

Insulated panels for external roof and wall cladding



**Conservation of Fuel and Power
Building Regulations (2011)**

England and Wales: AD-L2

Northern Ireland: Part F

Scotland: Section 6

**Guidance on compliance
using Insulated Panel Systems**

Introduction – 2010 Energy Regulations

New regulations – non-domestic buildings

The latest amendment to the England and Wales Part L Regulations for the conservation of fuel and power (2010) and Section 6 Scotland came into effect on 1 October 2010. This is the second amendment following the introduction of these mandatory regulations in 2002. The amendment to Part F Northern Ireland is expected late 2011.

The 2010 Amendment is the latest stage in the Government's planned progress to low-carbon buildings by 2019. There will be further reviews in 2013 and 2016.

The principal aim of these new Building Regulations is to reduce the CO₂ emissions to meet the UK and EU targets and to help comply with the European Energy Performance of Buildings Directive (EPBD).

AD-L2 follows the principle of the 2006 Regulations but with major and significant changes. As before, the whole building is assessed using the SBEM 'whole building methodology' that expresses the energy performance. Since it is the building services that emit CO₂ and not the building elements, the total energy building performance takes account of the CO₂ emissions resulting from the provision of heating, hot water, ventilation, cooling and lighting. It is therefore based on the building's use in occupation.

The EPIC guide

This Guide has been prepared by EPIC to assist Architects and Specifiers who are using Insulated Panels in the design of Industrial, Commercial, Leisure, Transport, Education, Health and other buildings.

Sections 1-4 of the Guide cover the new requirements as they are applied to new buildings.

Sections 5 & 6 summarise the requirements applied to the refurbishment and extension of buildings.

Sections 7 & 8 summarise the requirements applied to the shell and fit out of buildings.

The EPIC Guide gives information on:

- The data that is required to be inputted for Insulated Panels including the junctions and details as well as the airtightness of the building fabric
- How to understand the SBEM Calculation Tool and the influence of the various elements that affect energy consumption
- Which systems are penalised by the methodology and discouraged from use
- Keys to achieving compliance

	Title	Implementation date	Download
England and Wales	Approved Document AD-L2A (New build) and AD-L2B (Refurbishment) – Conservation of fuel and power	1 October 2010	www.planningportal.gov.uk/uploads/BR_PDF_AD_L2A_2010.pdf www.planningportal.gov.uk/uploads/BR_PDF_AD_L2B_2010.pdf
Scotland	Building (Scotland) Regulations – Technical Handbook: Section 6 Energy	1 October 2010	www.sbsa.gov.uk
Northern Ireland	DFP Technical Booklet F2 (2011) – Conservation of fuel and power other than dwellings	Anticipated late 2011	www.buildingregulationsni.gov.uk

Download information from the EPIC website

This guide to the amendments to the Building Regulations 2010 together with the other EPIC Guides can be readily downloaded from the EPIC website at www.epic.uk.com

Contents

New build

Section 1	Implications of the AD-L2A 2010 new build requirements	4
Section 2	Insulated Panels – Labelling and cost effective compliance	7
Section 3	Key issues – calculation method and the building envelope	9
3.1	Understanding SBEM	9
3.2	Building envelope – ‘U’-values	10
3.3	Building envelope – Air permeability	11
3.4	Building envelope Construction details – ψ -values	12
3.5	Building envelope – Km value	13
3.6	Building envelope – Rooflights and solar gain	14
3.7	Building services, lighting and controls	14
Section 4	Key factors to compliance using SBEM	15
4.1	Introduction	15
4.2	Methodology	15
4.3	Data entry into SBEM	16

Refurbishment

Section 5	Requirements under AD-L2B (England and Wales) and Part F (Northern Ireland) for refurbishment and extensions	20
5.1	Introduction	20
5.2	Insulated panels and refurbishment work	20
5.3	Types of work	20
5.4	Extensions	21
5.5	Material change of use/energy status	22
5.6	Consequential improvements	22
5.7	Guidance on thermal elements	23
Section 6	Refurbishment requirements – Section 6 (Scotland)	25
6.1	Requirements	25
6.2	Conversions	25
6.3	Extensions	26
6.4	Alterations	27

Shell and fit out buildings

Section 7	England, Wales and Northern Ireland	29
Section 8	Scotland	30

AD-L2A New build

Implications of the requirements

New compliance targets

The 2010 Amendment is the latest stage in the Government's planned progress to low-carbon buildings by 2019. There will be further reviews in 2013 and 2016.

This latest amendment to the England and Wales Part L Regulations for the conservation of fuel and power (2010) came into effect on 1 October 2010. It is the second amendment following the introduction of these mandatory regulations in 2002.

2002 introduced prescriptive thermal performance values (U-values) and air tightness requirements for non-domestic buildings.

2006 completely changed the way buildings are assessed by comparing the energy performance of the whole building against a 2002 notional building of the same type. This included assessment of building services as well as the building fabric. Compliance was measured using the National Calculation Method (SBEM or equivalent). To comply buildings had to show an improvement of between 23 and 28% over the 2002 model building.

