

CASE STUDY

A 19th century historic property



Edinburgh has numerous fine sandstone dwellings built in Georgian, Victorian and Edwardian periods.

Many are listed buildings, so improvements to bring their thermal performance in line with government targets must be carefully carried out and will require Listed Building Consent.

Holyrood Park Lodge

Used as a visitor centre by Historic Environment Scotland, the Lodge is of traditional construction with external ashlar masonry and internal linings of lath and plaster. The traditional timber single-glazed windows were built in the 1990s.

The works

Using 'best practice' conservation guidance, interventions were chosen on the basis of what the building could withstand, rather than to achieve a specific U Value (the insulation standard). External wall insulation is inappropriate for listed buildings with exterior masonry as it will affect the appearance of the building. Retrofits of modern buildings require airtightness to reduce heat loss, but in older properties this can be detrimental. This thermal upgrade focused on internal changes that also supported ventilation, vital to avoid condensation. The upgrade included:

- Removing 1980s alterations;
- Reinstatement of lost fireplaces and other features;
- Redecorating to original colours, using breathable clay paint;
- Adding internal insulation with natural, vapour-permeable materials, blown into the cavity behind lath and plaster, allowing original plaster to be retained;
- Upgrading windows with slim double-glazing;
- Adjusting ventilation routes;
- Insulating external doors between existing beading with aerogel blanket and ply lining;
- Insulating ground floor between joists, with improved air flow below;

- Inserting sloping roof insulation between rafters from above, leaving lath and plaster in place;
- Adding two types of insulation to attics, to test 'warm' and 'cold' roof solutions;
- Using fireplaces to improve passive ventilation, to prevent condensation;
- Retaining relatively modern condensing boiler, with supplementary electric heating in two difficult locations.

Pre-intervention assessment

1. SAP rating of 35 (Band F)

Recommended work to the Lodge:

- Floor insulation;
- Coomb ceiling and roof insulation;
- Suspended timber floor insulation.

Post intervention monitoring and assessment

1. SAP rating of 71 (Band C)

With further work and the addition of renewables, a rating of 82 (Band B) could be achieved:

- Moveable infrared heaters;
- Install damper in reinstated hearth;
- Zoned heating controls;
- Solar thermal hot water;
- Thicker insulation in the coombs;
- Solar PV panels;
- Air leakage - reduced by 26% to 11.25 m³/h/m²;
- Wall insulation - U value at west wall reduced from 1.07 W/m²K to 0.65 W/m²K (36%);
- Relative humidity levels through wall - stabilised with much lower humidity levels.

As a pilot project, Holyrood Lodge showed that traditionally constructed listed buildings can be thermally upgraded in a sensitive and proportionate way, but it is unrealistic to expect performance to be equal to that of a new building, or one that is easier to refurbish. Traditional approaches to ventilation have been successful, and the building is warm and comfortable. Monitoring has shown that careful intervention does not increase hygrothermal risk. The dominant factor in EPC rating for a domestic property is the fuel type, which could not be changed in this trial project.

Future challenges for listed and traditional homes

- Band B requirement (EESH) due to be brought in by the Scottish Government in 2032 where viable;
- Building must be in good condition prior to upgrade;
- Each building is unique and will have a different solution – accredited consultants will be required;
- Poor SAP ratings given by standard assessment methods.
- Development of new assessment software using only measures suitable for existing buildings;
- Higher cost of 'enhanced' SAP assessment for traditional construction;
- Decarbonising heating systems.
- Integrating renewables to listed buildings where appropriate;
- Regular maintenance required to prevent heat loss through damp areas etc.

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EXTERNAL PRE-REFURBISHMENT					
Date	Time	External Air T	Internal Air T	Wind Speed	Conditions
24 th January	8.20 – 9.05 am	9 °C	18 °C	2.0 m/s	Dry

EXTERNAL POST-REFURBISHMENT					
Date	Time	External Air T	Internal Air T	Wind Speed	Conditions
7 th February	8.45 – 9.25 am	4 °C	15 -20 °C	1.0 m/s	Dry

Pre-refurbishment

West Elevation

Post-refurbishment

West Elevation

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Energy Performance Certificate (EPC) Scotland

Dwelling type:	Detached house	Reference number:	9795-056-0237-6129-1224
Date of assessment:	11 March 2021	Type of assessment:	TechniC [®] existing dwelling
Date of certificate:	11 March 2021	Approved Organisation:	Elmhurst
Total floor area:	96 m ²	Main heating and fuel:	Boiler and radiators, mains gas
Primary Energy Indicator:	227 kWh/m ² /year		

You can use this document to:

- Compare current ratings of properties to see which are more energy efficient and environmentally friendly
- Find out how to save energy and money and also reduce CO₂ emissions by improving your home

Estimated energy costs for your home for 3 years*	£2,478
Over 3 years you could save*	£294

* based upon the cost of energy for heating, hot water, lighting and ventilation, calculated using standard assumptions.

Energy Efficiency Rating

This graph shows the current efficiency of your home, taking into account both energy efficiency and fuel costs. The higher this rating, the lower your fuel bills will be and the less impact it has on the environment.

Your current rating is band C (71). The average rating for EPCs in Scotland is band D (61).

The potential rating shows the effect of undertaking all of the recommended improvements listed within your recommendations report.

Very energy efficient - lower running costs	Current 71 Potential 83
Highly efficient	A
Efficient	B
Good	C
Avg	D
Below average	E
Poor	F
Very poor	G

Environmental Impact (CO₂) Rating

This graph shows the effect of your home on the environment in terms of carbon dioxide (CO₂) emissions. The lower this rating, the less impact it has on the environment.

Your current rating is band D (61). The average rating for EPCs in Scotland is band D (61).

The potential rating shows the effect of undertaking all of the improvement measures listed within your recommendations report.

Not environmentally friendly - higher CO ₂ emissions	Current 61 Potential 67
Very poor	A
Poor	B
Below average	C
Avg	D
Good	E
Efficient	F
Highly efficient	G

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years
1 Room-in-roof insulation	£1,500 - £2,700	£34.00
2 Heating controls (zone control)	£350 - £450	£129.00
3 Solar water heating	£4,000 - £6,000	£4.00

A full list of recommended improvement measures for your home, together with more information on potential cost and savings and advice to help you carry out improvements can be found in your recommendations report.

To find out more about the recommended measures listed above, visit greenenergyadvice.org or contact Home Energy Scotland on 0808 208 2202.

THIS PAGE IS THE ENERGY PERFORMANCE CERTIFICATE FOR THE PROPERTY AS IT EXISTED ON THE DATE OF THE DWELLING AND NOT BE REMOVED UNLESS IT IS REPLACED WITH AN UPDATED CERTIFICATE

- 1 Wood-fibre insulation in the south gable space; a 'warm roof'. Note the insulation continuing down in the coomb.
- 2 Wood-fibre insulation batts laid flat between the ceiling joists to give a 'cold roof'.
- 3 Ledged and braced door at the Lodge, before redecoration, showing the plywood panel on top of the aerogel board.
- 4 Ground floor plan of the Lodge as proposed.
- 5 Thermal imaging of 'leaky' doors and windows before and after.
- 6 Energy performance certificate Band C.

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