KNAUF INSULATION

August 2008: Issue 1

Non - Residential New Build
4.2.1 Built-up Metal Roofs

energy saving warmth quietness fire protection sustainability

Non-residential New Build

Built-up Metal Roofs Contents

Built-up metal roofs

Solution optimiser and pathfinder

Photograph courtesy of Corus Building Systems

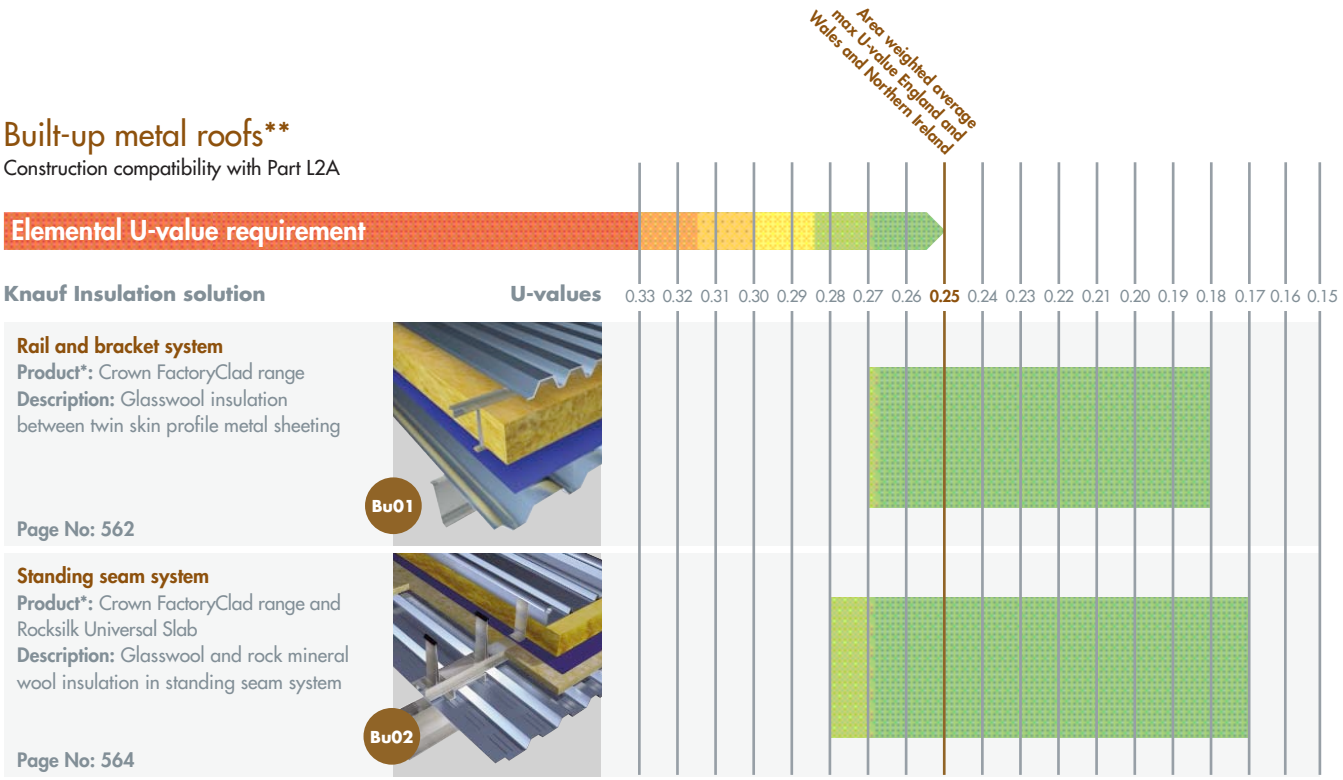
Profiled metal roofing systems have long been successfully used throughout the UK as a lightweight, fast and simple method of construction which can reduce both structural steel and foundation costs. Such systems typically consist of a low profile metal inner liner sheet, separated from an outer, higher profile, metal weather sheet. The cavity is filled with a layer of insulation to provide high levels of thermal performance. This insulation is normally a glass mineral wool quilt, a high performance, lightweight insulant with A1 fire resistance.

Built-up metal roofing systems are typically assembled on site with the design and components usually forming part of a proprietary system.

Knauf Insulation provide products with a range of thermal conductivities to be used in roof systems for modern commercial, industrial and warehouse buildings.

