

# Insulation systems for metal and special roofs

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**FOAMGLAS®**  
Building



**FOAMGLAS®**

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## Aesthetics and a long service life

In bygone centuries, metal was already being used as the roof covering material for technically and aesthetically demanding buildings. Even then, great master builders recognised the advantages. Metal's long service life and adaptability – even in complex roof landscapes – is very highly valued by architects and building contractors today as well. And in fact, more and more. In combination with a highly effective thermal insulation of FOAMGLAS® – the safety insulation made of glass foam – metal and special roofs can also prove to be economically viable because of the long term performance.

## A variety of design possibilities, economically

Metal roofs are unquestionably on the way up. For a long time people have been discovering the material no longer just on churches, on public or commercial buildings – it is being used more and more in residential buildings as well. Because even the most striking roof shapes can be clad with metal. Another thing that makes architects and clients equally happy: Not only is something offered to the eyes: In addition to aesthetics, metal roofs fulfil the

- 1 Spa, Alveneu
- 2 Penthouse, Palace Hotel, Gstaad
- 3 Eglise Ste-Thérèse de Lisieux, Fribourg



most demanding requirements in terms of service life, and therefore economics. Since metal roofs are nearly maintenance-free when expertly installed, the roof is also very economical in the long term.

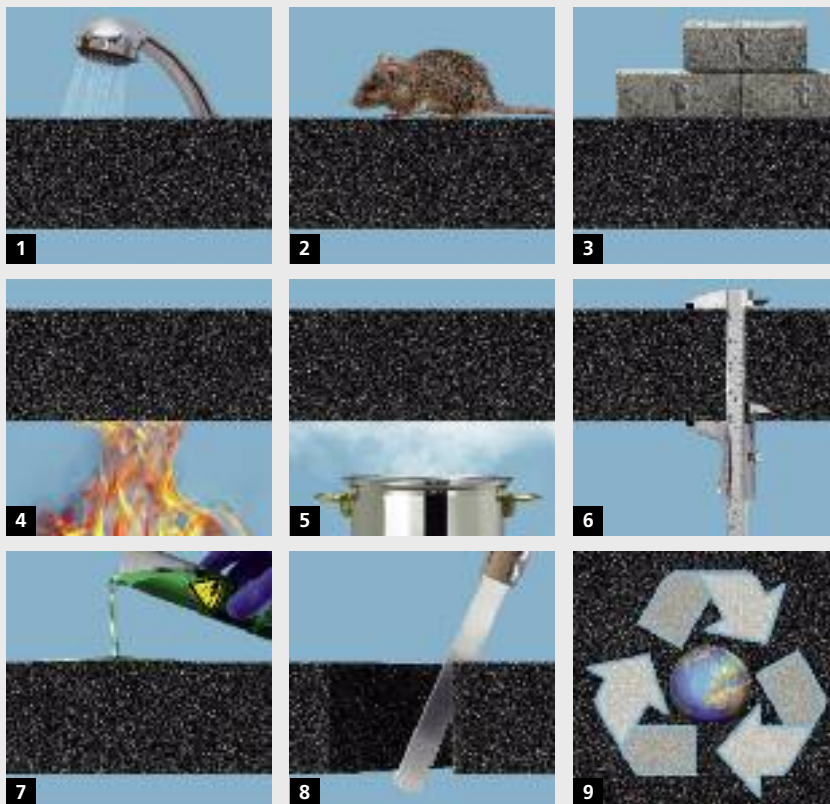
### Ecologically sensible system solutions

The “natural” building material is also valued for its positive ecological balance sheet. Economics and ecology are virtually merged in it, and add value to structures. Metal roofs emphasise their ecological attractiveness because, for example, after the end use of the building both the covering materials and the insulation – if it consists of FOAMGLAS® – can be recycled. While metals can be re-used in a closed cycle for the production of “fresh material”, the glass foam insulation can be used, for instance, as insulating back filler material.

### Crucial criterion: Long service life

Here metal especially distinguishes itself: Thus for example aluminium metal sheet roofs 100 years old are encountered all over Europe. And the copper roof of the Hildesheim cathedral has been “free of damage” for nearly 300 years. Titanium zinc alloy and high-grade steel, with applications appropriate to the system, also show a considerable expected service life according to current knowledge. Thus it is not surprising that both public and private clients increasingly bet on the functionality, the safety and the aesthetics of metal.

### FOAMGLAS® insulation: unrivalled performance



- 1 **Waterproof** FOAMGLAS® is waterproof because it consists of pure glass. **Advantage:** does not absorb any moisture and does not swell.
- 2 **Pest-proof** FOAMGLAS® cannot rot and is pest-proof because it is inorganic. **Advantage:** insulation without risk, especially in the base area and the soil. No basis for nesting, breeding or seed germination.
- 3 **Compression-proof** FOAMGLAS® is extraordinarily in-compressible even with long-term loads due to its cell geometry without deformation. **Advantage:** use as load-bearing thermal insulation without risk.
- 4 **Incombustible** FOAMGLAS® cannot burn because it consists of pure glass. Fire behaviour: Classification according to EN 13501: A1. **Advantage:** storage and processing not hazardous. No propagation of flames in the event of fire (chimney effect) in ventilation space.
- 5 **Vapour-tight** FOAMGLAS® is vapour-tight because it consists of hermetically sealed glass cells. **Advantage:** cannot soak through and already contains the vapour barrier. Constant thermal insulation value over decades. Prevents the penetration of radon.
- 6 **Dimensionally stable** FOAMGLAS® is dimensionally stable because glass neither shrinks nor swells. **Advantage:** no dishing, contracting or creep. Low coefficient of expansion, nearly equal to that of steel and concrete.
- 7 **Acid-resistant** FOAMGLAS® is resistant to organic solvents and acids because it consists of pure glass. **Advantage:** no destruction of the insulation by aggressive mediums and atmospheres.
- 8 **Easy to work with** FOAMGLAS® is easy to work with because it consists of thin-walled glass cells. **Advantage:** with simple tools like a saw blade or hand saw, FOAMGLAS® can be cut to any desired measurement.
- 9 **Ecological** FOAMGLAS® is free of environmentally damaging flame retardants and propellants, no relevant eco-toxic components. **Advantage:** After generations of use as thermal insulation, FOAMGLAS® can be used again: as filler in landscaping or thermally insulating granulate. Ecologically sensible recycling through re-use.



- 1 Cendres et Métaux, Biel
- 2 Mattenhof school building, Zurich
- 3 University, Zurich
- 4 Central Bank, Vaduz

## Flawless construction

It is essential, in combination with roof substrates or insulating materials, to choose the building components that represent both an ideal combination of materials with metal and also guarantee lasting flawless thermal and building physics operation.

FOAMGLAS® insulation is outstandingly suitable for the building and insulating of metal roofs. Various system solutions guarantee that the monocoque unventilated roof in combination with metal sheet covering is one of the safest and technically advanced options.

As a result the tiresome discussion of “warm roof – yes or no” can finally come to an end.

### Secure basis for the non-ventilated metal roof

FOAMGLAS® has clear advantages over traditional insulating materials. The safety insulation consists of glass foam. Millions of the smallest, gas filled glass cells give it a high degree of thermal insulating capability. The vapour barrier is already “built in” in the structure of the material.

**Glass foam is the only insulating material therefore that takes over the assignment of thermal insulation and vapour barrier in a single function.**

In addition the high compressive strength supplies the special argument that the fastening of the metal sheet roof takes place not in the load-bearing base, but through adhering in the insulation layer itself. It is therefore free of thermal bridges.

### Special roof systems

Both in new builds and in renovation projects there are roof structures that can be characterised as “special roof

systems". They are usually chosen for architectural, practical or acoustic reasons. Even though this does not explicitly concern flat roofs, the demands of the insulation are comparable with those of a flat roof.

For decades the "FOAMGLAS® compact roof principle" has proven itself due to its extraordinary properties. The reference examples are meant to demonstrate that FOAMGLAS® can also be used extremely advantageously for special

roofs – with the most varied geometrical shapes, with smooth or curved surfaces and/or special covering materials and substrate structures.

## Characteristics of warm roof construction with FOAMGLAS®

- Roof structure with long service life due to the combination of age-resistant building materials
- High-performance thermal protection with simultaneous lower structure heights
- Insulation value constant over the full operating life of the building
- Simple build-up in terms of structure and methods
- High building physics safety and low susceptibility to damage
- Minimal fire load; no propagation of fire
- Economical
- Independent of the roof slope with any roof size
- Can be used for practically all roof architectures



In the execution of metal roofs, titanium zinc alloy, aluminium, copper and stainless steel are in the foreground. These materials are processed on FOAMGLAS® according to the specialist rules of the metal roof contracting trade.

- 1 Copper
- 2 Titanium zinc alloy
- 3 Aluminium
- 4 High-grade steel



## Metal roof systems

### University of Zurich, Zurich

**Architect** Calatrava Santiago Valls SA, Zurich

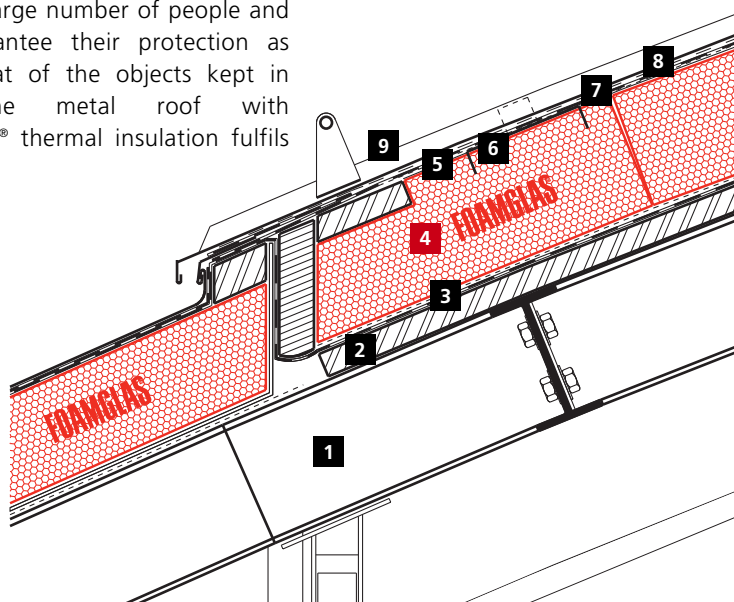
**Execution** 2002

**Use of FOAMGLAS®** roof insulation, ca. 1000 m<sup>2</sup>, Type T4+, Thickness 150 mm, adhered

**Covering** Pre-patined copper sheet metal covering, using the standing seam technique

When architects look for new aesthetic forms of expression, correspondingly innovative solutions are demanded. It is also not surprising that in building projects that are the focus of public interest, like the University of Zurich, special requirements are made. These buildings have to meet especially high safety standards because they accommodate a large number of people and must guarantee their protection as well as that of the objects kept in them. The metal roof with FOAMGLAS® thermal insulation fulfils

these stringent requirements, in terms of both aesthetics and safety. FOAMGLAS® offers great building physics safety, is non-combustible and in the event of a fire, does not propagate the flames. At the same time it provides long-lived, high-performance thermal protection that remains unchanged over decades.



