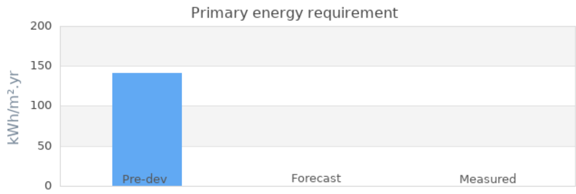
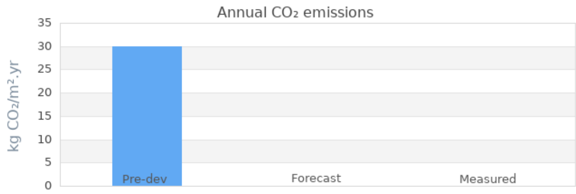
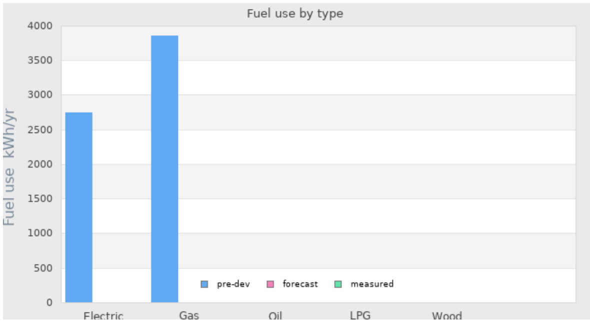
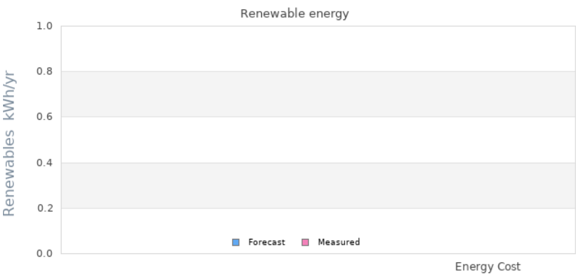
https://www.lowenergybuildings.org.uk/

Project name RetroPHit 04 - Steel Frame Bungalow
Project summary A steel framed, brick clad bungalow built off a concrete raft foundation









Project Description

Projected build start date	
Projected date of occupation	
Project stage	Occupied
Project location	Hereford, Herefordshire, England
Energy target	
Build type	Refurbishment
Building sector	Private Residential
Property type	Detached
Existing external wall construction	Steel frame
Existing external wall additional information	
Existing party wall construction	
Floor area	80 m²
Floor area calculation method	APPROX

Project team

Organisation	RetroPHit
Project lead	RetroPHit
Client	
Architect	Simmonds.Mills Architects
Mechanical & electrical consultant(s)	RetroPHit
Energy consultant(s)	David Olivier
Structural engineer	
Quantity surveyor	
Other consultant	
Contractor	

Design strategies

Planned occupancy	2

Space heating strategy	With older boilers, the most appropriate type of controls to heat your building and hot water used to be an intermittent heating regime. Advice suggested heating the building at regular intervals (perhaps a minimum 2 hours/day) to protect pipes and finishes against frost and condensation related damage, by keeping the building at a safe minimum temperature. BUILDINGS' SPACE HEATING REGIMES: Buildings built of thermally lightweight materials (timber frame with a plasterboard lining for example) tend to heat up faster than those built of heavyweight materials, such as solid brick or stone.The energy consumption of a heating system is related both to the buildings insulation and draughtproofing standards and to the usage pattern of the building. However, if a light usage is spread evenly over the week it can still become inefficient to try to heat a building rapidly and let it cool down many times a day/week etc. As a package of significant insulation and draught proofing measures are applied a heating system run on a more continuous heating regime could become the most energy-efficient approach. This applies to heating systems based on both condensing boilers or heat pumps. They both become more efficient in producing heat as the circulating water temperatures are reduced.Retain existing heating system at present time. However: AFTER MORE DETAILED WORK ASSESSING THE PACAKGE OF MEASURES THE FOLLOWING MAY BECOME APPROPRIATE:URBAN

