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Looking Critically at Heat Loss through Party Walls

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Abstract: Heat loss through party walls to outside (not the neighbouring dwelling) has received considerable attention in the UK, and this was flagged as a serious omission from the UK Building Regulations in 2010-12. There was evidence of significant heat loss between adjoined terraced or semi-detached new homes, which was increasingly important as heat loss from other parts of dwellings was being reduced. As a result, Building Regulations were changed so that other parts of the building envelope had to be improved in new homes to compensate for heat loss through the party wall. However, this empirical work based on measuring heat loss through the party walls of 55 UK dwellings indicates that fears about high heat loss through party walls may have been exaggerated. While a minority of dwellings (less than 10%) do suffer from a "thermal bypass" through the party wall, for the vast majority of existing homes with party walls, heat loss through the party wall is minimal. There may be a case for revising UK Building Regulations to reflect this new evidence, and for re-directing the efforts aimed at reducing heat loss through party walls towards other opportunities to improve the energy efficiency of dwellings.

Keywords: party wall; heat loss; thermal bypass; building regulations

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1. Introduction

'Party walls' are walls between adjacent homes in a terrace or two semi-detached houses. They are a potential route for heat exchange between dwellings and also to the outside. It is only the heat loss to outside that concerns us here.

The construction of these walls between homes in the UK has evolved over time. Nearly all party walls constructed in the UK before 1945 are solid. From 1945 to 1965, some homes have solid and others cavity party walls, but when the party wall is constructed from blockwork, cavities appear to dominate. From 1965 onwards, to reduce noise from one home to the next, party walls were typically of cavity construction. Typically, the cavities were built 50 to 80 mm wide. The first UK-wide Building Regulations [1], published in 1965, and the revised set in 1972, allowed three forms of construction for party walls:

- solid brick or blockwork party walls, with mass of at least 415 kg/m^2
- a cavity of at least 50 mm, with two leaves of brick or block with mass of at least 415 kg/m^2, or
- a cavity of at least 75 mm, with two leaves of lightweight concrete with mass of at least 250 kg/m^2.

The distinction between cavity and solid party walls is significant not only for acoustic reasons, but also thermally. Past work by Leeds Beckett University [2–4], identified a 'thermal bypass' through cavity party walls, where warm air passed by convection and stack effect up through the cavity, so avoiding even high levels of insulation in the floor, walls and roof of modern homes. A major benefit of the cavity in this type of party wall is that it is relatively economical, and straightforward, to insulate—in a similar way to external cavity-wall insulation. Past research has recommended carrying out this type of intervention as a way to save energy and so help to meet the UK's carbon reduction targets.

Cambridge Architectural Research, Leeds Beckett University and Bridgewater Surveyors worked jointly together to carry out detailed measurements of heat loss through party walls in English homes for the UK Government's Department of Business, Energy and Industrial Strategy (BEIS). The aim of this work was to improve understanding of heat loss through party walls in existing homes, and to understand the range and distribution of party-wall heat loss in different types of dwelling and built with different types of party-wall construction. Essentially, the Government needed more evidence to decide whether adding insulation to cavity party walls is a worthwhile intervention to support.

Over the course of two winters, we collected and analysed data from 284 sets of equipment, installed in 54 homes with uninsulated cavity party walls. We also carried out 'invasive' measurements where we drilled holes in the party walls of five dwellings, measuring air velocities, and used blower doors and smoke generators to examine air paths exiting the party walls.

This paper describes our sampling, how we carried out measurements, and the new and innovative methods we used for analysing these measurements. It also summarises findings from all of the homes we instrumented, as well as the statistical work we carried out using planning applications.

1.1. History of Party Walls in the UK

The construction of party walls in the UK evolved over time, and quite likely geographically, as a result of local by-laws introduced as a result of the Local Government Act of 1858, which gave local authorities the power to regulate buildings. Local builder preferences very likely also played a part in how party walls were constructed in different areas. Earlier solid party walls do not bring the risk of thermal bypass through walls such as cavity party walls. Nor do such walls offer potential for insulating a cavity. When the party wall is constructed from blockwork—in more recent construction—cavities appear to dominate.