Built-up metal roofs**

Construction compatibility with Part L2A



Key

U-values achievable by constructions within this document.

* Recommended Knauf Insulation product(s). Other products may be applicable.

Pb01 Find online. Visit www.knaufinsulation.co.uk and key in construction code to find the most up to date information on your chosen solution.

**Note: The above table shows typical U-values for built-up metal systems. Generic rail and bracket U-value calculations can be provided by our Technical Advisory Centre, however, for proprietary rail and bracket systems and all standing seam systems the system manufacturer should be consulted for project specific U-value calculations

Built-up metal roofs

Built-up metal roof design

Benefits

- Fast method of construction
- Lightweight construction
- High levels of fire resistance (when using mineral wool) with potentially lower insurance premiums compared to foam composite panels
- Secure and weatherproof at an early stage in the build programme
- Cost effective and energy efficient
- Easy to install

Photograph courtesy of Ash and Lacy Building Systems

Introduction

Profiled metal roofing systems typically consist of a low profile metal inner liner sheet, separated from an outer, higher profile, metal weather sheet. The cavity is filled with a layer of insulation to provide maximum thermal performance. This insulation is normally a glass mineral wool quilt, a high performance, lightweight insulation properties with A1 fire resistance. Built-up metal roofing systems are typically assembled on site with the design and components used forming part of a proprietary system.

Amongst the considerations the designer will have to include when designing a building with a built-up metal roof the following both influence and are influenced by the insulation materials in the system:

- Thermal insulation
- Air permeability
- Thermal bridging
- Acoustic performance
- Fire safety
- Control of condensation
- Environmental impact of the materials.

Thermal insulation

It is possible to achieve very high standards of thermal insulation using built-up metal systems, but due to the complex nature of heat flow through these systems due to the spacer systems it is not possible to calculate U-values using the normal simplified methods.

The Knauf Insulation Technical Advisory Centre can calculate the thickness of insulation needed to achieve specific U-values, including the effect of thermal bridging for simple rail and bracket systems but normally one would consult the system manufacturer, similarly for standing seam systems one should in the first place consult the system manufacturer.

Air permeability

The uncontrolled infiltration or leakage of air from a building has a significant impact on its energy efficiency. With good detailing and care in the construction phase it is possible to achieve very high standards of air tightness in built-up metal constructions. This will of course restrict uncontrolled air infiltration and leakage and improve the energy efficiency of the building. Building Regulations require a measurement of the air permeability to be included in the SBEM 'whole building' calculation used for compliance. Problem areas include at the junction of building elements such as the wall roof junction or penetrations through the system such as rooflights.

Thermal bridging

There are two categories of thermal bridging that occur in built-up Metal systems, the repeating thermal bridges inherent in the spacer system and the thermal bridges at junctions and openings in the construction. The effect of the repeating thermal bridges is included in the U value calculation for the roof. Thermal bridges at junctions and openings must be calculated separately and the heat losses at these points included in the SBEM calculation. This value is included by multiplying the length of each thermal bridge by the calculated psi value.

Acoustic performance

Buildings with built-up metal roofs may need to incorporate noise control measures not only to meet building regulation requirements, but also Health and Safety and Environmental Health Regulations regulations as well as the building occupiers specific requirements. These measures can be grouped into two categories, sound insulation and sound absorption.

Sound insulation

A poorly designed built-up metal roof will transmit a significant amount of sound, whether it be airborne sound or rain noise (the drumming sound that heavy rainfall can cause), which will lead to the building failing to provide an acceptable level of protection either to the occupants of the building (in the case of either noise outside the building or rain noise) or to

Photographs courtesy of Corus Building Systems

people living close to the building from noise generated within the building.

One of the most effective methods of improving sound insulation is to increase the mass of the structure. Built up metal roofs are generally lightweight, however they are able to provide a high level of separation between the two sides of the roof and also include glass and rock mineral wool within the structure which provide very high levels of sound absorption. When the effects of separation and sound absorption are combined in a built-up metal roof it is possible to achieve outstanding levels of sound insulation.

Building regulations impinge primarily on roofs in respect of schools where it is a requirement that the building should meet the standards set out in Section 1 of Building Bulletin 93 'The Acoustic Design of Schools'. This sets specific upper limits for indoor ambient noise levels.

