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Rooflight Design to meet Building Regulations Part L2 Guidance Documents ADL2A and ADL2B 2006

Introduction

This document is an interim fact sheet to assist designers, specifiers and the roofing industry to provide the basic requirements for rooflight design to meet the April 2006 Part L2 Regulations – new build, extensions and refurbishment for all non domestic buildings. Currently (April 2006) the official Approved Documents ADL2A and ADL2B, although issued, are being amended to accommodate technical and printing errors. It is not known when final and correct documents will be available. Additionally for new work under ADL2A and larger extensions that come under ADL2A, there is a requirement for the use of the National Calculation Tool to verify the carbon emission savings. This tool – the Simplified Building Energy Model (SBEM) although issued, is still being modified. It is unclear when this will be in final format but it could take many months.

Part L2 (2006)

The new Regulations supersede the previous Part L 2002 Regulations. The 2006 Regs make a fundamental change to the method of compliance. The old Regs were based on thermal values of the fabric of the building. The new Regs consider not only the fabric of the building, but also the energy efficiency of all the mechanical services – boilers, hot water and artificial lighting. The thermal values and energy requirements are converted into a carbon dioxide (CO_2) emission calculation known as the Carbon Footprint. To be compliant under the new Regs, the proposed building must achieve a prescribed level of CO_2 savings over the same "Notional" building designed to the 2002 Regs. When available, the SBEM will provide this calculation to show compliance.

Energy Savings Required Over 2002 Regs

Building designers are required to achieve a **Target CO_2 Emission Rate (TER).** The **TER** is the minimum energy performance required for the building:

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

where $\mathbf{C_{(Notional)}}$ is the CO_2 emission rate for the same building designed to the 2002 Regs. The **Improvement Factor** is defined in **Table 1 to ADL2A.** The **LZC Benchmark** is incorporated to allow low and zero carbon energy sources. Where not included, the benchmark is 0.10.

ADL2A Table 1 : Improvement Factors and LZC Benchmarks for use in TER Equation

Building Services Strategy for the Actual Building	(a) Improvement Factor	(b) LZC Benchmark
Heated and Naturally Ventilated Buildings	0.15	0.10
Heated and Mechanically Ventilated Buildings	0.20	0.10
Air Conditioned	0.20	0.10

Thus the **TER** for buildings with no mechanical ventilation is **76.5%**, a saving of **23.5% over the 2002 Notional Building.** For mechanical ventilation and air conditioned buildings the **TER** is **72%**, a saving of **28%.**

BER – Building Emission Rate

Once all the data for the building is known, the **BER** can be calculated for that building using SBEM (or other approved software). If the CO_2 emission rate is below 76.5% or 72% (as detailed above), then the building design is compliant.

Efficient Energy Sourcing

In the past, the building efficiency has only been measured in terms of the fabric of the building. The use of power to heat and light the building has not been part of the calculation. Under the new Regulations, artificial lighting will be part of the energy calculations and will be a key factor to energy efficiency for the building. The following carbon emission factors are used in the calculation of energy efficiency :

Natural Gas 0.194 Kg CO_2/kWh

Grid Supplied 0.422 Kg CO_2/kWh

This data tells us that artificial lighting supplied to a building via the National Grid is more than twice as inefficient as the power to heat the building when using Natural Gas. Couple this with the fact that very often the electric lights are switched on regardless of the need and remain on unnecessarily all day, it soon becomes clear that uncontrolled electric lighting is a major source of energy inefficiency for a building. These factors are taken into account in the SBEM calculations.

Keywords : - Roof Finishes - Overlapping Sheets - Reinforced Plastics

Achieving Complaince Rooflights Save Energy

In the past, designers have considered a reduction of rooflight area to minimise heat loss due to the lower thermal performance of rooflights compared with the opaque roof areas. The result is a high use of artificial lighting. Research has been carried out by De Montfort University that shows that the total (heating and lighting) energy demand for a building will reduce as the rooflight area is increased with the optimum being at around 20% of the floor area. **This data is shown in the graph below** and also takes into account that artificial lighting is less carbon efficient than the natural gas used in the heating requirements.

This graph clearly demonstrates that as the rooflight area is increased to around 20% of the floor area, the energy demand on the building reduces with considerable savings in CO_2 emissions. Similar data used for the graph above is incorporated into the SBEM. So as designers increase the rooflight area, the BER calculation from SBEM will reduce. The optimum rooflight area will generally be 15% - 20% of the floor area.

Lighting Controls

None of the above energy efficiency works if regardless of rooflight area, the artificial lights are switched on in the morning and just remain on all day. The key to energy efficiency is to install artificial lighting controls using sensors and dimmers that allow for the correct lux levels for that specific work area at all times of the day (and night).