There is nothing in the 1972 Building Regulations about capping party walls or different party wall construction above the joists in the loft. However, a cavity wall to the level of these joists, capped with a single-skin brick wall above, would have been more economical to build than either a full-height cavity or a heavyweight solid wall.

1.2. Literature Review

Previous work carrying out in-situ U-value measurements (which quantify the rate of heat transfer through a structure, measured in Watts per square meter per Kelvin of temperature difference between inside and outside the structure, W/m^2K) had indicated that the U-value near the edges of a cavity party wall can be as much as 0.9 W/m^2K—significantly higher than the U-value of an insulated external cavity wall [5].

The prospect of a new opportunity for the Government to intervene to encourage a different method of insulating homes is all the more significant now that most homes with easy-to-treat external cavity walls have already insulated them, and most homes with inadequate loft insulation (say less than 100 mm) and accessible lofts have also already had top-up insulation fitted.

Leeds Beckett University (LBU) carried out research of heat loss from cavity party walls from 2003 onwards, including the Stamford Brook field trial of newly-constructed dwellings. This identified significant heat losses via party-wall cavities (thermal bypasses) in new-build terraced and semi-detached masonry houses, and proposed various techniques to measure, eliminate or minimise the effect.

In 2008, MIMA (the Mineral Wool Insulation Manufacturers' Association) commissioned LBU to quantify thermal bypass in more detail, and to evaluate whether insulating the party-wall cavity with mineral wool would eliminate or significantly reduce this [6]. LBU and MIMA continued this work, investigating different layouts and construction types, and expanding from new build dwellings to existing dwellings with cavity party walls.

The Stamford Brook field trial [2,3] measured the energy performance of dwellings, comparing designed energy efficiency against actual building fabric efficiency once the homes were built. Whole house heat-loss measurements of dwellings were conducted, and initial results showed the greatest disparities between designed and actual fabric efficiencies in mid-terraced dwellings. The gaps were narrower (but still significant) for end-terraced and semi-detached dwellings.

Whole house fabric tests included 'co-heating' tests (based on maintaining constant even and elevated temperatures in empty homes, for up to three weeks, using fan heaters and fans), with and without cavity socks in the party wall.

The effective U-values with the socks in place were estimated at 0.18 and 0.26 W/m^2K, and with the sock removed, these rose to 0.63 and 0.50–0.64 W/m^2K, respectively. Earlier work by LBU, which included blowing insulation into the party wall and using heat flux sensors, indicated that filling the party-wall cavity reduced the effective U-value of the party wall by 0.66 W/m^2K. Fully insulating the cavity effectively stopped any thermal bypass through the party wall [4].

Another early paper using data from Stamford Brook [7] drew parallels between heat loss through cavity party walls and similar convective heat loss at the Twin Rivers Project in the US. The authors proposed straightforward construction methods to reduce or prevent this type of heat loss, including using mineral-fibre insulation in the cavity or using a cavity closer within the wall, at the level of the roof insulation. They also proposed changes to the UK's Building Regulations—now implemented—to encourage housebuilders to use these methods when building new homes. However, they did not consider how heat loss through party walls affects older dwellings, built using traditional wet-plaster techniques.

A subsequent paper [8] took the specific issue of infiltration into the party wall to form a generalized critique of the way air permeability testing is used in UK Building Regulations. This paper did not have any real-world measurements, but instead used modelling of two house types (flats and terraced houses) located in 14 different UK cities. The work found that overall infiltration rates assumed in UK Building Regulations for new homes were significantly lower than actual infiltration in cases where party walls were permeable—where gaps in construction and in the party-wall cavity allowed air into and out of the party wall.

Turning to international research, further modelling research, focused on homes in Jordan [9], assumed 'adiabatic' party walls—i.e., with no heat loss into or from the party wall. This may hold true for party walls in Jordan, but it does not apply to cavity-party walls in the UK.

