 - 13,000	94,000 - 100,000	160,000 - 180,000	810,000 - 890,000	1,400,000 - 1,600,000	1,200,000 - 1,300,000	660,000 - 730,000	920,000 - 1,000,000	230,000 - 260,000	-	220 - 250	5,500,000 - 6,100,000

Cavity type CO_2 savings (tonnes)

The following tables give the potential CO_2 saved from filling each type of cavity by dwelling type in tonnes of CO_2.

CO_2 saving, unconventional to fill cavities, Type 1: Non-Standard cavities – fillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Narrow cavity	720 - 4,100	24,000 - 140,000	8,300 - 47,000	4,600 - 26,000	-	5,000 - 28,000	26,000 - 140,000	69,000 - 390,000
Concrete construction	770 - 1,300	9,100 - 15,000	9,900 - 17,000	6,200 - 10,000	16,000 - 26,000	30,000 - 50,000	24,000 - 40,000	96,000 - 160,000
Random stone cavity	18 - 34	7,500 - 14,000	1,300 - 2,500	730 - 1,400	10 - 18	170 - 320	3,500 - 6,500	13,000 - 25,000
Metal construction	66 - 110	17,000 - 29,000	2,300 - 4,000	560 - 970	590 - 1,000	1,600 - 2,800	8,400 - 15,000	30,000 - 53,000
Timber uninsulated studwork (has masonry cavity)	120 - 210	9,700 - 17,000	5,800 - 10,000	2,100 - 3,600	84 - 150	1,700 - 2,900	7,100 - 12,000	27,000 - 46,000
Sub total	1,700 - 5,700	68,000 - 210,000	28,000 - 80,000	14,000 - 42,000	17,000 - 28,000	39,000 - 84,000	69,000 - 220,000	230,000 - 670,000

CO_2 saving, unconventional to fill cavities, Type 2: Standard cavities – some issues								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Standard cavity with a wall fault	2,900 - 5,300	61,000 - 110,000	30,000 - 55,000	22,000 - 40,000	160 - 290	23,000 - 42,000	73,000 - 140,000	210,000 - 390,000
Standard cavity in a building that is too high	360 - 670	2,700 - 5,100	630 - 1,200	590 - 1,100	690 - 1,300	2,300 - 4,300	1,200 - 2,200	8,400 - 16,000
Standard cavity in a exposed location	130 - 250	15,000 - 27,000	4,600 - 8,600	2,800 - 5,300	280 - 520	4,200 - 7,700	9,800 - 18,000	36,000 - 68,000
Standard Cavity with one of Wall fault, Exposure, too high	3,300 - 6,200	74,000 - 140,000	33,000 - 62,000	24,000 - 45,000	1,100 - 2,000	28,000 - 52,000	81,000 - 150,000	250,000 - 460,000

CO_2 saving, unconventional to fill cavities, Type 3: Non-standard cavities – not to be filled								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Timber insulated studwork (has masonry cavity)	56 - 97	11,000 - 18,000	2,600 - 4,600	2,000 - 3,400	71 - 120	2,300 - 4,000	3,200 - 5,600	21,000 - 36,000

CO_2 saving, filled cavity walls								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Fully filled	-	-	-	-	-	-	-	-
Partial fill	15 - 34	10,000 - 24,000	2,200 - 5,100	990 - 2,300	73 - 170	2,600 - 6,000	3,100 - 7,300	19,000 - 45,000
Sub total	15 - 34	10,000 - 24,000	2,200 - 5,100	990 - 2,300	73 - 170	2,600 - 6,000	3,100 - 7,300	19,000 - 45,000

CO_2 saving, solid wall/other - unfillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Solid	-	-	-	-	-	-	-	-
Timber frame insulated (no masonry cavity)	-	-	-	-	-	-	-	-
Sub total	-	-	-	-	-	-	-	-

CO_2 saving, solid wall/other - fillable								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Timber frame uninsulated no masonry cavity	51 - 88	16,000 - 28,000	3,400 - 5,900	1,800 - 3,200	16 - 28	850 - 1,500	3,300 - 5,600	25,000 - 44,000
Lath and Plaster	230 - 390	16,000 - 26,000	4,700 - 7,900	3,000 - 5,100	370 - 620	6,500 - 11,000	6,500 - 11,000	37,000 - 62,000
Sub total	280 - 480	32,000 - 54,000	8,100 - 14,000	4,900 - 8,200	390 - 650	7,300 - 12,000	9,700 - 16,000	62,000 - 110,000

