ENGINEERED PANELS IN CONSTRUCTION

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

Issued June 2011

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 CO_2 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 CO_2 and not the building elements, the total energy building performance takes account of the CO_2 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/BR_PDF_ADL2A_2010.pdf www.planningportal.gov.uk/uploads/br/BR_PDF_ADL2B_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

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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 CO_2 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 CO_2 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.

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 CO_2 emission rate [TER] and the building CO_2 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 apart 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 DECs (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/m^2K and roofs at U=0.18 W/m^2K – 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/m^2K and roofs at U=0.15 W/m^2K

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 – CO_2 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 CO_2. The generation of CO_2 in Kg per kW.h for each energy source is shown in Table 3.

Table 3. CO_2 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.

3.2 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/m²K	0.18 W/m²K	0.25 W/m²K
Walls	0.35 W/m²K	0.26 W/m²K	0.35 W/m²K
Floors	0.25 W/m²K	0.22 W/m²K	0.25 W/m²K
Glazing	2.2 W/m²K	1.8 W/m²K	2.2 W/m²K
Rooflights	2.2 W/m²K	1.8 W/m²K	2.2 W/m²K
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/m²K 0.25 W/m²K(1)	0.20 W/m²K
Walls (Scotland)		0.30 W/m²K	0.27 W/m²K

(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 $m^3/(h.m^2)$ at 50Pa with a backstop level of 10 $m^3/(h.m^2)$ at 50Pa. The 10 $m^3/(h.m^2)$ limit is a mandatory requirement for all new buildings except those below 500m^2 for which 15 $m^3/(h.m^2)$ can be adopted without testing. In Scotland, air permeability is expressed as a 'recommended limit' of 10 $m^3/(h.m^2)$ - 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 $m^3/(h.m^2)$ 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 $m^3/(h.m^2)$
- 80% would fail the 2010 benchmark in the SBEM Model of 5 $m^3/(h.m^2)$
- Of buildings with a footprint greater than 4000m^2, 84% achieved a measured air permeability less than 7 $m^3/(h.m^2)$ and 68% achieved a value of 5 $m^3/(h.m^2)$ 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 $m^3/(h.m^2)$ 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 $m^3/(h.m^2)$ 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 $m^3/(h.m^2)$ 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 $m^3/(h.m^2)$ 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.

3.4 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 psi-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.

* MCRMA and EPIC Technical Paper TP17 can be viewed or downloaded from www.epic.uk.com

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 TP17	MCRMA/EPIC TP17 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 TP17.

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 – Km values

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

The Km 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 Km 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. Km values for typical insulated panel systems

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

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 CO_2 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.

4.3 Data entry into SBEM

4.3.1 Building type

Building type – options	Notes and recommendations on data entry
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: • 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	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 In addition there are sub-divisions that are specific to each building type
Speculative buildings 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. (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)	*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)*

4.3.2 Location

Location options	Notes on data entry
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.	*It is important to select the correct location because the location automatically sets defaults for weather, heating and lighting and wind exposure.*
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.	*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.*

4.3.3 Building fabric

U-value and ψ-value – options	Notes and recommendations on data entry
U-values – roofs and walls Selection options are either to select the generic product type offered or enter the U-value as stated by the Insulated Panel manufacturer.	*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)*
Km – roofs and walls The SBEM default value should be checked to ensure that the correct value is used for insulated panel roof and wall systems: ● Roof: Km = 7.0 ● Wall: Km = 7.0	The Km default value in the calculation models must be checked. (See section 3.5).
U-values and Km – internal walls and ceilings U-values and Km values stated by the system manufacturer should be used in the SBEM calculations. In the case of 'imaginary' walls a U-value of '0' should be used.	
U-values – floors The U-value of floors varies with perimeter and any insulation applied to the edges. The U-value used by SBEM for the notional building is now adjusted for size in the calculation for the actual building.	Recommendation. Initially use the default value of 0.22 W/m^2K (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.
ψ–values – roofs and walls Designers should tick the box for QA ACD junctions [se 3.4] and either: ● 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 For any other details not involving metal cladding tick 'robust' if applicable	*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%.* *Note. Only enter ψ-values for the relevant details listed in the SBEM tool.*

4.3.4 Rooflights

Rooflight – options	Important notes on data entry
U-values	
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.*
Percentage of rooflights	
The amount of roof daylighting directly influences the internal lighting. However this has to be balanced against the increased solar gain.	*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.*