A Canadian Masters dissertation [10], concentrating on dwellings in Toronto, examined how infiltration through the party wall contributes to overall infiltration in different ages of buildings. This work included measurements of air leakage in 47 terraced and semi-detached dwellings. It found that older 'Century' homes (built from 1890–1920) had a much lower proportion of total infiltration attributable to party walls than modern dwellings: 22% of infiltration in Century homes versus 38% in modern ones.

Belgian research reported on three co-heating tests used to estimate heat-loss coefficients of vacant dwellings with party walls [11]. The findings were somewhat inconclusive, due to the small sample, but the authors recommended using heat-flux sensors on party walls to correctly account for heat passing between neighbouring properties connected by party walls. They did not identify thermal bypass through the party wall—perhaps because their sample dwellings did not have cavities in the party walls.

J B Siviour's work in the 1990s [12] is the earliest published research investigating heat loss through party walls. This was a subset of Siviour's work, which also examined heat loss through internal and external walls. Similar to this paper, Siviour took measurements to estimate U-values in occupied homes, and he found higher-than-predicted heat loss through all three types of wall. The relatively high heat loss was attributed to thermal bridging, high thermal conductivities (i.e., U-values), and excessive air movement within the walls.

The principal conclusion of this paper is that past research over-estimates the potential energy and carbon-saving potential from insulating cavity-party walls in existing UK homes. Our work suggests that mean savings from older homes, built using traditional wet plaster methods, are no more than 0.21 W/m^2K.

2. Materials and Methods

Participant households were recruited into the study using different methods. We contacted five housing associations, advertised through local environmental groups and large employers, put leaflets through doors of dwellings built in targeted periods, approached local homeowners by word-of-mouth, and advertised through social network sites including Facebook.

We offered cash incentives of £100 to the 'main' dwelling (which required unsightly instrumentation over a one-month period), and a £50 incentive to the neighbouring dwelling (the other side of the party wall, where smaller and more discreet instrumentation was needed, also for one month).

We carried out some pre-filtering of dwellings, by asking only households living in homes built from 1945 to 2010 to volunteer. In most cases, there was some dialogue by telephone or email before participants were recruited. This included a discussion of the party wall construction, but in most cases, households did not know whether their homes had cavity-party walls.

Before measurements could be undertaken in any of the dwellings, we had to ensure they had cavity-party walls. Our prior work suggested that approximately half of homes built from 1945 to 2010 had cavity party walls (either capped or full-height cavities). This meant we had to over-sample the recruitment to be sure of acquiring enough cases to instrument.

In most but not all cases, it was possible to identify the party wall construction from the loft: the brick pattern in the loft often showed whether the wall was solid or cavity construction. In other cases, a capped cavity could be definitively identified by examining the junction between the loft party wall and the party wall in the occupied part of the dwelling (below the joists). In these cases, there was a clear step from the single-skin wall in the loft to a wider cavity wall below the joists.

2.1. Installing Measuring Equipment

In all cases, before installing measuring equipment, we inspected each home and obtained the owner's consent to carry out research. The inspection included entering the loft and definitively identifying which type of party wall was involved, then, in each case, we also carried out a thermographic survey of each side of the party wall (including the loft) to provide qualitative evidence for any existing thermal bypass. The survey was also used to identify areas suitable for U-value measurement.

We further undertook a survey of the neighbouring dwelling to identify the locations of radiators, cookers, and other heat emitters, which could compromise U-value measurements. Subsequently, we installed the following monitoring devices:

- Three to five Hukseflux HFP01 heat flux plates (HFPs) installed on each party wall in areas away from heat sources. We installed the HFPs in the middle third of the party wall vertically, and 300 mm away from external walls, to avoid extreme measurements from thermal bridging at the edges of the wall. We recorded heat flux density at 10-min intervals using Leiderdorp LI19 battery-powered data loggers.
- Surface thermocouples (TinyTag TGU-4510s, with integrated thermistor probes) adjacent to each heat flux plate, providing a record of air and wall-surface temperatures immediately next to each heat flux plate.
- One to four air temperature sensors in the neighbouring home, installed as described below.
- Externally, a TinyTag weather station encased in a Stevenson screen, mounted 1.5 m off the ground, where possible at least the height of the nearest building horizontally away from that building.