CO_2 saving, standard cavities								
	Converted flat	Detached	End terrace	Mid terrace	Purpose built flat, High rise	Purpose built flat, low rise	Semi detached	Grand Total
Standard cavity, One of more of: (Mixed wall type, Conservatory)	610 - 1,000	140,000 - 240,000	34,000 - 56,000	25,000 - 42,000	300 - 490	24,000 - 39,000	88,000 - 150,000	310,000 - 520,000
Standard cavity	3,600 - 6,000	240,000 - 400,000	92,000 - 150,000	65,000 - 110,000	670 - 1,100	87,000 - 140,000	200,000 - 330,000	690,000 - 1,100,000
Sub total	4,200 - 7,100	380,000 - 640,000	130,000 - 210,000	90,000 - 150,000	970 - 1,600	110,000 - 180,000	290,000 - 480,000	1,000,000 - 1,700,000

Appendix B – Data Sources

This appendix gives a list of references, stakeholders and data sources to inform our assumptions.

General data sources

Source	Author	Year of publication
Study on hard to fill cavity walls in domestic dwellings in Great Britain	Inbuilt and Davis Langdon	2010
English Housing Survey	Department for Communities and Local Government	2008
Scottish House Condition Survey	Scottish Government	2009
Living in Wales	Welsh Government	2008
BRE Housing Design Handbook	BRE	1993
Cavity Insulation of masonry walls	BRE	1983
Scotland: Assessing U-values of existing housing, CE84	Energy Saving Trust	2005
Cavity wall insulation in existing dwellings: A guide for specifies and advisors	Energy Saving Trust	2007
Rain penetration through cavity walls	BRE	1988
Appraisal of existing structures 3rd edition	IStructE	2011
Cavity wall construction timeline	Peter Dicks/CIGA	Unpublished

Narrow Cavities

In order to gain a better understanding of narrow cavities a number of individuals were contacted who have expertise in the construction of field of early cavities. We would like to acknowledge their contribution.

Name	Organisation	Industry/sector	National/region
Richard Ford	Knauf	Technical Inspector Insulation manufacturer	North East England
Graeme Waugh	Knauf	Technical Inspector Insulation manufacturer	Scotland
Simon Johns	Peter Cox	Surveyor Wall tie replacement	South and East England
Chris Nicol	Action Wall Ties	Surveyor Wall tie replacement	Canterbury, Kent
David Smith	Arrow Fixings	Surveyor Wall tie replacement	Cardiff, Wales
Trevor Davies	Davies building contractors	Surveyor Wall tie replacement	Poole, Dorset
Russell Smith	1st Master Wall Ties	Surveyor Wall tie replacement	Waterlooville, Hampshire
Peter Dicks	CIGA	Technical director Industry body	UK
Elizabeth Shove	Lancaster University	Academic	UK
Ronald Brunskill	Retired	Historian and author	UK
Stephen Wise	Knauf	Technical manager Insulation manufacturer	UK
Michael Hammett	British Brick Society	Building historian and Industry body	UK
Michael Driver	Consultant	Interest group	UK
David Pickles	English Heritage	Ancient monuments & historic buildings	England
Peter Iles	BRE	Consultancy/Research	UK

Concrete Construction

Source	Author	Year of publication
The structural condition of cast-in-situ concrete high-rise dwellings	D H Glick and BR Reeves, BRE	1996
The structural condition of Wimpey No-Fines low-rise dwellings	B R Reeves and G R Martin, BRE	1989
The structural condition of Wates prefabricated reinforced concrete houses	BRE	1983

Metal frame construction

Only general data sources used.

Random stone construction

Source	Author	Year of publication
Mineral planning factsheet, building and roofing stone	British geological survey	2007

Timber frame construction (all forms)

Source	Author	Year of publication
Feasibility study on retrofit cavity wall insulation in timber frame dwellings	Peter Thompson, BRE	2004
Refurbishing timber-framed dwellings	Energy Saving Trust	2004

Partial Cavity

Source	Author	Year of publication
Quarterly survey 2010	NHBC	Not Published.

