Integrated Environmental Solutions Limited

Part L2 (2010) ApacheSim User Guide

IES Virtual Environment 2012

Building Regulations

Integrated Environmental Solutions Limited

Contents

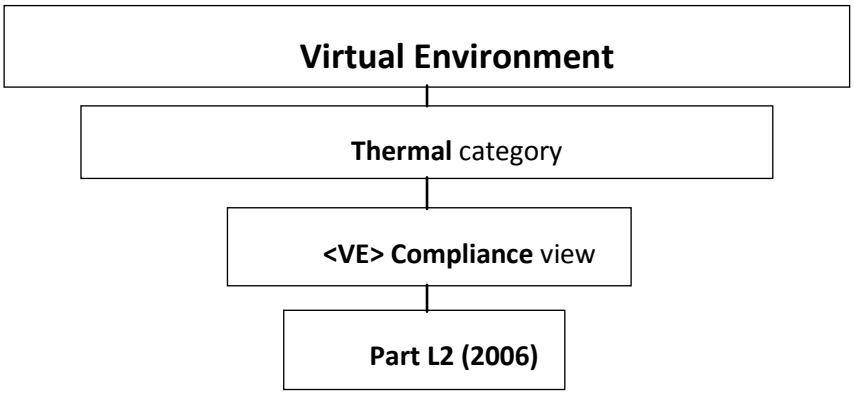
1 Introduction

1.1 What is Part L2 (2010) ApacheSim?

Part L (2010) ApacheSim is a facility within the Virtual Environment's <VE> Compliance view providing facilities for testing compliance with Part L2 of the Building Regulations (2010 edition). A further route to compliance is offered with the VE-SBEM facility; refer to the Part L2 (2010) VE-SBEM User Guide for further detail.

Part L2 (2010) ApacheSim applies to new buildings other than dwellings in England, Wales and Northern Ireland for which construction did not start before 6th April 2010. The regulation also covers dwellings with a floor area of more than 450m^2.

Part L (2002) applies to buildings in England, Wales and Northern Ireland for which construction started before 6th April 2010. If construction had not started before that date, the 2010 edition of Part L applies.



Data for the Part L (2010) ApacheSim analysis is taken from the <Virtual Environment> model, supplemented where necessary by inputs specific to the requirements of Part L (2010).

Results of the Part L (2010) ApacheSim analysis are presented in three levels of detail:
- Pass/fail verdicts for the methods tested.
- A summary of the checks carried out within each method and their results (an HTML file).
- A report setting out the analysis in detail (an HTML file).

Certain analysis results are processed and displayed immediately data is entered, providing instant feedback to the user.

1.2 Overview of Part L2 (2010) ApacheSim

The requirements of The Building Regulations, Part L2 (2010 edition) as applied to new buildings are set out in Approved Document L2A[1]. This document should be consulted in the course of any submission for Part L2 compliance.

The function and scope of the approved documents is set out in the 'Use of guidance' section:

"Approved Documents are intended to provide guidance for some of the more common building situations. However, there may well be alternative ways of achieving compliance with the requirements. Thus there is no obligation to adopt any particular solution contained in an Approved Document if you prefer to meet the relevant requirement in some other way."

The broad requirements of L2 are set out in the Requirement section of Approved Document L2A[1] (referred to in this document as 'L2A'). They cover:

Reasonable provision shall be made for the conservation of fuel and power in buildings by:

a. limiting heat gains and losses through i) thermal elements and other parts of the building fabric and ii) pipes, ducts and vessels used for space heating, space cooling and hot water services.

b. providing and commissioning energy efficient fixed building services with effective controls; and

c. providing the owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

The detailed requirements are outlined in Section 0: General guidance, under the heading Demonstrating Compliance. Five criteria must be satisfied (paragraph numbers refer to L2A):

Criterion 1: the calculated CO_2 emission rate of the building as constructed (the building emission rate, BER) must not be greater than the target rate (the target emission rate, TER) which is determined by following the procedures set out in paragraphs 18 to 23.

Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits set out in paragraphs 33 to 62…

Criterion 3: Those parts of the building that are not provided with comfort cooling systems have appropriate passive control measures to limit solar gains.

Criterion 4: the performance of the building, as built, is consistent with the prediction made in the BER…

Criterion 5: The necessary provisions for enabling energy efficient operation of the building are put in place…

L2A should be consulted for details of special considerations and exemptions applying to particular classes of buildings.

Some of the requirements of Part L2 cannot be tested in software (Criteria 4 and 5 fall into this category). However, IES aims to provide software covering all requirements that can be so tested.

1.3 Methods and Requirements

By contrast to L2 (2002), the 2010 regulations offer only one compliance route. This has some similarity with the Carbon Emissions Calculation Method in the 2002 regulations, though there

are important differences. The 2010 regulations have no counterpart of the L2 (2002) Elemental or Whole-building methods.

Within the single compliance route for L2 (2010) a choice is permitted regarding the analysis tool used to calculate the BER and TER. The carbon dioxide emission calculations that form the basis of these performance indicators can be calculated using either

The Simplified Building Energy Model (SBEM) developed by BRE, or

Approved commercial software

The L2 (2010) ApacheSim software falls into the second category.

The requirements tested by the software are Criteria 1 to 3, which are implemented in the software as follows:

1.3.1 Criterion 1: Achieving and acceptable building CO_2 emission rate (BER)

The BER and TER values are obtained from the simulated carbon dioxide emissions of two buildings.

The 'actual building', which forms the basis of the BER calculation, is the building as designed, but subject to standard operating conditions dictating levels and patterns of occupancy, internal gain and minimum ventilation.

The 'notional building', which forms the basis of the TER calculation, is a version of the actual building modified in accordance with rules relating to glazing area, insulation and system efficiency. These rules are related to the standards laid down for the 2002 Elemental Method. The notional building is also subject to the standard operating conditions.

Both buildings are simulated over a typical year using standard weather data appropriate to the building location. Results are automatically fed into the BRUKL compliance calculator provided by BRE.

The standard operating conditions are functions of the building type and the activities occurring within each room. They are laid down in the National Calculation Methodology (NCM)[3]. It is important to note that the stipulation of standard operating conditions for L2 (2010) compliance calculations means that simulation results as calculated for L2 (2010) will in general be different from those calculated for the 'real' building (for example in Apache View or for the L2 (2002) Carbon Emissions Calculation Method).

To obtain the TER, the CO2 emissions for the notional building are modified by certain factors as set out in the General Guidance section L2A under the heading Regulations. Details are set out in L2A.The purpose of these factors is to tighten the requirement on the actual building so that its performance exceeds that of the notional building. By this means the 2010 regulations impose a measurable degree of improvement over the standards applied in the 2002 regulations.

1.3.2 Criterion 2: Limits on design flexibility

Criterion 2 imposes constraints on U-values and other aspects of building and system performance.

Maximum and mean U-values for different classes of construction must not exceed stated values. The software applies checks for compliance with this requirement before performing the actual and notional building simulations.

Conditions are also laid down in the following areas (see L2A section headed Design limits for building services):

Controls
Energy metering
Heating and hot water service systems
Cooling plant
Air handling plant
Insulation of pipes, ducts and vessels
Lighting

1.3.3 Criterion 3: Limiting the effects of solar gains in summer

This criterion is aimed at controlling summertime temperatures in non air-conditioned rooms. The key provisions are set out in L2A paragraph 64:

Reasonable provision would be to show for every occupied space which is not air conditioned that:

a. when the building is subject to the solar irradiances for July as given in the table of design irradiances in CIBSE Design Guide A, the combined solar and internal casual gains (people, lighting and equipment) per unit floor area averaged over the period 0630 to 1630 Solar Time (GMT) is not greater than 35 W/m^2. TM47 gives guidance and supporting data to enable this check to be made and includes an adjustment factor to allow the basic limiting gain of 35 W/m^2 to be adjusted, dependent upon the location of the building; or
b. the operative temperature (the temperature index for thermal comfort as used in CIBSE Guide A) in the conditioned space does not exceed a threshold for more than a reasonable number of occupied hours per year when the building is tested against the CIBSE Design Summer Year appropriate to the building location; or
c. for school buildings, Building Bulletin 101 specifies overheating criteria and provides guidance on methods to demonstrate that reasonable provision has been made to control excessive solar gains.

The software provides an automated test by method b. Automated tests against the other two criteria will be introduced in due course. In the interim, these criteria may be tested for by suitable application of features available in the <Virtual Environment>.

1.4 Overview of L2 (2010) ApacheSim interface features

L2 (2010) ApacheSim constitutes one of the Regulatory Frameworks covered by the <VE> Compliance view of the <Virtual Environment>. A brief summary of its features follows.

1.4.1 Interface features shared with other Regulatory Frameworks

The <VE> Compliance view covers the following Regulatory Frameworks, which may be selected using the Regulatory Framework selector on the <VE> Compliance toolbar:

UK Dwellings
Part L1 (SAP 9.80) – England/Wales
Part L2 (2010) – ApacheSim method
Section 6 (2010) – Scotland

These Regulatory Frameworks all share core features of the <VE> Compliance view, such as the model workspace, the browsers, the menus and the toolbars. For a description of these please consult the <VE> Compliance view User Guide.

1.4.2 Current model selector (actual and notional buildings)

For the L2 (2010) ApacheSim Regulatory Framework a selector labelled 'Current model' appears at the right-hand side of the <VE> Compliance toolbar. This allows you to switch between displaying the actual building and the notional building.

In most respects the actual building is the same as the 'real' building used in other <VE> views and Regulatory Frameworks. However, there are differences in the Room Data, where for L2 (2010) certain attributes assigned to the 'real' building are overridden by attributes representing the standard internal conditions stipulated for L2 (2010) in the NCM methodology.

The notional building differs from the actual building in the following respects, in accordance with the rules set out in the NCM document:

Glazing (and in some cases door) areas are adjusted.

Standard constructions are applied.

Where there are unheated buffer spaces (including unheated roofs) in the actual building, the notional building treats these as heat loss paths for adjacent heated rooms (following the principles laid down in BS EN ISO 13789:1999[2]). For these adjacencies standard constructions are applied, replacing the heat loss paths (including the unheated spaces) in the actual building.

Standard Apache Systems are assigned to rooms depending on the type of conditioning assigned to the rooms in the actual building.

By selecting 'Notional' on the Current model selector, you can view the notional building and interrogate its features. However, no editing is permitted. The notional building is created automatically from the actual building and cannot be modified.

Trial simulations may be performed on the notional building using the button 'CO_2 emissions: test run (notional building)'.

1.4.3 Part L2 (2010) ApacheSim analysis settings

This dialogue, which appears on a tab at the bottom of the <VE> Compliance screen, deals with Part L2 (2010) ApacheSim data at the building or system level required by the BRUKL compliance module, together with simulation settings for the compliance analysis. It also provides buttons for performing compliance simulations, test runs and simulations related to

Criterion 3. Settings on this tab include the building type for Part L2 and a facility labelled 'Set Building & System Data', which can be also be accessed via the Apache view Settings menu.