4.3.5 Air leakage rate

Air leakage – options	Important notes on data entry
The default leakage rate is 5 $m^3/(h.m^2)$. (10 $m^3/(h.m^2)$ for Scotland).	
Buildings below 4000m² footprint.	
Research into levels of actual air permeability achieved for buildings with a footprint area under 4000 m² indicate that improvements from 10 to 5 $m^3/(h.m^2)$ at 50Pa are difficult to achieve unless specific attention is paid to the detailing.	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 $m^3/(h.m^2)$ may be difficult to achieve in practice. [see 3.3].
Buildings above 4000m² footprint.	
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.	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 $m^3/(h.m^2)$ at 50Pa is appropriate.
For larger, less complex buildings it may be possible to use an air permeability design value of .5less than 5 $m^3/(h.m^2)$ at 50Pa, however the risk of failing the final SBEM calculation and subsequent cost and program issues needs to be considered.	

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
Designs that reduce energy consumption play a key role in achieving compliance. 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. The use of photoelectric dimming is included in the Notional Building.	Lighting systems and controls have more influence on the energy consumption and therefore compliance than improving the values for the building fabric. Occupancy sensing according to SBEM is very inefficient and increases the kwh. *Note. Care is needed in defining the type of building associated with each zone.*

4.3.8 Building Services – HVAC and controls

HVAC and control – options	Important notes on data entry
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 CO_2 emissions than an unsuitable system that may have to be run at maximum for long periods.	Efficient heating systems have an influence on the energy consumption and therefore compliance.
The selection menu includes the following systems that are the most frequently used for the larger industrial/warehouse type buildings. ● 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) The services systems manufacturer should be contacted to obtain the required information for entry into the SBEM calculation.	*EPIC recommends FLUED heater types as the preferred options to avoid potential condensation problems.* 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.

5 Refurbishment AD-L2B and Part F2 Overview and implications of the requirements

5.1 Introduction

AD-L2B gives guidance on "what, in ordinary circumstances, will meet the requirements of Part L when carrying out work on buildings that are not dwellings". The requirements set out in Part F2: Section 3 for Northern Ireland are expected to be broadly similar. For Scottish requirements see section 6 of this guide.

AD-L2B 2010 presents some changes in the technical guidance. "The guidance is generally based on an elemental approach, with additional guidance that provides greater flexibility. The main technical changes comprise a strengthening of energy efficiency standards that are considered reasonable for work on thermal elements, controlled fittings and controlled services in existing buildings."

The two main areas for improvement during refurbishment works concern

- the building fabric and
- the building services and controls

This section of the EPIC Guide concentrates on those requirements that relate to the building fabric including roof daylighting and the rules for compliance.

The requirements in AD-L2B (2010) do not require the use of the SBEM calculation model unless the designer wishes to illustrate that performance will be better than the original building.

5.2 Insulated Panels and refurbishment works

Insulated panels by the nature of their single piece construction are ideal for re-cladding walls and roofs and have been used extensively on refurbishment projects for over 30 years. Panels offer real practical benefits in terms of speed, minimum disruption, use of existing structure (most cases), improved external and internal environment, low maintenance and increased security.

PIR cored panels have the best insulation performance for lowest thickness and weight and can transform the energy efficiency of a building to AD-L2B (2010) standards with immediate payback on investment. In addition to improved thermal performance, which is guaranteed by the factory controlled production, insulated panel systems also meet the AD-L2B requirements for maintaining continuous insulation and minimising the effect on useable floor area.

See www.epic.co.uk/refurbishment.jsp

5.3 Types of work covered by 'Refurbishment'

Five main types of refurbishment activity are subject to the requirements of AD-L2B:2010 and the other National Regulations:

- Construction of an extension
- Material change of use or a change to the buildings energy status
- Consequential improvements
- The provision or extension of a controlled service of fitting (not covered by this guide)
- The replacement or renovation of a thermal element

Each of the above activities may trigger an automatic appraisal of the fabric, either in respect of the new thermal elements, i.e. used in an extension, or the existing thermal elements. The specific requirements for each type of refurbishment activity are set out in the following paragraphs and may involve the replacement and/or upgrading of the elements.

