ABCB

Energy Efficiency BCA Volume 1

Regulation Document

Proposal for Class 5–9 Buildings
RD 2004–01

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Australian Government
Department of the Environment and Heritage
Australian Greenhouse Office

COMMERCIAL RD

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REGULATORY PROPOSAL

(Regulation Document RD 2004-01)

ENERGY EFFICIENCY MEASURES FOR CLASS 5 TO 9 BUILDINGS IN BCA VOLUME ONE

November 2004

Australian Government
Department of the Environment and Heritage
Australian Greenhouse Office

The Executive Director
Australian Building Codes Board
GPO Box 9839
CANBERRA ACT 2601

or

Mr John Kennedy
Project Manager
Phone: (02) 6213 7291
Facsimile: (02) 6213 7287
E-mail: John.Kennedy@abcb.gov.au

The document is also available on the ABCB web site at http://www.abcb.gov.au

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A PURPOSE

A1 Scope of measures

On 1 January 2003 the Australian Building Codes Board (ABCB) introduced energy efficiency measures for houses into Volume Two (Housing Provisions) of the Building Code of Australia (BCA). Since then, measures for Class 2, 3 and 4 buildings have also been developed and finalised for inclusion in BCA 2005 Volume One (Class 2 to 9 buildings). These measures include new Performance Requirements and Deemed-to-Satisfy Provisions for the following building elements:

- The thermal performance of walls, ceilings, floors and glazing including shading in order to avoid or reduce the use of artificial conditioning (heating and cooling).
- The sealing of buildings to reduce energy loss through air leakage.
- Natural ventilation and internal air movement, where appropriate, to avoid or reduce the use of artificial conditioning.
- Engineering services including-
  - Lighting systems.
  - Air-conditioning, heating and ventilation systems.
  - Hot water supply systems.
  - Maintenance of these systems.

This regulatory proposal (Regulation Document – RD) puts forward further changes for Volume One of the BCA. It proposes that energy efficiency measures for the above building elements be extended to Class 5 to 9 buildings, which include offices, retail outlets, industrial buildings and other buildings of a public nature (such as health and aged care buildings). It was also intended to introduce measures for lifts; however they are not sufficiently advanced at this time and will be considered as a separate proposal in the future.

Although it was originally intended to deal only with Class 5 buildings (offices) in this proposal as a first step, the full range of commercial classifications (Class 5 to 9) is being addressed as a group because they share many common aspects. For example, the practical and cost effective considerations for building fabric elements result in common outcomes once it is determined that air-conditioning is likely (these issues are discussed in more detail later). In addition, building insulation will be the same in most climate zones, irrespective of whether the building is heated and cooled or just heated, because any reasonable amount of insulation is cost effective provided it does not result in an increased cost of the base element (wall or roof), a non-standard fabrication technique or a loss of net rentable area. Lighting and air-conditioning systems also depend on a building's use rather than the BCA Classification system.

A regulatory assessment (Regulation Impact Statement - RIS) of the proposed BCA changes is scheduled to be released in January 2005. This Regulation Document, therefore, needs to be considered in conjunction with the impending RIS. The RD is being released for public comment ahead of the RIS to allow as much time as possible for all stakeholders to fully consider the draft proposals.

While the package of measures is considered to be cost effective, it is possible that the upcoming RIS may find some individual measures uneconomic.

This document has been prepared by the ABCB to meet the Council of Australian Governments (COAG) principles and guidelines for regulatory action. It explains the rationale for the proposals and is designed to enable all stakeholders to understand the proposed changes to the BCA. The document also provides the opportunity for the building industry and the community to comment on the proposals before they are considered for adoption into State and Territory building legislation.

If the measures proposed in this RD are accepted, they could be finalised in 2005 for inclusion in BCA 2006.

A2 Development of proposed measures

The ABCB project team has developed the technical proposals with advice from a series of working groups, committees and individual experts in the energy efficiency field. A Steering Committee and the ABCB's peak technical body, the Building Codes Committee, have been responsible for setting the direction of the project and monitoring its progress.

The ABCB also invited peak professional and industry organisations (listed in Attachment B) to participate in the development of the proposed measures. Their input has been through the ABCB's Commercial Buildings Technical Committee and specialist Working Groups.

In developing the measures, the ABCB has also consulted many other organisations. Although it is fair to say that consensus has not been reached on every issue, all organisations involved support the need for energy efficiency measures in the BCA.

This document is made available for people to consider, discuss and comment on. Comments may be submitted to the ABCB (as outlined in Section F) and they will be considered. The State and Territory Governments, who are responsible for building control, will then decide whether to call the proposed measures into law.

The draft measures contained in this RD are a result of extensive research and modelling. A bibliography of relevant reports is included in Section G. The reports are available from the energy page on the ABCB web site (http://www.abcb.gov.au).

The proposed BCA text changes for Class 5 to 9 buildings are at Attachment A. The entire energy efficiency measures are not reproduced in this document. Omitted are some of the BCA standard clauses such as Specification A1.3 (the list of referenced documents) and J1.0, J2.0, etc, the clauses for linking the Deemed-to-Satisfy Provisions to the Performance Requirements.

Where an existing clause needs to be extended for a proposed change, it is shown in Attachment A as black on white with the changed part in a grey background. Totally new clauses are in grey shading. In addition, there is an editorial note at the start of each clause to clarify what is new and what is being changed.

B BACKGROUND

B1 Energy Efficiency Project

On 19 July 2000, the Australian Government announced that agreement had been reached between it and the State and Territory Governments to examine and develop suitable national energy efficiency provisions for domestic and commercial buildings[1], through the introduction of minimum mandatory requirements in the BCA.

As a result, the Australian Greenhouse Office (AGO) and the ABCB entered into an agreement in January 2001 to develop energy efficiency measures for inclusion in the BCA. The Energy Efficiency Project comprises two elements:

- Development and implementation of energy efficiency measures for BCA Volume One (Class 2 to 9 buildings).
- Development and implementation of energy efficiency measures for BCA Volume Two (Housing Provisions – Class 1 and 10 buildings).

It is generally accepted that a regulatory approach to energy efficiency in buildings may be warranted due to market failure. The main market failures relate to:

- Greenhouse gas emissions being an unpriced externality: the negative impact of these emissions is not reflected in market transactions.
- Information asymmetries: market participants often lack the necessary information to assess the design and construction characteristics of buildings in relation to energy efficiency, and of the associated benefits arising from more energy efficient buildings. This information may be unavailable or expensive to obtain.
- The existence of 'split incentives' also impedes investment in energy efficiency: because developers and builders do not pay the operating energy bills, there is no direct market incentive to incorporate energy efficiency features when constructing new buildings.

Industry is supportive of the mandatory approach and accepts the need to eliminate worst practice. As a principle, industry takes the view that building-related matters should be consolidated in the BCA wherever possible.

Further background information on the Energy Efficiency Project is included at Attachment C. An explanation of the BCA and its application is included at Attachment D.

[1] "Commercial" is taken as those buildings in BCA Volume One and includes multi-residential and public buildings.

B2 BCA commercial buildings energy measures: program

Energy efficiency proposals for Class 2, 3 and 4 buildings have been developed and were released for public comment in September 2003. A draft RIS, which showed the measures to be cost effective, was subsequently released for public comment in February 2004. These measures have now been revised based on the submissions received, and are scheduled to be introduced into the BCA on 1 May 2005.

The proposals contained in this RD for other commercial building types, including offices, are now being released for public comment, following significant technical development with a range of government, industry and academic representatives. Following the public comment process, the measures will be revised as appropriate. They are scheduled to be introduced into the BCA on 1 May 2006.

Energy efficiency measures for other commercial buildings or systems not covered by this RD will be further examined by the ABCB.

B3 Environmentally sustainable development

The ABCB is conscious of the desire of many in the community to regulate other aspects of environmentally sustainable development (ESD) besides operational energy. Although operational energy is being tackled as a first step, the ABCB is also considering whether sustainability should also be part of the BCA. This is part of a separate project. There is also a divergence of opinion in the community as to what should be covered by ESD, and after the full scope is agreed, it may be found that only some elements are suitable for regulation or need to be regulated.

A difficulty yet to be overcome is the ability to regulate environmentally sustainable development matters nationally. Because building control is a State and Territory responsibility there are eight sets of legislation involved. Few, if any, of those have the power to control all aspects of ESD.

The BCA is constantly under review and changed on a 12 monthly cycle.

B4 Climate zones

Energy measures will vary from location to location. The Deemed-to-Satisfy Provisions in the BCA and the proposals described in this document are based on climate zones. The study titled “Feasibility study on a national approach to energy efficiency measures in houses” (CSIRO, 2000) discusses various possible climatic criteria as a basis for zoning, including dry bulb temperatures, degree-days of heating (for part of the country) and humidity.

The current BCA energy provisions include a climate zone map with eight climate zones (the same map is used in both volumes of the BCA). The basis of the zones is described in the following table.

The map has evolved from one developed some time ago by the Bureau of Meteorology (BOM). We have departed from the BOM map by adding another temperate zone and the existing BCA Alpine Zone. In some locations the accuracy of the map is limited by the availability of weather station records.

BASIS FOR BCA ENERGY EFFICIENCY CLIMATE ZONES					
Climate zones	**Description**	**Average 3 pm January water vapour pressure**	**Average January maximum temperature**	**Average July mean temperature**	**Average annual Heating degree days**
1	High humidity summer, warm winter	≥ 2.1kPa	≥ 30°C	-	-
2	Warm humid summer, mild winter	≥ 2.1kPa	< 30°C	-	-
3	Hot dry summer, warm winter	< 2.1kPa	≥ 30°C	≥ 14 °C	-
4	Hot dry summer, cool winter	< 2.1kPa	≥ 30°C	< 14 °C	-
5	Warm temperate	< 2.1kPa	< 30°C	-	≤ 1,000
6	Mild temperate	< 2.1kPa	< 30°C	-	1,000 to 1,999
7	Cool temperate	< 2.1kPa	< 30°C	-	2,000 to Alpine
8	BCA Alpine areas				

Note that while it is not included as part of the description, all the temperate zones have hot summer days.

The map evolved in four stages:

Stage 1: Development of a zone map using the fundamental criteria in the above Table.

Stage 2: Adjusting the map, where appropriate, so as to ease administration by aligning boundaries between zones with local government areas.

Stage 3: Further adjustment after testing by thermal modelling.

Stage 4: Further adjustment where:

- local knowledge identified topographical features such as an escarpment or significant micro-climate;
- there is a group of local government areas that form an administrative district and should be combined; and
- the jurisdiction considered the type of construction required in another zone to be more appropriate for a particular location.

In Stage 2 the boundaries between zones were adjusted, where appropriate, so that they coincide with local government areas. Generally, where a local government area contains more than one zone, the smaller zone has been merged with the larger one. In a few cases a smaller area of one zone has been used because of the location of a population centre in that smaller area.

The testing in Stage 3 involved verifying the map by the thermal modelling of a series of buildings in 51 locations for which there is contiguous weather data and then comparing the estimated energy consumption. The results are contained in ACADS-BSG reports.

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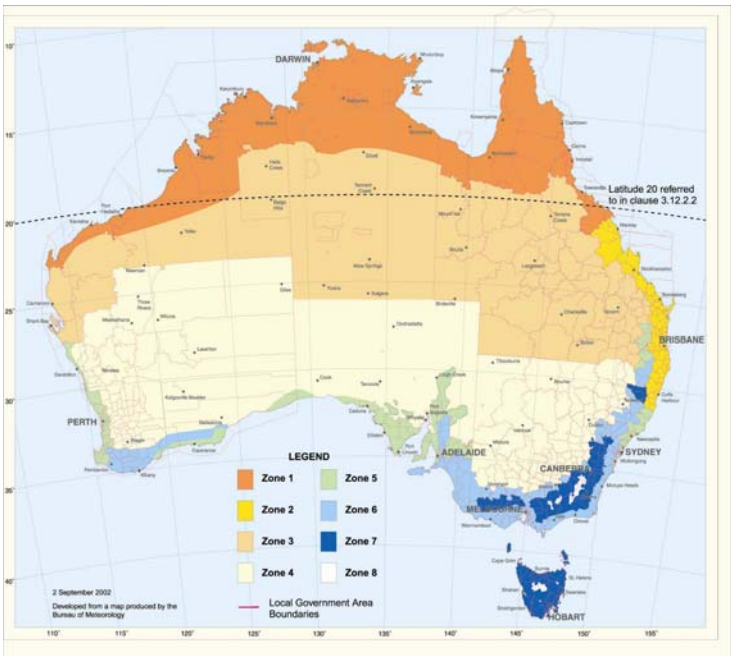
The current map is shown below and can also be viewed in an enlarged form on the ABCB energy webpage (http://www.abcb.gov.au).



It needs to be emphasised that these eight zones are used in the Deemed-to-Satisfy Provisions for simplicity. Although there was not universal consensus on the climatic basis of this approach, it is considered reasonable given the extent of the adjustments made for administrative purposes and the relatively small incremental cost increase between the measures from one zone to the next.

With a Verification Method, all of the climate data available from the Bureau of Meteorology that is formatted for the respective software can be used. For example, ACADS-BSG has climate data files for some 60 sites available.

B5 Outcome from RD 2003-1 for multi-residential buildings

The BCA energy efficiency measures proposed for Class 2, 3 and 4 buildings last year were, in the main, found to be cost effective and likely to reduce greenhouse gas emissions. Many of these provisions are being extended to Class 5 to 9 buildings such as those for roof lights, sealing and many services, while other provisions are being changed to a more appropriate value. Some, such as lighting provisions, are being substantially supplemented.

The plumbing related measures that were also included in the Class 2, 3 and 4 proposals were well supported during public comment. The cost effectiveness of the proposals were determined and referred to Standards Australia for inclusion in AS/NZS 3500, the plumbing standard.

The RD on energy efficiency measures for Class 2, 3 and 4 buildings included two possible Verification Methods: a stated value method and a reference building method. The public comment process indicated that there were differing views amongst stakeholders as to which

Verification Method should be included in the BCA. One view is that the stated value method can deliver differing results either through deliberate manipulation or making incorrect assumptions. Other stakeholders favour this method because it states a clear energy target. There is also a view that the reference building method is too complicated even though, in principle, it is the one preferred overseas. Although there is little Australian experience to draw on, it is felt that there is a place for both Verification Methods in the BCA. The stated value method is simpler, however to develop stated values for every type of building use would be prohibitively time-consuming, expensive and still not cover all situations.

Stakeholders have also indicated that in adopting the Verification Methods there is a need to protect the thermal performance of the building fabric by not permitting its energy performance to be traded for hi-tech engineering solutions. This is seen as necessary of a perception that regulators are not in a position to ensure that replacement engineering equipment is installed to maintain the intended performance.

To overcome this, a further step has been included in both Verification Methods when Alternative Solutions for the fabric are proposed. In addition to the energy consumption of the proposed services with the proposed fabric not exceeding the allowance value, the energy consumption of the proposed fabric with defined basic services must also not exceed the allowance value set. The allowance value, may be the stated value in JV2 or the determined Deemed-to-Satisfy value in JV3. The "defined services" are those used to determine the stated value in the first place and are a "low-tech" basic solution.

This limitation on trading is only one-way, in that it stops reducing the fabric's thermal performance while permitting an increase in the fabric's thermal performance to offset poor performing services.

B6 Stringency

In developing the 2003 BCA housing energy measures, the initial approach for setting the stringency was through the use of a cost benefit tool, expert judgment and consensus. After public comment indicated overwhelming support for the Nationwide House Energy Rating Scheme, the provisions were subsequently tested against a 4 star house energy rating. For Class 2, 3 and 4 buildings the stringency was based on the housing energy provisions and tested by modelling and life cycle analysis (as detailed in the Class 2, 3 and 4 draft Regulation Impact Statement – RIS 2004-1).

For Class 5 to 9 buildings, a tool has been developed which linked thermal analysis modelling to life cycle analysis. These processes, and the results generated, are discussed in detail in Part B2 of this report.

To assist in undertaking the life-cycle analysis, an independent study was carried out by Exergy Australia of existing office buildings, their actual energy consumption and their modelled predicted energy consumption. This study indicated that the actual energy consumption of buildings can be considerably more than the design target. From this study, a design target (as against actual energy consumption) of around 740 MJ/annum.m^2 for an office building in the temperate locations was recommended. An earlier study of 13 typical buildings by EMET Consultants resulted in an average energy consumption of 772 MJ/annum.m^2. Both studies showed a wide spread of results with different operating profiles, regimes of maintenance, internal loads and type of activities. However, the Exergy report concluded that an energy efficiency measure would achieve an operational saving.

The Property Council of Australia (PCA) Energy Guidelines 2001 differentiates between "new building design targets" and "best practice existing building benchmark". For "new building design targets" it sets a range of between 343 and 527 MJ/annum.m^2 with their standard criteria depending upon the location. Although the target proposed for the BCA is considerably higher (less demanding) than the PCA targets, it should be noted that the PCA values represent "best practice" while the BCA focuses on minimum cost effective standards. For this project, the agreed cost effectiveness criteria are based on that considered appropriate for a long term building owner.

It is important that the design target not be compared with any of the energy or sustainability rating criteria used for post occupancy evaluations. It must be emphasised that there can be no comparison of values and that the BCA proposed target is only applicable to a particular set of hypothetical circumstances. In addition, it is based on assumed operating profiles and internal loads, and does not take into account many buildability and operational matters.

The proposed design target represents a saving of around 20% of the energy consumption on average over a building treated with minimal energy measures. However, it must be emphasised that this is a design-based target only and is based on a set of assumptions that do not hold true for all buildings and all climates. In hot humid climates it is difficult to achieve the same target as for temperate climates while in cooler climates lower values can be more easily achieved.

This target has not been used to determine the measures; it has only been used as a useful check on the values in the stated value Verification Method (determined from the Deemed-to-Satisfy Provisions) and on the severity of the Deemed-to-Satisfy Provisions which have been developed by life-cycle costing. As was the case with the introduction of the BCA housing energy measures, while a greater stringency would be cost effective, the proposed provisions are considered a reasonable first step in eliminating worst practice. It is acknowledged that the stringency will need to be increased in the future, particularly the glazing provisions, as industry adapts its practices and the supply of energy efficient products increases.

B7 Level of complexity

Those familiar with overseas energy codes are aware of the level of complexity involved in the associated provisions. Efforts have been made to keep the BCA energy measures as simple as possible without making them too simplistic. The Housing energy provisions were pitched at a level that could be understood by most building practitioners and the same format has been used as far as possible for the commercial buildings energy provisions. However, for larger buildings - particularly where Alternative Solutions are proposed - and for elements such as the air-conditioning and lighting provisions, energy or services specialists will be needed to carry out the designs or check and certify compliance.

This requirement is not new to the BCA and the complexity and procedure involved is no different to that in other specialist areas such as structural engineering, fire safety engineering or indoor air quality. These require far more complex calculations than is proposed for energy efficiency.

B8 Building use versus BCA Classes

The BCA Classification system is basically a fire safety classification system and not necessarily suited to defining different energy efficiency measures for different types of buildings. Energy consumption depends more on the hours of operation, the activities undertaken in the building, the number of people using the building, the intensity of internal heat loads and whether the building is likely to be air-conditioned.

Whether or not a building is to be air-conditioned at some stage is particularly important as the building fabric or shell will need thermal insulation properties. Issues relating to industrial relations, employee health, customer comfort and noise intrusion mean that commercial buildings are more likely to be conditioned. Those that are not are more likely to be industrial type buildings.

Therefore, it is proposed that at least the BCA Deemed-to-Satisfy Provisions treat all Class 5, 6 and 9a buildings as if they will at some time be air-conditioned. Other Classes (7, 8, 9b and 9c) are more likely to be industrial buildings and therefore not conditioned. Those buildings that are unlikely to be conditioned, or only partially conditioned, could be exempted from the BCA energy efficiency requirements by setting a minimum threshold for needing to comply.

B9 Use of energy analysis software

The role of energy rating and analysis software has become a prominent issue for the ABCB. While the BCA does not reference specific software, overwhelming support from the community resulted in a star rating to the Nationwide House Energy Rating Scheme being included in the BCA housing energy provisions as part of the Verification Method for Class 1 and 10 buildings (Volume One) and Class 2, 3 and 4 buildings (Volume Two). This enables energy rating software to be used by building practitioners to demonstrate compliance with the BCA Performance Requirements.

As a result of the inclusion of the star rating approach in the BCA, and given the lack of documentation of the calculation methods for software, the ABCB has subsequently prepared a Protocol for House Energy Rating Software in consultation with key software technical experts, which was referenced in BCA 2004. The aim of the Protocol is to ensure that rating software is of an appropriate standard, provides results that are repeatable and that results are consistent using different software. It also aims to provide a mechanism for controlling amendments and revisions to software.

The ABCB has been consulting with relevant stakeholders to determine whether a similar type of document is required for commercial building energy analysis software. For houses, it was necessary to define the Nationwide House Energy Rating Scheme through the Protocol. There is no comparable scheme for commercial buildings. Those that exist are either sustainability rating schemes or post-occupancy energy rating schemes.

Some stakeholders feel that energy should not be treated any differently from structural engineering or fire engineering calculating software and therefore no Protocol is required. However, there is a counter view that these are established disciplines known to the industry, have accepted practices and some legal standing in terms of registration or recognition.

Whilst overseas the use of energy modelling is accepted, it has yet to gain that status in Australia.

Initial feedback suggests that some form of documentation will be necessary which outlines the essential elements that software should contain and what settings should be adopted. Such a document will serve as a useful reference point for software development, as well as providing a connection between the building regulatory requirements and the technical solutions from the software. A draft document is being prepared by the ABCB Office in consultation with key stakeholders, including energy analysis software suppliers. The draft is expected to be finalised by December 2004 and will then be placed on the ABCB website for public comment.

B10 Building regulations

The BCA is given legal standing by virtue of it being referenced in building law as the required construction standard. As explained in Attachment D, the construction standard can only address technical matters and cannot cover administrative issues such as staged completion, triggers for upgrading a building and work in design when the BCA is changed. These issues correctly reside in the regulations or other reference documents.

While it is expected that industry will be particularly concerned with these issues, they are not unique to energy efficiency and processes are already in place in all jurisdictions for dealing with them. Most building control administrations provide guidance on how such issues are handled in their jurisdiction as part of the education awareness seminars that are undertaken prior to the introduction of energy efficiency measures in the BCA.

B11 Maintenance

An important aspect of energy efficiency is the need to maintain the energy efficiency features, items and systems at their intended performance levels. To some extent this can be covered by State and Territory building law, including through the BCA. However, other important aspects such as optimising the settings of boilers, chillers, outside air dampers and the like, monitoring energy consumption and the detailed scheduling and supervision of maintenance, are currently outside the scope of building regulations in some jurisdictions. Therefore the latter aspects need to be addressed by other means such as industry guidance literature, education, codes of practice or other voluntary mechanisms.

C TECHNICAL COMMENTARY

Part A1 - Definition

Illumination power density

This term is more wide-reaching than the simpler "lamp power density" term used for Class 2, 3 and 4 buildings. It needs to be calculated taking account of the losses from ballast current regulators and control devices at the point of use. The calculation of illumination power density does not include for losses elsewhere in the system, such as cable losses.

Section I - Maintenance

This section is unchanged other than extending it beyond Class 3 buildings to Class 5 to 9 buildings. This extension is necessary because commercial buildings are usually artificially lit and air-conditioned, and the energy efficiency of these systems is highly dependent on the quality of maintenance of equipment, controls, luminaires, dampers, heat transfer surfaces etc. Many stakeholders would like to see better preventative maintenance performed in buildings, however, because of the scope of building regulations, there is a limit to which the BCA can be used for this purpose.

Section J - Energy Efficiency

Note that Section J already exists for Class 2, 3 and 4 buildings. The following describes how it is to be extended to cover other building Classes.

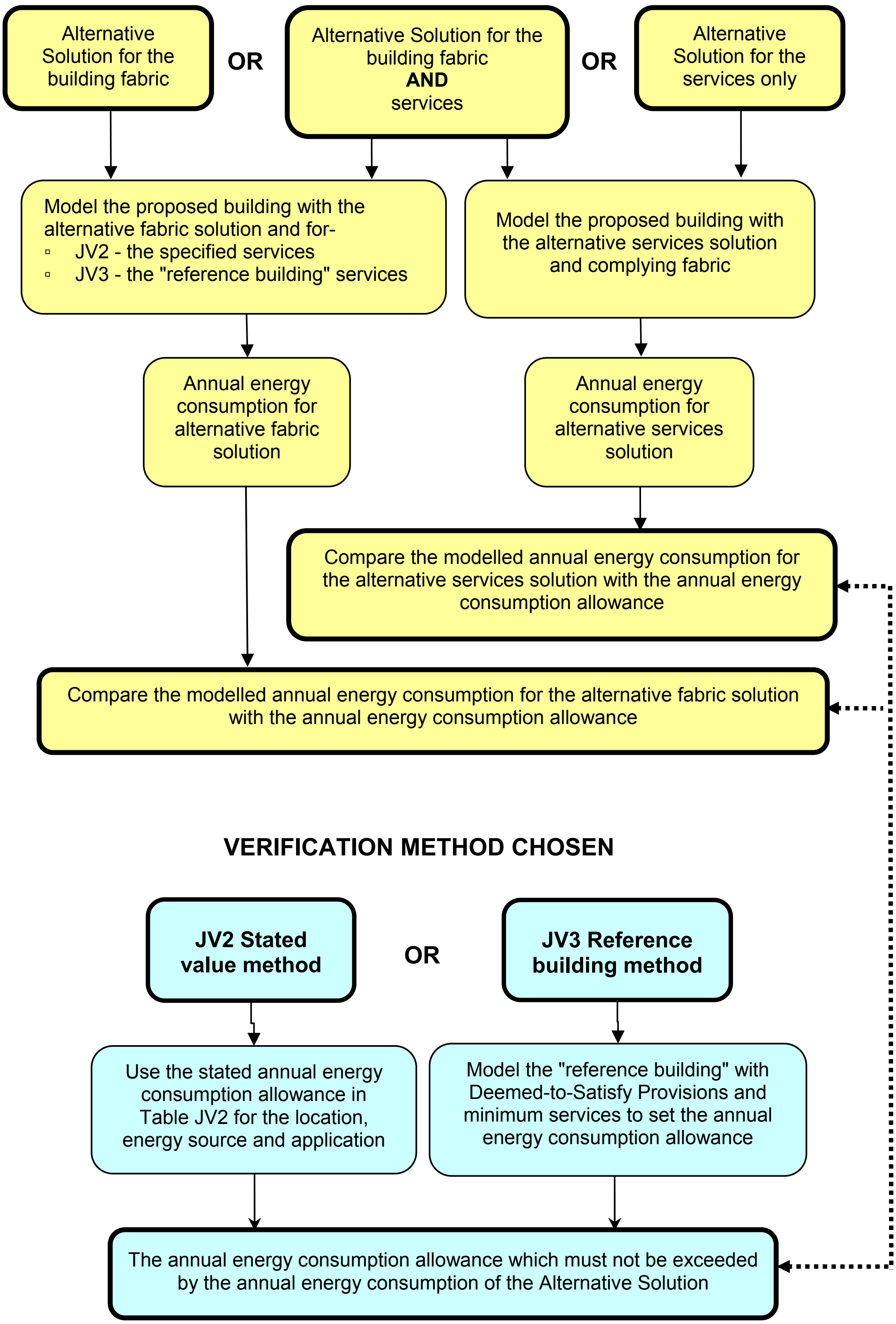
Performance Clauses, Applications and Limitations

These clauses are unchanged. However, the applications have been widened to cover other buildings. A limitation has been retained for JP2 so that services maintenance facilities are not applied to a sole-occupancy unit of a Class 2 building or Class 4 part. This is consistent with not applying the services maintenance facilities to Class 1 buildings, i.e. private residences.

Verification Methods JV

There are currently three Verification Methods in the BCA for Class 2, 3 and 4 buildings. These all remain. JV1 is for assessing dwellings and relates to the Nationwide House Energy Rating Scheme. JV2 and JV3 currently apply to Class 3 buildings and are being slightly modified so that they can also apply to other Class of buildings. The following diagram illustrates how the Verification Methods can be used to assess Alternative Solutions.

ALTERNATIVE SOLUTION OPTIONS



It is intended that JV2, the stated value method, be available for the most common buildings, (i.e. office, restaurant, and theatre type buildings and schools). More specialised buildings could use the reference building method.

It is important to note that the values in the table in JV1, the stated value method, and the values and profiles in the specification JV, are not intended to be compared with any actual building or any rating scheme criteria. They are only intended for a comparative analysis to assess BCA compliance.

JV2 Verification using a stated value

This verification method is in the current measures for Class 3 buildings and is extended to include stated values for some other types of buildings. Accordingly, the Verification Method now covers:

- Class 3 (currently in the BCA) and Class 9c aged care buildings.
- Class 5 office buildings, Class 8 laboratories and Class 9a clinics.
- Class 6 shops and shopping centres.
- Class 6 restaurants and cafes.
- Class 9b theatres and cinemas.
- Class 9b schools.

Note that Class 9c aged care buildings are being treated the same as Class 3 buildings, as they are basically residences and so have similar heating, cooling, lighting and supply hot water needs.

This Verification Method prescribes an annual energy consumption that must not be exceeded by the proposed building. The term "energy consumption" is used to describe the theoretical energy use of the building services determined from energy simulation calculations. There are two aspects to this Verification Method, as described in JV2(a)(i) and JV2(a)(ii). The first requires that a building, when modelled, would not consume more energy than that stated in Table JV2 for the applicable location. The second aspect is designed to limit the “trading” between the envelope and services of a building. "Trading" occurs when one element's over-performance is used to compensate for another element's under-performance. The specific purpose of JV2(a)(ii) is therefore to stop the under-performance of the building’s envelope providing over-performing services. However, trading the other way can take place, i.e. better performing envelope and under-performing services.

The steps to using this Verification Method are:

1. Determine the annual energy consumption allowance from Table JV2 for the location and energy source.
2. If there is an Alternative Solution proposed for the engineering services, calculate the theoretical annual energy consumption of the proposed alternative services solution using the operational criteria in Specification JV.
3. Compare the calculated annual energy consumption for the alternate services solution to the annual energy consumption allowance to ensure that consumption is not greater than allowed with the Alternative Solution.

4. If there is an Alternative Solution that involves the building fabric calculate the theoretical annual energy consumption with the proposed alternative fabric solution and with the services as if they were of the Deemed-to-Satisfy minimum standard and the air-conditioning system type described in JV2(c).
5. Also compare the theoretical annual energy consumption for the alternative fabric solution to the annual energy consumption allowance, to ensure that the alternative fabric solution does not use more energy than allowed.

In JV2(a)(ii), it is stated that services must be modelled with the "minimum standard specified". This means the criteria in the Deemed-to-Satisfy Clauses or Tables. In some cases, such as lamp power density, this may be a maximum permitted value. Even though it is a "maximum", it is also the "minimum standard specified".

JV2(a)(ii) will complicate the annual energy consumption calculations in some instances by requiring that a second modelling run be carried out.

JV2(b) and the unchanged JV2(c) establish a number of criteria for the annual energy consumption calculations to ensure that comparisons to the annual energy consumption allowances in Table JV2 are appropriate. The unchanged JV2(c) also describes the systems with which the annual energy consumption allowances in Table JV2 have been derived. JV2(c) does not act to restrict the actual building to these systems, but is simply to be used when analysing the under-performance of the building's envelope.

The two columns of annual energy consumption allowances for each type of building in Table JV2 are based on the two most likely mixes of energy for a building's services. The annual energy consumption allowance in the column titled "Gas" is based on cooling with air cooled refrigeration units and heating with reticulated hot water from a gas-fired boiler. The hot water system operates whenever there is a need for heating. The annual energy consumption allowance in the column titled "Elec.", is based on air-conditioning with reverse cycle package heat pumps, with supplementary electric resistance heating for times when the reverse cycle operation does not provide sufficient heating.

These systems represent the commonly used, minimum standard systems. The benefits of more efficient systems, such as those that use variable volume systems, outside air economy cycles on small units and the like, can take advantage of this Verification Method.

Development of values

The values have been derived by modelling typical building forms at the minimum standard specified in the Deemed-to-Satisfy Provisions. As these values are for a fully air-conditioned building, they may have a cooling component and a heating component. In Darwin, the conditioning is likely to be only for cooling and in Alpine areas the conditioning may be only heating; elsewhere it is likely to be a mixture. The least annual energy consumption is likely to be in temperate locations.

The allowances in the table for Class 3 and 9c aged care buildings are based on an occupancy profile developed for hotels and motels. They will be different from actual consumption data from hostels, boarding school dormitories, etc. The allowances may even be different from actual data from some hotels. This is of no consequence as the criteria has been generated using the same profile that must be used under Specification JV.

Extensive modelling has revealed that the difference in the total energy targets for buildings of different shapes and sizes is within reasonable agreement and so the same allowance has been set for all buildings of the same use and energy source. The energy consumed as a result of heat transfer through the envelope would be less for a high-rise building than a single storey of the same footprint, but this is approximately compensated for by the energy used by lifts.

The other types of buildings listed are grouped with buildings having similar occupancy and internal loads. The range is limited and for other applications, the "reference building" method could be used or an alternative Verification Method developed to demonstrate compliance. Because of the number of combinations, this would need to be done on a case-by-case basis.

Modelling versus actual

The annual energy consumption allowances in Table JV2 have been developed specifically for this Verification Method. They should not be compared with the actual annual energy consumption of a particular building as the energy consumption will vary depending upon a number of factors including internal load, hours of use and occupancy levels. In practice, the energy consumption is likely to be different for every building. Users need to understand that this difference is not an anomaly, and that the annual energy consumption allowances are only for modelling purposes and only appropriate when the criterion in Specification JV are used instead of a building's actual operating characteristics.

Designers are familiar with the energy target approach. However, some stakeholders feel that the stated value Verification Method should be dropped in favour of the reference building Verification Method because the stated value used in the modelling is far lower than actual building energy performance and may lead to unreasonable expectations. Another reason suggested for dropping the stated value method is that it is more likely to give different results depending upon the software used. A concerted awareness program may help to make people aware of the differences between design modelling and actual building performance. Respondents are requested to express their views on these issues.

JV3 Verification using a reference building

This Verification Method is unchanged in content from the current measures for Class 2, 3 and 4 buildings. It is similar to the stated value method (JV2), however, rather than using tabulated stated annual energy consumption allowances, the user must calculate the allowance. This is done by modelling a reference building which complies with the Deemed-to-Satisfy Provisions and the criteria in Table JV3. This establishes the theoretical annual energy consumption that would have been achieved by a building complying with the Deemed-to-Satisfy Provisions. The annual energy consumption obtained is equivalent to a stated value in Table JV2 for the proposed building. This sets the benchmark that must be achieved when modelling the Alternative Solution.

Through this modelling process, it can be demonstrated that an Alternative Solution is equivalent to, or better than, the Deemed-to-Satisfy Provisions. This is one of the Assessment Methods recognised in the BCA.

JV3 is structured in a similar way to JV2. It includes provisions in JV3(a)(ii) designed to protect the thermal performance of the building's envelope from "trading" off its performance as discussed above.

The steps to using this Verification Method are:

1. Calculate the annual energy consumption allowance of a "reference building", i.e. one using the criteria in JV3(b) including the Deemed-to-Satisfy Provisions and the operational criteria in Specification JV and complying services. This determines the annual energy consumption allowance for a complying building with complying services.
2. If there is an Alternative Solution proposed that involves the building fabric, calculate the theoretical annual energy consumption with the proposed Alternative Solution and the "reference building" services.
3. Compare the theoretical annual energy consumption for the alternative fabric solution to the annual energy consumption allowance to ensure that the alternative fabric solution does not use more energy than allowed.
4. If there is an Alternative Solution proposed for the engineering services, calculate the theoretical annual energy consumption of the alternative services solution using the operational criteria in Specification JV.
5. Compare the calculated annual energy consumption for the alternate services solution to the annual energy consumption allowance to ensure that the Alternative Solution does not use more energy than allowed.

Specification JV - Annual energy consumption calculation

This Specification is generally unchanged from the current measures for Class 2, 3 and 4 buildings, other than the inclusion of internal load criteria for some other types of buildings.

The Specification sets out a standard procedure for calculating annual energy consumption. Although the values stated may not be those achieved in some buildings, they are considered the most typical and must be used in JV2 and JV3.

Clause (c) refers to vertical transport being proportioned according to the *rise in storeys* for buildings of different classifications. For example, if an 8 storey Class 3 building is above a 2 storey Class 7 building (carpark), then $^{8}/_{10}$ or $^{4}/_{5}$ of the lift energy must be assigned to the Class 3 building.

Clause (e) does not permit the full credit of energy generated from sources that do not emit greenhouse gases because there are likely to be times when grid energy is used (such as during peak periods), when equipment is down for maintenance and, in the case of solar heaters, on overcast days. The credit is also limited to energy generated on-site because that represents the limit of building law control.

Deemed-to-Satisfy Provisions Clauses J1.0, J2.0, etc

This is a standard BCA clause already existing and will be adjusted when the measures are finalised.

Application of Part Clauses J1.1, J2.1, etc

It is proposed to extend the measures for Class 2, 3 and 4 buildings to include all buildings.

It could be argued that buildings that are only likely to be heated should have lesser provisions from those buildings that are likely to be heated and cooled because of their lesser potential to save energy and achieve a return on the investment. However, it is difficult to identify buildings that are currently only heated and are likely to remain only heated for their life, particularly with the cost of air-conditioners continually dropping. Further, even with only heating, the life cycle costing analysis shows that the cost of extra insulation is minimal, and justified, up to the point where there is an additional construction cost. In summary, irrespective of whether the building is to be only heated or fully air-conditioned, it is cost effective to provide as much insulation as practical.

Therefore, it is proposed that the Deemed-to-Satisfy Provisions treat all Class 5, 6 and 9a buildings as if they will at some time be air-conditioned. However, because there are industrial buildings that are unlikely to be air-conditioned, some of the application clauses exempt Class 7, 8 and 9b buildings that do not have a conditioned space or are only partially conditioned. Typical buildings that are not conditioned would be a carpark, market, foundry or warehouse.

Those buildings or parts of buildings that may be partially conditioned could be the check-out counter in a hardware store, workstations of a workshop or aircraft hanger, a laundry or even a church or community hall. An upper limit capacity of $15W/m^2$ for either heating or cooling has been set as a minimum threshold. The criteria of $15W/m^2$ is between 10% and 20% of the capacity of a heating or cooling system providing comfort temperature to the full area. Typically, the cooling needed for a building in climate zone 7 would be of the order of $100W/m^2$ to $120W/m^2$ and in climate zone 5, the heating would be of the order of $50W/m^2$. With a heat pump air-conditioner, the input power rates for climate zone 7 for cooling would be $30w/m^2$ and for climate zone 5 for heating, $20W/m^2$. Warmer climate zones would have higher cooling needs and colder climate zones would have higher heating needs.

