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Measuring the in-situ performance of dwellings

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Introduction

Who am I?

- Building Physicist
- Lecturer in Energy Efficiency
- Head of Applied Buildings and Energy Research Group
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Energy House

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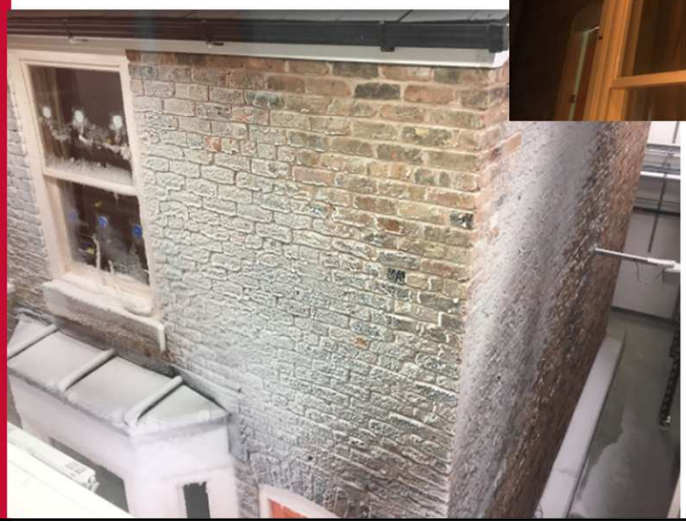

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Performance Gap

Performance gap is now well researched:

Measured energy - Modelled energy = Performance gap.

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Modelled Data Example

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Variations in U values

- 'Variations in U value of a whole dwelling using infrared thermography'
- Published in *Buildings 2018, 8, 46; doi:10.3390/buildings8030046*

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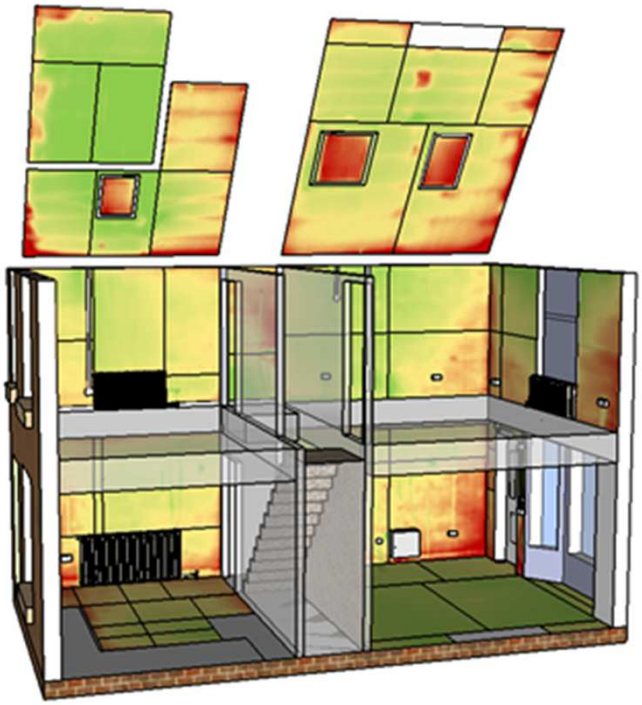

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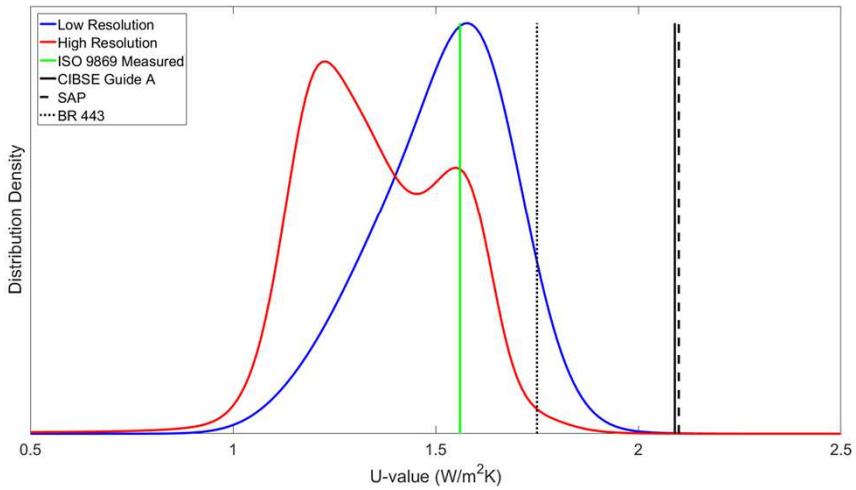

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Modelling Results

A heat transfer coefficient was determined under steady state modelled conditions.

	Model using point measurements	Model using Low-resolution IRT	Model using High-resolution IRT
HTC (W/K)	225 ± 6	233 ± 23	209 ± 26
Difference from Measured HTC	2.5%	6.1%	-4.8%

Measured HTC = 220 W/K

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Modelling Results

Dynamic simulations made predictions of the annual heating consumption and heating cost.

