Built-up metal roofs

Built-up metal roof design

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 between them is filled with a layer of thermal insulation to provide the specified level of thermal performance. The insulation is normally a lightweight, high performance, non-combustible glass mineral wool quilt, with a Euroclass A1 fire rating. Built-up metal roofing systems are typically assembled on site with the design and components used forming part of a proprietary system.

Design considerations
The designer will have to consider many things 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 levels 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.

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 roofs. 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 SAP and SBEM whole building compliance calculations.

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 SAP and SBEM calculations.

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 as well as the building occupiers specific requirements. These measures can be grouped into two categories, sound insulation and sound absorption.

Sound insulation
Incorporating glass and rock mineral wool insulation within a built-up metal roof system is one of the most cost effective methods of improving its sound insulation performance. 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 including rain noise.

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 08-01, or specific client requirements. Environmental health regulations may require specific sound insulation performance in roofs where high levels of internal noise are generated, such as industrial buildings and sports and concert halls in order 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 and a sound absorbing lining (usually glass or rock mineral wool) to control reverberation of sound which would otherwise be problematic.

Rain noise
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. 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
Glass and rock mineral wool are non-combustible with a Euroclass A1 `Reaction to fire` classification. 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 is available from roof system manufacturers.

Control of condensation
In order to achieve the overall U-value the modern spacer systems are likely to include a significant thermal break, and as such the chance of condensation where the spacer system is fixed to the liner sheet is negligible. If there are significant gaps in the insulation layer then it may be possible for localised condensation to occur.

To control condensation within the built-up metal roof structure it is normal to create an effective vapour control layer at the level of the liner sheet. This can be achieved by installing a separate vapour control layer (polythene sheet) or sealing all joints and penetrations in the metal liner sheet. Where a perforated liner sheet is used then a separate vapour control layer 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 food processing plants.

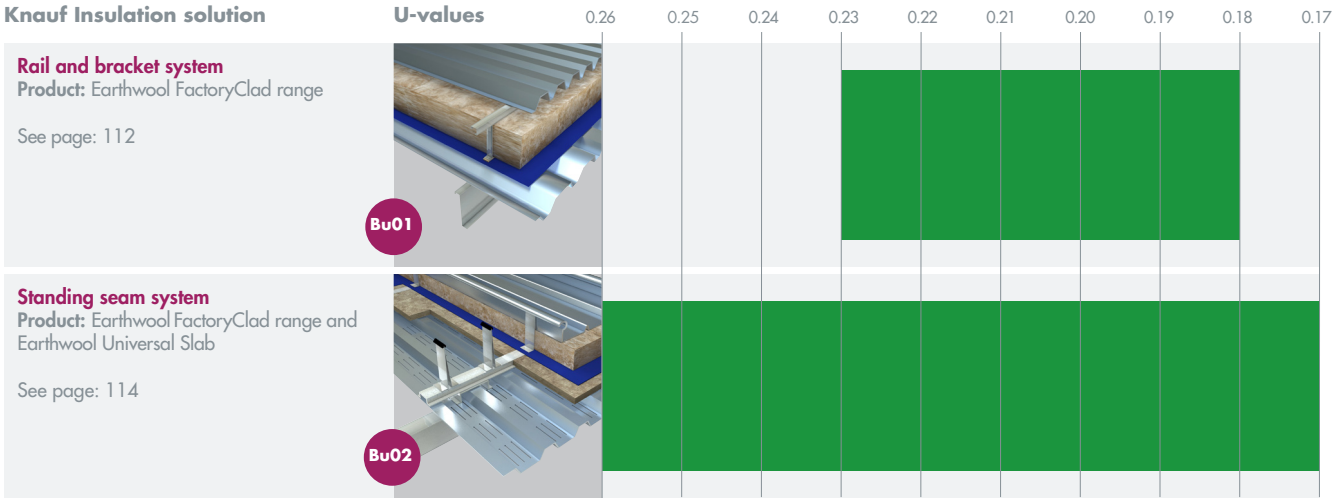
Photograph Courtesy of Kalzip

Photograph courtesy of Kalzip

Photograph courtesy of Kalzip

Solution optimiser and pathfinder

Knauf Insulation solution | **U-values**



Rail and bracket system
Product: Earthwool FactoryClad range

See page: 112

Standing seam system
Product: Earthwool FactoryClad range and Earthwool Universal Slab

See page: 114

Key

Thermal insulation achievable by constructions within this document.