Part J1 - Building Fabric Provisions

Insulation levels for roofs, walls and floors of Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to provide requirements for other building Classes. A fundamental difference is that Class 5 to 9 buildings are fully air-conditioned and are likely to have a significantly higher internal load (i.e. people, lighting and appliances) than residential buildings.

The values in the tables are based on the minimum likely hours of operation and a building that operated for longer periods could justify greater levels of insulation.

Insulation manufacturers should note that to comply with BCA Volume One, insulation may need to be non-combustible or meet fire hazard properties in some types of construction. This is in addition to complying with the thermal performance specified.

J1.3 Roof and ceiling insulation

The insulation levels for roofs and ceilings of Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to provide requirements for other building classes that are air-conditioned.

This clause covers roofs (including their ceilings), and any ceiling that is part of an intermediate floor between a conditioned space and a non-conditioned space such as a plantroom.

J1.3(a) and Table J1.3 detail the insulation properties required for a roof or ceiling. Table J1.3 provides the minimum Total R-Value to be achieved by the roof or ceiling. Part or all of this may be provided by the roof construction itself. Any inherent insulating property of the roof and air spaces reduces the amount of insulation needed. This table already exists for Class 2, 3 and 4 buildings and has been extended for Class 5 to 9 buildings. Note that Class 9a aged care buildings are being treated the same as Class 3 buildings, as they are basically residences and have similar heating, cooling, lighting and supply hot water needs.

Roof colour

A further proposed change is that the measures are designated for a dark coloured roof; a lighter coloured roof does not need to have as much insulation. The amount of the difference varies depending on whether the building is for residential or commercial purposes. If a building is for residential purposes, it is more likely to have a greater night-time use than a building used for commercial purposes, and so a light coloured roof is less beneficial. The measures in Table J1.3 are based on a designer choosing a dark coloured material. If a light material is chosen, such as galvanised steel, the note permits the R-Value to be reduced. An industry recognised international standard for testing absorptance is ASTM E903.

Condensation

Although the BCA housing energy efficiency provisions currently contain a Deemed-to-Satisfy Provision based on a ventilated roof space in conjunction with a light coloured roof and reflective insulation under the roof, this provision has not been repeated for commercial buildings. This is because these buildings are considered more likely to be air-conditioned for significant periods and therefore there is a greater likelihood of condensation and moisture damage. However, this provision can still be appropriate in a dry climate or where it can be assured that air-conditioning will not be installed. In this case, it could be proposed as an Alternative Solution.

The ABCB will continue to investigate the causes of condensation problems and possible regulatory action.

Direction of energy flow

The direction of energy flow stated in the provisions should not be taken as the only direction in which any insulating properties operate, but as a statement of the prominent direction for that particular climate zone. It is assumed that all materials will also have insulating properties in the other direction. For a residential building, the night time direction is important as the building is most likely to be occupied at that time.

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J1.5 Wall insulation

The insulation levels for walls of Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to provide requirements for other classes of buildings that are air-conditioned as well as modify the current measures with respect high-mass walls.

J1.5 provides a series of options for walls, including both external walls and internal walls, which are part of the building's envelope and therefore need to have insulating properties. It is also proposed to express the measures in tabular format listing the options for each climate zone.

The current options are:

- To provide the Total R-Value needed.
- To provide shading.
- To use wall materials of 220kg/m^2 surface density.
- To combine insulation and wall materials of 220kg/m^2 surface density.

A new option has been added. This allows compensating for any under-performance of the proposed walls with any over-performance in the glazing. This need not be a whole-of-building thermal modelling approach, but a relatively easy calculation based on the energy being transferred (or conductance) through the walls, and glazing not exceeding the same sum of a Deemed-to-Satisfy complying construction. It is also proposed to replace the current BCA text format of options with a tabular format clarifying the options in each climate zone.

For example, assume that a building is to be constructed in Perth of 120m^2 floor area. It has 110m^2 of total wall area of which 20m^2 is glazing (U-Value 0.64 and Frame Factor 1.2) and 90m^2 is cavity masonry without added insulation (Total R-Value 0.67).

In Table J2.3a the C_U for climate zone 5 is 1.9.

(A) The design conductance is-

(aa) for the external wall	= $^{Area}/_{Total\ R\text{-}Value}$	= 90/0.67	= 134.3
(bb) for the glazing	= Area x Total U-Value x Framing Factor	= 6.4 x 20 x 1.2	= <u>153.6</u>
		Design conductance total	= 287.9

(B) The *required* conductance is-

(aa) for the external wall	= $^{Area}/_{Required\ Total\ R\text{-}Value}$	= 90/1.4	= 64.3
(bb) for the glazing	= Floor Area x C_U	= 120 x 1.9	= <u>228.0</u>
		Required conductance total	= 292.3

As the design conductance is less than the required conductance, the design complies. If it did not, a better quality glass could have been tried. Note that the glazing should be selected to comply with J2.2 first. If not, then this trade-off would have to be checked afterwards, if the glazing is later adjusted.

Insulating performance

The cost-benefit modelling showed that in most climate zones, a Total R-Value of R1.9 would be appropriate. This would require a 65mm cavity or more in most lightweight wall constructions. However, there is a concern that current practice is to use 35mm furring channels. Even though the measures would not be in place until May 2006, it has been suggested that industry may need time to adjust and that a staged implementation may be needed. Public comment is sought on this issue.

High mass walls

Walls with a surface density of 220kg/m^2 or more provide an enhanced level of thermal performance in certain climate zones. This is related to their ability to store heat and therefore slow its transfer through the building fabric. These walls are defined by surface density (kg/m^2) to reduce the complexity when measuring mass walls with voids (surface density is the mass of one square metre of wall).

As a result of thermal modelling, it has been found that because commercial buildings are more likely to be air-conditioned for long periods, the high mass option is not as beneficial as it is for houses. However, it still offers a benefit, particularly in the temperate climates. Although different from the provisions for Class 2, 3 and 4 buildings, this benefit is recognised in the provisions for Class 5 to 9 buildings. For example, double brick with a thermal conductivity value of 0.75 or better achieves an equivalent performance to that of an insulated framed wall in climate zones 2, 5 and 6 without additional insulation (thermal conductivity is the property of a material from which R-Value is derived by dividing the thickness of the material by the thermal conductivity).

In other locations, it requires less insulation than the insulated framed wall would require. Although concrete panels and blockwork do not provide equivalent performance on their own, they also require less insulation than an insulated framed wall. Note also that the options in table J1.5 that include a slab-on-ground, would only apply to the walls on the ground floor.

Opaque curtain walls are considered as walls and must meet the Total R-Values for walls, while transparent or translucent elements are considered as glazing because of the solar energy they permit to enter the space.

Internal walls

Internal walls that are part of the building's envelope, i.e. that separate a conditioned space from a non-conditioned space, require less insulation than an external wall that is part of the envelope. In climate zones 1 to 3 and 5, there is no requirement as the non-conditioned space provides the required shading and meets the minimal insulating requirement. In climate zones 4, 7 and 8, it is important to also have some additional insulating performance and this can be provided by the non-conditioned space and its walls.

Thermal bridging

An ongoing issue has been the difference in thermal performance between different framing materials, wall ties, etc, and the bypassing of insulation called thermal bridging. An ABCB Working Group has been investigating the impact of this effect. The Group is still looking at other building elements. However, it is generally accepted that in a wall without an air gap, some form of thermal break or insulation is needed if the frame is metal, in order to break the heat flow between outside and inside. A draft clause has been included in the provisions.

J1.6 Floor insulation

Again, the insulation levels for floors of Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to provide R-Value levels for other Classes of buildings that are air-conditioned. For clarity, the values have now been tabulated.

An unenclosed perimeter means that the lowest floor of a building has a sub-floor which is not enclosed by ground-to-floor cladding such as masonry or cement sheet. The ground-to-floor cladding can have the required sub-floor vents and still be considered enclosed.

A local under-tile or in-screed heating system in a bathroom, amenity area or the like is not considered to be an in-slab system.

Part J2 - External Glazing Provisions

The insulation levels for floors of Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to provide requirements for other Classes of buildings that are air-conditioned.

J2.2 Alternative glazing

There are two different methods for determining glazing compliance. The first is based on a seasonal heat flow analysis, while the second is based on an annual dynamic simulation of energy use and Net Present Value (NPV) analysis. The two methods are quite different in their conceptual basis, however, they are considered appropriate for the respective Classes of buildings to which they are applied.

Class 2 and 3 buildings and Class 4 parts are essentially different configurations of residences. While heating and cooling may be provided during the peak seasons, these building types are less likely to be air-conditioned all year round. Therefore, seasonal heat flows for winter and summer were used to set the stringency criteria for the glazing provisions. This approach (Method 1) is in BCA 2005 for Class 2, 3 and 4 buildings.

The larger commercial Class 5, 6, 8 and 9b buildings are generally fully air-conditioned and so an annual dynamic simulation of energy use and NPV analysis was used as the conceptual basis of setting the stringency.

Method 1 calculates the glazing allowance for each storey of a sole-occupancy unit (or the public area of a Class 2 or 3 building), while Method 2 calculates the glazing allowance for each wall direction and for each storey. The criteria in Method 1 are calculated on the basis of each sole-occupancy unit being a single zone while the criteria in Method 2 are calculated on the basis of the air-conditioned zone adjacent the windows on one side of a building.

Because Method 2 provides solutions for glazing that are in the order of 50% of the wall area, it may be too demanding for a Class 6 shop, which traditionally has large display windows that may then be enclosed within the building. It is proposed to permit Class 6 buildings under $500m^2$ in floor area to use Method 1 which should provide a more favourable solution.

Another alternative is to exempt display windows that are totally enclosed although this is not in the draft provisions at this time. Respondents are asked to provide comment.

Consulting engineers, Arup, were asked to review the two approaches and the differing results that arise from using the two approaches. They concluded in their report that the two approaches lead to different results in terms of glazing stringency because of their different conceptual basis, and that the results are considered to be appropriate answers to different problems.

The provisions for both methods require any shading to extend on both sides of the glazing for a distance equal to the projection distance. This is required because there is significant flanking of a projection that does not extend beyond the sides of the glazing. An alternative approach would be to use vertical shading such as shading fins or recessed window reveals.

Measurement of glazing performance and evidence of suitability

Glazing performance in both methods is measured in terms of U-values (for conduction) and Solar Heat Gain Coefficients (SHGC). These terms were introduced to the BCA with the initial housing energy efficiency measures where they refer to the combined performance of glass and frames assessed as a complete system. Generic descriptions of glass and frame combinations that could achieve particular U-values and SHGCs were stated for convenience, however, the measures required glazing system performance to be verified on a whole system basis. (For example, such assessment and certification is available through the Window Energy Rating Scheme. The Scheme covers a range of proprietary and generic domestic window systems.)

The method in BCA 2005 for Class 2, 3 and 4 buildings was developed after advice that the numerous combinations of glass and frames used in commercial buildings had not been subjected to comprehensive whole system assessment. As a result, some designers and specifiers would not have convenient access to performance data comparable to that available for domestic windows. This could result in difficulties in demonstrating compliance in some cases. The Class 2, 3 and 4 provisions, therefore, measure performance in terms of the SHGC of the glass alone and the U-value of the glass modified by frame factors that approximate the effects of three frame types.

With the assistance of industry bodies, the practical means of measuring whole system performance has been further explored and these proposals include two compliance paths. The first is assessing system performance by using one of the calculation programs available. The second is by using the glass (translucent or transparent element) performance and applying a framing factor that is provided in the BCA.

Introduction of the BCA measures in 2006 will also allow industry more time to establish assessment and certification regimes than was available for the Class 2, 3 and 4 provisions.

The ABCB would appreciate feedback on the capacity of the glazing industry to certify the whole system performance of commercial glass and frame combinations to an extent that meets the needs of designers and specifiers seeking to comply with BCA Deemed-to-Satisfy Provisions.

Assessment standard

A complicating factor in the issue outlined above is that the whole system assessment of domestic windows has been based so far on Australian National Average Conditions (ANAC), which differs from the (US) National Fenestration Rating Council (NFRC100-2001) conditions used to assess glass performance reported in the International Glazing Database.

Performance assessed under the two sets of conditions can produce significantly different numbers for the same glass and frame combination (with obvious potential for confusion). ANAC underlie the performance reported by the Windows Energy Rating Scheme and recorded in the component libraries of house energy rating software such as NatHERS and FirstRATE. NFRC conditions are used to determine the performance data relied on by commercial building simulation software such as DOE2.

Methods 1 and 2 assume that whole system performance of glazing will be assessed in accordance with the NFRC100-2001 conditions. Industry advice is therefore sought on the practicalities of moving to whole system performance based on NFRC100-2001 conditions for both domestic and commercial glazing.

J2.3 Glazing - Method 1

This method is the one currently in BCA Volume One for Class 2 and 3 buildings and Class 4 Parts. It is also described in the current Guide to the BCA.

The approach with Method 1 is to relate glazing performance to glazing area and its exposure to solar radiation. This approach enables unlimited mixing of glazing sizes, glass and frame types, and shading projections or other shading devices.

The means by which heat enters or leaves a room through glazing are conduction, solar radiation and infiltration. The latter is covered under the sealing requirements. Conduction through glazing occurs when there is a temperature difference between the inside and the outside of the glazing. Conduction through both glass and frame must be considered. Solar radiation passes through glazing as direct beams of sunlight, but also as diffuse (or scattered) radiation and as reflected radiation. The intensity of solar radiation from different directions varies throughout the year and is also affected by the amount of shading provided to the glazing.

Glazing requirements in each climate zone are specified by separate constants for conductance and for solar radiation (or solar heat gain). These constants are labelled C_U and C_{SHGC} in J2.3(a) and J2.3(b). These clauses establish the performance targets for each storey of a sole-occupancy unit or of a public area. The constants for conductance and solar radiation are each multiplied by the floor area of the sole-occupancy unit or the public area to determine the performance targets that apply to that particular space in a given climate zone.

In a southern location conductance will often be the critical factor, while in a northern location solar radiation will usually be the critical factor. In the more temperate locations, either could be the critical factor.

J2.3(c) provides the method to calculate the combined performance of all the glazing on each storey of a sole-occupancy unit or of a public area. Two formulae set the solar and conductance performance of each glazing panel in the proposed installation. The calculated results must not exceed either of the calculated performance targets for conductance or for solar heat gain.

For conductance, the formula multiplies the glazing area by the Total U-Value of the glazing system (i.e. glass and frame combined). Alternatively, if the Total U-Value of the glazing panel is not available, the Total U-Value of the transparent or translucent element (usually glass) may be used, provided it is multiplied by the frame factor given in the BCA Table J2.3b. Values suitable for use in the formula can be found from the manufacturer's published data. Most manufacturers do not refer to Total U-Value but rather just U-Value even though they may allow for the air films. Some manufacturers may publish a single "winter" value, others may publish values for both "winter" and "summer". For consistency, the stringency has been formulated to allow the "winter" value to be used in all locations (including those without a significant winter).

It is imperative that the user is clear as to whether a Total U-Value obtained from a manufacturer or supplier is for the glass only or for the glazing system (glass and frame combined).

For solar radiation, the formula multiplies the glazing area facing a particular direction by the SHGC of the transparent or translucent element and by a solar exposure factor. No frame factor is used in this calculation. The SHGC of the glass can be found from the manufacturer's data. The solar exposure factors are provided in Table J2.3c which has a separate part for each climate zone. The factors make allowance for the different amounts of solar radiation received from different directions, and for the extent of physical shading that is proposed. The required solar radiation performance must be achieved by the glass itself if the glazing is unshaded, but can be provided by a combination of glass and shading.

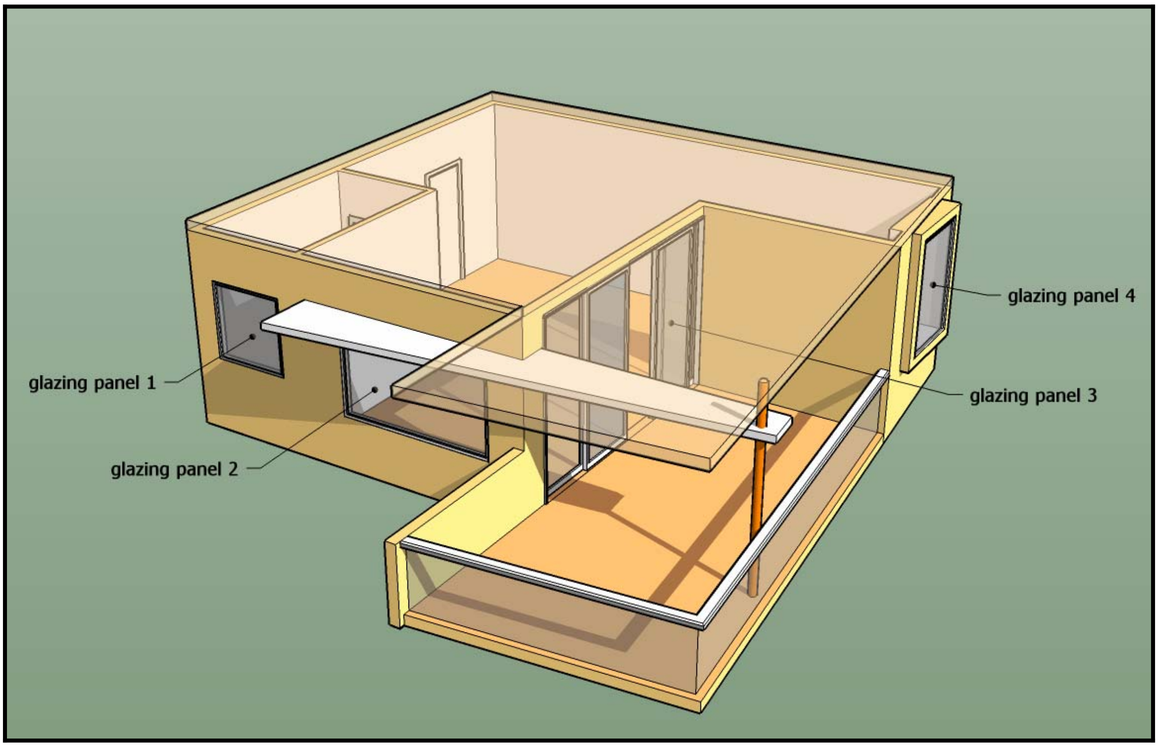
A note to Figure J2.4 permits a shading device that is capable of totally shading the window (such as a shutter) to use the lowest solar exposure factor shown for the direction the glazing faces.

Other devices offering partial shading will need to be assessed using a performance approach such as establishing equivalence to a tabulated value. In measuring the shading projection, note that for walls the shading projection was measured from the wall face, whereas for glazing the projection is measured from the glass face.

Example

The following is an example of how these provisions are applied in a small sole-occupancy unit with a total floor area 60m^2 in climate zone 5. There is a similar unit situated directly above, providing shading over the balcony (see diagram below).

The unit has two external walls facing northeast and southeast, a ceiling height of 2.7m, a 3m wide balcony outside the studio on the northeast wall and 4 panels of external glazing (including the doors opening to the balcony).



All the glazing is proposed as single glazing in toned glass (U-Value 6.3 and Solar Heat Gain Coefficient 0.6) with thermally broken aluminium frames.

The glazing details are:

Panel 1	facing SE	1.4m^2 area	unshaded
Panel 2	facing SE	3.6m^2 area	shaded by a 500mm projection at window head
Panel 3	facing NE	11.3m^2 area	shaded by a 3m balcony above
Panel 4	facing NE	2.2m^2 area	unshaded
Total glazing area =		18.5m^2	

J2.3(a)(i) For conductance

For each glazing panel, multiply A (area) x Total U-Value (of the glazing). As the Total U-Value of the glazing is not given, it can be calculated by multiplying the Total U-Value of the glass by the frame factor. The sum of these calculations must be no more than the total floor area multiplied by the conductance constant C_u for climate zone 5 in Table J2.3a, i.e.

$(A_1 \times U_1 \times F_1)+(A_2 \times U_2 \times F_2)+(A_3 \times U_3 \times F_3)+(A_4 \times U_4 \times F_4) \leq$ Total floor area $\times C_u$

The left hand side of the equation:
= (1.4 x 6.3 x 0.97) + (3.6 x 6.3 x 0.97) + (11.3 x 6.3 x 0.97) + (2.2 x 6.3 x 0.97) = 113

This must be no more than 60 x 1.9, i.e. 114. As this is the case, the proposed design complies for conductance.

Because the U-Value calculation does not consider which way the glazing faces and the same glass and frame types are used in all panels, the total glazing area (18.5m²) could simply be multiplied by the U-Value (6.3) and by the frame factor (0.97).

J2.3(a)(ii) For solar heat gain

To find the appropriate solar exposure factors (E) in climate zone 5, first calculate the P/H values:

Panel 1	P/H = 0 / 1200 = 0	Solar exposure factor for SE from Table J2.2c is 0.96
Panel 2	P/H = 500 / 1500 = 0.33	Solar exposure factor for SE from Table J2.2c is 0.64
Panel 3	P/H = 3000 / 2700 = 1.11	Solar exposure factor for NE from Table J2.2c is 0.28
Panel 4	P/H = 0 / 1200 = 0	Solar exposure factor for NE from Table J2.2c is 1.09

The P/H values between those shown in the table can be interpolated if greater precision is desired.

For each glazing panel multiply A (area) x SHGC x E (solar exposure factor). The sum of these calculations must be no more than the total floor area multiplied by the solar heat gain constant C_{SHGC} in Table J2.3a for climate zone 5, i.e.

$(A_1 x SHGC_1 x E_1)+(A_2 x SHGC_2 x E_2)+(A_3 x SHGC_3 x E_3)+(A_4 x SHGC_4 x E_4) \leq$ Total floor area x C_{SHGC}

The left hand side of the equation:
= (1.4 x 0.60 x 0.96) + (3.6 x 0.60 x 0.64) + (11.3 x 0.60 x 0.28) + (2.2 x 0.60 x 1.09) = 5.5

This must be no more than 60 x 0.14, i.e. 8.4. As this is the case, the proposed design complies for solar heat gain.

In summary, the proposed glazing installation fully complies with both performance targets.

J2.4 Glazing - Method 2

This method is based on an annual dynamic simulation of energy consumption and NPV analysis. It is intended for buildings which are fully air-conditioned and have a high day time use.

It has similarities to Method 1, particularly in the accumulation of the performance of individual windows and the fundamental formula and tables, but there are differences. The main difference is that Method 2 is about controlling the annual air-conditioning energy consumption, rather than reducing the impact of seasonal peak heating and cooling loads. As the main consideration is to reduce the energy consumed by air-conditioning plant over the year, the factors in the formula also make provision for the various efficiencies of the likely heating and cooling plant.

As in Method 1, the formula lends itself to being expressed in a spreadsheet or in a reckoner similar to the one being developed for Method 1. However, unlike Method 1, it has a single formula that covers the total air-conditioning energy consumption for the full year (although the heating and cooling components can be recognised within the formula).

As the relationships are approximately linear, they are expressed arithmetically with a series of constants.

The following outlines the methodology adopted in the setting of the glazing stringency for Class 5 to 9 buildings. A range of single and double glazing was selected with varying SHGC for the study. These glass types were chosen from the thermal analysis software DOE2.1E library and supplemented by other glass details provided by the glazing industry.

The glass types were modelled at specific locations in each of the following eight climate zones:

Climate zone 1:	Cairns and Darwin
Climate zone 2:	Brisbane and Mackay
Climate zone 3:	Alice Springs and Mt Isa
Climate zone 4:	Kalgoorlie and Wagga
Climate zone 5:	Adelaide, Perth and Sydney
Climate zone 6:	Albany and Melbourne
Climate zone 7:	Canberra and Hobart
Climate zone 8:	Alpine

The modelling provided the annual energy consumption of the perimeter space of a building's intermediate floor. The building was progressively rotated through N, NE, E, SE, S, SW, W and NW. The energy consumption was predicted using hourly dynamic simulation methods.

An NPV analysis was carried out based on energy costs identified in the Atech report[3], the predicted energy consumption above and glazing costs from the Australian Glass and Glazing Association and also from Rawlinsons Australian Construction Handbook.

The NPV analyses showed that reducing the SHGC or U-value would reduce energy use and would be cost effective in terms of payback on the initial cost. Cost effective glass types could be selected that would reduce the energy use of perimeter zones by up to 25%. The results of the cost benefit studies are described in the paper “Economic Analysis of Energy Provisions for Base Building Fabric Elements of Air-Conditioned Office Spaces”.

Heating and cooling performance equations were developed from the results of extensive modelling and they include the glazing SHGC and U-value with adjustments for external shade.

The glazing stringency was developed from the performance relationships and the performance of the cost effective glass types. Exergy Australia prepared a report for the ABCB recommending the predicted energy use of office buildings at the design stage in climate zones 2, 5 and 6. In other climate zones the energy use may be higher. With the performance relationships and the selected stringency for the glazing, the energy consumption of a typical building was modelled to assess if the target criteria could be met. The glazing stringency was adjusted as a result of this modelling.

The result of using this method is that a commercial building with approximately 50% of the facade as glazing (the anecdotal average for an office building), would require some shading or tinting in most climates and double glazing in the cold climate zone 8. This is considered a reasonable first step, however, it is acknowledged that the stringency will need to be increased as industry adapts. It is reported that in the USA, 90% of the glazing in new commercial buildings is double glazing and 40% has a low emissivity (low-e).

The "energy index" in the provisions has been developed for a building with an air-conditioning perimeter zone of the same height as the floor-to-floor height.

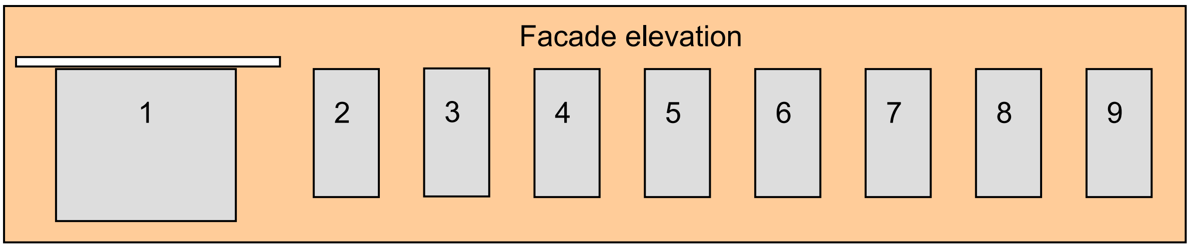
The stringency proposed provides an energy saving of the order of 10% to 15% for glazing in a typical office building (clear glass with internal Venetian blinds). The stringency allows the building designer to use simple tinted glass types to achieve between 45% and 60% glass area of a 3600mm high wall without the need for external or internal shading. This does not preclude the need for shading for comfort.

The effects on heating and cooling energy use of differing overhang projections above a window were examined by modelling. The energy use was related to the ratio of the projection to the window height (P/H). The heating and cooling energy of shaded windows was compared with the heating and cooling energy of unshaded windows. With unshaded windows the SHGC was varied. Equivalence between SHGC and the ratio of the shading projection to the glazing height (P/H) for heating was based on the same heating energy consumption. The same approach was adopted for cooling energy consumption.

In some cool and cold climates, the conduction constant (C_D) is negative, indicating that lower air temperatures reduce the cooling needed. Similarly, in cool and cold climates the heating solar constant (C_B) may be negative, indicating that the heating energy needed is reduced because of the solar gain through the glass. The heating and cooling shading multipliers (S_H and S_C) are separately applied to the heating and cooling solar factors (C_B and C_C) as shading has different effects on these two factors.

Example

The following is an example of how these provisions are applied in a north wall of a multi-storey building in climate zone 4. The proposed facade is 110m^2 in area containing 1 window of 2.8 metres high and 3.0 metres wide (8.4m^2 area) with a 1 metre projection over the window and 8 windows each of 4m^2 with no projection. This means that the wall component would be 69.6m^2. All the glazing is proposed as single glass toned (Total U-Value of glazing system is 6.9 and Solar Heat Gain Coefficient is 0.6). As the Total U-Value of the glazing system is given, there is no need to use the framing factor in Table J2.3b.



Aggregated air-conditioning energy factor = 110 x 0.32 (from table J2.4a) = 35.2

Panel 1: A_1 (C_A + $SHGC_1$ [C_B x S_{H1} + C_C x S_{C1}] + C_D x U_1) where-

A_1 = the area of the glazing panel 1

$C_{A\,B,\,C\,\&\,D}$ = the energy constants A, B, C and D for the specific orientation from Table J2.3b

$SHGC_1$ = the SHGC of the transparent and translucent element in the glazing unit

S_{H1} & S_{C1} = the heating shading multiplier and cooling shading multiplier for the glazing element 1 obtained from Table J2.4c and Table J2.4d respectively

U_1 = the Total U-Value of the glazing system

For panel 1: A_1 (C_A + $SHGC_1$ [C_B x S_{H1} + C_C x S_{C1}] + C_D x U_1)
= 8.4 (0.21 + 0.6 [-0.12 x 0.9 + 1.22 x 0.67] + -0.01 x 6.9)
= 8.4 (0.21 + .64 [-0.108 + 0.818] - 0.069)
= 8.4 x 0.567
= 4.76

For panel 2: A_2 (C_A + $SHGC_2$ [C_B x S_{H2} + C_C x S_{C2}] + C_D x U_2)
= 4.0 (0.21 + 0.6 [-0.12 x 1.0 + 1.22 x 1.0] + -0.01 x 6.9)
= 4.0 (0.21 + 0.64 [-0.12 + 1.22] - 0.069)
= 4.0 x 0.845
= 3.38

For all units: = 4.76 + (8 x 3.38)
= 31.8

As the 31.8 is less than the aggregated air-conditioning energy factor allowance of 35.2, the glazing complies.

Where there are large numbers of different glazing units, a spreadsheet would provide a quicker and easier calculation method.

Part J3 - Building Sealing Provisions

Provisions for sealing of Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to provide requirements for other Classes of buildings that are air-conditioned. There are also current exemptions, i.e. where the only conditioning is provided by an evaporative cooler or where there are ventilation openings necessary for the safe operation of a gas appliance.

A building that is conditioned by heating or refrigerated cooling needs to be sealed to conserve energy, but one that is conditioned by evaporative cooling does not need to be sealed as windows or doors would need to be opened anyway to provide the relief for the ventilation air. However, if the building is in climate zones 4 to 8, or has a refrigerated cooler, then it must be sealed because of the likelihood of heating during colder periods or to avoid the loss of cooled air when the refrigerated cooler is running.

Ventilation for safe operation of a gas appliance is not covered by the BCA, but is addressed by other legislation. Information on appropriate ventilation for gas appliances can be obtained from the relevant legislation, reference standards and product installation manuals.

Part J4 - Air Movement Provisions

The current provisions for providing air movement in Class 2, 3 and 4 buildings will not be extended beyond private residences, because most commercial and public buildings are likely to be artificially heated or cooled and have sealed windows for reasons of cost effectiveness, productivity, employee health, customer comfort and to avoid noise intrusion.

This does not preclude a naturally ventilated, free running commercial or public building being constructed.

Parts J5 to J7 - Building services

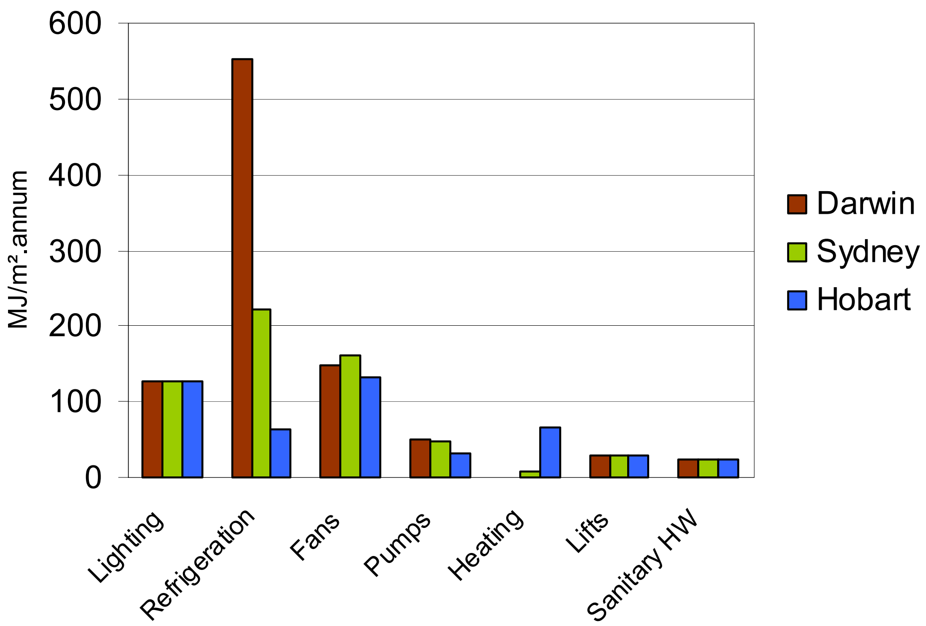
The energy consumed by a building is used for:

- Air-conditioning
  - Fans for air movement
  - Refrigeration for cooling
  - Boilers or reverse-cycle refrigeration for heating
  - Pumps for water movement
- Lighting
- Sanitary hot water supply
- Lifts

The proportions consumed by an office building complying with the proposed provisions are shown in the following graph. The proportions will vary depending on the particular location. In a hot climate, energy for cooling is more than half the total consumption, whereas in a cold climate it is less than a quarter.

The opposite is the case for heating which is a minor item. This is because of the heat already provided in a building by people, lighting and office equipment. However in all climates, fan and water transportation energy is a consistently high consumer of energy and may be even higher than lighting.

Although lighting may not be the greatest energy consumer, it has a double effect in that it consumes energy directly and also becomes a refrigeration load for the air-conditioning. Unlike domestic housing, sanitary hot water is a minor consumer, even less than lifts, unless the building has a "process" such as a kitchen or laundry.



Part J5 - Air-conditioning and Ventilating System Provisions

The provisions of this Part are generally independent of building classification and relate more to the use of the building.

J5.2 Air-conditioning and ventilation systems

Provisions for air-conditioning and ventilating systems for Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to extend them to other Classes of buildings with some additions.

Of the existing clauses, (a)(iii) outlines that when one space has a different thermal characteristic to another space, and both are conditioned by the same air-conditioner, it may be necessary to provide separate temperature control devices in the ductwork supplying the different spaces. For example, consider the differing thermal characteristics between a south facing room and an east facing room. If the temperature sensor is in the east facing room it will activate a higher level of cooling than the south facing room requires, resulting in the south facing room being cooler than desired. This will be prevented by an additional temperature control device.

Where a separate temperature control device is provided to reheat the air, then at the full supply air rate for the space, it must not increase the supply air temperature by more than 7.5K, as there are more cost effective solutions.

Clause (a)(iii)(C) states the allowable temperature rise can be determined by using an inverse relationship between allowable temperature rise and supply air rate. If, during the reheating, the supply air rate is also reduced, the temperature rise can be proportionally increased above 7.5K at the same rate that the supply air rate has been reduced.

For example, the reheat temperature could be increased to 11.7K when the supply air rate is reduced by 25%, or increased to 15K if the supply air rate is reduced by 50%.

Clause (a)(iv) has been modified to extend the requirement for an outside air cycle (in order to benefit from the free cooling effect of cold outside air) to smaller systems. It currently requires an outside air-cycle on plant of over 50 or 65 kerb depending upon the climate zone. It is proposed to lower the threshold to 50kWr in some climate zones. For a payback period of less than 10 years, climate zone 3 is marginally less beneficial than the other climate zones listed. An outside air cycle is never viable in climate zone 1 because of the sustained high ambient temperatures and high humidity of the outside air.

Clause (a)(vi) limits the power that air-conditioning fans can consume in order to find a cost effective balance between ductwork size and additional costs. Less ductwork means cheaper ductwork, but can result in more fan energy for the same air flow. Large ductwork may also result in a greater building cost. A system performance approach is preferred to individual component performance, such as coils, filters, attenuators and ductwork, as it is less restrictive and permits innovation. The two values have been developed by modelling typical systems in both large and small buildings. The values could be more limiting, however, it is felt that this is a reasonable first step and the requirement can be tightened later when designers are familiar with the approach.

Clause (b)(iii) and Table J5.2 defines the maximum allowable fan motor power to air flow rate ratio for varying levels of system resistance in a mechanical ventilation system over 1000 L/s. This clause is about selecting an efficient fan irrespective of the system pressure, but does so based on system performance. The fan motor power to air flow rate ratio is found by dividing the connected fan motor power (W) by the total flow rate (L/s). There are two options for fan motor power, the shaft power or the input power. The connected motor shaft power can be easily determined from motor name plate ratings. However, fans with an integral or fixed motor have the one size motor for a range of duties, so the fan motor input power option would be used.

The system flow rate and resistance is determined at the time of design. It should also be noted that the motor efficiency performance is set under the Australian Government's Minimum Energy Performance Scheme.

Clause (b)(iv) is new and covers carparks. Australian Standard AS 1668.2 - 1991 has provision for reducing the ventilation rate if an atmospheric contaminant monitoring system is installed. The revised standard AS/NZS 1668.2 - 2002 also includes for a minimum air-change rate and highlights the need for a separate system if contaminates other than vehicle emissions are present. However, this edition is not referenced by the BCA so some text relating to these two issues has been proposed for the BCA.

J5.4 Heating and cooling systems

Provisions for heating and cooling systems for Class 2, 3 and 4 buildings are already in the BCA and it is now proposed to extend them to other Classes of buildings with some additions.

Clause (a)(ii)(B) outlines that savings can be made in pump energy use if the pump speed can be lowered to meet a change in duty. However, in some equipment (for example chillers), higher water flow rates will provide higher efficiencies and greater energy savings than can be realised from pump energy savings. In these cases, the pump speed should not be varied.

Another instance where the flow rate should not be varied is where safety is reliant on the flow rate being held constant, for example, through boilers or water cooled heat pump air-conditioners. However, when the water cooled heat pump is not operational, the water flow through the condenser should be stopped by an automatically controlled valve.

Of the proposed new provisions, (a)(iv) is included to find a cost effective balance between pipe size and additional costs. Small long pipes use more pump energy than larger shorter pipes for the same water flow while large pipes mean greater capital costs. A system performance approach is preferred to individual component resistance, such as coils, heat exchangers, valves and piping, as it is less restrictive and permits innovation. The two values have been developed by modelling typical systems in both large and small buildings. The values could be more limiting, however, it is felt that this is a reasonable first step and the requirement can be tightened later when designers are familiar with the approach.