The AD-L2: 2010 Amendment significantly changes the way non-domestic buildings – industrial, commercial, retail, leisure, schools and health – are assessed in terms of the energy consumed and the associated carbon dioxide emitted. To comply, buildings shall not exceed the target CO₂ emission rate as calculated by the SBEM model or equivalent.

2010 Major changes

- 2010 introduces further changes in the way non-domestic buildings are assessed. New Notional Building targets have been set for a variety of non-domestic building types and are based on an average further improvement of 25% over 2006 levels.
- A new NCM Model has been introduced with the average 25% target improvement already programmed into the values for each notional building type. To comply the actual designed building has to equal or better the figures for the equivalent notional building.
- The emission rate calculation **has now to be completed at design stage** and submitted to Building Control before the work starts together with a list of specifications of the building envelope and the fixed building services.
- In order to achieve compliance it will be necessary to improve building fabric values – U-values and air tightness – as well as make significant improvements for lighting, heating/cooling, ventilation and system controls
- There are new rules for shell and fit-out buildings

Simplified Building Energy Model (SBEM)

The SBEM procedure remains the stated method for assessing compliance in AD-L2: 2010 England and Wales, and Section 6:2010 Scotland. It is expected to be the compliance method for Part F2:2011 Northern Ireland. SBEM is one of several approved software options for assessing compliance.

The latest SBEM programme and user guide can be downloaded from the following link:
www.ncm.bre.co.uk/index.jsp

New prescriptive building types

The major change for non-domestic buildings is that they have been divided into eight main building types (Table 1) and a specific Notional Building has been calculated for each within the SBEM model. The main building types have been allocated a target energy/carbon emissions saving over 2006 levels that is considered achievable and that represents an average saving over all building types of 25%.

The target savings are different for each group and have been programmed into SBEM or the equivalent compliance models.

Table 1. New prescriptive building types for 2010

Non-domestic building type	% new build
Shallow plan (heated only)	1
Shallow plan (air conditioned)	1
Deep plan (air conditioned)	40
Warehouse	33
Hotel	6
School	4
Retail	12
Supermarket	2

Implications for designers

Changes in Notional Building

In common with the 2006 Regulations, compliance is based on an assessment of the whole building performance – the envelope, lighting and services. However the balance between the savings contributions for the envelope, lighting and controls, and services has changed within the various building types.

In addition the NCM tool (SBEM) further sub-divides each building type. A basic design format is prescribed for each building sub-type, for example SBEM automatically assumes a given type of daylighting (side-lit windows or top-lit rooflights), hot water heating etc. It is vital that the correct type of building information is entered into SBEM, otherwise an incorrect computation could result in non-compliance.

Finally the calculation showing the target CO₂ emission rate is not exceeded has now to be completed at design stage and submitted to Building Control together with a list of specifications of the building envelope and the fixed building services.

Example – Industrial Buildings

Industrial type buildings are sub-divided into 4 principle categories (Table 2).

These can be found in the drop-down menu within SBEM or equivalent programmes. Designers should check against the NCM Handbook that the chosen notional building type has the same configuration as the design building particularly in terms of type of daylighting e.g. rooflights, side-lit windows and also assumed occupancy and type of building services.

AD-L2A New build

Implications of the requirements

Table 2. Example of building sub-types by planning class

Type	Definition of building type
A1/A2	Retail
B1	Offices and workshop businesses
B2 to B7	General industrial and special industrial groups
B8	Storage and distribution

The buildings are then further divided into zones, as with the previous SBEM, but new menus describe a choice of activities. The selection is different for each of the building types in Table 2.

Contributions towards compliance

The mechanism of compliance requires designers to look at the energy performance and efficiency of all elements and services affecting the consumption of energy. The contribution from each of these areas varies considerably and therefore it is essential that designers understand the workings of the calculation method and which areas represent the most cost effective route to compliance (see section 3).

Improvements to the building fabric performance and level of air permeability can make a significant contribution to the target savings. However trials using a range of buildings have shown that improving the fabric alone is not sufficient to achieve compliance. Improvements to services and particularly lighting and controls are also necessary to achieve compliance.

Improved values in the Notional Buildings

In order to achieve the 25% target improvement in energy/carbon emissions for 2010, the set values in the Notional Building have been improved significantly compared to 2006, including:-

- Lower fabric U-values
- Lower air permeability rate
- Improvements to lighting and controls
- Improved efficiency of services and controls
- Limitations on the effect of solar gain, though there are no checks on individual zones within the building

The overall level of improvement is so significant that in order to comply, **all** aspects of the building will have to be improved or made more efficient.

Interdependence of data

Significantly changing the performance in one area or of one element may create a change in other areas that may not necessarily be beneficial. For example increasing the roof daylighting percentage may reduce lighting energy requirement but will adversely affect the building fabric thermal weighted average and increase the effects of solar gain.

Notification on completion

After work has been completed the contractor/builder must notify the Building Control Body [BCB] of the target CO₂ emission rate [TER] and the building CO₂ emission rate [BER] and whether the building has been constructed in accordance with the list of specifications submitted to BCB before the work started. If changes have been made a revised list of specifications must be given to the BCB [AD-L2A #4.12].

2 New build Insulated Panels – labelling and cost effective compliance

The 2010 Amendment is the latest stage in the Government's planned progress to low-carbon buildings by 2019.