We left all measurement equipment in place for at least three weeks. (Extended from the fourth set of installations of the first winter because feedback from the first sets of installs suggested a longer monitoring period would be beneficial. We also switched from one temperature sensor in the neighbouring dwelling, installed in a representative location to using additional temperature sensors, as close as possible to the wall opposite the heat-flux plates in the main house. Again, analysis of the first two sets of installs suggested this would help to improve the reliability of measurements).

2.2. Invasive Measurements

'Invasive' measurements were also carried out in five homes where we had consent to drill holes into the party wall and, in some cases, to remove skirting boards and carpets to inspect the party wall-floor junctions.

Based on learning from the first winter, we used a 'five-on-the-dice' distribution (one central location and four towards each of the corners) across the party wall of all invasive study homes. This was in order to take a representative range of measurements including extreme values (likely to be near junctions between the party wall and external walls or close to the interface with the ground floor or the top-floor ceiling) as well as less extreme values (likely around the middle of the party wall, where there is likely to be a weaker link to outside).

In five of the 'Invasive' houses, in addition to inspecting the party wall-floor junctions, we were able to carry out pressurisation and smoke tests and identify the main areas of air leakage. On five occasions (three invasive houses, and two others), we were also able to install flux plates on the other side of the party wall also, which gave the opportunity to log heat loss from both sides of the party wall.

We also drilled two 16 mm holes into the party wall at different locations (ground floor, first floor, and front and back) and inserted hot-wire anemometers into the holes, to measure air velocity and direction. The anemometers were connected to Amazon Fire tablets using a Bluetooth connection.

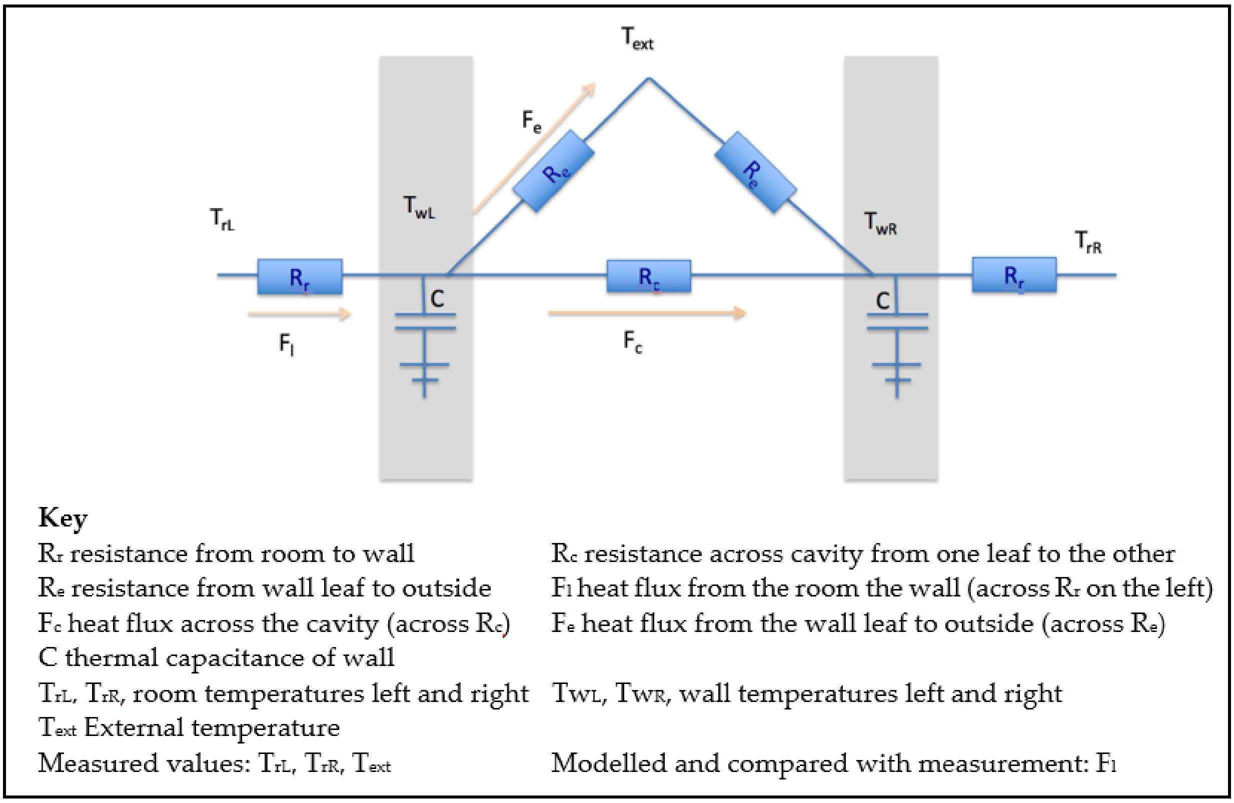
In addition, we installed a blower door to de-pressurise invasive test-houses temporarily and look for evidence of heat loss for half a day. We also carried out smoke tests, injecting smoke into the party wall, to identify obvious air pathways out of the party wall.