Factors affecting the performance required by the roof will include noise from road, rail and air traffic, industrial and commercial premises. The performance required in other types of buildings may be controlled by government requirements such as Hospitals under HTM 2045, or specific client requirements. Environmental Health Regulations may require specific sound insulation performance in roofs where high levels of noise are generated, such as industrial buildings, sports and concert halls to stop sound breaking out of the building and thus prevent noise nuisance to neighbours.

Sound absorption

The control of the indoor acoustic environment is important to maintain health and safety for workers and occupants of buildings. It is possible using perforated metal liner sheets with sound absorbing lining, usually glass or rock mineral wool, to control reverberation of sound which would otherwise be problematic.

Rain noise

Acoustic performance has traditionally not featured high on the list of design priorities but guidance now states that it is essential that rain noise is considered in the design of built-up metal systems as it can significantly increase the indoor ambient noise level. Addressing this issue has created focus on the governmental Building Schools for the Future programme. Future intention is that rain noise will be considered within BB93. Until this time, it is appropriate for design teams to provide evidence to the Building Control Body that the built-up metal system has been designed to minimise rain noise where required.

Fire protection

It is a requirement of the Building Regulations that external cladding elements shall resist the spread of fire from one building to another.
The degree of fire resistance which the external roofing element must provide will depend upon the size and use of the building and it's distance from any boundary. Further performance information will be available from the cladding system manufacturer.

Built-up metal roofs have the advantage of using non-combustible glass and rock mineral wool insulation.

Control of condensation

Condensation could potentially occur either on the underside of the liner sheet if there were significant thermal bridges through the system or within the structure of the system if there was a significant break in the vapour control layer.

The spacer system used to support the outer cladding sheet is a potential thermal bridge and thus could be a point for localised condensation on the liner sheet, however the modern spacer systems all include a significant thermal break, as a necessity for the achievement of the overall U-value, and as such the chance of condensation where the spacer system is fixed to the liner is negligible. If there are significant gaps in the insulation layer then it would be possible that localised condensation would occur.

To control condensation within the built-up metal roof structure it is normal to create an effective vapour barrier at the level of the liner sheet. This is done by sealing all joints in the liner sheet and where there are any penetrations through the liner sheet. Where a perforated liner sheet is used then a separate vapour barrier must be installed.

The likelihood of either problem occurring is very low however extra care needs to be taken in buildings with high levels of humidity such as swimming pools or certain industrial processes.

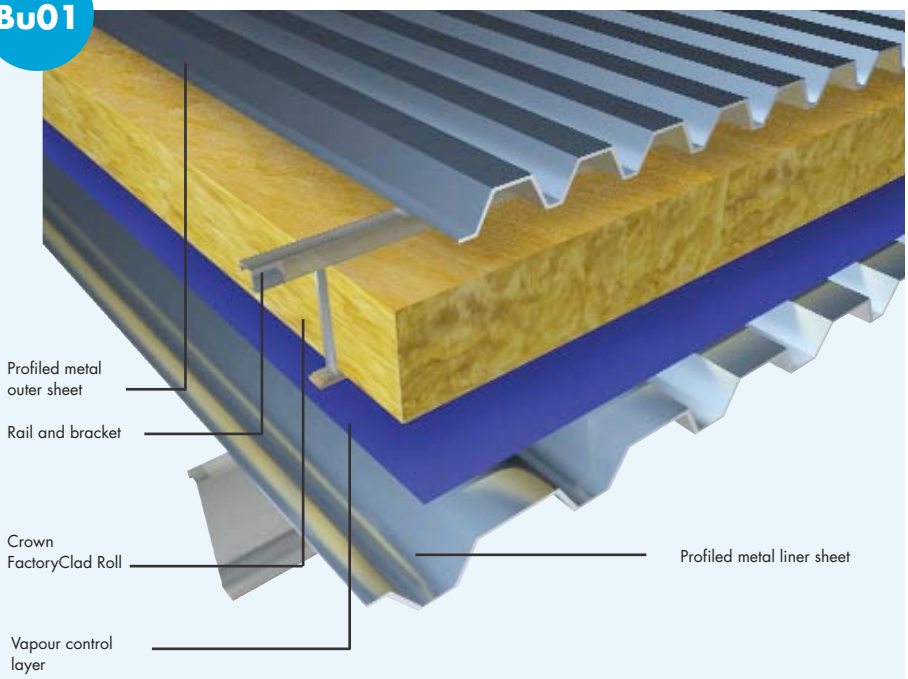
Built-up metal roofs

Rail and Bracket System

Advantages

- ✓ **Strong and easy to assemble**
- ✓ **Quick and economical to install**
- ✓ **Speeds up building programme**
- ✓ **Lightweight**
- ✓ **Building is secure and weatherproof at an early stage in the programme**
- ✓ **Non-combustible liner**

Bu01



Products

Crown FactoryClad Rolls are a range of flexible, lightweight rolls of resilient, non-combustible glass mineral wool with exceptionally high tear strength. They are produced in a range of four different thermal conductivities.
They have a very low impact on the environment and are classified as zero ODP and zero GWP*.