### Aesthetics and safety united

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#### Build-up

- 1 Steel beams
- 2 Wooden laminated boards
- 3 Separating layer of bitumen membrane
- 4 FOAMGLAS® T4+, 150 mm, in hot bitumen
- 5 Hot bitumen casting
- 6 PC fastening boards (claw plates)
- 7 Waterproofing single layer, bituminous,
- 8 Separating layer, sound-insulating fleece
- 9 Pre-patined copper metal sheet covering







## Metal roof systems

### Single family home Moser, Lüscherz

**Architect** Hans Nievergelt, dipl. Arch. ETH SIA, Erlach

**Execution** 2001

**Use of FOAMGLAS®** roof insulation, ca. 125 m<sup>2</sup>, Type T4+, thickness 150 mm, adhered

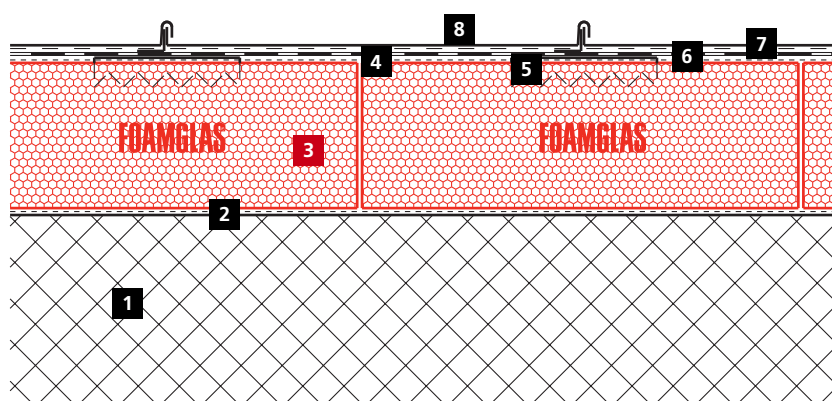
**Covering** of sheet metal VM Zinc+ in standing seam technique

Thermally optimised substrate structures for sheet metal roofs enable crucial energy savings. The strength and dimensional stability of FOAMGLAS® insulation make it possible to strike new paths in matters of roof structures. The own weight of the sheet metal covering and the wind forces are removed over the insulating layer into the substrate due to countersunk claw plates (PC® fixing plates). In comparison with

traditional substrate structures, this system reduces the heat losses and the structure height to a minimum.

### Thermally optimised roof structure

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### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 150 mm, in hot bitumen
- 4 Hot bitumen casting
- 5 PC fastening boards (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Separating layer, fleece
- 8 Sheet metal covering VM Zinc+





## Metal roof systems

### Alvaneu spa, Alvaneu-Bad

**Architect** Martin Stöhr, Architektur und Gestaltung, Davos-Platz

**Execution** 2000

**Use of FOAMGLAS®** roof insulation, ca. 600 m<sup>2</sup>, Type T4+, thickness 100 mm, adhered

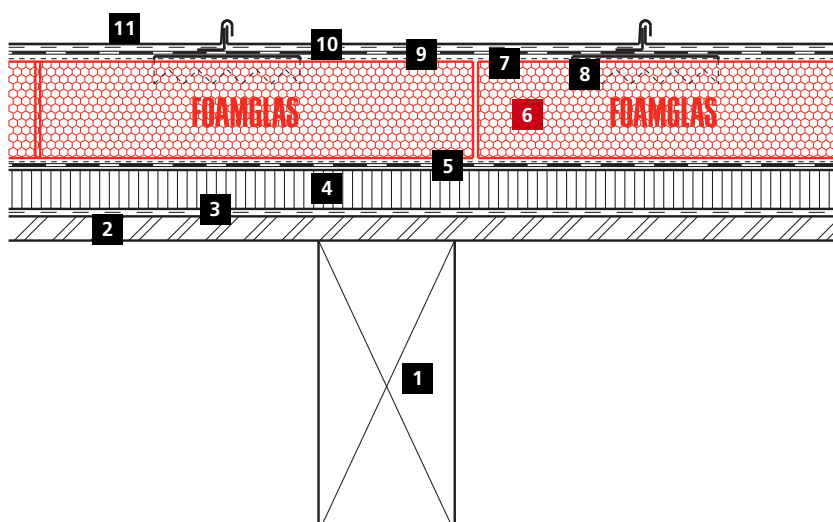
**Covering** of copper sheet metal with standing seam technique

The building client's assignment was to construct Bad Alvaneu as a structure that would be flawless in terms of building physics and have a long service life. In addition a declared goal was to choose a structure that represented a favourably priced variant both in relation to the building costs and the operating costs. Great importance was

given in the process to the thermal insulation aspect; after all Bad Alvaneu is located at around 1000 m above sea level. And of special importance in a spa: in the hermetically sealed cellular glass system no condensate can arise and no water can penetrate or accumulate: condensation within the build up is eliminated.

**Flawless building physics, long-lived structure**

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#### Build-up

- 1 Glued laminated girders
- 2 Formwork
- 3 Fleece separating layer
- 4 Mineral wool plates
- 5 Single layer waterproofing, bituminous
- 6 FOAMGLAS® T4+, 100 mm, in hot bitumen
- 7 Hot bitumen casting
- 8 PC fixing plates (claw plates)
- 9 Single layer waterproofing, bituminous
- 10 Fleece separating layer
- 11 Sheet metal covering, copper





## Metal roof systems

### Ruggell church, Ruggell (Principality of Liechtenstein)

**Architect** Architekturbüro Bargetze + Partner, Vaduz, Principality of Liechtenstein

**Execution** 1999

**Use of FOAMGLAS®** roof insulation, ca. 200 m<sup>2</sup>, Type T4+, thickness 140 mm, adhered

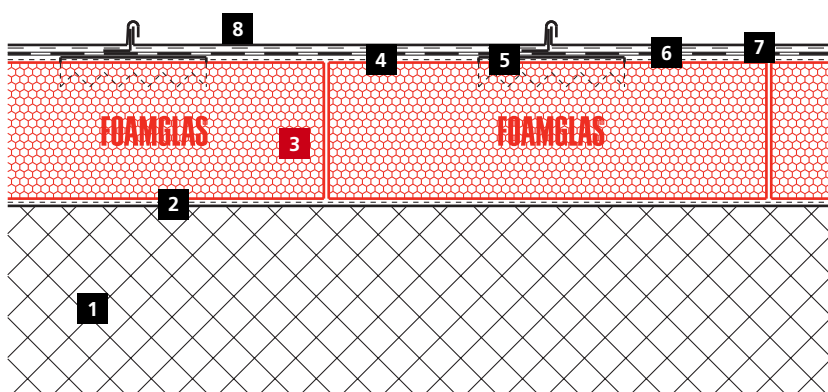
**Covering** of Uginox with standing seam technique

If there is a requirement for design reasons, as there is here, for a flat sloping sheet metal roof, the prerequisites for thermal operation are no longer present. Ventilation and dehumidification of the insulation are then prevented. What can be done? With FOAMGLAS®, the vapour and water-tight insulation material of glass foam, unventilated

roof structures can be executed in an optimum way. FOAMGLAS® is insulation layer, vapour barrier and load-bearing ceiling substrate for the metal roof in one.

**Where there is no moisture, no moisture has to be removed**

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#### Build-up

- 1 In-situ concrete, in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 140 mm, in hot bitumen
- 4 Hot bitumen casting
- 5 PC fixing plates (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Fleece separating layer
- 8 Sheet metal covering of Uginox





## Metal roof systems

### Expansion of Zelgli Housing Estate, Winterthur

**Architect** Beat Rothen, Winterthur

**Execution** 1999

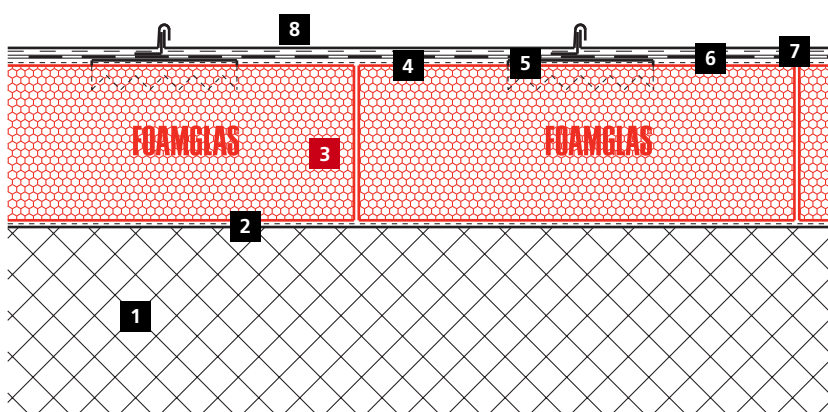
**Use of FOAMGLAS®** roof insulation, ca. 770 m<sup>2</sup>, Type T4+, thickness 160 mm, adhered

**Covering** of copper sheet metal using standing seam technique

Monopitch roofs offset from each other make it possible to bring additional light even to the depth of the room by means of bands of windows. With building and room heights prescribed in advance, therefore, it is important to keep the build-up height of the under roof to the minimum possible, in order to be able to maximise the window height and as a result the incidence of daylight. The monocoque

FOAMGLAS® compact roof system with sheet metal covering gets by without additional space-stealing layers like laths, ventilation spaces and formwork. The simplicity of the construction and the space gained through it make the system extremely economical.

**Economic feasibility and safety: the FOAMGLAS® formula for success**  
[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 160 mm, in hot bitumen
- 4 Hot bitumen casting
- 5 PC fixing plates (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Fleece separating layer
- 8 Copper sheet metal covering





## Metal roof systems

### Roche Forum Buonas, Buonas

**Architect** Scheitlin Syfrig + Partner Architekten AG, Lucerne

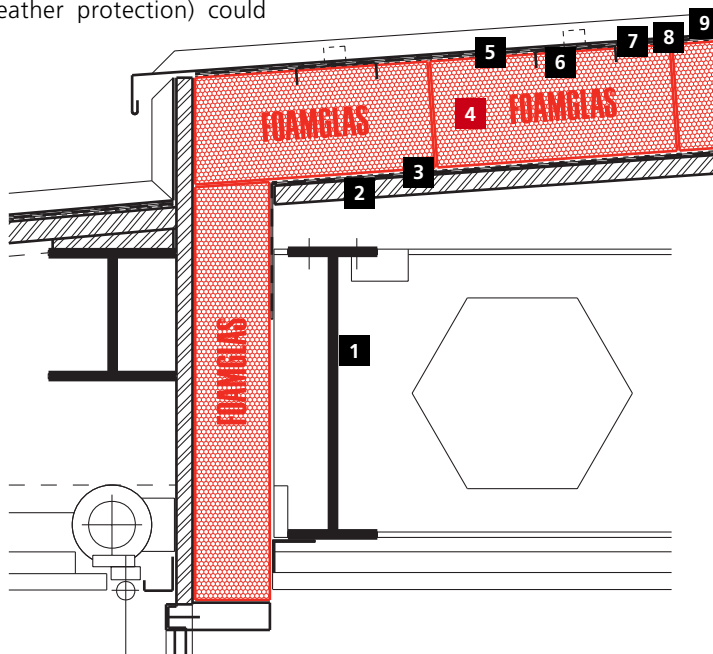
**Execution** 2002

**Use of FOAMGLAS®** roof insulation, ca. 1400 m<sup>2</sup>, Type T4+, thickness 200 mm, adhered

**Covering** of copper sheet metal using standing seam technique

As in the architecture and the colour concept, in the materials used as well the highest quality standards were set. Light yellow travertine predominates in the facade as the visible material, while the safety insulation FOAMGLAS® develops its effect invisibly. The maintenance of the roof is reduced to a minimum and the sheet metal covering (wind and weather protection) could

be renewed without restricting the thermal insulation and the substrate structure. In Roche Forum Buonas FOAMGLAS® in the flat roof with sheet metal covering and in the greenroof part guarantees effective thermal insulation as well as protection and value retention of the building substance.



