Edinburgh Napier UNIVERSITY

Institute for Sustainable Construction
Scottish Energy Centre

# Solid sandstone thermal performance retrofit trials - *superbead* EPS bonded bead in cavities

Thermal Intervention testing:

- *In-situ* thermal transmission (U-value)
- Air leakage (Air permeability)
- Condensation risk analysis

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Everwarm
Part of the Sureserve Group

energy store

CONSTRUCTION SCOTLAND INNOVATION CENTRE

Image credits: Julio Bros-Williamson, 2019, Edinburgh Napier University

# i. Foreword

This document presents findings from surveys, in-situ thermal transmission and air permeability monitoring and analysis of ten traditional dwellings in Paisley, Edinburgh and Forfar in Scotland. The Scottish Energy Centre (SEC) and Robin McKenzie Partnership (RMP), both affiliated to Edinburgh Napier University, performed this work during two phases: 1) January to March 2019 and 2) November to December 2019.

Acknowledgements go to Ralph McMaster the Operations Supervisor at Everwarm Ltd (Sureserve Group) who had direct contact with the HA's and provided survey information of all dwellings. Credit also goes to team members of the three housing associations: Williamsburgh HA in Paisley, Castle Rock Edinvar in Edinburgh and Hillcrest HA in Forfar for providing access and tenant engagement. Equally important are the residents of some of the dwellings who without their approval and patience, these tests would not be possible.

Likewise, the research team is thankful to CS-IC for providing the funding for this industry and academic engagement. Credit also goes to Amy Dickson, a 4th year student of the BSc Architectural Technology degree at Edinburgh Napier University who supported the equipment installs and performed data analysis retrieved from the monitoring.

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| Checked by: | JIC |

## ii. Key Results & Learnings / Outputs / Benefits

This report created a robust body of evidence of the effectiveness of the thermal improvements capable within a reduced cavity behind dry linings of solid walls. The trials involved the use of the *superbead* EPS bonded bead product by energystore Ltd.

### The stakeholders:

**energystore Ltd**; Material providers & main client.

**Everwarm Ltd**; Installers & main contact with HA's

**Williamsburgh HA**; Provided 3 dwellings in the study based in Paisley, Renfrewshire.

**CastleRock Edinvar HA.** Provided 1 dwelling in Edinburgh.

**Hillcrest HA**; Provided 6 dwellings in Forfar, Angus.

**Edinburgh Napier University**; Researchers, testing and main authors.

### Scope of the study:

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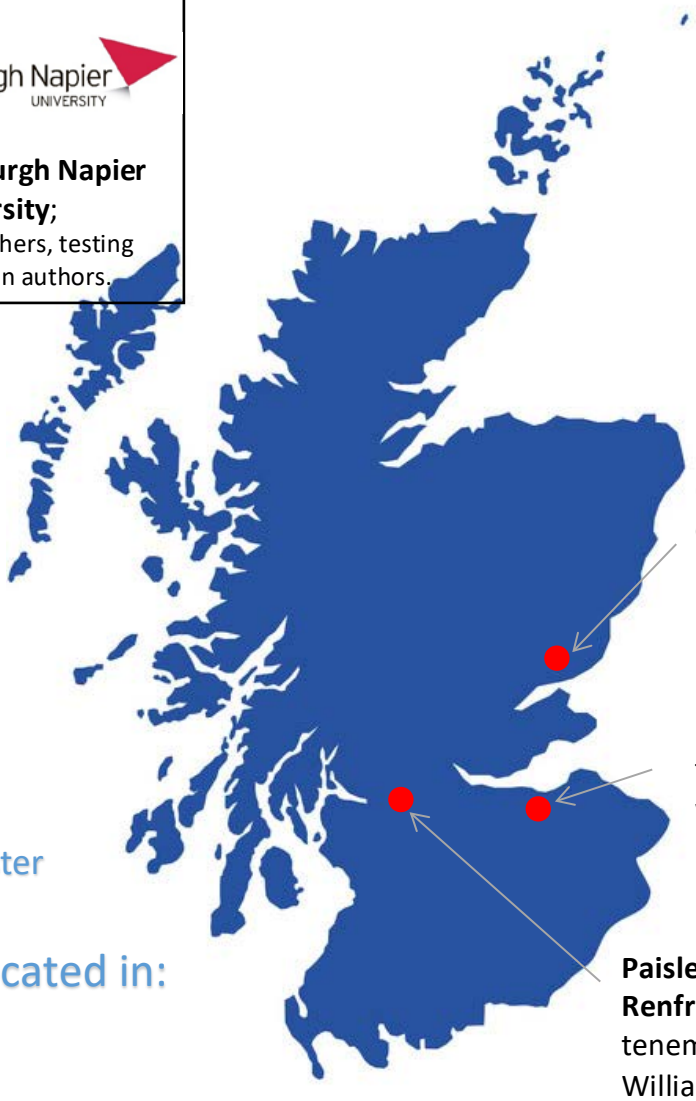
Solid stone dwellings with plasterboard or lath-&-plaster drylining