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

Built-up metal roofs

Rail and Bracket System

Earthwool FactoryClad Roll

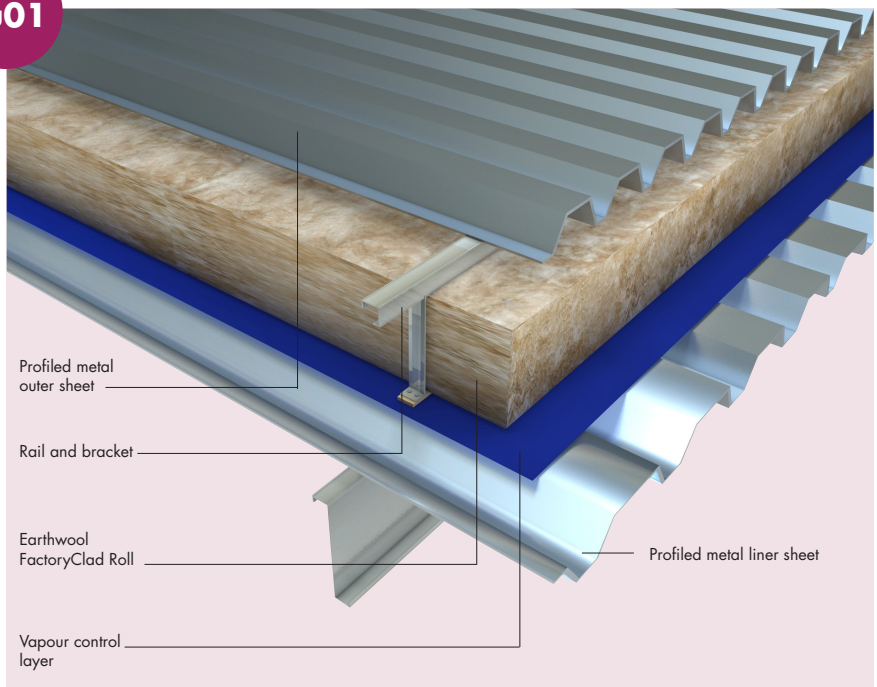
NEW BUILD REFURB

Bu01

- Significantly improves acoustic performance and reduces the drumming effect of rainwater on lightweight roofs
- Insulation knits together at joints ensuring no loss of thermal and acoustic performance
- Lightweight, easy and quick to install

Earthwool FactoryClad Roll

- Non-combustible with a Euroclass A1 reaction to fire rating
- A+ Generic BRE Green Guide Rating
- Zero Ozone Depletion Potential (ODP)
- Zero Global Warming Potential (GWP)



Products

Earthwool FactoryClad Roll is a range of flexible, lightweight rolls of resilient, non-combustible glass mineral wool with exceptionally high tear strength.

They have a very low impact on the environment and are produced in a range of three thermal conductivities.

Typical construction

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

Installation

Earthwool FactoryClad Roll is located between the 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 profiles.

Performance

Fire

Earthwool FactoryClad Roll is classified as Euroclass A1 to BS EN 13501-1

Vapour Resistivity

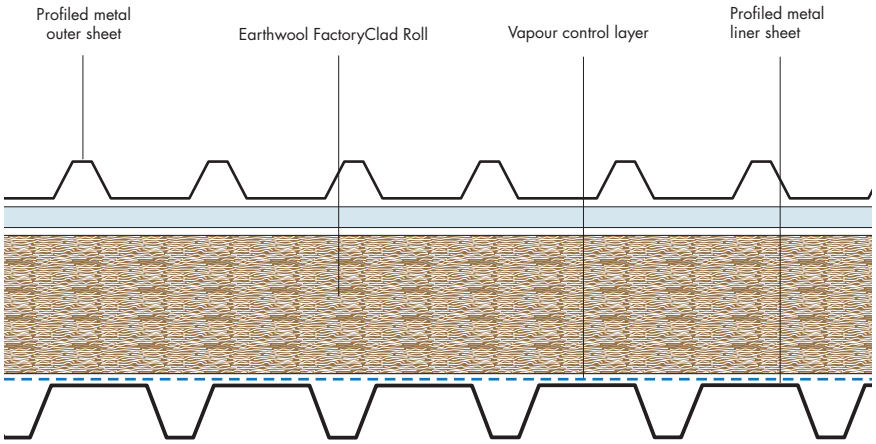
Earthwool FactoryClad Roll has a vapour resistivity of 5.00 MN.s.g.m.