Water heating strategy	(1) Natural gas Heat source: balanced flue natural gas-fired condensing boiler. To be located within the heated space wherever possible. Emitters: new or existing radiators, sized for low-temperature operation, with maximum flow/return temperatures on a design day of 60/40 degC, assuming continuous heating Radiators to use top bottom opposite end (TBOE) connection. Pipes: No heating pipes to be run in loft, ground floor or buried in external walls; i.e., they must be within the thermal envelope. Pipes can be concealed within timber first floors if appropriate. Insulation: heating pipework to be insulated, except exposed radiator tails.System control: Weather compensation controls to regulate the flow temperature as a function of the outside temperature. Other system controls to be chosen on a project-by-project basis. DHW system: tank-in-tank type heat exchanger. Tank insulation to be minimum 100 mm PU foam (= 0.025 W/mK) or equiv. Tank to be as close as possible, ideally within kitchen(s) and/or bathroom(s), where the largest number of DHW uses occur. Choose a compact plumbing system if the building is being extensively refurbished/remodelled. Measures to reduce the risk of legionella disease.

Fuel strategy	The choice of fuel is an important factor,. It May be limited by space to store fuel or by other regulations on the storage of heating oil, bottled gas or bulk LPG: Best use for electricity essential uses: Lighting Small appliances Heating pumps, fans and controlsNothing else apart from electricity can supply these uses. But they do not actually need very much power.Best choice of fuel for space and water heating at the present time: Natural gas where available, mainly in towns, used in a condensing boiler LPG 2where natural gas not available, and especially if building heat demand can be greatly reduced, in a similar boiler to natural gas Oil condensing boilers in some situations where LPG is not feasible. Electric heat pumps might be an option on some rural sites where the above are not an option.An example of an expensive fuel, poor heating system and poor fabric:Building A has a mixture of electric storage and underfloor heating, with top-up fan heaters, little insulation except some in the loft and poor draughtproofing. It uses 25,000 kWh/year of electricity for space and water heating. Overall, the heating system emits 16 tonnes/year of CO_2. An example of a cheaper fuel and an appropriate heating system (future proofed) and good fabricBuilding B is the same size as Building A. It has high levels of insulation and draughtproofing and an LPG condensing boiler to radiators, with weather compensation control and relatively low circulating water temperatures. It uses 850 litres/year (6,000 kWh) of bulk LPG. Overall, its heating system emits 1.5 tonnes/year of CO_2; i.e., 91 percent less than Building A.
Renewable energy generation strategy	50 % electricity from PV generated (kwh);total annual kwh generated 3500 kw h
Passive solar strategy	
Space cooling strategy	
Daylighting strategy	Daylighting strategies: improve daylighting levels by paint interiors lighter colours, when replacing or reglazing windows e.g., by reducing mullion & transom area, etc

Ventilation strategy

EXTRACT FANS. For a building where limited retrofit work is undertaken and draughtproofing can only reach a level similar to current Building Regulations; i.e., 5 ac/h @ 50 Pa, the most affordable option is extract fans in wet rooms and trickle vents.MEV. For a building that can be draughtproofed to a level at least twice as good as current building regulations; i.e. 5 ac/h @ 50 Pa then as long as there are no open-flued combustion appliances then 'Whole building Mechanical Extract Ventilation' (MEV) can be considered . This option does not normally recover any heat from the extracted air, but does yield consistent air quality and steady, predictable ventilation. It also almost eliminates the heat loss due to the draughts in a normal building. Air supply can be either via existing trickle vents (not in rooms where the MEV extracts from - these are closed off) or for improved comfort through the wall air inlets can be fitted (passive; i.e., not powered) behind or near radiators to prewarm the fresh incoming air.Clothes drying If mechanical ventilation to be installed & space available: If house has continuous Mechanical Ventilation, replace electric tumble drier with a clothes drying space with dedicated extract vent linked to MEV or MVHR.