Designing buildings in accordance with AD-L or the other National Regulations is part of the long-term implementation of the European EPBD (Energy performance of Building Directive). The EPBD includes a requirement for the building energy labelling of buildings including the determination of Operational Ratings for all buildings.

The EPD directive will lead to a new focus on the long-term energy performance of building envelope systems. Disclosure of the Operational Rating is likely to become a legal requirement and any drop in performance during the life of the cladding systems could materially affect the potential sale value and letability. Insulated Panels offer sustained performance over future years.

PIR Insulated Panels offer sustainable performance during the life of the building

Building certification and labelling

Energy Performance Certificates (EPCs) are now mandatory and are required for all buildings that are being built, let or sold. They are part of the establishment of Operational Ratings for buildings and are part of the new build process.

The calculation compliance summary from the SBEM or equivalent calculation methodology is used by the registered person as part of their assessment of the as-built construction and is checked against the reference building to create the EPC. An EPC lasts for 10 years.

EPCs should not be confused with DEC (Display Energy Certificates) for public buildings that are based on actual energy consumption and are reviewed annually.



Example of operational rating certificate.

Benefits and contribution to compliance and cost effectiveness of Insulated Panels

From their introduction Insulated Panels with PIR insulating cores have offered the designer a guarantee of long-term performance.

Both thermal performance and the airtightness of Insulated Panel systems can be readily controlled enabling the services engineer to design plant sizes efficiently to maximise capacity and energy efficiency. Under the original 2002 regulations this was of direct benefit to the building user. Following the 2006 and 2010 regulations this benefit also translates directly into carbon savings and a positive saving to the target savings under the SBEM compliance calculations.

Although the main focus will be how to achieve compliance in meeting the requirements of AD-L2 (2010) for both new build and refurbishment, the continuing rise in the cost of energy has placed renewed emphasis on the thermal performance of building envelopes.

Numerous studies over the past 20+ years, including new research on the 2010 Regulations, have shown the substantial benefits that can be achieved in heating energy costs by moving to an insulated panel clad building. In certain cases payback periods as low as 18 months have been achieved for the re-cladding of buildings.

2 New build Insulated Panels – labelling and cost effective compliance

Cost effective design – new research

A detailed analysis has been carried out to study the effect of improving insulation levels. The analysis compared the performance of a variety of non-domestic buildings (as detailed in the Building Regulations Part L:2010) under varying circumstances that reflect the practical use of top-lit buildings. This research assessed the energy requirements, carbon emissions, capital costs, net current values and cost effectiveness of the aggregate notional NCM 2010 warehouse buildings, considering four sets of usage options including internal usage types; heating temperature set points; occupancy assumptions; and three insulation levels.

The EPIC research study highlights that cost effectiveness of insulation levels is dependent on the building type, temperature set point and occupancy levels. The following general conclusions can be drawn.

- For warehouse storage buildings an improvement of insulation levels – to walls at $U=0.25$ W/m²K and roofs at $U=0.18$ W/m²K – was found to be cost effective for temperature set points and occupancies at the NCM levels
- For retail warehouse buildings the same improvement in insulation levels was found to be cost effective in all cases unless the temperature set point is reduced to 16°C.
- For industrial process buildings the National Calculation Method defines these buildings as having very high internal gains at a level that is not realistic for many industrial process buildings. Against these parameters the result was not cost effective but as there is a potential for change of use of these buildings to a lower internal gain activity it is reasonable to maintain good levels of insulation
- The impact of improved values on peak demand was also investigated. Peak demands in some cases reduce by up to 20% with the highest insulation levels. This could have an impact on the cost of the heating systems and would therefore reduce the additional capital costs of the insulation

The cost effectiveness of improving the fabric insulation increases further if DECC Fossil Fuel Price Assumptions are used (Natural Gas at 2.87p/kWh in 2010 rising to 4.06p/kWh by 2020). With only this change in natural gas fuel cost assumptions it is cost effective in nearly all top-lit buildings to insulate to levels of walls at $U=0.20$ W/m²K and roofs at $U=0.15$ W/m²K

Benefits of Insulated Panels

Insulated Panels with PIR insulating cores have from their introduction offered the designer a guarantee of long-term performance. Insulated Panels produced as single piece system under factory-controlled conditions ensure that:

- Insulation thickness and performance is calculated, controlled and maintained
- The insulation performance of PIR is one of the most efficient available allowing the dimensions of the wall and roof zone to be kept to a minimum
- The insulation performance remains virtually unchanged throughout the life of the panel due to the encapsulation of the metal facings
- The joints between panels are fully engineered to minimise heat transmittance and ensure that air leakage is minimised after onsite installation
- The complete system including approved details and accessories enable an airtight and energy efficient envelope to be installed by the established cladding installers

Control of both thermal performance and the airtightness of Insulated Panel systems enables the services engineer to design plant sizes efficiently to maximise capacity and energy efficiency. Under the original 2002 regulations this was of direct benefit to the building user. In 2006 and 2010 this benefit also translates directly into carbon savings and a positive saving to the target savings under the SBEM compliance calculations.

3 New build Key issues – the SBEM calculation method

3.1 Understanding SBEM – CO₂ contributors

Compliance is demonstrated by proving that the target carbon dioxide emission rate (TER) for the whole building is achieved, as determined by the SBEM or other similar calculation method.

