The ‘LESSONS’ Project
Understanding the Gaps Between Operational Energy Use and Modeling
Ruth Kerrigan: ruth.kerrigan@iesve.com
The LESSONS Project

“LESSONS is an innovative website, where case studies from previous projects will be stored in a data base. Practitioners will be able to search for ‘lessons’ from past projects to influence and improve their designs. Practitioners will also be able to upload their own ‘Lessons’ from projects they have completed”

www.buildinglessons.com
Introduction

20 20 20 Targets

• reduce GHG emissions to 20% of 1990 levels,
• 20% of EU energy to come from renewable resources
• 20% reduction in primary energy use compared with baseline projections.

Approximately 80% of a building’s total lifecycle energy usage occurs during its operational stage.

‘As-built’ performance of new or refurbished buildings frequently does not achieve the ‘as-designed’ predicted performance.

The EU Energy Efficiency Action Plan 2011 states that the barriers to energy efficiency in buildings need to be overcome in order to meet the targets.
Introduction

Reasons for Inefficiency in Buildings

• The discontinuity between the design and as-built building envelope and systems
• The discontinuity between the design of the building and the operation of the building
• The discontinuity between design stage assumptions and how the control systems are set up and operated
• Most building management systems (BMS) are fixed scheduled and unable to adapt to changing environmental, building envelope, and usage conditions
• Most BMS are using control algorithms several generations behind state-of-the art
• Typical BMS and non-BMS controls systems do not integrate the diverse building systems and equipment well
Concept

What is it?
A website to provide dramatically better guidance of design decisions to deliver zero carbon and low impact buildings

Why do it?
The real performance of ‘green’ buildings often falls well below design expectations because designers cease to be involved post occupancy
Concept

How will it improve design

- Creates a tool that allows designers to access previous design cases and insights relevant to their current projects
- Provides comparisons between the expected design performance and the actual operational performance to allow the user to use similar systems or a similar approach
- Allows the modelling providers, such as IES, Energy+, TAS etc to examine where operational data differs from estimated data and understand how to improve their design software
- Provides greater accessibility to design and decision tools for all practising engineers
- Provides access to relevant design information
- Provides tools that help “every stage of the design process”
Concept

What does it look like

www.buildinglessons.com
Functionality

Search

Search by Category

Total no of lessons available
Functionality

Search

Slide Bar

Check Box

Shows number available
Functionality

My Portfolio

- Allows you to enter a new case study
- Shows case studies I’ve entered
- Shows case studies I’ve viewed
- Favourite case studies etc
Functionality

New Case Study

Various levels of information

Post Occupancy Information to compare design against use

Enter anecdotal lessons

Design and Construction Information, which are effectively ‘Lessons’ in themselves
Functionality

Forum

Ask questions about a lesson or a case study
Email the person who created the case study
Start a discussion about the lesson etc
Functionality

Manufacturer Info

Choose a manufacturers product to add to your case study
View where a manufacturers product has been used
Manufacturers can upload data for use with case studies
Manufactures can create a ‘performance component’ of their technology to be linked with IES software and uploaded to a case study for use with a 3D design model
Functionality

About

Information about the website
Help files, manuals and youtube demos to show the user how to enter, search and use the website
Functionality

Upload/Download

Uploads and downloads user-chosen data, namely: templates, constructions, profiles, systems, openings, and room group definitions.

The user can control what data is imported/exported and how the imported data is applied to a model.

The function can match rooms by room name and replace existing data or just import the data to model databases for manual assignment.
Example
### Example

**Search Results**

<table>
<thead>
<tr>
<th>Image</th>
<th>Case Study Name</th>
<th>Lessons</th>
<th>Building Type</th>
<th>Region</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Brenzett</td>
<td>2</td>
<td>New Build</td>
<td>Kent</td>
<td><img src="rating1.png" alt="Rating" /></td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Bessemer Grange</td>
<td>1</td>
<td>New Build</td>
<td>London</td>
<td>No rating yet</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Windygoul Primary School</td>
<td>7</td>
<td>New Build</td>
<td>East Lothian</td>
<td>No rating yet</td>
</tr>
</tbody>
</table>
Example
Example
## GENERAL

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Information</td>
<td>P19 - Carbon Trust</td>
</tr>
<tr>
<td>Building Phase</td>
<td>Completed</td>
</tr>
<tr>
<td>Project Type</td>
<td>New Build</td>
</tr>
<tr>
<td>Building Sector</td>
<td>Primary</td>
</tr>
<tr>
<td>Construction Type</td>
<td>Offset MMC</td>
</tr>
<tr>
<td>Year of Completion</td>
<td>2007 Quarter 2</td>
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<tr>
<td>Building Area m²</td>
<td>3462</td>
</tr>
<tr>
<td>Town/City</td>
<td>Windygoul</td>
</tr>
<tr>
<td>County or Region</td>
<td>East Lothian</td>
</tr>
<tr>
<td>Postcode</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td></td>
</tr>
<tr>
<td>Performance Compliance</td>
<td>Part L Building Regulations 2006</td>
</tr>
<tr>
<td>Code for Sustainable Homes</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>EPC</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>BREEAM</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Passivhaus</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Energy Performance (predicted) kWh/m²/yr</td>
<td>1</td>
</tr>
</tbody>
</table>
### LESSONS

