



# **PROTOCOL FOR BUILDING ENERGY ANALYSIS SOFTWARE**

**For Class 3, 5, 6, 7, 8 and 9 buildings**

Version 2006.1

**AUSTRALIAN BUILDING CODES BOARD**

**JANUARY 2006**

## **TABLE OF CONTENTS**

### **Foreword**

- 1. Scope**
- 2. Purpose and context of use**
- 3. Essential features of the software**
- 4. Specific capabilities**
- 5. Inputs for calculating annual energy consumption**
- 6. Methods of assessment**
- 7. Energy analysis report**
- 8. Testing and quality assurance**
- 9. Training of users**
- 10. Evidence of suitability of software**
- 11. Process for validating and upgrading software**

### **Appendices**

- A. Sample energy analysis report**

## Foreword

The Australian Building Codes Board (ABCB), in conjunction with State and Territory building control Administrations, is responsible for developing and maintaining the provisions of the Building Code of Australia (BCA), including those for energy efficiency.

The BCA is given legal status by the State and Territory Building Acts and Regulations. Any material referenced in the BCA needs to be clearly identified and described as it also has legal status under those Acts and Regulations.

The main text of this Protocol has been prepared for referencing by the BCA. Other matters that merit attention, but which are not suitable for referencing, are contained in this Foreword.

### Need for a Protocol

Energy analysis software has been used for many years by designers, energy auditors and energy assessors to assess the energy consumption of a building. Software packages vary considerably in scope, complexity and application and therefore can deliver a wide range of results.

To ensure that software used to demonstrate compliance with the BCA energy efficiency measures is of an appropriate standard; this Protocol defines minimum requirements for software and training of its users. It also provides a process for demonstrating the acceptability of new software and revisions to existing software.

### BCA Energy Efficiency Measures

The BCA energy efficiency measures include three Verification Methods that can be used to demonstrate that an Alternative Solution complies with the BCA Performance Requirement. It is anticipated that software will be used to assist in demonstrating compliance by evaluating the annual energy consumption of a particular design.

The first Verification Method is for assessing the energy performance of housing and other private dwellings (i.e. Class 1 and 10 buildings, the sole-occupancy units of Class 2 buildings and Class 4 parts). It is based on achieving a star rating to the Nationwide House Energy Rating Scheme. The minimum requirements for energy rating software used to assess these buildings are described in a separate BCA reference document titled "Protocol for House Energy Rating Software".

The two other Verification Methods are based on the alternative building solution consuming the same or less energy than a maximum amount. In one method, the maximum amount is stated, and in the other, it is calculated. In both cases the amount equates to what a building would use under the defined conditions with the Deemed-to-Satisfy Provisions. Either method can be used for buildings (other than Class 1 and 10 buildings, the sole-occupancy units of Class 2 buildings and Class 4 parts), although the stated amount method is restricted to the most common buildings uses.

### Aims of this Protocol

The aims of this Protocol are to:

- provide a legal basis for determining the suitability of particular software to demonstrate compliance with BCA Performance Requirement JP1 via the Verification Method route;

- provide results that are repeatable and consistent using different software; and
- be neutral to all types and sources of software in accordance with National Competition Policy.

### **Suitability of software**

Software suppliers or their agents may need to provide an assurance, with supporting evidence, that their software complies with this Protocol. Accepting this assurance is the responsibility of the appropriate authority. Any assurances the ABCB Office may receive are forwarded to the State and Territory building control Administrations.

### **Process for revising the Protocol**

The Protocol may be revised from time to time as necessary. Revisions will occur in consultation with the State and Territory building control Administrations.

### **Other matters**

Additional requirements that are not included in the Protocol but are necessary to assure the reliability of modelling outcomes are:

- **Testing** that incorporates a procedure for rectifying software faults and inaccuracies.
- **Instructions** for the use of the software, including:
  - general software operating instructions and procedures (how to input the data) for all required building scenarios; and
  - details of all software functions, settings and limitations.
- **Software support** including:
  - support for software users, explanation of procedures, documentation of all technical limitations, and a help service to provide technical and functional information to users and other interested parties; and
  - advice to users on the appropriateness of manipulating the software beyond its stated use; and
  - a procedure for publishing and disseminating updates not in the original software documentation (including both new capabilities and new library data files).
- **Version control** of the software as part of the quality assurance program.

