31st January 2024

April Cottage

18th Century Grade II listed retrofit project

Prepared By Clare Fenton

Veritherm

BACKGROUND TO THE PROJECT AND PROPERTY

April Cottage has at its core a small one and a half storey cottage which dates back to at least the mid 18th century. It has been much altered including a 19th century re-fronting and a large late 20th century extension which is itself of a similar size to the original cottage.

The property does carry grade II listed building which applies to the original one and a half storey cottage which was first listed 19th June 1991: HEREFORD AND WORCESTERSHIRE WESTON BEGGARED SOUTH HEREFORDSHIRE SO 54 SE SHUCKNALL HILL, SHUCKNALL 2/183 No. 110 II Cottage. Circa late C17 or early mid C18, refronted in circa late C19. Timber frame with plastered wattle panels, faced in red brick on south east front; on stone rubble plinth. Thatched roof with gabled ends. Stone rubble outshut with plain tile roof. Large stone stack at north east end with set offs and brick shaft.

Planning permission for the extension was originally given in December 1991 along with Listed Building consent. This was superseded with a further listed building consent dated April 1994. A completion certificate was issued in December 2007.

The present owners purchased this property with the aim of carrying out sympathetic upgrades and repairs to provide a family house that addresses the requirements of modern living.

There was a further goal to make this a pilot project and to collect data to inform the value of retrofit measures that could be applied in an affordable way without damaging the integrity of this old dwelling. Could the owners establish the current heat load of given spaces and provide insights where possible, striking a balance between modern energy efficiency demands and the preservation of the historical integrity? It is hoped that this initiative and the data collected will contribute to measures in reducing the property's energy consumption undertaken by others. Improving comfort for building occupants. Crucially, it is anticipated that this initiative will give a snapshot that can guide any future retrofitting and renovation strategies that align with the building's age and status and facilitate the move towards net zero by providing an accurate sizing of low-carbon heating solutions and solar generation requirements.

At the moment current methods of calculating heat loads would struggle to model and size a property of this nature and it would probably be deemed unsuitable. Also, it should be noted that although photovoltaics cannot be placed on the roof for obvious reasons, the property sits in a 2 acre plot with an area already identified for them.

RETROFIT MEASURES

The retrofit strategy relies on striking the right balance between thermal efficiency upgrade and adequate ventilation for a building of this age. The analysis of real measured data collected at the end of the first 4 phases of retrofit will allow for the sizing of a low-carbon heating system. This will inform the homeowner as to whether their home is ready for this type of heating system, or whether further remediation will be required. Improved thermal performance, resulting from thermal efficiency upgrades, can potentially reduce the required capacity of a low-carbon heating system. This approach not only diminishes the initial system costs but also ensures long-term operational cost savings. The goal is to select a heating solution that efficiently meets energy needs while avoiding the financial and performance limitations of an undersized system. Through this dual approach of demand-reducing upgrades and capacity-appropriate solutions, both economic efficiency and environmental responsibility can be achieved.

The current owners purchased the property in October 2017 with a view to undertake some necessary and some aesthetic upgrades to the property.

Phase 1 - **completed March 2018:**
Modernising electrics
Replacing Kitchen
Reconfigure and modernise Guest Suite with repairs to Bedroom, removal of wall, remove and replace ensuite and updated plumbing works.

The next phases of the property upgrade focused on the building fabric, particularly the upgrade of the thatched roof and the replacement of windows in the newer part of the building.

Before the next upgrade phases, the owners undertook a Measured Heat Loss Assessment to gain a baseline to measure any enhancements against. At this time they did not undertake air leakage tests.

Phase 2 - Repair and replacement of thatched roof - completed April 2022
The property has two independent thatched roofs, a survey confirmed that the ridge to both roofs required replacement along with the rear open aspect slopes of both roofs. The survey determined that the front aspects of both roofs, which are protected by the slope of the hill and wood to the rear of the property, only required repairs.
Following upgrades it was anticipated that the roofs would achieve a thickness of around 12 inches with a u-value of 0.35.

Post-completion the owners undertook a Measured whole house Heat Loss Assessment. The improvement was surprisingly small in comparison to expected. The improvements to the thatch were deemed necessary due to its age rather than for performance. The smaller-than-expected improvements were attributed to:
One open chimney
Single-glazed leaky windows and doors, particularly in the newer part of the house.

Phase 3 - Air leaks through the chimney
The property has two chimneys one located in the kitchen in the older part and the other in the living room in the newer part.