Clauses (f)(i) and (f)(ii) state the performance of cooling tower fans. The guide will refer to internationally accepted standards such as the Cooling Technology Institute standard number CTI STD-201(02). This Standard is not appropriate for referencing as it contains administrative matters.

J5.5 Ancillary exhaust systems

Provisions for ancillary exhaust systems for Class 2, 3 and 4 buildings are already in the BCA. Where an air-conditioning or supply air system is installed to provide outside air for ventilation, and this air cannot be relieved from the space by other exhaust ventilation systems or by natural means, an ancillary exhaust ventilation system could help to achieve internal air balance. The provisions of this clause are not intended to apply to an ancillary exhaust system in these circumstances.

It is proposed to modify the clause to include fume hoods as an example, but also to permit an exemption where safety is an issue. Some fume hood situations can operate on reduced flow but some, like other safety relate exhaust systems, cannot.

Part J6 - Artificial Lighting and Power Provisions

The provisions of this Part are generally independent of building classifications and relate more to the use of the building. However, they do not apply to a sole-occupancy unit or a Class 4 part of a building, as these are considered privately-owned and operated residences, where the occupant can change the size of a bulb or tube as they choose.

J6.2 Interior artificial lighting

Energy usage is totally dependent on the switching patterns of the users and the daylight availability. Although the total annual energy usage of a lighting installation may be the best measure of the energy efficiency of a lighting installation, in practice, the associated assessment for compliance would require some form of modelling of the building with little certainty that the results were realistic. The cost of demonstrating compliance would be disproportional to the cost for a small to medium sized lighting installation or the likely energy used.

The approach adopted has been to minimise the power consumption of a lighting installation. This is independent of the extent of the usage. Limitation on the use of the system due to occupancy sensors, daylight switching or dimming therefore represents additional energy savings.

J6.2(a) Residential buildings

Clause J6.2a is in the BCA already. Of the existing provisions, lamp power density has been chosen as the means of setting energy consumption at an efficient level. It is a defined term and is calculated by adding the maximum power ratings of all the permanently wired lamps in a space and dividing this sum by the floor area, again a defined term.

The maintained illuminance will be designed to suit the use of the area and is usually based on the levels in Australian Standard AS 1680, or an equivalent document from an overseas standards organisation. However, the levels are not being controlled by Section J of the BCA.

Lamps plugged into general purpose socket outlets are excluded because of the difficulty in regulating such portable appliances.

Although lamp power density is used as the basis for achieving energy efficiency generally, bathroom provisions are rated by light source efficacy. This is because special fittings to provide ambience are unlikely to be used in a bathroom as they are in other rooms, so the provision can simply be based on lighting efficacy, i.e. Lumens per Watt. This does not mean that only sources with a luminous efficacy of greater than 40 lumens per watts can be used. Compliance will be determined by dividing the total lumen output of all the lamps in the room by the total power consumption (Watts) of the lamps in the room.

If a motion detector or corridor lighting timer is used, a concession is allowed on the lamp power density for the space. For example, the maximum lamp power density that is allowed for a gallery is $8W/m^2$. If the area has a motion detector that complies with Specification J6 then the allowable lamp power density could be increased by 40% to $11 W/m^2$.

Because of the increased proportion of light absorbed by the walls in small rooms, a room with a floor area of less than $20m^2$ is allowed more lamp power. For example, an office space would normally have a limit of $10W/m^2$ but if the room was less than $20m^2$, the limit could be increased by 30% to $13W/m^2$.

If a dynamic daylight control device is installed to switch off the lighting when adequate daylight is available, an additional 15% can be added to the maximum lamp power density.

If an office space is less than $20m^2$, has an occupancy sensor and a dynamic daylight control device, the maximum lamp power density would be increased by 85% (40% plus 30% plus 15%) to $21W/m^2$.

The adjustments do not apply to sole-occupancy units because the use of an occupancy sensor is already mandatory and portable lamps are more likely to be used.

If a motion detection or daylight control device does not operate the whole space, or does not operate all the lights within the space, then the adjustment factor is only applied to the portion of the space that is controlled. This would not apply to a portion containing lighting that is exempt.

The concession for a daylight control device is only available where the room has natural lighting complying with Part F4 of Volume One of the BCA.

J6.2(b) Non-residential buildings

The new Clause J6.2(b) is intended for other Classes of buildings. Residential buildings were kept as simple as possible, particularly as many such buildings have supplementary lamps plugged in to general purpose socket outlets.

Where lamp power density was the measure for residential buildings, illumination power density (IPD) is used to measure compliance for non-residential buildings.

Non-residential commercial buildings lighting is progressively moving towards the use of fluorescent lamps for general lighting and metal halide lamps for special lighting. At present other lamps are available, but because of the shift to fluorescent lamps for general lighting, the illumination power density levels have been developed for fluorescent lighting and fittings.

The maximum average IPD figures in Table J6.2b have been derived based on a lighting design complying with the recommendations of AS 1680 for the nature of the task, including an allowance for a safety margin in design and the physical limitation in placing a discrete number of fittings in a uniform array. The figures have been set at a level that can be achieved with reasonable surface reflectances, high efficacy light sources, low loss control gear and high efficiency luminaires.

It is recognised that there are many variables in lighting that limit the ability to achieve the maximum IPD. Rather than setting levels that allowed for the worst case, a series of adjustment factors have been included in table J6.2c that allow credit for additional energy control devices and concessions for the effect of small rooms.

The adjustment factors are applied to the actual illumination power density for the space prior to comparison with the maximum IPD. This means that if a designer chooses to use a less efficient light source or luminaire, compliance can be achieved by the use of a supplementary control device such as an occupancy sensor or photoelectric device.

In lecture theatres, auditoria and large spaces of transient usage the contribution of detectors should be assessed a using performance solution rather than Deemed-to-Satisfy Provisions.

The IPD is to be applied as an average over the space or building. This enables the energy usage to be traded from space to space. A designer can, for example, have an energy expensive lobby or conference room compensated for with surplus IPD savings on other parts of the building.

Example

Consider an office space 12.5 metres wide by 16 metres long with a 2.6 metres high ceiling. This gives a floor area of 200m^2. The work plane is 0.7 metres high, and the reflectances of the ceiling, walls and floor are 0.8, 0.5 and 0.2 respectively. The Room Index is calculated at 3.7. The proposed illuminance is 320 Lux, the design tolerance on the illuminance is 15% giving a design illuminance of 368 Lux. A maintenance factor of 0.8 further increases the illuminance to 460 Lux. From Table J6.2b, the maximum illumination power density is 10W/m^2. The following table explores 4 options, all of which comply.

Option 1 uses a reasonable quality recessed troffer fitting with a K12 refractor panel, low loss conventional control gear and two 26mm triphosphor lamps. As a base lighting system it does not comply, but with the addition of occupancy sensors or daylight control the installation does comply.

Option 2 uses the same light fitting and lamp as option 1 with the exception that electronic control gear is used. The installation complies as a base installation. With the addition of occupancy sensors or daylight control the IPD is reduced to give a surplus of 2-3.5W/m^2 which can be used to compensate for higher luminance levels or more decorative lighting in other areas.

Option 3 uses a high efficiency recessed troffer fitting, still with a K12 refractor panel and electronic control gear. Due to the limitations on the geometry of the room, the increase in efficiency of the lighting system is realised as an increase in luminance rather than a saving in energy.

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Option 4 uses a high efficiency recessed troffer fitting similar to option 3 except with a single lamp. Depending on the configuration there is up to 5.5W/m^2 available for use elsewhere.

Option	1	2	3	4
Luminaire	standard	Standard	high efficiency	high efficiency
No of Lamps	2	2	2	1
Lamp Lumens	3200	3200	3200	3200
Lamp watts	36	36	36	36
Ballast type	low loss	electronic	-	-
Ballast watts	5.5	-	-	-
Luminaire power consumption	83	72	72	36
Number of Luminaires	25	25	25	36
Calculated illuminance	380	380	510	400
Calculated base lighting total power	2075	1800	1800	1296
Illumination power density	**10.4**	**9.0**	**9.0**	**6.5**

These illumination power densities can be adjusted in accordance with Table J6.2b because of the type of dimming devices used.

1	Illumination power density with a motion detector <200m^2 (factor 0.9)	9.3	8.1	8.1	5.8
2	Illumination power density with a motion detector <6 luminaires (factor 0.7)	7.3	6.3	6.3	4.5

With a dynamic dimming system:

3	Dynamic off/on daylight control				
	Total power of controlled fittings (factor of 10)	830.0	720.0	720.0	360.0
	Adjustment factor	0.5	0.5	0.5	0.5
	Illumination power density of controlled fittings	2.1	1.8	1.8	0.9
	Total power of non controlled Fittings 1	1245	1080	1080	936
	Illumination power density of non controlled fittings	6.2	5.4	5.4	4.7
	Sum of illumination power densities	**8.3**	**7.2**	**7.2**	**5.6**

Therefore there is an extensive range of complying solutions.

J6.3 Control of interior artificial lighting and power

J6.3(a) and (b) are already in the BCA, while J6.3(c) to (g) are proposed.

The lighting control requirements are directed at ensuring that the energy is not wasted on lighting when the space is not occupied or when the lighting is not required.

Each room or space must be individually switched or controlled. This is to ensure that when lighting to a small area is required, lighting to a larger area is not also activated.

The requirement for an occupant activated device in a sole-occupancy unit of a Class 3 building is based on the likelihood that guests may not switch off the lights when leaving the room. In addition, a Class 3 sole-occupancy unit is required to have a switching device that switches off the lighting, air-conditioning, exhaust fans and bathroom heating when the unit is not occupied. The control device is not detailed, so the requirements can be met by various systems such as a security device like a room key slot at the door, a motion detector, or any device or system that can monitor the occupancy of the unit. For the purpose of applying this provision, occupancy should be taken as the physical presence of people in the room rather than having someone registered or checked into the unit.

In areas other than sole-occupancy units in a Class 2 and 3 building, lighting must be locally switched from a position that is visible in the room or in an adjacent room. If the controls are in an adjacent room, then the lighting that is controlled must be visible from the switching position. This is to reduce the possibility of lighting being left on in unoccupied areas because it cannot be seen.

All buildings or spaces in non-residential buildings would be required to have time switch controls to prevent the lighting operating 24 hours a day. If, however, the area has occupancy sensors, the time switching would be redundant and is therefore not required.

The time switching has to be relatively intelligent so that it does not switch lights on in spaces that are not occupied. There are also provisions for extending the hours of usage when required. Simple manual override switches or bypass switches are not allowed as they give the ability to permanently disable the control. The time switch control does not preclude the need for local control. All buildings are required to have local control of the lighting in manageable units. This is to avoid the situation where a large area of lighting has to be switched on when only a small area is required, simply because there is no subdivision of the switching area.

Occupancy sensors represent an efficient way of tailoring the lighting usage to the usage of the space. The fewer lights that are controlled by an individual sensor the greater the energy saved, however, there is less cost saving on the energy to offset the cost of the sensor. Therefore, there is a graduated scale of adjustment factors for the area of lights controlled.

The designer can look at the relative cost benefit of each option for the project. The cost benefit may not be a simple balance of the cost of the detector versus the potential energy saving. The criteria may be to increase the surplus illumination power density to offset another area.

J6.4 Exterior artificial lighting

It is not practical to apply illumination power density to external lighting as it is difficult to define the relevant area in a manner that applies to all situations. The requirements are therefore aimed at ensuring efficient light sources are used, and that the lighting does not operate when it is not required.

Tungsten halogen floodlights are encouraged when used with motion detectors as they have a fast run-up and restrike time, and the duration of operation can therefore be reduced.

J6.6 Vertical transport

Since the project's commencement, some importers of products have been of the view that Australia cannot impose its energy efficiency requirements on the overseas manufacturers as they are manufacturing to overseas codes and catering for a much bigger international market. Some importers were also of the view that energy efficiency is a minor consideration for their product. Lifts and escalators are one range of products with a high level of overseas manufacture to overseas standards.

However, it is not necessary to change overseas codes and manufacturing practices, but to simply set the BCA standard at a level that eliminate the worst performing equipment. Provided there are suitable products available, there is no need to directly attempt to influence practices; market forces will play their part. Many of the energy efficiency measures introduced do not individually contribute a significant saving, however, collectively they contribute approximately a 20% saving of the energy consumed by the building. To regulate the light fitting in a 6m^2 room, but not the same light fitting in a lift, is inconsistent. To require pumps, refrigeration chillers and boilers to be of a certain efficiency in order to eliminate the worst performers, and not to do the same with a lift, is again inconsistent.

A list of possible energy efficiency measures have been identified by Safralou Pty Ltd, a lift consultant. The report concluded that:

- There are in fact a number of possible measures warranting further consideration which, if implemented, could result in more energy efficient lift and escalator systems.
- There is at least one other jurisdiction which has imposed requirements to ensure energy efficient lift and escalator systems.
- Many of the suggestions are based on the requirements of the Code Of Practice For Energy Efficiency Of Lifts And Escalator Installations as required by the "Electrical And Mechanical Services Department, The Government Of The Hong Kong Special Administrative Region". This has been done primarily to align the suggestions with requirements of a larger lift market to ensure any final regulated requirements would not be confined to just the smaller Australian market which appears to have problems importing equipment from Europe with modifications necessary.
- It is not suggested in any way that Australia should just take the requirements for Hong Kong and impose them on Australian projects. It is recommended that considerable debate take place in the Australian industry before any firm regulations are implemented.

- The possible measures need to be considered in the context of the potential high cost of attempting to change basic overseas lift designs directly and should be aimed more at eliminating poor practice lifts from the Australian market. However, there is scope for some cost effective measures to be done locally.
- The next step, in conjunction with industry, would be to carry out a life cycle analysis on each of the possible measures.
- It is also important to note that as the BCA is a performance based code, even though a particular Deemed-to-Satisfy Provision may be stated as being required, under a performance approach it is there as a benchmark. If a building designer feels that a particular provision is unsuitable, it need not be included provided there is some compensating measure elsewhere in the building such as better quality general lighting, air-conditioning, glazing or roof insulation.

In summary, all of the possibilities need to be costed and need to be demonstrated as cost effective with life cycle analysis, and even if cost effective, some may be more appropriately dealt with by a means other than regulation. For now, they have been identified and further consultation with industry is needed before a regulatory proposal is developed.

Specification J6 - Lighting and power control devices

Specification J6 is in the BCA already. Of the existing provisions, corridor timers are time delay switches that activate a section of lighting when the button is pressed, and switches the lights off again after a predetermined time, provided the button is not pushed again. The provisions for the minimum distance of travel into the space, and for the 5% of lighting that must remain on in larger areas, are designed to reduce the situation of walking into a dark space to switch on the lighting. In many applications the exit signs will provide the continuous 5% of lighting required.

The motion detector requirements are similar to those of the corridor lighting timer, except that a motion detector is activated by the motion of people, and the operation of the lighting is maintained while the motion continues. The advantage of motion detectors are:

- A person does not need to find the button.
- A person can enter the space with more confidence as another person already within the space would have activated the lighting.
- The time duration for the lighting to be activated does not need to be as long as it does with a corridor lighting timer because the lighting is continuously reset. Whereas with a timer, the duration has to be set for the slowest person travelling the greatest distance.

Part J7 - Hot Water Supply Provisions

The measures for hot water supply for dwellings, i.e. housing and Class 2, 3 and 4 buildings, are contained in AS/NZS 3500. With both building legislation and plumbing legislation referencing the same standard there is little likelihood of the measures clashing with plumbing legislation. It is intended that the current provisions be extended to other building classifications.

Further possible provisions have been identified and, if supported, will be referred to the relevant Standards Australia committees for consideration. These measures are:

- Insulating dead-leg droppers to fixtures. This was considered for houses but did not proceed because it was found that insulation is of little benefit on a pipe infrequently used. The DASCEM report indicated that most of the heat in the water dissipates through the insulation within a half an hour. However, in a non-residential commercial building, hand basins and lunch room sinks will be used more frequently and so insulation could be justified, as could droppers to showers in gymnasiums, etc.

- Many hot water storage units and boilers are on all the time, maintaining the water at the required temperature over-night, during weekends or during holiday periods. Considerable energy would be saved by having them time-clock controlled which involves a very low cost (the payback period is less than a year). However, one issue that has been raised is the remote possibility of Legionella growth and the need for the water to reach temperature when re-energised, and be held at temperature, until decontamination occurs.

- Storage hot water units have insulation of a thickness that may be appropriate for a temperate climate, but if located outdoors in other climates, there could be considerably greater losses. The amount is difficult to quantify and analyse in life cycle terms because of the possible additional costs to provide indoor space. However, there is support for requiring the units to be located indoors (or in a purpose built enclosure) in at least Alpine areas, but possibly also in other very cold climates.

Part J8 - Access for maintenance

An emphasis of the BCA is to maintain the proposed performance. To achieve this, consideration needs to be given to ensure that any necessary maintenance of systems and equipment can be carried out. One consideration for maintenance is to provide adequate access and space around critical items of equipment.

Although not included for at this time, another critical consideration is the arranging of power and lighting circuits so that consumption can be monitored and high consumption circuits identified. This will be considered for a future revision.

D COST EFFECTIVENESS OF PROPOSALS

It is a requirement of the Inter-Government Agreement that established the ABCB, that all technical requirements be cost effective. This is also required by the Office of Regulation Review that monitors regulatory change proposals. With "cost effectiveness" meaning different things to different people, the stakeholders agreed that the cost effectiveness criteria should be that appropriate for a long term building owner.

D1 Stringency and cost effectiveness criteria

The ABCB commissioned the Atech Group to assist in determining a methodology and criteria for assessing the cost effectiveness of energy efficiency provisions. The recommendations contained in their report titled "Financial Analysis Procedure for Energy Efficiency in Buildings, Class 2 to 9 [Financial Analysis Assessment Procedure]" were accepted as a basis for developing and testing the commercial building energy measures.

A combined thermal simulation model and life cycle analysis model was developed to assist in determining the cost effectiveness of building elements. The procedure is described in the report titled "Economic Analysis of Energy Provisions for Base Building Fabric Elements of Air-Conditioned Office Spaces". Sensitivity analyses have been carried out with different internal loads, different sources of capital costs and different energy costs.

The analysis looks at the extra capital cost of the item, the energy it saves and, as a separate calculation, the impact of the reduced refrigeration and heating load on the size and cost of the air-conditioning system.

Only cost effective provisions are being proposed and the approach taken has been a conservative one, with operating profiles being used that limit the occupancy times of buildings. Any building that is occupied for longer periods, such as a 24 hour telephone exchange, police station, or casualty ward at a hospital, would achieve greater savings and be more cost effective.

As discussed earlier, there was a view that there should be separate provisions from those that are heated and cooled. However, upon further consideration, it became difficult to identify buildings that are currently only heated and are likely to remain only heated for their life.

Where there is a reduced level of insulation in the provisions for elements between a conditioned space and a non-conditioned space, such as a plant room, the amount of insulation has been determined by thermal modelling. The modelling compared the energy consumption of a building with the non-conditioned space to a building without a non-conditioned space, i.e. as if the element was a complying external one.

D2 Energy charges

The energy charges used in the analyses were the avoidable costs identified in the Atech Group report. Gas costs were not provided for Cairns, Darwin, Mackay, Hobart and Alpine so they were estimated from values given. Cairns and Mackay were assumed to be the climate zone 2 average in the Atech report. Darwin was assumed to be the same charges as Alice Springs, Hobart was assumed to be the average for climate zone 7 in the Atech report. As there are a number of Alpine locations where reticulated gas is not available, Alpine charges were taken to be twice those of the climate zone 7 average. The utilities avoidable charges for energy used in the analyses were:

Climate zone	City	Electricity cost c/kWh	Gas cost c/MJ
1	Cairns	6.1	0.51
	Darwin	9.8	0.46
2	Brisbane	6.0	0.49
	Mackay	5.9	0.51
3	Alice Springs	9.3	0.46
	Mt Isa	9.3	0.48
4	Kalgoorlie-Boulder	10.2	0.43
	Wagga Wagga	5.9	0.49
5	Adelaide	6.4	0.49
	Perth	6.0	0.43
	Sydney	6.0	0.49
6	Albany	6.4	0.43
	Melbourne	6.1	0.49
7	Canberra	6.0	0.49
	Hobart	6.0	0.51
8	Alpine	6.0	1.02

D3 Roof insulation cost analyses

The modelling described above indicated that adding roof insulation, up to the limit of analysis at R5, was found to be cost effective provided there are no additional construction costs other than the supply and installation of the insulation itself. The practical limit in most locations was considered to be an overall value of around R3. Beyond this value, there is some difficulty in fixing bulk insulation without considerable additional cost. With R3 the payback period is of the order of 1 to 3 years depending upon the location, the building's function and the internal equipment load.

Insulation costs (including installation) used, were provided by the insulation industry and the analysis was repeated using costs calculated from the Rawlinsons Australian Construction Handbook. The following table shows the costs used in the analyses.

Roof insulation costs provided by the insulation industry ($/m²)						
Climate zone	**City**	**Insulation R-Value**				
		1.0	**2.0**	**3.0**	**4.0**	**5.0**
1	Cairns	$2.85	$3.92	$4.90	$6.10	$7.10
	Darwin	$4.61	$5.60	$6.50	$7.70	$8.50
2	Brisbane	$2.85	$3.92	$4.90	$6.10	$7.10
	Mackay	$2.85	$3.92	$4.90	$6.10	$7.10
3	Alice Springs	$4.61	$5.60	$6.50	$7.70	$8.50
	Mt Isa	$2.85	$3.92	$4.90	$6.10	$7.10
4	Kalgoorlie-Boulder	$4.16	$5.25	$6.25	$7.45	$8.50
	Wagga Wagga	$2.69	$3.84	$4.90	$6.10	$7.30
5	Adelaide	$1.51	$3.03	$4.50	$5.70	$7.90
	Perth	$4.16	$5.25	$6.25	$7.45	$8.50
	Sydney	$2.69	$3.84	$4.90	$6.10	$7.30
6	Albany	$4.16	$5.25	$6.25	$7.45	$8.50
	Melbourne	$2.93	$3.96	$4.90	$6.10	$7.00
7	Canberra	$2.69	$3.84	$4.90	$6.10	$7.30
	Hobart	$4.61	$5.60	$6.50	$7.70	$8.50
8	Alpine	$2.69	3.84	$4.90	$6.10	$7.30
Roof insulation costs calculated from Rawlinsons Construction Handbook ($/m²)						
1	Cairns	$10.50	$14.10	$17.10	$20.40	$23.70
	Darwin	$9.20	$13.46	$17.09	$21.03	$24.98
2	Brisbane	$6.77	$9.90	$12.57	$15.47	$18.37
	Mackay	$10.50	$14.10	$17.10	$20.40	$23.70
3	Alice Springs	$9.20	$13.46	$17.09	$21.03	$24.98
	Mt Isa	$12.70	$16.90	$20.50	$24.40	$28.30
4	Kalgoorlie-Boulder	$9.90	$13.30	$16.30	$19.50	$22.70
	Wagga Wagga	$9.77	$12.90	$15.57	$18.47	$21.37
5	Adelaide	$6.40	$9.60	$12.40	$15.40	$18.40
	Perth	$6.00	$8.80	$11.30	$13.95	$16.60
	Sydney	$7.13	$10.40	$13.13	$16.13	$19.13
6	Albany	$8.37	$11.10	$13.57	$16.17	$18.77
	Melbourne	$7.37	$10.60	$13.37	$16.37	$19.37
7	Canberra	$10.37	$13.70	$16.57	$19.67	$22.77
	Hobart	$10.02	$14.42	$18.18	$22.26	$26.34
8	Alpine	$8.97	$11.90	$14.37	$17.07	$19.77

D4 Wall insulation cost analyses

Similarly to the roof analyses, adding wall insulation up to the limit of analysis at R3 was found to be cost effective provided there are no additional construction costs other than the supply and installation of the insulation itself.

With a Total R-Value of 1.9, the payback period is within the range of 3 to 13 years, depending upon the direction the wall is facing, the location and the building's function. A south wall needs to have less insulation than any of the other three walls, but industry indicated that treatments should be the same on all faces to simplify construction details. The longer payback periods are for buildings with more people or greater internal equipment loads. The higher internal loads reduce the need for heating.

A complication for walls is that increasing the thickness of walls to include insulation may reduce the net rentable area of the space, which would jeopardise the cost effectiveness of adding insulation. However, this is only the case if the wall area is the surface to which the net rentable area is measured (i.e. if the glazing is less than 50% of the facade).

Walls have a further complication in that some of the established construction practices do not allow any significant space in which to install insulation. The outcome has been to limit the Total R-value to 1.9 (which requires some 65mm space if bulk insulation is added) and also introduce the ability to trade between walls and glazing within the Deemed-to-Satisfy Provisions.

This trading means that it would not be necessary to resort to a Verification Method. It is intended to carry out the Regulation Impact Statement using the Total R-Value of 1.9 but for the first 12 months permit the Total R-Value to be reduced to R1.5 to give industry time to adapt.

Again, insulation costs (including installation) used were provided by the insulation industry and the analysis was repeated using costs calculated from the Rawlinsons Australian Construction Handbook.

The following table shows the costs used in the analyses.

Wall insulation provided by the insulation industry ($/m²)						
Climate zone	**City**	**Insulation R-Value**				
		0.5	**1.0**	**1.5**	**2.0**	**2.5**
1	Cairns	$2.80	$3.30	$3.80	$4.30	$4.80
	Darwin	$3.00	$4.00	$5.00	$6.00	$7.00
2	Brisbane	$2.80	$3.30	$3.80	$4.30	$4.80
	Mackay	$2.80	$3.30	$3.80	$4.30	$4.80
3	Alice Springs	$3.00	$4.00	$5.00	$6.00	$7.00
	Mt Isa	$2.80	$3.30	$3.80	$4.30	$4.80
4	Kalgoorlie-Boulder	$2.65	$3.50	$4.35	$5.20	$6.05
	Wagga Wagga	$2.80	$3.30	$3.80	$4.30	$4.80
5	Adelaide	$1.10	$2.00	$2.90	$3.80	$4.70
	Perth	$2.65	$3.50	$4.35	$5.20	$6.05
	Sydney	$2.80	$3.30	$3.80	$4.30	$4.80
6	Albany	$2.65	$3.50	$4.35	$5.20	$6.05
	Melbourne	$2.80	$3.30	$3.80	$4.30	$4.80
7	Canberra	$2.80	$3.30	$3.80	$4.30	$4.80
	Hobart	$3.00	$4.00	$5.00	$6.00	$7.00
8	Alpine	$2.80	$3.30	$3.80	$4.30	$4.80
Wall insulation costs calculated from the Rawlinsons Handbook ($/m²)						
1	Cairns	$8.85	$10.50	$12.00	$14.10	$15.30
	Darwin	$10.49	$12.44	$14.24	$16.67	$18.16
2	Brisbane	$7.77	$9.22	$10.55	$12.35	$13.45
	Mackay	$8.85	$10.50	$12.00	$14.10	$15.30
3	Alice Springs	$11.05	$13.10	$15.00	$17.50	$19.10
	Mt Isa	$10.75	$12.70	$14.50	$16.90	$18.40
4	Kalgoorlie-Boulder	$8.30	$9.90	$11.40	$13.30	$14.60
	Wagga Wagga	$8.32	$9.77	$11.10	$12.90	$14.00
5	Adelaide	$7.82	$9.27	$10.60	$12.40	$13.50
	Perth	$7.12	$8.45	$9.70	$11.25	$12.35
	Sydney	$8.43	$9.93	$11.30	$13.20	$14.30
6	Albany	$7.07	$8.37	$9.60	$11.10	$12.20
	Melbourne	$8.97	$10.47	$11.85	$13.70	$14.85
7	Canberra	$8.82	$10.37	$11.80	$13.70	$14.90
	Hobart	$12.11	$14.13	$16.00	$18.50	$20.05
8	Alpine	$7.62	$8.97	$10.20	$11.90	$12.90

D5 Floor insulation

As with the roof and wall analyses, adding floor insulation, up to the limit of analysis at R2.5, was found to be cost effective although some payback periods were long. Therefore, a level of R2.5 is only proposed for climate zone 8 (Alpine) and R1.5 is proposed for climate zones 1, 3, 4, 6 and 7. All payback periods are less than 10 years irrespective of the location, the building use or an internal load less than $35W/m^2$. No insulation is proposed for the milder climate zones 2 and 5.

D6 Glazing cost analyses

The glazing cost analyses was somewhat more complicated as it needed to include a mechanism for recognising the benefit of shading when considering solar radiation, while for conductance there are only two practical options in single glazing and double glazing. The benefits of changing the glass types were evaluated without internal or external shading by considering glazing with different tints.

Cost benefit studies were not carried out for external shading. However, energy modelling was undertaken to establish relationships between the size of a horizontal shade over a window and the resulting energy use with tinted glasses. The effect of shading by an overhang is expressed as a multiplier of the glass solar heat gain coefficient.

The glazing analyses were based on 50% of the wall being glazed with some sensitivity testing for larger and smaller percentages. It was found that the selected tinted glasses are cost effective with around a 5 year payback for north, east and west facing glazing, but around 20 years for south facing glazing.

It could be argued that the glazing measures could be more stringent, however, it should be noted that a single element analysis can be misleading. For example, using a deeper tint to reduce solar gain further may increase the time that perimeter lighting is needed which then is both an energy load in its own right and a cooling load on the air-conditioning as well.

To determine the order of savings with the proposed measures, a large, medium and small building was modelled in a range of locations, firstly as a Deemed-to-Satisfy building except for the glazing which was taken as clear single glazing with venetian blinds (except for Alpine areas). They were then modelled again with the proposed Deemed-to-Satisfy glazing being added. The savings in energy were of the order of 12 to 16% over the locations. Further, there was an increase of 3% saving from the larger building to the smaller.

Again, glazing costs used were provided by the glazing industry and the analysis was repeated using costs calculated from the Rawlinsons Australian Construction Handbook. The following table shows the costs used in the analyses.

Glazing costs provided by the glazing industry excluding installation ($/m^2)							
Climate zone	City	U-Value / solar heat gain coefficient					
Single glazing		**5.9/.82**	**6.0/.71**	**6.3/.6**	**6.3/.52**	**6.4/.4**	**6.4/.33**
1	Cairns	$133	$140	142	$177	$240	$240
	Darwin	$128	$135	137	$171	$232	$232
2	Brisbane	$118	$124	$126	$157	$213	$213
	Mackay	$133	$140	$142	$177	$240	$240
3	Alice Springs	$166	$174	$178	$221	$300	$300
	Mt Isa	$178	$187	$190	$237	$321	$321
4	Kalgoorlie-Boulder	$133	$140	$142	$177	$240	$240
	Wagga Wagga	$111	$116	$118	$147	$200	$200
5	Adelaide	$118	$124	$126	$157	$213	$213
	Perth	$118	$124	$126	$157	$213	$213
	Sydney	$118	$124	$126	$157	$213	$213
6	Albany	$114	$120	$122	$152	$206	$206
	Melbourne	$118	$124	$126	$157	$213	$213
7	Canberra	$96	$101	$103	$128	$174	$174
	Hobart	$93	$97	$99	$124	$168	$168
8	Alpine	$119	$125	$127	$158	$215	$215
Double glazing		**5.9/.82**	**2.20/.7**	**2.1/.61**	**2.1/.46**	**2.2/34**	**2.1/.25**
1	Cairns	$133	$182	$188	$188	$201	$276
	Darwin	$128	$175	$181	$181	$194	$267
2	Brisbane	$118	$161	$166	$166	$178	$245
	Mackay	$133	$182	$188	$188	$201	$276
3	Alice Springs	$166	$227	$234	$234	$250	$345
	Mt Isa	$178	$243	$251	$251	$268	$369
4	Kalgoorlie-Boulder	$133	$182	$188	$188	$20	$276
	Wagga Wagga	$111	$151	$156	$156	$167	$230
5	Adelaide	$118	$161	$166	$166	$178	$245
	Perth	$118	$161	$166	$166	$178	$245
	Sydney	$118	$161	$166	$166	$178	$245
6	Albany	$114	$156	$161	$161	$172	$237
	Melbourne	$118	161	$166	$166	$178	$245
7	Canberra	$96	132	$136	$136	$145	$200
	Hobart	$93	127	$131	$131	$140	$193
8	Alpine	$119	162	$168	$168.	$179	$247

Glazing costs from Rawlinsons Construction Handbook including installation ($/m^2)							
Climate zone	**City**	**U-Value / solar heat gain coefficient**					
Single glazing		**5.9/.82**	**6.0/0.71**	**6.3/0.6**	**6.3/0.52**	**6.4/0.4**	**6.4/0.33**
1	Cairns	$343	$357	$405	$454	$486	$486
	Darwin	$331	$344	$390	$438	$469	$469
2	Brisbane	$304	$316	$358	$402	$430	$430
	Mackay	$343	$357	$405	$454	$486	$486
3	Alice Springs	$467	$486	$550	$618	$661	$661
	Mt Isa	$459	$477	$541	$607	$650	$650
4	Kalgoorlie-Boulder	$367	$380	$423	$474	$500	$500
	Wagga Wagga	$343	$356	$391	$441	$465	$465
5	Adelaide	$300	$313	$351	$396	$422	$422
	Perth	$325	$336	$374	$419	$442	$442
	Sydney	$365	$379	$417	$470	$495	$495
6	Albany	$315	$326	$363	$406	$429	$429
	Melbourne	$362	$373	$411	$460	$484	$484
7	Canberra	$299	$310	$341	$385	$405	$405
	Hobart	$286	$294	$324	$363	$382	$382
8	Alpine	$368	$382	$421	$474	$499	$499
Double glazing		**5.9/.82**	**2.20/.7**	**2.1/.61**	**2.1/.46**	**2.2/.34**	**2.1/.25**
1	Cairns	$343	$472	$486	$486	$486	$645.
	Darwin	$331	$455	$469	$469	$469	$622
2	Brisbane	$304	$418	$430	$430	$430	$571
	Mackay	$343	$472	$486	$486	$486	$645
3	Alice Springs	$467	$642	$661	$661	$661	$878
	Mt Isa	$459	$631	$650	$650	$650	$862
4	Kalgoorlie-Boulder	$367	$480	$493	$493	$493	$645
	Wagga Wagga	$343	$413	$426	$426	$426	$558
5	Adelaide	$300	$430	$443	$443	$443	$578
	Perth	$325	$425	$436	$436	$436	$571
	Sydney	$365	$440	$454	$454	$454	$594
6	Albany	$315	$412	$423	$423	$423	$554
	Melbourne	$362	$465	$476	$476	$476	$615
7	Canberra	$299	$360	$372	$372	$372	$487
	Hobart	$286	$367	$376	$376	$376	$485
8	Alpine	$368	$444	$458	$458	$458	$599

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D7 Air-conditioning and ventilating system cost analyses

Most of the heating, ventilation and air-conditioning (HVAC) items proposed for Class 5 to 9 buildings were demonstrated to be cost effective in a DASCEM report titled "Energy Performance Assessment of HVAC Equipment for Class 2, 3 and 4 Buildings".

That report demonstrated the HVAC measures were cost effectiveness in any Class of building. The measures are already in the BCA for Class 2, 3 and 4 buildings. The additional items include extending the requirement for an outside air cycle to smaller plant, providing a carpark atmospheric contaminant monitoring system, limiting ductwork resistance and limiting piping resistance. All of the items specified are cost effective with a payback period of less than 10 years.

Air-conditioning cost relationships, based on the estimated heating and cooling plant capacities, were established from costs of preliminary air-conditioning designs for the B-form building. The base air-conditioning system selected was a ducted condenser water cooled system with hot water heating. Linear relationships between initial cost and capacity were established for each of sixteen locations. The relationships are of the form:

$\text{Cost} = A_C \times S_C + B_C + A_H \times S_H + B_H$

Where
A are the constants for the rate of change in costs for cooling and heating (see table below)
S are the respective cooling and heating system sizes in kW
B is a constant for the fixed cost for cooling and heating (see table below)

Climate zone	**City**	**Cooling Cost Equations**		**Heating Cost Equations**	
		A_C for cooling	**B_C for cooling**	**A_H for heating**	**B_H for heating**
1	Cairns	669	5385	0.0	0.0
	Darwin	838	6744	0.0	0.0
2	Brisbane	650	5228	24.0	9659
	Mackay	669	5385	24.7	9949
3	Alice Springs	796	6404	29.4	11832
	Mt Isa	747	6012	27.6	11108
4	Kalgoorlie-Boulder	695	5594	25.6	10335
	Wagga Wagga	637	5123	23.5	9466
5	Adelaide	650	5228	24.0	9659
	Perth	650	5228	24.0	9659
	Sydney	650	5228	24.0	9659
6	Albany	611	4914	22.5	9079
	Melbourne	650	5228	24.0	9659
7	Canberra	643	5175	23.7	9562
	Hobart	598	4809	22.0	8886
8	Alpine	604	4862	22.3	8983

Example:

Consider the plant in a building in Perth serving a perimeter zone of floor area 46m^2. The cooling capacity is estimated at 0.170kW/m^2 and the heating capacity estimated at 0.05kW/m^2.

Estimated cooling cost = 46 x 0.17 x 650 + 5228	=	$10,110
Estimated heating cost = 46 x 0.05 x 24 + 9659	=	$ 9,714
Total	=	$19,824

This cost is equivalent to $19,824 / 46 = $431/m^2

D8 Lighting cost analyses

As noted above, non-residential commercial building lighting is progressively moving towards the use of fluorescent lamps for general lighting and metal halide lamps for special lighting. Because of this shift to fluorescent lamps for general lighting, the illumination power density levels have been developed for fluorescent lighting and fittings with levels set by evaluating designs for the particular applications listed.

For illumination power density levels, it is difficult to quantify the likely savings without creating a series of building designs. However, by considering a representative area of 200m^2, indicative benefits can be evaluated.

If the area is an office space designed to meet a minimum lighting level of 320 Lux, the installed lighting level could be as high as 466 Lux, after the designer allows for variations in luminaire performance and provides for an illuminance allowance of 20%. With a basic luminaire that meets the Minimum Energy Performance Standard (MEPS), this would result in an illumination level of 11.6W/m^2. The basic luminaire was taken as being two 26mm tri-phosphor lamps in a prismatic refractor with a 5.5W iron-core ballast that has a light output ratio of 52%.

With a MEPS compliant luminaire, the level of lighting uniformity is 0.67. Australian Standard AS1680 recommends a level of 0.8. To achieve 0.8 with a two tube luminaire, the number of luminaires would need to be increased and the resulting illuminance power density would be of the order of 15W/m^2.