### **State & Territory regulatory matters**

Some States or Territories may have additional requirements for software in order to provide assurance and demonstrate reliability of modelling outcomes. These may include:

- **Accreditation of users**, possibly including the passing of an examination and registration.
- **Contact details** for the Software Company, or agent, responsible for the software including matters relating to software validation, support, testing, documentation and updates.
- **Software validation** and a quality assurance framework for integrating feedback and concerns of software accuracy.

- **Documentation for any State/Territory based:**

- examination schemes that States, Territories or industry may require for the examination of candidates in the use of software; and
- auditing schemes that States or Territories may require for ensuring that a sufficient sample of modelling runs be carried out as an audit for quality control of accredited assessors.

### **Energy analysis report format**

An energy analysis report is to be prepared by the energy analyst to quantify the modelled energy consumption under certain conditions and in so doing, assist in demonstrating compliance of an alternative building solution. Appendix A has been developed to provide an indication of the information needed in an energy analysis report. This sample is intended to provide sufficient information to facilitate the work of the analyst's supervisor by identifying key inputs and outputs for confirmation.

It could also be extended or supplemented to provide the regulatory information needed by the building control authority by identifying items that can be physically verified, the elements being varied in the alternative solution and the particular BCA assessment method or Verification Method used.

The information described in the Appendix will also help in providing consistency of the inputs and outputs of the main energy analysis program and other supporting programs.

# PROTOCOL FOR BUILDING ENERGY ANALYSIS SOFTWARE

## 1. Scope

This Protocol describes the essential elements of software suitable for use primarily with the energy efficiency Verification Methods JV2 and JV3 of the Building Code of Australia Volume One. It also describes requirements for software development and use such as documentation, testing, quality assurance and user training.

## 2. Purpose and context of use

This Protocol has been developed to specify the requirements of energy software that is used for calculating the annual energy consumption of a building in accordance with the BCA energy efficiency measures. Software in accordance with this Protocol can be used to demonstrate compliance with Performance Requirement JP1 via one of the two Verification Methods JV2 or JV3.

## 3. Essential features of the software

To comply with this Protocol, software must:

- be commercially available; and
- be based on a simulation program with an hourly climate data file; and
- be capable of computing the annual energy consumption of a building in accordance with the Verification Methods of the BCA; and
- be capable of geometrically describing the building in three dimensions including taking account of surface azimuth, tilt angle and adjacent structures and features; and
- provide results comparable with other similar software in accordance with ASHRAE Standard 140 -2001 Standard Method of Test for the Evaluation of Building Energy Analysis Computer programs using the International Energy Agency BESTEST (see Clause 8); and
- address all the specific capabilities in clause 4.

## 4. Specific capabilities

The software must be capable of addressing all the specific aspects of BCA Verification Methods JV2 and JV3, Specification JV and Clauses 4.1 and 4.2 below, by either direct modelling or by adding in pre-determined data.

The software must use the values for the thermal properties of building products that are available in Australia, either by accessing an extensive library of local products or by appropriately modifying in-built values.

## **4.1 By direct modelling**

Aspects of thermal modelling that the software must be capable of addressing directly are:

- the energy flow through the building's envelope, including at adiabatic surfaces and also including thermal storage effects;
- accurately modelling the performance of the air-conditioning and ventilation systems, including plant and equipment using their energy input ratios, coefficients of performance, or efficiency at full and part load;
- the control strategies, sequencing of plant and equipment, controlled settings and types of controls;
- the design relative humidity range; and
- the different energy types, e.g. electricity, gas, oil.

## **4.2 By direct modelling or by adding in pre-determined data**

Aspects of thermal modelling that may be addressed by adding in pre-determined data rather than by direct modelling are:

- lighting systems and equipment, provided the calculation included consideration of their loads, operating profiles and the distribution of the lighting load between the space load and return air load;
- vertical transport loads; and
- supply hot water loads in accordance with BCA Specification JV.