2.3. Analysis

Measurements alone cannot quantify heat loss through cavity party walls, because they need to be interpreted in combination—heat flux with surface, neighbour and external temperature—and because there is considerable noise in the data (due to temperature variations, lag effects, and heat moving in different directions). It is only with appropriate analysis that measurements become meaningful.

To determine the in-situ U-value (the accepted measure of thermal transmittance through a structure, in W/m^2K, where a lower U-value represents better insulation) for the cavity party wall, we developed a new mathematical model, based upon the measured heat flux density over time, and corresponding temperature conditions. The model has parameters including thermal resistance and capacitance, and we vary these until the model closely matches the measured heat flux.

Three thermal resistances are important: from the room to the wall, from one leaf of the party wall to the other leaf, and from the party wall to outside (see Figure 1 below). Each of these has corresponding heat flux (again, from room to wall, leaf to leaf, and from the wall to outside). The party wall also has thermal capacitance, and we consider the thermal capacitance of both leaves of the wall together. We used the model to calculate what the heat flux would be if the two homes were always at the same temperature, so there is no heat flux through the party wall, driven by differences in room temperature.



Key

R_r resistance from room to wall

R_c resistance across cavity from one leaf to the other

R_e resistance from wall leaf to outside

F_l heat flux from the room the wall (across R_r on the left)

F_c heat flux across the cavity (across R_c)

F_e heat flux from the wall leaf to outside (across R_e)

C thermal capacitance of wall

T_{rL}, T_{rR}, room temperatures left and right

T_{WL}, T_{WR}, wall temperatures left and right

T_{ext} External temperature

Measured values: T_{rL}, T_{rR}, T_{ext}

Modelled and compared with measurement: F_l

Figure 1. A mathematical model was used to calculate heat flux when dwellings on either side of the party wall are the same temperature.

We assume that the two sides of the cavity wall are symmetrical in terms of same thermal resistance and capacitance, though not temperatures, as each house has a different heating regime. We ignore the capacitance of the air gap as this is very small. We know the room temperatures and external temperature T_{ext}. We used the model to estimate resistances (R_r, R_e and R_c) and thermal capacitance (C). Then we calculated the in-situ U-value, as the reciprocal of the resistances:

$$U_e = 1/(R_r + R_e).$$

To test each set of parameters, we ran the model to see what the heat flux density would be and compared this with the measured value. To run the model, we worked in short time steps (10 min). We estimated the initial temperatures of the walls (T_{WL} T_{WR}) and then at each step used the temperatures to estimate the heat-flux density and then the heat flux to estimate the new temperatures. Hence each run gave a sequence of values for the wall temperatures and, importantly, the heat-flux density. We optimised the parameters (thermal capacity, resistances and initial wall temperature) to acquire the best fit for flux using the least squares error method.