The fireplace in the kitchen houses a log burner resulting in the chimney being blocked off. The older part of the house tends to stay warmer than the newer part so this log burner is never used.

The fireplace in the living room remains open and is used during particularly cold spells, therefore, it wasn't practical for the owners to permanently block this chimney. Instead, the owners researched temporary measures to block a chimney and decided to trial a 'Chimella' when not in use. This method is not insulated so only addresses losses through air leakage.

The owners completed an Air Leakage Test before installing the Chimella and a Measured Heat Loss Test and air leakage test after.

It should be noted that the air test proved the home to be extremely leaky with particular issues to the windows and doors in the newer aspects of the property.

Phase 4 - window upgrades June 2023
Initially, the owners intended to replace all windows and doors. Due to listing constraints on the older part of the property, it was decided to concentrate on the windows and French doors in the newer aspect of the property first, along with one set of French doors to the dining room in the older side.

Replacement wooden windows were considered, but initial quotations were very high and the owners worried about the quality of installation, disruption, and redecoration. At this time the owners were introduced to another product 'Extraglaze magnetic secondary glazing'.

The system uses a specialist, lightweight, shatter-resistant acrylic material for the glazing panels. The panels are 3mm thick, edged with very slender, precisely polarised magnetic strips that automatically align themselves when removed and replaced. There are no frames as such.

The overall thickness of an installation is just under 8.5mm which includes the thickness of the magnets and adhesive. We were advised that a thicker panel would not add any significant improvement, and only increases the weight to be held by the magnets. For older windows, which commonly take a shape with the rest of the building, the 3mm thick panel is ideal, with enough flex to "mould itself" for a perfect seal.

The installation was quick and almost effortless, of a high standard and with minimum disruption. Prior to installation the owners did hold reservations about the aesthetics. Upon installation, the panels seemed invisible and made no difference to the original look of the property inside or out.

The install was completed in the summer and it was not practical to complete Measured Heat Loss Assessments at this time so this was delayed until January 2024.

WHAT IS MEASURED ENERGY PERFORMANCE?

Measured energy performance can be gained through measured heat loss tests and it is recommended they are accompanied by an air leakage test. This allows apportionment of the whole heat loss directly to air leakage or fabric heat loss. This will allow an asset owner to make a more informed decision as to best retrofit steps as necessary in a targeted and cost-effective way. In this project the client has used two different methods for measuring heat loss, however, one was deemed unsuitable due to electricity demands outside of the home (home office, greenhouse and hot tub).

HOW DOES IT WORK?

For the successful method used, in-situ measurements are performed with temperature sensors located around the house. The internal temperature of the property is elevated for 4-5 hours, and then allowed to cool passively. Our smart algorithms combine internal temperature data, external weather data, and energy data to calculate the heat loss score for the building. We also detect leaks and failures to help diagnose areas of weakness in the building fabric.

HOW DID APRIL COTTAGE PERFORM?

The table below reports the various retrofit measures and data collected before and after measures (where taken).

	Veritherm Measured HTC (W/K) Figure in brackets gives a Thermal efficiancy Rating (ThER)	Measured Air Tightness (m3/hr/m2 @50Pa)	Upgrade Measure
Phase 1 (2018)	N/A	N/A	Kitchen, Bathroom, Electrics, Plumbing Upgrades
Benchmark - (March 2022)	294.7 (2.7 Poor)	N/A	Benchmark
Phase 2 (June 2022)	288.4 (2.6 Poor)	20	Thatch
Phase 3 (Jan 2024)	286.2 (2.6 Poor)	17	Block Chimney
Phase 4	256.2 (2.3 Poor)	14	Magnetic Secondary Glazing System