## **5. Inputs for calculating annual energy consumption**

### **5.1 Climate data**

Climate data used must be based on hourly data derived from Australian meteorological records taken at no more than 3 hourly intervals and adjusted to provide a representative year for the proposed locations (such as Test Reference Year, Typical Meteorological Year or Weather Year for Energy Calculations).

Where sufficient records are unavailable, the data needed may be estimated from other recorded data provided a reliable method is used to make these estimates, e.g. cloud cover records or satellite measurements can be used to estimate solar radiation data in the absence of recorded solar data.

Appropriate climate data based on the Australian Bureau of Meteorology records is available in the "Australian Climatic Data Bank for Use in the Estimation of Building Energy Use" which is maintained by ACADS-BSG by agreement with the Australian Government.

### **5.2 Other technical inputs**

Program inputs for calculating the annual energy consumption of services in a building must be in accordance with Specification JV in BCA Volume One.

Program inputs for calculating the annual energy consumption of a reference building must be in accordance with Verification Method JV3.

### **5.3 Social policy**

The software and its recorded outputs must not contain computations of a social policy nature. Computations of a social policy nature include inputs or settings based on a policy decision rather than engineering principles (eg, adding a weighting to the annual energy consumption on the basis of the floor area of the building).

## **6. Methods of assessment**

The BCA energy efficiency Verification Methods JV2 and JV3 are available as a means for assessing compliance with Performance Requirement JP1. The definition of the nominated thermal calculation method permits the use of software.

Any software used in the Verification Methods must be based on well-established models that are in accordance with the principles of thermodynamics and fluid mechanics. The calculation methodology used in the software must be documented and be available for inspection.

Sources of reference data on the thermal properties of building materials, insulation etc. must be identified and be from test results or authoritative data sources such as the Australian Institute of Refrigeration, Air-Conditioning and Heating (AIRAH), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) or other recognised international standard.

## **7. Energy analysis report**

The energy analysis report must include all relevant inputs for the building fabric, the air-conditioning and ventilation systems, the lighting and power systems, the vertical transport systems and the supply hot water systems.

Inputs and outputs must be detailed on the energy analysis report produced in order to demonstrate compliance with the chosen Verification Method and so that in conjunction with the relevant plans and specifications and any supplementary regulatory information, the building control authority can check compliance with JV2 or JV3 including Specification JV. Appendix A provides a sample energy analysis report format.

The outputs must be presented in terms of annual energy consumption of the building in MJ/m<sup>2</sup> of floor area per annum for a particular climate region for both (a)(viii) and (a)(ix) of JV2 and JV3. A distinction must be made as to whether the energy source for the building heating is electricity (with heat pump plant) or gas.

The energy analysis report must also include details of any limitations of the software or any approximations that were made to adapt the software to the application.

## **8. Testing and quality assurance**

The software must be tested in accordance with ASHRAE Standard 140 -2001 'Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs' using the International Energy Agency BESTEST. The results should be within the range of results from acceptable comparable programs indicated in the Standard.

While results that fall outside this range are not necessarily incorrect, the sources of the differences must be investigated, documented and made known, particularly to the building control authority.

The software supplier must have in place a quality assurance program and be able to demonstrate its effectiveness.

## **9. Training of users**

A training program for users must be available. This program must include training in the current version and any proposed new version of the software. Trainers must be technically qualified and be well versed in the functionality of the particular program and the calculation methods employed.

## **10. Evidence of suitability of software**

Evidence must be produced to demonstrate that the software is suitable. This will include evidence that:

- a) the software has the features outlined in Clause 3 and the specific capabilities outlined in Clause 4; and
- b) the software has undergone appropriate testing and result analysis, and the process has undergone quality assurance; and
- c) a training program is available for users.

Evidence of training must state the software name and the version.

The status of the software, such as whether it has been approved by any appropriate authority, must also be clearly indicated.