**Highest quality and value retention of the building substance.**

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#### Build-up

- 1 Steel girders
- 2 Plywood
- 3 Separating layer of bitumen sheeting fleece-coated
- 4 FOAMGLAS® T4+, 200 mm, in hot bitumen
- 5 Hot bitumen casting
- 6 PC fixing plates (claw plates)
- 7 Single layer waterproofing, bituminous
- 8 Separating layer of sound insulating fleece
- 9 Copper sheet metal covering





## Metal roof systems

### New build and renovation Control centre of the Power Plant, Dallenwil

**Architect** Hans Eichenberger AG, Engineering firm, Zurich

**Execution** 1999

**Use of FOAMGLAS®** roof insulation, ca. 240 m<sup>2</sup>, Type T4+, thickness 100 mm, adhered

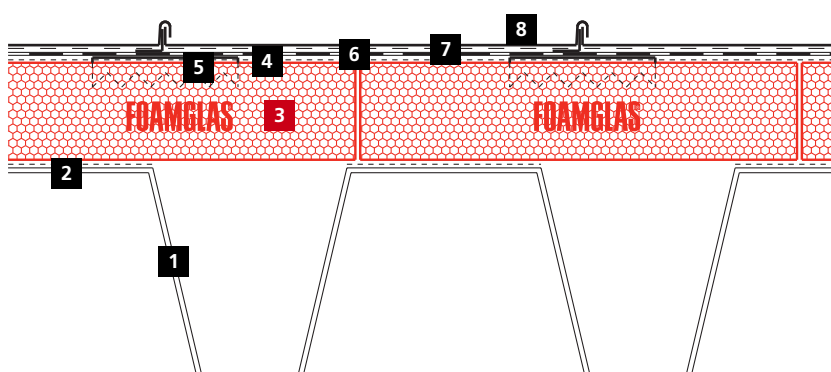
**Covering** of VM Zinc sheet metal using standing seam technique

Metal roofs that slope slightly or taper off to zero require a great deal of the thermal insulation underneath. Water infiltration must be reckoned with, and only an additional waterproofing membrane or an insulating material that is insensitive to moisture and waterproof can protect the structure. FOAMGLAS® with its unique material properties offers ideal conditions for such a roof

build-up. The water penetrating through the folds is drawn off over the waterproofing membrane, and the moisture protection, and as a result the thermal protection, are ensured over the long term.

**Long-term guaranteed moisture and thermal protection**

[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 Steel deck
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 100 mm, in hot bitumen
- 4 Hot bitumen casting
- 5 PC fixing plates (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Fleece separating layer
- 8 VM Zinc sheet metal covering





## Metal roof systems

### Penthouse Palace Hotel, Gstaad

**Architect** Jaggi & Partner AG, Architektur und Planung, Gstaad

**Execution** 2000

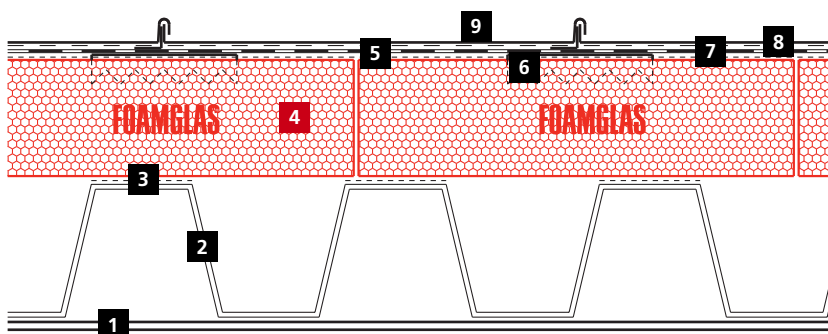
**Use of FOAMGLAS®** roof insulation, ca. 250 m<sup>2</sup>, Type T4+, thickness 120 mm, adhered

**Covering** of VM ZINC+ sheet metal using standing seam technique

The monopitch roof sloping slightly to four sides is the combination of a steel substrate structure with a steel deck covering, the FOAMGLAS® is adhered to it and finished with a covering of titanium zinc alloy sheet metal. This structure and choice of materials, innovative for the region, has proven to be an elegant solution whose advantages cannot be overlooked: aestheti-

cally as well as ecologically and economically. Here in the mountains one further system advantage is demonstrated: The roof has proven itself equal to even the highest degree of wind suction. Without additional mechanical fastening! This is hardly conceivable with any other material.

**A choice of materials that is great in aesthetic, ecological and economic terms**  
[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 Steel girder structure
- 2 Steel deck
- 3 Bituminous primer
- 4 FOAMGLAS® T4+, 120 mm, in hot bitumen
- 5 Hot bitumen casting
- 6 PC fixing plates (claw plates)
- 7 Single layer waterproofing, bituminous
- 8 Fleece separating layer
- 9 VM Zinc+ sheet metal covering





## Metal roof systems

### Multi-purpose building, Dornbirn (Austria)

**Architect** ARGE Dipl. Ing. Leopold Kaufmann, Dipl. Ing. Oskar Leo Kaufmann, BM Johannes Kaufmann

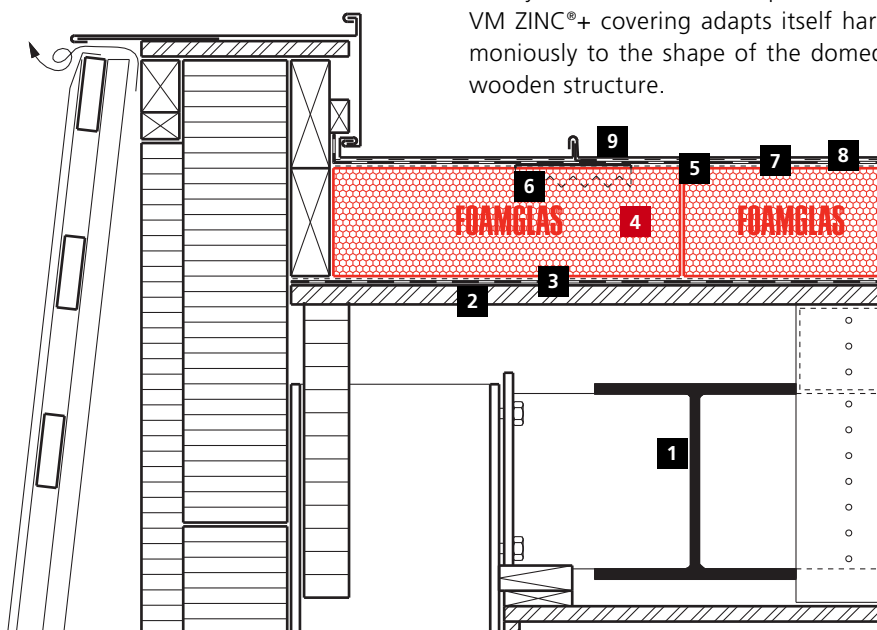
**Execution** 1998

**Use of FOAMGLAS®** roof insulation ca. 5000 m<sup>2</sup>, Type T4+, thickness 140 mm, adhered

**Covering** of VM Zinc Quartz+ sheet metal, using standing seam technique

From the point of view of the architects, the special shape of the building suggested a sheet metal covering from the beginning. The choice fell unambiguously on VM ZIN® QUARTZ+. For building physics reasons the FOAMGLAS®

compact roof proved to be the ideal solution for the 80 m long roof surface which is often covered by winter snow. The 140 mm thick insulation layer results in a functioning vapour barrier. In the roof there are no uncontrolled air layers or intermediate spaces. The VM ZINC®+ covering adapts itself harmoniously to the shape of the domed wooden structure.



### Innovative roof structure with long-term safety

[www.foamglas.com](http://www.foamglas.com)

#### Build-up

- 1 Steel girders
- 2 Wooden shell
- 3 Separating layer of Bitumen sheeting, nailed up for storm proofing
- 4 FOAMGLAS® T4+, 140 mm, in hot bitumen
- 5 Hot bitumen casting
- 6 PC fixing plates (claw plates)
- 7 Single layer waterproofing, bituminous
- 8 Fleece separating layer
- 9 VM Zinc Quartz+ sheet metal covering







## Metal roof systems

### Museum Tinguely / Niki de Saint Phalle, Fribourg

**Architect** Michel Waeber Architekt (Project), Jean-Claude Sauterel, Fribourg (Supervision of works)

**Execution** 1998

**Use of FOAMGLAS®** roof insulation, ca 500 m<sup>2</sup>, Type T4+, thickness 100 mm, adhered

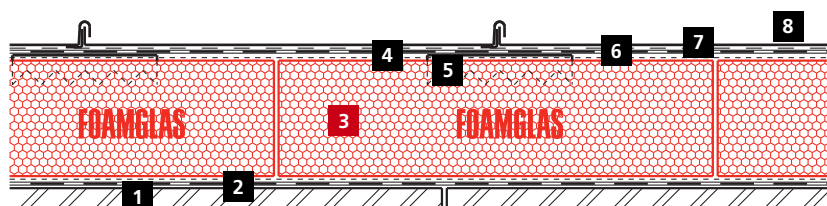
**Covering** of VM Zinc Quartz+ sheet metal, using standing seam technique

Here a century-old railway station with a turbulent history recently converted into a museum. Thanks to FOAMGLAS® it was possible to keep and enhance the old building structure. Museums are meant to protect: Therefore especially high standards are also imposed for the building quality. This is true as well for the insulating material. The greatest attention must also be paid to

passive fire protection. FOAMGLAS® fulfils these demands. It is not combustible (Fire index number 6.3) and among insulating materials it is the only material that neither smoulders nor gives off black smoke.

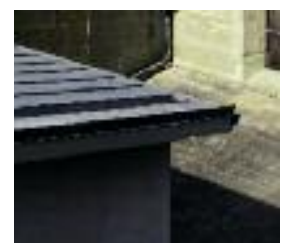
**FOAMGLAS® fulfils the stringent expectations in terms of quality, long service life and fire protection**

[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 Wooden formwork
- 2 Separating bitumen sheeting, nailed down for storm-proofing
- 3 **FOAMGLAS® T4+, 100 mm, in hot bitumen**
- 4 Hot bitumen casting
- 5 PC fixing plates (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Fleece separating layer
- 8 VM Zinc Quartz+ sheet metal covering





## Metal roof systems

### Summit Station Glacier 3000, Les Diablerets

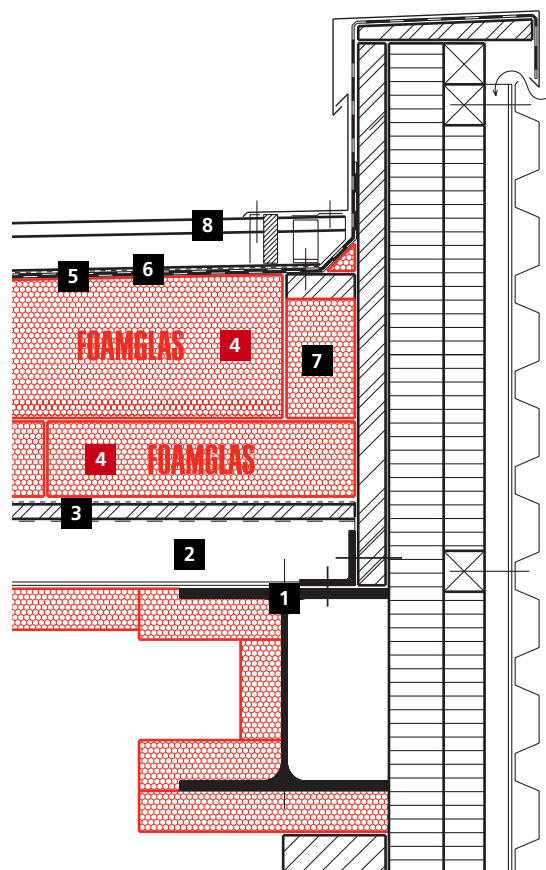
**Architect** Mario Botta, Lugano

**Execution** 2001

**Use of FOAMGLAS®** roof insulation, ca. 400 m<sup>2</sup>, Type T4+, 2-lagig, Tapered Roof System (Flat roof with sloping pavement), mean thickness 320 mm, adhered, 571 COMPOSIT fastening element with wooden support

**Covering** of aluminium sheet metal, System KAL-ZIP

Safety from the floor to the roof. In order to satisfy the stringent requirements, roof, floor, exterior and interior walls are thermally insulated with FOAMGLAS® and at the same time safeguarded in terms of fire protection. The whole load-bearing structure of steel is fully sheathed in the safety insulation. The uppermost layer of roof insulation was installed with the FOAMGLAS® Tapered Roof System. This provided the desired falls and was covered with an Aluminium roof sheet.