5.4 Extensions

A. Large extensions:

The regulations relating to 'large extensions' apply where the proposed extension has a total useful floor area that is both

a. greater than 100m^2; and

b. greater than 25% of the total useful floor area of the existing building

In these cases the work should be regarded as a new building and the guidance in AD-L2A followed (see sections 1 to 4 of this EPIC guide).

In buildings with a 'total useful floor area' greater than 1000m^2 it is possible for the construction of an extension to trigger the requirement for consequential improvements. In such cases the guidance in 5.6 should be followed.

B. Other extensions

Reasonable provision would be for the proposed extension to meet the following performance standards: (relevant to refurbishment projects using insulated panels.)

- New thermal elements shall meet the standards of 0.18 W/m^{2}K for roofs and 0.28 W/m^{2}K for walls
- Existing opaque fabric that becomes part of the thermal envelope whereas previously it was not should be improved to 0.1.8 W/m^{2}K for roofs and 0.30 W/m^{2}K for walls. If this is not feasible a minimum threshold performance value should be met – see section 5.7. Retained thermal elements.
- Areas of windows and rooflights should not exceed the values given in table 7 unless a proportion of glazing is present in the part of the building to which the extension is attached. In such cases, reasonable provision would be to limit the proportion of glazing in the extension so that it is no greater than the proportion that exists in the building to which it is attached.

Table 7. Opening areas in an extension

Building type	Rooflights as % of area of roof	Windows and personnel doors as % of exposed wall
Industrial and storage buildings	20%	15%
Places of assembly, offices and shops	20%	40%
Residential buildings where people temporarily or permanently reside	20%	30%
Vehicle access doors and display windows and similar glazing	N/A	As required
Smoke vents	As required	N/A

Notes on the requirements for 'other extensions'

1: AD-L2B also gives a formula for greater design flexibility by recalculating the area-weighted value of the respective U-values and rooflight area (AD-L2B #4.7).

2: AD-L2B also allows the facility to use SBEM or an approved calculation tool to show that the calculated CO_2 emissions for the building plus proposed extension is no greater than for the building plus a notional extension complying with note 1 above (AD-L2B #4.9).

5.5 Material change of use and change of energy status

Two changes are covered by this provision:

- A material change of use as defined in AD-L2B #4.15
- Where a building changes its energy status #4.16 to #4.18 (including where a previously unheated building were to be heated in the future.

Under these changes a reasonable provision would be to meet the following performance standards: (relevant to refurbishment projects using insulated panels.)

- Where the work involves the provision of a new or replacement element, the thermal elements shall meet the standards of 0.18 W/m²K for roofs and 0.28 W/m²K for walls
- Where the thermal element is to be renovated or retained the thermal element should be improved to 0.18 W/m²K for roofs and 0.30 W/m²K for walls. If this is not feasible a minimum threshold performance value should be met – see section 5.7 Retained thermal elements
- Any existing window, including roof window or rooflight, or door which separates a conditioned space from an unconditioned space or the external environment and which has a U-value worse than 3.3 W/m²K should be replaced (AD-L2B #4.23 to #4.28).

5.6 Consequential improvements

Consequential improvements means those energy efficiency improvements required when an existing building is extended or renovated.

Consequential improvements apply to existing buildings over 1000m² where the work consists of:
a. an extension
b. the initial provision of a fixed building service or
c. an increase to the installed capacity of any fixed building service

Consequential improvements are in addition to the proposed building works and should be made to ensure that the building complies with Part L provided that any such improvements are technically, functionally and economically feasible.

The following improvements relating to the building fabric are considered to be practical and economically feasible in ordinary circumstances e.g. if the remaining life of a building is less than 15 years it would be economic to carry out improvements with payback periods within that life:

1. Upgrading thermal elements which have U-values worse than 0.70 W/m²K for walls and 0.35 W/m²K for roofs
2. Replacing existing windows, roof windows or rooflights or doors which have a U-value worse than 3.3 W/m²K (AD-L2B #4.23 to #4.28)

Where the installed capacity per unit area of a cooling system is increased the following improvements relating to the building fabric are considered to be practical and economically feasible in ordinary circumstances:

- to upgrade or replace the thermal elements within the heated areas which have a U-value worse than 0.7 W/m²K (to 0.35 W/m²K) for walls and 0.35 W/m²K (to 0.25 W/m²K) for roofs
- if the windows, roof windows within the area served exceeds 40% of the façade area or the area of the rooflights exceeds 20% of the area of the roof and the design solar load exceeds 25W/m², then the solar control provisions should be upgraded (see AD-L2B #6.11)
- any lighting system within the area served with a lamp efficacy of less than 45 lamp-lumens per circuit watt shall be upgraded with new luminaries and/or controls (AD-L2B #6.11).