Located in:

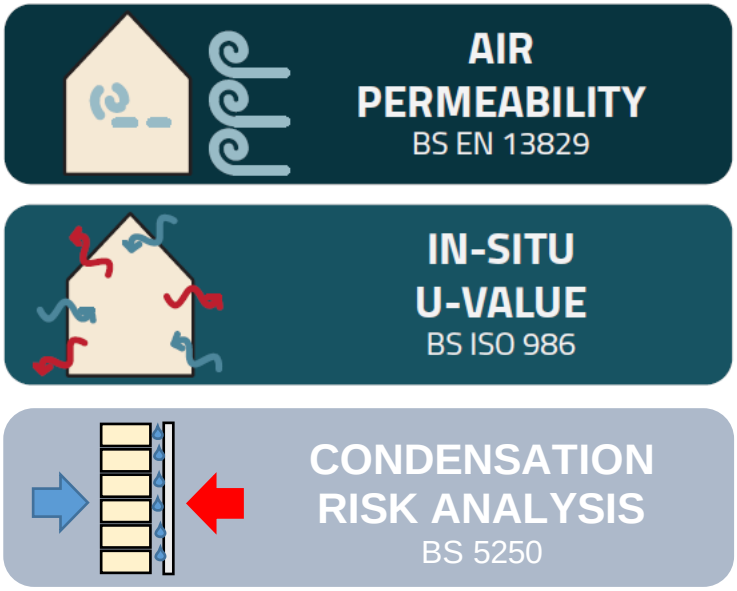


**Forfar, Angus**. 6 bungalow dwellings with Hillcrest HA.

**Edinburgh**, 1 basement tenement flat with Castle Rock Edinvar HA.

**Paisley, Renfrewshire**. 3 tenement flats with Williamsburgh HA.

# 3 Main tests performed:

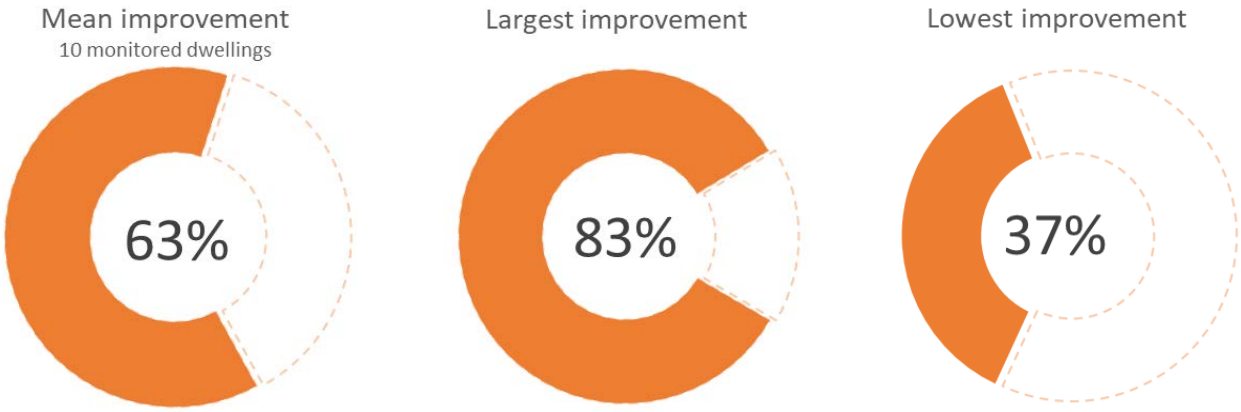



In-situ tests were performed at the pre-intervention stage (baseline) and then post-intervention stage with EPS beads in cavity.

## Results:

### In-situ U-value comparison

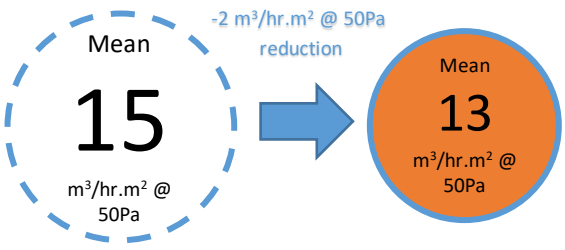
Mean, largest and lowest difference between pre and post-intervention testing



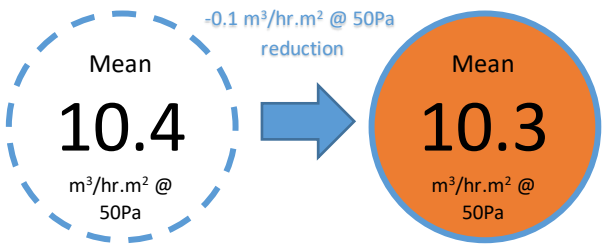

The dwellings presented varying cavity depths between 80mm and 130mm. This impacted on the results where the volume of *superbead* insulation determined the thermal resistance improvement.

### Air permeability (Air leakage) comparison

Dwellings with the EPS *superbead* in <u>all</u> wall's achieved (3 dwellings, all tenement flats):




Dwellings with the EPS *superbead* in <u>only one</u> wall achieved (6 dwellings, all bungalow homes):



## Condensation risk analysis

- During monitoring (15 days) no risk of condensation built-up was observed. However, this was a snapshot of the baseline and post-intervention periods.
- The separation between cavity temperature and dew point temperature (margin) was calculated which presented a mean of 8˚C at pre-intervention and 10.5˚C at post-intervention.

# Key outcomes and discussion

Although the mean U-value improvement is a high 63%, this corresponds to 10 dwellings monitored. Robust data from the 6 dwellings in Forfar showed a reduction of 56%.

Varying wall cavity depths impacted the thermal resistance. Different depths were also found in single walls due to the rough sandstone finish.

The importance of wall surveys in all retrofit projects highlights the varying conditions found in existing buildings, which often directs the most adequate intervention.

Air permeability reduction between baselines and post-intervention was higher when all walls were insulated, and other retrofit interventions were in place.

Less exposed tenement dwellings at ground floor had a higher reduction of air permeability compared with those in a top floor.

Using *superbead* EPS bonded bead behind dry linings of solid walls is an efficient non-invasive solution that can save: 3,450kWh energy, £136 on bills and 750 $kgCO_2e/yr.$*

More testing is required to assess the risk of condensation using dewpoint margin; monitoring a larger sample over a 12-month period is recommended.

*These yearly estimates are based on projections using current EPC calculations for space heating only, using natural gas as the heating fuel and all walls insulated using the energystore Ltd *superbead* EPS bonded beads.