It is electrical, oil or gas energy used by the building services that produces CO₂. The generation of CO₂ in Kg per kW.h for each energy source is shown in Table 3.

Table 3. CO₂ emission factor by energy source

Energy source	CO ₂ (kg/kW.h)
Electricity	0.591
Gas	0.206
Oil	0.284

Table 3 illustrates clearly that electrical energy used for lighting and the running of services has a considerably greater effect than gas or oil used for heating. Selecting energy efficient plant and equipment that are high users of electrical energy or restricting the use of electrical energy (e.g. lighting controls) produces the largest contribution in SBEM and the other calculation methods. EPIC's recommendations later in this section and in section 4 take this into account.



3 New build

Key issues – the SBEM calculation method

3.2 Building envelope U-values

U-values (Thermal performance of roofs, walls and floors)

Although the AD does not prescribe U-values, the fact that significantly improved levels have been set into SBEM means that adopting inferior U-values in the design specification could lead to non-compliance. If inferior values are specified then additional major improvements will have to be made in the Building Services to achieve compliance.

Using the 2010 values or better can also be cost effective - see Section 2 - as well as being an important factor in achieving compliance.

Table 4 shows the U-values used in the 2010 Notional (non-domestic) Buildings together with the new backstop values (maximum area weighted average values for Scotland), compared to 2006 levels.

Table 4. Fabric U-values and backstop levels

Notional building	2006 Values	2010 Notional building values	2010 New backstop values
AD-L2A England & Wales			
Roofs	0.25 W/m ² K	0.18 W/m ² K	0.25 W/m ² K
Walls	0.35 W/m ² K	0.26 W/m ² K	0.35 W/m ² K
Floors	0.25 W/m ² K	0.22 W/m ² K	0.25 W/m ² K
Glazing	2.2 W/m ² K	1.8 W/m ² K	2.2 W/m ² K
Rooflights	2.2 W/m ² K	1.8 W/m ² K	2.2 W/m ² K
Rooflight (Max. area)	20% area	12% area	N/A
Section 6 Scotland			Maximum area weighted values ⁽²⁾
Roofs (Scotland) (pitched) (flat) ⁽¹⁾		0.16 W/m ² K 0.25 W/m ² K ⁽¹⁾	0.20 W/m ² K
Walls (Scotland)		0.30 W/m ² K	0.27 W/m ² K

(1) 'Flat' is defined as 'flat or roofs with integral insulation' including Insulated Panels

(2) Maximum area weighted average values for all elements of the same type (see clause 6.2.1)

EPIC recommends

EPIC recommends designing non-domestic buildings to the new 2010 U-values set in the Notional Building or better as a cost effective way to compliance.

3.3 Air permeability

In AD-L2: 2010 for non-domestic buildings the target level has been lowered to $5 \text{ m}^3/(\text{h.m}^2)$ at 50Pa with a backstop level of $10 \text{ m}^3/(\text{h.m}^2)$ at 50Pa. The $10 \text{ m}^3/(\text{h.m}^2)$ limit is a mandatory requirement for all new buildings except those below 500m^2 for which $15 \text{ m}^3/(\text{h.m}^2)$ can be adopted without testing. In Scotland, air permeability is expressed as a 'recommended limit' of $10 \text{ m}^3/(\text{h.m}^2)$ - the same value as that used in SBEM for Scotland. Testing became mandatory for warrants made after 1 May 2011.

In September 2010 EPIC commissioned Building Sciences to conduct an analysis of the performance of 245 building reports issued between January 2008 and August 2010. The objective was to obtain an understanding of how actual building performance compared against the 2006 regulatory requirement of $10 \text{ m}^3/(\text{h.m}^2)$ and in particular whether it is more difficult to achieve lower air permeability values with smaller footprint areas.

Research summary

- 33% of the buildings tested either failed to comply or only just passed $10 \text{ m}^3/(\text{h.m}^2)$
- 80% would fail the 2010 benchmark in the SBEM Model of $5 \text{ m}^3/(\text{h.m}^2)$
- Of buildings with a footprint greater than 4000m^2 , 84% achieved a measured air permeability less than $7 \text{ m}^3/(\text{h.m}^2)$ and 68% achieved a value of $5 \text{ m}^3/(\text{h.m}^2)$ or better
- Generally the lower the foot print area the worse the air permeability value, especially where the structures are more complex with mixed cladding types

Buildings below 4000m^2 footprint

Research into levels of actual air permeability achieved for buildings with a footprint area under 4000m^2 indicate that improvements from 10 to $5 \text{ m}^3/(\text{h.m}^2)$ at 50Pa are difficult to achieve unless specific attention is paid to the detailing at both the design and construction stages. Air tightness is very dependant on workmanship however good the joints and details from the manufacturer.

The research data suggests that designers should give very careful thought to air permeability values and the design value that is put into the SBEM calculation. In many cases the new AD-L2A: 2010 Notional Building value of $5.0 \text{ m}^3/(\text{h.m}^2)$ may be difficult to achieve in practice. Failure to achieve the design air permeability value will compromise the ability of the completed building to achieve overall compliance with the Building Regulation. Failure to comply will inevitably involve project delays and additional costs.