If, for the 200m^2 office space, the luminaires are changed to high efficiency luminaires, the light output ratio can be reduced to 8.3W/m^2. The high efficiency luminaire has a prismatic lens, a light output ratio of 82%, T8 tri-phosphor lamps and a 5.5W iron-core ballast. The cost benefit analysis in the following table shows that the use of high efficiency luminaires would provide a payback within one year. An alternative would be to use a lower output efficiency luminaire and electronic ballasts.

Device	Load W/m^2	Saving W/m^2	Energy saving kWhr	Energy cost saving	Unit cost	Addit. instl'. cost	No of units	Additional cost	Benefits	Payback years	Benefit cost ratio
Base case with MEPS compliant luminaires (466 Lux)	11.6										
High efficiency luminaires (466 Lux)	8.3	3.3	2265	$226	130	75	20	$180	$1331	0.8	7.4
STATIC DIMMING											
MEPS compliant luminaires with dimmers (320 Lux)	7.97	3.6	2495	$249	$700		1	$700	$1583	3	3
High efficiency luminaires with dimmers. (320 Lux)	5.7	2.6	1785	$178	$700		1	$700	$1179	4	5
ELECTRONIC BALLAST											
MEPS compliant luminaires with electronic ballasts	10.1	1.5	1030	$103	30		28	$782	$812	12.2	0.7
PASSIVE INFRARED DETECTOR (PID)											
MEPS compliant luminaires											
PID that achieves 42% reduction in office hours usage	6.77	4.83	3318	$332	100	75	8	$1,400	$2,215	4.2	1.6
PID that achieves 58% reduction in office hours usage	4.83	6.77	4645	$464	100	75	8	$1,400	$2,970	3.0	2.1
PID that achieves 75% reduction in office hours usage	2.9	8.7	5972	$579	100	75	8	$1,400	$3725	2.5	2.7
MEPS compliant luminaires with electronic ballasts											
PID that achieves 42% reduction in office hours usage	5.89	4.21	2889	$289	100	75	8	$1,400	$1,971	4.8	1.4
PID that achieves 58% reduction in office hours usage	4.21	5.89	4044	$404	100	75	8	$1,400	$2,628	3.5	1.9
PID that achieves 75% reduction in office hours usage	2.53	7.58	5199	$519	100	75	8	$1,400	3,285	2.7	2.3
High efficiency luminaires with low loss ballasts (7.6W/m^2 basis)											
PID that achieves 42% reduction in office hours usage	4.43	3.17	2174	$217	100	75	8	$1,400	$1,564	6.4	1.1
PID that achieves 58% reduction in office hours usage	3.17	4.43	3043	$304	100	75	8	$1,400	$2,059	4.6	1.5
PID that achieves 75% reduction in office hours usage	1.9	5.7	3912	$391	100	75	8	$1,400	$2,553	3.6	1.8

The illumination power density level of $10W/m^2$ can be achieved using high efficiency lamps without the need for additional control gear.

The cost benefit analyses shown in the above table are based on an electricity cost of 10c/kWhr, an annual inflation rate of 2.5%, a rate of return of 7% per year, an asset life of 10 years and a usage pattern of 12 hours per day and 5.5 days per week, i.e. 3,432 hours of operation. No benefit is included for the reduction in the size or possible energy use of the air-conditioning system.

The table provides for a number of options to reduce the illumination level to or below $10W/m^2$. Options include the use of static dimming, electronic ballasts and passive infra-red detectors. These are combined with basic luminaires and with high efficiency luminaires. In some cases the use of the control devices with the basic luminaires and the assumed surface reflectances, cannot achieve the maximum level of $10W/m^2$.

In all combinations that comply with the $10W/m^2$ maximum illumination power level the cost of the installation is achieved in less than five years. By prudent system design and fitting selection, additional capital may not even be needed in some cases.

Although there are additional costs with energy efficiency features such as electronic ballasts, motion detectors, time clocks and smaller switching areas, previous energy audits for a range of buildings have found these items to have paybacks of relatively short periods (most range from less than a year for time switches, less than three years for some electronic ballasts and motion detectors). Some other features have longer payback periods. These are not proposed as mandatory measures, but rather as part of a range of options from which the user can choose.

Like many of the energy efficiency proposals, some stakeholders are of the view that the stringency for lighting could be greater and needs to be increased after an initial bedding-down period. Others, however, are of the view that achieving the proposed measures will be difficult.

D9 Hot water supply cost analyses

Most of the items proposed for Class 5 to 9 buildings were demonstrated to be cost effective in the DASCEM report [12] titled "Assessment of Energy Efficiency Measures BCA Vol One: Part J4 - Services Clause J4.6 Hot Water Supply". The report demonstrated their cost effectiveness in any Class of building.

E ENERGY SAVING EFFECTIVENESS

The following table provides an indication of the likely annual energy consumption rates of a currently unregulated base building and a regulated one using the proposed Deemed-to-Satisfy Provisions. The modelling carried out to determine the values used 5 different forms of buildings (A to E as described in the table below) and 5 different uses, namely, offices, shops and shopping centres, restaurants, theatres and schools.

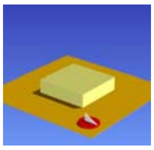
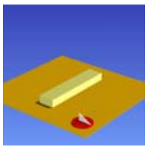
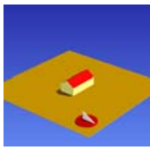
The average saving in energy for all the proposals together, over a relatively poorly designed base building is around 20%, except for theatres which is less because they have no glazing, and Alpine areas because the base building was assumed to have double glazing already.

The base unregulated case is a building with R1.5 insulation added to the roof, no insulation in the walls and no insulation under the floor. Windows (other than theatres) are generally clear single glazed with internal venetians giving a shading coefficient of 0.74 except for the Alpine areas where they are double glazing. No effort has been made to seal the building and there is no outside air cycle on the air-conditioning plant. Lighting is by fluorescent tubes at an intensity of 14 W/m^2.

The air-conditioning system in the A, B and D form buildings uses water cooled air-conditioning units, each controlled by a single temperature sensor, with hot water coils and a central cooling tower, gas boiler and water pumps. The air-conditioning system in the E form building uses a reverse cycle air-cooled air-conditioning unit controlled by a single temperature sensor with electric trim heating. The C form building, when a theatre uses both types of systems.

Building form	Form A	Form B	Form C	Form D	Form E
Area (m^2)	10,000	2,000	1,000	500	200
Length : width ratio	1:1	2:1	1:1	5:1	2:1
Storey	10	3	1	1	1
Floor height (metres)	3.6	3.6	6	3.3	3.3
Open or carpark under	Yes	Yes	No	No	No



The buildings were modelled for various locations in climate zones 1 to 7 using appropriate weather data (TRY/WYEC) and the results averaged. There is no appropriate weather data available for Alpine areas (climate zone 8). However, ACADS-BSG have constructed a data file which is an amalgam of temperature, 9 am and 3 pm wind records at Perisher Valley (NSW) and radiation data derived from Orange (NSW).

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Whilst the solar data is sufficient to estimate the solar load on a building, the lack of representative wind data understates the calculated heat conductance. Consequently the energy consumption values calculated are probably too low.

Further, the base unregulated case has been assumed to have double glazing which may not always be the case.

Climate zone	Building form	Offices and laboratories			Shops & shopping centres			Schools		
		Base unregulated	With the provisions	Percentage reduction	Base unregulated	With the provisions	Percentage reduction	Base unregulated	With the provisions	Percentage reduction
1	A	1078	873	19%	Not modelled			Not modelled		
	B	1115	888	20%	1527	1154	24%			
	C	Not modelled			1745	1448	17%			
	D	1200	933	22%	1347	966	28%	945	739	22%
	E	1172	903	23%	1633	1212	26%	968	759	22%
2	A	960	786	18%	Not modelled			Not modelled		
	B	976	801	18%	1268	970	24%			
	C	Not modelled			1430	1171	18%			
	D	1047	838	20%	1043	749	28%	730	584	20%
	E	975	778	20%	1260	943	25%	680	540	21%
3	A	991	804	19%	Not modelled			Not modelled		
	B	1026	829	19%	1335	1007	25%			
	C	Not modelled			1504	1239	18%			
	D	1102	877	21%	1119	810	28%	765	619	19%
	E	1095	860	22%	1429	1061	26%	785	623	21%
4	A	866	679	22%	Not modelled			Not modelled		
	B	894	688	23%	1139	855	25%			
	C	Not modelled			1267	1038	18%			
	D	948	739	22%	887	647	27%	627	506	19%
	E	907	702	23%	1125	832	26%	561	434	23%

Climate zone	Building form	Offices and laboratories			Shops & shopping centres			Schools		
		Base unregulated	With the provisions	Percentage reduction	Base unregulated	With the provisions	Percentage reduction	Base unregulated	With the provisions	Percentage reduction
5	A	835	673	19%	Not modelled			Not modelled		
	B	850	692	19%	1053	817	22%			
	C	Not modelled			1171	999	15%			
	D	898	724	19%	787	587	25%	556	467	16%
	E	832	662	20%	1004	754	25%	479	382	20%
6	A	745	569	24%	Not modelled			Not modelled		
	B	773	579	25%	985	758	23%			
	C	Not modelled			1111	925	17%			
	D	804	626	22%	712	558	22%	579	498	14%
	E	726	564	22%	860	648	25%	406	319	21%
7	A	743	563	24%	Not modelled			Not modelled		
	B	793	594	25%	1079	846	22%			
	C	Not modelled			1229	1032	16%			
	D	830	647	22%	819	660	20%	706	614	13%
	E	736	578	22%	892	688	23%	455	371	19%
8	A	677	572	16%	Not modelled			Not modelled		
	B	757	667	12%	1154	1087	6%			
	C	Not modelled			1432	1374	4%			
	D	827	741	10%	983	956	3%	950	907	5%
	E	747	669	10%	1029	951	8%	685	649	5%

F HOW TO MAKE COMMENTS

The BCA changes proposed in this Regulation Document are issued for public comment.

Readers are asked to assist by answering the questions on the enclosed *pro forma*. General comments, or comments on other issues or proposals, can then be made in the space provided or as an attachment. It will assist in finalising the measures if readers present their comments, complete with suggested alternatives. If the proposals are to be finalised in 2005, it is important that specific proposals are provided. Any comments requiring investigation can be dealt with through subsequent revisions to the BCA, which occur every twelve months.

Respondents are advised that in keeping with the ABCB's transparency policy, submissions will be made public on the ABCB web site, unless the respondent indicates a preference otherwise by ticking the box near the top of the response sheet.

It will also assist the ABCB Office if readers could forward their technical comments relating to the proposed energy measures contained in this document as soon as possible. A RIS outlining the costs and benefits of the proposed measures will be released before comments on this RD closes. The closing date for comments on this RD is COB Friday 15 April 2005. Submissions can be sent to:

The Energy Efficiency Project

Australian Building Codes Board

GPO Box 9839

CANBERRA ACT 2601

OR

Fax to (02) 6213 7287

OR

E-mail to John.Kennedy@abcb.gov.au

To ensure that all comments are received by the ABCB Office, hard copies of faxed or emailed submissions should also be forwarded to the above address.

G BIBLIOGRAPHY

1. ACADS-BSG Pty Ltd in conjunction with Elms Consulting Engineers (May 2002), Energy Modelling of Office Buildings (Class 5) for Climate Zoning Stages 1, 2 & 3 [Climate Report (Parts 1, 2 &3)]

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9. Brian Reilly, Booth & Reilly Consulting Engineers (May 2002), Report on – Determination of Average Lighting Power Densities for Commercial Buildings

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12. DASCEM Holdings Pty Ltd (April 2004), Assessment of Energy Efficiency Measures BCA Vol 1: Part J4 - Services Clause J4.6 Hot Water Supply

13. EMET Consultants Pty Ltd (Jul 2002), Comparison of Actual Energy Use and Energy Use Predicted by a Simulation Package – Report [EMET Buildings Report]

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15. Ernest Donnelly PhD FIEAust, Consultant to the ABCB (Apr 2002), Modelling the Building Fabric Independent of Building Class – Discussion Paper [Space, Function & Class]

16. Ernest Donnelly PhD FIEAust, Consultant to the ABCB (Jul 2003), Development of an Energy Consumption Allowance for Multi-Residential Buildings [Perf Criteria Class 2 & 3]

17. Ernest Donnelly PhD FIEAust, Consultant to the ABCB (Apr 2004), Economic Analysis of Energy Provisions for Base Building Fabric Elements of Air-Conditioned Office Spaces

18. Exergy (March 2004) Australian Building Codes Board: Class 5 Benchmarking

19. Norman Disney & Young (Sep 2002), Power Factor Correction Evaluation

ATTACHMENT A

PROPOSED BCA TEXT

PART A1 INTERPRETATION

A1.1 Definitions

Editorial note: The following new definition is proposed.

Illumination power density means the total of the power that will be consumed by the lights in a space, other than those that are plugged into general purpose socket outlets, divided by the *floor area* of the space. This includes power consumed by lamps, ballast current regulators and control gear of track and flexible lighting systems, lighting integral with modular furniture and workstation lights but excludes the power lost in distribution cables throughout the building.

Editorial note: The following definitions are already in the BCA and are reproduced here for information.

Air-conditioning, for the purposes of Section J, means a *service* that actively cools or heats a space within a building in order to provide a suitable environment for the building occupants.

Annual energy consumption means the theoretical amount of energy used annually by building *services*, excluding ventilation for a car park, kitchen exhaust and the like, calculated using a method that-

(a) uses climatic data based on hourly recorded values representative of a typical year (Test Reference Year or Weather Year for Energy Calculations) for the proposed location; and

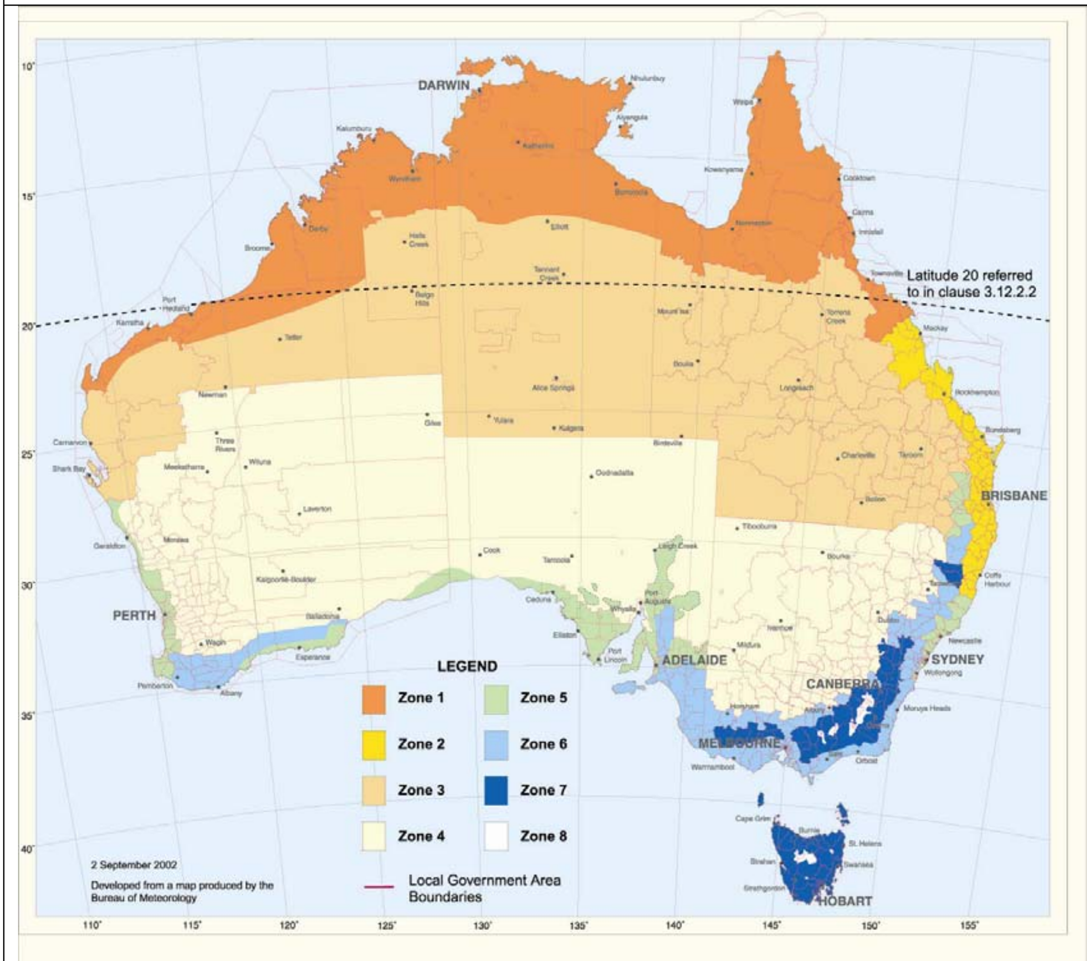
(b) is capable of assessing the contribution of-

- (i) the building *fabric* including *glazing* and shading; and
- (ii) air infiltration and ventilation; and
- (iii) internal heat sources including people and appliances; and
- (iv) different occupant usage patterns; and
- (v) relevant built-environment and topographical features; and
- (vi) the actual elements of the *air-conditioning* system such as fans, cooling and heating plant, including their efficiencies and part load operation characteristics; and
- (vii) the zoning of an *air-conditioning* system; and

(viii) the artificial lighting of the proposed building.

Climate zone means an area defined in Figure A1.1 and in Table A1.1 for specific locations, having energy efficiency provisions based on a range of similar climatic characteristics.

Figure A1.1
CLIMATE ZONES FOR THERMAL DESIGN



Notes:

1. This map can be viewed in enlargeable form on the Energy Efficiency page of the ABCB web site at www.abcb.gov.au.
2. A Zone 4 area in South Australia, other than a council area, at an altitude greater than 300 m above the Australian Height Datum is to be considered as Zone 5.

Table A1.1
CLIMATE ZONES FOR THERMAL DESIGN - VARIOUS LOCATIONS

Location	*Climate zone*	Location	*Climate zone*	Location	*Climate zone*	Location	*Climate zone*
Australian Capital Territory				Canberra	7		
New South Wales							
Albury	4	Cobar	4	Lord Howe Island	2	Tamworth	4
Armidale	7	Coffs Harbour	2	Moree	4	Thredbo	8
Batemans Bay	6	Dubbo	4	Newcastle	5	Wagga Wagga	4
Bathurst	6	Goulburn	7	Nowra	6	Williamtown	5
Bega	6	Grafton	2	Orange	7	Wollongong	5
Bourke	4	Griffith	4	Port Macquarie	5	Yass	6
Broken Hill	4	Ivanhoe	4	Sydney East	5		
Byron Bay	2	Lismore	2	Sydney West	6		
Northern Territory							
Alice Springs	3	Elliot	3	Renner Springs	3		
Darwin	1	Katherine	1	Tennant Creek	3		
Queensland							
Birdsville	3	Cunnamulla	3	Maryborough	2	Toowoomba	5
Brisbane	2	Longreach	3	Mount Isa	3	Torrens Creek	3
Bundaberg	2	Gladstone	2	Normanton	1	Townsville	1
Cairns	1	Labrador	2	Rockhampton	2	Warwick	5
Cooktown	1	Mackay	2	Roma	3	Weipa	1
South Australia							
Adelaide	5	Kingscote	6	Marree	4	Port Lincoln	5
Bordertown	6	Leigh Creek	4	Mount Gambier	6	Renmark	5
Ceduna	5	Lobethal	5	Murray Bridge	6	Tarcoola	4
Cook	4	Loxton	5	Oodnadatta	4	Victor Harbour	6
Elliston	5	Naracoorte	6	Port Augusta	4	Whyalla	4
Tasmania							
Burnie	7	Flinders Island	7	Launceston	7	Rossarden	7
Bicheno	7	Hobart	7	New Norfolk	7	Smithton	7
Deloraine	7	Huonville	7	Oatlands	7	St Marys	7
Devonport	7	King Island	7	Orford	7	Zeehan	7
Victoria							
Anglesea	6	Bright	7	Horsham	6	Swan Hill	4
Ararat	7	Colac	6	Melbourne	6	Traralgon	6
Bairnsdale	6	Dandenong	6	Mildura	4	Wangaratta	4
Ballarat	7	Echuca	4	Portland	6	Warrnambool	6
Benalla	6	Geelong	6	Sale	6	Wodonga	4
Bendigo	6	Hamilton	7	Shepparton	4		

Table A1.1 CLIMATE ZONES FOR THERMAL DESIGN - VARIOUS LOCATIONS (Continued)							
Location	***Climate zone***	**Location**	***Climate zone***	**Location**	***Climate zone***	**Location**	***Climate zone***
Western Australia							
Albany	6	Cocos Island	1	Kalgoorlie-Boulder	4	Port Hedland	1
Balladonia	4	Derby	1	Karratha	1	Wagin	4
Broome	1	Esperance	5	Meekatharra	4	Wyndham	1
Bunbury	5	Exmouth	1	Northam	4		
Carnarvon	3	Geraldton	5	Pemberton	6		
Christmas Island	1	Halls Creek	3	Perth	5		

Conditioned space means a space within a building where the environment can be controlled by *air-conditioning*, but does not include a non-*habitable room* in which a heater with a capacity of not more than 1.2 kW provides the *air-conditioning*.

Cooling load means the calculated amount of energy removed from the cooled spaces of the building annually, by artificial means, to maintain the desired temperatures in those spaces.

Envelope means the parts of a building's *fabric* that separate a *conditioned space* or *habitable room* from-

(a) the exterior of the building; or

(b) a non-*conditioned space* (other than a space through which conditioned air is being exhausted such as a cleaner's room, chemical storage room or exhaust riser) including-

  (i) the floor of a rooftop plant room, lift-machine room or the like; and

  (ii) the floor above a *carpark* or warehouse; and

  (iii) the *common wall* with a *carpark,* warehouse or the like.

Fabric means the basic building structural elements and components of a building including the roof, ceilings, walls and floors.

Glazing, for the purposes of Section J, means a transparent or translucent element and its supporting frame located in the external *fabric* of the building, and includes a *window* other than a *roof light*.

Heating load means the calculated amount of energy delivered to the heated spaces of the building annually, by artificial means, to maintain the desired temperatures in those spaces.

Latent heat gain means the heat gained by the vaporising of liquid without change of temperature.

Lamp power density means the total of the maximum power rating of the lamps in a space, other than those that are plugged into general purpose socket outlets, divided by the *floor area* of the space.

Light source efficacy means the luminous flux of a lamp or the total radiant flux in the visible spectrum weighted by the spectral response of the eye, divided by the electric power that will be consumed by the lamp but excluding ballast and control gear power losses.

Piping, for the purposes of Section J, means an assembly of pipes, with or without valves or other fittings, connected together for the conveyance of liquids.

Reflective insulation means a building membrane with a reflective surface such as a reflective foil laminate, reflective barrier, foil batt or the like capable of reducing radiant heat flow.

Reference building means a hypothetical building that is used to calculate the maximum allowable annual energy load, or maximum allowable *annual energy consumption* for the proposed building.

R-Value means the thermal resistance (m^2.K/W) of a component calculated by dividing its thickness by its thermal conductivity.

Roof light, for the purposes of Section J, means a skylight, *window* or the like installed in a roof–

(a) to permit natural light to enter the room below; and
(b) at an angle between 0 and 70 degrees measured from the horizontal plane.

Sensible heat gain means the heat gained which causes a change in temperature.

Service, for the purposes of Part I2 and Section J, means a mechanical or electrical system that uses energy to provide *air-conditioning*, ventilation, hot water supply, artificial lighting, vertical transport and the like within a building, but which does not include-

(a) systems used solely for emergency purposes; and
(b) cooking facilities; and
(c) portable appliances; and
(d) ventilation to *carparks*.

Solar Heat Gain Coefficient (SHGC) means the fraction of incident irradiance on the transparent or translucent element of a *glazing* system that adds heat to a building's space.

Thermal calculation method means a calculation method that identifies-

(a) a *heating load*; or

(b) a *cooling load*; or

(c) a *heating load* and a *cooling load* (annual energy load),

based on the sum of hourly loads or an equivalent approach.

Total R-Value means the sum of the *R-Values* of the individual component layers in a composite element including any air spaces and associated surface resistances.

Total U-Value means the thermal transmittance ($W/m^2.K$) of the composite element including any air spaces and associated surface transmittances.

Ventilation opening*,* for the purposes of Section J, means an opening in the *external wall*, floor or roof of a building designed to allow air movement into or out of the building by natural means including a permanent opening, an openable part of a *window*, a door or other device which can be held open.

SPECIFICATION A1.3 DOCUMENTS ADOPTED BY REFERENCE

Editorial note: The following specification clauses are already in the BCA and are reproduced here for information.

1. Schedule of referenced documents

The Standards and other documents listed in Table 1 are referred to in Volume One of the BCA.

Table 1:
SCHEDULE OF REFERENCED DOCUMENTS

No.	Date	Title	BCA Clause(s)
AS/NZS 3500		Plumbing and drainage	
Part 4	2003	Heated water services	J7.2
AS/NZS 3823		Performance of electrical appliances - Airconditioners and heat pumps	
Part 1.2	2001	Test Methods - Ducted airconditioners and air-to-air heat pumps - Testing and rating for performance Amdt 1, Aug 2002 Amdt 2, May 2003	J5.4
AS/NZS 4859		Materials for the thermal insulation of buildings	
Part 1	2002	General criteria and technical provisions	J1.2 Spec J5.2
ABCB	2004	Protocol for House Energy Rating Software Version 2005.1	JV1
ARI 460	2000	Remote mechanical-draft air-cooled refrigerant condensers	J5.4
ARI 550/590	1998	Water chilling packages using the vapour compression cycle	J5.4
BS 7190	1989	Assessing thermal performance of low temperature hot water boilers using a test rig	J5.4

PART I2 ENERGY EFFICIENCY INSTALLATIONS

Editorial note: The performance clauses of Part I2 remain unchanged, except for the application of IO2, IF2.1 and IP2.1, which changes to a limitation.

OBJECTIVE

IO2 The *Objective* of this Part is to reduce greenhouse gas emissions by efficiently using energy throughout the life of the building.

> **Application:**
> IO2 does not apply to a *sole-occupancy unit* in a Class 2 building, or a Class 4 part of a building.

FUNCTIONAL STATEMENT

IF2.1 A building's *services* are to be continually capable of using energy efficiently.

> **Application:**
> IF2.1 does not apply to a *sole-occupancy unit* in a Class 2 building, or a Class 4 part of a building.

PERFORMANCE REQUIREMENT

IP2.1 A building's *services* must continue to perform to a standard of energy efficiency no less than that which they were originally *required* to achieve.

> **Limitation:**
> IP2 does not apply to a *sole-occupancy unit* in a Class 2 building, or a Class 4 part of a building.

PART I2 ENERGY EFFICIENCY INSTALLATIONS

Editorial note: The Deemed-to-Satisfy clauses of Part I2 remain unchanged, except for the Application of Part clause I2.1. Clause I2.2 is already in the BCA and is reproduced here for information.

I2.1 Application of Part

The *Deemed-to-Satisfy Provisions* of this Part do not apply within a *sole-occupancy unit* of a Class 2 building or a Class 4 part of a building.

I2.2 Components of services

Components of *services* must be maintained to ensure that they perform to a standard not less than they were originally *required* to achieve, including-

(a) adjustable or motorised shading devices; and
(b) time switches and motion detectors; and
(c) room temperature thermostats; and
(d) plant thermostats such as on boilers or refrigeration units; and
(e) outside air dampers; and
(f) reflectors, lenses and diffusers of light fittings; and
(g) heat transfer equipment.

SECTION J ENERGY EFFICIENCY

Editorial note: Clauses JO1, JF1 and JP1 remain unchanged, except that the application is deleted in order to apply to all buildings.

OBJECTIVE

JO1 The *Objective* of this Section is to reduce greenhouse gas emissions by efficiently using energy.

FUNCTIONAL STATEMENTS

JF1 A building, including its *services*, is to be capable of efficiently using energy.

PERFORMANCE REQUIREMENT

Editorial note: The performance clause JP1 remains unchanged and is only reproduced here for information.

JP1 A building, including its *services*, must have, to the degree necessary, features that facilitate the efficient use of energy appropriate to-

(a) the function and use of the building and *service*; and
(b) the internal environment; and
(c) the geographic location of the building; and
(d) the effects of nearby permanent features such as topography, structures and buildings; and
(e) solar radiation being-
 (i) utilised for heating; and
 (ii) controlled to minimise energy for cooling; and
(f) the sealing of the building *envelope* against air leakage; and
(g) the utilisation of air movement to assist heating and cooling; and
(h) the energy source of the *service.*

Editorial note: The performance clause JP2 remain unchanged, except for the application, which changes to a limitation.

JP2 A building, including its *services*, must have, to the degree necessary, features that facilitate the maintenance of systems and components appropriate to the function and use of the building.

> **Limitation:**
> JP2 does not apply to a *sole-occupancy unit* in a Class 2 building, or a Class 4 part of a building.

VERIFICATION METHODS

JV1 Verification using a stated value for a Class 2 building or a Class 4 part of a building

Editorial note: Verification Method JV1 remains unchanged and is reproduced here for information.

(a) For a Class 2 building or Class 4 part, other than its *services*, compliance with JP1 is verified when it is determined using a *thermal calculation method* that-
   (i) each *sole-occupancy unit* has an annual energy load equivalent to an energy rating of not less than 3 stars; and
   (ii) the average energy rating of all of the *sole-occupancy units* is not less than-
      (A) in *climate zones* 1 to 3, 3.5 stars; and
      (B) in *climate zones* 4 to 8, 4 stars.

(b) Energy rating must be determined in accordance with the ABCB Protocol for House Energy Rating Software.

(c) Averaging of energy ratings must be carried out in MJ/m^2.annum or points.

JV2 Verification using a stated value

Editorial note: Verification Method JV2 is technically the same but is proposed to be extended to some other types of buildings.

(a) For other than a Class 2 building or Class 4 part, compliance with JP1 is verified when it is calculated in accordance with (b) that-

(i) the *annual energy consumption* is not more than the *annual energy consumption* allowance in Table JV2; and

(ii) the *annual energy consumption,* with the *services* modelled at the minimum standard specified in the *Deemed-to-Satisfy Provisions* and in accordance with (c), is not more than the *annual energy consumption* allowance in Table JV2.

(b) The *annual energy consumption* in (a) must-

(i) be calculated in accordance with Specification JV; and

(ii) be calculated for the same range of *services* covered by Table JV2; and

(iii) be compared to the *annual energy consumption* allowance for the nearest location in Table JV2, with similar climatic conditions, if the location where the building is to be constructed is not listed; and

(iv) be calculated for the same occupancy category covered by Table JV2.

(c) The *annual energy consumption* in (a)(ii) must be based on-

(i) for a building with gas heating and all other *services* electric - a cooling only air-cooled air-conditioning unit with a hot water coil serving each individual *sole-occupancy unit* and common area space, and a central gas boiler and hot water pump; and

(ii) for a building with all the *services* electric - a reverse-cycle air-conditioning units serving each individual *sole-occupancy unit* and common area space.

Table JV2
ANNUAL ENERGY CONSUMPTION ALLOWANCES (MJ/annum. m^2 *floor area*)

Location		Class 3 or 9c *aged care buildings*		Class 5 building, Class 8 laboratory or a Class 9a clinic		Class 6 shop or shopping centre		Class 6 restaurant or cafe		Class 9b theatre or cinema		Class 9b *school*	
		Gas [3]	Elec [3]	Gas[3]	Elec[3]	Gas[3]	Elec[3]	Gas	Elec	Gas	Elec	Gas	Elec
ACT	**Canberra**	710	580	620	620	780	740	2160	1370	1810	970	590	400
New South Wales	**Cobar**	640	590	680	700	730	820	1780	1390	1310	940	500	430
	Coffs Harbour	630	520	700	660	700	740	1470	1150	960	710	450	380
	Moree	630	590	700	720	810	840	1760	1420	1270	940	500	450
	Nowra	590	520	590	590	730	650	1570	1070	1330	760	420	310
	Orange	820	610	650	610	1020	750	2570	1580	2410	1270	700	430
	Richmond	570	500	700	680	780	770	1650	1270	1140	810	470	390
	Sydney City	550	510	690	660	740	740	1520	1190	1060	740	450	370
	Tamworth	620	550	650	650	810	760	1800	1300	1370	870	480	380
	Wagga Wagga	590	520	650	650	830	780	2120	1420	1690	990	590	420
	Williamtown	650	530	720	670	720	780	1810	1330	1340	870	530	420
	Thredbo	1020	760	670	670	1230	950	3610	2430	3860	2390	910	650
Northern Territory	**Alice Springs**	660	610	770	800	840	950	1910	1670	1350	1110	560	540
	Darwin	830	820	970	1000	1440	1430	2850	2850	2100	1990	910	960
	Tennant Creek	700	690	860	910	1000	1140	2030	2020	1430	1370	650	680

Table JV2
ANNUAL ENERGY CONSUMPTION ALLOWANCES (MJ/annum. m^2 *floor area*) (Continued)

Location		Class 3 or 9c *aged care buildings*		Class 5 building, Class 8 laboratory or a Class 9a clinic		Class 6 shop or shopping centre		Class 6 restaurant or cafe		Class 9b theatre or cinema		Class 9b *school*	
		Gas 3	Gas3	Elec3	Gas3	Elec3	Gas3	Gas	Elec	Gas	Elec	Gas	Elec
Queensland	Amberley	580	550	760	740	940	870	1680	1420	1100	890	520	480
	Brisbane	560	540	760	730	940	850	1630	1370	1050	850	520	470
	Cairns	660	660	880	860	1230	1140	2230	2000	1490	1290	750	710
	Charleville	640	570	730	740	780	880	1830	1520	1310	1010	530	480
	Cloncurry	690	680	860	910	990	1130	2010	2000	1400	1360	640	680
	Gladstone	610	600	830	800	1010	990	1880	1640	1190	1020	630	580
	Longreach	700	690	860	900	1000	1120	2020	1940	1380	1280	650	660
	Mackay	630	630	830	810	970	1010	1990	1730	1270	1070	640	590
	Mount Isa	670	660	850	890	980	1110	1990	1940	1380	1300	640	660
	Oakey	560	520	740	710	770	830	1830	1460	1320	950	520	450
	Rockhampton	620	610	830	810	920	1000	1900	1710	1270	1090	610	590
	Townsville	680	670	870	860	1220	1140	2280	2070	1570	1380	730	700
South Australia	Adelaide	650	600	650	630	730	730	1690	1190	1350	820	470	350
	Ceduna	650	520	650	620	730	710	1620	1170	1220	780	430	330
	Mt Gambier	660	520	560	540	700	640	2000	1160	1840	880	530	310
	Oodnadatta	620	600	720	750	800	880	1650	1400	1110	900	500	470
	Woomera	690	580	700	720	790	860	1770	1450	1290	980	510	450
Tasmania	Hobart	680	510	540	530	770	610	2070	1130	2000	870	540	300
	Launceston	740	550	570	560	860	660	2380	1330	2240	1020	620	350

Table JV2
ANNUAL ENERGY CONSUMPTION ALLOWANCES (MJ/annum. m² *floor area*) (Continued)

Location		Class 3 or 9c *aged care buildings*		Class 5 building, Class 8 laboratory or a Class 9a clinic		Class 6 shop or shopping centre		Class 6 restaurant or cafe		Class 9b theatre or cinema		Class 9b *school*	
		Gas [3]	Elec [3]	Gas[3]	Elec[3]	Gas[3]	Elec[3]	Gas	Elec	Gas	Elec	Gas	Elec
Western Australia	Albany	570	480	550	530	690	580	1490	970	1360	720	390	260
	Broome	740	740	920	950	1290	1300	2400	2440	1760	1690	760	830
	Carnarvon	580	560	780	770	850	920	1770	1580	1170	1020	550	520
	Esperance	540	500	630	590	720	650	1490	1070	1200	720	420	310
	Forrest	570	540	650	670	670	760	1560	1220	1190	830	430	380
	Geraldton	610	480	750	720	810	840	1560	1350	1020	820	480	450
	Giles	680	650	760	790	850	960	1830	1630	1310	1130	540	520
	Halls Creek	710	700	920	980	1090	1240	2160	2140	1470	1380	740	780
	Kalgoorlie-Bolder	620	580	670	690	700	800	1640	1340	1190	900	450	400
	Learmonth	650	640	830	850	1090	1080	1980	1910	1380	1280	620	640
	Meekatharra	660	630	730	770	900	930	1790	1590	1260	1070	520	500
	Onslow	660	650	870	870	1200	1160	2240	2110	1540	1430	710	710
	Perth	660	570	690	680	730	760	1490	1210	990	760	430	380
	Port Hedland	710	710	880	920	1220	1240	2260	2280	1590	1560	710	770

Table JV2
ANNUAL ENERGY CONSUMPTION ALLOWANCES (MJ/annum. m² *floor area*) (Continued)

Location		Class 3 or 9c *aged care buildings*		Class 5 building, Class 8 laboratory or a Class 9a clinic		Class 6 shop or shopping centre		Class 6 restaurant or cafe		Class 9b theatre or cinema		Class 9b *school*	
		Gas [3]	Elec [3]	Gas[3]	Elec[3]	Gas[3]	Elec[3]	Gas	Elec	Gas	Elec	Gas	Elec
Victoria	**East Sale**	670	540	570	560	700	650	2030	1220	1780	910	530	330
	Melbourne - City	640	540	590	580	740	670	1800	1170	1560	840	520	350
	Melbourne - Tullamarine	700	560	620	590	820	700	2130	1270	1900	950	600	370
	Mildura	680	560	660	630	860	760	1960	1370	1520	950	560	390
	Mt Buller	1020	760	670	670	1230	950	3610	2430	3860	2390	910	650

Notes:

1. The *services* covered by Table JV2 are the *air-conditioning*, internal artificial lighting, bathroom and toilet exhaust, appliance electric power, lifts and esculators and hot water supply.
2. If the building is being heated using gas and other services using electricity, use the value in the column headed "Gas" but if electricity is being used for heating as well as all other services, use the value in the column headed "Elec.".
3. The *annual energy consumption* allowances above are based on *air-conditioning* plant with an outside air cycle. If the *air-conditioning* plant serving a building other than a Class 6 restaurant or cafe or a Class 9b building, is small enough to not *require* an outside air cycle under the *Deemed-to-Satisfy Provisions*, the *annual energy consumption* allowance may be increased by-
   (a) 5% in *climate zones* 2 and 3; and
   (b) 10% in *climate zones* 4 to 8.