In practice, we use the wall surface temperature rather than room temperature where it is known, because it is more reliable. We then applied an adjustment to allow for the surface resistance:

$$0.13\ m^2K/W.$$

$$F_l = (T_{sl} - T_{WL})/(R_r - 0.13)$$

There were 15 cases (out of 284) where optimisation did not converge on a clear best fit set of parameter values, and these were excluded from the analysis and findings. It is possible these failed because of structural factors that meant our assumption that the two sides of the wall were symmetric was not valid for these cases.

2.4. Analysing Planning Drawings

Alongside our physical measurements, we examined planning applications submitted since 1980 for homes in Cambridge, Welwyn-Hatfield, Leeds and Manchester in considerable detail to establish what proportion of homes built in different decades had cavity party walls. This required us to interrogate large numbers of planning applications in electronic databases and as hard copies in the planning departments of the respective planning authorities, and inspect many different drawings of each site or dwelling.

In many cases, the party walls were not drawn clearly enough to show the wall construction in planning drawings, so although we examined planning applications for more than 2000 new homes in total (all of the available drawings still held in the planning authorities' archives), the party-wall construction was only visible in 1076 cases, see Table 1 below. There are regional variations between the planning applications we viewed (for example, many times more common to have cavity party walls in Welwyn-Hatfield and Cambridge, but a roughly even split between cavity and solid party walls in Manchester), so we would not suggest that these proportions are nationally representative. The higher prevalence of cavity party walls in the South may suggest that there are proportionately more such dwellings in the South than in the North (indicating greater potential for insulating cavity party walls in the South), but just four planning authorities provide insufficient evidence to be sure of this.

Table 1. Evidence from planning drawings since 1980 suggests that many more homes with party walls have cavities in the party wall.

Planning Authority	Party Cavity Wall	Solid
Manchester	35	32
Leeds	55	28
Welwyn-Hatfield	636	57
Cambridge	191	42
Total	**917**	**159**
	85%	15%

Our sample is also skewed towards homes built more recently—since 2010—because the drawings for these more modern homes are more commonly accessible online than older homes. No planning drawings were available for any home built prior to 1980, and it is possible that the proportion with cavity party walls is different among homes built from 1940 to 1980.

3. Results

Broadly, the findings from this research are of two types. First, evidence about the number of homes with cavity-party walls that could potentially be insulated economically. This helps to understand the number of homes where there is potential for retrofit measures, which could subsequently save energy and reduce carbon emissions. Second, evidence about the actual heat loss through party walls of different types—which helps to quantify what savings could be realised if large numbers of homes have their party walls upgraded.

We begin this section of the paper by reporting findings about the number of homes with different types of party wall.

3.1. How Many Homes Have Cavity-Party Walls?

Viewed logically, most house types apart from detached homes could have one or more party walls. The English Housing Survey [13] tells us there were 12.3 million terraced dwellings in 2016–2017, 11.3 million semi-detached dwellings, and almost 8 million flats. This compares to 7.9 million detached dwellings. This suggests that close to two-thirds of all homes in England have party walls.

However, only a proportion of these properties have cavity party walls. The English Housing Survey does not record whether dwellings have solid or cavity party walls.

However, the recent planning drawings referred to in the previous section suggested that the majority (perhaps as much as 85%) of homes built since 1980 have cavity party walls. Our inspections of planning drawings also indicated regional disparities in the proportion of recent homes built with cavity party walls—92% in Welwyn and Hatfield, compared to just 52% in Manchester.

It is entirely possible that local preferences, largely driven by volume house-builders and standardised housing designs, dictate whether party walls are solid or have cavities (both are permitted under current Building Regulations, although solid party walls are required to use heavy-weight blocks or bricks to achieve acoustic separation between neighbouring dwellings).

Overall, our sample included more terrace homes than other house types (see Table 2 below). We recruited as widely as possible, with no bias towards any specific dwelling type, age, or construction type, and we instrumented all homes with cavity party walls whose occupants and neighbours agreed to participate. However, the final sample over-represents terraces and under-represents semi-detached houses and flats, compared to national totals. A majority of them (29) were full-height cavity party walls, with the cavity extending all the way to the ridge of the roof, with no cap. Next most common were full-height cavities capped with bricks where the wall meets the roof (15). Least common were cavities capped at the roof joists (9), where there is just a single-skin, solid brick wall in the lofts of adjacent properties.