5.7 Guidance on thermal elements

This section summarises the requirements listed above under various refurbishment categories.

Newly constructed or replacement elements.

Reasonable provision is given as follows in AD-L2B:

- For newly constructed thermal elements such as those constructed as part of an extension – Table 8(a)
- For those thermal elements constructed as replacements – Table 8(b)
- No individual element should have a U-value worse than those set out in – Table 8(c).

Table 8. Standard for use of new insulated panels in refurbishment

Element	(a) Standard for new thermal elements	(b) Standard for replacement thermal elements	(c) Limiting U-value for existing elements – not worse than
Walls	0.28	0.28	0.70
Roofs (with integral insulation)	0.18	0.18	0.35

Continuity of insulation and air tightness

The building fabric should be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements, and at the edges of elements such as those round windows and door openings. Reasonable provision should be made to reduce unwanted air leakage through the new envelope parts AD-L2B #5.5 to #5.7

Renovation (replacement) of thermal elements

AD-L2B states that reasonable provision would be to achieve the standard set out in Table 9 (b) provided the area to be renovated is greater than 50% of the surface of the individual element or 25% of the total building envelope AD-L2B #5.8 to #5.9.

If such an upgrade is not technically or functionally feasible or would not achieve a payback of 15 years or less the element should be upgraded to the best standard that is technically or functionally feasible and which can be achieved within a simple payback no greater than 15 years.

Retained thermal elements

Retained thermal elements refers to the following circumstances:

- where an existing element is part of a building subject to a material change of use
- where an existing element is to become part of the thermal envelope and is to be upgraded
- where an existing element is being upgraded as a consequential improvement

AD-L2B states that reasonable provision would be to upgrade those thermal elements whose U-value is worse than the threshold value in Table 9 column (a) to achieve the U-value given in column (b) providing this is technically and economically feasible.

A reasonable test of economic feasibility is to achieve a simple payback of 15 years or less. Where the standard given in column (b) is not technically or functionally feasible, then the element should be upgraded to the best standard that is technically or functionally feasible and which can be achieved within a simple payback no greater than 15 years.

5 Refurbishment AD-L2B and Part F2
Overview and implications of the requirements

Table 9. Upgrading retained thermal elements

Element	(a) Threshold U-value	(b) Improved U-value
Walls	0.70	0.30
Roofs (with integral insulation)[1]	0.35	0.18/0.20

[1] A lesser provision may be appropriate if there are particular problems associated with the load-bearing capacity of the frame or the upstand height.

6 Refurbishment – Scotland
Overview of the requirements

6.1 Requirements

Guidance on refurbishment is set out in Section 6.2 of the Technical Standard (2010) as follows.

- 6.2.8 Conversions
- 6.2.11 Extensions
- 6.2.13 Alterations

This section of the EPIC Guide summarises the basic requirements in terms of the building element. Although many of the values for insulating elements are similar to those set for England, Wales and Northern Ireland, Section 6 for Scotland aims to set higher basic levels for Extensions to heated buildings especially for walls.

There is also a strong emphasis on the need to upgrade to the highest standards and Section 6 recommends consultation with the verifier of the relevant local authority on refurbishment issues at an early stage of the works.

6.2 Conversions

Section 6.2.8 states that in the case of the conversion of an unheated building it is appropriate to treat the building as if it were an extension – see 6.3 below. In certain instances it may be more worthwhile to demolish these buildings and rebuild to the latest standards.

In the case of a building that was previously designed to be heated, it is appropriate to examine the insulation envelope and upgrade, if necessary, following table 10.

Table 10. Conversion of a heated building that remains heated after conversion (Scotland)

Maximum U-values (W/m²K) for building elements of the insulation envelope		
Type of element (excluding separating walls and separating floors)	**(a) Area weighted average U-value for elements of the same type**	**(b) Individual element U-value**
Wall(1)	0.30	0.7
Roof [Insulated Panels](1)	0.25	0.35
Floor(1)	0.25	0.7
Windows, doors, roof windows and rooflights	1.6	3.3

(1) Where upgrading work is necessary to achieve the U-values, reference should be made to ‘Reconstruction of elements (clause 6.2.13) and more demanding U-values achieved where reasonably practicable.