JV3 Verification using a reference building

Editorial note: Verification Method JV2 is technically the same but is proposed to be extended to other Classes of buildings. (b) and Table JV3 are unchanged.

(a) For other than a Class 2 building or Class 4 part, compliance with JP1 is verified when it is calculated that-
  (i) the *annual energy consumption* of the proposed building is not more than the *annual energy consumption* of a *reference building*; and
  (ii) the *annual energy* consumption of the proposed building is not more than the *annual energy consumption* of a *reference building* using the same complying services in both cases.

(b) The *annual energy consumption* in (a) must be calculated-
  (i) in accordance with Specification JV; and
  (ii) for the *reference building,* using the *Deemed-to-Satisfy Provisions* and the criteria specified in Table JV3; and
  (iii) for both the proposed building and the *reference building,* using the same-
    (A) calculation method*;* and
    (B) location; and
    (C) adjacent structures and features; and
    (D) environmental conditions such as ground reflectivity sky and ground form factor, temperature of external bounding surfaces, air velocities across external surfaces and the like; and
    (E) orientation; and
    (F) roof form; and
    (G) external doors; and
    (H) floor plan; and
    (I) ground to lowest floor arrangement; and
    (J) dimensions of external, internal and separating walls; and
    (K) density of *envelope* walls over 220 kg/m^2; and
    (L) number of *storeys*; and
    (M) intermediate floors; and
    (N) floor coverings; and
    (O) internal shading devices, their criteria such as colour and their operation; and
    (P) lifts and esculators; and
    (Q) range of *services* and energy sources; and
    (R) internal artificial lighting levels; and
    (S) internal power loads; and
    (T) internal *air-conditioning* zones; and

(U) daily and annual profiles of the-
  (aa) building occupancy; and
  (bb) usage of *services*; and
(V) internal relative humidity range; and
(W) supply hot water temperature and rate.

Table JV3
REFERENCE BUILDING DESCRIPTION

Item	Description	Criteria
1	Envelope elements	External surfaces of 0.7 solar absorptance.
2	Ground floor	Concrete slab-on-ground.
3	External shading	The *glazing* complying with the *Deemed-to-Satisfy* provisions of Clause J2.4 for no shading.
4	*Glazing* area distribution	Distribute the *glazing*- (a) to each external wall of the reference building that is suitable for the installation of glazing; (b) in the same ratio as the wall to the total wall area available for the glazing.
5	Exhaust ventilation systems	Exhaust ventilation systems complying with the *Deemed-to-Satisfy Provisions* of Part F4 and with fans running 24 hours per day at a system resistance of 100 Pa.
6	*Air-conditioning* system selection	(a) For a package unit fan, the power to air flow rate ratio in Table J5.2 for 400 Pa with a filter and coil; and (b) For a hot water pump and a cooling water pump, the power to water flow rate in Table J5.4a for 200 Pa system resistance and 5.5 K temperature rise.

SPECIFICATION JV ANNUAL ENERGY CONSUMPTION CALCULATION

Editorial note: Specification JV is basically the same but the clause extended to include criteria likely in other Classes of buildings and Table 2 extended to include other occupancy and operating profiles.

1. Scope

This Specification contains the requirements for calculating the *annual energy consumption* of *services* in a building.

2. Annual energy consumption of services

The annual energy consumption-

(a) for *air-conditioning,* must be calculated on the basis of-
   (i) the space temperature being within the range of 20^{o}C to 24^{o}C for 98% of the plant operating time other than the first hour of operation each day; and
   (ii) the daily occupancy and operation profiles in Table 2; and
   (iii) plant serving public areas of a Classs 3 or Class 9c building being available on thermostatic control 24 hours per day; and
   (iv) the amount of ventilation *required* by Part F4; and
   (v) the internal heat gains in a building-
      (A) from the occupants, at an average rate of 75 W per person *sensible heat gain* and 55 W per person *latent heat gain*, with the number of people calculated in accordance with Table D1.13; and
      (B) from appliances and equipment, in accordance with Table 2; and
      (C) from artificial lighting, that calculated in (b); and
   (vi) infiltration values, for a perimiter zone of depth equal to the floor-to-ceiling height, of-
      (A) when pressurising plant is operation, 0.5 air changes per hour; and
      (B) when pressurising plant is not operating, 1.0 air changes per hour; and
   (vii) blinds being operated when the solar radiation on the *glazing* exceeds 150 W/m^2; and
   (viii) furniture and fitings density of 20 kg/m^3; and
   (ix) the *R-Value* of air films being in accordance with Specification J1.2; and
   (x) heat migration across air-conditioning zone boundries.

Table 2 **INTERNAL HEAT GAINS FOR APPLIANCES AND EQUIPMENT**	
Application	**Internal sensible heat heat gain rate (W/m^2)**
Sole-occupancy unit of a Class 3 or Class 9c building and a Class 9a building *ward area*	5 W/m^2 averaged for 24 hours per day, 7 days per week, continuous operation
Class 5 building, Class 8 laboratory and a Class 9a clinic and *treatment area*	15 W/m^2 peak
Class 6 shop and shopping centre, Class 6 cafe and restauraunt and Class 9b *school*	5 W/m^2 peak
Other applications	0.0 W/m^2 peak

(b) for artificial lighting, is calculated on the basis of the proposed level of artificial lighting in the building with the daily profile in Table 2; and

(c) for a lift in a building with more than one classification, may be proportioned according to the *rise in storeys* of the part for which the annual energy consumption is being calculated; and

(d) for hot water supply is calculated on the basis of-

  (i) in a Class 3 or Class 9c building, 160 L of hot water at 60^{o}C for each *sole-occupancy unit* for each day that the *sole-occupancy units* are occupied; and

  (ii) for sanitary purposes in a non-residential building, 4 L of hot water at 60^{o}C for each person; and

(e) may be reduced by 50% for energy generated on-site from sources that do not emit greenhouse gases such as solar and wind power.

Editorial note: Table 2a for residential buildings is unchanged and Tables 2b, 2c and 2d are new.

Table 2a
OCCUPANCY AND OPERATION PROFILES OF A CLASS 3 BUILDING

Time period	Occupancy		Artificial lighting	*Air-conditioning*	
	Monday to Friday	Saturday and Sunday		Monday to Friday	Saturday and Sunday
12:00am to 1:00am	85%	85%	5%	On	On
1:00am to 2:00am	85%	85%	5%	On	On
2:00am to 3:00am	85%	85%	5%	On	On
3:00am to 4:00am	85%	85%	5%	On	On
4:00am to 5:00am	85%	85%	5%	On	On
5:00am to 6:00am	85%	85%	25%	On	On
6:00am to 7:00am	85%	85%	80%	On	On
7:00am to 8:00am	80%	85%	80%	On	On
8:00am to 9:00am	50%	50%	50%	On	On
9:00am to 10:00am	10%	50%	20%	Off	On
10:00am to 11:00am	10%	20%	20%	Off	Off
11:00am to 12:00pm	10%	20%	20%	Off	Off
12:00pm to 1:00pm	10%	20%	20%	Off	Off
1:00pm to 2:00pm	10%	20%	20%	Off	Off
2:00pm to 3:00pm	10%	20%	20%	Off	Off
3:00pm to 4:00pm	10%	30%	20%	Off	Off
4:00pm to 5:00pm	50%	50%	20%	On	On
5:00pm to 6:00pm	50%	50%	50%	On	On
6:00pm to 7:00pm	70%	50%	50%	On	On
7:00pm to 8:00pm	70%	70%	50%	On	On
8:00pm to 9:00pm	80%	80%	50%	On	On
9:00pm to 10:00pm	85%	80%	50%	On	On
10:00pm to 11:00pm	85%	85%	50%	On	On
11:00pm to 12:00am	85%	85%	5%	On	On

Note:
Occupancy profiles are expressed as a percentage of the maximum number of people that can be accommodated in the building and artificial lighting is expressed as a percentage of the maximum *lamp power density*.

Table 2b
OCCUPANCY AND OPERATION PROFILES OF A CLASS 5 BUILDING, A CLASS 8 LABORATORY AND A CLASS 9a CLINIC

Time period (1 hour to)	Occupancy (Monday to Friday)	Artificial lighting (Monday to Friday)	Appliances and equipment (Monday to Friday)	*Air-conditioning* (Monday to Friday)
To 1:00am	0%	10%	10%	Off
To 2:00am	0%	10%	10%	Off
To 3:00am	0%	10%	10%	Off
To 4:00am	0%	10%	10%	Off
To 5:00am	0%	10%	10%	Off
To 6:00am	0%	10%	10%	Off
To 7:00am	0%	10%	10%	On
To 8:00am	25%	100%	45%	On
To 9:00am	90%	100%	95%	On
To 10:00am	97%	100%	100%	On
To 11:00am	97%	100%	100%	On
To 12:00pm	97%	100%	100%	On
To 1:00pm	97%	100%	100%	On
To 2:00pm	97%	100%	100%	On
To 3:00pm	97%	100%	100%	On
To 4:00pm	97%	100%	100%	On
To 5:00pm	97%	100%	100%	On
To 6:00pm	75%	80%	80%	On
To 7:00pm	25%	60%	60%	Off
To 8:00pm	10%	40%	40%	Off
To 9:00pm	2%	20%	30%	Off
To 10:00pm	2%	10%	10%	Off
To 11:00pm	0%	10%	10%	Off
To 12:00am	0%	10%	10%	Off

Notes:

1. Occupancy profiles are expressed as a percentage of the maximum number of people that can be accommodated in the building and artificial lighting is expressed as a percentage of the maximum *lighting power density*.
2. Saturday and Sunday profiles are 10% continuous artificial ighting and 10% continuous appliances and equipment. There is no occupancy and the *air-conditioning* is "off".

Table 2c OCCUPANCY AND OPERATION PROFILES OF A CLASS 6 SHOP AND SHOPPING CENTRE				
Time period (1 hour to)	**Occupancy (Daily)**	**Artificial lighting (Daily)**	**Appliances and equipment (Daily)**	***Air-conditioning* (Daily)**
To 1:00am	0%	10%	10%	Off
To 2:00am	0%	10%	10%	Off
To 3:00am	0%	10%	10%	Off
To 4:00am	0%	10%	10%	Off
To 5:00am	0%	10%	10%	Off
To 6:00am	0%	10%	10%	Off
To 7:00am	0%	10%	10%	On
To 8:00am	10%	100%	70%	On
To 9:00am	20%	100%	70%	On
To 10:00am	20%	100%	70%	On
To 11:00am	15%	100%	70%	On
To 12:00pm	25%	100%	70%	On
To 1:00pm	25%	100%	70%	On
To 2:00pm	15%	100%	70%	On
To 3:00pm	15%	100%	70%	On
To 4:00pm	15%	100%	70%	On
To 5:00pm	15%	100%	70%	On
To 6:00pm	5%	100%	70%	On
To 7:00pm	5%	100%	70%	Off
To 8:00pm	0%	10%	10%	Off
To 9:00pm	0%	10%	10%	Off
To 10:00pm	0%	10%	10%	Off
To 11:00pm	0%	10%	10%	Off
To 12:00am	0%	10%	10%	Off
Note: Occupancy profiles are expressed as a percentage of the maximum number of people that can be accommodated in the building and artificial lighting is expressed as a percentage of the maximum *lighting power density*.				

Table 2d
OCCUPANCY AND OPERATION PROFILES OF A CLASS 6 RESTAURANT AND CAFE

Time period (1 hour to)	Occupancy (Monday to Saturday)	Artificial lighting (Monday to Saturday)	Appliances and equipment (Monday to Saturday)	*Air-conditioning* (Monday to Saturday)
To 1:00am	0%	5%	15%	Off
To 2:00am	0%	5%	15%	Off
To 3:00am	0%	5%	15%	Off
To 4:00am	0%	5%	15%	Off
To 5:00am	0%	5%	15%	Off
To 6:00am	0%	5%	15%	Off
To 7:00am	5%	40%	40%	On
To 8:00am	5%	40%	40%	On
To 9:00am	5%	60%	60%	On
To 10:00am	5%	60%	60%	On
To 11:00am	20%	90%	90%	On
To 12:00pm	50%	90%	90%	On
To 1:00pm	80%	90%	90%	On
To 2:00pm	70%	90%	90%	On
To 3:00pm	40%	90%	90%	On
To 4:00pm	20%	90%	90%	On
To 5:00pm	25%	90%	90%	On
To 6:00pm	50%	90%	90%	On
To 7:00pm	80%	90%	90%	On
To 8:00pm	80%	90%	90%	On
To 9:00pm	80%	90%	90%	On
To 10:00pm	50%	90%	90%	On
To 11:00pm	35%	50%	50%	On
To 12:00am	20%	30%	30%	On

Notes:

1. Occupancy profiles are expressed as a percentage of the maximum number of people that can be accommodated in the building and artificial lighting is expressed as a percentage of the maximum *lighting power density*.
2. Sunday profile is 5% continuous artificial ighting and 5% continuous appliances and equipment. There is no occupancy and *air-conditioning* is "off".

Table 2e OCCUPANCY AND OPERATION PROFILES OF A CLASS 6b THEATRE AND CINEMA						
Time period (1 hour to)	**Occupancy**		**Artificial lighting**		***Air-conditioning***	
	Monday to Friday	**Sat. & Sun**	**Monday to Friday**	**Sat. & Sun**	**Monday to Friday**	**Sat. & Sun**
To 1:00am	0%	0%	5%	5%	Off	Off
To 2:00am	0%	0%	5%	5%	Off	Off
To 3:00am	0%	0%	5%	5%	Off	Off
To 4:00am	0%	0%	5%	5%	Off	Off
To 5:00am	0%	0%	5%	5%	Off	Off
To 6:00am	0%	0%	5%	5%	Off	Off
To 7:00am	0%	0%	5%	5%	Off	Off
To 8:00am	0%	0%	5%	5%	Off	On
To 9:00am	0%	20%	100%	100%	Off	On
To 10:00am	0%	80%	10%	10%	Off	On
To 11:00am	0%	80%	10%	10%	Off	On
To 12:00pm	0%	80%	10%	10%	On	On
To 1:00pm	20%	20%	100%	100%	On	On
To 2:00pm	80%	80%	5%	5%	On	On
To 3:00pm	80%	80%	5%	5%	On	On
To 4:00pm	80%	80%	5%	5%	On	On
To 5:00pm	80%	80%	5%	5%	On	On
To 6:00pm	20%	20%	100%	100%	On	On
To 7:00pm	20%	20%	100%	100%	On	On
To 8:00pm	80%	80%	100%	100%	On	On
To 9:00pm	80%	80%	5%	5%	On	On
To 10:00pm	80%	80%	5%	5%	On	On
To 11:00pm	80%	80%	5%	5%	On	On
To 12:00am	10%	10%	100%	5%	On	On

Note:

Occupancy profiles are expressed as a percentage of the maximum number of people that can be accommodated in the building and artificial lighting is expressed as a percentage of the maximum *lighting power density*.

Table 2f **OCCUPANCY AND OPERATION PROFILES OF A CLASS 9b SCHOOL**				
Time period (1 hour to)	**Occupancy (Monday to Friday)**	**Artificial lighting (Monday to Friday)**	**Appliances and equipment (Monday to Friday)**	***Air-conditioning* (Monday to Friday)**
To 1:00am	0%	5%	5%	Off
To 2:00am	0%	5%	5%	Off
To 3:00am	0%	5%	5%	Off
To 4:00am	0%	5%	5%	Off
To 5:00am	0%	5%	5%	Off
To 6:00am	0%	5%	5%	Off
To 7:00am	0%	5%	5%	Off
To 8:00am	5%	30%	30%	On
To 9:00am	75%	85%	85%	On
To 10:00am	90%	95%	95%	On
To 11:00am	90%	95%	95%	On
To 12:00pm	90%	95%	95%	On
To 1:00pm	50%	80%	70%	On
To 2:00pm	50%	80%	70%	On
To 3:00pm	90%	95%	95%	On
To 4:00pm	70%	90%	80%	On
To 5:00pm	50%	70%	60%	On
To 6:00pm	20%	20%	20%	Off
To 7:00pm	20%	20%	20%	Off
To 8:00pm	20%	20%	20%	Off
To 9:00pm	10%	10%	10%	Off
To 10:00pm	5%	5%	5%	Off
To 11:00pm	5%	5%	5%	Off
To 12:00am	5%	5%	5%	Off

Notes:

1. Occupancy profiles are expressed as a percentage of the maximum number of people that can be accommodated in the building and artificial lighting is expressed as a percentage of the maximum *lighting power density*.
2. Saturday and Sunday profile are 5% continuous artificial lighting and 5% continuous appliances and equipment. There is no occupancy and *air-conditioning* is "off".

PART J1 BUILDING FABRIC

Editorial note: Clause J1.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J1.1 Application of Part

Editorial note: Clause J1.1 extends this Part to all buildings likely to be air-conditioned.

The *Deemed-to-*Satisfy *Provisions* of this Part do not apply to a Class 7, 8 and 9b building-

(a) that does not have a *conditioned space*; or

(b) where an *air-conditioning* system needs less than 15 Watts of input power per square metre of the *floor area*.

J1.2 Thermal construction general

Editorial note: Clause J1.2 is unchanged and included for information.

(a) Where *required*, insulation must comply with AS/NZS 4859.1 and be installed so that it-
   (i) abuts or overlaps adjoining insulation; and
   (ii) forms a continuous barrier with ceilings, walls, bulkheads, floors or the like that inherently contribute to the thermal barrier; and
   (iii) does not affect the safe or effective operation of a *service* or fitting.

(b) Where *required*, *reflective insulation* must be installed with-
   (i) the necessary airspace, to achieve the *required R-Value*, between a reflective side of the *reflective insulation* and a building lining or cladding; and
   (ii) the *reflective insulation* closely fitted against any penetration, door or *window* opening; and
   (iii) the *reflective insulation* adequately supported by framing members; and
   (iv) each adjoining sheet of roll membrane being-
      (A) overlapped not less than 50 mm; or
      (B) taped together.

(c) Where *required*, bulk insulation must be installed so that it-
   (i) maintains its position and thickness, other than where it crosses roof battens, water pipes, electrical cabling or the like; and
   (ii) in ceilings where there is no bulk insulation or *reflective insulation* in the wall, overlaps the wall member by not less than 50 mm.

(d) Roof, ceiling, wall and floor materials, and associated surfaces are deemed to have the thermal properties listed in Specification J1.2.

J1.3 Roof and ceiling construction

Editorial note: Clause J1.3 is unchanged. However, Table J1.3 is changed to include other Classes of buildings.

(a) A roof or ceiling that is part of the *envelope* must achieve the *Total R-Value* specified in Table J1.3 for the direction of heat flow.

(b) Roof and ceiling construction is deemed to have the thermal properties listed in Specification J1.3.

Table J1.3
ROOFS - MINIMUM TOTAL R-VALUE FOR EACH CLIMATE ZONE

(a) Classes 2, 3, 4 and 9c buildings

Climate zone		**1**	**2**		**3**	**4**	**5**	**6**	**7**	**8**
			Below 300 m altitude	**At or above 300 m altitude**						
Minimum *Total R-Value* for a roof or ceiling generally	**A roof or ceiling generally**	2.2	2.2	2.5	2.2[2]	3.0	2.7	3.2	3.8	4.3
	A ceiling below a non-*conditioned space* such as a plant room, lift machinery room, store room or the like	1.1	1.1	1.25	1.1	1.5	1.35	1.6	1.9	2.15
Direction of heat flow		Downwards		Downwards and upwards		Upwards				

(b) Classes 5 to 8, 9a and 9b buildings

Climate Zone		**1**	**2**		**3**	**4**	**5**	**6**	**7**	**8**
			Below 300 m altitude	**At or above 300 m altitude**						
Minimum *Total R-Value* for a roof or ceiling generally	**A roof or ceiling generally**	3.2				3.2			3.2	4.3
	A ceiling below a non-*conditioned space* such as a plant room, lift machinery room, store room or the like	1.6				1.6			1.6	2.15
Direction of heat flow		Downwards							Upwards	

Note:

The minimum *Total R-Value* may be reduced in climate zones 1, 2 and 3 by-

(a) R0.5 for a roof upper surface solar absorptance of 0.55 down to 0.35; or

(b) R1.0 for a roof upper surface solar absorptance of 0.35 or less.

J1.4 Roof lights

Editorial note: Clause J1.4 has changed to include other Classes of buildings.

(a) *Roof lights*-
  (i) serving a *habitable room*, public area or an interconnecting space such as a corridor, hallway, stairway or the like in a Class 2 or 3 building or Class 4 part of a building; or
  (ii) that form part of the *envelope* of a Class 5, 6, 7, 8 or 9 building,

  must satisfy (b), (c) and (d).

(b) *Roof lights* must comply with Table J1.4 if their total area is more than 1.5% but not more than 10% of the *floor area* of the room or space they serve.

(c) The total area of the *roof lights* may exceed 10% of the *floor area* of the room or space they serve, where–
  (i) compliance with the natural lighting requirements of Part F4 can only be achieved by a *roof light*; and
  (ii) the transparent and translucent elements of the *roof lights*, including any imperforate ceiling diffuser achieve-
    (A) an *SHGC* of not more than 0.25; and
    (B) a *Total U-Value* of not more than 1.3.

(d) The aggregate area of *roof lights* serving a *storey* of a *sole-occupancy unit* must not exceed 3% of the total *floor area* of the *storey* of the *sole-occupancy unit* served.

Table J1.4 ROOF LIGHTS - THERMAL PERFORMANCE OF TRANSPARENT AND TRANSLUCENT ELEMENTS			
Roof light shaft index (see Note 1)	**Total area of *roof lights* serving the room or space as a percentage of the *floor area* of the room or space**		
	More than 1.5% and up to 3%	**More than 3% and up to 5%**	**More than 5% and up to 10%**
Less than 0.5	*SHGC* of not more than 0.75 and a *Total U-Value* of not more than 5.0	*SHGC* of not more than 0.50 and a *Total U-Value* of not more than 5.0	*SHGC* of not more than 0.25 and a *Total U-Value* of not more than 2.5
0.5 to less than 1.0	*Total U-Value* of not more than 5.0	*SHGC* of not more than 0.70 and a *Total U-Value* of not more than 5.0	*SHGC* of not more than 0.35 and a *Total U-Value* of not more than 2.5
1.0 to less than 2.5	*Total U-Value* of not more than 5.0	*Total U-Value* of not more than 5.0	*SHGC* of not more than 0.45 and a *Total U-Value* of not more than 2.5
2.5 and above	*Total U-Value* of not more than 5.0	*Total U-Value* of not more than 5.0	*Total U-Value* of not more than 2.5

Notes:

1. The *roof light* shaft index is determined by measuring the distance from the centre of the shaft at the roof to the centre of the shaft at the ceiling level and dividing it by the average internal dimension of the shaft opening at the ceiling level (or the diameter for a circular shaft) in the same units of measurement.
2. The total area of *roof lights* is the combined area for all *roof lights* serving the room or space.
3. The area of a *roof light* is the area of the roof opening that allows light to enter the building.
4. The thermal performance of an imperforate ceiling diffuser may be included in the *Total R-Value* of the *roof light.*

1.5 Walls

Editorial note: J1.5 is changed to include other Classes of buildings. It is also presented in tabular format for easier understanding of the options in a particular climate zone. Clause (b) enables trading between walls and glazing while (f) covers thermal bridging. Unchanged clauses are (c), (d) and (e).

(a) An *external wall* that is part of the *envelope* must satisfy one or a combination of the options in Table J1.5, except for-
   (i) an *external wall* facing the south orientation sector, as described in Figure 3.12.2.1, in *climate zones* 1, 2 and 3 south of latitude 20^{o} south; and
   (ii) opaque non-glazed openings in *external walls* such as doors (including garage doors), vents, penetrations, shutters and the like.

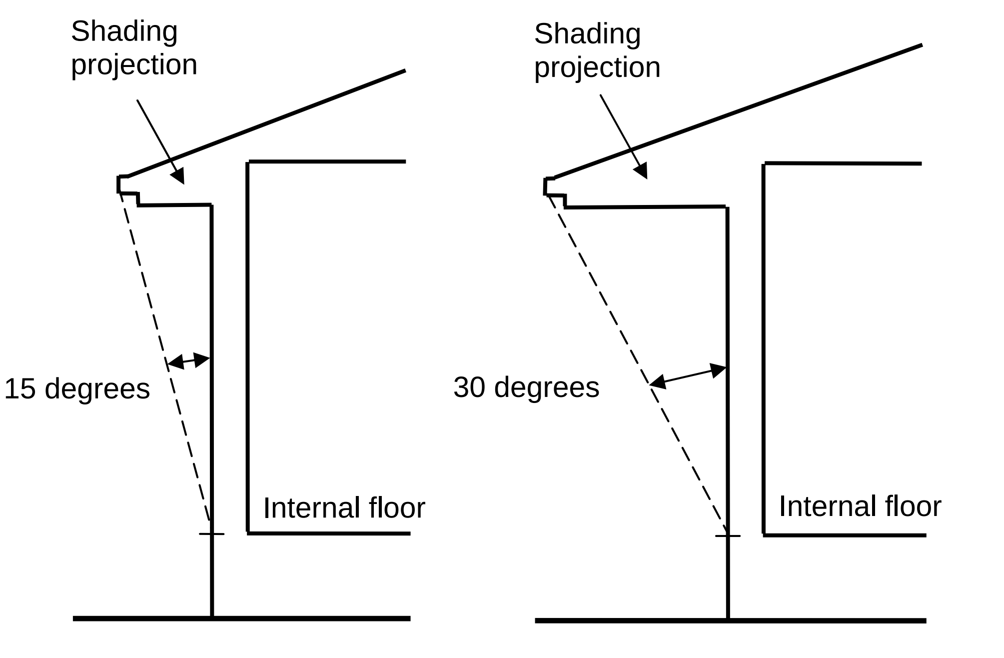
Table J1.5
EXTERNAL WALL OPTIONS

Climate zone	Options for external walls and associated building elements
Class 2, 3, 4 and 9c buildings	
1, 2 and 3	Achieve a minimum *Total R-Value* of 1.4.
	Shade each storey of the building with a verandah, balcony, eaves, carport or the like which intersects an angle of 15 degrees in accordance with Figure J1.5.
	Satisfy 3.12.1.4(b).
4	Achieve a minimum *Total R-Value* of 1.7.
	Achieve a surface density of not less than 220 kg/m^2
	Satisfy 3.12.1.4(b).
5	Achieve a minimum *Total R-Value* of 1.4.
	Achieve a surface density of not less than 220 kg/m^2
	Satisfy 3.12.1.4(b).
6	Achieve a minimum *Total R-Value* of 1.7.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) be constructed on a flooring system that is in direct contact with the ground, such as a concrete slab or the like.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) incorporate insulation with an *R-Value* of not less than 1.0.
	Satisfy 3.12.1.4(b).
7	Achieve a minimum *Total R-Value* of 1.9.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) incorporate insulation with an *R-Value* of not less than 1.0.
	Satisfy 3.12.1.4(b).
8	Achieve a minimum *Total R-Value* of 2.8.
	Satisfy 3.12.1.4(b).

Table J1.5 (Continued) EXTERNAL WALL OPTIONS	
Climate zone	**Options for external walls and associated building elements**
Class 5, 6, 7, 8, 9a and 9b buildings	
1, 3 and 7	Achieve a minimum *Total R-Value* of 1.9.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate insulation with an *R-Value* of not less than 1.0.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate an air gap; and (d) incorporate insulation with an *R-Value* of not less than 0.5.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) incorporate an air gap; and (c) incorporate insulation with an *R-Value* of not less than 1.0.
	Satisfy 3.12.1.4(b).
2 and 5	Achieve a minimum *Total R-Value* of 1.9.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate an air gap.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate insulation with an *R-Value* of not less than 0.5.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) incorporate an air gap; and (c) incorporate insulation with an *R-Value* of not less than 1.0.
	Shade each storey of the building with a verandah, balcony, eaves, carport or the like which intersects and angle of 30 degrees in accordance with Figure J1.5.
	Satisfy 3.12.1.4(b).

Table J1.5 (Continued) EXTERNAL WALL OPTIONS	
Climate zone	**Options for external walls and associated building elements**
Class 5, 6, 7, 8, 9a and 9b buildings	
4	Achieve a minimum *Total R-Value* of 1.9.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate insulation with an *R-Value* of not less than 1.0.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate an air gap; and (d) incorporate insulation with an *R-Value* of not less than 0.5.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) incorporate an air gap; and (c) incorporate insulation with an *R-Value* of not less than 1.0.
	Shade each storey of the building with a verandah, balcony, eaves, carport or the like which intersects an angle of 30 degrees in accordance with Figure J1.5.
	Satisfy 3.12.1.4(b).
6	Achieve a minimum *Total R-Value* of 1.9.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate an air gap.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) all masonry has a thermal conductivity of less than 0.8; and (c) incorporate insulation with an *R-Value* of not less than 0.5.
	(a) Achieve a surface density of not less than 220 kg/m^2; and (b) incorporate an air gap; and (c) incorporate insulation with an *R-Value* of not less than 1.0.
	Satisfy 3.12.1.4(b).
8	Achieve a minimum *Total R-Value* of 2.8.
	Satisfy 3.12.1.4(b).

Figure J1.5
MEASUREMENT OF PROJECTION FOR WALL SHADING



(b) Where the minimum *Total R-Value* specified in (a) cannot be achieved, the deficit may be compensated by the *glazing*, provided the sum of the conductance of the *external walls* and *glazing* is not more than that *required*, where-

(A) the design conductance is calculated-

(aa) for the *external wall*, by dividing its area by its *Total R-Value*; and

(bb) for the *glazing,* by multiplying its area by its *Total U-Value* and the applicable frame factor in Table J2; and

(B) the *required* conductance is calculated-

(aa) for the *external wall*, by dividing its area by its minimum *Total R-Value*; and

(bb) for the *glazing,* in accordance with J2.3(a) or J2.4(a).

(c) Any other wall that is part of the *envelope* must satisfy one of the following:

(i) Satisfy the requirements for an *external wall* that is part of the *envelope*.

(ii) In *climate zones* 6, achieve 50% of the *Total R-Value* specified in Table J1.5.

(iii) In *climate zones* 4, 7 and 8, achieve 50% of the *Total R-Value* specified in Table J1.5 provided each element bounding the adjoining non-*conditioned space* achieves 50% of the *Total R-Value* that would be *required* if it were part of the *envelope*.

(d) The requirements of (c) do not apply in *climate zones* 1, 2, 3 and 5.

(e) Wall construction is deemed to have the thermal properties listed in Specification J1.5.

(f) A metal framed wall that is *required* to achieve a minimum *Total R-Value* and has an external cladding of weatherboards, fibre cement sheet, or similar light weight material attached directly to the metal frame, must have a thermal break-
   (i) installed between the metal frame and the external cladding; and
   (ii) with an *R-Value* of not less than 0.2.

J1.6 Floors

Editorial note: Clause J1.6 is unchanged except for now referencing a new table for the Total R-Values rather than them being specified in text. The new table also includes other Classes of buildings.

(a) A suspended floor that is part of a building's *envelope*-
   (i) with an unenclosed perimeter, must achieve the *Total R-Value* specified in Table J1.6; and
   (ii) with an in-slab heating system, must be insulated around the vertical edge of its perimeter and underneath the slab with insulation having a minimum *R-Value* of not less than 1.0.

Table J1.6
SUSPENDED FLOORS - MINIMUM TOTAL R-VALUE FOR EACH CLIMATE ZONE

Building classification	Climate zone							
	1	2	3	4	5	6	7	8
2, 3, 4 and 9c	Nil					1.0	1.0	2.5
5 to 8, 9a and 9b	1.5	Nil	1.5		Nil	1.5		2.5

PART J2 EXTERNAL GLAZING

Editorial note: Clause J2.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J2.1 Application of Part

Editorial note: Clause J2.1 extends this Part to all buildings likely to be air-conditioned.

The *Deemed-to*-Satisfy *Provisions* of this Part do not apply to a Class 7, 8 and 9b building-

(a) that does not have a *conditioned space*; or

(b) where an *air-conditioning* system needs less than 15 Watts of input power per square metre of the *floor area*.

J2.2 Alternative glazing provisions

Editorial note: There are now two methods for determining glazing compliance.
The text of Clause J2.3 is basically unchanged other than introducing the concept of Total U-Value of the glazing system (glass and frame) and now being designated as Method 1. This clause states to which buildings both clauses apply.

Glazing must be designed and installed-

(a) for a Class 2 or 3 building or Class 4 part, in accordance with J2.3; and

(b) for a Class 6 building with a total *floor area* of not more than 500 m^2, in accordance with J2.3 or J2.4; and

(c) for a Class 6 building with a total *floor area* of more than 500 m^2, in accordance with J2.4.

(c) for a Class 5, 7, 8 and 9 building, in accordance with J2.4.

J2.3 Glazing - Method 1

Editorial note: Clause J2.3 is modified to be designated as Method 1 and it now applies, as an option, to smaller whole Class 6 buildings.

(a) For a Class 2 or 3 building or Class 4 part, the aggregate conductance and solar heat gain of the *glazing* in each *storey* of a *sole-occupancy unit* or public area must not exceed the values obtained by multiplying the floor area of the *sole-occupancy unit* or public area, measured within the enclosing walls, by-

    (i) for conductance, the constant C_U; and

    (ii) for solar heat gain, the constant C_{SHGC},

    obtained from Table J2.3a.

(b) For a Class 6 building, the aggregate conductance and solar heat gain of the *glazing* in each *storey* that forms part of the *envelope* must not exceed the values obtained by multiplying the floor area of the area enclosed by the *envelope*, measured within the enclosing walls, by-

(i) for conductance, the constant C_U; and

(ii) for solar heat gain, the constant C_{SHGC},

obtained from Table J2.3a.

Table J2.3a
CONSTANTS FOR CONDUCTANCE AND SOLAR HEAT GAIN

Climate zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
$\mathbf{C_U}$	2.4	2.5	1.6	1.2	1.9	1.4	1.2	0.7
$\mathbf{C_{SHGC}}$	0.09	0.15	0.10	0.13	0.14	0.19	0.22	0.32

(c) The aggregate conductance and solar heat gain of the *glazing,* as *required* by (a) and (b), must be calculated by adding the conductance and solar heat gain of each *glazing* element in accordance with the following formulae:

(i) For conductance-

$(A_1 x U_1)+(A_2 x U_2)+(A_3 x U_3)+\ldots..$

where-

$A_{1,\,2,\,etc}$ = the area of each *glazing* element; and

$U_{1,\,2,\,etc}$ = the *Total U-Value* of the *glazing* element.

(ii) For solar heat gain-

$(A_1 x \mathit{SHGC}_1 x E_1)+(A_2 x \mathit{SHGC}_2 x E_2)+(A_3 x \mathit{SHGC}_3 x E_3)+\ldots..$

where-

$A_{1,\,2,\,etc}$ = the area of each *glazing* ; and

$\mathit{SHGC}_{1,\,2,\,etc}$ = the *SHGC* of the transparent or translucent element in each *glazing* element; and

$E_{1,\,2,\,etc}$ = the solar exposure factor for each *glazing* element obtained from Table J2.3c.