Lath and Plaster

Source	Author	Year of publication
Energy Efficiency in traditional homes	David S Mitchell, Historic Scotland	2008
Energy Efficiency Pilot Refurbishment Projects	Roger Curtis, Historic Scotland	2011
Innovative solutions to make traditional buildings more energy efficient	Moses Jenkins, Historic Scotland	2008

Standard Cavity

Only general data sources used.

Too high

Only general data sources used.

Wall fault

Only general data sources used.

Access issues

Only general data sources used.

Exposure

Source	Author	Year of publication
Assessing exposure of walls to wind-driven rain BS 8104	BSI	1992
Thermal Insulation: Avoiding Risks BR262	BRE	2002

Mixed wall type

Only general data sources used.

CO_2 saving calculations

Source	Author	Year of publication
BS EN ISO 6946	BSI	2007
Field investigations of the thermal performance of construction elements as built, No. 78132	Sean Doran, BRE	2000
Thermal transmittance of walls of dwellings before and after application of cavity wall insulation No. 222077	Sean Doran, BRE	2008

Appendix C – Derivation of local authority

The Living in Wales dataset and the Scottish House Condition Survey dataset record the local authority for each property included in the survey. This is not the case for the English Housing Survey which only gives the government region.

To estimate numbers of random stone dwellings and dwellings with partial cavity walls we had to know number of samples in a particular local authority.

To do this the number of actual dwellings per local authority was taken, used to calculate the relative size of that local authority within its government region.

For example: If a government region contained two local authorities, one local authority with 40% of the government region dwellings and the other local authority with 60% of the dwellings. The samples in EHS would be split using the same ratio. Using this method the distribution of samples in EHS will be consistent with the number of actual dwellings in each local authority.

Appendix D – Local authorities that typically use stone construction

The table below identifies local authorities that typically use stone, not brick, for building construction. The table is based on the areas defined by the BGS[6] as typically using stone construction.

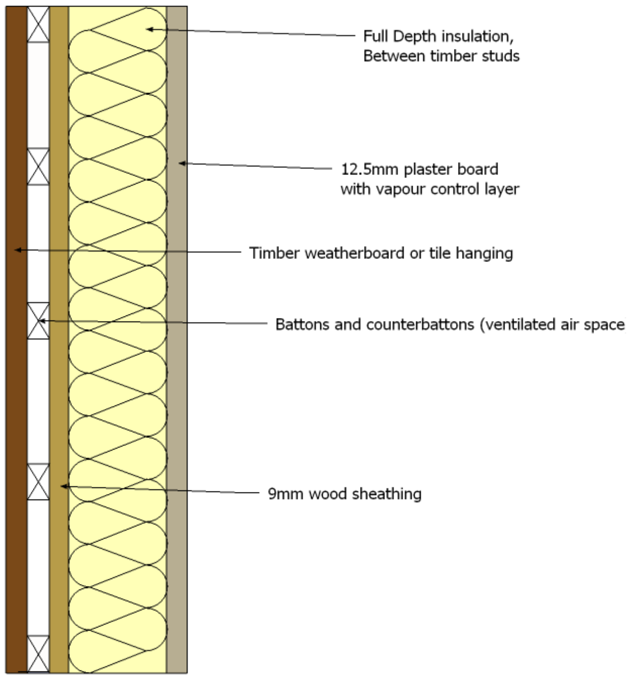
Amber Valley	East Lindsey	North Wiltshire
Bolsover	Erewash	Poole
Boston	Forest of Dean	Purbeck
Bournemouth	Gloucester	Richmondshire
Bradford	Harrogate	Salisbury
Calderdale	High Peak	South Derbyshire
Cheltenham	Kennet	South Holland
Chesterfield	Kirklees	South Kesteven
Christchurch	Leeds	Stroud
Cotswold	Lincoln	Swindon
Craven	North Dorset	Tewkesbury
Derbyshire Dales	North East Derbyshire	Wakefield
East Dorset	North Kesteven	West Dorset
		West Lindsey