Acoustic performance

Sound absorption: Achieved by installing a perforated metal liner sheet and incorporating a 'soft' absorbing insulation material behind it, such as Earthwool FactoryClad Roll. 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 density of the insulation layers as well as adding additional mass into the construction.

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.

Earthwool FactoryClad Roll 40*/37*/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)

NBSPlus Alternatively, consult the National Building Specifications, Standard version clause/clauses...H31/50 and 271.....

Knauf Insulation specification clauses can be downloaded from knaufinsulation.co.uk/nbs

Rain impact noise and flanking sound:
Proprietary system manufacturers achieve significant impact noise and flanking sound reduction by incorporating mineral wool insulation within their systems.

Thermal performance

Earthwool FactoryClad Roll 40 has a thermal conductivity of 0.040 W/mK.

Earthwool FactoryClad Roll 32 has a thermal conductivity of 0.032 W/mK.

Example U-values for built-up metal roofs - rail and bracket systems

Product	Rails at 1.20 metre spacings	
	Thickness (mm)	U-value (W/m²K)
Earthwool FactoryClad Roll 40	240 (2x120)	0.18
	220	0.20
	200	0.22
	180	0.24
Earthwool FactoryClad Roll 32	160 (2x80)	0.23

IMPORTANT:
These U-values are taken from default values in the BRE U-value calculator as examples only. To ensure an accurate U-value calculation, the roof or wall manufacturer should be contacted for the U-value specific to the system and associated components being used.

Built-up metal roofs

Standing seam system

Earthwool FactoryClad Roll and Earthwool Building Slab RS 100

NEW BUILD REFURB

Bu02

- Significantly improves acoustic performance and reduces the drumming effect of rainwater on lightweight roofs
- Insulation knits together at joints ensuring no loss of thermal and acoustic performance
- Lightweight, easy and quick to install

Earthwool FactoryClad Roll

- Non-combustible with a Euroclass A1 reaction to fire rating
- A+ Generic BRE Green Guide Rating
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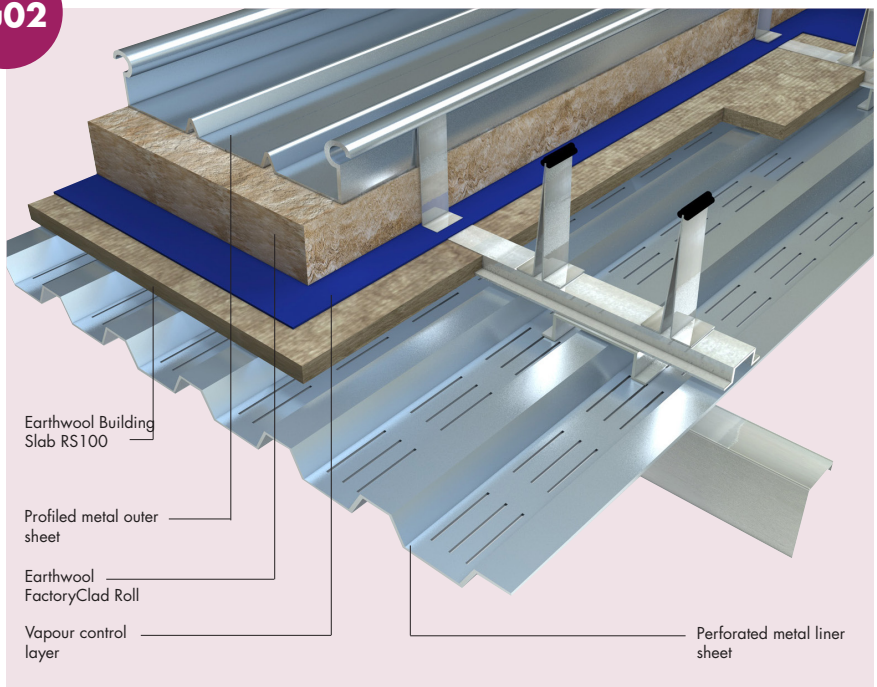


Products

Earthwool FactoryClad Roll is a range of flexible, lightweight rolls of resilient, non-combustible glass mineral wool with exceptionally high tear strength.