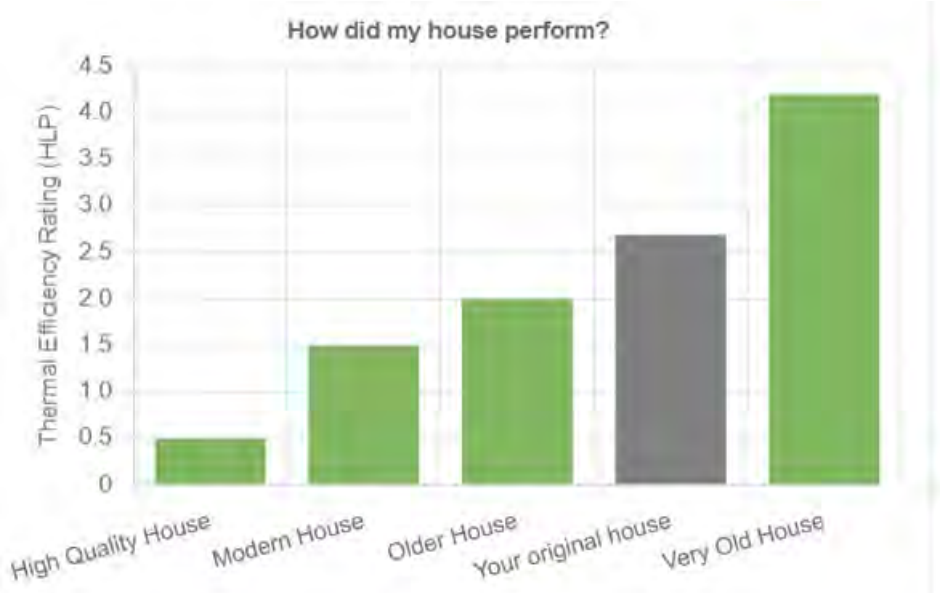
The thermal efficiency figures allow properties to be compared regardless of size or type. A property of this age would expect a poor rating, it would not be a candidate to improve much above poor/average unless a larger study of the property was complete to ensure the correct materials were selected and ventilation was maintained. Heating and PV could also be considered.

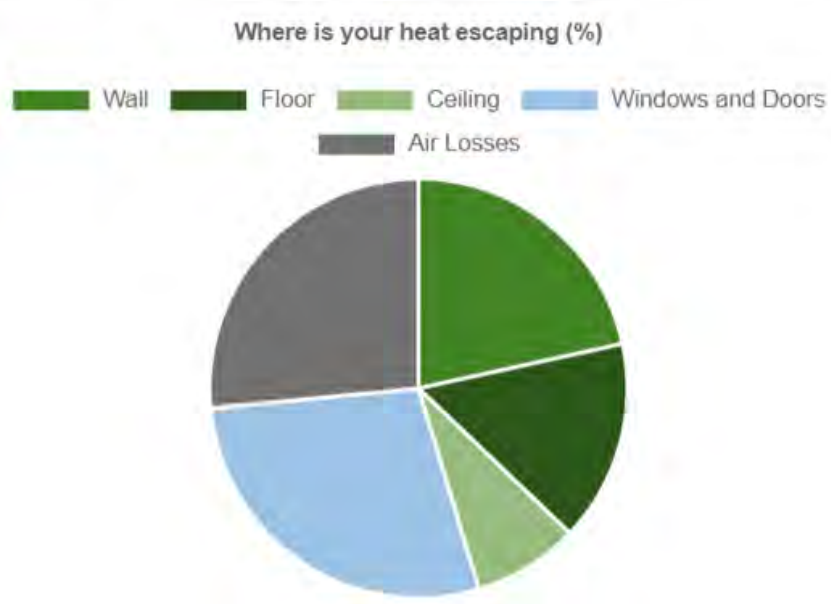
For this study, figures in the table show that all measures gave some improvement, the greatest improvement coming after Phase 4 the Secondary Magnetic Glazing System. It should be remembered that this improvement was only undertaken for the newer part of the home.

WHERE AM I LOSING HEAT?

Before undertaking home energy improvements, it is important to understand where heat is escaping so you can make better informed retrofit decisions. Generally, heat escapes a building in two main ways, by conduction through solid building elements (like roofs, walls, floors etc.), and by warmed air escaping as drafts.

Looking at the benchmark test results post thatch the most significant energy losses for April Cottage are from windows and doors (28.17%) and then air leaks and drafts (26.5%) which is probably about expected for a typical building of its age and archetype. This is shown in the block graph below. The pie chart shows distribution of losses.