[6] BGS, Mineral planning factsheet, Building and roofing stone

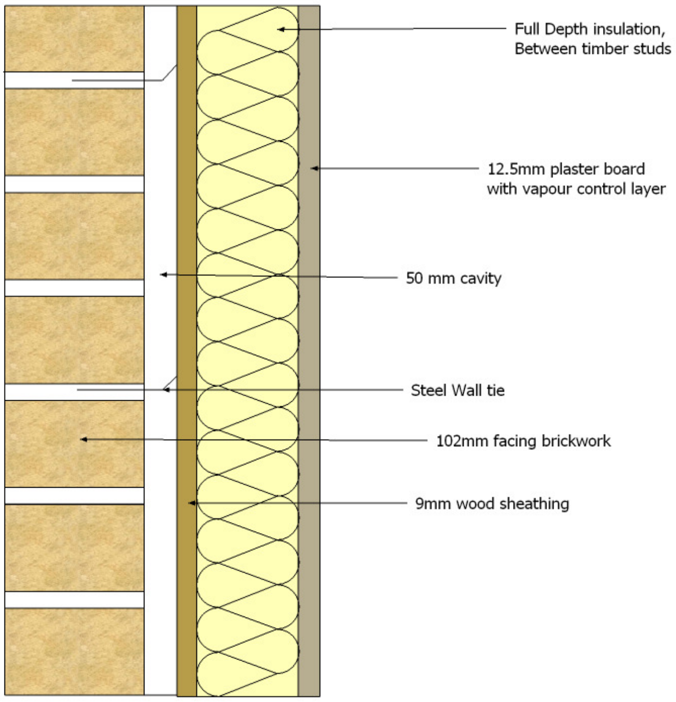
Appendix E – Timber frame construction diagrams

The two diagrams below show diagrams for the two main types of timber frame construction: with and without masonry cavities. The uninsulated equivalents are identical apart from their lack of insulation.

Timber frame, insulated studwork (no masonry cavity)



Timber frame, insulated studwork (with masonry cavity)



Appendix F – Assumed U-values for different wall types

The table gives the assumed wall values for each type of wall. The unfilled values are taken from the 2010 DECC report. The filled values were calculated assuming that each cavity could be fully filled with a substance with a thermal conductivity of 0.040 W/mK

	Unfilled	Filled
Concrete	1.427	0.596
Narrow cavity	1.693	0.666
Partial Cavity	0.464	0.36
Random Stone Cavity Wall	1.083	0.855
Lath and Plaster	1.158	0.816
Timber frame cavity (filled between the studwork)	1.129	0.383
Timber frame cavity (masonry cavity, unfilled studwork)	1.129	0.311
Timber frame cavity(masonry cavity, filled studwork)	0.383	0.269

Appendix G – Carbon Savings by dwelling type ($kgCO_2/yr$)

The table below gives the carbon savings from insulating a single dwelling of a specific dwelling type and specific wall type. The carbon savings were calculated using SAP 2009.

	Concrete	Narrow cavity	Partial Cavity	Random Stone Cavity	Lath and Plaster cavity	Timber frame (unfilled studwork, no masonry cavity)	Timber frame (unfilled studwork and masonry cavity)	Timber frame cavity (masonry cavity, filled studwork)
Bungalow	545	288	68	149	224	489	536	75
Detached	871	461	109	239	358	781	857	119
End terraced	711	376	89	195	292	638	699	98
Purpose built flat, high rise	220	117	28	60	91	198	217	30
Converted flat	258	136	32	71	106	231	254	35
Purpose built flat, low rise	344	182	43	94	142	309	339	47
Mid terrace	314	166	39	86	129	282	309	43
Semi detached	511	271	64	140	210	459	503	70

Appendix H – Modelled dwelling types

The following graphics give the inputs used to model each type of dwelling. U-values were changed depending on the assumed wall type.

Bungalow

Data Input Report

Design - Draft

NHER

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	Bungalow		
Built form:	Semi-detached	Year built:	1975
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m²)	Height (m)
Lowest occupied	81.00	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m²)	Area (m²)	U-value (W/m²K)
Floor 1	Ground	Solid	Lowest occupied	20.25	81.00	0.66

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m²)	U-value (W/m²K)
Wall 1	External	Cavity	86.95	0.10
Wall 2	Party	Solid	100.00	0.00

Roofs

Name	Construction	Gross Area (m²)	U-value (W/m²K)
Roof 1	Pitched (rafters)	81.00	2.30

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	16.78	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.72	U-value (W/m²K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	0	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known
Type:	Boiler	Efficiency source:	SAP table

URN: detbung1strgar version 3
NHER Plan Assessor version 5.4.0
Page 1
SAP version 9.90

Product index:	N/A		
Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	No	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Detached House

Data Input Report

Design - Draft

NHER

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	House		
Built form:	Detached	Year built:	1920
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	0	Terrain:	Low Rise U/S

