The National Calculation Method and SBEM

Paul Davidson,
Director, Sustainable Energy Centre
BRE
Agenda

• Reminder of the role of SBEM and iSBEM
• Recent developments
• Issues
• Future development
SBEM – meeting two inter-related requirements

• Building Regulations (E&W) Part L2a
  – As effective from April 2006
  – New buildings – design approval and completion
  – Equivalent regulations in Scotland and N Ireland

• Energy Performance of Buildings Directive
  – Minimum energy performance for new buildings (Part L2a)
  – Energy certificate required when sold or leased
  – Energy certificate required for public display?
National Calculation Methodology (NCM)

- Deals with Part L2A Compliance
- And with Asset Ratings (not Operational Ratings)
- Specifies the general approach
- Defines the Notional Building
- Specifies standard modelling rules
- Includes standard databases for building components and activities
- Allows the use of different calculation cores, including accredited simulation tools
- Encourages the development of different user interfaces for SBEM
SBEM produces an Asset Rating

• The calculated intrinsic performance of the building as built
• Normalised to standard conditions (weather, occupancy)
• Recognises different ‘activity areas’
• Applicable to both new and existing buildings
• Automatically generates the appropriate Notional Building as the baseline for compliance tests
• Used to demonstrate compliance with minimum standard
• And soon to generate a comparative rating (‘A-G’ or 0-100)
• Used to compare one building with others
• Also produces a ‘Design rating’ before building is built

• (Dwellings use SAP)
The SBEM development project

- Funded by DCLG via Faber Maunsell
- To produce a ‘simple’ tool
- To comply with the emerging CEN standards
- To cover the majority of ‘ordinary’ buildings
- To complement more sophisticated simulation-based methods
- Based on the Dutch NEN2916 method
- Monthly calculation process
- To include a basic user interface – iSBEM
- And the associated NCM databases
- Now 14 optional locations for standard weather data
The calculation methodology

A methodology which calculates ‘integrated energy performance of buildings’ (EPBD Article 1),

- Taking account of (Annex):
  - Indoor conditions
  - Fabric performance
  - HVAC and DHW
  - Lighting and daylighting
  - Position and orientation
  - Passive design features
  - Renewable and chp options
- Doesn’t specifically mention controls – but vital
- For the full range of non-domestic buildings
- For standardised use of the building (Art 2)
The process

• Calculates monthly demands for
  – Heat
  – Ventilation
  – Cooling
  – Lighting
  – Hot water

• Based on
  – Geometry
  – Construction
  – Activity schedules

• Calculates energy needed to meet demands, using
  – System types
  – System efficiencies
  – Control corrections, etc
Simplified Schematic: Standard Method

Many users will use the freely available standard SBEM / iSBEM package:

- User interface: iSBEM
  - User input; Data output

- Compliance check: BRUKL

- Calculation engine: SBEM
  - Heating, cooling, lighting, HVAC auxiliary energy

- Accessible databases:
  - HVAC performance
  - Constructions

- Locked databases:
  - Activity parameters
  - Weather

Notional building
Interface issues

• iSBEM is an Access application
  – CD-ROM version available
• Alternative interfaces now available
Simplified Schematic: Alternative Methods

User level

Commercial user interface (Hevacomp, Carbon Checker)

Compliance check: BRUKL

Calculation engine: SBEM

Notional building

Accessible databases: HVAC performance, Constructions

Locked databases: Activity parameters, Weather

Heating, cooling, lighting, HVAC auxiliary energy
Simplified Schematic: Alternative Methods

User level

Commercial user interface
User input; Data output

Compliance check:
BRUKL

Calculation engine:
Approved software
(Tas, IES)

Accessible databases:
HVAC performance
Constructions

Locked databases:
Activity parameters
Weather

Notional building
Issues

• Mismatch between answers
  – Some is inevitable
  – Notional building definitions vary in some simulation tools
  – Other discrepancies being investigated

• Co-operation mostly very good
  – Some negative publicity
Simplified Schematic: Standard Method

User interface: iSBEM
User input; Data output

Compliance check: BRUKL

Calculation engine: SBEM
Heating, cooling, lighting, HVAC auxiliary energy

Accessible databases:
- HVAC performance
- Constructions

Locked databases:
- Activity parameters
- Weather

Notional building
NCM Databases
Construction, Glazing, Activity, HVAC, Weather, ...