Airtightness strategy	OVERVIEW. Reducing air leakge (draughtproofing) should be dealt with for all elements - walls, floors, roofs/sloping ceilings/attic floor - and at all major junctions between elements - wall to floor, intermediate floor to wall, roof to wall, wall to windows/doors, service penetrations. Draughtproofing strategy is aimed at reducing uncontrolled air leakage to a minimum, improving the performance of insulation measures and reducing the risk of hidden condensation (which can damage building structure and create conditions for the growth of moulds) and of course miniming your heating bills whilst improving your comfort level. However it is necessary to adopt a ventilation strategy to ensure consistently good indoor air quality. 'Natural' ventilation has in the past meant uncontrolled air entering and leaving the building through gaps, cracks, air vents, unsealed service pipes etc and perhaps to a lesser extent via open windows and doors! Most buildings now use (in addition to uncontrolled air leakage) mechanical fans in an attempt to aid ventilation and ensure indoor air quality, ususally to extract stale air from bathrooms or kitchens and usually in conjunction with 'trickle vents' set into the heads of windows and doors and air inlet grills through walls installed for various reasons, such as to supply air for gas fires or wood stoves. RetroPHit recommends ventilation strategies that ensure good indoor air quality & high levels of comfort whilst keeping heat loss and fuel bills to a minimum. All RetroPHit strategies allow for normal opening of windows and doors! Extensive draughtproofing recommended: We recommend an air pressure test to identify all air leaks; Insulation in attic areas has been added without sealing against air leakage from the rooms below. Remove insulation, seal against leaks and re-instate and top up insulation; Ventilation by uncontrolled air leakage inc. wall vents & opening windows. No trickle vents or other dedicated background ventilation.
Strategy for minimising thermal bridges	
Modelling strategy	

Insulation strategy	Steel-frame walls - with internal board lining & external brick cladding;Treat as 'solid wall' property & externally insulate. External face of brickwork to receive draughtproofing layer prior to application of EWI;Aim for average of 125mm thick proprietary EWI (e.g. Graphitised expanded polystyrene with render). Alternatively use a timber clad RetroPHit system.Wall Base - DPC to Ground level;Insulated plinth, render face, closed cell, tanked.Ground Floor : Solid concrete raft foundation extending approx. 1.0m beyond external walls ; Perimeter insulation with paved finish & continuous with EWI.Pitched Roofs: Maintain ventilated loft space & insulate at attic level .Attic Floor: Steel joists (with timber battens to lower face); Remove quilt insulation. Vacuum floor and raise wiring if neccessary. Air seal leaks in attic floor areas. Top up with quilt insulation. Insulate all walls facing heated spaces and 1.0m up gable walls. Ensure attic ventilation. Horizontal insulation levels c. 3-400mm deep. Vertical areas either 50 - 100mm spray foam or 100 150mm quilt between battens/studs (EWI style).WINDOWS: uPVC, frames good condn.If windows break or opportunities otherwise arise to replace glazed units: If casement seals/frames are sufficiently airtight, replace glazed units by high performance DG or TG. Optimise low-e for orientation.DOORS: uPVC -If in poor condition or draughtly ; Replace by economical foam-filled steel or GRP door, UK-type.
Other relevant retrofit strategies	
Other information (constraints or opportunities influencing project design or outcomes)	

Energy use

Fuel use by type (kWh/yr)

Fuel	previous	forecast	measured
Electric	2750		
Gas	3850		
Oil			
LPG			
Wood			

Primary energy requirement & CO_2 emissions

	previous	forecast	measured
Annual CO2 emissions (kg CO2/m².yr)	30	-	-
Primary energy requirement (kWh/m².yr)	141	-	-

Renewable energy (kWh/yr)

Renewables technology	forecast	measured
-		
-		
Energy consumed by generation		

Airtightness (m³/m².hr @ 50 Pascals)

	Date of test	**Test result**
Pre-development airtightness	-	-
Final airtightness	-	-

Annual space heat demand (kWh/m².yr)

	Pre-development	forecast	measured
Space heat demand	-	-	-

Whole house energy calculation method	
Other energy calculation method	
Predicted annual heating load	-
Other energy target(s)	