The research suggests a conservative value for air permeability should be adopted at design stage, generally above the Notional Building value, to minimise the risk of non-compliance

Buildings above 4000m^2 footprint

In general terms as a building increases in size and volume it will be easier to achieve a low air infiltration value. However, the more complex buildings such as those with a large level of interface details, for example, offices, schools, hospitals and hotels need careful consideration as to whether an air permeability design value of $5 \text{ m}^3/(\text{h.m}^2)$ at 50Pa is appropriate. Using a higher air permeability design value would lower the risk of failing the final SBEM calculation.

For larger, less complex buildings it may be possible to use an air permeability design value of less than $5 \text{ m}^3/(\text{h.m}^2)$ at 50Pa however the risk of failing the final SBEM calculation and subsequent cost and program issues needs to be considered.

It is worthwhile remembering that buildings which beat the target carbon emission rate will achieve a better EPC rating and, if BREEAM assessed, will gain additional credits in the energy section.

3 New build

Key issues – the SBEM calculation method

3.4 Construction details

AD-L2: 2010 refers to Accredited Construction Details for non-domestic buildings. At the time of publication of this guide no accredited construction details schemes have been approved by the Secretary of State. Until such time that accredited construction details schemes have been approved, the calculated value of linear transmittance may be used in SBEM without any performance penalty being added where this has been calculated by a suitably experienced and qualified person and the builder has provided information about the way the detail is to be constructed to the Building Control Body.

Reference:

<http://www.communities.gov.uk/publications/planningandbuilding/divletterapproveddocumentfjl> (# C14) and <http://www.2010ncm.bre.co.uk/newsdetails.jsp> (Point 6)

EPIC and MCRMA (Metal roofing and Manufacturers Association) prepared Technical Paper 17 (see link below) for the 2006 AD-L Regulations. TP17 lists all the basic details and their ψ -values that have been calculated by third parties using finite element analysis. All EPIC members have a full set of details for their Insulated panels calculated by the same method and should be contacted directly for further information.

The SBEM calculation tool imposes a 50% penalty if Accredited Construction Details are not used. However this penalty can be avoided if manufacturers 'accredited details' are used and installed. The following steps permitted by DCLG must be followed.

Steps for avoiding a 50% penalty on construction details in the SBEM Calculation

- Tick the box for QA ACD junctions and enter accredited ψ -values
- The Ψ -values entered in the calculation should be calculated by a suitably experienced and qualified person in which case the 'Quality Assured' box should be ticked against each entry to avoid penalty
- The Ψ -values supplied either by EPIC panel manufacturers or from TP17 as applicable meet this criteria
- Installation should be to a reasonable standard of workmanship including continuity of insulation and air seals. EPIC panel manufacturers provide detailed information on the seven principal details listed in the SBEM dropdown lists
- The installer must provide information on the construction of the details to Building Control

NOTE. Some alternative approved calculation methods take a different approach to thermal bridging and do not require the input of ψ -values.

Approved details from the Insulated Panel Manufacturers are generally designed to give lower and more efficient ψ -values for most of the common junctions. Use of these details can result in improvements in TER

Table 5 summarises junction details listed in SBEM together with ψ -values quoted by IP 01/06 and used as the SBEM default values. The approved details recommended by the Insulated Panel manufacturers generally give improved ψ -values.

Table 5 Summary of ψ -values found in SBEM compared to manufacturers details

Junction detail	ψ -values from Insulated Panel manufacturers	ψ -values from IP 01/06 and MCRMA/EPIC TPI7	MCRMA/EPIC TPI7 Figure No for generic detail
Roof – wall combined eaves and verge*	ψ -values provided by manufacturers for approved details are equal to or better than IP 01/06	0.28	Fig. 11 & 12
Wall – ground floor		1.15	Fig. 13
Wall – wall corner		0.25	Fig. 14
Wall – floor not ground		0.00	Fig. 15
Lintel above window or door		1.27	Fig. 16
Sill below window		1.27	Fig. 17
Jamb at window or door		1.27	Fig. 18

* SBEM uses a combined detail to represent both eaves and verge arrangement. The calculation method for this can be found in MCRMA/EPIC TPI7.

EPIC recommends

Due to the limitations of the SBEM calculation tool, EPIC recommends that designers do not enter ψ -values for any additional details that are not listed in SBEM. Their inclusion is likely to have a negative effect on the TER.

3.5 Building envelope – K_m values

In addition to U-values, the thermal mass of the cladding element (K_m in kJ/m^2) is now included as part of the SBEM calculation to determine the effects of intermittent heating etc.

The K_m value includes an average thermal mass for a steel portal frame and sheeting rails on the heated side of the Insulated Panel.

EPIC recommends

Check that the K_m value in the SBEM Calculation is set at 7.0 kJ/m^2 for the metal panel cladding system. (Some versions of SBEM have different default values and should be corrected).

Table 6. K_m values for typical insulated panel systems

	K_m value (kJ/m^2)
Roof – metal faced insulated panel	7.0
Wall – metal faced insulated panel	7.0

3 New build

Key issues – the SBEM calculation method

3.6 Building envelope – rooflights and solar gain

The regional Building Regulations indicate a minimum U-value requirement of 2.2 W/m²K. However, SBEM uses a default U-value of 1.82 W/m²K area weighted average for profiled in plane rooflights, which is a non-standard value for most triple-skin rooflights.