Construction Database

General:
- Name: Cavity wall, 50 mm mineral wool
- Spec. Method: LAYER INPUT
- Env. type: Wall
- Category: Cavity wall (full fill)
- Source: DOE2 (ASHRAE)
- Description: Wall with 50 mm cavity, fully filled with mineral wool

Layers:
- Absorptivity: 0.7
- U-value: 0.55 W/mK
- CM1: -
- CM2: -

Inference for Walls:
- Full fill cavity wall, 50 mm mineral wool batts
- U-value-calc: 0.56 W/m2K
- CM1-calc: -
- CM2-calc: -

Record: 52 of 132
NCM Databases
Construction, Glazing, Activity, HVAC, Weather, ...

This form does not allow edition. To modify these layers go to Layers\Layer definition or click here.
NCM Databases
Construction, Glazing, Activity, HVAC, Weather, ...

Activity Database

Activities
Object selector: RestPub_EatDrink

Basics and Occupancy
Name: RestPub_EatDrink
Type: CONDITIONED
Build. type: RESTAURANT/PUBLIC HOUSE
Source: CIBSE A
Full name: Eating/drinking area

Occupancy
Occupancy sch.: RestPub_EatDrink_Occ
People density: 0.2 pers/m2
Metabolic rate: 110 W/pers
Latent gain: 39%

Max. Humidity: 100 %
Min. Humidity: 0 %
Cool: RestPub_EatDrink_Cool
Heat: RestPub_EatDrink_Heat
Set back temperature: 12 °C
<table>
<thead>
<tr>
<th>Building Types/Activities</th>
<th>cellular office</th>
<th>open plan office</th>
<th>storage - ambient</th>
<th>circulation (corridors and stairs)</th>
<th>toilets</th>
<th>tea making</th>
<th>reception</th>
<th>classroom/meeting room</th>
<th>dry sports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Office</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 primary schools</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 secondary school</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 further education universities</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 primary health care buildings</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 nursing, residential homes and hostels</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 hospital</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 hotel</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 restaurant/bar/public house</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 sports centre/leisure centre</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 sports ground/arena</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 retail</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Database issues

Activities

• Some feedback from sector representatives
• Modifications made in successive releases
  – EG. School ventilation rates and occupancies
• More feedback welcome

Constructions

• Some minor modifications
• Plans to allow user-generated ‘private’ databases

HVAC system efficiencies, etc

• Some changes
• New systems added
• Facility to over-write defaults
Simplified Schematic: Standard Method

User interface: iSBEM
User input; Data output

Compliance check: BRUKL

Calculation engine: SBEM
Heating, cooling, lighting, HVAC auxiliary energy

Accessible databases:
HVAC performance
Constructions

Locked databases:
Activity parameters
Weather

Notional building
Describing the building - key stages

• Geometry
  – Overall building layout
  – Distribution of activity areas
• Construction
• Systems
• Controls

• Two different input routes:
  – New build – from plans
  – Existing buildings – from brief survey and other sources (eg log book data), supplemented by inference
Issues

• Importance of correct zoning
• Impact of daylight
• Set of consistent zoning rules
How to zone your building - the end result

The end result of zoning your building should be a set of zones which are distinguished from all others in contact with it by one or more of the following:

- Activity within it
- HVAC system
- Lighting system
- Access to daylight

With the final aim of allowing the tool to respond to the different conditions within the building, without too much complication.
An example of zoning due to lighting from windows

1. Divide floor plate by physical boundaries
2. Divide again if an area created has different HVAC or lighting systems within it
3. Attribute an Activity to each area
4. Merge any contiguous areas with same parameters
5. Divide each resulting area into zones which receive significantly different amounts of light:
   i. **6m from an external wall containing 15% glazing or more**
   ii. 1.5 room heights beyond the area of covered by an array of roof lights
6. Where a boundary of a zone is a virtual rather than physical boundary, created by the above process, it does not need to be entered into iSBEM
Simplified Schematic: Standard Method

User level

User interface: iSBEM
User input; Data output

Compliance check: BRUKL

Calculation engine: SBEM
Heating, cooling, lighting, HVAC auxiliary energy

Accessible databases:
HVAC performance
Constructions

Locked databases:
Activity parameters
Weather

Notional building
Issues

• ‘It’s harder to get a naturally ventilated building to pass’

• ‘There are fewer options to improve’

• ‘The Notional Building is too demanding in some circumstances’
  – Treatment of roof-lights
  – Lighting controls

• ‘Simulation tools can model whole HVAC systems’
  – Too time-consuming?
  – More scope for tool-specific variations
Energy Certificates for existing buildings – issues

• How is rating determined?
  – Relative to Notional Building or some other Reference?

• How long will the process take?
  – Can we simplify the process?
  – Merge zones?

• Sensitivity analysis underway
  – What data is critical?