**Well insulated thermally and safeguarded against fire**

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#### Build-up

- 1 Steel girders
- 2 Steel deck
- 3 Duripanel slab
- 4 FOAMGLAS® T4+, 320 mm, Tapered Roof System in hot bitumen
- 5 Two-layer bituminous waterproofing
- 6 Fleece separating layer
- 7 Composite fastening element
- 8 Sheet metal covering, Aluminium





## Metal roof systems

### Sion Indoor swimming pool, Sion

Planning Roland Dournow, Meyrin

**Execution** 2003

**Use of FOAMGLAS®** roof insulation, ca. 2300 m<sup>2</sup>, Type T4+, 2-layer, thickness 230 mm, adhered

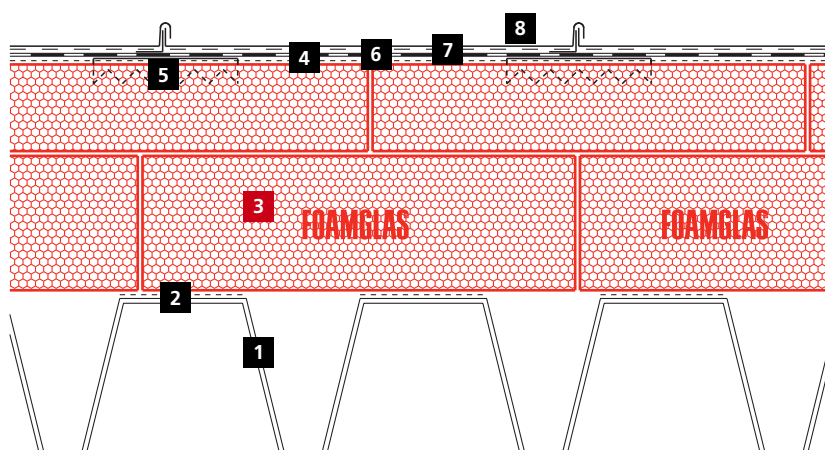
**Covering** Copper sheet metal covering using the standing seam technique

With an indoor swimming pool the building physics requirements for the building shell are complex. Condensate in the building structure can only be prevented by ventilation in the case of traditional insulating materials. This is not the case with FOAMGLAS®. Thanks to its structure, with millions of hermetically sealed glass cells, FOAMGLAS® is

vapour tight end to end, and as a result forms the vapour barrier. It is possible to install without ventilation and easily damaged vapor control layers.

**Complex building physics requirements fulfilled**

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#### Build-up

- 1 Steel deck
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 230 mm, in hot bitumen
- 4 Hot bitumen casting
- 5 PC fixing plates (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Fleece separating layer
- 8 Copper sheet metal covering





## Metal roof systems

### Single family home, Winterthur

**Architect** Beat Rothen, dipl. Architekt ETH SIA BSA, Winterthur

**Execution** 2001

**Use of FOAMGLAS®** roof insulation, ca. 100 m<sup>2</sup>, Type T4+, thickness 160 mm, adhered

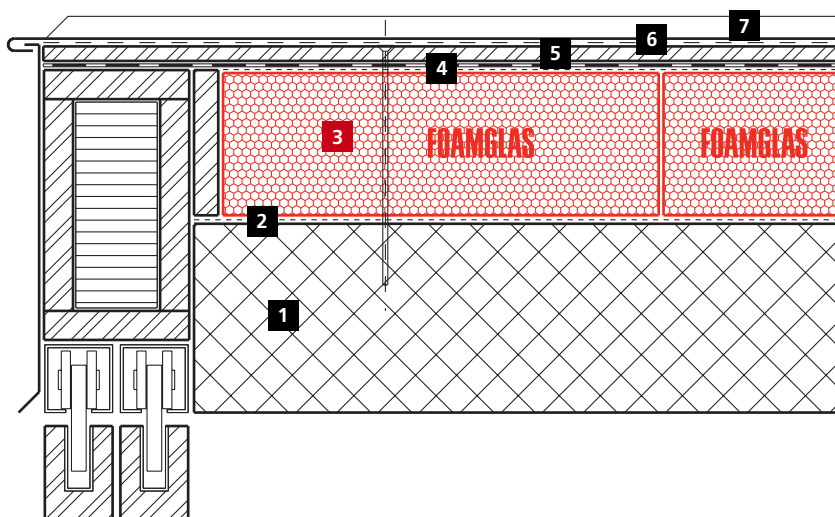
**Covering** Sheet metal covering, Rheinzink

Simple structures reduced to a minimum also demand simple building solutions. FOAMGLAS® with its unique material properties offers the optimum conditions for this: The safety insulation of glass foam does not take up any water, is absolutely vapour proof, non-rotting, temperature resistant, compression-resistant and dimensionally stable. In addition, all layers are lami-

nated to each other with hot adhesive. Water penetrating within the layers is impossible; due to the system, water penetration of the insulation layer is ruled out. The structure is accordingly safe and easy to maintain.

**Optimum all-round protection against harmful effects**

[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 160 mm, in hot bitumen
- 4 Single layer waterproofing, bituminous
- 5 Wooden covering
- 6 Fleece separating layer
- 7 Sheet metal covering of Rheinzink





## Metal roof systems

### Office building, Hurden

**Architect** Feusi & Partner AG, Architektur und Planungsbüro, Pfäffikon SZ

**Execution** 2000

**Use of FOAMGLAS®** FOAMGLAS® READY BOARD, 120 mm, 150 m<sup>2</sup>,  
FOAMGLAS® TAPERED T4+, 120 mm, 145 m<sup>2</sup>

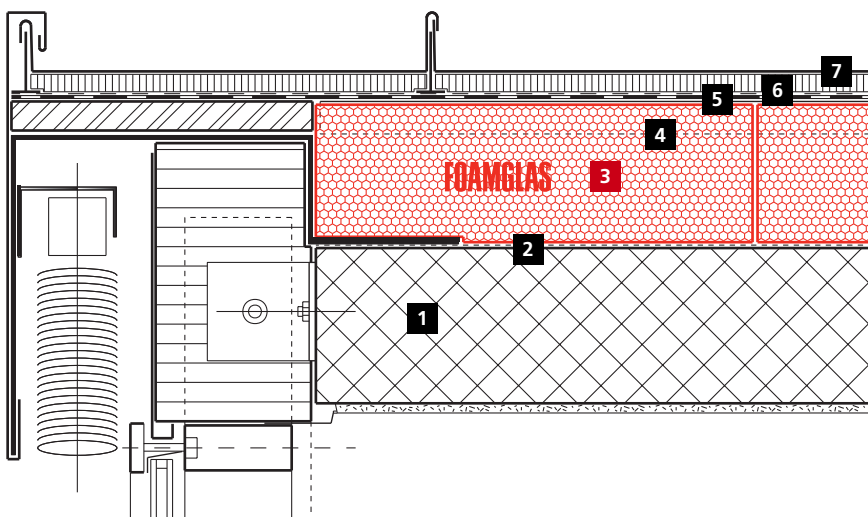
**Covering** of sheet metal, Aluminium, System KAL-Zip

Covering with metal means an enormous load on the substrate structure, in particular the thermal insulation under it. Due to trapped heat, in the summer extremely high temperatures are reached under the metal. With thunder showers they decrease sharply within seconds. The consequences of this are often condensate appearances in the roof build-up. No other sheet

metal roof system and no insulating material other than FOAMGLAS® can deal with this in the long term and meet such high demands: absolute protection against moisture, high dimensional stability, no dishing or shrinking – even with great temperature variations.

**Not comparable with any other system**

[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® READY BOARD T4+, 120 mm, in hot bitumen
- 4 Metal profile
- 5 Single layer waterproofing, bituminous
- 6 Fleece separating layer
- 7 Aluminium sheet metal covering





## Special roof systems

### Centrum Bank, Vaduz (Principality of Liechtenstein)

**Architect** Prof. Hollein, Vienna/Bargeze + Partner, Vaduz, Principality of Liechtenstein

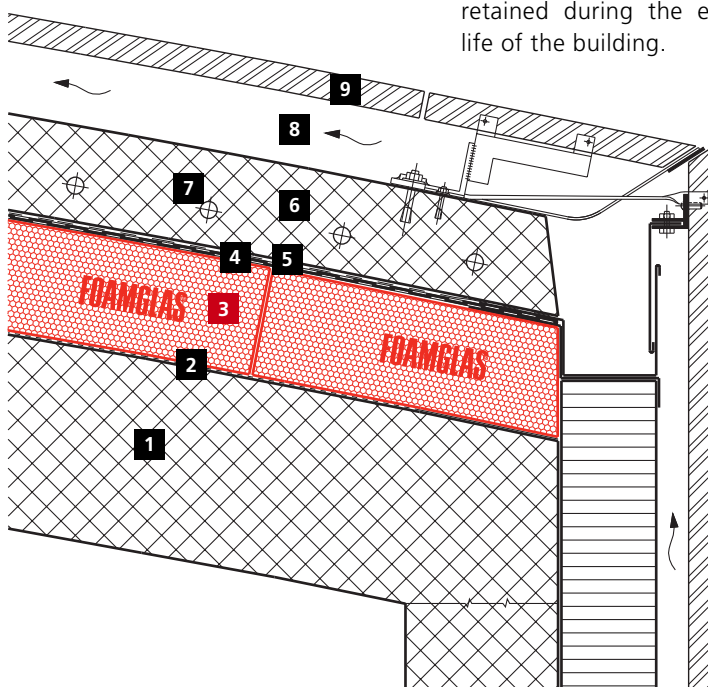
**Execution** 2002

**Use of FOAMGLAS®** roof insulation, ca. 500 m<sup>2</sup>, Type T4+, thickness 160 mm, adhered

**Covering** of Andeer granite slabs

Banks place great value on roof structures that are stable in value, with a longer service life. Natural stone is an optimum covering material for this purpose. Covering that is high-ranking in terms of quality does not suffice, however, for guaranteeing a long service life expectancy for the whole struc-

ture. The layers underneath it, in particular the insulating material, must also fulfil this criterion. Due to its specific properties, FOAMGLAS® is extremely resistant to harmful effects of every kind, such as water penetrating over the joints. The quality and the value of the whole roof system are therefore retained during the entire operating life of the building.



**Value retention and long service life through quality products**

[www.foamglas.com](http://www.foamglas.com)

#### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 160 mm, in hot bitumen
- 4 Two-layer bituminous waterproofing
- 5 Fleece separating layer
- 6 Protective concrete/trass cement sealed
- 7 Heat recovery
- 8 Ventilation
- 9 Andeer granite slabs





## Special roof systems

### Centro Sportivo, Tenero

**Architect** Studio Mario Botta, Lugano

**Execution** 1999

**Use of FOAMGLAS®** roof insulation, ca. 1800 m<sup>2</sup>, Type T4+, thickness 120 mm, adhered

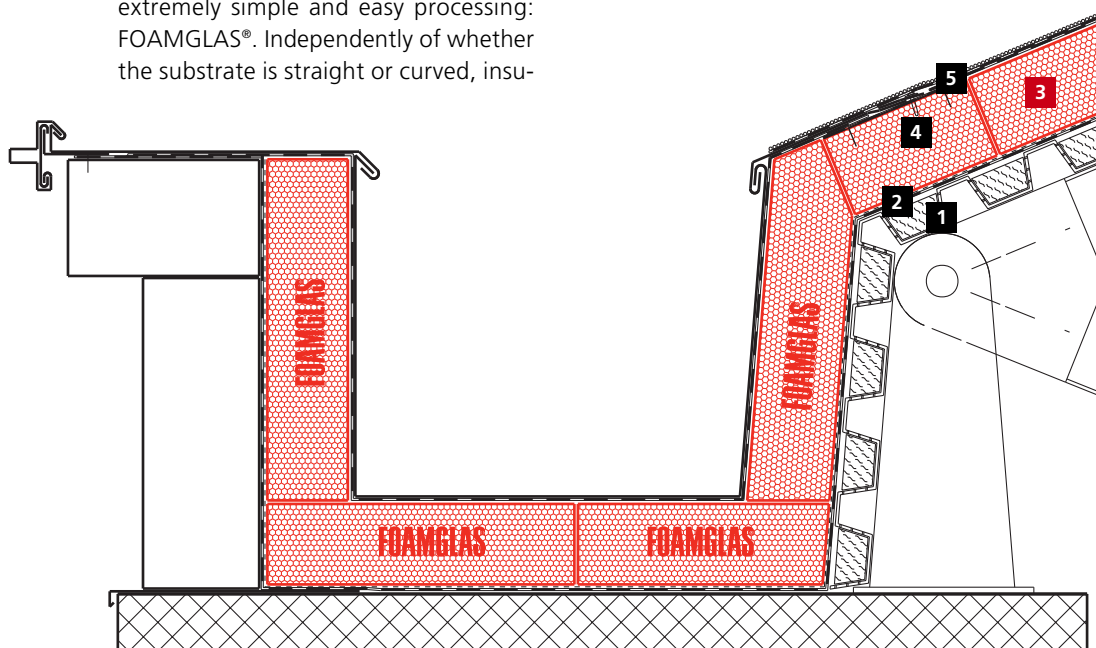
**Covering** open roof, 2 layers polymer bitumen roofing sheet, 1<sup>st</sup> layer mechanically fastened, 2<sup>nd</sup> layer slate waterproofing membrane.