1.4.4 Building regulations room data

Data relating to individual rooms is entered via the Room Data tabs for the actual building. General Building Regulations data, such as the room 'activity', is specified on the Building Regulations tab. Other tabs specify data for heating, cooling, gains and ventilation, some of which is forced to standard settings for the purposes of Part L2 (2010).

1.4.5 Building regulations construction data

Building regulations data relating to constructions (for instance, whether a window is classified as display glazing) is entered via fields labelled 'Building Regulations' within the construction data dialogues in APcdb.

1.4.6 Part L analysis and results

The Part L analysis and results dialogue on the lower edge of the <VE> Compliance view is divided into two parts:

Part L (2002) – England/Wales/NI - Analysis: facilities for specifying the Part L analysis to be performed

Results: facilities for viewing the results of the analysis

This dialogue also provides a route to the Part L2 (2010) ApacheSim building and system data.

2 Guidance on performing Part L2 (2010) assessments

The <VE Compliance> View provides the means to test compliance with the conservation of fuel and power requirements of the UK building regulations, including the 2010 regulations applying in England, Wales and Scotland.

This User Guide covers Part L2, the section of the regulations covering non-domestic buildings in England and Wales. The following guidance is aimed at providing an overview of the implementation of the regulations in the <VE> software.

2.1 Fundamentals of Part L2 2010

New Part L2 regulations came into force on May 6th 2010 and apply to non-domestic buildings beginning construction after this date. The regulations requiring designers to demonstrate significant reductions in carbon emissions from building energy use relative to the standards set by the previous (2002) edition of the regulations. This is achieved by performing a detailed analysis of the carbon emissions of two buildings:

- The ***actual building*** – the building as designed, but subject to standard patterns of occupancy and plant operation, and
- The ***notional building*** – a version of the building that conforms to standards similar to those applying in the Part L2 (2002) Elemental Method. The notional building is subject to the same occupancy and plant operation patterns as the actual building.

The analysis must demonstrate that the actual building's carbon emissions improve on those of the notional building by a specified margin – 28% for an air conditioned building. It is this improvement that constitutes the tightening of the regulations in the 2010 edition.

The analysis of carbon emissions must be performed with accredited software applying the National Calculation Methodology (NCM), such as <VE> Compliance or BRE's SBEM program.

By contrast with the 2002 regulations, where a choice of three compliance routes was offered, the 2010 regulations stipulate a single compliance procedure. This has much in common with the Carbon Emissions Calculation Method (CECM) of the 2002 regulations, but there are important differences including the following:

The actual building's performance must not merely match, but significantly improve on that of the notional building.
Assessments must be performed under standard occupancy and plant operating conditions. This means that under the new regulations, some of the data entered by the user to model the building for design work has to be replaced by different data for the purpose of compliance analysis.
Requirements on the control of summertime solar gains apply to the actual, not the notional building, and only to rooms without mechanical cooling. In this respect the 2010 notional building sets a slightly less demanding performance target than the 2002 notional building.

In terms of analysis methodology, the most significant change with respect to the 2002 Carbon Emissions Calculation Method is the requirement for standard occupancy and plant operating conditions. The consequence of this is that, in addition to the actual and notional buildings, the

designer will usually need to model and analyse (for design and other non-regulations purposes) a third building:

- The ***real building*** – this is the building as designed, and with the occupancy and plant operation conditions expected to apply in reality, rather than the standard conditions stipulated for Part L2 compliance.

The real building is the building presented in Apache View, where the special conditions required for Part L2 (2010) do not apply.

The testing of carbon emissions constitutes Criterion 1 of Part L2. The full set of criteria is as follows:

- **Criterion 1** – Achieving an acceptable building CO2 emission rate (*BER*).
- **Criterion 2** – Limits on design flexibility: this sets minimum standards for building fabric and system performance.
- **Criterion 3** – Limiting the effects of solar gains in summer: this imposes limitations on solar gains and temperatures in those parts of the building that are not provided with comfort cooling systems
- **Criterion 4** – Quality of construction and commissioning: this lays down requirements that the building must meet after construction. (Not covered by <VE> Compliance.).
- **Criterion 5** – Providing information: certain information must be provided to the owners of the building. (Not covered by <VE> Compliance.).

Users of the <VE> Compliance software are strongly advised to study the official documents defining the regulations.

2.2 Organisation of Part L2 2010 compliance analysis in the <VE>

In the IES <Virtual Environment> all building regulations compliance testing is performed in the <VE> Compliance View. This covers the 2002 and 2010 regulations for England and Wales as applied to both dwellings and non-dwellings, together with their counterparts in Scotland.

The starting point for a compliance analysis, however, is the input of geometrical data in ModelIT. The Template Manager, a central resource available from all Views, is typically used next to set up room system and ventilation parameters. Apache View, while not essential for compliance testing, commonly plays a part in the input of Part L data that is shared by other Apache View application, and Views such as SunCast and MacroFlo may also be invoked. The purpose of this section is to provide an overview of the roles played by the different parts of the <VE> in the compliance testing process.

ModelIT handles the input of the building geometry.

The **Template Manager** provides facilities for setting room conditions for a range of thermal applications. In the context of Part L2, it also allows the specification of *room activities* that define the standard occupancy and plant operation conditions that apply in Part L2 (2010). In Part L2 compliance tests these standard conditions automatically override certain of the Room Data settings that would otherwise be taken from the Room Template.

Apache View covers thermal applications such as heating and cooling loads calculation, and simulation outside the context of Part L. The analysis in this View applies to the *real building*, for which all the input data is under your control. Where data is shared between the real building

and the actual building, this data may be entered in either Apache View or <VE> Compliance. Examples of such shared data include:

- Location
- Constructions
- HVAC systems
- Infiltration
- Renewables

<VE> Compliance covers thermal analysis specific to the Building Regulations. Some of the data required by the Building Regulations is shared with Apache View, as indicated above, and may be entered or edited in either View. Other regulations-specific data must be entered in the <VE> Compliance view. This includes:

Regulatory framework – eg Part L2 (2010) (assumed in the list that follows)

- Building type
- Room activities (may be specified by means of templates)
- Data relating to lighting energy savings
- Heat bridging data
- Stage of analysis (Design or As Built)
- Data required by the BRUKL compliance calculator, including addresses, system characteristics and air-tightness properties

<VE> Compliance displays data for the actual building by default. The notional building may also be inspected in this View. Facilities are provided for performing compliance simulations, test compliance simulations (on both the actual and notional buildings) and summertime temperature analyses for Criterion 3.

SunCast analyses shading and internal solar penetration, factors which may optionally be taken into account in compliance simulations.

MacroFlo and **ApacheHVAC** are other Views covering natural ventilation analysis and component-based HVAC system simulation, respectively, that are also available as adjuncts to compliance simulations.

Vista provides facilities for viewing the results of <VE> Compliance and other simulations.

2.3 Real, actual and notional buildings

The definition, creation and purpose of these three buildings can be summarized as follows.

The *real building* is the building that you see in Apache View. It is the building as designed, and with the occupancy and plant operation conditions expected to apply in reality, rather than the standard conditions stipulated for Part L2 compliance. In Apache View it forms the basis for the analysis of heating and cooling loads and simulations.

The *actual building* is the building as designed, but subject to standard patterns of occupancy and plant operation for Part L2 (2010), as defined in NCM. The actual building is the building displayed by default in <VE> Compliance. It is identical to the real building in all respects except occupancy (including associated internal gains and minimum ventilation rates) and plant operation conditions, which are given standard settings in <VE> Compliance as a function of the attributes 'building type' and 'room activity'. Aspects of the actual building that are shared with the real building may be edited either Apache View or <VE> Compliance.

The *notional building* is a version of the actual building that is modified to conform to a clearly defined set of standards relating to glazing area, constructions and system characteristics. Its purpose is to provide a benchmark or target against which to measure the performance of the actual building. The notional building is subject to the same occupancy and plant operation patterns as the actual building. It can be viewed in <VE> Compliance by switching the Current Model from *Actual* to *Notional*. It is created automatically from the actual building, and may not be edited. (One exception to this rule is dealt with below.)

The real building

Users interested in compliance testing only will not need to consider the real building as an entity distinct from the actual building. They can thus bypass Apache View. They should, however, be aware that certain room template attributes are overridden in <VE> Compliance.

Aside from this point, which is covered in more detail below, the real building does not need to be considered further in the context of <VE> Compliance.

The actual and notional buildings, however, can usefully be described in more detail.

The actual building

The actual building allows you control over the following aspects of the design, which it shares with the real building:

- Data shared between actual building and real building:
- Location
- Geometry (including orientation and glazing)
- Constructions
- System characteristics including renewables
- Infiltration rates (permeability)

The actual building differs from the real building in terms of its occupancy and plant operation, which for the purpose of Part L2 (2010) are forced to standard patterns linked to the activity associated with each room. The data in this category is

- Activity (NCM Template) Room Data:
- Occupancy
- Equipment gains
- Lighting levels (expressed in terms of illuminance)
- Room conditioning (heating and cooling set points and operation periods)
- Minimum ventilation rates

For the purpose of Part L2 (2010) compliance analysis, this data is outside your control and cannot be edited. Note that these attributes are present in the Room Template for use in Apache View analyses, but the settings appearing there are overridden in the Part L analysis.

The standard settings for <VE> Compliance are brought into the room by means of a second template called the *NCM Template* which is applied in combination with the usual Room Template. The NCM Template contains the standard operating conditions (as listed above) associated with the room's *NCM activity*. For example, a room assigned the activity 'Open plan office' in a building of type 'Office' has an NCM Template called 'NCM Office: Open plan office'. This contains the occupancy and equipment gains, the lighting level and profile, the room conditioning settings and the minimum ventilation regime laid down as standard for NCM

assessments of an open plan office. NCM Templates appear in the list of Room Templates in the Template Manager, where they can be examined in detail.

The activity (sometimes called the *NCM activity*) is assigned to the room on the Room Data Building Regulations tab, and may optionally be specified by means of the corresponding attribute in the Room Template. The activity, which is always associated with a particular *building type,* exists solely for the purpose of building regulations and is only used by <VE> Compliance. Setting the room activity automatically assigns the correct NCM Template and all the data associated with it. The name of the NCM template, together with that of the room template, can be seen displayed on the General tab of the Room Data dialogue.

Not all the Room Data is set by the NCM Template. Just as in Apache View, each room in <VE> Compliance has a Room Template, and this sets the parts of the Room Data that are not covered by the standard activity settings – namely

- User-supplied Room Data:
- System characteristics
- Measures to improve the efficiency of lighting systems
- Infiltration rates

The Room Data displayed and used in <VE> Compliance is thus drawn partly from the NCM Template and partly from the Room Template, as follows.