Storeys:

Name	Area (m^2)	Height (m)
Lowest occupied	70.51	2.40
+1	70.50	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m^2)	Area (m^2)	U-value (W/m^2K)
Floor 1	Ground	Solid	Lowest occupied	17.63	70.51	0.69

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m^2)	U-value (W/m^2K)
Wall 1	External	Cavity	168.61	0.10

Roofs

Name	Construction	Gross Area (m^2)	U-value (W/m^2K)
Roof 1	Pitched (rafters)	70.51	0.40

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	24.02	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m^2K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	1	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known
Type:	Boiler	Efficiency source:	SAP table

URN: dethse2stry version 2
NHER Plan Assessor version 5.4.0
SAP version 9.90

Product index:	N/A		
Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	N/A	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification: Default y value — y-value: 0.15

Internal lighting

Standard fittings: 0 — Low energy fittings: 7 — Total fittings: 7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Data Input Report
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	Bungalow		
Built form:	Semi-detached	Year built:	1965
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m²)	Height (m)
Lowest occupied	34.66	2.40
+1	34.66	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m²)	Area (m²)	U-value (W/m²K)
Floor 1	Ground	Solid	Lowest occupied	8.67	34.66	0.73

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m²)	U-value (W/m²K)
Wall 1	External	Cavity	83.19	0.10
Wall 2	Party	Solid	1.00	0.00

Roofs

Name	Construction	Gross Area (m²)	U-value (W/m²K)
Roof 1	Pitched (rafters)	34.66	2.60

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	17.24	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m²K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	0	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known

URN: semidet2stry version 2
NHER Plan Assessor version 5.4.0
SAP version 9.90

Type:	Boiler	Efficiency source:	SAP table
Product index:	N/A		
Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	No	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Data Input Report
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	Flat		
Flat type:	Top floor	Year built:	1980
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m²)	Height (m)
Lowest occupied	53.54	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m²)	Area (m²)	U-value (W/m²K)
Floor 1	Ground	Solid	Lowest occupied	13.39	53.54	0.63

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m²)	U-value (W/m²K)
Wall 1	External	Cavity	54.05	0.10

Roofs

Name	Construction	Gross Area (m²)	U-value (W/m²K)
Roof 1	Pitched (rafters)	53.54	1.50

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	9.80	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m²K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	0	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known
Type:	Boiler	Efficiency source:	SAP table
Product index:	N/A		

Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	N/A	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

High rise flat

Data Input Report
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	Flat		
Flat type:	Top floor	Year built:	1925
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m^2)	Height (m)
Lowest occupied	45.50	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m^2)	Area (m^2)	U-value (W/m^2K)

Living area that has no heat loss: 11.40

Walls

Name	Type	Construction	Gross Area (m^2)	U-value (W/m^2K)
Wall 1	External	Cavity	35.27	0.10

Roofs

Name	Construction	Gross Area (m^2)	U-value (W/m^2K)
Roof 1	Flat	45.50	2.30

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	7.63	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m^2K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	0	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known
Type:	Boiler	Efficiency source:	SAP table
Product index:	N/A		

URN: hrflat3wall version 2
NHER Plan Assessor version 5.4.0
SAP version 9.90

Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	No	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Mid Terrace

Data Input Report

Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	House		
Built form:	Semi-detached	Year built:	1975
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m²)	Height (m)
Lowest occupied	34.35	2.40
+1	34.34	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m²)	Area (m²)	U-value (W/m²K)
Floor 1	Ground	Solid	Lowest occupied	8.59	34.35	0.55

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m²)	U-value (W/m²K)
Wall 1	External	Cavity	46.39	0.10
Wall 2	Party	Solid	1.00	0.00

Roofs

Name	Construction	Gross Area (m²)	U-value (W/m²K)
Roof 1	Pitched (rafters)	34.35	0.40

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	12.50	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m²K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	1	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known

URN: midterr2stry version 2
NHER Plan Assessor version 5.4.0
SAP version 9.90

Type:	Boiler	Efficiency source:	SAP table
Product index:	N/A		
Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	N/A	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Data Input Report
Design - Draft

NHER

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	Bungalow		
Built form:	Semi-detached	Year built:	1985
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m²)	Height (m)
Lowest occupied	36.90	2.40
+1	36.90	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m²)	Area (m²)	U-value (W/m²K)
Floor 1	Ground	Solid	Lowest occupied	9.23	36.90	0.71