Table J2.3c
SOLAR EXPOSURE FACTOR (E)

CLIMATE ZONE 1

P/H (refer Figure J2.4)	Orientation Sector (refer Figure J2.3)							
	North	North east	East	South east	South	South west	West	North west
0.00	0.52	0.84	1.29	1.24	0.87	1.27	1.32	0.85
0.05	0.44	0.74	1.19	1.13	0.75	1.17	1.23	0.75
0.10	0.41	0.68	1.11	1.07	0.68	1.09	1.15	0.69
0.15	0.39	0.64	1.06	1.00	0.61	1.02	1.08	0.64
0.20	0.37	0.59	1.01	0.94	0.55	0.94	1.00	0.60
0.25	0.35	0.56	0.95	0.88	0.52	0.89	0.96	0.57
0.30	0.33	0.52	0.90	0.82	0.48	0.85	0.92	0.53
0.35	0.32	0.49	0.84	0.76	0.45	0.80	0.88	0.50
0.40	0.30	0.45	0.79	0.69	0.42	0.75	0.83	0.47
0.50	0.27	0.41	0.72	0.64	0.38	0.67	0.75	0.42
0.60	0.25	0.37	0.66	0.59	0.34	0.60	0.66	0.38
0.70	0.24	0.34	0.59	0.53	0.32	0.56	0.62	0.35
0.80	0.22	0.31	0.53	0.47	0.30	0.52	0.58	0.32
0.90	0.20	0.28	0.49	0.44	0.27	0.48	0.53	0.30
1.00	0.19	0.26	0.45	0.41	0.25	0.43	0.48	0.28
1.10	0.18	0.24	0.41	0.37	0.23	0.41	0.45	0.27
1.20	0.18	0.23	0.37	0.33	0.22	0.39	0.42	0.26
1.30	0.17	0.22	0.35	0.32	0.22	0.36	0.40	0.24
1.40	0.17	0.21	0.32	0.30	0.22	0.32	0.37	0.22
1.50	0.16	0.20	0.30	0.28	0.20	0.31	0.36	0.22
1.60	0.15	0.18	0.28	0.26	0.18	0.29	0.34	0.21
1.70	0.14	0.18	0.28	0.24	0.18	0.29	0.32	0.20
1.80	0.13	0.18	0.27	0.22	0.17	0.28	0.30	0.18
1.90	0.13	0.18	0.25	0.22	0.17	0.26	0.29	0.17
2.00	0.12	0.17	0.23	0.21	0.16	0.24	0.28	0.17

Table J2.3c SOLAR EXPOSURE FACTOR (E) (Continued)								
CLIMATE ZONE 2								
P/H (refer Figure J2.4)	Orientation Sector (refer Figure J2.3)							
	North	North east	East	South east	South	South west	West	North west
0.00	0.72	1.05	1.22	1.04	0.72	1.12	1.34	1.11
0.05	0.60	0.92	1.10	0.92	0.60	1.01	1.23	0.99
0.10	0.55	0.85	1.04	0.86	0.57	0.94	1.14	0.90
0.15	0.51	0.79	0.98	0.81	0.53	0.89	1.07	0.84
0.20	0.47	0.74	0.92	0.76	0.50	0.84	1.00	0.78
0.25	0.45	0.69	0.87	0.72	0.47	0.80	0.96	0.73
0.30	0.43	0.65	0.83	0.68	0.45	0.76	0.92	0.69
0.35	0.41	0.60	0.78	0.65	0.43	0.72	0.87	0.64
0.40	0.39	0.56	0.73	0.61	0.40	0.67	0.83	0.60
0.50	0.36	0.50	0.67	0.55	0.37	0.61	0.75	0.53
0.60	0.33	0.44	0.60	0.49	0.33	0.55	0.67	0.45
0.70	0.31	0.40	0.55	0.45	0.31	0.51	0.62	0.42
0.80	0.29	0.37	0.50	0.41	0.29	0.46	0.58	0.39
0.90	0.27	0.34	0.46	0.38	0.27	0.43	0.52	0.35
1.00	0.26	0.30	0.43	0.35	0.24	0.40	0.47	0.32
1.10	0.24	0.29	0.39	0.33	0.23	0.37	0.44	0.30
1.20	0.23	0.27	0.35	0.30	0.22	0.34	0.41	0.28
1.30	0.22	0.26	0.34	0.29	0.22	0.32	0.39	0.26
1.40	0.21	0.24	0.32	0.28	0.21	0.30	0.36	0.24
1.50	0.20	0.24	0.30	0.26	0.20	0.29	0.33	0.23
1.60	0.19	0.23	0.28	0.25	0.19	0.27	0.31	0.22
1.70	0.18	0.22	0.26	0.23	0.18	0.26	0.29	0.21
1.80	0.17	0.20	0.24	0.22	0.17	0.26	0.28	0.20
1.90	0.17	0.19	0.23	0.21	0.17	0.24	0.27	0.19
2.00	0.17	0.19	0.22	0.21	0.16	0.22	0.27	0.19

Table J2.3c SOLAR EXPOSURE FACTOR (E) (Continued)								
CLIMATE ZONE 3								
P/H (refer Figure J2.4)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.56	1.04	1.42	1.18	0.66	1.16	1.36	1.01
0.05	0.47	0.94	1.32	1.08	0.57	1.05	1.26	0.90
0.10	0.44	0.85	1.25	1.02	0.54	0.99	1.19	0.83
0.15	0.41	0.79	1.17	0.96	0.50	0.93	1.13	0.78
0.20	0.38	0.73	1.10	0.90	0.46	0.87	1.06	0.73
0.25	0.36	0.69	1.05	0.85	0.44	0.83	1.00	0.68
0.30	0.35	0.64	0.99	0.81	0.42	0.79	0.95	0.64
0.35	0.34	0.60	0.93	0.76	0.40	0.75	0.90	0.60
0.40	0.32	0.56	0.88	0.71	0.38	0.72	0.84	0.56
0.50	0.30	0.49	0.81	0.65	0.35	0.64	0.77	0.50
0.60	0.28	0.43	0.74	0.58	0.31	0.57	0.71	0.44
0.70	0.26	0.39	0.67	0.53	0.29	0.53	0.65	0.40
0.80	0.24	0.35	0.59	0.47	0.27	0.50	0.60	0.35
0.90	0.22	0.32	0.54	0.44	0.25	0.46	0.56	0.32
1.00	0.20	0.29	0.50	0.40	0.24	0.43	0.53	0.29
1.10	0.20	0.28	0.46	0.37	0.22	0.40	0.48	0.28
1.20	0.19	0.26	0.42	0.34	0.21	0.37	0.43	0.26
1.30	0.18	0.24	0.39	0.33	0.20	0.35	0.42	0.25
1.40	0.17	0.22	0.35	0.31	0.20	0.32	0.41	0.23
1.50	0.17	0.21	0.34	0.29	0.18	0.32	0.38	0.22
1.60	0.17	0.20	0.33	0.27	0.16	0.31	0.35	0.21
1.70	0.16	0.19	0.31	0.25	0.16	0.29	0.34	0.20
1.80	0.15	0.19	0.30	0.24	0.16	0.28	0.33	0.19
1.90	0.15	0.18	0.28	0.24	0.15	0.26	0.30	0.18
2.00	0.15	0.18	0.25	0.24	0.15	0.24	0.27	0.17

Table J2.3c SOLAR EXPOSURE FACTOR (E) (Continued)								
CLIMATE ZONE 4								
P/H (refer Figure J2.4)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**Sout h**	**South west**	**West**	**North west**
0.00	0.72	1.19	1.40	1.05	0.57	0.99	1.31	1.12
0.05	0.61	1.10	1.31	0.97	0.49	0.91	1.22	1.02
0.10	0.56	1.00	1.24	0.91	0.46	0.85	1.17	0.94
0.15	0.49	0.94	1.18	0.86	0.44	0.81	1.11	0.87
0.20	0.43	0.87	1.12	0.82	0.41	0.76	1.05	0.81
0.25	0.40	0.82	1.07	0.78	0.39	0.73	1.00	0.76
0.30	0.37	0.76	1.02	0.74	0.38	0.69	0.95	0.71
0.35	0.33	0.71	0.97	0.71	0.36	0.66	0.90	0.66
0.40	0.30	0.66	0.92	0.67	0.34	0.62	0.85	0.62
0.50	0.29	0.58	0.83	0.61	0.31	0.58	0.79	0.53
0.60	0.27	0.50	0.74	0.56	0.29	0.53	0.72	0.45
0.70	0.26	0.44	0.68	0.52	0.27	0.49	0.66	0.40
0.80	0.24	0.38	0.63	0.49	0.25	0.45	0.59	0.36
0.90	0.22	0.35	0.59	0.46	0.23	0.42	0.55	0.33
1.00	0.20	0.31	0.55	0.42	0.22	0.39	0.51	0.30
1.10	0.20	0.29	0.50	0.39	0.21	0.37	0.48	0.27
1.20	0.19	0.26	0.46	0.37	0.20	0.35	0.45	0.25
1.30	0.17	0.24	0.43	0.35	0.18	0.34	0.41	0.23
1.40	0.16	0.23	0.39	0.34	0.17	0.33	0.38	0.21
1.50	0.16	0.21	0.38	0.32	0.17	0.31	0.35	0.21
1.60	0.16	0.20	0.38	0.30	0.16	0.29	0.33	0.20
1.70	0.15	0.19	0.35	0.29	0.15	0.27	0.32	0.18
1.80	0.14	0.18	0.32	0.27	0.14	0.25	0.32	0.17
1.90	0.14	0.17	0.30	0.25	0.14	0.24	0.29	0.16
2.00	0.13	0.17	0.28	0.23	0.14	0.24	0.26	0.16

Table J2.3c SOLAR EXPOSURE FACTOR (E) (Continued)								
CLIMATE ZONE 5								
P/H (refer Figure J2.4)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.82	1.09	1.19	0.96	0.68	1.04	1.30	1.16
0.05	0.69	0.96	1.07	0.85	0.57	0.92	1.19	1.04
0.10	0.63	0.88	1.01	0.79	0.54	0.86	1.11	0.94
0.15	0.57	0.82	0.95	0.75	0.51	0.81	1.05	0.88
0.20	0.51	0.76	0.89	0.70	0.48	0.76	0.99	0.83
0.25	0.48	0.72	0.85	0.67	0.46	0.72	0.95	0.77
0.30	0.45	0.67	0.80	0.64	0.43	0.69	0.90	0.72
0.35	0.42	0.63	0.76	0.60	0.41	0.65	0.85	0.67
0.40	0.39	0.58	0.71	0.57	0.38	0.62	0.81	0.62
0.50	0.37	0.52	0.65	0.52	0.36	0.56	0.73	0.55
0.60	0.35	0.46	0.58	0.47	0.33	0.51	0.65	0.48
0.70	0.32	0.42	0.54	0.43	0.31	0.47	0.59	0.44
0.80	0.30	0.37	0.50	0.40	0.28	0.43	0.52	0.40
0.90	0.28	0.34	0.46	0.37	0.26	0.40	0.49	0.35
1.00	0.26	0.31	0.42	0.34	0.25	0.37	0.46	0.31
1.10	0.25	0.28	0.39	0.32	0.23	0.35	0.43	0.29
1.20	0.24	0.26	0.36	0.30	0.22	0.33	0.40	0.27
1.30	0.23	0.25	0.34	0.28	0.21	0.31	0.37	0.26
1.40	0.21	0.23	0.32	0.27	0.20	0.29	0.34	0.24
1.50	0.21	0.22	0.30	0.25	0.19	0.28	0.32	0.23
1.60	0.20	0.22	0.29	0.23	0.18	0.27	0.30	0.21
1.70	0.19	0.21	0.27	0.22	0.18	0.25	0.29	0.20
1.80	0.18	0.20	0.25	0.21	0.17	0.23	0.27	0.20
1.90	0.18	0.19	0.24	0.21	0.17	0.22	0.26	0.19
2.00	0.17	0.17	0.24	0.21	0.16	0.21	0.25	0.19

Table J2.3c
SOLAR EXPOSURE FACTOR (E) (Continued)

CLIMATE ZONE 6

P/H (refer Figure J2.4)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.84	1.08	1.15	0.87	0.61	1.05	1.40	1.24
0.05	0.71	0.97	1.05	0.78	0.52	0.96	1.30	1.13
0.10	0.65	0.90	0.99	0.74	0.49	0.91	1.25	1.04
0.15	0.58	0.83	0.93	0.69	0.47	0.86	1.18	0.97
0.20	0.52	0.77	0.88	0.65	0.44	0.82	1.12	0.91
0.25	0.48	0.72	0.84	0.62	0.42	0.78	1.06	0.85
0.30	0.44	0.68	0.80	0.59	0.40	0.75	1.01	0.80
0.35	0.40	0.63	0.75	0.57	0.38	0.71	0.95	0.75
0.40	0.36	0.58	0.71	0.54	0.36	0.67	0.90	0.69
0.50	0.33	0.51	0.66	0.49	0.33	0.63	0.83	0.60
0.60	0.30	0.43	0.61	0.45	0.31	0.58	0.76	0.51
0.70	0.28	0.39	0.56	0.42	0.29	0.54	0.71	0.45
0.80	0.26	0.35	0.50	0.38	0.26	0.50	0.66	0.40
0.90	0.24	0.32	0.46	0.35	0.25	0.46	0.61	0.38
1.00	0.22	0.29	0.42	0.32	0.23	0.42	0.56	0.36
1.10	0.21	0.26	0.40	0.30	0.23	0.41	0.52	0.32
1.20	0.20	0.24	0.37	0.29	0.23	0.39	0.48	0.29
1.30	0.19	0.23	0.34	0.27	0.21	0.36	0.45	0.27
1.40	0.18	0.22	0.32	0.26	0.19	0.34	0.42	0.26
1.50	0.17	0.21	0.30	0.25	0.19	0.32	0.40	0.24
1.60	0.16	0.19	0.28	0.24	0.18	0.31	0.38	0.21
1.70	0.16	0.19	0.27	0.23	0.18	0.29	0.36	0.20
1.80	0.15	0.18	0.26	0.22	0.17	0.28	0.34	0.20
1.90	0.15	0.18	0.25	0.21	0.17	0.27	0.32	0.19
2.00	0.14	0.17	0.24	0.21	0.17	0.26	0.31	0.17

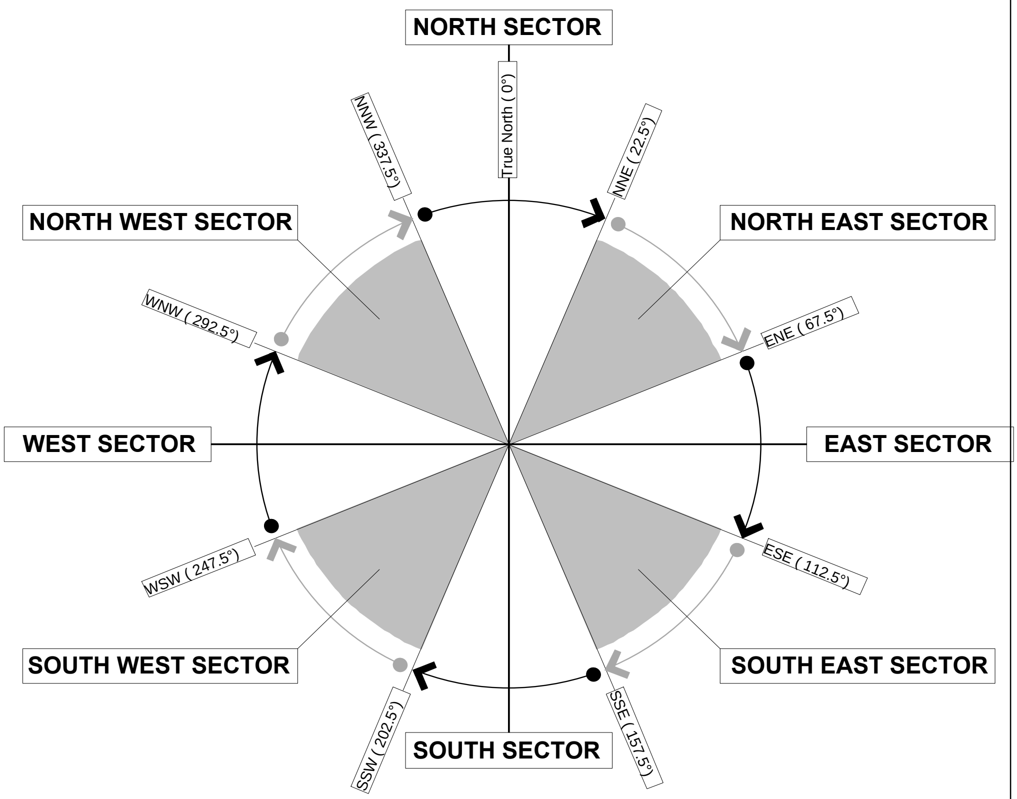
Table J2.3c SOLAR EXPOSURE FACTOR (E) (Continued)								
CLIMATE ZONE 7								
P/H (refer Figure J2.4)	Orientation Sector (refer Figure J2.3)							
	North	North east	East	South east	South	South west	West	North west
0.00	0.96	1.17	1.21	0.94	0.64	0.91	1.19	1.18
0.05	0.83	1.05	1.10	0.83	0.54	0.81	1.09	1.07
0.10	0.76	0.97	1.04	0.80	0.51	0.76	1.03	0.98
0.15	0.69	0.91	0.98	0.75	0.48	0.72	0.97	0.92
0.20	0.62	0.85	0.93	0.70	0.45	0.68	0.91	0.86
0.25	0.56	0.80	0.89	0.67	0.43	0.65	0.87	0.81
0.30	0.51	0.75	0.84	0.64	0.41	0.62	0.82	0.75
0.35	0.46	0.70	0.80	0.61	0.40	0.59	0.78	0.69
0.40	0.40	0.65	0.76	0.58	0.38	0.55	0.74	0.64
0.50	0.36	0.58	0.71	0.54	0.35	0.51	0.69	0.57
0.60	0.32	0.51	0.65	0.50	0.33	0.47	0.63	0.51
0.70	0.30	0.45	0.60	0.47	0.30	0.44	0.58	0.45
0.80	0.28	0.40	0.54	0.44	0.28	0.41	0.53	0.40
0.90	0.26	0.36	0.51	0.41	0.27	0.38	0.48	0.36
1.00	0.25	0.33	0.48	0.37	0.25	0.35	0.44	0.32
1.10	0.24	0.30	0.45	0.36	0.24	0.33	0.41	0.29
1.20	0.22	0.28	0.41	0.34	0.23	0.31	0.38	0.27
1.30	0.21	0.26	0.39	0.32	0.22	0.30	0.36	0.25
1.40	0.19	0.23	0.36	0.30	0.21	0.28	0.33	0.24
1.50	0.19	0.22	0.34	0.29	0.20	0.27	0.32	0.22
1.60	0.18	0.21	0.33	0.27	0.20	0.26	0.31	0.21
1.70	0.18	0.20	0.30	0.26	0.19	0.25	0.29	0.20
1.80	0.17	0.20	0.28	0.24	0.18	0.24	0.27	0.19
1.90	0.17	0.19	0.27	0.24	0.18	0.22	0.26	0.18
2.00	0.16	0.19	0.27	0.23	0.18	0.21	0.25	0.18

Table J2.3c SOLAR EXPOSURE FACTOR (E) (Continued)								
CLIMATE ZONE 8								
P/H (refer Figure J2.4)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	0.85	1.12	1.20	0.96	0.68	1.01	1.27	1.16
0.05	0.71	0.99	1.09	0.85	0.57	0.90	1.16	1.04
0.10	0.65	0.90	1.02	0.79	0.54	0.84	1.09	0.95
0.15	0.59	0.85	0.96	0.75	0.51	0.78	1.04	0.89
0.20	0.52	0.79	0.90	0.70	0.48	0.73	0.98	0.83
0.25	0.49	0.74	0.86	0.67	0.45	0.70	0.93	0.78
0.30	0.45	0.70	0.82	0.64	0.43	0.67	0.88	0.73
0.35	0.42	0.65	0.77	0.61	0.41	0.64	0.84	0.68
0.40	0.39	0.60	0.73	0.57	0.39	0.61	0.79	0.63
0.50	0.36	0.53	0.67	0.53	0.36	0.56	0.73	0.56
0.60	0.34	0.46	0.60	0.48	0.33	0.50	0.66	0.49
0.70	0.32	0.41	0.55	0.45	0.31	0.47	0.60	0.44
0.80	0.30	0.37	0.50	0.41	0.29	0.43	0.53	0.40
0.90	0.28	0.33	0.46	0.38	0.27	0.40	0.50	0.36
1.00	0.25	0.30	0.42	0.35	0.25	0.37	0.47	0.33
1.10	0.24	0.29	0.40	0.33	0.24	0.35	0.43	0.29
1.20	0.23	0.28	0.37	0.31	0.23	0.33	0.39	0.26
1.30	0.22	0.26	0.35	0.30	0.22	0.31	0.37	0.25
1.40	0.21	0.23	0.32	0.29	0.20	0.29	0.34	0.24
1.50	0.20	0.22	0.31	0.27	0.19	0.27	0.32	0.23
1.60	0.20	0.21	0.30	0.25	0.18	0.25	0.31	0.22
1.70	0.19	0.21	0.28	0.23	0.18	0.24	0.29	0.21
1.80	0.19	0.20	0.25	0.22	0.17	0.23	0.28	0.20
1.90	0.17	0.19	0.24	0.22	0.16	0.23	0.26	0.19
2.00	0.16	0.18	0.23	0.21	0.16	0.22	0.24	0.19

Notes:

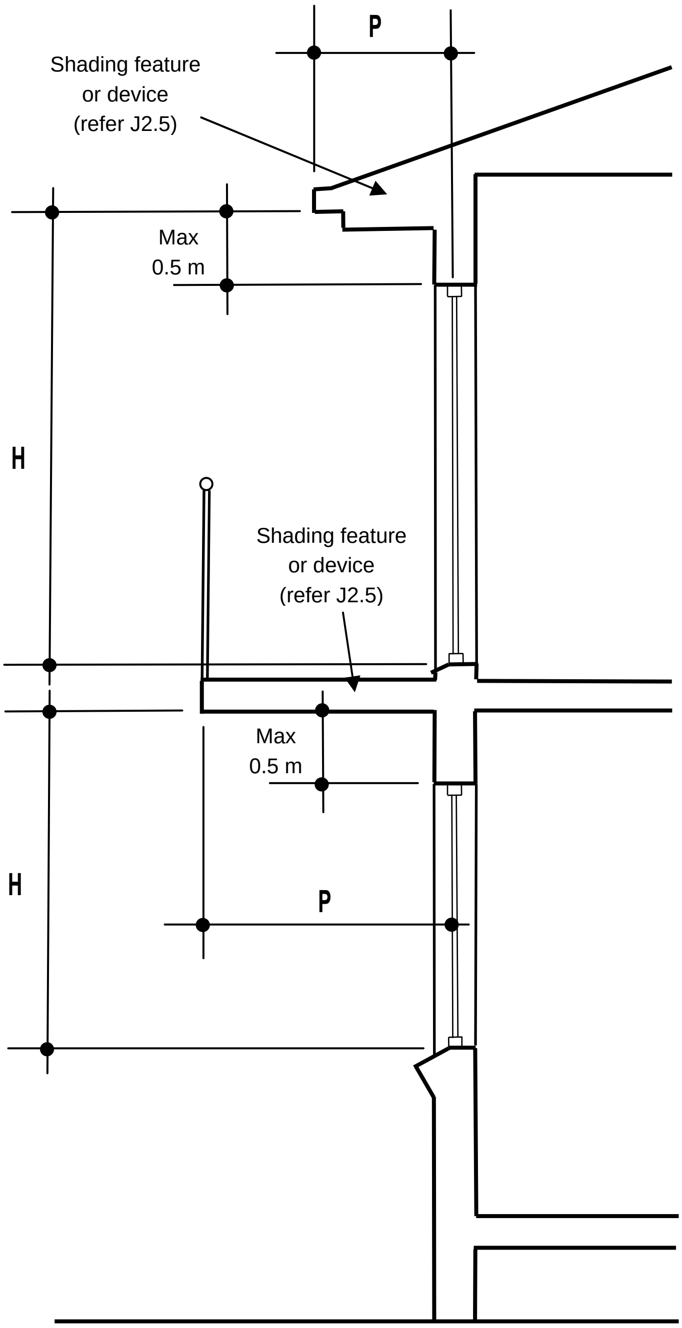
1. The orientation sector of the *glazing* is based on True North.
2. Exposure factors for P/H values between those shown in the Table can be interpolated.

Figure J2.3
ORIENTATION SECTORS



Note:
A building wall, including the *glazing* it contains, is considered to face north if it faces any direction in the north orientation sector of Figure J2.3. The orientation of other walls, including the *glazing* they contain, are determined in a similar way.

Figure J2.4
METHOD OF MEASURING P AND H



Note:
An adjustable shading device that is capable of completely covering the *glazing* may be considered to achieve a P/H value of 2.

J2.4 Glazing - Method 2

Editorial note: Clause J2.4 is proposed for large commercial buildings that are likely to be air-conditioned.

(a) the aggregated *air-conditioning* energy factor resulting from the thermal load through the *glazing* of each orientation of each *storey* of a building must not exceed the allowance obtained by multiplying the facade area for each orientation, by the energy index for the *climate zone* obtained from Table J2.4a.

Table J2.4a
ENERGY INDEX

Climate zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Energy index	0.283	0.284	0.284	0.320	0.260	0.326	0.317	0.315

(b) The aggregated *air-conditioning* energy factor resulting from the thermal load through the *glazing* of each orientation of each *storey* of a building is the sum of the *air-conditioning* energy factors resulting from the thermal loads through each *glazing* element calculated in accordance with the following formula:

$A_1 (C_A + SHGC_1 [C_B \times S_{H1} + C_C \times S_{C1}] + C_D \times U_{1)}$

where-

A_1 = the area of the *glazing* element 1; and

$C_{A, B, C \& D}$ = the energy constants A, B, C and D for the specific orientation from Table J2.3b; and

$SHGC_1$ = the SHGC of the transparent and translucent element in the *glazing* system; and

S_{H1} & S_{C1} = the heating shading multiplier and cooling shading multiplier for the *glazing* element 1 obtained from Table 2.4c and 2.4d respectively; and

U_1 = the *Total* U-Value of *glazing* element 1.

Table J2.4b
ENERGY CONSTANTS (C_A , C_B , C_C and C_D)

Climate zone	Energy constants C_A, C_B, C_C and C_D	Orientation Sector (refer Figure J2.3)							
		North	North east	East	South east	South	South west	West	North west
1	C_A	0.30	0.33	0.34	0.29	0.23	0.30	0.35	0.34
	C_B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C_C	0.83	0.95	0.94	0.70	0.51	0.70	0.91	0.94
	C_D	0.01	0.0	0.0	0.01	0.01	0.01	0.0	0.0
2	C_A	0.25	0.29	0.29	0.21	0.15	0.19	0.24	0.26
	C_B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C_C	1.19	1.38	1.30	0.84	0.47	0.69	1.02	1.15
	C_D	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.02	-0.02
3	C_A	0.24	0.26	0.26	0.20	0.14	0.21	0.27	0.28
	C_B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	C_C	1.03	1.17	1.10	0.71	0.43	0.69	1.03	1.10
	C_D	0.0	-0.01	0.0	0.0	0.01	0.0	0.0	-0.01
4	C_A	0.21	0.23	0.27	0.36	0.35	0.36	0.30	0.25
	C_B	-0.12	-0.15	-0.22	-0.29	-0.27	-0.31	-0.30	-0.20
	C_C	1.22	1.33	1.15	0.67	0.35	0.59	0.96	1.16
	C_D	-0.01	-0.01	0.01	0.05	0.07	0.06	0.03	0
5	C_A	0.22	0.25	0.26	0.29	0.28	0.28	0.26	0.24
	C_B	-0.05	-0.07	-0.14	-0.30	-0.31	-0.31	-0.22	-0.11
	C_C	1.41	1.51	1.29	0.73	0.39	0.66	1.09	1.33
	C_D	-0.03	-0.02	-0.01	0.03	0.05	0.04	0.0	-0.02
6	C_A	0.22	0.24	0.30	0.41	0.45	0.42	0.35	0.30
	C_B	-0.29	-0.29	-0.45	-0.57	-0.55	-0.62	-0.63	-0.47
	C_C	1.43	1.56	1.31	0.75	0.34	0.61	1.00	1.25
	C_D	-0.02	-0.02	0.02	0.08	0.11	0.09	0.06	0.01
7	C_A	0.19	0.23	0.34	0.52	0.54	0.55	0.43	0.30
	C_B	-0.30	-0.33	-0.53	-0.48	-0.41	-0.54	-0.66	-0.54
	C_C	1.23	1.30	1.03	0.56	0.23	0.44	0.76	1.02
	C_D	0.0	0.0	0.04	0.10	0.12	0.11	0.08	0.04
8	C_A	0.36	0.40	0.55	0.68	0.77	0.72	0.58	0.45
	C_B	-0.63	-0.58	-0.48	-0.27	-0.34	-0.37	-0.55	-0.65
	C_C	0.50	0.55	0.48	0.25	0.09	0.23	0.42	0.49
	C_D	0.10	0.09	0.10	0.12	0.15	0.14	0.17	0.11

Table J2.4c HEATING SHADING MULTIPLIER (S_H)								
CLIMATE ZONE 4 AND 5								
P/H (refer to Figure J2.3)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	1.0	1.0	1.00	1.0	1.0	1.0	1.0	1.0
0.05	0.99	0.99	0.98	0.97	0.98	0.97	0.98	0.99
0.10	0.98	0.97	0.96	0.93	0.95	0.95	0.96	0.98
0.15	0.97	0.96	0.93	0.90	0.93	0.92	0.94	0.97
0.20	0.96	0.94	0.90	0.86	0.91	0.89	0.91	0.95
0.25	0.94	0.91	0.87	0.82	0.88	0.86	0.88	0.92
0.30	0.92	0.89	0.83	0.78	0.85	0.82	0.84	0.90
0.35	0.89	0.86	0.80	0.73	0.82	0.79	0.81	0.88
0.40	0.86	0.82	0.75	0.70	0.80	0.76	0.77	0.84
0.50	0.79	0.74	0.67	0.63	0.76	0.69	0.69	0.78
0.60	0.65	0.63	0.57	0.57	0.72	0.63	0.60	0.68
0.70	0.50	0.51	0.46	0.51	0.68	0.58	0.51	0.58
0.80	0.30	0.37	0.35	0.47	0.65	0.53	0.42	0.44
0.90	0.14	0.22	0.23	0.43	0.63	0.48	0.33	0.29
1.00	0.00	0.06	0.11	0.39	0.60	0.44	0.25	0.12
1.10	0.00	0.02	0.05	0.36	0.58	0.40	0.17	0.06
1.20	0.0	0.0	0.0	0.33	0.56	0.36	0.10	0.01
1.30	0.0	0.0	0.0	0.29	0.54	0.33	0.05	0.0
1.40	0.0	0.0	0.0	0.27	0.53	0.30	0.03	0.0
1.50	0.0	0.0	0.0	0.25	0.52	0.27	0.02	0.0
1.60	0.0	0.0	0.0	0.23	0.50	0.25	0.02	0.0
1.70	0.0	0.0	0.0	0.21	0.49	0.22	0.01	0.0
1.80	0.0	0.0	0.0	0.19	0.48	0.20	0.01	0.0
1.90	0.0	0.0	0.0	0.16	0.47	0.17	0.00	0.0
2.00	0.0	0.0	0.0	0.14	0.46	0.15	0.00	0.0

Table J2.4c HEATING SHADING MULTIPLIER (S_H) Continued								
CLIMATE ZONE 6 AND 7								
P/H (refer to Figure J2.3)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.0
0.05	0.99	0.98	0.97	0.96	0.97	0.97	0.97	0.98
0.10	0.98	0.97	0.95	0.93	0.95	0.94	0.95	0.97
0.15	0.97	0.95	0.92	0.89	0.92	0.91	0.92	0.95
0.20	0.94	0.93	0.89	0.85	0.89	0.87	0.88	0.92
0.25	0.92	0.90	0.85	0.81	0.86	0.83	0.84	0.89
0.30	0.89	0.87	0.81	0.77	0.83	0.79	0.80	0.86
0.35	0.86	0.84	0.77	0.73	0.80	0.75	0.75	0.82
0.40	0.82	0.80	0.73	0.69	0.77	0.71	0.71	0.77
0.50	0.77	0.76	0.69	0.65	0.75	0.68	0.67	0.73
0.60	0.73	0.72	0.65	0.62	0.72	0.64	0.62	0.69
0.70	0.66	0.67	0.61	0.59	0.69	0.61	0.58	0.63
0.80	0.60	0.63	0.56	0.56	0.67	0.57	0.53	0.58
0.90	0.53	0.58	0.51	0.53	0.64	0.54	0.49	0.52
1.00	0.45	0.53	0.47	0.50	0.62	0.51	0.45	0.46
1.10	0.37	0.47	0.42	0.48	0.60	0.48	0.41	0.40
1.20	0.29	0.41	0.38	0.46	0.58	0.45	0.37	0.34
1.30	0.21	0.36	0.33	0.43	0.56	0.42	0.33	0.27
1.40	0.14	0.29	0.29	0.41	0.54	0.40	0.30	0.21
1.50	0.07	0.23	0.25	0.39	0.52	0.38	0.26	0.14
1.60	0.0	0.16	0.21	0.38	0.50	0.35	0.22	0.08
1.70	0.0	0.11	0.17	0.36	0.49	0.33	0.19	0.06
1.80	0.0	0.07	0.13	0.34	0.47	0.31	0.15	0.03
1.90	0.0	0.02	0.10	0.32	0.46	0.29	0.11	0.01
2.00	0.0	0.0	0.07	0.31	0.44	0.27	0.08	0.0

Table J2.4c HEATING SHADING MULTIPLIER (S_H) Continued								
CLIMATE ZONE 8								
P/H (refer to Figure J2.3)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.05	0.97	0.97	0.96	0.96	0.96	0.95	0.97	0.97
0.10	0.94	0.95	0.93	0.91	0.93	0.91	0.94	0.94
0.15	0.91	0.92	0.89	0.87	0.89	0.86	0.91	0.91
0.20	0.87	0.88	0.84	0.84	0.85	0.81	0.87	0.87
0.25	0.81	0.83	0.79	0.81	0.81	0.76	0.83	0.82
0.30	0.76	0.79	0.73	0.79	0.76	0.72	0.79	0.78
0.35	0.70	0.74	0.68	0.77	0.72	0.67	0.74	0.73
0.40	0.64	0.69	0.65	0.75	0.68	0.61	0.69	0.69
0.50	0.58	0.64	0.61	0.73	0.64	0.56	0.64	0.64
0.60	0.52	0.59	0.57	0.71	0.60	0.51	0.60	0.59
0.70	0.46	0.55	0.54	0.67	0.57	0.47	0.55	0.53
0.80	0.40	0.50	0.51	0.62	0.53	0.44	0.50	0.48
0.90	0.35	0.45	0.47	0.57	0.50	0.41	0.45	0.42
1.00	0.29	0.41	0.45	0.53	0.46	0.38	0.41	0.37
1.10	0.23	0.36	0.42	0.48	0.43	0.36	0.38	0.33
1.20	0.17	0.32	0.40	0.44	0.40	0.34	0.34	0.28
1.30	0.12	0.27	0.38	0.40	0.38	0.32	0.30	0.24
1.40	0.08	0.22	0.35	0.35	0.35	0.31	0.27	0.20
1.50	0.04	0.17	0.32	0.31	0.33	0.29	0.24	0.16
1.60	0.0	0.12	0.29	0.27	0.30	0.28	0.20	0.13
1.70	0.0	0.09	0.25	0.23	0.28	0.27	0.18	0.10
1.80	0.0	0.05	0.22	0.19	0.26	0.26	0.15	0.07
1.90	0.0	0.01	0.18	0.15	0.24	0.25	0.13	0.04
2.00	0.0	0.0	0.15	0.11	0.22	0.24	0.11	0.03

Notes:

1. The orientation sector of the glazing is based on True North.
2. Exposure factors for P/H values between those shown in the Table can be interpolated.
3. The heating shade multipliers for climate zones 1, 2 and 3 are 0.

Table J2.4d
COOLING SHADING MULTIPLIER (S_C)

CLIMATE ZONE 1, 2 AND 3

P/H (refer to Figure J2.3)	Orientation Sector (refer Figure J2.3)							
	North	North east	East	South east	South	South west	West	North west
0.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.05	0.95	0.96	0.97	0.97	0.97	0.97	0.97	0.96
0.10	0.90	0.93	0.94	0.93	0.94	0.94	0.94	0.92
0.15	0.85	0.89	0.9	0.9	0.9	0.91	0.91	0.89
0.20	0.80	0.85	0.87	0.86	0.87	0.87	0.87	0.85
0.25	0.74	0.8	0.83	0.82	0.85	0.84	0.83	0.8
0.30	0.69	0.76	0.79	0.78	0.82	0.81	0.80	0.76
0.35	0.63	0.72	0.75	0.75	0.8	0.77	0.76	0.72
0.40	0.59	0.68	0.72	0.71	0.77	0.75	0.73	0.68
0.50	0.54	0.64	0.69	0.68	0.75	0.72	0.7	0.64
0.60	0.49	0.6	0.65	0.65	0.73	0.69	0.67	0.61
0.70	0.46	0.57	0.63	0.63	0.72	0.67	0.64	0.58
0.80	0.44	0.54	0.60	0.60	0.70	0.64	0.61	0.55
0.90	0.41	0.51	0.57	0.58	0.68	0.62	0.59	0.52
1.00	0.39	0.48	0.54	0.55	0.67	0.60	0.56	0.49
1.10	0.37	0.46	0.52	0.53	0.66	0.58	0.54	0.47
1.20	0.35	0.43	0.5	0.51	0.65	0.57	0.52	0.45
1.30	0.33	0.41	0.47	0.50	0.64	0.55	0.50	0.43
1.40	0.32	0.39	0.45	0.48	0.63	0.54	0.48	0.41
1.50	0.31	0.37	0.44	0.47	0.62	0.52	0.47	0.39
1.60	0.29	0.35	0.42	0.45	0.61	0.51	0.45	0.38
1.70	0.28	0.34	0.40	0.44	0.61	0.50	0.44	0.36
1.80	0.28	0.33	0.39	0.43	0.6	0.48	0.42	0.35
1.90	0.27	0.32	0.37	0.42	0.59	0.47	0.41	0.34
2.00	0.26	0.31	0.36	0.41	0.59	0.46	0.4	0.32

Table J2.4d COOLING SHADING MULTIPLIER (S_C) Continued								
CLIMATE ZONE 4 AND 5								
P/H (refer to Figure J2.3)	**Orientation Sector (refer Figure J2.3)**							
	North	**North east**	**East**	**South east**	**South**	**South west**	**West**	**North west**
0.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.05	0.95	0.96	0.97	0.97	0.98	0.97	0.97	0.96
0.10	0.91	0.93	0.94	0.93	0.95	0.94	0.94	0.92
0.15	0.86	0.89	0.9	0.9	0.93	0.91	0.91	0.89
0.20	0.81	0.85	0.87	0.87	0.9	0.88	0.87	0.84
0.25	0.76	0.8	0.83	0.83	0.88	0.84	0.83	0.8
0.30	0.70	0.76	0.79	0.79	0.85	0.81	0.79	0.75
0.35	0.65	0.72	0.75	0.76	0.83	0.78	0.75	0.70
0.40	0.61	0.68	0.72	0.72	0.81	0.75	0.72	0.67
0.50	0.57	0.64	0.68	0.69	0.79	0.72	0.69	0.63
0.60	0.53	0.60	0.65	0.66	0.77	0.69	0.66	0.59
0.70	0.49	0.57	0.62	0.64	0.75	0.67	0.63	0.56
0.80	0.46	0.54	0.59	0.61	0.74	0.65	0.60	0.52
0.90	0.42	0.5	0.57	0.59	0.72	0.62	0.57	0.49
1.00	0.39	0.48	0.54	0.57	0.71	0.6	0.55	0.47
1.10	0.37	0.45	0.52	0.55	0.70	0.59	0.53	0.44
1.20	0.34	0.43	0.50	0.53	0.68	0.57	0.51	0.42
1.30	0.32	0.40	0.48	0.52	0.67	0.55	0.49	0.40
1.40	0.31	0.38	0.46	0.50	0.66	0.54	0.47	0.38
1.50	0.29	0.36	0.44	0.49	0.65	0.52	0.45	0.36
1.60	0.28	0.34	0.42	0.48	0.64	0.51	0.44	0.34
1.70	0.27	0.33	0.41	0.47	0.64	0.50	0.42	0.33
1.80	0.26	0.32	0.40	0.46	0.63	0.48	0.41	0.32
1.90	0.25	0.30	0.38	0.44	0.62	0.47	0.40	0.30
2.00	0.24	0.29	0.37	0.43	0.62	0.46	0.38	0.29

Table J2.4d
COOLING SHADING MULTIPLIER (S_C) Continued

CLIMATE ZONE 6 AND 7

P/H (refer to Figure J2.3)	Orientation Sector (refer Figure J2.3)							
	North	North east	East	South east	South	South west	West	North west
0.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.05	0.95	0.96	0.97	0.97	0.97	0.97	0.97	0.96
0.10	0.91	0.93	0.93	0.93	0.94	0.94	0.93	0.92
0.20	0.86	0.89	0.90	0.90	0.92	0.90	0.90	0.88
0.25	0.81	0.85	0.86	0.87	0.89	0.87	0.86	0.84
0.30	0.76	0.81	0.82	0.83	0.86	0.83	0.82	0.79
0.35	0.70	0.76	0.78	0.79	0.83	0.80	0.78	0.74
0.40	0.66	0.72	0.75	0.76	0.81	0.76	0.74	0.70
0.50	0.61	0.68	0.71	0.73	0.79	0.73	0.71	0.66
0.60	0.57	0.64	0.68	0.70	0.76	0.70	0.68	0.62
0.70	0.53	0.60	0.65	0.67	0.74	0.68	0.65	0.58
0.80	0.50	0.57	0.62	0.64	0.73	0.65	0.62	0.55
0.90	0.47	0.54	0.59	0.62	0.71	0.63	0.59	0.52
1.00	0.44	0.51	0.56	0.59	0.69	0.61	0.56	0.49
1.10	0.42	0.48	0.54	0.57	0.68	0.59	0.54	0.46
1.20	0.40	0.46	0.52	0.56	0.67	0.57	0.52	0.44
1.30	0.38	0.44	0.50	0.54	0.66	0.55	0.50	0.42
1.40	0.36	0.41	0.48	0.52	0.64	0.53	0.48	0.40
1.50	0.35	0.40	0.46	0.51	0.64	0.52	0.46	0.38
1.60	0.33	0.38	0.44	0.5	0.63	0.51	0.45	0.37
1.70	0.32	0.36	0.43	0.49	0.62	0.49	0.43	0.36
1.80	0.31	0.35	0.41	0.48	0.61	0.48	0.42	0.35
1.90	0.31	0.34	0.40	0.47	0.60	0.47	0.41	0.34
2.00	0.30	0.33	0.39	0.46	0.60	0.46	0.39	0.33

Table J2.4d COOLING SHADING MULTIPLIER (S_C) Continued								
CLIMATE ZONE 8								
P/H (refer to Figure J2.3)	Orientation Sector (refer Figure J2.3)							
	North	North east	East	South east	South	South west	West	North west
0.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0.05	0.94	0.96	0.96	0.96	0.96	0.96	0.96	0.96
0.10	0.88	0.91	0.93	0.92	0.93	0.93	0.93	0.91
0.15	0.82	0.87	0.89	0.88	0.89	0.89	0.89	0.87
0.20	0.76	0.82	0.85	0.84	0.85	0.85	0.85	0.82
0.25	0.70	0.77	0.80	0.80	0.82	0.81	0.81	0.77
0.30	0.64	0.71	0.76	0.75	0.78	0.77	0.77	0.72
0.35	0.59	0.67	0.72	0.71	0.75	0.73	0.73	0.67
0.40	0.55	0.63	0.68	0.68	0.73	0.70	0.69	0.63
0.50	0.51	0.59	0.65	0.65	0.7	0.67	0.66	0.59
0.60	0.47	0.55	0.61	0.62	0.68	0.64	0.63	0.55
0.70	0.45	0.52	0.58	0.60	0.66	0.62	0.6	0.52
0.80	0.43	0.49	0.55	0.58	0.64	0.60	0.57	0.5
0.90	0.41	0.46	0.53	0.55	0.62	0.57	0.55	0.47
1.00	0.40	0.44	0.50	0.54	0.61	0.55	0.52	0.45
1.10	0.39	0.42	0.48	0.52	0.60	0.54	0.51	0.43
1.20	0.39	0.4	0.46	0.51	0.59	0.52	0.49	0.41
1.30	0.38	0.39	0.45	0.49	0.57	0.5	0.47	0.40
1.40	0.38	0.38	0.43	0.48	0.57	0.49	0.45	0.39
1.50	0.37	0.37	0.42	0.47	0.56	0.48	0.44	0.38
1.60	0.37	0.36	0.41	0.46	0.55	0.47	0.43	0.37
1.70	0.37	0.36	0.40	0.46	0.54	0.46	0.42	0.36
1.80	0.37	0.35	0.39	0.45	0.54	0.45	0.41	0.35
1.90	0.37	0.35	0.38	0.44	0.53	0.44	0.40	0.35
2.00	0.37	0.34	0.37	0.44	0.53	0.44	0.39	0.34

Notes:

1. Exposure factors for P/H values between those shown in the Table can be interpolated.
2. An adjustable shading device that is capable of completely covering the glazing may be considered to achieve a P/H value of 2.