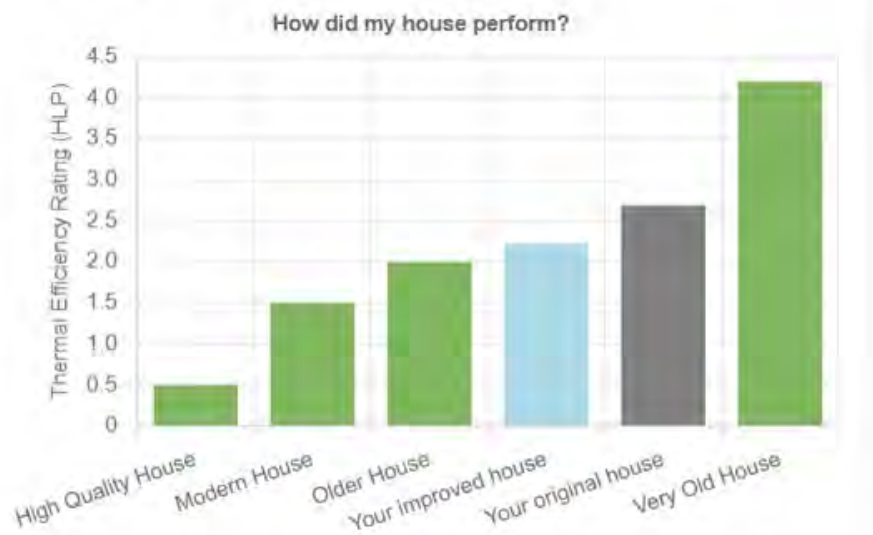


WHAT IMPROVEMENTS SHOULD I MAKE?

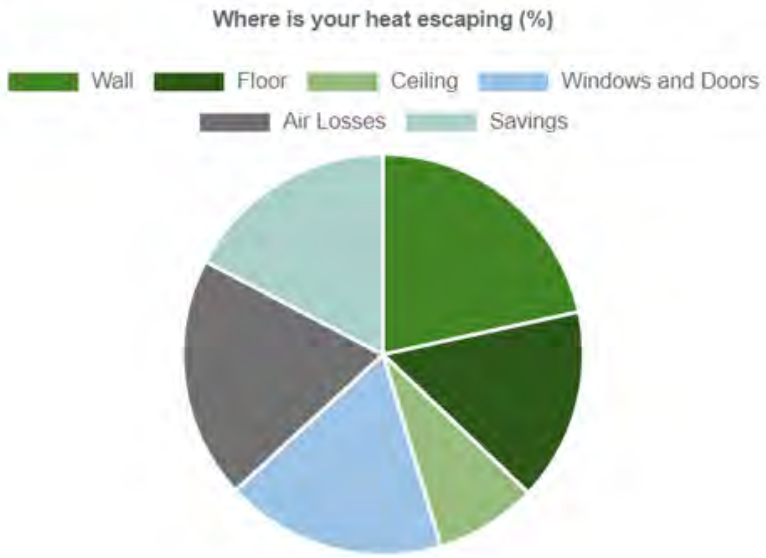
Energy Savings

If we model in the potential savings, using the Redbarn HEAT tool, we find that it estimates a reduction in thermal losses of 17.8% and a yearly energy bill saving of £564 based on figures provided by the homeowner. The following is the new representation of the graphs post retrofit.
In reality the actual savings have been significantly higher, not only can the owner run the thermostat at a lower temperature but the building stays warmer for longer. The savings are anticipated to be closer £1500 per year, more certain figures will be provided at the end of this heating season.

Improved Building Efficiency



Improved Heat Loss Sources



Draughtproofing

The building was and still is very draughty, and is leaking about 4 times more air than a building that meets the current building regulations target. This was reduced to 3 times with the addition of the windows and blocking the open chimney. There are further significant gains to be made.

The owner feels that the small investment made to block the chimney when not in use was an excellent return on investment.

Glazing

The addition of the secondary glazing to the new part of the property and French doors has made a significant difference to the thermal performance and in turn energy efficiency of the property.

Again, the owner feels that the investment made to improve the windows not only improved the way their home feels in the winter, draughts have been significantly reduced and it will potentially see a payback through reduced energy bills of around 4 years.

WHAT SIZE HEATING SYSTEM DO I NEED?

When transitioning to a renewable heating technology, such as a ground source or air source heat pump, it is important to get your heating system sized correctly.

A heat pump that is too big can be expensive to run, and have a shorter life expectancy. A heat pump that is too small could struggle to keep your home warm during the winter months.

We calculate your peak heating demand using real heat loss data and base our assumptions on the expected temperature difference on the coldest day in winter. Typically, an internal temperature of 21 degrees, and an external temperature of -3.2 are used to calculate your heating requirements.

Based on the current heat loss measurements, you require a heating system size of 6.4kW.

Please note - if your hot water usage is higher than average you may need to consider additional power for DHW heating and recovery.