Built-up metal roofs

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.

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.

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 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.

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 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 mineral wool) to control reverberation of sound which would otherwise be problematic.

Fire protection

Glass mineral wool is 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

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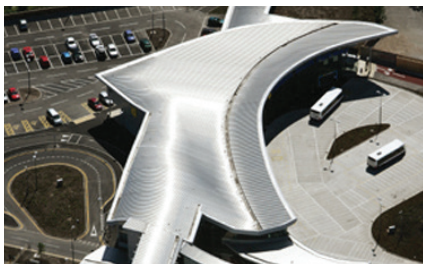
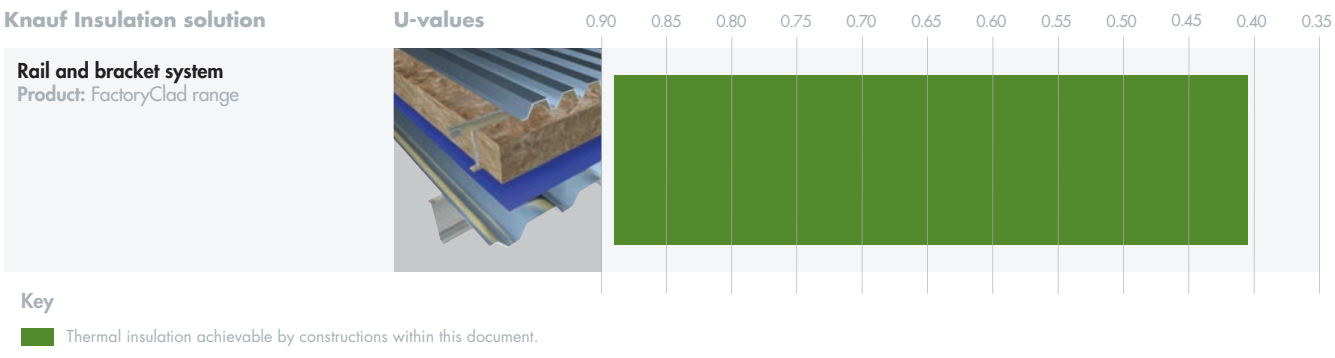


Photograph courtesy of Kalzip

Solution optimiser and pathfinder



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Rail and Bracket System

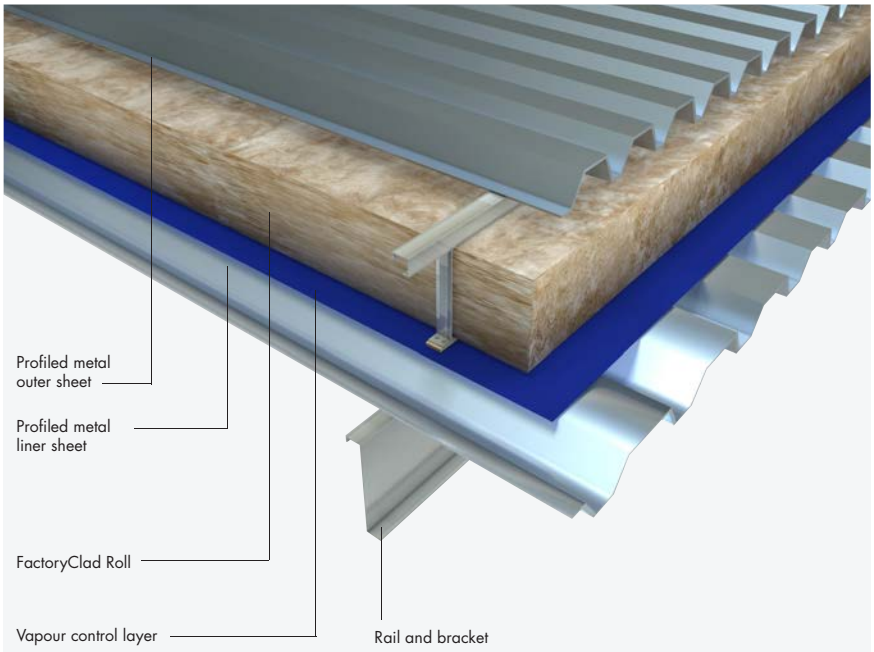
FactoryClad Roll

NEW BUILD REFURB

- **Significantly improves acoustic performance**
- **Insulation knits together at joints ensuring no loss of thermal and acoustic performance**
- **Lightweight, easy and quick to install**

FactoryClad Roll

- **Glass mineral wool is non-combustible**
- **Zero Ozone Depletion Potential (ODP)**
- **Zero Global Warming Potential (GWP)**



Products

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

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

Installation

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 performance

FactoryClad Roll is tested and listed UL 723, ASTM E84

Classification (UL723)	FSK	WMP-10
Flame spread	not over 25	not over 25
Smoke developed	not over 50	not over 50

Vapour Resistivity

FactoryClad insulation with WMP-10 facing has a vapour transmission of 0 perms

FactoryClad insulation with FSK facing has a vapour transmission of 0.02 perms

Acoustic performance

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

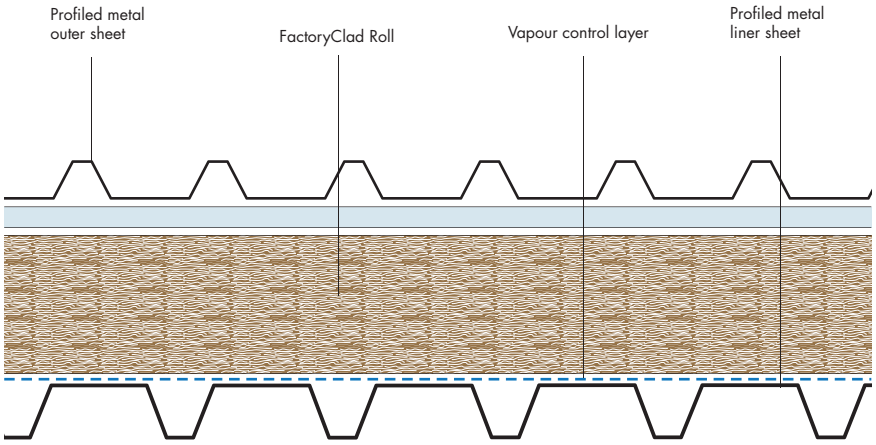
Airborne sound reduction: A standard insulated roof construction will have an approximate weighted sound reduction (Rw) of 33dB with an aluminium trapezoidal liner and 36dB with a steel trapezoidal liner. The sound reduction performance can be increased by varying the number and the density of the insulation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

Thermal performance

FactoryClad Roll 44 Roof as a thermal conductivity of 0.044 W/mK.

FactoryClad Roll 41 has a thermal conductivity of 0.041 W/mK.

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.

FactoryClad Roll 44*/41* .....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)

Product	Rails at 1.20 metre spacings	
	Thickness (mm)	U-value (W/m²K)
FactoryClad Roll 44 Roof	100	0.44
	50	0.88
FactoryClad Roll 41	100	0.41
	50	0.82

Note: Knauf Insulation recommend that the system designer/manufacturer is contacted for U-values specific to their systems.