* Ecohomes and Code for Sustainable Homes classification

Typical construction

Crown FactoryClad is used for the thermal and acoustic insulation in profiled metal clad roofing systems.

Installation

Crown FactoryClad is located between profiled metal outer cladding sheets and inner lining sheets. The lining sheets are fixed on top of the supporting purlins. The inner and outer metal cladding sheets are separated by rail and bracket systems or preformed insulated spacer systems.

To maintain continuity of the insulation where rail and bracket systems are used, the insulation is tucked under the rails, with all quilt edges tightly butted. There is no continuous airspace in the construction other than that created by the cladding profile.

Performance

Fire

Crown FactoryClad is classified as Euroclass A1 to BS EN ISO 13501-1

Vapour Resistivity

Crown FactoryClad has a vapour resistivity of 7.00 MN.s.g.m.

Acoustic performance

Sound absorption: Achieved by installing a perforated metal liner sheet and incorporating a 'soft' absorbing insulation material behind it. Different combinations of perforations and levels of insulation will give varying results of sound absorption. See pages 556-7.

Airborne sound reduction: A standard insulated roof construction will have an approximate weighted sound reduction (Rw) of 33dB with an aluminium trapezoidal liner and 36dB with a steel trapezoidal liner. The sound reduction performance can be increased by varying the number and the densities of the insulation layers as well as adding additional mass into the construction.

Rain impact noise and flanking sound: Proprietary System manufacturers have achieved significant impact noise reductions by incorporating mineral wool insulation.

Thermal performance

Crown FactoryClad 40 has a thermal conductivity of 0.040 W/mK

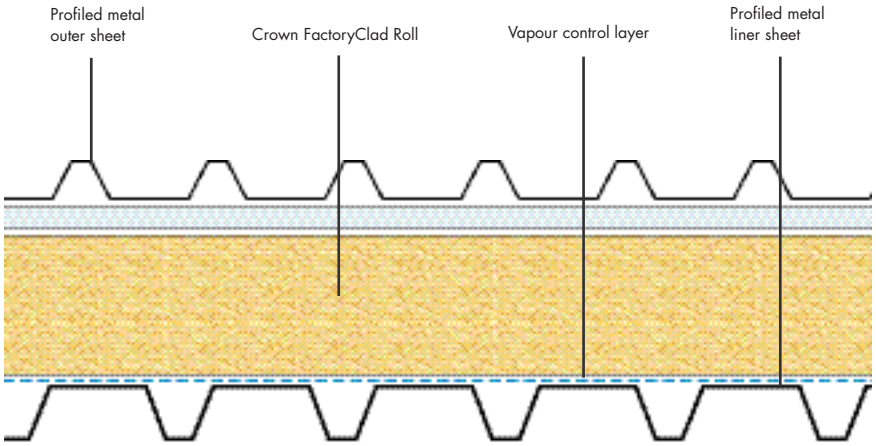
Crown FactoryClad 37 has a thermal conductivity of 0.037 W/mK

Crown FactoryClad 35 has a thermal conductivity of 0.035 W/mK

Crown FactoryClad 32 has a thermal conductivity of 0.032 W/mK

Thickness of Crown FactoryClad required to achieve U-values is shown on Table 32.

Typical section



Typical specification

Liner panels to be positioned over purlins and a metal spacer system secured to the liner and purlin to ensure the full thickness of insulation is maintained between the liner and cladding sheets. Crown FactoryClad 40*/37*/35*/32* .....mm thick, to be laid over the lining sheets and installed according to system manufacturer's instructions, with all joints closely butted. Cladding sheets to be securely fixed in position. (*Delete as appropriate)

Alternatively, refer to NBS clause H31/50 and 271

Table 32: Typical U-values for built-up metal roofs - rail and bracket systems

Product	Rails at 1.20 metre spacings	
	Thickness (mm)	U-value
Crown FactoryClad 40	200	0.22
	180	0.24
	160	0.27
Crown FactoryClad 37	200 (2x100)	0.20
	180	0.23
	160	0.26
Crown FactoryClad 35	200 (2x100)	0.19
	180 (2x90)	0.22
Crown FactoryClad 32	200 (2x100)	0.18
	180 (2x90)	0.20
	170 (80+90)	0.21

Notes: The U-values are based on SCI P312. Knauf Insulation recommend that the system designer/manufacturer is contacted for U-values specific to their systems.