Curved roof shapes are demanding and complex structures. Even surfaces are hardly to be found in them. For the thermal insulation, therefore, a material was chosen that distinguishes itself among other things due to its extremely simple and easy processing: FOAMGLAS®. Independently of whether the substrate is straight or curved, insu-

lation of FOAMGLAS® can be installed with an optimum adhered surface to the substrate. The surface is adjusted to the desired shape by sliding. With FOAMGLAS® there are no limits to freedom of design.

**Freedom of design thanks to simple processing**

[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 Acoustic sheet metal section
- 2 Self-adhesive bitumen membrane
- 3 FOAMGLAS® T4+, 120 mm, in hot bitumen
- 4 GS Promet
- 5 Two-layer bituminous waterproofing





## Special roof systems

### Mattenhof school building, Zurich

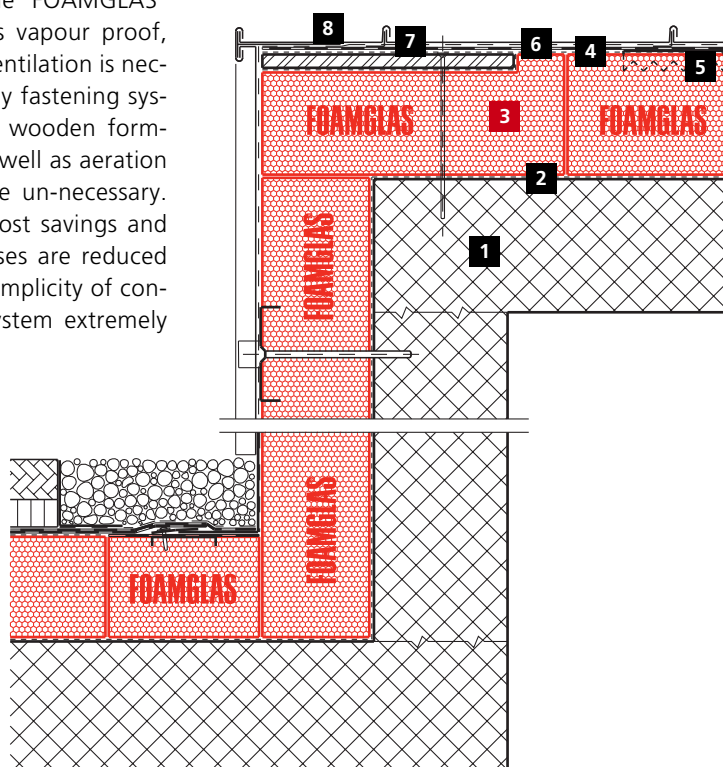
**Architect** B.E.R.G. Architekten, Zurich

**Execution** 2003

**Use of FOAMGLAS®** roof insulation, ca. 550 m<sup>2</sup>, Type T4+, 2-layer, thickness 200 mm, adhered

**Covering** of chromium steel sheet metal using the standing seam technique

Build-ups like skylights, etc. with sheet metal covering can be executed in the simplest way with the FOAMGLAS® system. FOAMGLAS® is vapour proof, hence in principle no ventilation is necessary. Lavish and costly fastening systems, additional laths, wooden formwork as a subgrade as well as aeration and ventilation slits are unnecessary. As a result there are cost savings and the structural thicknesses are reduced to the minimum. The simplicity of construction makes the system extremely economical.



**Economical and simple construction solution**

[www.foamglas.com](http://www.foamglas.com)

#### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 FOAMGLAS® T4+, 200 mm, in hot bitumen
- 4 Hot bitumen casting
- 5 PC fixing plates (claw plates)
- 6 Single layer waterproofing, bituminous
- 7 Fleece separating layer
- 8 Chromium steel sheet metal covering







## Special roof systems

### Kindergarten, Biel

**Architect** Leimer + Tschanz, Architekten HTL, Biel

**Execution** 1998

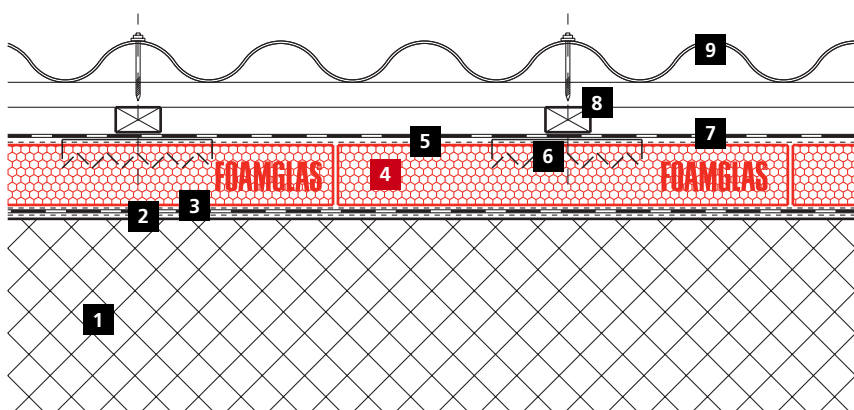
**Use of FOAMGLAS®** roof insulation, ca. 180 m<sup>2</sup>, Type T4+, thickness 40 mm, adhered

**Covering** of Welleternit covering

Once the building envelope is sealed many building components become inaccessible. Too many building projects become expensive renovation cases after a short time. In hindsight everyone is smarter ... As in this case as well: After two failed renovation attempts, they built with quality – with insulation made of glass foam. FOAMGLAS® safety insulation, insensitive to moisture, proof against rotting and non-compressible, now ensures that protection

against moisture and thermal protection will be in full force during the entire service life of the building.

**Foresight is better than hindsight ...**  
[www.foamglas.com](http://www.foamglas.com)



#### Build-up

- 1 In-situ concrete in the fall
- 2 Bituminous primer
- 3 Waterproofing during construction
- 4 FOAMGLAS® T4+, 40 mm, in hot bitumen
- 5 Hot bitumen casting
- 6 PC fixing plates (claw plates)
- 7 Single layer waterproofing, bituminous
- 8 Wooden formwork
- 9 Welleternit covering





## Building physics and technology

In the past people believed they could only solve condensation problems in metal roofs by virtually lifting the metal covering from the load-bearing and insulating structure. With FOAMGLAS® these problems can be eliminated safely and sustainably.

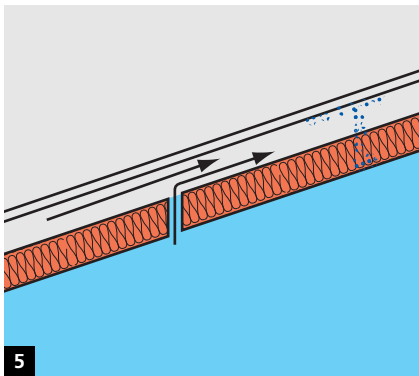
**In principle a structure is free of condensate if:**

- the thermal insulation value of the building component layers increases from the inside to the outside, i. e. the Lambda value becomes smaller
- the water vapour diffusion resistance of the building component layers decreases from the inside to the outside, i. e. the SD value becomes smaller.

At first glance, consideration of a structure with metal covering reveals that

- 1 Multi-family home, St. Gallen, Uginox FTE sheet metal covering using standing seam technique
- 2 Considerable amounts of condensation drip from the underside of the metal covering; the roof structure is subject to continuous moisture stresses. The fastening elements pierce through the sarking membrane.
- 3 Increased condensation formation underneath the metal covering. The cause: moisture-laden air current condenses on the "cold" surface.
- 4 "White rust" as a result of condensation formation on the underside of the zinc covering.





this principle is reversed here, because the metal layer, with the worst thermal insulation value and the highest water vapour diffusion resistance, is on the outside. This approach assumes the diffusion-proof nature of the metal covering that does not exist in reality.

### Ventilated roofs of thin sheet metal

An air layer between the roof skin and the substructure diverts moisture that diffuses in over the inner building components, which are in the "right" order in terms of building physics.

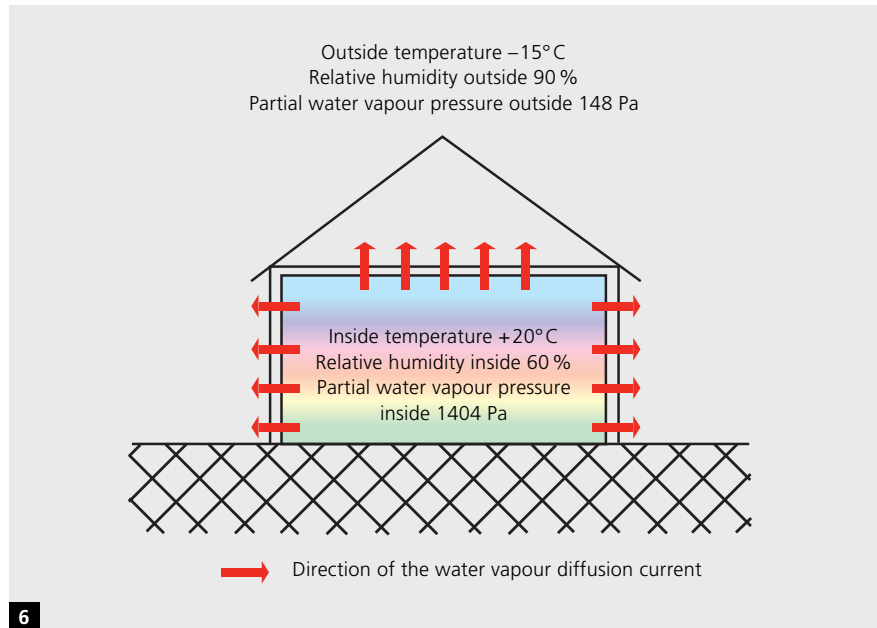
Basically this principle of the separation of functions is still correct. On the other hand there are also limits to use here, which are set by construction constraints or outside influences and can lead to a situation where a structure executed in this way is not protected against condensate loss in every case.

This double-shell ventilated structure does not "forgive" faults in execution at all. It does not cope well with leaking points in the substructure or indeed with missing diffusion barriers or damages.

### Factors with an influence on the removal of moisture

The function of a ventilated metal covering, to remove moisture that diffuses in, is dependent on various factors.

■ **The moisture that diffuses into the structure with ventilation pres-**



ent and functioning must also be kept to a small amount through appropriate construction measures.

■ **The air conduction in the structure must be designed in such a way as to guarantee the most continuous possible flow of air.**

To reduce the amounts of moisture diffusing into the structure, the build-up of layers underneath the air layer must be carried out in such a way that sufficient resistance is put up against the diffusion pressure. Therefore in lightweight structures a so-called vapour seal is incorporated underneath the insulation, usually in the form of a plastic film. In theory this eliminates the problems.