The data on the **Room Conditions** tab is drawn entirely from the NCM Template. These parameters, which include set points and operation times for heating and cooling plant and hot water demand, are fixed for Part L2 by the room activity, and override the corresponding settings in the room template.

The data on the **System** tab is drawn entirely from the room template. The system parameters are under your control, and may be adjusted as part of the process for achieving compliance.

The data on the **Internal Gains** tab is, with one permitted exception, drawn from the NCM Template. Occupancy and equipment gains form part of the standard pattern for the activity. Lighting gains and power consumptions must also follow the pattern laid down for the activity, but here it is permitted to adjust these figures downwards for the actual building if this can be justified on the basis of lighting system efficiency. It is also permitted to implement daylight-linked lighting control by means of formula profiles. This option is described in more detail in the appropriate section of the User Guide.

The data on the **Air Exchange** tab is drawn partly from the room template and partly from the NCM template. The NCM template stipulates ventilation rates for the activity, and these appear as Auxiliary Ventilation air exchanges, replacing any air exchanges of this type appearing in the room template. Other types of air exchange – those of type Infiltration and Natural Ventilation – are taken from the room template.

By applying these rules, <VE> Compliance automatically sets the attributes that are laid down by the room's NCM Activity, while giving you control over those aspects where good design can produce energy and carbon savings – namely system performance, infiltration (air-tightness) and ventilation strategies involving the use of outside air for cooling. To this list can be added improvements to the building fabric, and to system characteristics, which of course do not feature in the room template data.

It should be added that wherever the room template is mentioned above, there is (as usual) the option to override the template settings manually in individual rooms or groups of rooms.

However, NCM template settings cannot be overridden in this way, except in the special case of lighting gains.

System characteristics for the actual building (which it shares with the real building) are set by means of Apache Systems. A suitable set of systems should be created and assigned to groups of rooms. The 'UK NCM system data wizard' facilitates this process and allows the system characteristics to be specified using an iSBEM-like interface.

The notional building

The notional building is derived automatically from the actual building according to rules laid down in the NCM methodology. These rules are set out in full in the official documents and what follows is a summary.

The notional building settings represent standards of construction and system efficiency that are similar to those applying in the Elemental Method of Part L2 (2002).

The location and geometry of the notional building (with the exception of glazing and door area) are copied from those of the actual building:

Glazing in the notional building is modified to conform to standard facade area percentages depending on the building type, and there are particular rules applying to areas of display glazing, doors (of two kinds) and smoke vents.

The notional building is assigned standard constructions for external elements – walls, roofs, floors and glazing. A special rule applies to ground floor constructions. In broad terms the notional building constructions conform to the standards of the 2002 regulations. Where the actual building has spaces that are designated 'Unheated roof', 'Unheated buffer space' or 'Glazing cavity' – indicating spaces that form part of the building envelope rather than the occupied areas – these spaces are absorbed into the elements by which they connect to the occupied areas in the notional building, which are assigned the appropriate standard constructions.

Rooms in the notional building are assigned the same NCM Templates as their counterparts in the actual building, so that the occupancy, gain and plant operation regime in each room conforms to the appropriate NCM Activity.

In the notional building, room data that is not covered by the NCM Activity (and which in the actual building is set by means of the Room Template) is also set by the NCM Template, which in respect of these attributes contains the data stipulated in the official notional building definition. In particular, infiltration rates are set in conformance with the Part L2 (2010) standards of air-tightness as interpreted by BRE TM 23.

Three types of systems may be present in the notional building, depending on the type of room conditioning used in the actual building:

- Heating and natural ventilation,
- Heating and mechanical ventilation, or
- Air conditioning

For each type of system, standard efficiency characteristics are laid down in the official notional building definition. In <VE> Compliance, the three types of system appear as Apache Systems named

- NCM notional heating + nat vent system
- NCM notional heating + mech vent system

- NCM notional air conditioning system

Rooms which in the actual building are served by an Apache System of a given type (as indicated by the 'Cooling mechanism' setting) are assigned the appropriate NCM notional building system in the notional building.

2.4 Steps in performing a <VE> Compliance analysis

The following workflow is recommended for preparing and performing a <VE> Compliance analysis for Part L2 (2010). The plan need not be followed slavishly. Variations can be made in the ordering of the tasks and experienced users may wish to take alternative approaches to some of the stages. The purpose of the plan is to guide you through the basic process.

2.4.1 Step 1. Create geometry

The process usually begins with the entry of building geometry in ModelIT.

2.4.2 Step 2. Set location and weather data

The building location is specified in the APLocate utility. The L2 regulations currently cover locations in England and Wales.

Weather data for simulation-based Part L2 (2010) assessments is provided by CIBSE and consists of two weather files – a Test Reference Year (TRY) used for Criterion 1 and a Design Summer Year (DSY) which is used in one of the methods for showing compliance with Criterion 3. TRY and DSY files are provided for 14 UK locations. You will need the TRY and DSY files corresponding to the nearest of these locations to the building location. A licence to use this data must be obtained from CIBSE. IES acts as an agent for CIBSE and the licence to use the data may be purchased online using an option on the IES Online menu. If you use this option, copies of the files in the IES .fwt format will automatically added to your installation.

2.4.3 Step 3. Create and assign constructions

Constructions for building elements such as walls, roofs and glazing are created in the Constructions Database (CDB) utility accessible via Apache View or <VE> Compliance. They should satisfy the U value requirements of Criterion 2. The construction definition should include allowance for non-repeating thermal bridging, using an area-based thermal bridging coefficient. Constructions may be assigned to building elements in either Apache View or <VE> Compliance.

2.4.4 Step 4. Set building type and general data

At this stage you may wish to go to <VE> Compliance and set up some of the high-level data required for the compliance analysis.

First check that the Regulatory framework selector is set to 'Part L2 (2010) – ApacheSim'.

In the 'Building settings' box near the bottom of the screen select a building type from the list. This indicates the type of building for Part L2 purposes and determines what room activities can be specified in the building. It also automatically sets the Building Category, which determines glazing areas in the notional building.

For a building with multiple use, the various parts can be analysed by including NCM activities from other NCM building types. **This is a new feature in version 5.6.**

Not all zones may need to be included in a compliance run for example separate buildings may exist within the same model. The part(s) of the building included in a particular analysis is defined by the settings of the check boxes 'Include room in Building Regs analysis?' for each room on the Room Data Building Regulations tab.

2.4.5 Step 5. Create or import room templates

An efficient way to assign Room Data is by means of Room Templates. A Room Template contains a collection of settings that define the internal conditions applying in a room of a given kind. By defining these conditions centrally you can assign them quickly to large numbers of rooms and transfer them readily to other models via the Import Template mechanism.

Room Templates contain data arranged on tabs under the headings Building Regulations, Room Conditions, Systems, Internal Gains and Air Exchanges. Not all this data is used in <VE> Compliance assessments, some being overridden by standard settings. It is therefore important to understand where and how the various components of Room Template data are used. In particular, if you do not intend to use the analysis options available in Apache View (which analyses the *real building*) you do not need to set Room Template data on the Room Conditions and Internal Gains tabs, or create air exchanges of the Auxiliary Ventilation type.

One of the attributes that can usefully be set in the Room Template is the *NCM Activity*, which is always partnered with an *NCM Building Type*. If these attributes are set in the Room Template, rooms assigned the template will automatically have the NCM Activity (and all the Room Data associated with it) set in <VE> Compliance.

If you adopt a policy of including NCM Activity settings in your Room Templates you will save a lot of time and effort assigning NCM Activities to individual rooms and groups of rooms in <VE> Compliance.

The next section provides guidance on the Room Template settings.

2.4.6 Step 6. Room Template and Room Data settings for L2 (2010) assessments

When creating Room Templates it is important to understand which Room Template settings will be used in <VE> Compliance and which are overridden by standard activity-based settings.

Building Regulations (taken from Room Template or specified room by room)

This tab contains data used exclusively by <VE> Compliance. Some of the fields can be set in the Room Template. Others appear only in the <VE> Compliance Room Data and must be set on a room-by-room basis.

The check box 'Include room in Building Regs analysis?' allows you to restrict the Part L analysis to part of the building only.

The 'Type of room' attribute is normally set to 'Heated room', but the following alternative settings are provided to cover various types of unheated space:

- **Unheated roof** – use this type for an unheated roof space lying outside the insulated building envelope (ie where the insulation is at ceiling level).
- **Glazing cavity** (required only rarely) – use this type for a glazing cavity that has been modelled as a separate room for simulation purposes.
- **Unheated buffer space** – use this type for other types of unheated space attached to the building but lying outside the insulated building envelope. Examples are car parks and lean-to outbuildings.
- **Internal void or warm roof** – use this type for floor and ceiling voids, and for roof spaces that lie inside the insulated building envelope (ie with insulation at rafter level).

In the case of the first three types listed above – all representing types of unheated buffer space – an external ventilation rate must also be entered for the purpose of calculating U values for Criterion 2. All the above types of room are excluded from the floor area summation upon which the emission ratings are based.

The settings NCM Building type and NCM Activity together specify the activity assigned to the room for the compliance analysis, which in turn (via the NCM Template) sets the standard conditions applied for occupancy and plant operation. While these attributes are optional in the Room Template, it is a good idea to set them there to save effort in <VE> Compliance.

Room conditions (taken entirely from NCM template)

The data set on this tab in the Room Template will be ignored in <VE> Compliance (but it will be used for assessments of the *real building* in Apache View).

In <VE> Compliance, the data on this tab can be viewed but not edited. It is taken from the NCM Template as part of the specification of standard occupancy and plant operation conditions.

System (taken from Room Template)

The data set on this tab in the Room Template will be used in both <VE> Compliance and Apache View.

In either of these views, data on this tab is initially taken entirely from the Room Template (but as usual you have the option to override this data in individual rooms).

For compliance assessments, the important parameters on the System tab are the following.

In the Systems box:

- HVAC system – this indicates the Apache System serving the room's space conditioning needs
- DHW system – this indicates the Apache System serving the room's hot water needs including any solar energy system

In the System outside air supply box:

- Free cooling flow capacity – this indicates the maximum intake of outside air that is available for free cooling. In the case of a naturally ventilated room, a value of 5 ach would be typical to model ventilation by window opening. In the case of an air conditioned room, where the outside air is brought in via the system, it would be usual to express the value in l/(s·m^2) and a value of 0.5 in l/(s·m^2) would be typical. Note that this figure represents the additional outside air intake over and above the minimum ventilation level. Free cooling is covered further in the User Guide.

Parameters on the System tab that can be ignored are:

- Auxiliary ventilation system – this is not applicable because under the NCM conventions there is no conditioning of ventilation air.
- Sizeable parameters (shown in blue) – sizing plays no part in <VE> Compliance.
- Humidity limits – these are disabled for <VE> Compliance assessments in line with the conventions applying in the NCM systems approach.
- Flow rate and profile for System outside air supply – in <VE> Compliance this type of air supply is replaced by standard ventilation patterns handled by Auxiliary Ventilation air exchanges.