ADL2A - Limiting U-values

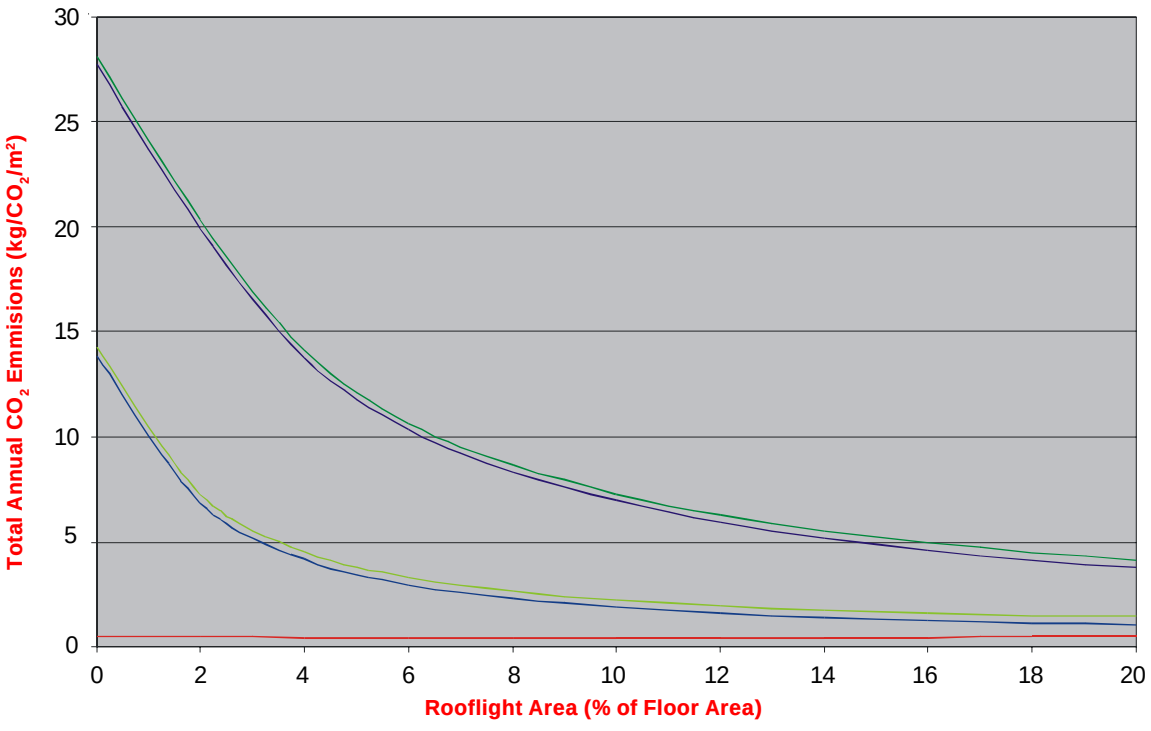
The purpose of the new Regulations is to allow a greater freedom of choice of materials and design provided the TER is achieved. However the Regulations do provide for some limiting values. Maximum thermal U-values of the fabric of the building are defined in **Table 4 to ADL2A** and for rooflights these are given below:

ADL2A - Table 4 : Limiting U-value Standards (W/m²K)

Element	(a) Area-weighted Average	(b) For any Individual Element
Wall	0.35	0.70
Floor	0.25	0.70
Roof	0.25	0.35
Window, Roof Windows, **Rooflights**,Curtain Walling	**2.20**	**3.30**
Pedestrian Doors	2.20	3.00
Vehicle Access and Similar Large Doors	1.50	4.00
High Usage Entrance Doors	6.00	6.00
Roof Ventilators (inc.smoke vents)	6.00	6.00

This means that for all ADL2A buildings, rooflights of a U-value worse than 2.2 may be installed to a worst case of 3.3, but the average for all the rooflights must not be worse than 2.2.

The Effect of Rooflight Area on Total CO_2 Emissions - 9am to 5pm



The top line on the graph shows lighting at 600 lux + heating CO_2 emissions falling as rooflight area increases to 20%.

The middle line on the graph shows the same effect at 300 lux.

The red line is gas heating emissions only.

The solution for FILON grp rooflights is to install FILON site assembled or factory assembled units with a U-value no worse than 2.2 This will now be the norm for all new build work. The odd double skin rooflight with a U-value of 3.3 will be acceptable provided the average for all rooflights on the building is 2.2.

ADLB2 - Extensions & Refurbishment

When reading ADL2B, a key point to understand is that "**rooflights**" are not a "**thermal element**", they are "**controlled fittings**" and have their own set of requirements that are detailed in **Table 5 to ADL2B.** Please note that the current version (April 06) of **Table 5** is incorrect. In the first line to the Table, a line has been left out in error. The first line should be :

"**Windows, Roof Windows & Glazed Rooflights"**

Beneath this and in the same box should be:

"Plastic Rooflights (a) 2.2 (b) 2.2"

(a) u-value Standards for new rooflights in extensions

(b) u-value Standard for replacement rooflights in existing buildings

This is saying, as for ADL2A, all FILON rooflights, for both extentions and replacements during refurbishment where there is a need to comply with ADL2B, that all FILON rooflights should have a U-value no worse than 2.2 W/m^{2}K.