### Ventilation not without problems

However, problems often arise in the area where the membranes overlap and above all in the wall joints, places where the roof is pierced, etc. Due to joints that are not sufficiently closed, room air streams into the structure as a result of pressure differences. The amount of water vapour penetrating amounts to a multiple of what could be introduced through diffusion. The large amount of water vapour can no longer be removed quickly enough; saturation of the air flow occurs, with the result of condensation and water

- 5 **Vapour diffusion processes**  
 Direction of the water vapour diffusion current with temperature gradients from inside to outside. Is there really diffusion impermeability?
- 6 Suction effect through the ventilation with open joints in the vapour seal.

ingress into the insulation. The consequences are energy losses due to the room air flowing out and through the decrease in the insulating capacity as a result of condensation formation – to say nothing of the probable damages in the structure.

Attention must therefore be given to the air and wind impermeability of the vapour barrier connections, also and specifically with ventilated structures.

### Air current

For removing small amounts of moisture diffusing into the ventilation space, the most continuous possible air flow is necessary. The velocity of the ventilation current is primarily dependent on two factors:

- the ventilation path
- the ventilation height (slope)

Ideally the best thermal relationships arise in an air layer that is as steep as possible, because the ratio of height to air path length is the most favourable.

### Openings for intake and outflow

The position and shape of the openings for intake and outflow must also be given great attention. The openings

should be executed as slits that pass through and must be of a sufficient size.

The thermal relations are determined by the temperature difference with the outside air.

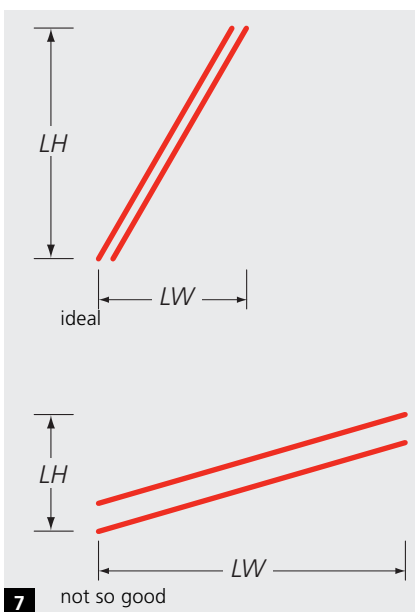
The insulation values required today due to the thermal protection regulations minimise the passage of heat so that the warming of the air layer due to heat passing from the inside of the building which is necessary for the thermal relations can hardly take place.

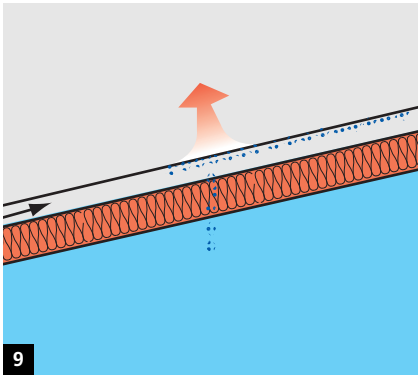
### Problem of secondary condensation

Conversely, under some circumstances there is even the danger that at low temperatures with high humidity – frost and freeze/thaw – the outside air penetrating into the ventilation space will also form water or hoarfrost on the underside of the roof surface and in this way moisture will be brought into the structure, so-called secondary condensation.

These points alone already make it clear that a ventilated structure is not always without risks. If a few imperfections or faults come together in the shaping of the shifted air layer, it can

- 7 Ventilation path and height
- 8 Multi-family houses, Zurich, compact roof with sheet metal covering – roof inclination too small for functional ventilation





result in condensation dripping off into the building components, resulting in damage to the substructure.

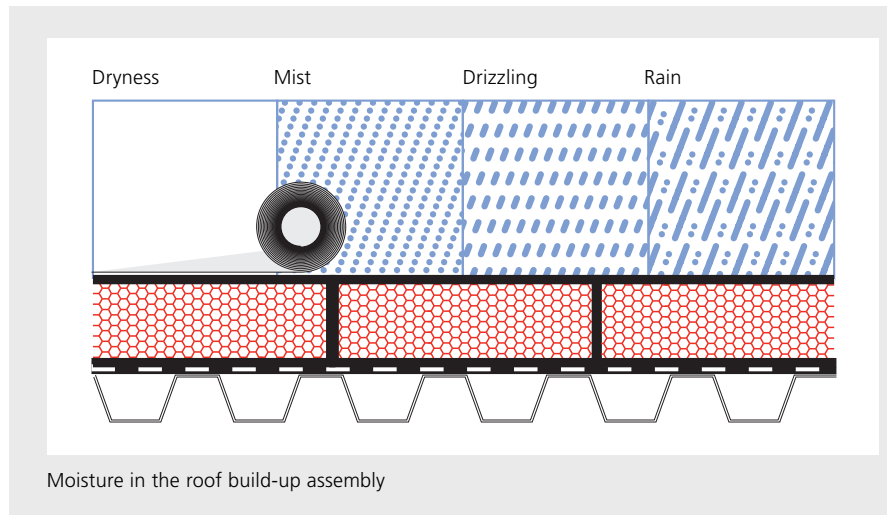
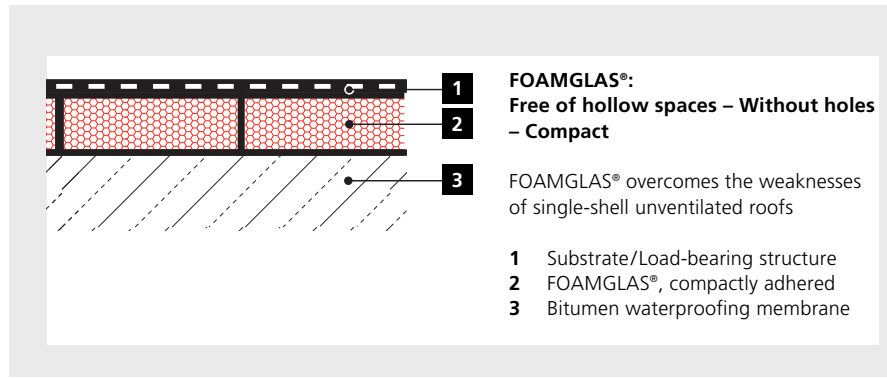
### Unventilated roofs of thin sheet metal

For a long time metal roofs have been executed as a monocoque (single shell), if this is necessary for design reasons and if the conditions do not allow ventilation, for example in large, flat sloping roofs.

**Since this construction principle offers a great many advantages when executed properly, in the future it will be accepted more and more.**

### New, advantageous possibilities

In particular the differentiated roof geometries of modern architecture, high demands for thermal protection and the development of innovative sheet metal roof systems, such as e.g. the FOAMGLAS® compact roof with sheet metal covering, lead to the expectation of a further development in the direction of the unventilated roof. In addition there is the fact that processors are increasingly becoming familiar with this technique, supported not least by the specialist rules for monocoque unventilated metal coverings. If the diffusing of moisture into the structure is ruled out by the incorporation of a vapour barrier or a vapour-proof insulation like glass foam on the inner side of the structure, continuous ventilation of the metal covering is no longer necessary. **Where there is no moisture, none must be removed.** The height of the roof build-up is



reduced through this; openings for air intake and outflow, which are costly in money and construction time, are eliminated; and the designer has greater freedom of design. Not least, the work is simpler for the metal roofing contractor, and risks such as rain or snow entering through ventilation openings are excluded.

The ability of a monocoque metal roof system to operate depends essentially on whether moisture is brought into the roof structure. In principle moisture can penetrate into the roof in three ways:

1. Leaking of rain in the upper deck shell
2. Building moisture during the assembly phase
3. Condensation as a result of water vapour diffusion/condensate as a result of moisture transport through air currents through leaks in the roof structure

**On point 1 and 2:** An important con-

- 9 Secondary condensation. Outside air streaming in condenses on the underside of the roofing.

dition for a warm roof free of damage consists in no moisture being incorporated between air-seal layer and the bituminous membrane and in the insulation not getting wet during the installation phase. If there is unwanted moisture between the two sealing layers (vapour seal and bituminous membrane) there is a danger that the structure will be damaged because drying out takes place slowly. Incorporated building moisture, in addition, increases the building physics load on the bituminous membrane and can lead to condensate dripping off and incrustation of fouling matter from micro-organisms on the underside.

**On point 3:** As with a ventilated structure as well, the execution of the wind, air and water-proof vapour barrier has crucial significance for the ability of the monocoque structure to function. A vapour barrier is always required with traditional systems, even with substructures with high diffusion resistance like concrete.

The wind and water-proof execution of the butt joints and edge joints also has decisive significance here. Roof edges, eaves, verges and roof penetrations require extreme care in execution. The effects of open joints and edge joints cause problems similar to those with the double-shell ventilated execution.

**FOAMGLAS®:  
a guarantee of safety**

As a compression resistant, vapour and water-proof insulation, FOAMGLAS® offers product-specific plus points and unambiguous answers to critical questions concerning unventilated metal roofs.

Thermal insulation and vapour barrier. No water can accumulate in the closed cellular structure. FOAMGLAS® is insulating layer, vapour barrier and load-bearing deck substrate for the metal roof "in one". In the compact installation procedure, the insulating layer blocks the diffusion and air current in all directions – and not only as a limited thin layer vapour barrier.

Through the butt joint adhering of the FOAMGLAS® slabs, the insulating layer in the installed system is resistant against vapour diffusion and has airtight joints.

In the case of roof structures with FOAMGLAS® the question does not arise as to whether – e.g. with ventilation layer or actively breathing, costly intermediate layers – the accumulated moisture can be removed. Or as to whether as a result of labour-intensively executed vapour/air barrier the warm roof principle also actually works.

FOAMGLAS® prevents the passage of moisture in the form of water or water vapour. The dew point lies in the closed cellular insulation layer. Due to this the FOAMGLAS®-insulation layer remains uncritical and indestructible in terms of building physics.

**For the most stringent requirements**

Dew point displacement through water accumulation in the insulating materials or deterioration of the thermal insulating properties cannot take place with FOAMGLAS®. In addition the high degree of compression resistance provides the special argument that the fastening of the metal roof covering takes place not in the load-bearing backing – and therefore encumbered with thermal bridges – but rather through adhering in the insulation layer itself.

With other roof structures with a separate vapour barrier, on the other hand, the vapour sealing layer is interrupted or perforated. Condensate in the insulation layer and corrosion of the fasteners are then as much to be feared as thermal bridges.

- 10 How securely can air barriers and vapour barriers be connected to the edge of the roof?
- 11 Clear formation of folds in the air and vapour barrier. The result: air streaming through carries moisture into the insulation layer package.

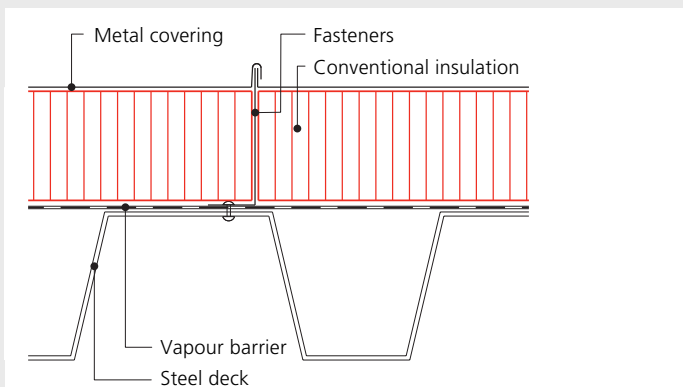


The use of FOAMGLAS® leads to a warm roof structure that corresponds to the highest performance requirements in terms of thermal technology and building physics, and in addition can be built using suitable craftsmanship procedures.