• What data is difficult to find?
  – Inference aids
Existing buildings: Inference procedures - fabric

- Wall/roof/floor construction
- U-values
- Glazing areas and performance
- Thermal mass effects
- Infiltration rates

- Based on available data:
  - Age (e.g., Building Regs in force at construction)
  - Generic system
  - Building type
Inference procedures - systems

• Heating
• Ventilation
• Cooling
• Lighting

• For each system, need:
  – Type
  – Standard seasonal efficiency
  – Part-load performance

• Using minimal survey/inspection data
• ‘Expert system’ logic tree
• CT funding started process for HVAC
Other improvements
iSBEM – Help functions

Weather (Location)

Specifies the location of the building in order that the data can be used. Locations available are London, Manchester and Edinburgh. OIBSE hourly Test Reference Years have been used. The monthly average weather data needed to run OIBSE.
Defining the envelope

## Geometry - Hill Close Gardens Visitor Centre -

### Zones for All HVAC-Systems

**Zone selector:** Mixed use space

<table>
<thead>
<tr>
<th>Connects zone to</th>
<th>Construction</th>
<th>Area</th>
<th>% glazed</th>
<th>Glazing</th>
<th>Disp?</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South-East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North-East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North-West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South-West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Record:** 1 of 2

---

*bre*
Checking the zone envelopes

### Geometry - Example Building Complete File

<table>
<thead>
<tr>
<th>Zones</th>
<th>Envelope</th>
<th>Windows</th>
</tr>
</thead>
</table>

#### Zones for All hvac-systems

- **Zone selector**: z0/01

#### Envelope Summary

<table>
<thead>
<tr>
<th>Envelopes</th>
<th>Type</th>
<th>Connects to</th>
<th>Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>z0/01/s</td>
<td>Wall</td>
<td>Exterior</td>
<td>45</td>
</tr>
<tr>
<td>z0/01/e</td>
<td>Wall</td>
<td>Exterior</td>
<td>90</td>
</tr>
<tr>
<td>z0/01/n</td>
<td>Wall</td>
<td>Exterior</td>
<td>45</td>
</tr>
<tr>
<td>z0/01/w</td>
<td>Wall</td>
<td>Exterior</td>
<td>90</td>
</tr>
<tr>
<td>z0/01/ci</td>
<td>Floor or Ceiling</td>
<td>Conditioned adjoining space</td>
<td>450</td>
</tr>
<tr>
<td>z0/01/f</td>
<td>Floor or Ceiling</td>
<td>Underground</td>
<td>450</td>
</tr>
</tbody>
</table>

Record: 1 of 6
### HVAC Efficiency Data

**Building Services - Example building**

<table>
<thead>
<tr>
<th>General</th>
<th>Project Database</th>
<th>Geometry</th>
<th>Building Services</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC systems</td>
<td>DHW generators</td>
<td>SES</td>
<td>PVS generators</td>
<td>Wind generators</td>
</tr>
</tbody>
</table>

#### HVAC systems

- **Record selector**: HVAC for the example building

#### Heating

<table>
<thead>
<tr>
<th>Heating system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat source: Air heater</td>
</tr>
<tr>
<td>Fuel type: Natural gas</td>
</tr>
</tbody>
</table>

- **Do you know the generator seasonal efficiency?**
  - No, use default value: 0.75
  - Yes, seasonal efficiency is: 0.92

- **Do you know the generator radiant efficiency?**
  - No, use default value: 0.4
  - Yes, radiant efficiency is: 0.4

---

**Record:** 1 of 1
Defining the purpose of the analysis
<table>
<thead>
<tr>
<th>Feature</th>
<th>SBEM/iSBEM applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night ventilation strategy</td>
<td>Can be approximated with SBEM but not with the current version of iSBEM</td>
</tr>
<tr>
<td>Mixed mode operation</td>
<td>Can be approximated within SBEM but not with current version of iSBEM</td>
</tr>
<tr>
<td>Ventilation with enhanced thermal coupling to structure</td>
<td>Not currently available</td>
</tr>
<tr>
<td>Demand-controlled ventilation</td>
<td>Can be represented but requires calculation of parameter values</td>
</tr>
<tr>
<td>Automatic blind control</td>
<td>Not currently available</td>
</tr>
<tr>
<td>Variable speed pumping</td>
<td>Not currently available</td>
</tr>
</tbody>
</table>
Future development

- Addressing some of these needs
- Produce an SBEM Manual
- Can it be run on Apple Mac?
- Incorporate overheating calculation

- Other improvements as identified by users
SBEM Development Team

SBEM Helpline: 0870 460 8141

Go to www.ncm.bre.co.uk
- Download
- FAQs
- Feedback

BRE
Garston
Watford
WD25 9XX