EPIC recommends that designers use the rooflight manufacturers' values and not the default value in SBEM. Although this may result in a small negative effect within the compliance calculation it has the benefit of being in agreement with the as-built computation.

For normal industrial portal frame, insulated panel clad buildings the optimum contribution according to SBEM model calculations occurs with about 12% of rooflights.

The contribution of rooflights has changed with the varying drafts of the SBEM calculation tool. The amount of roof daylighting directly influences the internal lighting requirements and the potential solar gain.

For AD-L2A:2010, reasonable provision for limiting solar gain is set out in AD-L2A #4.43 and #4.44 according to whether the space in the NCM data base is defined as being:

- top lit with a zone height below 6m
- top lit with a zone height greater than 6m
- side lit

3.7 Lighting and building services

Contributions to the improved targets have substantially changed in the 2010 AD. The benefits of improved efficiencies and controls for heating, ventilation and air conditioning services had largely been taken in meeting the requirements for the 2006 change. As a result greater emphasis has been placed on lighting and controls in the 2010 model. PV dimming is now included in the calculation for the Notional Building.

The less efficient forms of lighting and the least efficient types of plant are penalised in the energy saving calculation. Designers should contact the lighting or services provider to confirm the latest energy efficient technology and its effect on compliance within the SBEM and other calculation tools.

One of the most difficult areas to understand is the way SBEM and similar models have treated lighting, heating, cooling and controls and the inter-relationship between services and controls. One of the principal aims of the model is to encourage the use of automatic controls such as photoelectric dimming and efficient means of providing heating and cooling.

In section 4 EPIC provides guidance on the positive and negative effects of a variety of the most common lighting, heating and HVAC systems. This is critical in some cases because compliance cannot be achieved with some of the older traditional systems and for others there is a significant penalty.

EPIC's experience with the 2010 calculation methods shows that they are very sensitive to changes in services and in particular lighting systems and it is almost impossible to predetermine the affect of any change.

WARNING: Designers are advised not to accept specification or system changes to building services or controls without carrying out a trial check using the calculation tool

4 New build

Key factors to compliance using SBEM

4.1 Introduction

This section of the guide, compiled with the assistance of EPIC's Consultants and technical experts, has been designed:

- To give designers a better understanding of the key variables that control the CO₂ emissions
- To facilitate their path through the SBEM screens
- To optimise the inputs into the calculation tool for Insulated Panel buildings

The information in this EPIC supporting document focuses on metal portal frame buildings constructed with insulated panels as the building envelope. It complements the guidance given in the SBEM tutorial programmes that are downloadable from BRE. However the guidance in the tutorials is general in nature and attempts to cover a wide variety of buildings. As a result certain options are not valid for Insulated Panel buildings or if entered may set up a string of irrelevant criteria.

The methodology and data input for insulated panels set out in Section 3 is also valid for alternative metal cladding systems on all building types input. Similarly, the principles apply to other approved compliance calculation tools on the market, which are based on SBEM.

Great care should be taken with the preparation and input of data. Problems are not readily identifiable if unexplained results/non-compliance are produced by the SBEM calculation tool

This section is set out in the same order as the data input into SBEM. However the experts recommend that time should be spent defining a method of working and pre-planning the zoning and data input before embarking on the task of data input (see 4.2).

4.2 Methodology

SBEM is a methodology and it is beneficial to establish a method of working to facilitate the input of data.

Initial steps

1. Determine the building use through the basic building information – menu for end use.
2. Assign each zone to one of the end use using the sub-menu.
3. Each zone has to have the activity selected from the sub-menu. This is different for each end use. Care is required because the menu is presented in a different order for each end use and resets to the first line if the zone is changed from say B8 to B2/B7.

Zoning

One of the most important preliminary tasks is to mark out and identify the various distinct zones within a building. SBEM defines zones as spaces that are distinct from adjacent areas in terms of activity, heating/cooling requirement, lighting provided or required, or other services required.

These zones have to be separately identified and may be bounded by physical walls, or 'imaginary' walls to create virtual zones with different heating or lighting requirements to save energy. It is assumed that imaginary walls have a zero transmission where there are similar conditions in the adjacent spaces.

ADL2A defines daylit space as 'any space within 6 m of a window wall, provided that the glazing area is at least 20% of the internal area of the window wall.' This can be used as a yardstick for zoning as can specific areas under runs of rooflights.