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Process</td>
<td>The walls of the building are constructed from pre-fabricated timber frame panels which contain insulation manufactured from recycled newspaper. In addition to offering insulation in excess of the levels required under current legislation, the panels fit neatly together with air-tight joints and so reduce uncomfortable and energy wasting draughts. These prefabricated panels accelerated the build process and reduced the generation of on-site waste during construction.</td>
</tr>
<tr>
<td>Construction</td>
<td>Process</td>
<td>An underfloor heating system has been installed in most areas of the building. Underfloor heating is an efficient means of providing warmth evenly across a whole room and improves comfort levels by avoiding the creation of hot and cold spots. The heating system is supplied by highly efficient gas condensing boilers.</td>
</tr>
<tr>
<td>Construction</td>
<td>Process</td>
<td>The school was designed to maximise the availability and use of natural lighting. The classrooms have sloped ceilings and are glazed at occupant level on both exterior walls. On the opposing walls, which face into the courtyard, windows are mounted at a higher level. The classrooms are thus provided with ample daylight. Glazing on the Northern elevation of the building is minimised to prevent heat loss. Inevitably, however, some artificial lighting was required in the school. To provide this without excessive energy consumption, the design team opted for highly efficient fluorescent lighting with automatic controls. These controls, which monitor both occupancy and level of natural light in the room, minimise energy use by ensuring that lights are only switched on when the room is occupied and automatically dimming the lights in relation to the amount of daylight available.</td>
</tr>
<tr>
<td>Technology</td>
<td>Types</td>
<td>Glazing</td>
</tr>
<tr>
<td>Wider Professions</td>
<td>Management</td>
<td>Control Lighting to Save Energy: No matter how efficient the light, it will waste energy if left on whilst the room is empty. Also, using natural light will only save energy when electric lights are controlled in relation to the amount of daylight available (i.e., dimming or switching off when there is sufficient daylight to support the activity being undertaken in the room). For new buildings, or refurbishment of lighting systems in existing buildings, select automatic lighting controls which take account of room occupancy and natural light levels.</td>
</tr>
<tr>
<td>Construction</td>
<td>Process</td>
<td>By installing opening windows on opposing walls in the classrooms, the designers created a passive ventilation system that supplies fresh air and cooling without the need for power hungry air conditioning systems. The windows are opened and closed under manual control, with the higher level windows using small motors controlled by the room’s occupants. As the air in the room warms up, it rises to the higher part of the ceiling and escapes via the high level windows. In doing so, cooler fresh air is drawn into the room through the outer facade windows. The lower windows have a higher hooper so that fresh air does not blow across occupants and cause discomfort in winter. Modelling of the building carried out by consultants during the design process indicated that, by using this passive ventilation strategy, with solar shading on the outside, excessive temperatures would not be a problem. The experience of the occupants of the school is that comfort levels are good and that...</td>
</tr>
</tbody>
</table>
### CONSTRUCTION

#### Category
- External Wall


### BUILDING SERVICES

#### Category
- Other Renewables


### DESIGN

#### Strategy | Priority | Description
--- | --- | ---
- daylighting | High | The school was designed to maximize the availability and use of natural lighting. The classrooms have sloped ceilings and are glazed at occupant level on both outer facing walls. On the opposing walls, which face into the courtyard, windows are mounted.
- ventilation | High | By installing opening windows on opposing walls in the classrooms, the designers created a passive ventilation system that supplies fresh air and cooling without the need for power hungry air conditioning systems.

### TEAM

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Lothian Council</td>
<td>Client</td>
<td>East Lothian Council</td>
</tr>
</tbody>
</table>

### ENERGY

<table>
<thead>
<tr>
<th>Property</th>
<th>Design</th>
<th>Estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Use: Electric kWh/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Use: Gas kWh/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Use: Oil kWh/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Use: LPG kWh/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Use: Wood kWh/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂ Emissions: Electric kg CO₂/yr</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO₂ Emissions: Gas kg CO₂/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂ Emissions: Oil kg CO₂/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂ Emissions: LPG kg CO₂/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂ Emissions: Wood kg CO₂/yr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Impact

Benefits with respect to operation versus model

- Design is based on lessons from existing buildings, therefore comparison of how the design performed versus how the building operated can be taken into account.
- Lessons with respect to design strategy, systems used, constructions used etc can be examined and learnt from.
- Models of exemplar buildings with respect to ‘as designed’ performance against ‘as built’ performance can be downloaded and used with your own design model.
- Technologies used can be examined with respect to their advantages and disadvantages and informed decisions with respect to whether or not to use them can be made.
Impact

Wider Impacts

• Improved design, quality and productivity
• Better design at early stage
• 40-50% lower energy use and carbon emissions
• Drive towards zero carbon buildings
• Informed information for the retrofit market
• ...

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Thank you
Q&A