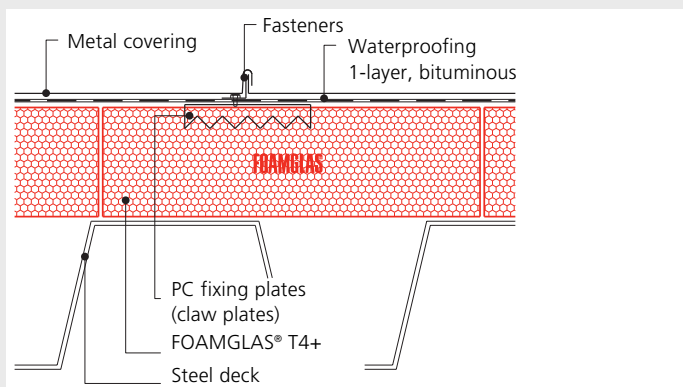
### Hardly any thermal bridges or heat losses with FOAMGLAS®

In the traditional warm roof, e.g. with mineral fibres or plastic foam, mechanical connectors must be anchored through the insulation layer into the load-bearing substrate. Depending on the way the inside space is used and on the humidity, there are risks of corrosion and condensation formation, in particular with low outdoor temperatures.

If for example a conventional sheet metal roof system with mineral wool insulation slabs of compression-resistant quality, in combination with the penetrating fasteners typical for the system, is compared with the FOAMGLAS®-compact roof with sheet metal covering, a decreased insulation thickness in favour of FOAMGLAS® is revealed. The reason: FOAMGLAS® insulation structures do not require any mechanical fasteners that penetrate to take up the covering. Heat losses due to thermal bridges are also correspondingly minimised.



In the warm roof with e.g. mineral fibres or rigid plastic foam, fastening is done mechanically between the metal covering and the load-bearing shell. The result: thermal bridges! In addition there is the question: How secure is the vapour/air barrier?



FOAMGLAS® insulation structures do not require any mechanically penetrating fastening devices to take up the covering. The sheet metal covering is assembled with "claw plates" (PC® fixing plates).



## Passive fire protection

After fires, heated discussions are often ignited about responsibility and protection against fires. Here the question of insulation materials also often plays a central role. Scientific investigations clearly show: FOAMGLAS® can contribute conclusively to passive fire protection. The safety insulation is not only absolutely non-combustible, but also develops no black smoke or toxic gases.

- 1 Fire spreading over facade and roof is often the cause of devastating total damages.
- 2 Sheet metal roofs create special requirements in the event of fire.

### Prevention begins with the choice of materials:

“Fire disaster”, “Indications that there were infringements against the fire protection regulations”, “Swift spread of the fire favoured”, “Flaming Inferno”. Headlines of this kind make it clear: Precisely in the roof area – perhaps in spite of legally fulfilled fire protection conditions – building fires can only be extinguished with difficulty.





It is all the more important to pay attention to prevention. Through the choice of suitable building materials and roof systems the risk of a fire breaking out, above all also of the fire spreading through hollow spaces and through combustible materials, can be significantly lessened. FOAMGLAS®, the safety insulation of glass foam, and the compact roof system free of hollow spaces, have already done this in many cases.

**Smouldering fires as a special hazard**

Fires of this kind primarily spread inside building components and therefore often remain unnoticed for a long time. Sometimes hours can pass between the hidden fire and the breakout of the open fire. The physical and chemical

properties of insulating materials many hold the danger of such smouldering fires: air (oxygen) can stream through the building material, even though not completely unhindered. **Not so with FOAMGLAS®: The closed cell structure of the glass foam insulation prevents this.**

**Prefabricated metal roof insulating elements of rigid foam with timber structure:** And how does it look with metal roof insulating elements – of rigid foam, with inlaid timber structures – for warm roof structures?

Rigid foam insulating materials, e. g. polystyrene or polyurethane, are combustible. While the fire processes drip off material residues, which likewise burn. Especially in the area of public buildings, in connection with rooms

**Fire brigade reports in practice:**

“... metal roofs make attacking extinguishing through the fire escape more difficult. It is almost impossible to bring water from above into the building, since the roof, to the extent that it does not cave in, remains sealed even with great heat. In this case it is urgent that openings be made. This could only be done with heavy construction machinery. Through the structure of the roof (hollow space) the fire was able to extend over the whole building ...”

“... Since targeted extinguishing with water was not possible through the sheet metal roof, the fire service used a thermal imaging camera and high expansion foam generator. By recognising the source of fire by means of the camera, targeted extinguishing was enabled and post-ignition through flooding of the roof area with the high expansion foam generator was averted ...”



that are used for gathering purposes, in office complexes as well as in buildings of the catering trade, the use of combustible material has to be ruled out.

**FOAMGLAS®: Neither thick smoke nor poisonous gases**

It does not always have to be a “flaming hell” when fire disasters are spoken of. One is reminded for instance of the disasters of the Düsseldorf airport (1995) with 17 victims or the Montblanc Tunnel (1999), in which 39 people lost their lives. In both cases toxic gases from insulation that was technologically problematic in terms of fire (Düsseldorf polystyrene, Montblanc polyurethane) played a deadly role.

FOAMGLAS® however, develops neither thick smoke nor toxic gases. In matters of fire protection FOAMGLAS® is not comparable with any other so-called “non-combustible” insulation. The difference results also from the fact that FOAMGLAS® does not smoulder in the event of fire, and consequently does not cause any passing on of the fire.

**FOAMGLAS® melting point > 1000 °C**

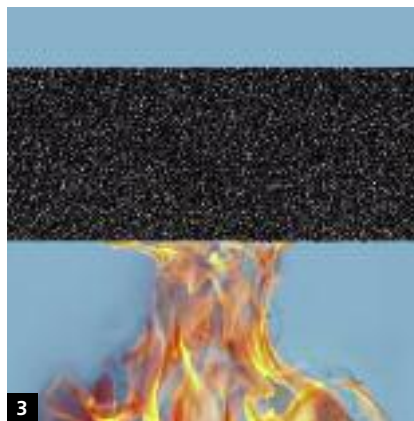
According to German DIN 4102-17 the melting point of FOAMGLAS® was tested at MPA Braunschweig Institute (D). More than 50 % of the insulation thickness lasted the 90 minute fire period without significant damage. As an official result the melting point is >1000 °C.

**General protection with FOAMGLAS® in case of fire: Melt Shield-Effect**

Comparable as a thermal protection shield the melted glass surface of the flame treated area is protecting the lower cell structure. The temperature on bearing structure is remaining low. FOAMGLAS® is defending the building structure in case of fire.

**FOAMGLAS® provides real preventive fire protection**

- FOAMGLAS® safety insulation consists of pure foamed glass and is absolutely non-combustible (Combustibility class A, Fire index no. 6.3, not combustible, approved by the VFK with TA No. 5273).
- Due to the closed cell structure of FOAMGLAS® no fire-fuelling oxygen can reach the source of the fire.
- FOAMGLAS® is vapour tight. The passage of hot conflagration gases or their propagation in the insulation is excluded. The safety insulation prevents the spreading of fire.



- 3 No propagation of flames in the event of fire. FOAMGLAS® is absolutely non-combustible
- 4 Conclusion after test procedure: FOAMGLAS® melting point > 1000 °C.
- 5 Experimental setup for testing the melting point of FOAMGLAS®.



## Excellent Ecological profile

FOAMGLAS® insulation systems are stable under all conditions of use and protects the owner from unexpected expenditures for heating or expensive replacement of the insulation or repair. FOAMGLAS® systems safeguard the environment one way or another. They allow for energy saving and, from the cradle to the grave, they do not contribute to environmental pollution, a safe product consistent with the principles of building physics. Cellular glass is certified to standards of health and indoor air quality. Ecologically viable product recycling is possible in the case of building demolition.

Typically 66%+ of the raw material is recycled glass. A very low percentage of carbon is added during manufacturing which makes the charcoal grey color of the insulation. In the cellulating furnace the soft, viscous glass is foamed through release of carbon dioxide (CO<sub>2</sub>) and forms millions of airtight glass cells enclosing the gas. This closed cell glass structure ensures full resistance to the transmission of vapor (resistance to water vapor transmission  $\mu = \infty$ ).

### Production and composition

FOAMGLAS® manufacturing is two sub-processes. In the first part of the process the recycled glass is melted and subsequently batched with the remaining raw materials and crushed in a mill. In the second sub-process the powder mix passes in the cellulating furnace at high temperature where FOAMGLAS® cellular glass is foamed – comparable to the process of fermentation in bread baking.

- 1 Renewable energy sources are increasingly used in FOAMGLAS® production.
- 2 FOAMGLAS®: millions of airtight glass cells



## Environmentally friendly production

The raw materials used in the FOAMGLAS® production are inherently mineral and thus environmentally friendly. Principal raw material is recycled glass. Further raw materials are feldspar, sodium carbonate, iron oxide, manganese oxide, carbon, sodium sulfate and sodium nitrate. By the introduction of recycled glass into the production FOAMGLAS® makes a relevant contribution to the protection of the environment.

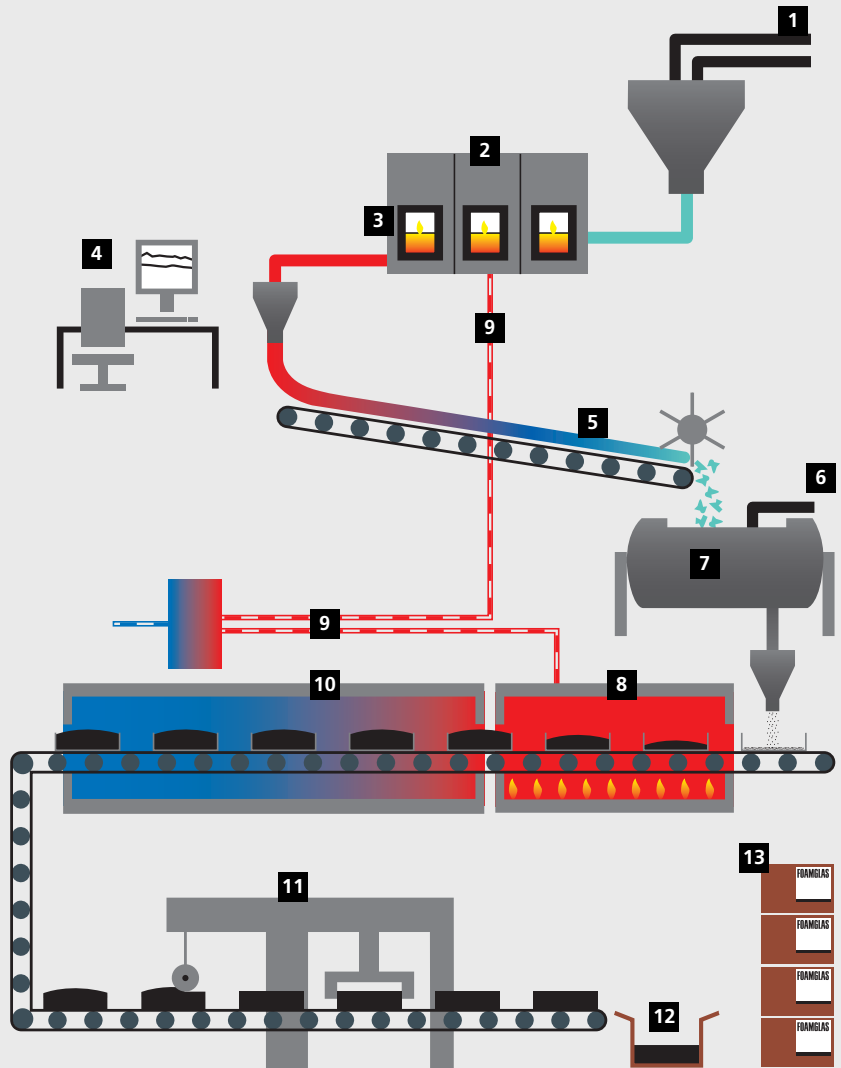
## Minimal environmental pollution

Due to improvements in process engineering and in the energy supply (coming from hydro electric energy and wind turbines) significant progresses has been achieved in recent years regarding air pollution, greenhouse gas emissions, consumption of energy and resources:

- The demand for non-renewable energy was reduced 4.24 kWh/kg.
- Greenhouse gas emissions have been halved.
- The percentage of recycled glass was progressively increased from 0 % to 30 and to 66 %.
- The environmental pollution score (UBP97) was reduced from 1619 to 743 points.
- The eco-indicator (EI99 H, A) dropped from 0.13 to 0.09 points.