4 New build

Key factors to compliance using SBEM

4.3 Data entry into SBEM

4.3.1 Building type

Building type – options	Notes and recommendations on data entry
<p>The 2010 SBEM model identifies for the first time distinct types of buildings and building activity. [See 1.3]. It is essential that this is correctly entered as it automatically sets some of the energy parameters such as:</p> <ul style="list-style-type: none"> ● the notional hours of building use and therefore the main energy contribution ● types of heating and cooling ● domestic hot water requirements ● daylighting, especially in terms of top-lit or side-lit <p>Speculative buildings</p> <p>Developers have the option of selecting ‘shell and core’. The activity e.g. B1, B2/7, B8 has to be selected before the tick box for shell and core.</p> <p>(The only visible change is a note to Building Control to check that fit out services are at least as good as those specified in the SBEM calculation)</p>	<p>Compliance is achieved by comparing the actual building with a Notional Building of the same basic design. If the correct predominant use is not entered this could severely affect the ability to comply and services etc will not be compared on a like-for-like basis. The target improvement is different for each of the new building types</p> <p>In addition there are sub-divisions that are specific to each building type</p> <p><i>Note. Speculative buildings. A full SBEM calculation has to be repeated and compliance proven when the building is brought into use. (See sections 7 and 8)</i></p>

4.3.2 Location

Location options	Notes on data entry
<p>Initial selection is to choose the relevant Building Regulations – England and Wales, Northern Ireland or Scotland. The second selection parameter is ‘weather [location]’ – a drop-down list of locations.</p> <p>Scotland. Selection of Scottish Building Regulations and weather (Scotland) will automatically set defaults for any U-value and other parameters that are different from England and Wales and Northern Ireland.</p>	<p><i>It is important to select the correct location because the location automatically sets defaults for weather, heating and lighting and wind exposure.</i></p> <p><i>Note. Where Scotland/Scottish Building Regulations are selected an additional ‘tick-box’ appears, to confirm that in the case of naturally ventilated buildings, studies have confirmed that they will not overheat.</i></p>

4.3.3 Building fabric

U-value and ψ -value – options	Notes and recommendations on data entry
<p>U-values – roofs and walls</p> <p>Selection options are either to select the generic product type offered or enter the U-value as stated by the Insulated Panel manufacturer.</p>	<p><i>EPIC recommends that the U-value stated by the manufacturer for the specified Insulated Panel system be entered. These values are calculated by accredited methods and include allowances for the thermal performance at the joints and fixings used for securement. (see section 3.2)</i></p>
<p>Km – roofs and walls</p> <p>The SBEM default value should be checked to ensure that the correct value is used for insulated panel roof and wall systems:</p> <ul style="list-style-type: none"> ● Roof: Km = 7.0 ● Wall: Km = 7.0 	<p>The Km default value in the calculation models must be checked. (See section 3.5).</p>
<p>U-values and Km – internal walls and ceilings</p> <p>U-values and Km values stated by the system manufacturer should be used in the SBEM calculations.</p> <p>In the case of ‘imaginary’ walls a U-value of ‘0’ should be used.</p>	
<p>U-values – floors</p> <p>The U-value of floors varies with perimeter and any insulation applied to the edges.</p> <p>The U-value used by SBEM for the notional building is now adjusted for size in the calculation for the actual building.</p>	<p>Recommendation. Initially use the default value of 0.22 W/m²K (uncorrected). If the TER result for the building is non-compliant recalculate using the correction factors for perimeter. The method of correction is set out in BR443. The BRE and other software packages for U-value calculations can be used to determine the effective U-value.</p>
<p>ψ-values – roofs and walls</p> <p>Designers should tick the box for QA ACD junctions [se 3.4] and either:</p> <ul style="list-style-type: none"> ● Specify the Insulation Panel manufacturer’s approved details and enter the manufacturer’s calculated ψ-values for each of the applicable details or ● Specify details in accordance with IP 01/06 <p>For any other details not involving metal cladding tick ‘robust’ if applicable</p>	<p><i>EPIC strongly recommends that the Insulated Panel Manufacturer’s approved details are always used and the manufacturer’s quoted values entered in the calculation. If non-approved details are used the SBEM tool will default to the values for the notional building +50%.</i></p> <p><i>Note. Only enter ψ-values for the relevant details listed in the SBEM tool.</i></p>

4 New build

Key factors to compliance using SBEM

4.3.4 Rooflights

Rooflight – options	Important notes on data entry
<p>U-values</p> <p>Building Regulations indicate a minimum U-value requirement of 2.2 W/m²K. However, SBEM uses a default U-value of 1.82 W/m²K area weighted average for profiled in plane rooflights, which is a non-standard value for most triple-skin rooflights.</p> <p>Percentage of rooflights</p> <p>The amount of roof daylighting directly influences the internal lighting. However this has to be balanced against the increased solar gain.</p>	<p><i>EPIC recommends that designers use the rooflight manufacturers' values and not the default value in SBEM.</i></p> <p><i>For normal industrial portal frame, insulated panel clad buildings the optimum contribution according to SBEM and the other accredited model calculations occurs with about 12% of rooflights.</i></p>

4.3.5 Air leakage rate

Air leakage – options	Important notes on data entry
<p>The default leakage rate is 5 m³/(h.m²). (10 m³/(h.m²) for Scotland).</p> <p>Buildings below 4000m² footprint.</p> <p>Research into levels of actual air permeability achieved for buildings with a footprint area under 4000 m² indicate that improvements from 10 to 5 m³/(h.m²) at 50Pa are difficult to achieve unless specific attention is paid to the detailing.</p> <p>Buildings above 4000m² footprint.</p> <p>In general terms as a building increases in size and volume it will be easier to achieve a low air infiltration value. Using a higher air permeability design value would lower the risk of failing the final SBEM calculation.</p> <p>For larger, less complex buildings it may be possible to use an air permeability design value of less than 5 m³/(h.m²) at 50Pa, however the risk of failing the final SBEM calculation and subsequent cost and program issues needs to be considered.</p>	<p>The research data suggests that designers should give very careful thought to air permeability barriers and the design value that is put into the SBEM calculation. In many cases 5.0 m³/(h.m²) may be difficult to achieve in practice. [see 3.3].</p> <p>The more complex buildings such as those with a large level of interface details, for example, offices, schools, hospitals and hotels need careful consideration as to whether an air permeability design value of 5 m³/(h.m²) at 50Pa is appropriate.</p>