6.3 Extensions

Section 6 anticipates that in the case of extensions to the building envelope, the majority of the construction will be 'new-build' and seldom will there be a need to construct to a lesser specification.

Where the insulation envelope of a building is extended, the new building fabric should be designed (or upgraded) in accordance with Table 11 below.

The extended part of an insulation envelope or the unheated to heated category of an extension should be constructed in such a way that there are no substantial thermal bridges or gaps where the layers of insulation occur.

Table 11. Extensions to the insulation envelope of buildings [Scotland]

Maximum U-values (W/m²K) for building elements of the insulation envelope		
Type of element (excluding separating walls and separating floors)	**(a) Area weighted average U-value for elements of the same type**	**(b) Individual element U-value**
Wall	0.25	0.7
Roof [Insulated Panels]	0.15	0.35
Floor	0.20	0.7
Windows, doors, roof windows and rooflights	1.6	3.3

Where the insulation envelope of a building is extended, the new opening areas should be designed in accordance with Table 12.

Table 12. Maximum window and rooflight areas for extensions [Scotland]

Building type	Rooflights as % of area of roof	Windows and doors as % of exposed wall
Industrial and storage buildings	20%	15%
Residential buildings, offices and shops and buildings for entertainment and assembly purposes	20%	40%

Compensatory arrangements – area weighted average U-values

Table 11 illustrates that the Building (Scotland) Regulations – Section 6 sets tighter (lower) values for the thermal elements in Refurbishment than for new constructions. This also applies for Shell and fit-out (see section 8 of this guide).

However Table 12, taken from Section 6.2.11 of the Standard, also contains a table of maximum opening areas for widows, doors and rooflights and SBSA have confirmed that it is permissible to trade off between panel and opening areas to achieve the required area weighted average U-values for the whole roof or wall construction based on the values in Table 11 column (a).

This ability to make compensatory arrangements by reducing the opening areas allows panels of the standard thickness required for new constructions to be used i.e. 0.20 W/m²K for roofs and 0.27 W/m²K for walls.

Example calculation

Roof refurbishment project – example of compensatory arrangement between roof panel and rooflights using heat loss calculation.

Note. A similar calculation can be extended for the whole building to include the walls and window openings.

A. Building to be refurbished/extended – footprint area 1000m². Using a proposed standard panel U-value of 0.25 W/m².K

Exposed element	Exposed surface area (m²)	U-value (W/m²K)	Rate of heat loss (W/K)
Roof	905 (90.5%)	x 0.25 (U-value of standard panel)	226.2
Rooflight [1]	95 (9.5%)	x 2.20 (most common rooflight value)	209.0
Total rate of heat loss			435.2

[1] reduced percentage area from 20% maximum level in Notional Building calculation.

B. Notional refurbishment/extension – footprint area 1000m²

Exposed element	Exposed surface area (m²)	U-value (W/m²K)	Rate of heat loss (W/K)
Roof	800	x 0.15	120
Rooflight	200	x 1.60	320
Total rate of heat loss			440

6.4 Alterations

Reconstruction of elements

Section 6.2.13 states that where the element forming part of the insulation envelope is to be altered or replaced the opportunity should be taken to improve the level of thermal insulation. Column (a) of Table 11 gives 'benchmark' U-values that in many cases can be achieved without technical risk, within the constraints of the existing construction.

The Standard recognises that there are certain constructions that lend themselves better than others as candidates for upgrading. Where it is inappropriate for these changes to be made, due to reductions of internal space or by causing excessive enabling alterations, or impact on other building standards worse levels may be acceptable. The Standard states that 'there are not many cases however, where after an alteration to the insulation envelope, a roof or wall cannot achieve the values given in column (b) of Table 11'.

When an alteration is carried out, attention should be paid to limiting thermal bridging at junctions and around openings and also limiting air infiltration.

Infill of openings

Where the opening is less than 4m², the infill should match the thermal performance of the surrounding fabric and not be worse than 0.35W/m²K for a roof and 0.7 W/m²K for a wall.

In the case of larger openings the infill should achieve the values in column (a) of Table 11, or by compensating for the energy efficiency deficit by improving the overall U-value of other parts of the envelope.

6 Refurbishment – Scotland
Overview of the requirements

Additional guidance

Section 6.2.13 also gives guidance on the creation or replacement of windows and where internal parts or elements become part of the insulating envelope.