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m²)	U-value (W/m²K)
Wall 1	External	Cavity	96.07	0.10
Wall 2	Party	Solid	1.00	0.00

Roofs

Name	Construction	Gross Area (m²)	U-value (W/m²K)
Roof 1	Pitched (rafters)	36.90	0.68

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	14.26	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m²K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	1	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known

URN: endterr2stry version 2
NHER Plan Assessor version 5.4.0
SAP version 9.90

Page 1

Type:	Boiler	Efficiency source:	SAP table
Product index:	N/A		
Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	N/A	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Data Input Report
Design - Draft

NHER

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr William Wright	Assessor number	1
Client		Last modified	15/11/2011
Address	1 1, 1, 1		

Dwelling

Property type:	Flat		
Flat type:	Top floor	Year built:	1985
Tariff:	Standard	Assess summer overheating:	Yes
Thermal mass:	Medium	Thermal mass parameter:	250.00
Separated heated conservatory:	No	Degree day region:	Thames
Sheltered sides:	2	Terrain:	Low Rise U/S

Storeys:

Name	Area (m²)	Height (m)
Lowest occupied	48.00	2.40

Floors

Name	Type	Construction	Storey Location	Living Area (m²)	Area (m²)	U-value (W/m²K)
Floor 1	Ground	Solid	Lowest occupied	12.00	48.00	0.49

Living area that has no heat loss: 0.00

Walls

Name	Type	Construction	Gross Area (m²)	U-value (W/m²K)
Wall 1	External	Cavity	35.79	0.10

Roofs

Name	Construction	Gross Area (m²)	U-value (W/m²K)
Roof 1	Pitched (rafters)	48.00	0.68

Openings

Opening Ref: 1 Window, Double glazed (low-E), ' All Glazing', master: No, linked to: 0

Location:	Wall 1	Source:	From Manufacturer	Orientation:	West
Overshading:	Average / Unknown	Width (m):	6.40	Height (m):	1.00
Frame:	u-PVC	Transmittance factor:	0.76	U-value (W/m²K):	2.30

Ventilation

Air permeability entered:	No	Draught lobby:	N/A

Number of...	Open fireplaces	Open flues	Flueless gas fires	Extract fans	Passive vents
	0	1	0	1	1

Mechanical ventilation: Not present (natural)

Space heating

Main heating category:	Individual system/s	Number of systems:	1
Secondary heating:	No	Open flue or chimney:	No
Unconnected gas point:	N/A	Smoke control area:	Not known
Type:	Boiler	Efficiency source:	SAP table
Product index:	N/A		

URN: lrflat2wall version 2
NHER Plan Assessor version 5.4.0
SAP version 9.90

Product details:	N/A N/A N/A		
Boiler type:	Regular	Fuel:	Mains gas
Condensing:	Yes	Flue type:	Open
Fan assisted flue:	Yes		
System:	Condensing with automatic ignition (1998 or later)		
Controls:	Programmer, room thermostat and TRVs		
Interlock:	Yes	Delayed start thermostat:	No
Compensation:	None	Burner control:	On/off
Emitter:	Radiators	Pump in heated space:	Yes

Water heating

Type:	From main	Fuel:	Mains gas
Water separately timed:	No	Water use ≤125 litres/person/day:	No
Heat pump uses immersion:	N/A	Summer immersion:	N/A
Thermal store type:	None		

Store details:

Cylinder volume (litres):	160.00		
Insulation type:	Jacket	Insulation thickness (mm):	100
Thermostat:	N/A	In heated space:	Yes
Primary pipework insulated:	Yes		

Renewables

No renewables present

Other

Thermal Bridging

Thermal bridge specification:	Default y value	y-value:	0.15

Internal lighting

Standard fittings:	0	Low energy fittings:	7	Total fittings:	7

Summer overheating

Thermal mass parameter (TMP):	250.00		
User defined air change rate:	No	Air change rate (ach):	N/A
Cross ventilation on most floors:	Yes	Window ventilation:	Fully open half the time
Source of user defined values:	N/A		
Curtains closed in daylight hours:	Yes	Fraction curtains closed:	1.00
Blind/curtain type:	Dark-coloured curtain or roller blind		

Special features (Appendix Q)

No Appendix Q special features present

Cooling details

No space cooling present

Contact details

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DECC URN: 12D/028