## **11. Process for validating and upgrading software**

Energy analysis software used to demonstrate compliance with the BCA Volume One Performance Requirement JP1 must meet the requirements of this Protocol.

The software providers are responsible for validating software and correcting deficiencies and faults.

The ABCB should be advised, in writing, of any new validated versions of the software and the corrections or revisions to the software to ensure that building control authorities, and in turn the practitioners are adequately informed. Correspondence should be sent to:

The General Manager  
Australian Building Codes Board  
GPO Box 9839  
CANBERRA ACT 2601

Any revisions, updates or new versions must be identified by a unique number or other form of designation. The status of any revisions, updates or new versions, such as whether it has been approved by an appropriate authority, must also be clearly indicated.

## APPENDIX A - SAMPLE ENERGY ANALYSIS REPORT

### GENERAL

Reference No:.....Date:.....

Property title:.....

Address:.....

Building Class and use:.....

Verification Method used (JV2 or JV3):.....

Location used (if JV2 see Table JV2 of BCA Volume 1):.....

BCA Climate Zone (if for JV3 reference building):.....

Name and version of the software used in analysis:.....

Name and contact details of the organisation responsible for the analysis:  
.....  
.....

Name, qualifications and training with the software of the person responsible for the analysis:  
.....

### OUTPUT

#### Temperature control

The percentage of the plant operating time that the temperature can be maintained within the required range [Spec. JV Clause 2(a)(i)].....(%)

#### Annual energy consumption

Floor area used in calculating annual energy consumption:.....(m<sup>2</sup>)

Energy source for heating:.....

#### Components of annual energy consumption

Component	Calculated annual energy consumption for each run			
	With proposed building fabric and services (a)(i)		With proposed building fabric and specified services (a)(ii)	
	Electricity	Gas	Electricity	Gas
Lighting	kWh	MJ	kWh	MJ
Heating	kWh	MJ	kWh	MJ
Cooling	kWh	MJ	kWh	MJ
Air-handling	kWh	MJ	kWh	MJ
Ventilation	kWh	MJ	kWh	MJ
Lifts	kWh	MJ	kWh	MJ
Hot water supply	kWh	MJ	kWh	MJ
<b>Sub-total</b>	kWh	MJ	kWh	MJ
<b>Conversion factor</b>	times 3.6		times 3.6	
<b>Conversion</b>	MJ		MJ	
<b>Total</b>		<b>MJ</b>		<b>MJ</b>

Annual energy consumption allowance..... (MJ/m<sup>2</sup>.annum)  
Annual energy consumption calculated (a)(viii)..... (MJ/m<sup>2</sup>.annum)  
Annual energy consumption calculated (a)(ix)..... (MJ/m<sup>2</sup>.annum)

**INPUTS**

**(a) For air-conditioning**

Ground floor construction:.....  
External surfaces solar absorptance:.....  
R-Value of internal air film:.....  
External shading:.....  
Glazing area distribution:.....  
Solar radiation value at which blinds operate:.....  
Space temperature range:.....  
Furniture and fittings density:.....  
Daily occupancy and operating profile:.....  
Sensible internal heat gain per occupant:.....  
Latent internal heat gain per occupant:.....  
Occupant density:.....  
Air-conditioning system selection:.....  
Availability of plant:.....  
Reheat limit:.....  
Outside air cycle:.....  
Mechanical ventilation rate - outside air:.....  
Mechanical ventilation rate - exhaust air:.....  
Exhaust ventilation system operation:.....  
Internal heat gains from appliances and equipment:.....  
Internal heat gains from artificial lighting:.....  
Infiltration air change rate per hour when pressurisation plant operating:.....  
Infiltration air change rate per hour when pressurisation plant not operating:.....  
How heat migration across air-conditioning zone boundaries has been assessed:  
.....  
Carpark contaminant control:.....  
.....  
Pump speed control:.....  
Plant sequencing and flow water control:.....  
Boiler or heating water heater efficiency:.....  
Package air-conditioning plant energy efficiency ratio:.....  
Refrigerant chiller part load energy efficiency ratio:.....  
Air cooled condenser fan performance and control:.....

