CIBSE Application Manual AM11 ‘Building Performance Modelling’
Chapter 3: Modelling for energy performance regulations compliance & certification

Contents

- Background
- Compliance modelling vs design modelling
- Modelling for building energy performance regulations compliance & certification
- Modelling for building assessment & rating schemes
- Validity of results

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AM11 Overview Seminar: March 15th 2016
Background [Section 3.1]

Objectives & Scope (3.1.1-3.1.2)

• familiarise general users with energy performance related regulatory processes in various countries where modelling is used

• ensure the differences between compliance modelling & modelling for design are well understood & where overlaps exist

• make users of compliance modelling tools aware of QA principles
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Background [Section 3.1]

Modelling for compliance (3.1.3)

• What is Compliance?
• What Can you Comply with?
  Energy Efficiency Legislation
  Assessment Systems
• When does compliance modelling occur?

RIBA & AIA IPD mapping

Key stages for compliance modelling in the project life cycle (Fig. 3.1)
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General Modelling Approach [Section 3.2]

(Fig 3.2) General Compliance/Rating Assessment Process
General Modelling Approach [Section 3.2]

General Definitions:

• Compliance Methodology
• Modelling/Simulation Tool
• Proposed Design
• Notional, Baseline or Reference Buildi
• Compliance Benchmark
Compliance vs Design Modelling [Section 3.3]

Key differences:

• Some energy or mass flow paths may be approximated or omitted, may only focus on ‘regulated’ energy uses

• Limited ability in representing complexities of HVAC systems & dynamic interconnectedness of building technologies

• Limited ability to account for impact of possible future changes in climate & occupant behaviour

(Fig. 3.4) Compliance Vs. Design Modelling Vs. Actual Energy Use
(Menezes, 2012)
European Legislation & Policy

• 2000-European Climate Change Programme (ECCP)


• 2010- Recast of European Energy Performance of Buildings Directive (EPBD2)

• Extends scope of 2002 EPBD
• Strengthens certain provisions
• Gives public sector leading role in energy efficiency
In accordance with the requirements stated in Article 3 of the EPBD, the National Calculation Methodology (NCM) was defined by the ODPM as the unified calculation-based methodology for the demonstration of compliance.
The UK Case (section 3.4.1.1):

- Devolved administrative structure
- Jurisdictions: England, Wales, Scotland & Northern Ireland
- Each governed by separate body issuing their own regulatory documents.
The UK Case (section 3.4.1.1):
• Unified NCM method
• Relevant technical guides
• Compliance requirements
• Secondary associated documents

(Fig 3.6) Compliance procedure for the NCM
Adapted from BSRIA, 2010
Modelling for energy performance regulations compliance & certification [Section 3.4]

The UK Case (section 3.4.1)

(Table 3.3) Application of the NCM procedure: Wales 2014 Regulations
Modelling for energy performance regulations compliance & certification

3. Building Certification Requirements

- The Asset Rating (AR) - Energy Performance Certificates
  \[ AR = 50 \times \frac{BER}{SER} \]
- The Operational Rating (OR) - Display Energy Certificates
  \[ OR = \frac{\text{Building } CO_2 \text{ emissions/Building area}}{(100/\text{Typical } CO_2 \text{ emissions per unit area})} \]
The UK Case (section 3.4.1)

(Fig 3.7) Rating Scale for Energy Performance Certification & Example EPCs Source: DCLG 2008, 2012

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The UK Case (section 3.4.1.1):