Table 2. Dwelling types of instrumented homes, compared to national proportions.

Dwelling Type	Number	Proportion of National Housing Stock *
Semi-D	15	25%
Mid-terrace	33	20%
End terrace	4	10%
Bungalow	1	9%
Flat	1	21%
Detached	-	17%
Total	**54**	**100%**

* Source: MHCLG (2018) English Housing Survey 2016-17, Table 2.1. London: MHCLG.

Our modest sample of 110 dwellings in the North and South of England where the loft was inspected to identify the party-wall type is unlikely to be representative of all homes in England. However, in the absence of any stronger evidence, and factoring up to all homes in England with party walls (i.e., excluding detached homes, using data from the English Housing Survey), this suggests that in the region of 7.3 million dwellings may have the potential for insulating the party wall cavity. (The remaining 7.3 million—coincidentally the same number—have solid party walls that cannot easily be insulated, and where heat loss through the party wall is lower).

3.2. Estimated U-Values

Overall U-values were estimated based on 284 measurements (comprising heat-flux density, surface temperature and neighbour temperature data) taken across 54 homes.

The simple mean across all instrumented homes came out at 0.20 W/m^{2}K (95% confidence interval between 0.153 and 0.25). For homes with uninsulated cavity party walls the mean was 0.21 W/m^{2}K (0.16 to 0.26). The highest average value for a property was 0.81 W/m^{2}K (0.72 to 0.90), for a bungalow with an uncapped full-height cavity in the party wall, cavity-wall insulation in the external walls, a suspended timber floor, and block cavity wall construction. There were three properties with in-situ U-value less than 0.01 W/m^{2}K. All three properties were terraces, all with full-height cavities capped at the ridge, all with blockwork party walls and solid concrete ground floors. Two of these also had retrofit party-wall insulation. (Two of only four homes in the study that had insulated party walls).

It is possible that there is correlation between the in-situ U-value and whether the party cavity was full-height (open at the ridge) or capped (either at the ridge or at the loft joists). Of the 10 dwellings with the highest in-situ U-values, seven are full-height cavities, while of the 10 dwellings with the lowest in-situ U-values, seven were capped—either at the ridge or at the loft joists. However statistical analysis was inconclusive; perhaps because the sample size was small and the relationship is weak.

4. Discussion

Given that temperatures vary over time in real homes, and because heat moves between neighbouring dwellings as well as from inside to outside, U-values in real homes cannot be measured directly. The in-situ U-values presented in this paper were estimated through modelling based on detailed measurements taken in occupied homes.

Spot measurements of in-situ party wall U-values varied significantly from location to location even in the same dwelling. This indicates there are considerable local factors (including proximity to external walls, the floor, the roof, as well as construction anomalies such as mortar 'snots' and wall ties bridging the party cavity) that affect measured in-situ U-values. There was up to a four-fold difference between measured U-values in a single dwelling (from 0.3 to 1.3 W/m^{2}K). There were even larger differences between measured spot U-values in different homes (more than 100-fold).

For homes with un-insulated cavity-party walls, the mean was 0.21 W/m^{2}K. The highest average value for a property, from 284 measurements in total, was 0.81 W/m^{2}K, and this was a bungalow with an uncapped full-height cavity in the party wall, cavity-wall insulation in the external walls, a suspended timber floor, and blockwork cavity-wall construction. At the other end of the scale there were six properties with un-insulated party walls with an in-situ U-value less than 0.05 W/m^{2}K. These were a mixture of mid-terrace and semi-detached homes, with three different types of party cavity wall construction, with blockwork or brick party walls, and five of the six had solid concrete ground floors. This emphasises the finding, unknown previously, that the construction of the party wall is not a good indicator of its thermal performance.

These findings suggest that reductions in the U-value of the party wall of 0.66 W/m^{2}K, identified through previous research of new, modern homes, could not be achieved by insulating party-wall cavities in most older homes. Instead, this research of older existing homes with cavity party walls suggests that the mean saving would not be more than 0.21 W/m^{2}K. This means that the total potential saving in energy use, and potential carbon savings, from insulating cavity party walls in the UK is significantly lower than was understood previously.