4.3.6 Windows and doors

Selection options	Important notes on data entry
It is important within the SBEM and other model calculation methods to select well insulated window glazing and well insulated door units.	Select well insulated window glazing. Select well insulated doors.

4.3.7 Building Services – Lighting and controls

Lighting and control – options	Important notes on data entry
<p>Designs that reduce energy consumption play a key role in achieving compliance.</p> <p>The choice of energy efficient lighting and the optimisation of lighting controls in conjunction with rooflight and glazing areas are critical to achieving compliance in the 2010 model.</p> <p>The use of photoelectric dimming is included in the Notional Building.</p>	<p>Lighting systems and controls have more influence on the energy consumption and therefore compliance than improving the values for the building fabric.</p> <p>Occupancy sensing according to SBEM is very inefficient and increases the kwh.</p> <p><i>Note. Care is needed in defining the type of building associated with each zone.</i></p>

4.3.8 Building Services – HVAC and controls

HVAC and control – options	Important notes on data entry
<p>Heating systems should be selected that are effective for the type of building and not chosen purely to achieve compliance. An effective heating system will achieve lower CO₂ emissions than an unsuitable system that may have to be run at maximum for long periods.</p> <p>The selection menu includes the following systems that are the most frequently used for the larger industrial/warehouse type buildings.</p> <ul style="list-style-type: none"> ● Unflued radiant heater ● Flued radiant heater ● Multiburner radiant heaters ● Flued forced-convection air heaters ● Unflued forced-convection air heaters ● Single-duct VAV (heating and cooling) ● Dual-duct VAV (heating and cooling) <p>The services systems manufacturer should be contacted to obtain the required information for entry into the SBEM calculation.</p>	<p>Efficient heating systems have an influence on the energy consumption and therefore compliance.</p> <p><i>EPIC recommends FLUED heater types as the preferred options to avoid potential condensation problems.</i></p> <p>Heater systems should be chosen according to the application. Flued forced-convection heaters are more suited for better warm air distribution in high-bay racking applications than radiant heaters and probably in distribution buildings.</p>

EPIC was set up in 1991 to promote quality roofing and cladding systems through the use of factory-engineered panels. Insulated panels maximise thermal efficiency whilst reducing the risk and effects of condensation and significant energy loss through air leakage.

The new building regulations and today's cost competitive and quality conscious environment require that industrial and commercial buildings are high performance designs working with maximum efficiency and minimum running costs. Rigid urethane insulated panels allow designers to achieve these goals with confidence and minimum risk.

Contact EPIC 29 High Street, Ewell, Surrey KT17 1SB Telephone: 020 8786 3619 Fax: 020 8786 8887 www.epic.uk.com

Download information from the EPIC website

This guide on the compliance of buildings in accordance with the 2006 Energy Conservation Regulations can be downloaded from the EPIC website at www.epic.uk.com

EPIC have also published a series of other Guides including:

- Fire safety, Specification and Installation of Insulated Panels
- Insulated Panels, The Fire Safety Order (2005)
- Insulated Panels. Identification and disposal

These guides are available in hard copy form and through the website.

Information on CD Rom

EPIC has produced two CD Roms that provide comprehensive information on the design and performance of Insulated Panels used as the roofs and walls of buildings. These can be ordered directly from EPIC or through the EPIC website.

- Guide to the performance of insulated cladding systems: The CD covers cladding problems and solutions: thermal design and performance: and design detailing.
- Insulated cladding systems – performance in fire: The CD provides essential data about the fire performance of external cladding panels based on extensive research programmes.

THE EPIC MEMBERS ARE:

Kingspan (Insulated Panels) Limited

Greenfield Business Park No 2, Greenfield,
Holywell, Flintshire CH8 7HU
Telephone: 01352 716100 Fax: 01352 710161
info@kingspanpanels.com
www.kingspanpanels.com

A. Steadman & Son Limited

Warnell, Welton,
Carlisle CA5 7HH
Telephone: 0169 74 78277 Fax: 0169 74 78530
info@steadmans.co.uk
www.steadmans.co.uk

Panels and Profiles (Tata Steel)

Shotton Works, Deeside,
Flintshire CH5 2NH
Telephone: 0845 30 88 330 Fax: 0845 30 11 013
technical@coruspanelsandprofiles.co.uk
www.coruspanelsandprofiles.co.uk

ASSOCIATE MEMBER

Huntsman Polyurethanes

Everslaan 45, B-3078 Everberg, Belgium
Telephone: +32 2 758 92 68 Fax: +32 2 758 72 68
insulation_europe@huntsman.com
www.huntsman.com