The setting of data on the System tab is closely linked with the setting of data in Apache Systems, which is dealt with below.

Internal gains (taken from NCM Template – lighting editing permitted)

In the <VE> Compliance Room Data, this data is taken from the NCM Template as part of the specification of standard occupancy and plant operation conditions. It can be viewed but, with the exception of the lighting data, should not normally be edited.

An exception to this rule can occasionally be appropriate where rooms have been subdivided with horizontal partitions for modelling purposes. In such cases it is permissible to distribute the gains as appropriate among the sub-spaces. However, it is your responsibility to ensure that the total gains for the room are as specified in the NCM template.

The lighting data in <VE> Compliance has a special status. Whilst it is initially set from the NCM Template (activity) it may be edited in order to model improvements to lighting system efficiency over that assumed in the notional building. The types of edit permitted are a) changes to the gains and associated power consumptions of the lights and b) changes to the profiles applied to the lighting.

The lighting levels laid down for the different NCM room activities are specified in terms of a lighting illuminance (lux). The rules for the notional building translate this to a power consumption (and corresponding room gain) expressed in W/m^2 using an installed power density factor (W/m^2 per 100 lux). The power density factor assumed in the notional building is 3.75 W/m^2 per 100 lux for offices and similar rooms such as classrooms, seminar rooms and conference rooms, and 5.20 W/m^2 per 100 lux for rooms of other types. In an office, for example, an illuminance level of 500 lux lighting level would require a power input of 18.75 W/m^2. The same power density factors form the basis for the lighting gain and consumption data (expressed in W/m^2) contained in the NCM templates used in both the notional building and the actual building. This means that if the lighting system in the actual building achieves a 20% reduction in power density factor over the value assumed in the template (for example from 3.75 to 3.0 W/m^2 per 100 lux), this should be accounted for by reducing the lighting gain

by the same factor (for example from 18.75 to 15.0 W/m^2). Note that both the gain (which affects cooling loads and summer temperatures) and the power consumption (which directly affects carbon emissions) should be reduced.

Daylight compensation controls can also be included in the compliance assessment. The recommended way to do this is with *dimming profile* which is applied in combination with the variation profile and can be used to reduce the lighting gains in the rooms in response to available daylight. Contact support@iesve.com for further guidance on this approach.

It is important to emphasize that where changes are made to the lighting data, this must be done in the rooms, not in the NCM Template (which is uneditable). Data for a group of rooms may be edited together by means of the 'Edit group attributes' toolbar icon.

The data appearing on this tab in the Room Template will be ignored in <VE> Compliance (but will be used for assessments of the *real building* in Apache View).

Air exchanges (auxiliary vent from NCM Template, other vent from Room Template)

Some of the data on the Room Template's Air Exchange tab is used in <VE> Compliance, and some is overridden. The rules are as follows.

The activity (NCM Template) for a room specifies a rate and a schedule for minimum ventilation supplied to the room. This ventilation appears in the NCM template as an air exchange of type Auxiliary Ventilation, which replaces any other Auxiliary Ventilation air exchanges that might be assigned to that room by means of the Room Template or manual additions. By contrast, other types of air exchange (those of type Infiltration or Natural Ventilation) assigned to the room by the template or otherwise are retained in <VE> Compliance.

One further rule is that any settings for 'System outside air supply' on the System tab are, like Auxiliary Ventilation air exchanges, ignored in <VE> Compliance.

The straightforward way to ensure that ventilation is correctly modelled in <VE> Compliance is to follow the scheme set out below:

1. Specify infiltration based on air leakage characteristics.
2. If you are not concerned with the real building (as used for Apache View analyses) ignore Auxiliary Ventilation air exchanges and System outside air supply settings in the Room Template.
3. If you are modelling the real building, set up its minimum ventilation rates as either Auxiliary Ventilation air exchanges or System outside air supply settings, keeping this component of ventilation separate from ventilation of other kinds.
4. Where additional ventilation – that is, ventilation over and above the minimum levels – is required, use either Natural ventilation or Free cooling (the latter being the recommended first choice).

This will ensure that those ventilation components that are subject to standard settings for compliance purposes are identifiable and correctly substituted without omissions or double counting.

Under normal circumstances auxiliary ventilation should not be edited, as this data forms part of the NCM activity specification. There is one exception to this rule: if ventilation is provided by an ApacheHVAC system (at the rate set in the NCM template), it would be appropriate to turn off the auxiliary ventilation.

More guidance on ventilation in compliance assessments is provided in Appendix A of this User Guide.

2.4.7 Step 7. Create and assign HVAC and DHW Systems

It is recommended that HVAC and DHW systems characteristics for <VE> Compliance analysis are specified within the framework of Apache Systems. Apache Systems provide a robust and uncomplicated system model that has been harmonised with that provided in iSBEM with the aim of providing a point of reference and common ground between these alternative compliance methods.

Systems are one of the aspects of building design where substantial carbon emissions improvements can be introduced. The system data is therefore under your control, and it is shared between the real building (as displayed in Apache View) and the actual building (as displayed in <VE> Compliance).

The Apache System HVAC model has three key parameters, which can be defined in summary as follows:

SCoP – the efficiency of the heating system

SSEER – the efficiency of the cooling system (if present)

Auxiliary Energy Value – energy required for fans, pumps and controls

These are the most important parameters featuring in the calculation of the energy consumed by the space heating and cooling systems. Taken together with the fuels specified for heating and cooling, they encapsulate most of the important data about system performance in relation to carbon emissions.

On the Apache System dialogue there are other parameters that are linked with the heating and cooling system efficiencies and do not represent independently editable settings. For example, the heating system's Generator seasonal efficiency and Heating delivery efficiency are linked to the SCoP by the relation

SCoP = (Generator seasonal efficiency) × (Heating delivery efficiency)

so that in terms of carbon emissions they can be viewed as secondary to the SCoP.

On the cooling side an analogous relationship exists between SSEER and the following parameters:

EER – the cooling system generator energy efficiency ratio or COP

CDE – the cooling delivery efficiency, and

HRP – the heat rejection pump and fan power fraction

namely

SSEER = EER * CDE / (1 + (EER + 1)*HRP)

In terms of carbon emissions EER, CDE and HRP can thus be viewed as secondary to the SSEER.

These 'secondary' parameters are important for certain design tasks in Apache View – for example the calculation of boiler and chiller loads. But for <VE> Compliance, SCoP and SSEER are the key efficiency measures.

Auxiliary energy value is a concept that has been developed in connection with the NCM methodology. This parameter indicates the power consumption of fans, pumps and controls associated with the space heating and cooling systems. It is expressed in terms of Watts per square metre of floor area served, and is incurred when the heating, cooling or ventilation systems are running.

Parameter values can be entered directly into the Apache System dialogue. But it will usually be appropriate to make use of the UK NCM System Data Wizard to assist this task.

The UK NCM System Data Wizard has been developed as a replica of the analogous facility in iSBEM. Its purpose is to guide you through the process of describing the system properties and to generate values for the three key parameters.

In addition to the key parameters mentioned so far, there are other system parameters of importance such as heating and cooling system fuels and ventilation heat recovery effectiveness. These are also generated automatically from data entered in the wizard.

More information on using the wizard is provided in the <VE> Compliance User Guide.

New nomenclature for heating, cooling efficiencies has recently been introduced that aligns <VE Compliance> with the NCM. Definitions of these can be found in the DCLG document 'Non-Domestic Heating, Cooling and Ventilation Compliance Guide'. This is freely downloadable from the DCLG website:

http://www.odpm.gov.uk/index.asp?id=1130726

SCoP and SEER values for commonly available plant can be found at:

www.eurovent-certification.com

The Apache System approach to DHW systems is slightly different from that adopted in iSBEM, but allows essentially the same flexibility. By default DHW is assumed to be the supplied by the same Apache System as the space heating system. If the building has a separate DHW system this can be created as an Apache System and connected to the rooms it supplies by means of the DHW System selector on the Room Data System tab. The efficiency of the DHW system must be expressed in terms of a generator (eg boiler) efficiency and a DHW delivery efficiency, the overall efficiency of the system being the produce of these two efficiencies.

The DHW system wizard enables the definition of the delivery efficiency, storage and the secondary circulation efficiencies and pumping power. The DHW heating demand can be derived from a solar water heating system. This system will use solar power, when available, to pre-heat the water for the DHW system. A storage system can be defined for the solar water heating system.

While the real (Apache View) and actual (<VE> Compliance) systems are in most respects identical, one difference is enforced in <VE> Compliance because of the way minimum ventilation is specified in NCM. For the real building there are controls on the Room Data System tab allowing you to specify air supplied to the room in the form of a 'System air supply'. In <VE> Compliance all such air supplies are handled by Auxiliary Ventilation air exchanges, and for this reason the System air supply is disabled in this View. Following on from this the settings in Apache Systems dealing with setting the condition of the System air supply do not play a part in <VE> Compliance. In <VE> Compliance, ventilation is always supplied to rooms (or their terminal HVAC units) at outside air temperature.

2.4.8 Step 8. Define renewable systems

Four renewable systems are available for use within the actual building; CHP, Wind, PVs and Solar water heating. CHP should be sized to provide the base load of heating for the building and the power generated will be used to offset the electrical energy usage in the building. Wind and PV systems will, when the prevailing weather conditions permit, provide electrical energy that will offset electrical energy usage in the building.

2.4.9 Step 9. Set or check fuel carbon emission factors

The carbon emission factors to be used in L2 (2010) compliance assessments are stipulated in the NCM methodology for a range of fuels. The Fuels Data facility in Apache View and <VE> Compliance allows fuel carbon emission factors to be edited. The default values are those which conform with NCM. For compliance runs, any departure from these values, or use of fuels not on the NCM list, would need to be carefully justified in supporting documentation.

2.4.10 Step 10. Set Building & System Data

We now return to the Building & System Data dialogue to prepare for the compliance simulations. If the 'Set Building & System Data' button is not visible at the bottom of the screen, move the cursor into an empty space on the model workspace graphic and click once.

Building & System Data is distributed over three tabs.

First, on the General tab, fill in the address and contact details.

Then move to the Building & System Performance tab. This contains data required by the BRUKL compliance checker that collates the simulation results and generates the compliance report.