Reduction of the production energy means that the time period for energy amortization of the investment in thermal insulation – as an important evaluation unit – is considerably reduced.

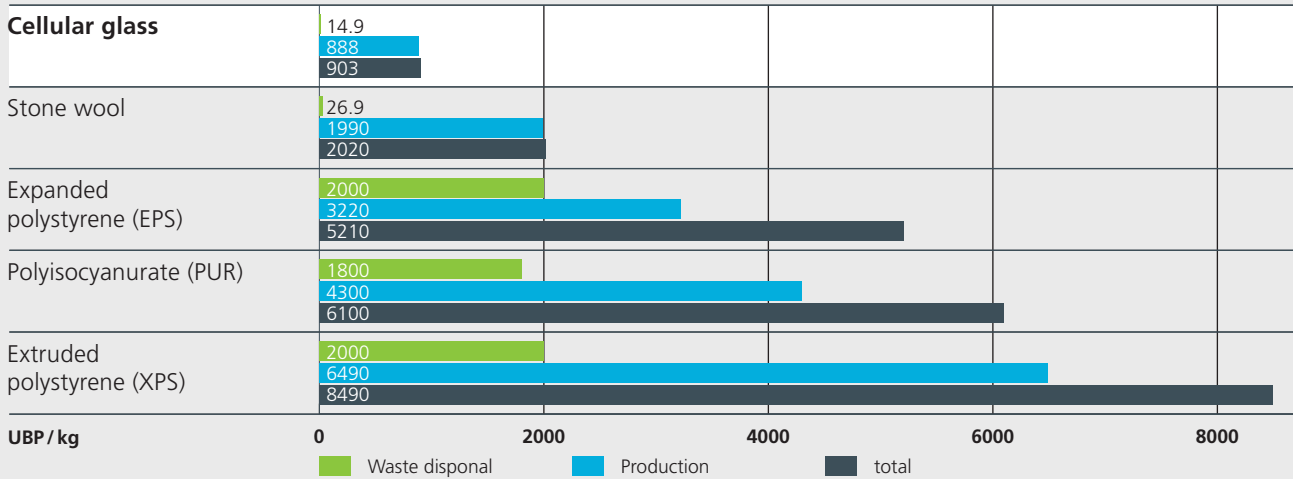
## FOAMGLAS® manufacturing (Tessenderlo Plant, Belgium)



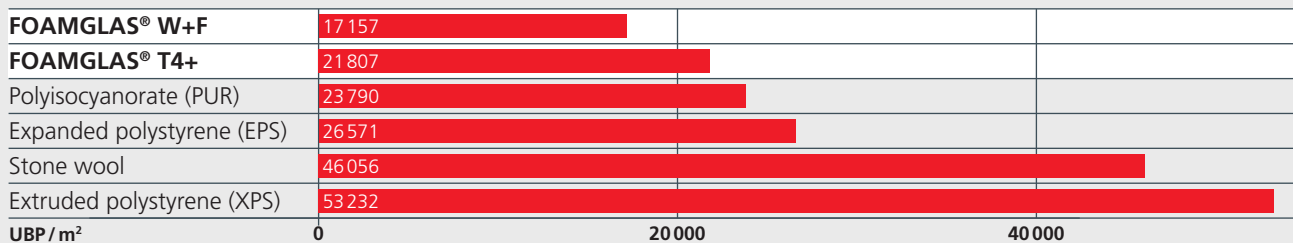
- 1 Mixing and batching of the raw materials: Recycled glass, feldspar, sodium carbonate, iron oxide, manganese oxide, sodium sulphate, sodium nitrate.
- 2 the smelting furnace has a constant temperature of 1250°C.
- 3 molten glass is drawn out of the furnace.
- 4 control room for monitoring the production.
- 5 The glass is drawn off and falls onto the conveyor band where it cools down before entering into the ball mill.
- 6 Production waste is re-introduced into the process.
- 7 Addition of "carbon black".
- 8 ball mill grinds all ingredients into a fine powder before putting into stainless steel moulds.
- 9 the filled moulds pass through a cellulating oven (Foaming furnace) with a temperature of 850°C. This is where the material gains its unique cell structure.
- 10 energy recovery of heat.
- 11 The FOAMGLAS® blocks pass through an annealing oven to allow carefully controlled cooling of the block without thermal stress.
- 12 The blocks are cut to size and sorted by batch. Production Waste returns back into the process.
- 13 FOAMGLAS® slabs are then packaged, labelled and palletized.
- 14 Finished FOAMGLAS® products are stored and prepared for transport.

### FOAMGLAS® stands comparison

The environmental pollution score (UBP 2006\*\*) for the production and waste disposal of FOAMGLAS® is 903 points/kg (insulation). This puts FOAMGLAS® into the pole position in eco-balance. Other insulation products show points between 2020 (stone wool) and 8490 (Extruded polystyrene).



Compared to surfaces, with a specified insulation value of 0,20 W/m<sup>2</sup>K, FOAMGLAS® performs very well. The environmental pollution score (UBP 2006\*\*) of cellular glass is 17 157 points (FOAMGLAS® W+F), 21 807 points (FOAMGLAS® T4+) per square meter. Other insulation products show 23 790 points (PUR), 26 571 points (EPS), 46 056 points (stone wool) and 53 232 points (XPS) for an identical U-value (see table).



Insulation	ρ	λ <sub>D</sub> *	d	weight per m <sup>2</sup>	UBP* per kg	UBP per m <sup>2</sup>
	kg/m <sup>3</sup>	W/mK	m	kg/m <sup>2</sup>	UBP/kg	UBP/m <sup>2</sup>
<b>FOAMGLAS® T4+</b>	<b>115</b>	<b>0.041</b>	<b>0.21</b>	<b>24.15</b>	<b>903</b>	<b>~ 21 807</b>
<b>FOAMGLAS® W+F</b>	<b>100</b>	<b>0.038</b>	<b>0.19</b>	<b>19.00</b>	<b>903</b>	<b>~ 17 157</b>
Polyisocyanurate (PUR)	30	0.026	0.13	3.90	6100	~ 23 790
Stone wool	120	0.038	0.19	22.80	2020	~ 46 056
Expanded polystyrene (EPS)	30	0.034	0.17	5.10	5210	~ 26 571
Extruded polystyrene (XPS)	33	0.038	0.19	6.27	8490	~ 53 232

\* The data are taken from building database KBOB/EMPA, June 2009.

\*\* The environmental pollution score (UBP 2006) quantifies the pollution coming from resources, water consumption, emissions into air, water and ground and also for the waste disposal. The environment pollution through grey energy and global warming are included in the UBP score.

## World resources

The principal raw material of FOAMGLAS® production today is select-ed recycled glass (in the past the main raw material was silica sand). The sup-plies of recycled glass are ample, as in the construction and other industries large quantities amass and have to be disposed of as waste. Plastic foam insulation, however, is produced from crude oil, which is a non renewable fossil fuel.

## Service life

Having outstanding qualities (mineral, impermeable to water and vapor, resist-ant to acids, non-combustible, high-temperature resistant), cellular glass is a very durable material. The long service life of the material has very positive effects, ecologically and financially, on the service-life of the construction and, consequently, on the life of the build-ing. Maintenance and replacement cycles can significantly be reduced by the use of durable materials.

## Emissions / nuisance during installation and use

Cellular glass does not release harmful or toxic components into the environ-ment. It does not contain green house gases or ozone depleting products, no flame retardant and no con-taminative or carcinogenic particles and fibers. When recommended installation instruc-tions are followed, cellular glass insula-tion does not produce emissions that degrade the environment or health, at production, installation nor use.

## Emissions in case of fire

Dumping and burning of construction waste is most critical for the environ-ment, even in small quantities. In par-ticular plastic foam materials are classi-fied as harmful. In the case of burning of these materials high levels danger-ous emissions are released than in com-bustion in an incineration plant. Studies have been conducted in Germany on thermal combustion of polystyrene

insulation, which clearly indicated that released fumes are acutely toxic. Serious adverse health effects in the long-term cannot be excluded. Even with com-bustion in a waste incineration plant, there is high impact to the environ-ment, as annually several thousand tons of slag and filter residue have to be transported to special disposal sites. The non-combustibility of cellular glass makes the toxicity issues irrelevant.

### Ecological assessment for different thermal Insulation materials.

	Production energy	Resources	Nuisance for workers	Emissions during production	Emissions in case of fire	Long-term performance	Disposal / Recycling
Glass wool	Yellow	Yellow	Orange	Yellow	Yellow	Orange	Orange
Stone wool	Yellow	Yellow	Orange	Yellow	Yellow	Orange	Orange
Cellulose insulation	Yellow	Yellow	Yellow	Yellow	Yellow	Red	Yellow
Pure expanded cork	Yellow	Red	Yellow	Yellow	Orange	Orange	Yellow
Expanded polystyrene	Orange	Red	Yellow	Yellow	Orange	Orange	Orange
Extruded polystyrene	Orange	Red	Orange	Yellow	Orange	Yellow	Red
Polyurethane (PUR)	Orange	Red	Orange	Yellow	Red	Orange	Red
FOAMGLAS®	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow

Very good      Acceptable      Critical      Very critical

Positive ecological assessment for FOAMGLAS®: Source: Cellular glass insulation, a cost-effective and environmentally sustainable solution. [Schaumglas-Dammstoff, Wirtschaftlich und umweltver-traglich Dämmen.] Markus Welter, Lucerne

## Waste disposal

In the assessment of insulation materials one consideration is repercussions on the environment from waste disposal. There are significant differences between the various insulation products. In total evaluation – and considering the scarcity of raw materials – as documented in eco-balance data sheets for the building industry, plastic foam insulation receives poor ratings for environmental pollution.

## Recycling

Cellular glass being non-combustible, combustion in a waste incineration plant is not a possibility. An option is the recycling of cellular glass as crushed stone (for bedding in road construction) or infill material for noise barriers. Recycled FOAMGLAS® is a safe and suitable product for these applications, as it is dimensionally stable, neutral for the environment, inorganic, rot-proof and without any risks for the ground water (meets ELUAT-test requirements). If crushed and recycled FOAMGLAS® is not used as bedding or infill material, it can be taken to an inert waste disposal site, like crushed concrete or brick.

## FOAMGLAS® – a valuable contribution to the protection of the environment.

- Today FOAMGLAS® is made from 66 %+ recycled glass. The FOAMGLAS® manufacturing concept is waste reduction and green energy utilisation.
- For the FOAMGLAS® production only energy from renewable sources is used.
- Environmental pollution during manufacturing has halved when compared to 1995.
- FOAMGLAS® insulation meets all environmental and health requirements for construction products.
- At the end of its service-life FOAMGLAS® disposal is simple. One option is the use of recycled cellular glass as infill in trenches or back-up for buried pipes.
- FOAMGLAS® has an outstanding service-life, which is clearly the best for the environment.
- On balance: FOAMGLAS® is an insulation concept fit for the future that gives an answer to the genuine concerns for the environment. The system ensures that all demands on performance, durability, environmental integrity and sustainability are fulfilled.



- 3 The percentage of recycling glass in the FOAMGLAS® production is from 30 to 66 %.
- 4 Crushed FOAMGLAS® – a recycled filler material for trenches.
- 5 FOAMGLAS® Environmental product declaration (according to ISO 14025) confirms the sustainable and ecological value of FOAMGLAS®.

[www.foamglas.com](http://www.foamglas.com)



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**ELUAT – elution test.** FOAMGLAS® meets the requirements of ELUAT test (Investigative report EMPA Nr. 123544 A, based on the successful testing of bitumen coated FOAMGLAS® specimens). According to declaration scheme D.093.09 of the Swiss Technical Directive for Waste Management [Technischen Verordnung über das Abfallwesen (TVA)], FOAMGLAS® is an authorised material for inert waste disposal sites.

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[www.foamglas.com](http://www.foamglas.com)