J2.5 Shading

Editorial note: Clause J2.5 is already in the BCA and reproduced here for information.

Where shading is *required* to comply with J2.3, it must-

(a) be provided by a permanent feature, such as a verandah, balcony, fixed canopy, eaves or shading hood, which-
   (i) extends horizontally on both sides of the *glazing* for the same projection distance P in Figure J2.4; or
   (ii) provides the equivalent shading with a reveal or other shading element; or

(b) be provided by a shading device, such as a shutter, blind, vertical or horizontal building screen with blades, battens or slats, which-
   (i) is capable of restricting at least 80% of summer solar radiation; and
   (ii) if adjustable, is readily operated either manually, mechanically or electronically by the building occupants.

PART J3 BUILDING SEALING

Editorial note: Clause J3.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J3.1 Application of Part

Editorial note: Clause J3.1 extends this Part to all commercial buildings likely to be air-conditioned.

The *Deemed-to-Satisfy Provisions* of this Part do not apply to-

(a) a building in *climate zones* 1, 2, 3 and 5 where the only means of *air-conditioning* is by using an evaporative cooler; and

(b) for a building *ventilation opening* that is necessary for the safe operation of a gas appliance; and

(c) a Class 7, 8 and 9b building-
  - (i) that does not have a *conditioned space*; and
  - (ii) where an *air-conditioning* system needs less than 15 Watts of input power per square metre of the *floor area*.

Editorial note: Clauses J3.2, J3.3, J3.4 and 3.5 are already in the BCA and are reproduced here for information.

J3.2 Chimneys and flues

The chimney or flue of an open solid-fuel burning appliance must be provided with a damper or flap that can be closed to seal the chimney or flue.

J3.3 Roof lights

(a) A *roof light* must be sealed, or capable of being sealed, in accordance with (b) to minimise air leakage when serving-
  - (i) a *conditioned space*; or
  - (ii) a *habitable room* in *climate zones* 4, 6, 7 and 8.

(b) A *roof light required* by (a) to be sealed or capable of being sealed must be constructed with-
  - (i) an imperforate ceiling diffuser or the like installed at the ceiling or internal lining level; or
  - (ii) a weatherproof seal if it is a roof *window*; or
  - (iii) a shutter system readily operated either manually, mechanically or electronically by the occupant.

J3.4 External windows and doors

(a) A seal to restrict air infiltration must be fitted to each edge of an external door, openable external *window* or the like-
  (i) when serving a *conditioned space*; or
  (ii) in *climate zones* 4, 6, 7 and 8 when serving a *habitable room*.

(b) The requirements of (a) do not apply to-
  (i) a window complying with AS 2047; or
  (ii) an external louvre door, louvre *window*, or other such opening; or
  (iii) a fire door.

(c) A seal *required* by (a) may be a foam or rubber compressible strip, fibrous seal or the like.

(d) An external door at the main point of entry to the building, if leading to a *conditioned space* with a *floor area* of more than 50 m^2, must have a means of minimising the loss of conditioned air such as an airlock, *self-closing* door, revolving door or the like.

J3.5 Exhaust fans

An exhaust fan must be fitted with a sealing device such as a self-closing damper, filter or the like when serving-

(a) a *conditioned space*; or

(b) a *habitable room* in *climate zones* 4, 6, 7 and 8.

J3.6 Construction of roofs, walls and floors

(a) Roofs, *external walls*, external floors and any opening such as a *window*, door or the like must be constructed to minimise air leakage in accordance with (b) when forming part of the external *fabric* of-
  (i) a *conditioned space*; or
  (ii) a *habitable room* or a public area of a Class 2 or 3 building in *climate zones* 4, 6, 7 and 8.

(b) Construction *required* by (a) must be-
  (i) enclosed by internal lining systems that are close fitting at ceiling, wall and floor junctions; or
  (ii) sealed by caulking, skirting, architraves, cornices or the like.

PART J4 AIR MOVEMENT

Editorial note – Clause J4.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions. Clauses J3.1, J3.2, J3.3 and J3.4 are unchanged and will not apply to Classes 5 to 9 buildings.

PART J5 AIR-CONDITIONING AND VENTILATING SYSTEMS

Editorial note: Clause J5.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J5.1 * * * * * *

Editorial note: Clause J5.1 has been removed as these provisions apply to all buildings without exception.

J5.2 Air-conditioning and ventilating systems

Editorial note: Clause J5.2 has been extended to include carpark ventilation and a maximum resistance for ductwork. Table J5.2 remain unchanged.

(a) An *air-conditioning* unit or system must-

- (i) be capable of being inactivated when the *sole-occupancy unit*, building or part of the building served is not occupied; and
- (ii) have any ductwork insulated and sealed in accordance with Specification J5.2; and
- (iii) when serving more than one *sole-occupancy unit, air-conditioning* zone or area with a unique thermal characteristic-
  - (A) thermostatically control the temperature of each *sole-occupancy unit, air-conditioning* zone or area; and
  - (B) not control the temperature by mixing actively heated air and actively cooled air; and
  - (C) limit reheating to not more than a 7.5 K rise in temperature at the supply air rate for the space served and may be increased or decreased at the same rate that the supply air rate is respectively decreased or increased; and
- (iv) have an outside air cycle-
  - (A) in *climate zones* 2, 4, 5, 6, 7 and 8, when the system capacity is over 50 kWr; and
  - (B) in *climate zone* 3, when the system capacity is over 65 kWr; and
- (v) in a Class 3 building be capable of controlling the temperature of a *sole-occupancy unit* at a different temperature during sleeping periods than during other periods; and

(vi) be designed so that the total of the input power to the *air-conditioning* fans does not exceed-
   (A) 12 W/m^2 for a building of less than 500 m^2 *floor area*; and
   (B) 15 W/m^2 for a building of 500 m^2 *floor area* or more; and
(vii) when the air flow rate is greater than 1000 L/s have a fan motor shaft power to air flow rate ratio, or fan motor input power to air flow rate ratio, in accordance with Table J5.2; and
(viii) the requirements of (vi) do not apply to-
   (A) fans in package *air-conditioning* plant complying with J5.4(c); and
   (B) fans in fan powered variable air volume boxes.

(b) A mechanical ventilation system *required* by Part F4 must-
(i) be capable of being inactivated when the building or part of the building served is not occupied; and
(ii) not provide mechanical ventilation in excess of the minimum quantity *required* by Part F4 by more than 50% other than where there is-
   (A) additional unconditioned outside air supplied-
      (aa) to provide free cooling; and
      (bb) to balance *required* exhaust ventilation such as toilet exhaust; and
   (B) additional exhaust ventilation needed to balance the *required* outside air ventilation; and
(iii) when the air flow rate is more than 1000 L/s have a fan motor shaft power to air flow rate ratio, or fan motor input power to air flow rate ratio, in accordance with Table J5.2; and

Table J5.2 **MAXIMUM FAN MOTOR POWER TO AIR FLOW RATE RATIO**		
System static pressure (Pa)	**Maximum fan motor shaft power to air flow rate ratio W/(L/s)**	**Maximum fan motor input power to air flow rate ratio W/(L/s)**
Up to 200	0.55	0.73
300	0.75	1.0
400	0.95	1.27
500	1.15	1.5
600	1.4	1.9
700	1.6	2.1
800	1.8	2.4
900	2.0	2.7
1000	2.2	2.9
Greater than 1,000	2.5	3.3

Notes:

1. The maximum fan motor power to air flow rate ratio may be increased to that for the next higher system resistance where a fixed pitch and fixed speed fan is used.
2. The system static pressure includes all the resistance against which the fan must operate including integrated fan cowls, flaps and grilles.

(iv) when serving a *carpark* of over 40 cars-

(A) be controlled by an atmospheric contaminant monitoring system in accordance with AS 1668.2 so as to change the ventilation rate in response to the contaminant level; and

(B) maintain a minimum air-change rate, constant or intermittent, of 0.5 air changes per hour other than when the *carpark* is not occupied for a period in excess of 2 hours; and

(C) be supplemented by a separate system when contaminants, other than from vehicles, are present.

J5.3 Time switch

Editorial note: Clause J5.3 remains unchanged and is reproduced for information.

Power supply to-

(a) an *air-conditioning* system of more than 10 kWr; and

(b) a ventilation system with a air flow rate of more than 1000 L/s; and

(c) heating systems of more than 10 $kW_{heating}$

must be controlled by a time switch in accordance with Specification J6.

J5.4 Heating and cooling systems

Editorial note: Clause J5.4(a) has been extended to include a maximum resistance for pipework. Clauses 5.4(b), (c), (d) and (f) remain remains unchanged as do Tables J5.4a, J5.4b and J5.4c.

(a) Systems that provide heating or cooling for *air-conditioning* systems must-
  (i) have any *piping*, vessels or tanks containing heated or cooled media insulated in accordance with Specification J5.3; and
  (ii) where water is circulated by pumping at greater than 2 L/s-
    (A) have a pump motor power to water flow rate ratio in accordance with Table J5.4a; and
    (B) have the pump capable of varying its speed when it is-
      (aa) operating for more than 3,500 hours per year; or
      (bb) is more than 11 kW of motor power;
      except when the pump is needed to run at full speed for safe or efficient operation; and
  (iii) be capable of stopping the flow of water to any heat transfer unit when the unit is not operating; and
  (iv) be designed so that the total of the input power to the *air-conditioning* pumps does not exceed-
    (A) 3 W/m^2 for a building of less than 500 m^2 *floor area*; and
    (B) 4 W/m^2 for a building of 500 m^2 *floor area* or more.

Table J5.4a
MAXIMUM PUMP MOTOR POWER TO WATER FLOW RATE RATIO

System resistance (kPa)	Maximum pump motor power to water flow rate ratio kW/(L/s)
Less than 100	0.26
150	0.33
200	0.40
250	0.51
300	0.57
350	0.67
400	0.77
Greater than 400	0.85

Notes:
1. The maximum pump motor power to water flow rate ratio may be increased to that for the next higher system resistance where a fixed speed pump with a fixed size impeller is used.
2. System resistance includes all the resistance against which the pump must operate.

(B) have the pump capable of varying its speed when it is-

(aa) operating for more than 3,500 hours per year; or

(bb) is more than 11 kW of motor power;

except when the pump is needed to run at full speed for safe or efficient operation.

(b) A boiler must achieve a thermal efficiency complying with Table J5.4b when tested in accordance with BS 7190.

Table J5.4b
MINIMUM THERMAL EFFICIENCY OF BOILER

Fuel type	**Rated capacity ($kW_{heating}$)**	**Minimum gross thermal efficiency (%)**
Gas	Less than 90	75
	90 to 750	80
	More than 750	83
Oil	Less than 90	76
	90 to 750	78
	More than 750	80

(c) Package *air-conditioning* plant, including a heat pump, must have an energy efficiency ratio complying with Table J5.4c when tested in accordance with AS/NZS 3823.1.2.

Table J5.4c
MINIMUM ENERGY EFFICIENCY RATIO FOR PACKAGED AIR-CONDITIONING PLANT

Equipment type and operational mode	**Plant capacity**	
	65 kWr to 95 kWr	**More than 95 kWr to 125 kWr**
Air-conditioner cooling only	2.7	2.8
Heat pump cooling mode	2.6	2.7
Heat pump heating mode	3.4	3.7

(d) A refrigerant chiller over 125 kWr capacity, when determined in accordance with ARI 550/590, must have an energy efficiency ratio of not less than-

(i) 3.1 for full load operation; and

(ii) 4.2 for integrated part load.

(e) An air cooled condenser fan motor must not consume more than 0.015 kW of electricity per kW of heat rejected from the refrigerant when determined in accordance with ARI 460.

(f) The fan of a cooling tower must-
  (i) if a propeller or axial fan, provide not less than 3.2 L/s of air for each kW of motor power; and
  (ii) if a centrifugal fan, provide not less than 1.7 L/s of air for each kW of motor power.

J5.5 Ancillary exhaust systems

Editorial note: Clause J5.4(a) has been extended to include fumehoods as another example but with the caveat that safety must take precedence.

(a) An ancillary exhaust system that has a variable demand, such as serving a commercial kitchen hood, fume hood or the like, must-
  (i) have the means for the operator to-
    (A) reduce the energy used, such as by a variable speed fan, and
    (B) stop the motor when the system is not needed; and
  (ii) not exhaust *conditioned* air.

(b) The requirements of (a) do not apply where-
  (i) within a *sole-occupancy unit*; and
  (ii) additional exhaust ventilation is needed to balance the required outside air for ventilation; and
  (iii) the air flow must be maintained for safe operation.

PART J6 ARTIFICIAL LIGHTING AND POWER

Editorial note: Clause J6.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J6.1 Application of Part

Editorial note: Clause J6.1 extends this Part to other buildings.

The *Deemed-to-Satisfy Provisions* of this Part do not apply within a *sole-occupancy unit* of a Class 2 building or a Class 4 part of a building.

J6.2 Interior artificial lighting

Editorial note: Existing Clause J6.2(a) has a minor change to limit its application, Clause J6.2(b) becomes J6.2(c) with some additions, there is a new Clause J6.2(b), Table J6.2a does not change in content but Tables J6.2b and J6.2c are new.

(a) Artificial lighting in a Class 2 or 3 building must:
- (i) not exceed the *lamp power density* in Table J6.2a; and
- (ii) in a bathroom, dressing room or the like, provide an artificial light source efficacy of not less than 40 Lumens/W.

(b) For areas other than *sole-occupancy units*, the maximum *lamp power density* in Table J6.2a may be increased by-
- (i) 30% for areas of less than 20 m^2 *floor area*; and
- (ii) 40% where artificial lighting is switched by a motion detector or a corridor lighting timer in accordance with Specification J6; and
- (iii) 15% where artificial lighting is switched by a daylight sensor and dynamic lighting control device in accordance with Specification J6.

Editorial note: J6.2(c) is new and the current J6.2(c) becomes J6.2(d) with some additions.

(c) The *illumination power density*, other than a Class 2 or 3 building, must not exceed the maximum *illumination power density* in Table J5.2b, after adjustment for an energy saving control device or room size index in accordance with Table J6.2c.

Editorial note: Table J6.2 is renamed Table J6.2a.

Table J6.2a **MAXIMUM LAMP POWER DENSITY**	
Location	**Maximum *Lamp power density* (W/m²)**
Within a Class 3 building *sole-occupancy unit*	10
Within a dormitory of a Class 3 building used only for sleeping	5
Within other areas of a Class 2 or 3 building that are frequently occupied such as a lounge room, a dining room, restaurant or gymnasium	8
Within: (a) Public corridors and the like (b) Stairways	 3 5
Service areas such as plant rooms or store rooms	6
Employees' work areas such as reception areas	10

(d) The requirements of (a) and (b) do not apply to artificial lighting used for the following purposes:
   (i) Emergency lighting in accordance with Part E4.
   (ii) Signage and display lighting within cabinets and display cases.
   (iii) Safe movement in accordance with F4.4.
   (iv) Accommodation within the residential part of a *detention centre.*
   (v) Bathroom heating.
   (vi) Lighting of theatrical or musical performances.
   (vii) The permanent display and preservation of works of art or objects in a museum or gallery but not for retail.

Table J6.2b MAXIMUM ILLUMINATION POWER DENSITY	
Location	**Maximum illumination power density (W/m^2)**
Circulation space and corridor	6
Entry lobby	15
Offices - general	10
Offices – lit to an ambient level of <600 lux	7 (excluding task lights)
Board rooms and conference rooms	8
Restaurant, cafe, bar, hotel lounge and a space for the serving and consumption of food or drinks	20
Kitchen and food preparation areas	8
Retail space including museums and galleries whose purpose is the sale of objects	19
Wholesale storage and display areas	10
Storage with shelving no higher than 75% of the height of the aisle lighting	8
Storage with shelving higher than 75% of the height of the aisle lighting	10
Service areas, locker rooms, staff rooms, cleaners rooms, rest rooms and the like	3
Public toilets	5
Carpark - general	3
Carpark – entry zone (first 20 m of travel)	25
Laboratories	10
Factories, industrial tasks and processes	17
Farm and rural buildings – general	7
Dairies and shearing	10
Plant rooms	5
Control rooms, switch rooms, and the like	10

Table J6.2b (continued)
MAXIMUM ILLUMINATION POWER DENSITY

Location	Maximum illumination power density (W/m^2)
All health-care areas other than those listed in this table	10
Health-care examination rooms	20
Patient wards in a health-care building	10
Children's ward	15
Auditorium, church and public hall	10
Schools and tertiary institutions	10
Library – general	12
Library – reading room	10
Museum and gallery - circulation, cleaning and service lighting	8
Courtroom	12

Notes:

1. In areas not listed above, the maximum *illumination power density* must be:
   (a) For an illuminance of 40 Lux or less 13 W/m^2
   (b) For an illuminance of 80 Lux 16 W/m^2
   (c) For an illuminance of 160 Lux or more 20 W/m^2
2. For illuminance levels greater than 600 Lux, the maximum *illumination power density* must only be applied to the floor area of the task.
3. Where there are multiple lighting systems serving the same location the cumulative lighting power load of all systems must be used unless there is a control system that permits only one system to operate at a time, in which case the power level to be used-
   (a) must be the highest; or
   (b) may be determined by the formula:
   Illumination power density = [M x T/2 + N x (100 – T/2)] / 100
   Where:
   M is the maximum lighting power load
   T is the time for which the maximum lighting power load will occur, expressed as a percentage
   N is the normal lighting power load
4. For the purpose of calculating the lighting power load, tracking lighting that is at-
   (a) extra low voltage, must be calculated as 80% of the power rating of the transformer; and
   (b) mains voltage, must be calculated as 100 W per metre.

<table>
<tr><th colspan="3">Table J6.2c
ILLUMINATION POWER DENSITY ADJUSTMENT FACTOR</th></tr>
<tr><th>Item</th><th>Description</th><th>Illumination power density adjustment factor</th></tr>
<tr><td rowspan="4">Motion detector</td><td>(a) Where:
(i) at least 75% of the floor area of a space is controlled by motion detectors complying with Specification J5; and
(ii) an area of less than 200m^2 is switched as a block by one or more detectors.</td><td>0.9</td></tr>
<tr><td>(b) Where up to 6 lights are switched as a block by one or more detectors.</td><td>0.7</td></tr>
<tr><td>(c) Where an area of a carpark of less than 500m^2 is switched as a block by one or more detectors.</td><td>0.7</td></tr>
<tr><td>(d) Where up to 2 lights are switched as a block by one or more detectors.</td><td>0.55</td></tr>
<tr><td>Manual dimming system</td><td>Where at least 75% of the floor area of a space is controlled by manually operated dimmers.</td><td>0.95</td></tr>
<tr><td>Programmable dimming system</td><td>Where at least 75% of the floor area of a space is controlled by programmable dimmers.</td><td>0.85</td></tr>
<tr><td>Dynamic dimming system</td><td>Automatic compensation for lumen depreciation (Note 1).</td><td>(a) The design lumen depreciation factor; and
(i) with fluorescent lights, no less than 0.9 or
(ii) with high pressure discharge lights, no less than 0.8.</td></tr>
<tr><td>Fixed dimming</td><td>Where at lease 75% of the floor area is controlled be fixed dimmers that reduce the overall lighting level and the power consumption of the lighting.</td><td>% of full power to which the dimmer is set multiplied by 1.05</td></tr>
<tr><td>Dynamic lighting control device in accordance with Specification J5</td><td>Lights within the space adjacent to windows for a distance from the window equal to the depth of the floor to window head height.</td><td>0.5 (Note 1)</td></tr>
<tr><td rowspan="3">Dynamic lighting control device in accordance with Specification J5 – dimmed or stepped switching of lights adjacent windows</td><td>(a) Lights within the space adjacent to windows for a distance from the window equal to the depth of the floor to window head height.</td><td>0.5 (Note 1)</td></tr>
<tr><td>(b) Where the total area of the roof lights is less than 10% of the floor area.</td><td>0.6 (Note 1)</td></tr>
<tr><td>(c) Where the total area of the roof lights is 10% or more of the floor area.</td><td>0.5 (Note 1)</td></tr>
</table>

Table J6.2c (continued) **ILLUMINATION POWER DENSITY ADJUSTMENT FACTOR**		
Item	**Description**	**Illumination power density adjustment factor**
Dynamic lighting control device in accordance with Specification J5 – dimmed or stepped switching of lights adjacent *windows*	(a) Lights within the space adjacent to *windows* for a distance from the *window* equal to the depth of the floor to *window* head height.	0.5 (Note 1)
	(b) Where the total area of the *roof lights* is less than 10% of the *floor area.*	0.6 (Note 1)
	(c) Where the total area of the *roof lights* is 10% or more of the *floor area.*	0.5 (Note 1)
Room size	Room index less than 0.7.	0.5
	Room index 0.7 and more but less than 1.5.	0.7
	Room index 1.5 and more but less than 3.0.	0.9
	Room index 3.0 and greater.	1.0

Notes:

1. The *illumination power density* adjustment factor is only applied to lights controlled by that item. This adjustment factor does not aply to tungsten halogen or other incandescent sources.
2. The room index is an expression of the room's proportions with respect to the lights and is determined by the formula:
   Room index = $L \times W / (L + W) \times H_m$
   Where:
   L is the length of the room
   W is the width of the room
   H_m is the height that the fitting is mounted above the floor
3. Where more than one *illumination power density* adjustment factor is applicable to an area they are to be applied using the following formula:
   Adjusted *illumination power density* = *illumination power density* x A x [B + (1 - B) / 2]
   Where:
   A is the lowest applicable *illumination power density* adjustment factor
   B is the second lowest applicable *illumination power density* adjustment factor
   A maximum of 2 *illumination power density* adjustment factors can be applied to an area.
4. Manual dimming is where lights are controlled by a knob, slider or other mechanism or where there are pre-selected scenes that are manually selected.
5. Programmed dimming is where pre-selected scenes or levels are automatically selected by time of day, photoelectric cell or occupancy sensor.
6. Fixed dimming is where lights are controlled to a level and that level cannot be adjusted by the user.
7. Dynamic dimming is where the lighting level is varied automatically by a photoelectric cell to either proportionally compensate for the availability of daylight or the lumen depreciation of the lamps.

J6.3 Control of interior artificial lighting and power

Editorial note: Clauses J6.3(a) is only changed so as to apply to all buildings. Clause J6.3(b) is unchanged while (c), (d), (e) and (f) are new.

(a) Artificial lighting of a room or space must be individually operated by a switch or other control device.

(b) An occupant activated device, such as a room security device, motion detector or the like, must be provided in the *sole-occupancy unit* of a Class 3 building to cut power to the artificial lighting, air-conditioner, local exhaust fans and bathroom heater when the *sole-occupancy unit* is unoccupied.

Editorial note: Clauses J6.3(c), (d), (e), (f) and (g) are new.

(c) An artificial lighting switch must-
- (i) be located in a visible position-
  - (A) in the room or space being switched; or
  - (B) in an adjacent the room or space from where the lighting being switched is visible; and
- (ii) not operate lighting within an area of more than-
  - (A) 250 m^2 for a space of not more than 2,000 m^2 *floor area*; or
  - (B) 1,000 m^2 for a space of more than 2,000 m^2 *floor area*.

(d) Artificial lighting adjacent windows in a Class 5, Class 6 or Class 8 building must be controlled separately from artificial lighting not adjacent windows.

(e) Artificial lighting in a building, or a *storey* of a building, of more than 250 m^2 in *floor area* must be controlled by a time switch or occupancy sensor in accordance with Specification J6.

(f) The requirements of (a), (b) and (c) do not apply to artificial lighting used for the following purposes:
- (i) Emergency egress.
- (ii) Safe movement in accordance with F4.4.
- (iii) Where artificial lighting is needed for 24-hour occupancy such as for a manufacturing process, an airport control tower or within a *detention centre*.

(g) The requirements of (e) do not apply to artificial lighting in a *patient care area*.

J6.4 Exterior artificial lighting

Editorial note: Clauses J6.4 is new.

(a) Exterior artificial lighting, must-
  (i) be automatically switched off when daylight is available; and
  (iii) when the total external lighting load exceeds 100 W-
    (A) have an average *light source efficacy* greater than 60 Lumens/W; or
    (B) be controlled by a motion detector in accordance with Specification J6.
  (iii) when for decorative purposes, such as facade lighting or signage lighting, have a separate time switch.

(b) The requirements of (a) do not apply to exterior artificial lighting used for the purposes listed in J6.2(c).

J6.5 Decorative and display lighting

Editorial note: Clauses J6.5 is new.

(a) Decorative and display lighting, such as for a foyer mural or art display must be controlled-
  (i) separately from other artificial lighting; and
  (ii) by a manual switch for each area except where the operating times of the displays are the same in a number of areas such as in a museum, art gallery or the like, in which case they may be combined; and
  (iii) by a time switch in accordance with Specification J6 where the display lighting exceeds 7 kW.

(b) Window display lighting must be controlled separately from other display lighting.

J6.6 Boiling water unit

Editorial note: Clauses J6.6 is new.

Power supply to a boiling water unit must be controlled by a time switch in accordance with Specification J6.

PART J7 HOT WATER SUPPLY

Editorial note: Clause J7.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J7.1 * * * * * *

Editorial note: Clause J7.1 has been removed as these provisions apply to all buildings without exception.

J7.2 Hot water supply

Editorial note: Clause 7.2 remain unchanged in that it will continue to reference the Australian Standard AS/NZS 3500. Any of the changes discussed in Part B of this Regulation Document that are accepted, will take place within the standard.

A hot water supply system, other than a solar hot water supply system in *climate zones* 1, 2 and 3, must be designed and installed in accordance with Section 8 of AS/NZS 3500.4.

PART J8 ACCESS FOR MAINTENANCE

Editorial note: Clause J8.0 will be adjusted to reflect the final structure of the Deemed-to-Satisfy Provisions.

J8.1 Application of Part

Editorial note: Clause J8.1 extends this Part to all commercial buildings.

The *Deemed-to-Satisfy Provisions* of this Part do not apply within a *sole-occupancy unit* of a Class 2 building or a Class 4 part of a building.

SPECIFICATION J1.2 MATERIAL PROPERTIES

Editorial note: Specification J1.2 is already in the BCA and is reproduced here for information.

1. Scope

This Specification lists the thermal properties of some common construction materials.

2. Construction Deemed-to-Satisfy

(a) Table 2a lists the thermal conductivity considered to be achieved by some common construction materials.

Table 2a
THERMAL CONDUCTIVITY OF TYPICAL WALL, ROOF/CEILING AND FLOOR MATERIALS

Material description	Material density kg/m^3	Thermal conductivity W/m.K
1. Framing		
(a) Steel	7850	47.5
(b) Timber – kiln dried hardwood (across the grain)	677	0.16
(c) Timber - Radiata pine (across the grain)	506	0.10
2. Roof Cladding		
(a) Aluminium sheeting	2680	210
(b) Concrete or terra cotta tiles	1922	0.81
(c) Steel sheeting	7850	47.5
3. Wall Cladding		
(a) Aluminium sheeting	2680	210
(b) Autoclaved aerated concrete	650	0.13
	500	0.17
(c) Cement render (1 cement : 4 sand)	1570	0.53
(d) Clay bricks		
(i) Clay brick - 2.75 kg	1430	0.55
(ii) Clay brick - 3.25 kg	1690	0.65
(iii) Clay brick - 3.75 kg	1950	0.78
(e) Dense weight hollow concrete block	1526	0.95

Table 2a (continued) THERMAL CONDUCTIVITY OF TYPICAL WALL, ROOF/CEILING AND FLOOR MATERIALS		
Material description	**Material density kg/m^3**	**Thermal conductivity W/m.K**
(f) Fibre-cement	1360	0.25
(g) Gypsum plasterboard	880	0.17
(h) Lightweight hollow concrete block	1260	0.75
(i) Pine weatherboards	506	0.10
(j) Plywood	530	0.14
(k) Solid concrete	2400	1.44
(l) Steel sheeting	7850	47.5
(m) Prestressed hollow core concrete panel	1680	0.80
4. Flooring Materials		
(a) Carpet underlay	-	0.04
(b) Carpet	-	0.05
(c) Prestressed hollow core concrete planks	1680	0.80
(d) Particleboard	640	0.12
(e) Plywood	530	0.14
(f) Timber - kiln dried hardwood (across the grain)	677	0.16
(g) Timber - Radiata pine (across the grain)	506	0.10
(h) Solid concrete	2400	1.44
(i) Vinyl floor tiles	2050	0.79
5. Other Materials		
(a) Air (still)	1.2	0.03
(b) Clay soil (10% moisture content)	1300	0.06
(c) PMMA (polymethylmethacrylate)	1180	1.00
(d) Polycarbonates	1200	0.2
(e) Sand (6% moisture content)	1800	1.64
(f) Soda lime glass	2500	1.0
Note: For materials which incorporate cores or hollows in regular patterns (such as cored brickwork, hollow blockwork and cored floor or wall panels), the tabulated material densities and thermal conductivities are based on the gross density (mass divided by external dimensions).		

(b) Table 2b lists the R-Values considered to be achieved by air films and air spaces.

Table 2b
TYPICAL R-VALUES FOR AIR SPACES AND AIR FILMS

Position of air space	**Direction of heat flow**	***R-Value***
1. Air spaces non-reflective unventilated		
Pitched roof space	Up	0.18
Pitched roof space	Down	0.28
Horizontal	Up	0.15
Horizontal	Down	0.22
450 slope	Up	0.15
450 slope	Down	0.18
Vertical	Horizontal	0.16
2. Air spaces non-reflective ventilated		
Pitched roof space	Up	Nil
Pitched roof space	Down	0.46
3. Air films – Still air		
Horizontal	Up	0.11
Horizontal	Down	0.16
450 slope	Up	0.11
450 slope	Down	0.13
Vertical	Horizontal	0.12
4. Air films – Moving air		
7 m/s wind	Any direction	0.03
3 m/s wind	Any direction	0.04

Note:
R-Values are for a temperature of 10°C and temperature difference 15 K.

(c) The thermal properties considered to be achieved by reflective surfaces are:
    (i) within a wall-
        (A) with a inner reflective surface of 0.05 emittance and a 20 mm air gap to the wall lining, an added *R-Value* of 0.38; and
        (B) with a inner reflective surface of 0.05 emittance and a 70 mm air gap to the wall lining, an added *R-Value* of 0.42; and
        (C) with a inner reflective surface of 0.05 emittance and a 70 mm air gap to the wall lining and an outer anti-glare reflective surface of 0.9 emittance and a 70 mm air gap to the wall cladding, an added *R-Value* of 0.42; and
    (ii) within a roof, those in Table 2c.

Table 2c
TYPICAL Thermal Properties for air spaces and air films

Emittance of added *reflective insulation*	**Direction of heat flow**	***R-Value* added by a reflective surface**					
		Pitched roof (≥10°) with horizontal ceiling		**Flat, skillion or pitched roof (<10°) with horizontal ceiling**	**Pitched roof with cathedral ceiling**		
		Ventilated roof space	**Non-ventilated roof space**		**22° pitch**	**30° pitch**	**45° pitch**
0.2 outer 0.05 inner	Downwards	1.21	1.21	1.28	0.96	0.86	0.66
0.2 outer 0.05 inner	Upwards	0.59	0.75	0.68	0.72	0.74	0.77
0.9 outer 0.05 inner	Downwards	1.01	0.92	1.06	0.74	0.64	0.44
0.9 outer 0.05 inner	Upward	0.40	0.55	0.49	0.51	0.52	0.53

SPECIFICATION J1.3 ROOF AND CEILING CONSTRUCTION

Editorial note: Specification J1.3 is already in the BCA and is reproduced here for information.

1. Scope

This Specification describes the thermal performance of some common forms of roof and ceiling construction.

2. Construction Deemed-to-Satisfy

Figure 2 details the *R-Values* considered to be achieved by some common forms of roof and ceiling construction.