Modelling Tools

• Accredited tools
• Accreditation processes & schemes

<table>
<thead>
<tr>
<th>CLASS</th>
<th>INPUT METHOD/DATA</th>
<th>CALCULATION METHOD</th>
<th>OUTPUTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBEM</td>
<td>Non-graphical, Microsoft Access based forms.</td>
<td>Monthly Average</td>
<td>-BRUKL/SBEM outputs&lt;br&gt;-Data reflection reports&lt;br&gt;-EPC Certificates</td>
</tr>
<tr>
<td>FI-SBEM TYPE A</td>
<td>Front-end graphical interface is used for geometry input. Interfaces with iSBEM for additional input.</td>
<td>Monthly Average</td>
<td>-BRUKL/SBEM outputs&lt;br&gt;-Data reflection reports&lt;br&gt;-EPC Certificates</td>
</tr>
<tr>
<td>FI-SBEM TYPE B</td>
<td>A front-end graphical interface is used for building geometry &amp; information input.</td>
<td>Monthly Average</td>
<td>-BRUKL/SBEM outputs&lt;br&gt;-Data reflection reports&lt;br&gt;-EPC Certificates</td>
</tr>
<tr>
<td>DSM</td>
<td>3D CAD front-end modules allow building geometry to be input &amp;/or imported from CAD packages, 3D BIM &amp; other software.</td>
<td>Detailed Hourly</td>
<td>-BRUKL/SBEM outputs&lt;br&gt;-Data reflection reports&lt;br&gt;-EPC Certificates&lt;br&gt;-Load /energy analysis</td>
</tr>
</tbody>
</table>
Modelling for energy performance regulations compliance & certification [Section 3.4]

Other EU nations (sections 3.4.1.2-3.4.1.4):
- Netherlands, France, Germany

Beyond the EU (sections 3.4.2.1-3.4.2.4)
- USA, Australia, Canada, Hong Kong

- Compliance requirements & modelling approach
- Building certification requirements
- Modelling tools
Modelling for building assessment & rating schemes [Section 3.5]

- Industry adopted standards, which set higher performance targets compared to national regulations
- Compliance checking with national building regulations an integral component for allocation of credits
- Overview of rating schemes in over 30 countries
- Focus on key International schemes

(Fig 3.8) Building assessment & certification schemes
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Modelling for building assessment & rating schemes [Section 3.5]

• Key International schemes (sections 3.5.1-3.5.4)

LEED, BREEAM, GreenStar, Pearl Estidama

• Scheme overview
• Relevant energy credits
• Compliance requirements
• Modelling approach
• Modelling tools

<table>
<thead>
<tr>
<th>LEED Rating System</th>
<th>EAP2 Method &amp; requirement</th>
<th>EAc1 Method &amp; requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Buildings: Operations &amp; Maintenance</td>
<td>Compare performance with the national average for similar building type where: Energy Star EPA Rating ≥ 69 or USGBC Option B &amp; C calculator shows energy efficiency ≥19% better than national average.</td>
<td>Compare performance with the national average for similar building type where: Energy Star EPA Rating ≥ 71 or USGBC Option B &amp; C calculator shows energy efficiency ≥21% better than national average.</td>
</tr>
<tr>
<td>New Buildings: New Construction, Schools, Comm Interiors, Core &amp; Shell</td>
<td>Demonstrate a specified % energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM</td>
<td>Demonstrate further energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM</td>
</tr>
<tr>
<td>Retail</td>
<td>Comply with ASHRAE 90.1 through the use of the PRM</td>
<td>Demonstrate further energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM</td>
</tr>
<tr>
<td>Healthcare</td>
<td>Demonstrate 10% energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM</td>
<td>Demonstrate further energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM</td>
</tr>
</tbody>
</table>

(Table 3.15) LEED Compliance methods & energy credit requirements
Modelling for building assessment & rating schemes [Section 3.5]

- Key International schemes (sections 3.5.1-3.5.4)
  - LEED, BREEAM, GreenStar, Pearl Estidama

- Scheme overview
- Relevant energy credits
- Compliance requirements
- Modelling approach
- Modelling tools

(Fig 3.9) The PRM method as applied for LEED NC
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Validity of Compliance Modelling Results [Section 3.6]

Potentially calls into question the validity of modelling results & the impact on the credibility of using modelling as a tool for demonstrating legislative compliance & allocating building ratings.

Causes of predictive variability

- Reliability & accuracy of physical input data
- User skill in data interpretation & tool use
- Applicability of the tool to the building & climate
- Ability of the tool to predict building performance/
calculation method used.
Summary & conclusions

• Compliance modelling may occur throughout the building’s lifecycle & has been increasingly integrated into planning application processes at local/city level.
• Compliance & design modelling are not the same, despite overlaps.
• Compliance modelling is simplified, indicative = not suitable for design development.
• Modelling methodologies utilise a common approach: Proposed designs are compared against benchmarks using accredited simulation tools.
• Environmental sustainability ranking systems are voluntary & aim to certify better performance.
• Often require compliance checking with national regulations/standards for credit allocation.