They have a very low impact on the environment and are produced in a range of three thermal conductivities.

Earthwool Building Slab RS100 is a multi purpose non-combustible rock mineral wool slab, it has a very low impact on the environment.

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 between them is filled with a layer of thermal insulation to provide the specified level of thermal performance. Built-up roofing and cladding systems are assembled on site, the components used are usually part of a proprietary system.

Installation

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

Performance

Thermal:

Earthwool FactoryClad Roll 40 has a thermal conductivity of 0.040 W/mK

Earthwool FactoryClad Roll 32 has a thermal conductivity of 0.032 W/mK

Earthwool **Building** Slab RS100 has a thermal conductivity of 0.034 W/mK

Fire

Earthwool FactoryClad Roll and Earthwool **Building** Slab RS100 are classified as Euroclass A1 to BS EN 13501-1.

Vapour resistivity

Earthwool FactoryClad Roll and Earthwool **Building** Slab RS100 have a vapour resistivity of 5.00 MN.s.g.m.

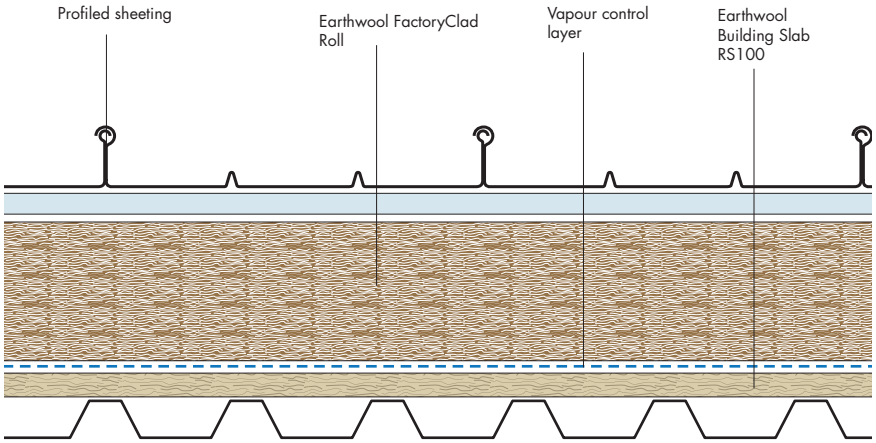
Acoustic performance

Sound absorption: Achieved by installing a perforated metal liner sheet and incorporating a 'soft' absorbing insulation material behind it, such as Earthwool FactoryClad Roll. Different combinations of perforations and mineral wool products deliver varying levels of sound absorption performance.

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 achieve significant impact noise and flanking sound reduction by incorporating mineral wool insulation within their systems.

Typical section



Typical U-values for standing seam systems

Thickness (mm)	Product	U-values (W/m²K) Purlin Centres (m) 1.00	1.40	1.80	2.00
220	Earthwool FactoryClad Roll 32	0.20	0.19	0.18	0.17
	Earthwool FactoryClad Roll 37	0.23	0.21	0.20	0.20
	Earthwool FactoryClad Roll 40	0.24	0.22	0.21	0.21
180	Earthwool FactoryClad Roll 32	0.23	0.21	0.20	0.20
	Earthwool FactoryClad Roll 37	0.26	0.25	0.23	0.23
170	Earthwool FactoryClad Roll 32	0.24	0.22	0.21	0.21

IMPORTANT:
These U-values are taken from default values in the BRE U-value calculator as examples only. To ensure an accurate U-value calculation, the roof or wall manufacturer should be contacted for the U-value specific to the system and associated components being used.

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. Earthwool FactoryClad Roll 40*/37*/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)

NBSPlus Alternatively, consult the National Building Specifications, Standard version clause/clauses...H31/50 and 271.....

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Acoustic system

Perforated metal liner sheets to be positioned over purlins and support brackets fixed to the purlins. Earthwool **Building** 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. Earthwool FactoryClad Roll 40*/37*/32* .....mm thick, to be laid over the vapour control layer and tucked under the metal spacer as each layer 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.

NBSPlus Alternatively, refer to NBS clause H31/254