	Model using point measurements	Model using Low-resolution IRT	Model using High-resolution IRT
Heating (Gas) Consumption	5547 ± 83 kWh	5656 ± 272 kWh	5202 ± 279 kWh
Heating Cost	£271 ± 4	£277 ± 29	£254 ± 27

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WG13 Work - General

- **Title:** Thermal Insulation – Construction products, building elements and structures – In-situ measurement of thermal performance

Five documents:

- **Part 1 General Principles,**
- **Part 2/3 Testing of components or elements**
- **Part 4 Testing of structures**
- **Part 5 Testing of Domestic properties**

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What are we doing ?

- It was felt that there was a need for a recognised and ratified standard for the measurement of the “heat loss” of a small building. To include all include all three mechanisms of heat transfer;
- Convection
- Conduction
- Radiation
- = Global Heat Loss / Heat Transfer Coefficient

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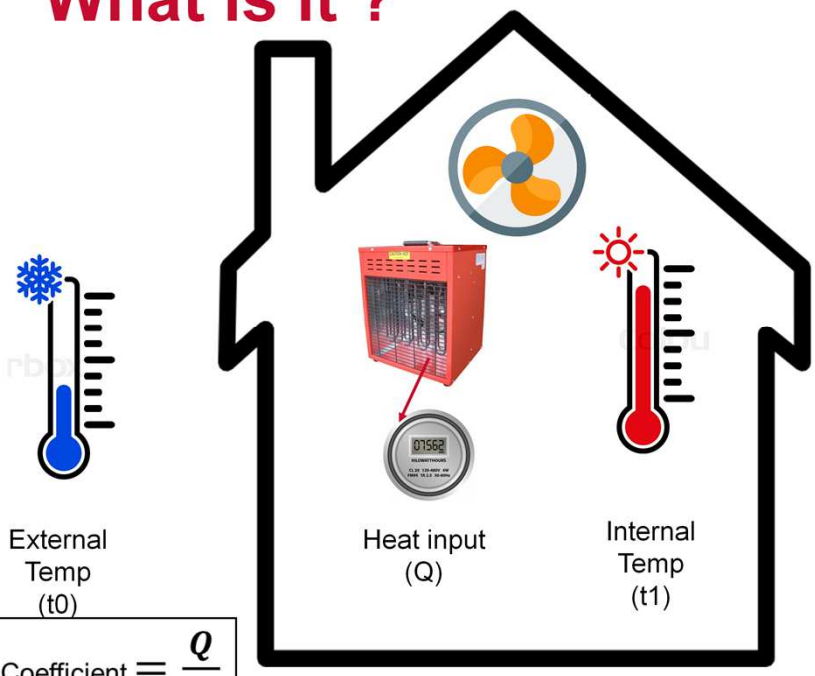
What is it ?



External Temp (t0)

Heat input (Q)

Internal Temp (t1)

$$\text{Heat Transfer Coefficient} = \frac{Q}{\Delta t}$$

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What is it?

Whole building aggregate heat loss test methodology

- The method produces a heat transfer coefficient (HTC) for the dwelling, Watts Per Kelvin (W/K) how many Watts does it take to lift the building's temp by 1 deg C
- Takes around 1-2 weeks
- The standard also suggests that these may be suitable conditions to carry out airtightness measurements (to allow for a convective heat transfer split) and for U value measurements to be carried out in line with ISO9869
- Home must be vacant
- Late autumn, to early spring acceptable
- Northern EU climates, further south needs consideration.

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How are we doing it:

- 11 members covering industry, academia and research organisations, throughout the EU.
- Working on a methodology for testing from start to finish. Data Collection, Data Analysis and Reporting.
- Not reinventing the wheel, other methodologies will be incorporated (Leeds Beckett method etc.)
- Results can be used to make comparisons with energy models/predictions

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What will the standard contain

- 11 members covering industry, academia and research organisations, throughout the EU.
- Working on a methodology for testing from start to finish. Data Collection, Data Analysis and Reporting.
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What will the standard contain

Parts:

1. Data collection:
   - ✓ Scope, what's in and out
   - ✓ Data to be collected
   - ✓ Equipment setup, calibration
   - ✓ Detailed methodology, duration of test etc
   - ✓ Reporting of data

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What will the standard contain

2. Steady State Data Analysis:
   - ✓ Scope
   - ✓ Terms
   - ✓ General Principles of Data Analysis
   - ✓ Input Data, errors, gaps, filtering and checking
   - ✓ Measurement uncertainty
   - ✓ Statistical Analysis
   - ✓ Standard reporting format

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What will the standard contain

3. Dynamic data analysis

- This standard is currently being defined, to be completed in 2019
- Inputs from IEA A71 are to be used to assist
- Monitoring periods to be shorter, more flexible to internal and external conditions
- As yet largely untested compared to SS method.

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What will the standard contain

3. Dynamic data analysis

- Other dynamic methods exist such as QUB, by Saint Gobain, ISABELE by CSTB
- Expertise will be drawn from the innovators of these systems to suitable method, or a series of methods that are deemed to be appropriate.

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How does this fit with Annex 71

- The dynamic aspects of the data analysis may have overlaps although the data collection will be different.
- The aim of the two groups ultimately is the same; to measure the HTC.
- We understand the closeness of the groups and standards writing group for WG13 has approximately 50% of people who are in A71.

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How does this fit with Annex 71

- Aside from shared goal of HTC there are other overlaps
- Uncertainty analysis
- Repeatability
- Sensitivity analysis
- Data handling
- Reporting outputs and other useful metrics such as comfort etc