When does ADL2B Apply to Extensions and Repair/Refurbishment

Extensions

The following conditions will apply:

a) Large extensions that are greater than 100m^2 **and** greater than 25% of the floor area of the existing building are to be regarded as new buildings and comply to ADL2A.

b) Conservatories less than 30m^2 are exempt from Building Regulations and exempt from ADL2.

c) For existing buildings that exceed 1000m^2 floor area, an extension will trigger Consequential Improvements to the original building.

Other than applies above, Extensions will be compliant if built to the Elemental Method and subject to given design constraints. In this respect, rooflights are constrained by allowable U-values and allowable rooflight areas. For rooflight U-values, reasonable provision will be if the U-values comply with Table 5 as shown in the previous column.

For allowable rooflight area to the extension, this is limited to **ADL2B Table2 – Opening Areas in the Extension**. For all extension types, the rooflight area is limited to 20% of the roof area. However, also note, that where the existing building has in excess of 20% rooflight area, a reasonable provision for the extension will be to have a rooflight area which is limited to the same area as the original building to which the extension is attached.

ADL2B - Table 2 : Opening Areas in the Extension

Building Type	Windows/Personnel Doors as % of Exposed Wall	Rooflights as %of Area of Roof
Residential Buildings where People Temporarily or Permanently Reside	30	20
Places of Assembly, Offices or Shops	40	20
Industrial and Storage Buildings	15	20
Vehicle Access Doors and Display Windows and Similar Glazing	As required	N/A
Smoke Vents	N/A	As required

Repair and Refurbishment

The Guidance Document says that where ever an element is being replaced, then it should be to a standard that will be compliant to the 2006 Regulations. If rooflights need replacing, for whatever reason, then compliance will be achieved if supplied in accordance with **ADL2B – Table 5** (when amended) to a U-value of 2.2 W/m^{2}K.

There is no requirement that where one or a number of rooflights are to be replaced – then all the rooflights should be replaced. The only requirement is that those that are replaced, meet the new standard as above **and provided** it is economical and feasible to do so.

Consequential Improvements

Where an existing building has a floor area over 1000m^2, and work is to carried out on the building by way of an extension, initial provision or increase in installed capacity of any fixed building services, then there is a requirement for some consequential improvement to the building to improve the energy performance of the original building.

Consequential improvement will be deemed to be satisfied if:

a) the improvements achieve a **simple payback** of not more than 15 years, i.e. the cost of improvement over the savings in energy cost over 15 years. **Simple Payback** is defined in **Section 5 ADL2B**, **or**

b) the cost of improvement was no more than 10% of the value of the **principal work** , i.e. the cost of the extension or the service upgrade. **Principal work** is defined in **Section 5 ADL2B.**

The Guidance Document provides a list of 8 practical solutions to upgrade the original building that are shown in **ADL2B Table 1 – Improvements that in ordinary circumstances are practical and economically feasible. Item 7** identifies "Replacing existing windows, roof windows or rooflights or doors which have a U-value worse than 3.3 W/m^{2}K, following the Guidance to **ADL2B Table 5 – Standards for Controlled Fittings"**.

Since there will be a basic requirement to upgrade the original building in line with the financial limits stated, there will be considerable advantage to selecting **Item 7** as one of the improvements costs since –

- There will be considerable thermal efficiency savings by replacing old rooflights at a U- value of 5.7 W/m^{2}K to new rooflights at a value of 2.2

- The old rooflights may have lost a large part of their light transmitting qualities – new rooflights will put daylight back into the building to make it a more pleasant place to work

- The additional daylight will mean the electric lights can be switched off creating further considerable energy savings

- The new rooflights will be non-fragile making the roof a safer place should maintenance staff need to access the roof. (Note that the opaque roof areas are also likely to be fragile and will remain so after the rooflights have been replaced).

Conclusions

1) The new Part L (2006) Regulations require, as a general rule, that all Filon rooflights are fitted with a U-value of no worse than 2.2 W/m^{2}K

2) There is a recognition from Government that good natural daylighting is carbon efficient provided the electric light is switched off. In practice carbon efficiency is maximised at 15% to 20% rooflight area.

3) On Extensions or Refurbishment work where Consequential Improvements are required on the existing building, a useful solution is to replace the old single skin rooflights improving the U-value from 5.7 to 2.2W/m^{2}K to achieve the 10% consequential improvement and the additional benefit that the environment within the building will be a far more pleasant place to work.

4) The use of 20% rooflights at a U-value of 2.2W/m^{2}k is a basic requirement of the Notional Building (2002 Regs) and will provide the basis of a BER at 100%. To achieve the necessary carbon savings to a minimum BER at 76.4%, further savings must be achieved in building design, services and air tightness. If less than 20% rooflight area is used, the BER will increase, requiring even further savings in design, services and air tightness.

5) The use of 15% - 20% rooflights, will not only provide energy savings, it will provide a very pleasant environment for people working in the building leading to greater work efficiency, less accidents and an improvement in the feel good factor.

For a smaller Carbon Footprint just add rooflights and feel better

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