- Building air permeability at 50 Pa – BRUKL requires confirmation of this air-tightness parameter, which must have a value of 10 $m^3/(m^2 \cdot h)$ or less. Note that setting this parameter must be set in addition to the infiltration rates used in simulations.
- Is solar gain acceptable in occupied zones without mechanical cooling (L2A paragraphs 59 & 60)? - If the building contains any occupied spaces without mechanical cooling (air conditioning), you are required to make a statement that the solar gain in those rooms has been shown to be acceptable (Criterion 3).
- Method used to show compliance with L2A paragraph 60 (supply supporting documentation) - If the previous box displays 'Yes', the method used to demonstrate that Criterion 3 is satisfied must be indicated here. The recommended setting for <VE> Compliance methodology is Method b (temperature simulation).
- Heat, cool source and DHW efficiency - BRUKL requires the overall system heat source efficiency as an input. You may type a value or tick the box labelled 'Derive from Apache System?' to get the software to calculate an area-weighted average heat source efficiency for all Apache Systems used in the building. In addition BRUKL requires confirmation of the stage of analysis either as designed; or as built and the overall building specific fan power.

The remaining parameters appear in the box labelled 'Adjustment for management features'. These settings allow credit to be taken in the BER calculation for management features applied to electrical power and lighting:

- Electric power factor
- Lighting systems have provision for metering?
- Lighting systems metering warns of 'out-of-range' values?

Finally, click on the Simulations settings tab, which displays the ApacheSim simulation settings that will be used in the Compliance simulations and test runs. Note that where appropriate these are shared between the Notional and Actual building, and between compliance and summer temperature check simulations. The following are the important settings:

- Results file – the name you enter here (prefixed by 'a_' for the actual building and 'n_' for the notional building) will be used to store the results of the simulations, which can be viewed in Vista.
- SunCast link? – tick this box if you wish to use SunCast shading data in the simulation of the actual building.
- Preconditioning period – make sure (using test runs if necessary) that this is sufficient to establish a realistic starting condition for the simulations.

Other settings which you may also need to use are:

- Natural ventilation air exchange? – tick this box if you have specified any ventilation by means of natural ventilation air exchanges
- Use previous results for notional building? – tick this box to save simulation time if you are repeating a compliance test with changes that do not affect the notional building, for example changes to system efficiencies.

You may also change the time step, reporting interval and output options to generate more detailed results data for Vista.

Note that the weather file is forced to the appropriate TRY dataset for compliance simulations. If this file is not present compliance simulations will not be enabled.

2.4.11 Step 11. Inspect notional building

Select 'Notional' from the Current model selector at the top right of the screen. You can then inspect the notional building. Note the changes to glazing (and in some cases doors), constructions, Apache Systems and Room Data. You may if you wish perform test simulations on the notional building to check its performance over periods of a few days up to a year.

Under the NCM rules, the notional building is generated automatically from the actual building and is in almost every respect uneditable. The only attribute of the notional building that may in some instances be edited is the heating system fuel in the appropriate Apache System(s). If natural gas is not available at the site, this fuel may be switched to oil. This can be done in the Apache System utility, accessed from any suitable View.

2.4.12 Step 12. Perform test runs

Before committing to a full compliance analysis it is generally advisable to check the model settings by performing one or two test runs on the actual building. This is done using the button 'CO2 emissions: test run (actual building)'. Test runs may also be performed on the notional building.

Simulate the building for a few days in winter and a few days in summer. View the results in Vista and check that the model is behaving as designed. In particular, check room temperature control, the operation of mechanical and free cooling and take a look at system loads and energy consumptions. This feedback provides a check on the overall design and helps eliminate model input errors.

2.4.13 Step 13. Perform compliance run

When you are satisfied that the actual building model is performing as intended, click on the button 'CO2 Emissions: Part L compliance'. The software will immediately begin the analysis for compliance with Criterion 1.

The first stage of the analysis is a check on building element U values as required by Criterion 2. Any failures will result in a screen message and the analysis will halt.

The next step is the simulation of the actual building. Progress is indicated on the screen.

This is followed by simulation of the notional building.

Results from both buildings, together with data provided on the Building & System Data dialogue, is then fed into the BRUKL compliance calculator. The calculations performed there to produce the Building CO_2 Emission Rate (BER) and Target CO_2 Emission Rate (TER) are set out in Appendix B

When the process is complete a summary of the result of the Part L2 analysis will be displayed on the Results tab, and you can click on a button to display the compliance document generated by BRUKL.

2.4.14 Step 14. Review, revise and repeat as necessary

If the result is a pass for Criterion 1 you may move on to the next stage.

Otherwise you will need to improve the design and try again.

2.4.15 Step 15. Perform Criterion 3 check

For buildings including rooms that are not served by comfort cooling, a check against Criterion 3 is required.

The recommended procedure is to use method b, which is based on operative temperature statistics in these rooms.

Click on the button labelled 'Summer temperature check (actual building)'. This displays an interface for performing summer temperature simulations. You will need to assign or check the settings, including the following:

- Results file – the name you enter here (prefixed by 's_=') will be used to store the results of the simulation, which can be viewed in Vista.
- SunCast link?

Note that the settings appearing here are shared, where appropriate, with other <VE> Compliance simulations. However, you will need to set the simulation period. A whole year's simulation is normally appropriate, but there is some flexibility in the rules.

Document L2A should be consulted for the requirements governing summer temperature performance.

At the end of the simulation a report is generated on the incidence of high temperatures in the rooms without comfort cooling, which can form part of your Part L2 submission.

2.4.16 Step 16. Collate and submit results

Assuming a successful outcome, the Part L2 (2010) compliance process is now complete in relation to those aspects that can be tested before construction. The reports generated, together with appropriate supporting evidence, can now be submitted to Building Control.

The content of Part L submissions should be agreed in advance with the local Building Control officer as there may be differing interpretations during the early stages of implementation of the new regulations. These are likely to be resolved over time as a sufficient number of Competent Persons are trained and accredited. It may be necessary, for instance, to agree how compliance with Criterion 4 will be met post construction as part of the pre-Construction report.

2.5 Tips for Passing Part L2a

The following measures should be considered when attempting to achieve a pass for the Building CO_2 Emission Rate (Criterion 1). Many of them will also benefit summer temperatures (Criterion 3). They are listed in rough order of importance.

i. Systems

Substantial reductions in building emission rate can be achieved by improving HVAC efficiency. The UK NCM System Data Wizard provides options for changing a range of system settings and parameters. For systems that are not covered there, it is permissible to enter appropriate parameters in the Apache System dialogue, provided they can be justified on the basis of manufacturers' data.

Fuel choice has a major effect on carbon emissions.

Specific fan power (SFP) is a parameter that has a significant effect on system performance. The Non-Domestic Heating, Cooling and Ventilation Compliance Guide defines requirements for a number of features including SFP. These are potentially onerous requirements that need to be taken into account from the start of projects. Designers need to be careful to allow large enough plant and riser space to ensure that these requirements can be met. Note that default values for SFP in the UK NCM System Data Wizard (which mirror those in iSBEM) tend to be somewhat high, often exceeding the Criterion 2 requirement. These therefore need to be edited.

The 'System adjustment' and 'Control corrections' options in the wizard produce worthwhile improvements in performance.

DHW systems should be examined for efficiency opportunities.

ii. Lighting

Efficient lighting and lighting controls offer substantial potential for bringing down emission rates and moderating summer temperatures. Any saving in lighting consumption has a double benefit, directly reducing electrical load and by reducing room gains having a favourable effect on summertime cooling loads and temperatures.

iii. Glazing

Reducing glazing area, introducing shading and optimising glazing type may all improve the building's performance. The implications for natural lighting, should, however be borne in mind.

iv. Ventilation

Since infiltration is reduced to low levels by Criterion 2, and minimum ventilation levels are laid down by the room activities, the main opportunity for using ventilation control to reduce carbon emissions and summer temperatures is free cooling.

Night-time ventilation (which should be implemented using natural ventilation air exchanges) can significantly reduce summer temperatures in naturally ventilated buildings.

It is possible to use both MacroFlo and ApacheHVAC in compliance simulations. However, the inputs to both these programs need to be set with care in order to ensure that the ventilation levels and schedules specified for the room activities are accurately reproduced. In both cases profiles will need to match that of the NCM usage schedules, which means that special models will need to be created for the compliance simulations.

v. DHW demand (changing areas)

The NCM templates for DHW usage have been found to be high for some activities, particularly changing areas in sports centres and schools. The DHW usage can be changed by altering the designation of activity areas, but this would need to be agreed in advance with Building Control.

vi. Adjustments for management features

The settings entered in this box on the Building & System Data 'Building & System Performance' tab produce useful reductions in the Building Emission Rate (BER).

vii. Constructions

Improving U-values will tend to reduce heating, but may increase cooling demand in air-conditioned buildings. Increasing the solar performance of the glass by reducing the solar gains into the building can reduce cooling requirement, but may also increase heating demand.

To assess which option (U-value or solar performance) will have the greatest effect, perform a test run on the actual building and look for the dominant load. Buildings with high internal gains and large areas of glazing will almost certainly be cooling dominated.

Increasing the thermal mass of the building, for example using exposed ceiling slabs, will tend to reduce cooling demand and moderate summer temperatures.

viii. Infiltration

The air permeability of the building envelope has to conform to the standard set by Criterion 2, namely a permeability of 10 $m^3/hr/m^2$ at 50 Pa (corresponding to an air leakage index of 15 $m^3/hr/m^{2)}$. Guidance in CIBSE TM23 indicates that this permeability typically gives rise to an air infiltration rate of about 0.25 ach. An improved permeability can be assumed to produce an improved infiltration rate in proportion.

Note that while reducing infiltration rates will tend to lower heating energy, it may increase cooling energy by reducing the building's ability to dispose of internal heat gains.

3 Part L2 (2010) ApacheSim – Analysis

This dialogue, on a tab at the lower edge of the <VE> Compliance screen, deals with general data required for Part L (2010) ApacheSim compliance analysis. It also provides the means to execute compliance simulations and other types of simulation. Results from the compliance simulations are displayed on the neighbouring Results tab.

The Analysis and Results tab will be visible provided no room is selected.

3.1 Building settings

This frame handles the input of general data required for Part L (2010) ApacheSim compliance simulations.

3.1.1 Building type

The building type for the L2 (2010) compliance analysis, sometimes referred to as the NCM building type. The NCM methodology requires the building to be assigned a type such as 'Airport terminal', 'Hospital' or 'Office'. For each building type there is a set of 'activities' that can be assigned to rooms in the building (optionally via templates) and which dictate the conditions assumed in those rooms. The building type also determines the building category, which is used to set the glazing percentages in the notional building.

3.1.2 Building Category

For each building type a Building Category is automatically set. This determines glazing in the notional building.

3.1.3 Set Building & System Data

This button displays the Building & System Data dialogue, which is also accessible via the Settings menu.

3.2 Simulations

Three types of simulation can be performed on the actual building. In the case of the notional building only the second type of simulation (test run) is enabled.

3.2.1 CO2 Emissions: Part L compliance

This button triggers the Part L2 (2010) compliance analysis, which has four stages:

- U-value checks
- Simulation of the actual building using ApacheSim
- Simulation of the notional building using ApacheSim
- Invocation of the BRUKL compliance calculator

The U-value checks test for compliance with the fabric requirements of Criterion 2. A test failure halts the compliance analysis.