Building services

Occupancy

Space heating

Hot water

Ventilation

Controls

Cooking

Lighting

Appliances

Renewables

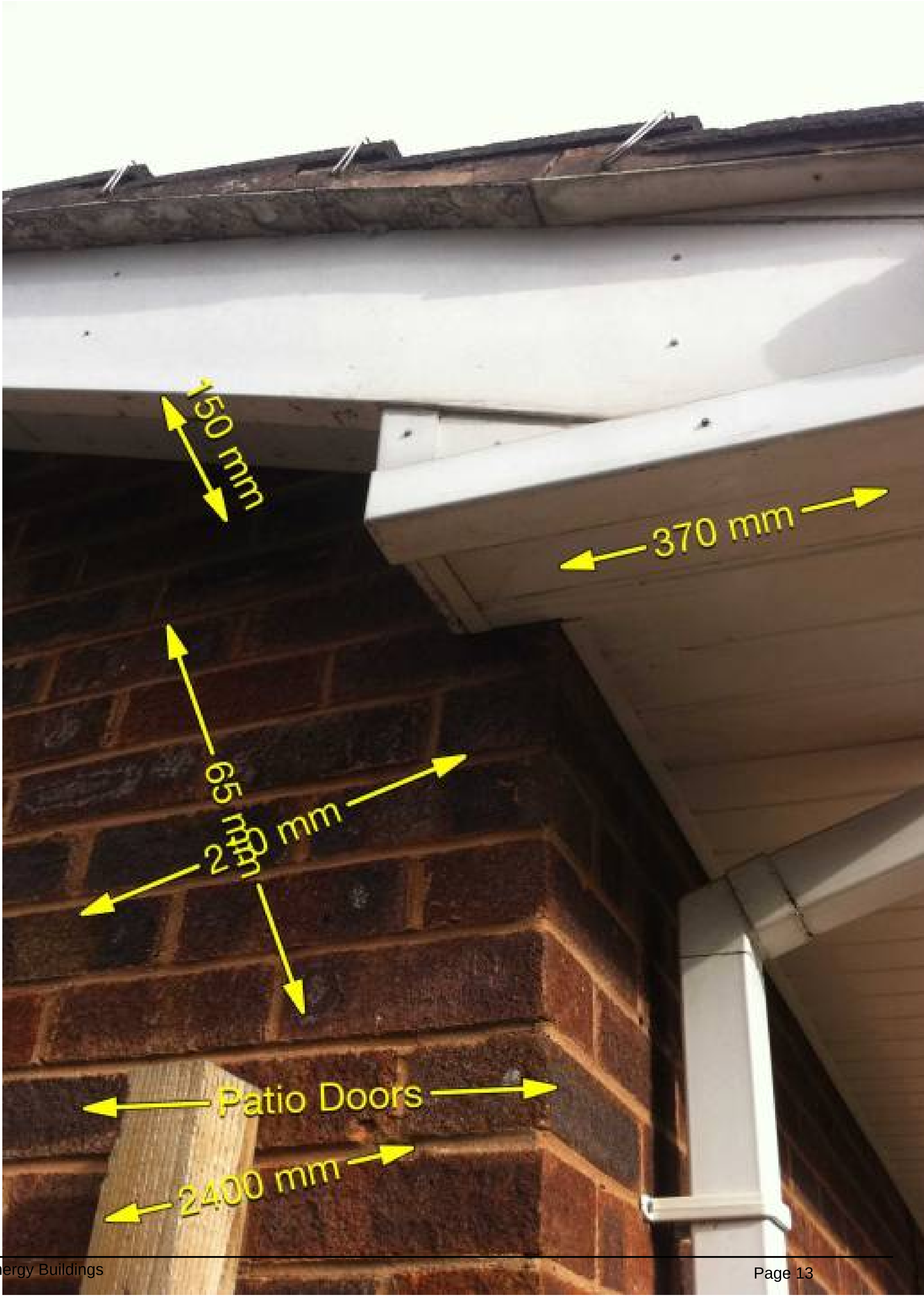
Strategy for minimising thermal bridges

Building construction

Storeys

Volume	
Thermal fabric area	
Roof description	
Roof U-value	
Walls description	
Walls U-value	
Party walls description	
Party walls U-value	
Floor description	
Floor U-value	
Glazed doors description	
Glazed doors U-value	
Opaque doors description	
Opaque doors U-value	
Windows description	
Windows U-value	
Windows energy transmittance (G-value)	
Windows light transmittance	
Rooflights description	
Rooflights light transmittance	
Rooflights U-value	

Project images


150 mm
370 mm
65 mm
Patio Doors
2400 mm


G3
G3