Figure 2
TYPICAL R-VALUES FOR ROOF AND CEILING CONSTRUCTION

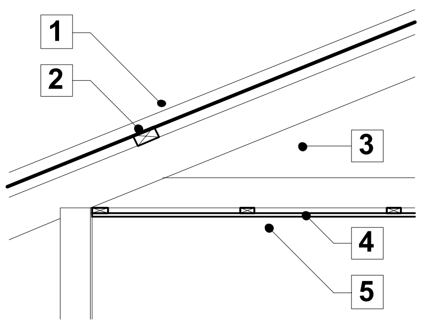
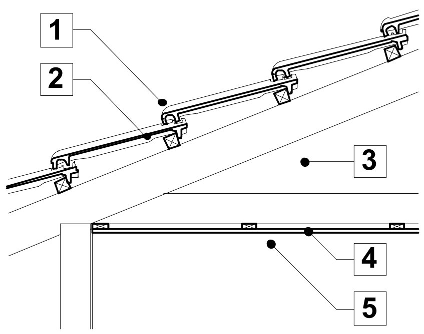
Roof construction description	Item	Item description	*R-Value* Unventilated		*R-Value* Ventilated	
			Up	Down	Up	Down
(a) Roof 22^0 to 45^0 pitch - Horizontal ceiling – Metal cladding 	1.	Outdoor air film (7m/s)	0.03	0.03	0.03	0.03
	2.	Metal cladding	0	0	0	0
	3.	Roof air space (non-reflective)	0.18	0.28	0	0.46
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06	0.06	0.06
	5.	Indoor air film (still air)	0.11	0.16	0.11	0.16
		Total R-Value	0.38	0.53	0.20	0.71
(b) Roof 22^0 to 45^0 pitch - Horizontal ceiling - Clay tiles 19 mm 	1.	Outdoor air film (7m/s)	0.03	0.03	0.03	0.03
	2.	Roof tile, clay or concrete (1922 kg/m^3)	0.02	0.02	0.02	0.02
	3.	Roof air space (non-reflective)	0.18	0.28	0	0.46
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06	0.06	0.06
	5.	Indoor air film (still air)	0.11	0.16	0.11	0.16
		Total R-Value	0.37	0.55	0.22	0.73

Figure 2 (continued)
TYPICAL R-VALUES FOR ROOF AND CEILING CONSTRUCTION

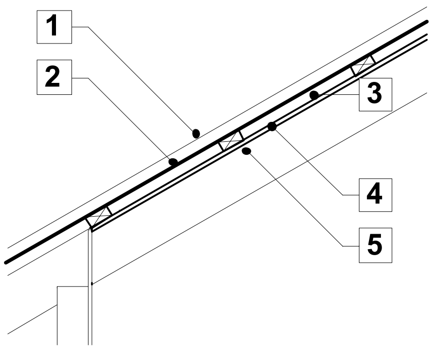
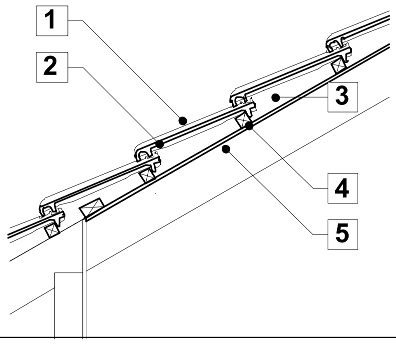
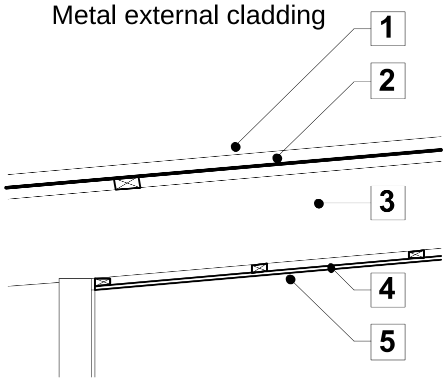
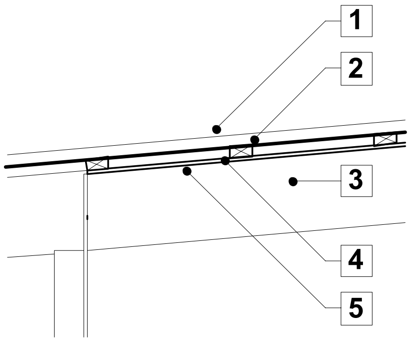
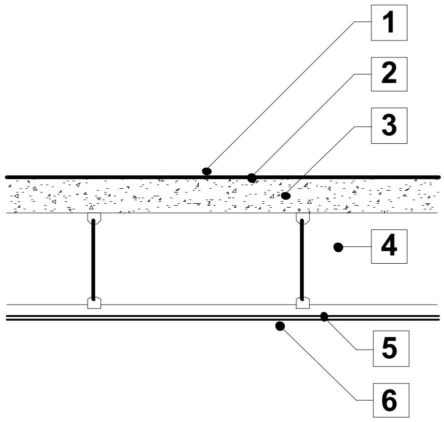
Roof construction description	Item	Item description	*R-Value* Unventilated	
			Up	**Down**
(c) Cathedral ceiling 22^0 to 45^0 pitch – 10 mm plaster on top of rafters – Metal external cladding 	1.	Outdoor air film (7m/s)	0.03	0.03
	2.	Metal cladding	0	0
	3.	Roof air space (30 mm to 100 mm, non-reflective)	0.16	0.18
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06
	5.	Indoor air film (still air)	0.11	0.16
		Total R-Value	0.38	0.53
(d) Cathedral ceiling 22^0 to 45^0 pitch – 10 mm plaster on top of rafters – Tiles external cladding 	1.	Outdoor air film (7m/s)	0.03	0.03
	2.	Roof tile, clay or concrete (1922 kg/m^3)	0.02	0.02
	3.	Roof air space (30 mm to 100 mm, non-reflective)	0.10	0.18
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06
	5.	Indoor air film (still air)	0.11	0.16
		Total R-Value	0.38	0.45
(e) Skillion roof 20 to 120 pitch – 10 mm plaster below rafters – Metal external cladding 	1.	Outdoor air film (7m/s)	0.03	0.03
	2.	Metal cladding	0	0
	3.	Roof air space (100 mm to 300 mm, non-reflective)	0.15	0.22
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06
	5.	Indoor air film (still air)	0.11	0.16
		Total R-Value	0.35	0.47

Figure 2 (continued)
TYPICAL R-VALUES FOR ROOF AND CEILING CONSTRUCTION

Roof construction description	Item	Item description	*R-Value* Unventilated Up	*R-Value* Unventilated Down
(f) Skillion roof 20 to 120 pitch – 10 mm plaster on top of rafters - Metal external cladding 	1.	Outdoor air film (7m/s)	0.03	0.03
	2.	Metal cladding	0	0
	3.	Roof air space (30 mm to 100 mm non-reflective)	0.15	0.22
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.07	0.07
	5.	Indoor air film (still air)	0.11	0.16
		Total R-Value	0.36	0.48
(g) 100 mm solid concrete roof - 10 mm plaster, suspended ceiling – Applied external waterproof membrane 	1.	Outdoor air film (7m/s)	0.03	0.03
	2.	Waterproof membrane, rubber synthetic (4 mm, 961 kg/m^3)	0.03	0.03
	3.	Solid concrete, (100 mm, 2400 kg/m^3)	0.07	0.07
	4.	Ceiling air space (100 mm to 300 mm, non reflective)	0.15	0.22
	5.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06
	6.	Indoor air film (still air)	0.11	0.16
		Total R-Value	0.45	0.57

Notes:

1. The *R-Value* of an item, other than an air space, air film or air cavity, may be increased in proportion to the increased thickness of the item.
2. The *Total R-Value* of a form of construction may be increased by the amount that the *R-Value* of an individual item is increased.

SPECIFICATION J1.5 WALL CONSTRUCTION

Editorial note: Specification J1.5 is already in the BCA and is reproduced here for information.

1. Scope

This Specification describes the thermal performance of some common forms of external wall construction.

2. Construction Deemed-to-Satisfy

Figure 2 details the *R-Values* considered to be achieved by some common forms of wall construction.

Figure 2
TYPICAL R-VALUES FOR WALL CONSTRUCTION

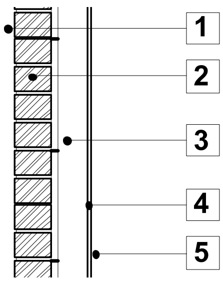
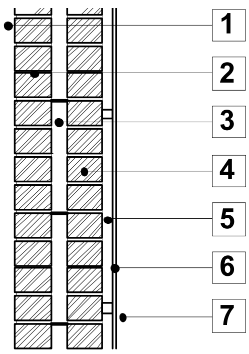
External wall construction description	Item	Item description	*R-Value*
(a) Masonry veneer – 25 mm to 50 mm cavity space, 10 mm internal plaster on 90 mm stud frame 	1.	Outdoor air film (7m/s)	0.03
	2.	Masonry (See note 3)	0.09
	3.	Cavity air space (115 to 140 mm, made up of 90 mm stud + 25 mm to 50 mm air space non-reflective)	0.16
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06
	5.	Indoor air film (still air)	0.12
		Total R-Value	0.46
(b) Cavity masonry – 20 mm to 50 mm cavity space, 10 mm internal plaster on battens or furring channels 	1.	Outdoor air film (7m/s)	0.03
	2.	Masonry (See note 3)	0.09
	3.	Brick cavity air space (20 mm to 50 mm, non-reflective)	0.16
	4.	Masonry (See note 3)	0.09
	5.	Cavity air space (20mm to 35 mm, non-reflective)	0.16
	6.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06
	7.	Indoor air film (still air)	0.12
		Total R-Value	0.71

Figure 2 (continued)
TYPICAL R-VALUES FOR WALL CONSTRUCTION

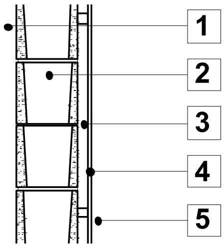
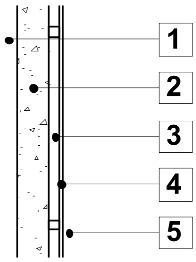
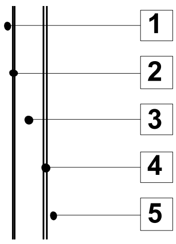
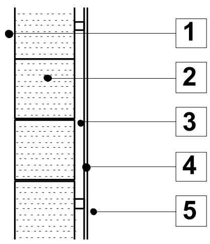
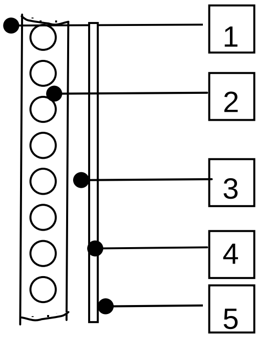
External wall construction description	Item	Item description	*R-Value*
(c) Denseweight hollow concrete block with internal plaster on battens or furring channels	1.	Outdoor air film (7m/s)	0.03
	2.	Denseweight hollow concrete block (See note 3)	0.15
	3.	Cavity air space (20 mm to 35 mm non-reflective)	0.16
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06
	5.	Indoor air film (still air)	0.12
		Total R-Value	0.52
(d) Solid reinforced concrete (dense weight) – 10 mm internal plaster on battens or furring channels	1.	Outdoor air film (7m/s)	0.03
	2.	Solid reinforced concrete (See note 3)	0.09
	3.	Cavity air space (20 mm to 35 mm non-reflective)	0.16
	4.	Plasterboard, gypsum (10 mm, 880 kg/m3)	0.06
	5.	Indoor air film (still air)	0.12
		Total R-Value	0.46
(e) Timber wall – external 6 mm cement sheet cladding, 90 mm stud frame, 10 mm plaster	1.	Outdoor air film (7m/s)	0.03
	2.	Fibre cement (6 mm, 1360 kg/m^3)	0.03
	3.	Cavity air space (90 mm non-reflective)	0.16
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06
	5.	Indoor air film (still air)	0.12
		Total R-Value	0.41
(f) 200 mm autoclaved aerated concrete block – 10 mm internal plaster on battens or furring channels	1.	Outdoor air film (7m/s)	0.03
	2.	Autoclaved aerated concrete block (200 mm, 500 kg/m^3)	1.34
	3.	Cavity air space (20 mm to 35 mm non-reflective)	0.16
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06
	5.	Indoor air film (still air)	0.12
		Total R-Value	1.68

Figure 2 (continued)
TYPICAL R-VALUES FOR wall CONSTRUCTION

External wall construction description	Item	Item description	*R-Value*
(g) 150 mm hollow-core concrete panels – 10 mm internal plaster on battens or furring channels 	1.	Outdoor air film (7m/s)	0.03
	2.	Prestressed hollow-core concrete panels (150 mm, 1,680 kg/m3, 30% cores)	0.14
	3.	Cavity air space (20 mm to 35 mm non-reflective)	0.16
	4.	Plasterboard, gypsum (10 mm, 880 kg/m3)	0.06
	5.	Indoor air film (still air)	0.12
		Total R-Value	0.51

Notes:

1. The *R-Value* of an item, other than an air space, air film or air cavity, may be increased in proportion to the increased thickness of the item.
2. The *Total R-Value* of a form of construction may be increased by the amount that an individual item is increased.
3. The addition of 10 mm of render to a concrete or masonry wall will increase the *Total R-Value* by 0.02.
4. (a) The typical *R-Value* in Figure 2(a) and (b) is for 90 mm denseweight concrete block.
   (b) The typical *R-Value* in Figure 2(c) is for 140 mm denseweight hollow concrete block.
   (c) The typical *R-Value* in Figure 2(d) is for 125 mm solid reinforced concrete (2400 kg/m^3).
   (d) Other typical values are as follows and may be substituted:
   90 mm clay brick:
   (density 1430 kg/m^3) 0.16
   (density 1690 kg/m^3) 0.14
   (density 1950 kg/m^3) 0.12
   110 mm clay brick:
   (density 1430 kg/m^3, 2.75 kg) 0.2
   (density 1690 kg/m^3, 3.25kg) 0.17
   (density 1950 kg/m^3, 3.75 kg) 0.14
   Denseweight hollow concrete block:
   110 mm 0.12
   190 mm 0.20
5. The *Total R-Values* in this Figure are for external walls. The *Total R-Value* for an internal wall of the same construction would be 0.09 greater because the *R-Value* for an outdoor air film would be replaced by that of an indoor air film.

SPECIFICATION J1.6 FLOOR CONSTRUCTION

Editorial note: Specification J1.6 is already in the BCA and is reproduced here for information.

1. Scope

This Specification describes the thermal performance of some common forms of floor construction.

2. Construction Deemed-to-Satisfy

Figure 2 details the *R-Values* considered to be achieved by some common forms of floor construction, other than a concrete floor with an embedded floor heating system.

Figure 2
TYPICAL R-VALUES FOR FLOOR CONSTRUCTION
(for a floor without a floor heating system)

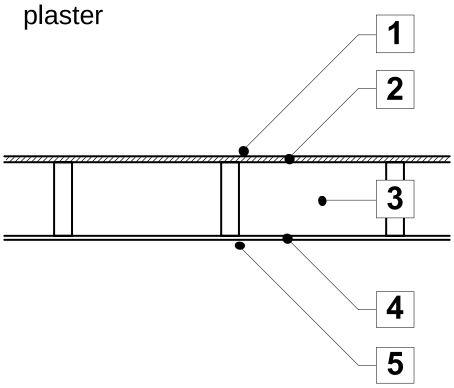
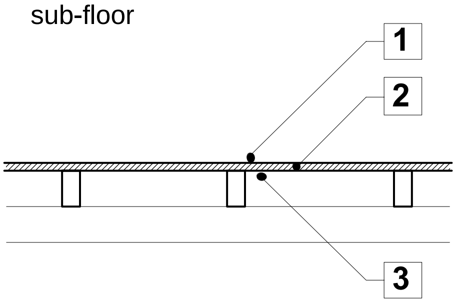
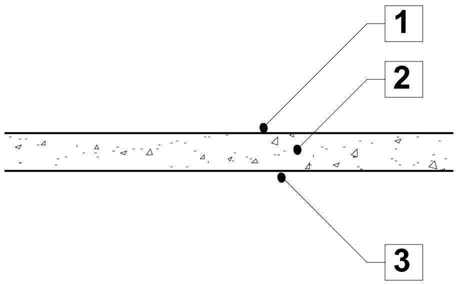
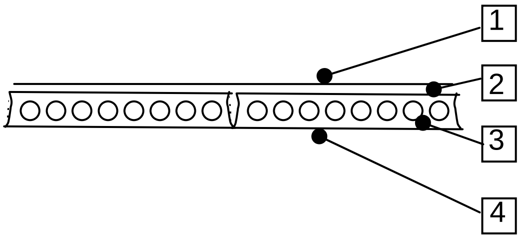
Floor construction description	Item	Item description	*R-Value* Up	*R-Value* Down
(a) Timber internal floor, 10 mm internal plaster 	1.	Indoor air film (still air)	0.11	0.16
	2.	Particleboard flooring (19 mm, 640 kg/m^3)	0.15	0.15
	3.	Floor air space, 100 mm to 300 mm (non-reflective)	0.15	0.22
	4.	Plasterboard, gypsum (10 mm, 880 kg/m^3)	0.06	0.06
	5.	Indoor air film (still air)	0.11	0.16
		Total R-Value	0.58	0.75
(b) Timber, suspended ground floor, open sub-floor 	1.	Indoor air film (still air)	0.11	0.16
	2.	Particleboard flooring (19 mm, 640 kg/m^3)	0.15	0.15
	3.	Outdoor air film (7m/s)	0.03	0.03
		Total R-Value	0.29	0.34

Figure 2 (continued)
TYPICAL R-VALUES FOR FLOOR CONSTRUCTION
(for a floor without a floor heating system)

Floor construction description	Item	Item description	*R-Value*	
			Up	**Down**
(c) Solid concrete slab	1.	Indoor air film (still air)	0.11	0.16
	2.	Solid concrete (150 mm, 2400 kg/m^3) (See note 3)	0.10	0.10
	3.	Outdoor air film (7m/s)	0.03	0.03
		Total R-Value	0.24	0.29
(d) 150 mm hollow-core concrete planks	1.	Indoor air film (still air)	0.11	0.16
	2.	Concrete topping (60 mm, 2,400 kg/m^3)	0.04	0.04
	3.	Hollow-core concrete planks (150 mm, 1,680 kg/m^3, 30% cores)	0.14	0.14
	4.	Outdoor air film (7m/s)	0.03	0.03
		Total R-Value	0.32	0.37

Notes:

1. The *R-Value* of an item, other than an air space, air film or air cavity, may be increased in proportion to the increased thickness of the item.
2. The *Total R-Value* of a form of construction may be increased by the amount that an individual item is increased.
3. For floor types (b), (c) and (d) that are located over an internal space, the *Total R-Value* can be calculated by replacing the value for outdoor air film (R0.03) on the underside of the floor with the value for indoor air film (R0.11)
4. The addition of 10 mm of render to the ceiling of a suspended internal concrete floor will increase the *Total R-Value* by 0.02.
5. Solid concrete slab includes concrete beam and infill floors and concrete precast permanent formwork panels.

Specification J5.2 DUCTWORK INSULATION AND SEALING

Editorial note: Specification J5.2 is already in the BCA and is reproduced here for information.

1. Scope

This Specification contains the requirements for the sealing and the insulating of ductwork used to heat or cool a building.

2. Ductwork sealing

(a) Heating or cooling ductwork and fittings must be sealed against air loss–
- (i) by closing all openings in the surface, joints and seams of ductwork with adhesives, mastics, sealants or gaskets in accordance with AS 4254 for the static pressure in the system; or
- (ii) for flexible ductwork at an operating static pressure of less than 500 Pa, with a sealant and draw band encased with adhesive tape.

(b) The requirements of (a) do not apply to ductwork and fittings located within a *sole-occupancy unit* or within a space that is air-conditioned where the ductwork only serves that space.

3 Ductwork insulation

(a) Ductwork and fittings for heating or cooling must–
- (i) be thermally insulated to achieve the minimum *Total R-Value* specified in Tables 3a and 3b; and
- (ii) use insulation material that is in accordance with AS/NZS 4859.1.

(b) Insulation on cooling ductwork and fittings must be protected by a vapour barrier on the outside of the insulation.

(c) Ductwork insulation must be protected against the effects of weather and sunlight.

(d) The requirements of (a) do not apply to heating and cooling ductwork and fittings located within the *envelope* or within the space being air-conditioned.

Table 3a
DUCTWORK - MINIMUM INSULATION (For systems of no more than 65kW capacity)

Location and element		**Minimum *Total R-Value* for ductwork**			
		Evaporative cooler	**Heating system or refrigerated cooling system**		
		All *climate zones*	**1, 2, 3, 4, 6 and 7**	**5**	**8**
1. Under an enclosed suspended floor; or 2. in a roof space with insulation installed directly beneath the roofing.	Ductwork and cooling fittings	0.6	1.0	1.0	1.5
	Heating fittings	Not applicable	0.1	0.1	0.1
All other locations including- 1. external to the building; or 2. under an unenclosed suspended floor; or 3. in a roof space with insulation installed at the ceiling level.	Ductwork, cooling and heating fittings	0.6	1.5	1.0	1.5

Table 3b
DUCTWORK - MINIMUM INSULATION (For systems greater than 65 kW capacity)

Location	**Minimum *Total R-Value* for ductwork**				
	Evaporative cooling	**Air-conditioning system**			
	All *climate zones*	**1, 2, 3 and 4**	**5**	**6 and 7**	**8**
Within a conditioned space other than where the space is the only space served.	Nil	0.75	0.75	1.0	1.25
1. Under an enclosed suspended floor; or 2. in a roof space with insulation installed directly beneath the roofing; or 3. in a plant room.	0.6	1.0	1.25	1.5	1.5
All other locations including- 1. external to the building; or 2. under an unenclosed suspended floor; or 3. in a roof space with insulation installed at the ceiling level.	0.6	1.5	1.25	1.5	1.75

SPECIFICATION J6 LIGHTING AND POWER CONTROL DEVICES

Editorial note: Clauses 1, 2, 3 and 5 remain unchanged with Clause 4 being extended in order to apply it to other Classes of buildings.

1. Scope

This Specification contains the requirements for lighting and power control devices including timers, time switches, motion detectors and daylight control devices.

2. Corridor lighting timer

A corridor lighting timer must-

(a) be located within 2 m of every entry door to the space; and

(b) have an indicator light that is illuminated when the artificial lighting is off; and

(c) not control more than-

  (i) an area of 100 m^2 with a single push button timer; and

  (ii) 95% of the lights in spaces of area more than 25 m^2; and

(d) be capable of maintaining the artificial lighting-

  (i) for not less than 5 minutes and not more than 15 minutes unless it is reset; and

  (ii) without interruption if the timer is reset.

3. Time switch

A time switch must be capable of-

(a) switching on and off electric power to lighting systems-

  (i) at variable pre-programmed times and on variable pre-programmed days; and

  (ii) limiting the period the lighting is switched on to 2 hours beyond the time for which the building is occupied; and

(b) being overridden by a manual switch for a period of up to 2 hours, after which the time switch shall resume control.

4. Motion detectors

Editorial note: Clause 4 already exists but is being restructured and extended in order to apply to other Classes of buildings.

A motion detector must-

(a) in a Class 3 building-
- (i) be capable of sensing movement such as by infra-red, ultrasonic or microwave detection or by a combination of these means; and
- (ii) be capable of detecting somebody before they are 1 m into the space; and
- (iii) other than within a *sole-occupancy unit* of a Class 3 building, not control more than-
  - (A) an area of 100 m^2; and
  - (B) 95% of the lights in an area greater than 25 m^2; and
- (iv) be capable of maintaining the artificial lighting when activated-
  - (A) for not less than 5 minutes and not more than 15 minutes unless it is reset; and
  - (B) without interruption if the motion detector is reset by movement.

(b) in other than a Class 2 or 3 building or Class 4 Part-
- (i) be capable of sensing movement by infra-red, ultrasonic or microwave detection or by a combination of these means; and
- (ii) be capable of detecting-
  - (A) somebody before they are 1 metre into the space; and
  - (B) movement of 500 mm within the usable part of the space; and
- (iii) not control more than-
  - (A) an area of 250 m^2 with a single sensor or group of parallel sensors; and
  - (B) 75% of the lights in spaces using high intensity discharge; and
- (iv) be capable of maintaining the artificial lighting when activated-
  - (A) for a minimum of 5 minutes and a maximum of 30 minutes unless it is reset; and
  - (B) without interruption if the motion detector is reset by movement; and
- (v) have a manual override switch which enables the lighting to that, or a greater area, to be turned off. The manual override shall not be able to switch the lights permanently on.

(c) when outside a building-
- (i) be capable of sensing movement by infra-red, ultrasonic or microwave detection or by a combination of these means; and
- (ii) be capable of detecting somebody within a distance from the light equal to-
  - (A) twice the mounting height; or

(B) 80% of the ground area covered by the light's beam; and

(iii) not control more than five lights; and

(iv) be operated in series with a photoelectric cell or astronomical time switch so that the light will not operate in daylight hours; and

(v) be capable of maintaining the artificial lighting when the switch is on for a minimum of 1 minutes and a maximum of 10 minutes unless it is reset; and

(vi) have manual override switches which must reset after a period of 4 hours maximum.

5. Daylight sensor and dynamic lighting control device

A daylight sensor and dynamic lighting control device must-

(a) for switching on and off-

(i) be capable of having the switching level set point adjusted between 50 and 1000 Lux; and

(ii) control artificial lighting rather than external shutters or shades; and

(iii) have-

(A) a delay of more than 2 minutes; or

(B) a differential of more than 50 Lux, and

(b) for dimmed or stepped switching, be capable of reducing the power consumed by the controlled lighting in proportion to the incident daylight on the working plane either-

(i) continuously down to a power consumption that is less than 50% of full power; or

(ii) in no less than 4 steps down to a power consumption that is less than 50% of full power; and

(c) have a manual override switch which enables the lighting in an area to be turned off but is not able to switch the lights permanently on or bypass the lighting controls.

ATTACHMENT B

PARTICIPATING ORGANISATIONS

Air-Conditioning and Mechanical Contractor's Association of Australia

Air-Conditioning and Refrigeration Equipment Manufacturers Association

Aluminium Foil Insulation Association

Australian Council of Building Design Professions

Australian Glass & Glazing Association

Australian Greenhouse Office

Australian Institute of Building Surveyors

Australian Institute of Refrigeration, Air-Conditioning and Heating

Australian Local Government Association

Australian Window Association

Building Designers Association of Australia

Business Council for Sustainable Energy

Cement and Concrete Association of Australia

Clay Brick and Paver Institute

Commonwealth Scientific & Industrial Research Organisation (CSIRO)

Concrete Masonry Association of Australia

Department of Industry, Tourism and Resources

Earth Building Association of Australia

Facility Management Association

Housing Industry Association

Illuminating Engineering Society of Australia & New Zealand

Institution of Engineers, Australia

Insulation Manufacturers Association of Australia

Lighting Council Australia/Australia's Electronics and Electrical Manufacturing Industries

Master Builders Australia

Timber Development Association

Property Council of Australia

Royal Australian Institute of Architects

Skylight Industry Association

Standards Australia International

ATTACHMENT C
THE BCA ENERGY EFFICIENCY PROJECT
BACKGROUND INFORMATION

Introduction

As party to the United Nations Framework Convention on Climate Change (UNFCCC), Australia agreed at Kyoto in 1997 to limit its greenhouse gas emissions to 108 percent above 1990 levels by 2008-2012. The Australian Government's approach to addressing greenhouse gas issues was enunciated in the Prime Minister's 1997 Statement *Safeguarding the Future: Australia's Response to Climate Change*.

In this Statement, the Prime Minister announced a package of measures designed to reduce greenhouse gas emissions while protecting the Australian economy. The built environment was identified as one sector displaying strong growth in greenhouse emissions and where cost-effective reductions were required.

Accordingly, the Statement indicated that the Government would work with key stakeholders to develop voluntary minimum energy performance standards for new houses and commercial buildings. If, after 12 months, the Government assessed that the voluntary approach had not achieved acceptable progress towards higher energy efficiency standards, *mandatory* requirements would be implemented through the Building Code of Australia (BCA).

Following further consultation, the Government announced in July 2000 that agreement had been reached with industry and State and Territory governments to adopt a two-pronged approach to reducing greenhouse gas emissions from buildings: the introduction of mandatory minimum energy performance requirements through the BCA, and the encouragement of best practice voluntary initiatives by industry. Industry was supportive of this approach, taking the view that building-related matters should be consolidated in the BCA wherever possible.

Given the importance of the energy performance of buildings to overall national greenhouse gas emissions performance, the Australian Building Codes Board (ABCB) and the Australian Greenhouse Office (AGO) entered into a formal agreement to jointly develop the BCA energy efficiency measures.

Project Objective and Scope

The objective of the BCA Energy Efficiency Project is to develop nationally consistent, cost effective, minimum energy regulations for residential and commercial buildings. The project is being undertaken by the ABCB and AGO in consultation with State, Territory and local governments, building practitioners, industry and the community. At specific stages of the project, the ABCB also seeks the views of the wider community through formal public consultation processes.

In November 1999, the AGO released a report (prepared by the CSIRO) titled “Scoping Study of Minimum Energy Performance Requirements for incorporation into the Building Code of Australia”. It identified some minimum energy performance measures that could be considered and concluded that the appropriate place for minimum mandatory energy measures for buildings was the BCA. A subsequent survey of international building energy codes identified other possible measures that could also be included in the BCA.

Based on this information, the ABCB subsequently released a Directions Report (April 2001) which sought comment on the project’s overall proposed direction and issues to be considered in developing the BCA energy provisions. These reports and other studies that are relevant to this project can be accessed on the Australian Greenhouse Office Internet site at http://www.greenhouse.gov.au or the Australian Building Codes Board Internet site at http://www.abcb.gov.au

Program

The BCA Energy Efficiency Project comprises the development and implementation of energy efficiency measures for BCA:

- Volume One (Class 2-9 Buildings)
- Volume Two (Housing Provisions) (Class 1 and 10 Buildings)

Prior to the commencement of the project, industry had expressed concern at the proliferation of residential ‘energy codes’ being implemented at a regional level and called for the expedient development of mandatory measures in the BCA. The Board, therefore, gave priority to developing measures for housing.

These measures were finalised during 2002 and implemented in BCA Volume Two on 1 January 2003. Their introduction was on the basis that the stringency level of some of the provisions would be temporarily lower than desirable to allow industry time to adjust. There was, however, an expectation that the stringency would be reviewed in the future, and some jurisdictions have now indicated their intention to increase the stringency of the measures. As a result, and to facilitate a nationally consistent approach, the ABCB agreed in September 2003 that the housing energy provisions should be reviewed and the stringency increased where appropriate.

The ABCB has now released a set of revised housing measures for public comment and a draft RIS will follow. The revisions aim to increase the stringency of the measures to around 5 stars to the Nationwide House Energy Rating Scheme. If approved, the measures are scheduled to be finalised during 2005 for introduction in the BCA the following year.

The development of energy efficiency measures for commercial buildings has proceeded in two streams. Energy efficiency proposals for Class 2, 3 and 4 buildings were developed and released for public comment during 2003. A RIS, which showed the measures to be cost-effective, was subsequently released for public comment in February 2004. These measures have now been finalised for introduction in BCA 2005.

Measures for other commercial buildings, including office buildings, have been developed in parallel with the review of the housing energy efficiency provisions. A Regulation Document (RD) outlining the proposed energy provisions for these buildings will be released for public comment in late 2004 and a draft Regulation Impact Statement on the proposals is scheduled to be available by January 2005. It is intended that these measures be finalised during 2005 for introduction in the BCA the following year.

Stringency

The BCA energy efficiency measures are intended to reduce the greenhouse gas emissions of new buildings by focusing on the efficient use of energy, while avoiding technical and commercial risks and unreasonable costs.

The fundamental stringency guidelines discussed in the Directions Report and used in developing the energy measures are:

- What is considered a reasonable first step.
- That the provisions be no less than extending current measures nationally.
- That the provisions be cost-effective under an agreed perspective for the economic life of the building.
- Otherwise - determined by expert consensus.

Communication and Education

It is ABCB policy to actively involve stakeholders to assist with the development of the BCA energy efficiency provisions. To facilitate this, the Energy Efficiency Project has several committees and working groups comprising representatives from a range of government, industry and community organisations.

The Energy Efficiency Steering Committee is the policy advisory body for the Energy Efficiency Project and comprises ABCB Board Members and representatives from key industry and government organisations, as well as a community advocate. This Committee oversights the development of the project and provides policy advice to the ABCB and its energy efficiency technical committees and working groups.

The Housing Technical Committee and Commercial Building Technical Committee provide advice to the ABCB and the Energy Efficiency Steering Committee on energy efficiency technical issues. They also assist in the development of technical proposals for inclusion in the BCA energy provisions. In addition, working groups have been established to advise on energy efficiency issues relating to specific building elements.

The Building Codes Committee is the ABCB's peak technical advisory body. It includes extensive representation from industry and State and Territory building control administrations that, in turn, have their own consultation processes. This Committee will review the proposed BCA energy provisions throughout various stages of the project.

The ABCB also seeks the views of the wider community at specific stages of the project, for example, through public comment processes used on the release of Regulation Documents and Regulation Impact Statements.

Education seminar programs on new energy efficiency requirements are delivered by the ABCB prior to the implementation of the measures in the BCA. This ensures not only that building practitioners are adequately prepared for the new requirements, but also raises awareness of current technologies, practices and products designed to increase the energy performance of new buildings.

Further Information

Further information on the Energy Efficiency Project can be obtained from the ABCB Website: www.abcb.gov.au

ATTACHMENT D
THE BUILDING CODE OF AUSTRALIA (BCA)
BACKGROUND INFORMATION

Regulatory Environment

The BCA is written and maintained by the ABCB in conjunction with the State and Territory governments. The Governments of Australia have charged the ABCB with developing a nationally consistent regulatory framework that provides efficient, simple and cost effective building solutions. The BCA sets the minimum community standard in order to eliminate poor practices, which are sometimes described as worst practices. The building industry or consumers may choose better performing systems as part of the building process.

The BCA is prepared and written on the basis that it is the uniform set of minimum technical provisions for the design and construction of buildings and other structures covered under building law throughout Australia. Each State and Territory has its own building control legislation that references the BCA as the technical standard specifying the requirements for the design and construction of buildings and other structures.

Respondents to proposals to change the BCA often suggest including matters such as fit-outs, refurbishments, accreditation, qualifications and duties of designers, inspectors, owners and tenants as well as other non-technical matters. These are not matters for the BCA, but are covered in State and Territory building Acts, regulations or other administrative documents.

Each State and Territory determines the application of the BCA within its jurisdiction. Due to recognition of local considerations, the manner of application and the administrative arrangements vary among the States and Territories.

Although not desirable for achieving national consistency, States and Territories also have the power to vary or add to the technical provisions of the BCA. They may do so if they choose to adopt an alternative method to the common approach, or if the BCA has no provisions for a particular aspect.

Easy to understand and use

The Inter-Government Agreement under which the ABCB was established charges the ABCB with developing efficient and simplified building regulatory systems. For this reason, the proposed energy efficiency measures do not contain the multitude of options or the complexity found in some overseas codes.

Likewise, the BCA Deemed-to-Satisfy Provisions will not specifically contain any mechanism or procedure for using renewable energy for the services. If, for some reason, a designer wishes to pursue such an approach, an Alternative Solution that satisfies the Performance Requirements can be proposed.

Performance-based BCA

The BCA is a performance-based code that sets out the level of performance that a building or structure is to achieve. This allows cost savings in building construction by:

- the use of alternative or innovative materials and forms of construction or designs;
- allowing designs to be tailored to a particular building;
- being clear and providing guidance on what the BCA is trying to achieve; and
- allowing the designer flexibility while still permitting existing building practices through the Deemed-to-Satisfy Provisions.

Allowing for innovation is particularly relevant in developing energy efficiency measures because technologies are rapidly emerging as the community and industry become more conscious of the issues.

Performance hierarchy

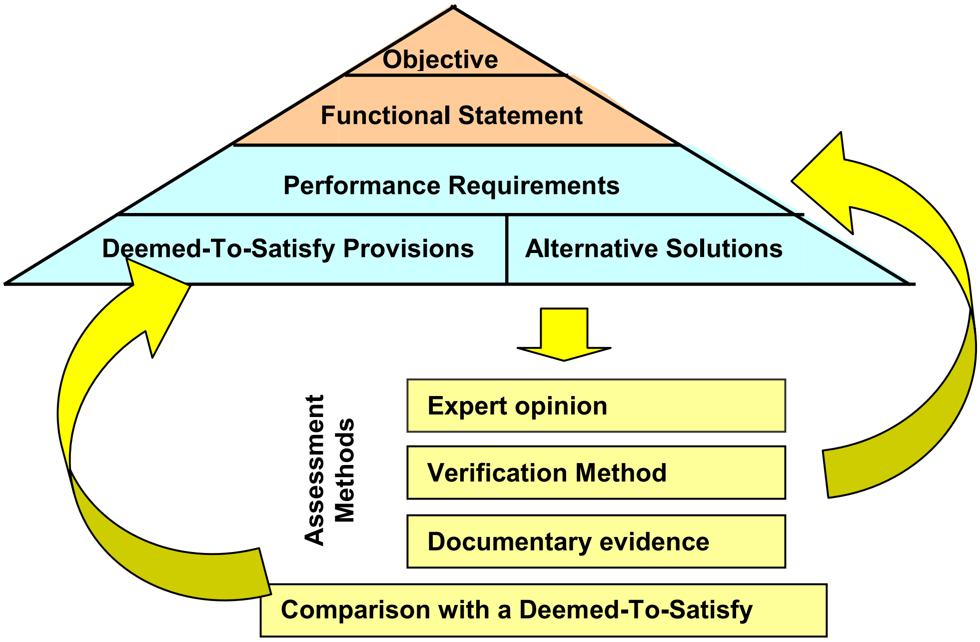
The performance-based BCA has a hierarchy that starts with an Objective and is followed by Functional Statements, Performance Requirements and Building Solutions. The Building Solution may be one that is Deemed-to-Satisfy the Performance Requirements, or may be an Alternative Solution.

Generally, it is the Performance Requirements that are recognised under building law. The Objective is the broad societal goal, while the Functional Statement describes what the building needs to do to meet the Objective.

The building industry believes that the use of Alternative Solutions will be limited in everyday domestic construction, especially as the approval of an Alternative Solution may require complex justification to an approval authority. However, for other buildings, in particular central business district high-rise buildings, an Alternative Solution is more likely to be adopted.

There may be a number of Building Solutions that meet the Performance Requirements. To assist users, at least one approved solution is identified that is considered to meet the Performance Requirements. For user friendliness, simpler solutions are often bound within the BCA while more complicated solutions are contained in separate documents that are referenced by the BCA.

To assess Alternative Solutions for compliance with the Performance Requirements there are a series of Assessment Methods, ranging from equivalence to the Deemed-to-Satisfy Provisions to a defined Verification Method. The following diagram shows the BCA hierarchy and the Assessment Methods.



Alternative Solutions

Rather than use the Deemed-to-Satisfy Provisions, a designer may choose to use an Alternative Solution. For this, the approval authority needs to be satisfied that the Alternative Solution meets the Performance Requirements. There are four means of assessing Alternative Solutions. They are:

- Use of a Verification Method;
- Equivalence to a Deemed-to-Satisfy Provision;
- Evidence of suitability; and
- Expert judgment or opinion.

Using a Verification Method involves following a specific procedure to determine whether, under the prescribed conditions, the required criterion is met. For example, this criterion may be a star rating to the Nationwide House Energy Rating Scheme or the energy load per annum per unit area. The Verification Method can also be a procedure for determining the required criterion.

For energy efficiency measures, equivalence to a Deemed-to-Satisfy Provision could mean analysing the subject building with the Deemed-to-Satisfy Provisions and then adjusting the analysis input using the Alternative Solution. Provided the estimated energy load of the Alternative Solution does not exceed that of the Deemed-to-Satisfy Provision, the proposed solution could be acceptable. Acceptable forms of Evidence of Suitability are described in Clause A2.2 of BCA Volume One.

Expert Judgement is an Assessment Method involving peer opinion and may be used, for example, where the other forms of assessment are not suitable.

The structure of the BCA

Building regulations and the BCA are structured in a unique way in order to meet legislative protocols. For ease of use and national uniformity, any mandatory energy efficiency measures must follow that structure.

The BCA is in two volumes. Volume One is for all buildings (Class 2-9) other than housing, while Volume Two is for housing and associated garages, carports, sheds, etc.

Each Section or Part of the BCA reflects the hierarchy as follows:

- Objective
- Functional Statement
- Performance Requirement
- Verification Methods
- Deemed-to-Satisfy Provisions

Reference documents

Rather than include all the technical requirements in the BCA, many are included in other documents that are then referenced by the BCA. As reference documents are not bound within the BCA, there is no restriction on their size. These documents can also be typically more complex than the Deemed-to-Satisfy Provisions contained in the BCA. Most of the documents currently referenced by the BCA are Australian Standards.

BCA amendment process

There is ongoing research and review of aspects of the BCA technical content. However, responsibility for building control regulations and changes to the BCA resides with the eight State and Territory governments. To change the body of the BCA requires their agreement.

The BCA can only be changed by following the established process of developing measures suitable for calling-up under building law, and for significant changes:

- preparing a regulatory proposal and a regulation impact assessment;
- seeking public comment; and
- satisfying the requirements of the Governments and the Office of Regulation Review.

The BCA is republished annually.

Further information

Further information on the BCA and its application in the regulatory context is available from the ABCB website: http://www.abcb.gov.au