The simulations are performed over a year using the appropriate CIBSE Test Reference Year (TRY) weather dataset. Simulation settings for these simulations may be edited in a facility accessed via the Building & System Data dialogue. Simulation settings are shared between the three types of simulation (except where overridden by the demands of a particular type of simulation – for example the requirement for compliance simulations to cover the whole year).

The BRUKL compliance calculator uses the simulation results to calculate the TER and BER, which then determine whether compliance has been achieved. The results are incorporated in reports accessible via the Results tab.

3.2.2 CO2 Emissions: test run (actual building)

This button pops up an ApacheSim dialog allowing test simulations to be carried out on the actual building under the conditions applied for compliance simulations. This provides a means of testing the performance of the actual building before committing to a compliance run.

3.2.3 Summer temperature check (actual building)

This button pops up an ApacheSim dialog allowing simulations to be performed to assess the performance of the building under Criterion 3 (method b). At the end of the simulation a report on temperature statistics for non air-conditioned rooms is automatically generated. This type of simulation uses the Design Weather Year appropriate to the building location.

3.3 Tools

This frame provides shortcuts to tools for setting the following model data:

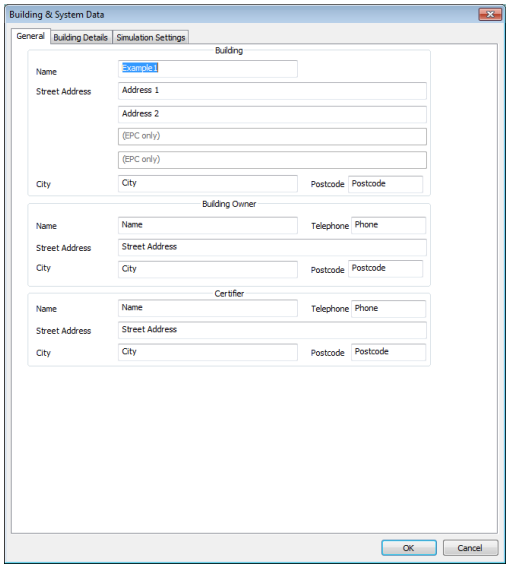
- Site location and weather data (APlocate)
- Constructions
- Building Templates
- Apache Systems

4 L2 (2010) Building & System data

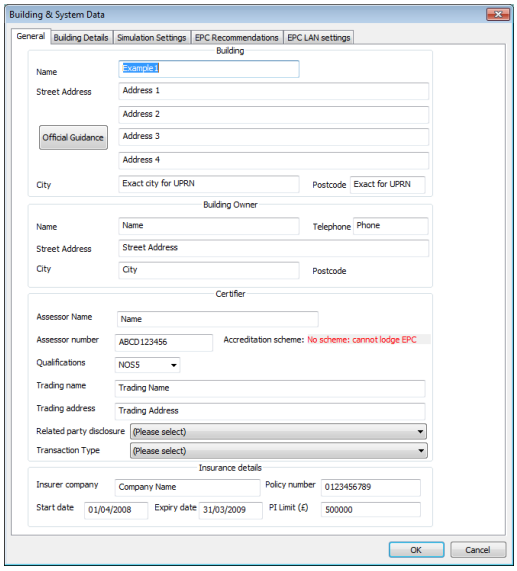
This pop-up dialogue, which may be accessed either via the Building Settings menu 'Set Building & System Data' or via the Settings menu, allows you to enter general data relating to the building and its systems required by the BRUKL and EPC compliance calculators. It also allows the editing of Apache simulation settings for compliance simulations.

Different inputs are displayed/hidden depending on what Regulations and Method are selected.

4.1 General



Compliance



EPC

These entries provide data general for the BRUKL compliance calculator.

4.1.1 Building details

Building name, street address, city, postcode

4.1.2 Building Owner details

Building owner name, telephone, street address, city, postcode

4.1.3 Certifier details

Certifier name, telephone, street address, city, postcode

Certifier Assessor number (EPC only): Input for EPC Assessor to enter assessor number (stored in machine registry after an EPC has been successfully generated)

Accreditation Scheme (EPC only): Shows scheme assessor is accredited with, automatically set based on Assessor Number.

Qualifications (EPC only): Qualification level of assessor, must be set to Level 5 for DSM.

Trading name & Address (EPC only): The employer or the trading name and address of the energy assessor.

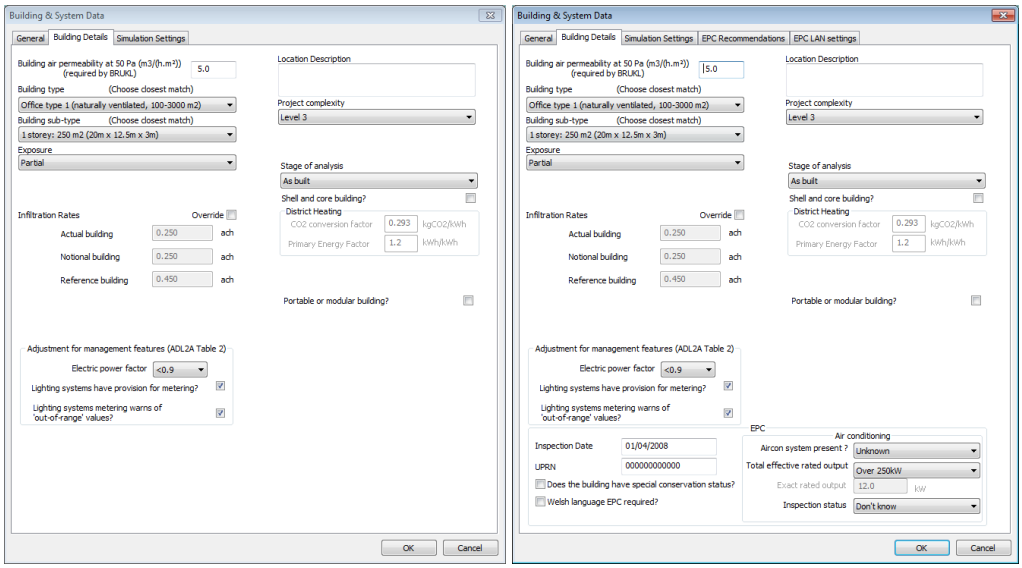
Related Party Disclosure (EPC only): Any related party disclosure by the Energy Assessor.

Transaction Type (EPC only): The transaction type which has prompted the generation of the EPC.
Note: Related Party Disclosure and Transaction Type must be set before an EPC can be generated.

4.1.4 Insurance Details

(EPC only) The assessors insurance company and assessors insurance policy number, effective start date, expiry date and policy cover limit.

4.2 Building Details



4.2.1 Building air permeability at 50 Pa (m3/(m2.h))

The design value of the building air permeability. The value must be no more than 10 $m^3/(m^2\ h)$. The value set here effects the infiltration rates used for the Actual building.

4.2.2 Building Type

Choose one of the given options, that would describe the building type best. Infiltration rate settings will be updated accordingly.

4.2.3 Building sub-type

Choose one of the given building sub-types, that would describe the building. Infiltration rate settings will be updated accordingly.

4.2.4 Exposure

Choose an appropriate exposure of the building. Infiltration rate settings will be updated accordingly.

4.2.5 Infiltration Rates

Displays the Infiltration rates for the Actual and benchmark buildings. These are calculated based on the Permeability (actual uses the value entered while notional uses 5 $m^3/(m^2\ h)$ and Reference uses 10 $m^3/(m^2\ h)$) and Building type options selected. Permeability-based Infiltration is applied in room data as an air exchange.

If *override* is selected and the Actual building infiltration rate is edited then the benchmark buildings will be proportionally increased/decreased in line with the change.

4.2.6 Adjustment for management features

These settings allow credit to be taken in the BER calculation for management features applied to electrical power and lighting.

- Electric power factor
- Lighting systems have provision for metering?
- Lighting systems metering warns of 'out-of-range' values?

4.2.7 Location Description

Give a location description for the building.

4.2.8 Project Complexity

Set the project complexity according regulations definitions.

4.2.9 Stage of analysis

Set whether the building is analysed "As designed" or "As built".

4.2.10 Shell and Core Building?

Tick this option to define building as a shell and core building (shell and core rooms as defined on Building regs tab of Room Data)

4.2.11 District Heating

This section is only active when a system with Heat source/fuel type set to District Heating is assigned to a room in the building.

District Heating CO2 Conversion Factor: Enter the CO2 Conversion Factor to be used by systems whose heat source/fuel type is District Heating.

Primary Energy factor: The conversion factor used to calculate the Primary Energy consumption associated with the District Heating system energy usage.

4.2.12 Portable or Modular Building

Tick to define building as Portable or Modular and reveal 'Planned time of use in given location' and further related input options.

4.2.13 Inspection date (EPC only)

The date on which the energy assessor inspected the building for the purposes of energy calculations for EPCs.

Enter in the format dd/mm/yyyy

4.2.14 UPRN (EPC only)

The Unique Property Reference Number (UPRN) of the building. (must be 12 digits)

4.2.15 Special Conservation Status (EPC only)

Tick box to indicate whether the building has a special conservation status (i.e., the building has been identified as being: one of special architectural or historical interest, in a conservation area, in a designated area of special character or appearance, or of traditional construction).

4.2.16 Welsh Language EPC (EPC only)

Option to generate EPC in Welsh.

4.2.17 Air Conditioning (EPC only)

Enter details of the air conditioning system in the building. Not used in calculations (HVAC data is defined in Apache systems/System Wizard) but instead used in EPC report.

Aircon system present?: Specify if air conditioning system is present in the building (if applicable).

Total effective rated output: If actual output is known then choose 'EXACT' and enter value in 'exact rated output' input else choose dropdown option that matches estimated value.

Inspection status: Has an air conditioning inspection been commissioned for compliance with Energy Performance of Buildings Regulations

4.3 Simulation Settings

Use this dialog to edit the settings for L2 (2010) ApacheSim compliance simulations. These settings are shared (as appropriate) with the other L2 (2010) simulations available in <VE> compliance.

Simulation settings are described in the <VE> Compliance and Apache View user guides. The special features applying for the various types of <VE> Compliance simulations are as follows.

Results file names are given a prefix to distinguish the following types of simulation:

- Compliance simulation for actual building (including test run) - prefix 'a_'
- Compliance simulation for notional building (including test run) - prefix 'n_'
- Summer temperature simulation for actual building – prefix 's_'

For compliance simulations and compliance test runs the weather file is automatically set to the Test Reference Year (TRY) appropriate to the building location. For summer temperature simulations the weather file is automatically set to the appropriate Design Summer Year (DSY)

In the case of compliance simulations, ticking the check box 'Use previous results for notional building' bypasses the simulation for the notional building in cases where this building has not changed since the previous compliance simulation. This would be the case if, for example, the only input to have been changed was a system efficiency.