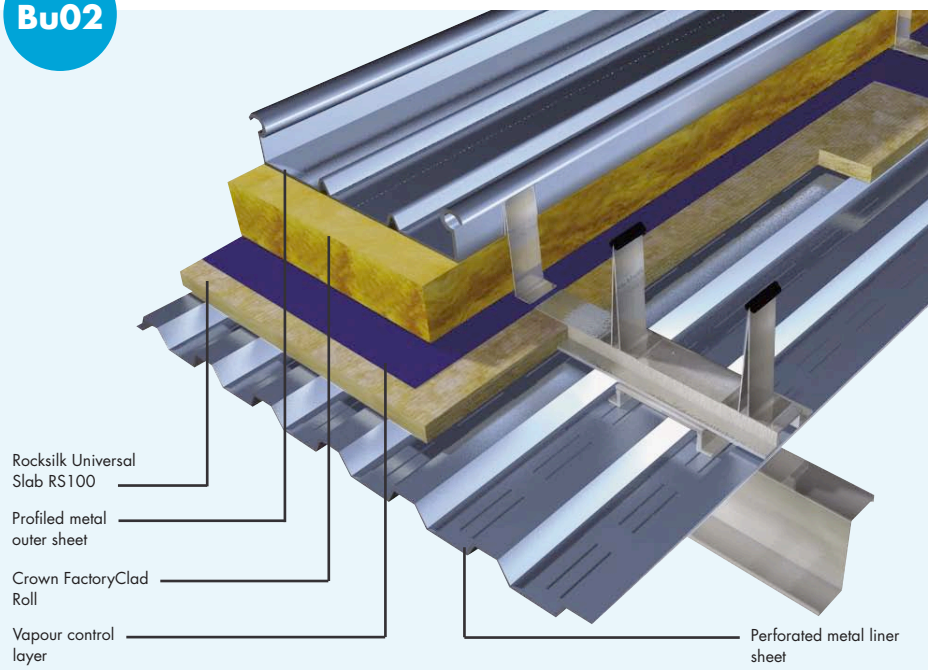
Built-up metal roofs

Standing seam system

Bu02

Advantages

- ✓ **Euroclass A1 fire classification**
- ✓ **Exceptionally high tear strength**
- ✓ **Combines thermal and acoustic insulation**
- ✓ **Cost effective**
- ✓ **Easy to install**
- ✓ **Lightweight and easy to handle**



Products

Crown FactoryClad Rolls are a range of flexible, lightweight rolls of resilient, non-combustible glass mineral wool with exceptionally high tear strength. They are produced in a range of four different thermal conductivities.
They have a very low impact on the environment and are classified as zero ODP and zero GWP*.

* Ecohomes and Code for Sustainable Homes classification

Rocksilk Universal Slab is a multi purpose rock mineral wool slab which has a very low impact on the environment and is classified as zero ODP and zero GWP*.

Typical construction

Standing seam profiles are able to meet the most demanding construction and design requirements to create a roof which combines functionality with aesthetics. Profiled metal systems typically consist of a low profile metal inner liner sheet, separated from an outer, higher profile, metal weather sheet. The cavity is filled with a layer of insulation to provide maximum thermal performance. Built-up roofing and cladding systems are assembled on site. The design and components used are usually part of a proprietary system.

Installation

Crown FactoryClad is used for the thermal and acoustic insulation in profiled metal clad roofing systems. With Euroclass A1 fire classification, its use can potentially reduce insurance premiums when compared to foam composite panels. Crown FactoryClad is manufactured 1200mm wide and in long lengths, making it particularly suitable for use in standing seam roofs.

Performance

Thermal:

Crown FactoryClad 40 has a thermal conductivity of 0.040 W/mK

Crown FactoryClad 37 has a thermal conductivity of 0.037 W/mK

Crown FactoryClad 35 has a thermal conductivity of 0.035 W/mK

Crown FactoryClad 32 has a thermal conductivity of 0.032 W/mK

Rocksilk Universal Slab RS100 has a thermal conductivity of 0.035 W/mK

Fire

Crown FactoryClad and Rocksilk Universal Slab RS100 are classified as Euroclass A1 to BS EN ISO 13501-1.