The finding that heat loss through party walls is higher in modern than in older homes is consistent with the Masters dissertation from Toronto, Canada, cited in the Literature Review section of this paper [10]. Even though we would expect quite different construction methods in Canada from those in the UK, it is quite possible that Canada has also witnessed a move away from wet-plaster techniques towards dry plastering, with similar impacts on infiltration and heat loss through party walls.

The range of in-situ U-values is significant, indicating that overall party-wall heat loss from seemingly similar homes with cavity party walls may be four times greater in one than another—or even more if the home with a higher in-situ U-value has a larger party wall area. This means that the benefit of installing insulation in the party cavity can be four times or more beneficial from one home to another.

There was no statistically significant correlation between heat loss through the party wall and dwellings being located in the North or South of England, or different construction in terms of block or brick, floor construction, external cavity-wall insulation, or other characteristics that are discernible without carrying out detailed measurements. This suggests that other factors, including missing bricks or holes in the party wall, poor seals at the floor-wall, party wall-external wall and party wall-roof junctions, are more important than the construction type.

Using the mean in-situ party-wall U-values and taking the English Housing Survey average wall area for a semi-detached house (33 m^2) allows an approximate estimate of typical savings from insulating party walls. This suggests that insulating an average cavity party wall would bring savings in the region of 0.8% of gas use for a typical semi-detached property: from around 72 to 152 kWh a year, depending on the house, heating and controls. This compares with typical savings from cavity wall insulation (i.e., all external walls) of 6.5%, or from around 580 to 1240 kWh a year (based on actual reductions in gas bills analysed in the National Energy Efficiency Data Framework [14], and assuming typical gas use of 14,000 kWh a year).

We examined in detail the effect of wind speed on heat loss through the party wall in a subset of five dwellings. This did not support our hypothesis that higher wind speeds correlate to greater heat loss, which does not support the idea of prioritising interventions in dwellings in windy areas.

If the modest sample reported here is representative of the whole English housing stock, then there are around 7.3 million dwellings with potential for insulating party walls. This estimate should be treated with some caution, and the likely range is 6.6 to 8.0 million homes. The theoretical 'technical potential' from insulating all cavity party walls in England would be 0.5–1.2 TWh a year, if all UK homes with party-cavity walls were insulated.

Recommendations

Consider revising the U-value deemed scores in RdSAP (Reduced Data Standard Assessment Procedure, used to generate Energy Performance Certificates and in energy policy more widely for existing homes)—currently 0.5 W/m^2K for un-insulated cavity party walls, and 0.2 W/m^2K for insulated cavity party walls. [15] This indicates a saving of 0.3 W/m^2K in heat loss through the party wall, which is higher than the mean potential saving identified for existing dwellings in this paper: 0.2 W/m^2K.

The Government and house builders should not assume that heat loss through party walls is the same for all house types. It is likely that 'dry' construction methods (without wet plaster that usually blocks the air path into the party wall) results in greater heat loss into the party-wall cavity. This is significant, since these dry construction methods have almost completely replaced wet plastering in hew homes because it is faster and more economical to build. It is quite possible that heat loss through un-insulated party walls in new dwellings is much higher and similar to that estimated in past research.

We would recommend further research into heat loss through party walls in new homes, built using different types of dry construction (e.g., Structural Insulated Panels, solid and cavity party walls, with and without insulation), with samples that include different regions and housebuilders, and different countries of the UK (Scotland, Wales and Northern Ireland, as well as England). Future research should record gaps in party walls and/or poor seals at junctions at the top, bottom and sides of the party wall and incorporate this in analysis. This would help to quantify the relative importance of gaps and weak seals compared to the method of construction per se.

We would also recommend more work exploring the prevalence of wiring installed into the cavity in party walls. This makes insulating a party wall more complicated, and it is not easy to identify whether a dwelling could have cables running through the party-wall cavity. Further research aimed at diagnosing which dwellings could have such cavity—which could be just a small minority—would be extremely useful.

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