The 'Auxiliary ventilation air exchange?' check box is ticked automatically. This is because auxiliary ventilation air exchanges form part of the standard room conditions for Part L2 (2010) simulations. An exception to this rule applies in the case where an ApacheHVAC system is used, as in this case the standard ventilation rates may be included in the system air supplies. See Appendix A for further guidance on ventilation settings.

In the case of compliance simulations, the simulation period is forced to the whole year.

Simulation Options are forced to standard settings for the sake of uniformity.

Options are provided, as in Apache View, to incorporate MacroFlo and ApacheHVAC models in <VE> Compliance simulations. If these options are used, special care must be taken with ventilation settings and profiles to ensure that these are consistent with the standard room conditions laid down for L2 (2010) simulations. Guidance on this issue is provided in Appendix A.

5 Room Data (actual building)

5.1 Room Data in the context of Part L2 (2010)

Each room has a set of attributes that describe conditions within it. This data, known as Room Data, provides input to the thermal analysis programs. In the <VE> Compliance view, Room Data is divided into six categories:

- **General** – Room name and ID, Templates, floor area and volume data
- **Building Regs** – room attributes for Building Regulations compliance checks
- **Room Conditions** – heating and cooling set points and room thermal modelling settings
- **System** – parameters describing the system serving the room
- **Internal Gains** – Specification of internal gains to the room
- **Air Exchange** – Specification of infiltration, natural ventilation and mechanical ventilation

For most thermal applications, a single set of Room Data applies to each room. However, for Part L (2010) the picture is complicated by two factors:

1. Special room conditions are stipulated for Part L2 (2010) compliance analyses.
2. There is a notional building which has room conditions that differ in some respects from those in the actual building.

This section deals with the conditions in the actual building. Here, certain room conditions are taken from data entered by the user (these are often specified by means of a Room Template), and others are dictated by the conditions laid down in the NCM methodology for the particular building type and activity applying to the room (in the main these are taken from an 'NCM template').

Each tab of the Room Data dialog must be considered separately to gain a full understanding of the way the NCM rules are applied. The basic content of the Room Data tabs, and the procedures for editing it, are described in the <VE> Compliance and Apache User Guides, as these features are common to all thermal applications and Regulatory Frameworks. The exceptions and special rules applying to Room Data in Part L2 (2010) are described below.

5.2 General tab (actual building)

With one exception, data displayed on this tab is the same for all thermal applications. The exception is the NCM Template, which is displayed only for Part L 2010.

NCM Template

The template automatically assigned to the room as a function of its 'activity' (see Building Regs tab) to specify those aspects of Room Data that are dictated by the NCM methodology for use in L2 (2010) compliance simulations.

5.3 Building Regs tab (actual building)

The content of this tab varies with the Regulatory Framework, so is covered in its entirety here rather than in the <VE> Compliance User Guide.

Include room in Building Regs analysis?

Tick this box to include the room in the building regulations analysis. By switching off rooms using this box you can perform separate analyses on different parts of the model.

Simulations in <VE> Compliance will include only the rooms that have this box ticked. If an included room is adjacent to an excluded room, or a room in an inactive layer, the adjacency is treated as a 'reflexive boundary condition', which means that conditions in the adjacent, non-included, room will be assumed to be the same as in the included room.

Type of room

This setting determines how the room will be treated for Part L2 (2010). The options are as follows:

- ***Heated or occupied room*** – the usual designation, applying to all occupied spaces within the insulated building envelope (whether they are directly served by heating plant or not). Spaces of this type must be assigned an NCM activity, and will be treated as heated for the purpose of the Part L analysis.
- ***Unheated roof*** – assign this type to a 'cold' roof space that has insulation at its base (ie at ceiling level). Rooms assigned this type will not be explicitly modelled in the notional building but incorporated in the elements linking the unheated space with adjacent conditioned spaces.
- ***Glazing cavity*** – windows, rooflights & doors connecting heated rooms with this space will be treated as external. This type is included to cover cases where a glazing cavity is treated for modelling purposes as a separate space.
- ***Other buffer space*** – this room type applies to spaces such as car parks, unheated stairwells and other spaces that form a buffer between the conditioned areas of the building and the outside. This type should only be assigned to spaces lying outside the insulated building envelope. Rooms assigned this type will not be explicitly modelled in the notional building but incorporated in the elements linking the unheated space with adjacent conditioned spaces.
- ***Internal void or warm roof*** – this room type applies to ceiling and floor voids, and to 'warm' roofs – those with insulation at rafter level. This type should be applied to unheated, unoccupied spaces that lie within the insulated building envelope.

Note: Where a space is subdivided for simulation purposes into separate levels connected by holes there are 3 possible approaches to the assignment of 'Type of room':

a) Combine all the levels into one space.

b) Assign the upper levels the same type of room and activity as the occupied space at floor level. They will then be heated and ventilated like that space, but will not receive gains because their floor area will be zero.

c) Assign the upper levels the type 'Internal void or warm roof', so that they will be unheated.

A drawback with option c) is that in the notional building air exchange between the levels will not be modelled so there will be unrealistic thermal barriers between them. Options a) and b) are therefore preferred.

External ventilation rate (air changes per hour)

This parameter applies only to rooms of type unheated roof space, unheated buffer space and glazing cavity. It is used for the calculation of effective U-values through the space from adjacent heated spaces using BS EN ISO 13789:1999[7]. These U-values are used in the Part L2 Criterion 2 checks.

Template NCM building type

An efficient way to set NCM activities for rooms is to set the activity in the Room Template. The activity will then be automatically set, along with other Room Template attributes, for all rooms to which the template is assigned. If the selected room has an NCM activity set in its Room Template, the building type associated with that activity is displayed here, provided that it matches the building type set for the model in Building Settings. In other instances, the Template NCM building type box displays the text 'Unset or incompatible'.

For unheated rooms (those with Type of room set to anything other than Heated room), the NCM activity is undefined and is not displayed.

NCM activity

Each heated room (defined as a room for which Type of room is set to Heated room) must be assigned an NCM activity. This defines the standard operation pattern of the room for the purpose of L2 (2010), which is defined by attributes on the various Room Data tabs. The assignment of these Room Data attributes is effected by the NCM template corresponding to the activity.

Each NCM building type has a predefined list of NCM activities available to its rooms. Once the model building type is defined in Building Settings, the associated activities will be available to heated rooms in the building and can be assigned using the NCM activity attribute.

It is recommended that the NCM activity is set in the Room Template. This saves work as it means that the activity will be automatically set for all rooms assigned that template. An NCM activity is only meaningful in the context of a building type, so this, too, must be set in the template. If no activity is specified in the template the room's NCM activity will revert to the default activity for the model building type.

If the NCM activity is set in the template, and is compatible with the model building type, it may (like other template settings) be overridden in the room by un-ticking the Template check box and selecting an alternative activity from the drop-down list.

For unheated rooms (those with Type of room set to anything other than Heated room), the NCM activity is undefined and is not displayed. In this case a special NCM template called 'NCM unheated space' is automatically assigned to the room.

In Part L2 (2010) certain Room Data settings are under your control (via the room template, which may be overridden in individual rooms) and others are set automatically by the NCM template. This is explained in the context of each of the Room Data tabs in the sections which follow. A brief account of the data used to populate the various tabs appears on the tab title bar.

High pressure drop air treatment

NCM lighting data - Button

This button opens the dialogue *NCM lighting data* , to adjust settings

5.4 Room Condition tab (actual building)

All the data on this tab is taken from the NCM template and cannot be edited.

This data specifies the set points and profiles for heating and cooling and the hot water consumption rate.

5.5 System tab (actual building)

All the data on this tab is under your control. It is shared with other <VE> views such as Apache View and other Regulatory Frameworks within <VE> Compliance. In particular, the room should be assigned an Apache System with properties accurately describing the system proposed for the actual building.

The following System tab attributes that would normally appear in the 'System outside air supply' frame are, however, hidden from view in Part L2 (2010):

- Flow rate
- Variation profile

The reason is that a specification of scheduled minimum ventilation forms part of the standard room conditions associated with the NCM activity (which is handled via data on the Air Exchange tab). To avoid a double specification of minimum ventilation the System tab ventilation parameters are disabled in Part L2 (2010).

Ventilation & Exhaust

Mechanical supply

This option becomes active, when the Apache System serving the room has Cooling/mechanical ventilation mechanism set to '*Mechanical ventilation*'. In other cases this is disabled.

Mechanical exhaust

This option allows setting mechanical ventilation for the selected zone. Specify the *Exhaust flow rate* together with the *Specific fan power*.

5.6 Internal Gains tab (actual building)

All the data on this tab is taken from the NCM template.

Unlike the NCM template data on the Room Conditions tab, however, aspects of this data may be edited in certain circumstances.

The NCM activity room conditions specify levels and schedules (profiles) for internal gains and (where relevant) electrical consumptions associated with lighting, equipment and occupancy. These gains are automatically set on the Internal Gains tab as a function of the NCM activity.

Lighting gains and consumption, however, are a special case. The NCM activity specifies lighting levels in terms of lux. In the NCM template these are translated to W/m^2 using a fixed conversion factor – the luminous efficacy. The value of this factor depends on the activity. It is 3.75 W/m^2 per 100 lux for office, storage and industrial spaces and 5.20 W/m^2 per 100 lux for other spaces. If the luminous efficacy of the lights in the building differs from the figure assumed in the NCM activity, it is permissible to change the W/m^2 values for lighting gains appearing on the Internal Gains tab. It is also permissible to change either the W/m^2 values or

the lighting profile in cases where there are controls which dim the lights when daylight is available. In this instance the dimming profile modulating the lighting gain may be replaced by a user-defined formula profile.

5.7 Air Exchange tab (actual building)

Data on this tab is partly taken from the NCM template and partly user-supplied. The rules are as follows.

The NCM activity specifies a minimum ventilation regime for the activity in terms of a flow rate and a profile. This appears as an air exchange of type Auxiliary Ventilation, taken from the NCM template. The NCM minimum ventilation regime applies to all heated rooms, whether air conditioned, mechanically ventilated or naturally ventilated.

Auxiliary ventilation assigned to the room by the user (via the room template or room-specific assignments) is automatically removed. This is to avoid a double-specification of minimum ventilation requirements.

All other air exchanges set by the user – those of type Infiltration and Natural Ventilation –are retained. These are shared with other <VE> views and other Regulatory Frameworks within the <VE> Compliance view, and any edits to them will be reflected in those places.