7 Shell and fit out buildings
Requirements – England and Wales

The following guidance has been taken from AD-L2A:2010 # 4.25 and # 4.26.

If a building is offered to the market as a shell for specific fit-out work by the incoming occupier, the developer should demonstrate via the design stage TER/BER submission how the building shell as offered could meet the energy efficiency requirements.

For those parts of the building where certain systems are not installed at the point the building is to be offered to the market, the model that is used to derive the BER will have to assume efficiencies for those services that will be installed as part of the first fit-out work. The specification provided to Building Control should identify which services have not been provided in the base build and the efficiency values assumed for each system.

At practical completion of the base building the as-built TER/BER calculation should be based only on the building and systems actually constructed: the fit-out areas should be assumed to be conditioned to temperatures appropriate for their designated use, but no associated energy demand included. With a shell and core building that is heated the SBEM model requires heating and lighting systems to be specified. A formal EPC is not required at this stage.

When an incoming occupier does first fit-out work on all or part of the building, then the TER/BER submission should be made to Building Control after completion to demonstrate compliance for the part of the building covered by the fit-out work. This submission should be based on the building shell as constructed and the fixed building services actually installed. If the fit-out work does not include the provision or extension of any of the fixed services then reasonable provision would be to demonstrate that any lighting systems that are installed are at least as efficient as those assumed in the developer's initial submission.

A new EPC is required for that part of the physical building covered by the fit-out.

8 Shell and fit out buildings Requirements – Scotland

Shell and fit out projects may be treated in two ways when applying for a building warrant.

A. As a staged application with the internal fit out being at a final stage.
B. With separate warrants for the shell and fit out.

A. Staged applications

The staged application approach can be of benefit when the eventual building occupier and building use are not known.

Under staged applications the building design and construction should meet the requirements for 'New Build' set out in Section 6 of the Technical Standard (2010) including satisfying the compliance calculation method, SBEM or equivalent – see sections 3 and 4 of this Guide – at the final stage.

Internal fit out is the final stage of the shell and fit out. A Completion Certificate can only be submitted/ accepted once all the works have been completed.

Note. Section 6 of the Standard recommends consultation with the verifier of the relevant local authority on shell and fit out issues at the time of application for the initial building warrant.

B. Separate warrants for shell and fit out

Under the separate warrant approach the building design and construction for the shell should meet the requirements for the building envelope set out in # 6.2.4 (U-values), # 6.2.5 (thermal bridging) and # 6.2.6 (air infiltration) of Section 6 of the Technical Standard (2010), the details of which are set out below.

Completion Certificates are submitted for both the shell and the fit out warrants, with the shell being subject to a continuing requirement confirming that the building may not be used until the Completion Certificate for the fit out has been accepted. No Completion Certificate or authorisation of temporary use certificate can be accepted/issued at the completion of the shell.

Building element requirements under shell and fit out – separate warrants

New buildings which have been constructed as a shell for later fit out that are not the subject of a staged building warrant should meet the maximum U-values for building elements of the insulation envelope as given in Table 13 column (a) and also should meet the air permeability requirements.

The values are lower (better) than the requirements set for new build.

Localised areas of the same type of element may be designed to give a poorer performance. These in turn will need to be compensated by the rest of the element being designed and built to a more demanding level. These areas should be better than the figures given in Table 13 column (b).

No compensatory arrangements, such as those allowed for refurbishment projects, are allowed for shell and fit out projects.

Table 13. U-values and air permeability for shell and fit out buildings

Maximum U-values (W/m^2K) for building elements of the insulation envelope		
Type of element (excluding separating walls and separating floors)	**(a) Area weighted average value for elements of the same type**	**(b) Individual element U-value**
Wall	0.23	0.7
Roof [Insulated Panels]	0.15	0.35
Floor	0.20	0.7
Windows, doors, roof windows and rooflights	1.6	3.3
Air permeability	$7m^3/(h.m^2)$	

Thermal bridging. For shell buildings thermal bridging should meet or improve upon the values for the notional building given in # 6.1.4.

Where a building warrant is made for the building shell only, air permeability should not exceed 7 $m^3/(h.m^2)$ and testing should be carried out both at completion of the shell and again when fit-out is completed.

Note. Section 6 recommends consultation with the verifier of the relevant local authority on shell and fit out issues at an early stage of the development.

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.

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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.

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