Thickness of Crown FactoryClad required to achieve U-values is shown in Table 33.

Vapour resistivity

Crown FactoryClad has a vapour resistivity of 7.00 MN.s.g.m.

Acoustic performance

Sound absorption: Achieved by installing a perforated metal liner sheet and incorporating a 'soft' absorbing insulation material behind it. Different combinations of perforations and levels of insulation will give varying results of sound absorption.

Airborne sound reduction: A standard insulated roof construction will have an approximate weighted sound reduction (Rw) of 33dB with an aluminium trapezoidal liner and 36dB with a steel trapezoidal liner. The sound reduction performance can be increased by varying the number and the densities of the insulation layers as well as adding additional mass into the construction.

Rain impact noise and flanking: Proprietory system manufacturers have achieved significant rain impact noise reductions by incorporating mineral wool insulation within their systems.

Typical section

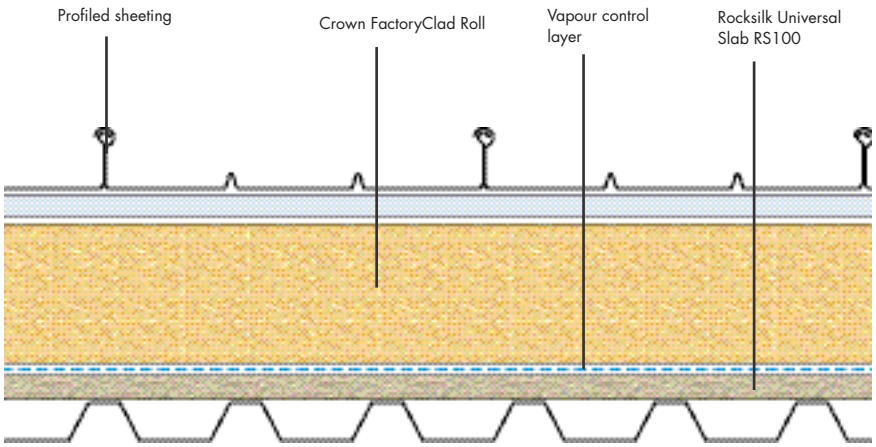


Table 33: Typical U-values for standing seam systems

Product		Purlin centres (m)			
	Thickness (mm)	1.00	1.40	1.80	2.00
				U-value	
Crown FactoryClad 40	200	0.25	0.23	0.22	0.22
	180	0.28	0.26	0.25	0.25
Crown FactoryClad 37	200	0.24	0.22	0.21	0.21
	180	0.25	0.24	0.23	0.23
	160	0.28	0.26	0.23	0.23
Crown FactoryClad 35	200	0.23	0.21	0.20	0.20
	180	0.25	0.23	0.22	0.22
Crown FactoryClad 32	200	0.20	0.19	0.18	0.17
	180	0.23	0.21	0.21	0.20
	170	0.24	0.22	0.21	0.21

Notes: The U-values are based on SCI P312. Knauf Insulation recommend that the system designer/manufacturer is contacted for U-values specific to their systems.

Typical specification

Liner panels to be positioned over purlins and a metal spacer system secured to the liner and purlin to ensure the full thickness of insulation is maintained between the liner and cladding sheets. Crown FactoryClad 40*/37*/35*/32* .....mm thick, to be laid over the lining sheets and installed according to system manufacturer's instructions, with all joints closely butted. Cladding sheets to be securely fixed in position. (*Delete as appropriate)

Alternatively, refer to NBS clause H31/50 and 271

Acoustic system

Perforated metal liner sheets to be positioned over purlins and support brackets fixed to the purlins. Rocksilk Universal Slab RS100, ...mm thick, to be laid over the lining sheets and overlaid with a vapour control layer. Secure a metal spacer system through the vapour control layer to the support bracket to ensure the full thickness of thermal insulation is maintained between the vapour control layer and cladding sheets. Crown FactoryClad 40*/37*/35*/32* .....mm thick, to be laid over the vapour control layer and tucked under the metal spacer as each tier is completed with all joints closely butted. Cladding sheets to be securely fixed in position. (*Delete as appropriate) Insulation to be installed according to system manufacturer's instructions.

Alternatively, refer to NBS clause H31/254

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it's time to save energy

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