These rules mean that in models for which a Part L2 (2002) analysis is anticipated, care is needed in ventilation settings. Minimum ('fresh air') ventilation must be specified in the form of either auxiliary ventilation air exchanges or system outside air supply parameters on the System tab. It will then be automatically removed for the L2 analysis and will not feature twice. Infiltration should be included at a rate characteristic of the building leakage – that is, with no allowance for window opening or trickle vents. Any natural ventilation introduced for cooling purposes should be modelled in one of the following ways:

a) using Natural Ventilation air exchanges controlled by formula profile

b) using the free cooling parameter on the System tab, or

c) using MacroFlo.

Further guidance on ventilation settings in <VE> Compliance simulations is provided in Appendix A.

6 Room Data (notional building)

In the notional building, all data, including Room Data, is set automatically. Room Data is set using the NCM template, with the exception of data on the System tab data, where the following rules apply.

Depending on the type of conditioning assigned in the corresponding room of the actual building (as specified by the Cooling Mechanism parameter for the rooms Apache System), the notional building room is assigned one of three standard Apache Systems:

- NCM notional heating + nat vent system
- NCM notional heating + mech vent system
- NCM notional air conditioning system

These systems are set up with attributes specified in the NCM methodology document[3].

For rooms without air conditioning, a free cooling ventilation allowance of 5 ach is made in the notional building. This is to avoid the extreme overheating that would otherwise result, which would have an effect on heating loads at other times in the daily cycle.

7 Building Regulations Construction Data

Part L (2010) requires certain attributes to be entered for constructions in addition to the data required for other thermal calculations. This data is entered in the constructions database program APcdb. The additional attributes (broken down by construction category, and including attributes required for Part L1 (dwellings)) are:

7.1 Glazing

Display window?

Tick this box if the window is a display window. Such windows are exempt from certain L2 (2010) requirements.

Glazing type (dwellings only)

The SAP procedure which features in Part L1 has its own classification system for glazing types. Glazing types used in L1 SAP analyses must have the appropriate glazing type set.

% sky blocked (dwellings only)

The Part L1 SAP procedure requires the degree of overshading to be specified for each window. Select an appropriate option from the list. In accordance with the SAP method, rooflights are automatically set to '< 20% Very little'.

Frame material (Part L (2002) only)

Select a frame material from the drop-down list. This determines the required glazing/door U-values for Part L1 and Part L2 (2002).

7.2 Doors

Door type

Select from the following types:

a) personnel door
b) vehicle access or similar large door
c) wall or roof element that is not to be treated as a door for the purposes of Part L
d) smoke vent
e) high usage entrance doors

Doors of types b, d and e form special categories in Part L. Type c is provided to allow door drawing facilities in ModelIT to be used to create wall or roof elements.

7.3 Ground floors

Ground floor U-values can be calculated using a floor area / perimeter method.

- Floor area
- Enter the ground floor area

- Exposed floor perimeter
- Enter the exposed floor perimeter
- External wall thickness
- Enter the wall thickness of the external wall that bounds the floor perimeter.
- Ground conductivity
- Enter the conductivity of the ground below the ground floor

7.4 All construction categories

Thermal bridging coefficient

Part L2 (2010) requires an allowance to be made for non-repeating thermal bridging. In the <VE> implementation this is handled via a coefficient expressing this component of heat loss as a multiple of element area. This can be thought of as an addition to element U-value. The default value of 0.035 W/m^2K represents a typical value for office spaces built to the standards of the *Robust construction details* defined in IP 17/01[4].

In the notional building, thermal bridging coefficients are set to standard values laid down in the NCM methodology document.

8 Part L2 (2010) ApacheSim – EPC

8.1 EPC generation

EPC's can be generated using ApacheSim method.

To generate an EPC make sure the Regulation is set to Part L2. Then change the Method to ApacheSim – EPC.

Now in the Calculations section of the Regulation tab a *Generate EPC* button is available to perform required dynamic simulations and generating an EPC based on the results.

When the calculation has completed the Results tab is active and displays results depending on which Regulation is being assessed. The *View EPC* and *View Recommendation* buttons are now available on this tab.

Watermarks are being displayed on the Certificate until the certifier details are given. Once these are entered, rerun the *Generate EPC* process, to create a new EPC.

8.2 Recommendation Report

A Recommendation Report will also be using the details set in *Building&Systems Data* – dialogue , *EPC Recommendations* tab.

Click the *View Recommendation* – button to launch the EPC Recommendations as a secure pdf.

9 Part L2 (2010) ApacheSim Results

This tab on the dialogue at the lower edge of the <VE> Compliance screen allows you to view the results of Part L2 (2010) compliance simulations.

Building Emissions Rate (BER)

The Building Emissions Rate ($kgCO_2/m2$) calculated for the actual building.

Notional Building Emissions Rate

The Building Emissions Rate ($kgCO_2/m2$) calculated for the notional building ($C_{notional}$).

Target Emissions Rate (TER)

The target building emissions rate, derived from the Notional Building Emissions Rate ($C_{notional}$) by applying the Improvement Factor and LZC Factor using the formula:

$TER = C_{notional} \times (1 - \text{improvement factor}) \times (1 - LZC)$

Improvement Factor

A preset factor determining the degree to which the TER must improve on the Notional Building Emissions Rate ($C_{notional}$).

LZC Factor

The Low and Zero Carbon benchmark, which together with the Improvement Factor determines the degree to which the TER must improve on the Notional Building Emissions Rate ($C_{notional}$).

Did the analysis pass the CO2 emissions rating?

The pass/fail result for Criterion 1. 'YES' if BER<TER, 'NO' otherwise.

View Compliance Doc

Click on this button to view the Compliance Document generated by BRUKL using inputs from the actual and notional building simulations, together with the data entered in Building & System Data and the results of the Criterion 2 U-value checks.

View results in Vista

A shortcut to the <VE> Vista view, where simulation results for the actual and notional buildings may be viewed in detail.

References

1. The Building Regulations 2000. Approved document L2A. Conservation of fuel and power in new buildings other than dwellings. 2010 edition. The Stationery Office. Free download available.
2. BS EN ISO 13789:1999 Thermal performance of buildings – Transmission heat loss coefficient – Calculation method.
3. National Calculation Methodology document – in preparation.
4. IP 17/01. Assessing the effects of thermal bridging at junctions and around openings. Tim Ward. BRE East Kilbride.

Appendix A. Ventilation in compliance simulations

This appendix provides guidance on the setting of ventilation in <VE> Compliance simulations.

1. Infiltration

Infiltration should normally be entered as an Infiltration air exchange (though occasionally it can be handled by MacroFlo). With the degree of air-tightness specified in the new Part L a value of 0.25 ach would be appropriate. Infiltration is carried across to <VE> Compliance for the actual building. An infiltration level of 0.25 ach is assumed for the notional building.

2. Fresh air requirement

This is the minimum level of ventilation (sourced from outside air) required by occupants.

Fresh air requirement is a function of occupancy and is typically calculated on the basis of 8 l/s/person. It applies all year round during the occupancy hours.

In the 'real building' (the model for non-compliance simulations, as presented in Apache View and in the Room Template) the fresh air requirement should be set using either 'System outside air supply' (Room Data 'System' tab) or 'Auxiliary ventilation' (Room Data 'Air Exchange' tab).

Fresh air requirement applies to all types of conditioning (A/C, mech vent and nat vent). In the case of natural ventilation the implication is that it is achieved by window opening or trickle vents. Using MacroFlo for this is not recommended because of the complications this gives rise to in <VE> Compliance.

For Part L2 (2010), all user-specified settings for 'System outside air supply' and 'Auxiliary ventilation' are turned off and replaced by standard values and schedules appropriate to the relevant NCM activities and associated occupancy levels. Note that occupancy levels will in general be different in the 'real' and actual buildings, so the fresh air requirements will also be different.

3. Cooling ventilation

Superimposed on the fresh air requirement it may be advantageous to add ventilation for cooling purposes (that is, when rooms get warm). There are 4 ways to do this:

5. Using 'Natural ventilation' or 'Infiltration' air exchanges controlled by formula profiles.
6. Using MacroFlo openings controlled by formula profiles.
7. Using the new 'free cooling' option.
8. Using ApacheHVAC.

These mechanisms will apply in the same way in the 'real' and actual buildings.

Options 1 and 2 can be used in the usual way. However, it is important to bear in mind that whatever is specified here should not include the fresh air requirement – otherwise this will be assigned twice in the actual building. These mechanisms should be limited to the additional ventilation required for cooling.

Option 3 (free cooling) provides a simple way to introduce additional air for cooling purposes. The additional air will be brought in, subject to a given maximum (typically 5ach) and only if appropriate (ie outside temperature is less than inside) when the room temperature reaches the cooling set point. This applies whether or not there is air conditioning in the room. If there is

no air conditioning, the free cooling represents an idealised form of natural ventilation, introducing just enough air to hold the room temperature at the set point. If there is air conditioning, the free cooling represents an idealised form of fresh air optimisation. The notional building assumes up to 5 ach of free cooling ventilation for naturally ventilated rooms (this is not spelt out in the notional building specification, but represents a reasonable assumption – without it the notional building would seriously overheat, which would tend to reduce its heating loads during subsequent hours). Free cooling is recommended as a quick way to model natural ventilation, and for all types of simulation, not just <VE> Compliance runs.

Option 4 (ApacheHVAC) introduces additional complications in relation to fresh air requirement and should be undertaken only with considerable care. Ventilation profiles for the ApacheHVAC model must be set in such a way as to mimic the ventilation profiles in the standard NCM activities. The same also applies to plant operation profiles. These constraints mean that if this route is adopted it will almost certainly be necessary to create a special version of the ApacheHVAC system for the compliance simulation.

Appendix B. Calculation of BER and TER

This appendix sets out the calculation of the emission rates BER and TER used in the Part L2 (2010) Criterion 1 compliance test.

The CO_2 variables used in the calculation can be viewed in Vista:
Cse = total System elec. CE
Cst = total Total system CE
Clt = total Total lights CE (assumed to be electrical)

Note that carbon emissions associated with Equipment energy consumption are not taken into account in the BER and TER calculations.

BER calculation

Electrical carbon emissions (Cse and Clt) are subject to adjustment factor Fe as follows (see L2A Table 3):

If power factor < 0.9, Fe = 1.0.

If 0.9 < power factor < 0.95, Fe = 1 - 0.01 = 0.99.

If power factor > 0.95, Fe = 1 - 0.025 = 0.975.

Lighting energy consumption is adjusted with factor F1 as follows:

If there is metering and warning of out-of-range values, Fl = 0.95, otherwise Fl=1.0.

Applying these factors the revised carbon emission figure to be carried forward to the BER calculation is

$BER = Cst - (1-Fe) \times Cse + Fe \times Fl \times Clt$

TER calculation

Notional building carbon emissions rate,

$NER = Cst + Clt$

$TER = NER * (1.0 – Improvement\ Factor) \times (1.0 – LZC\ Factor)$

where (L2A Table 1):
Improvement Factor is a function of system type weighted by floor area

LZC Factor = 0.1