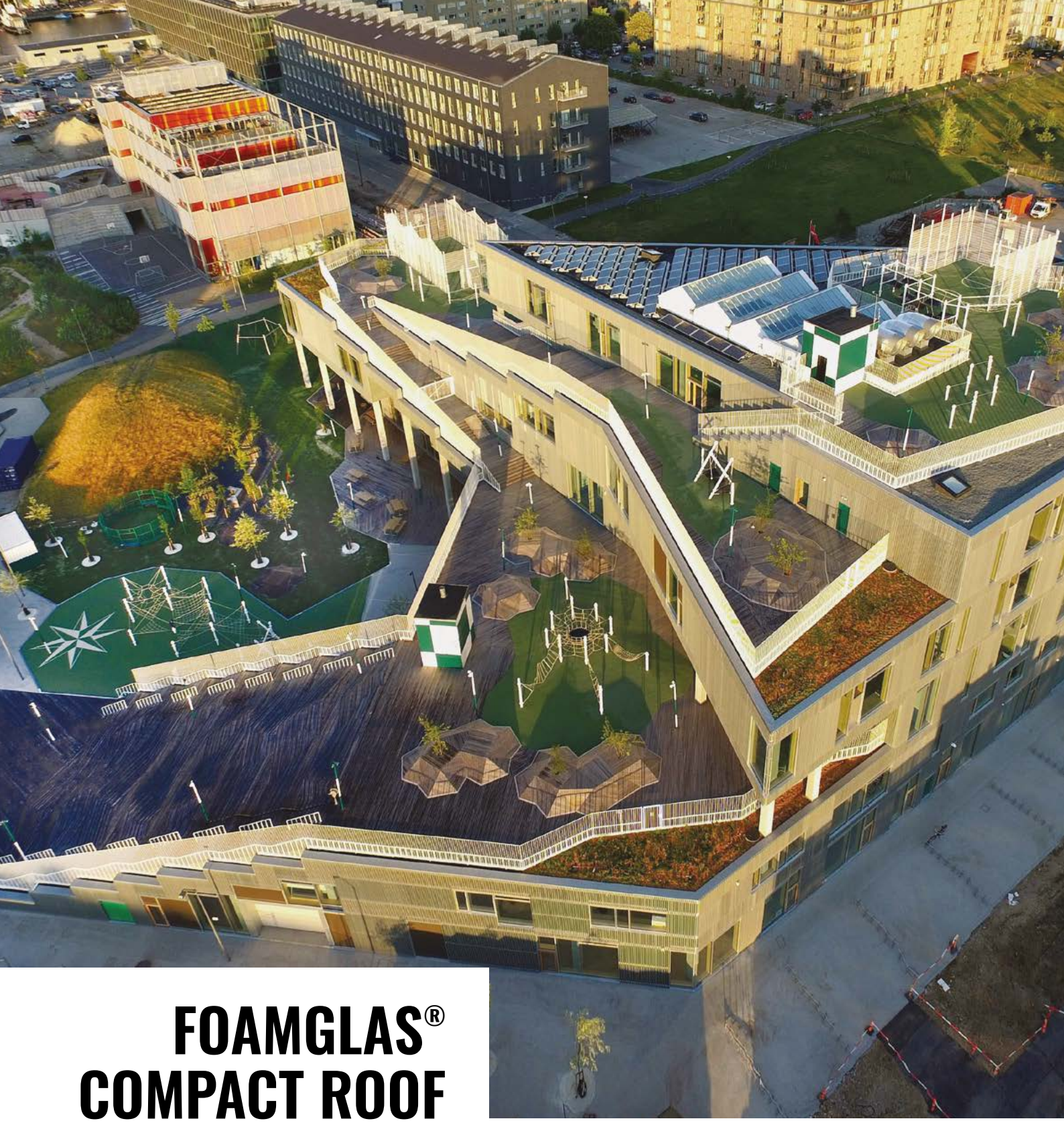
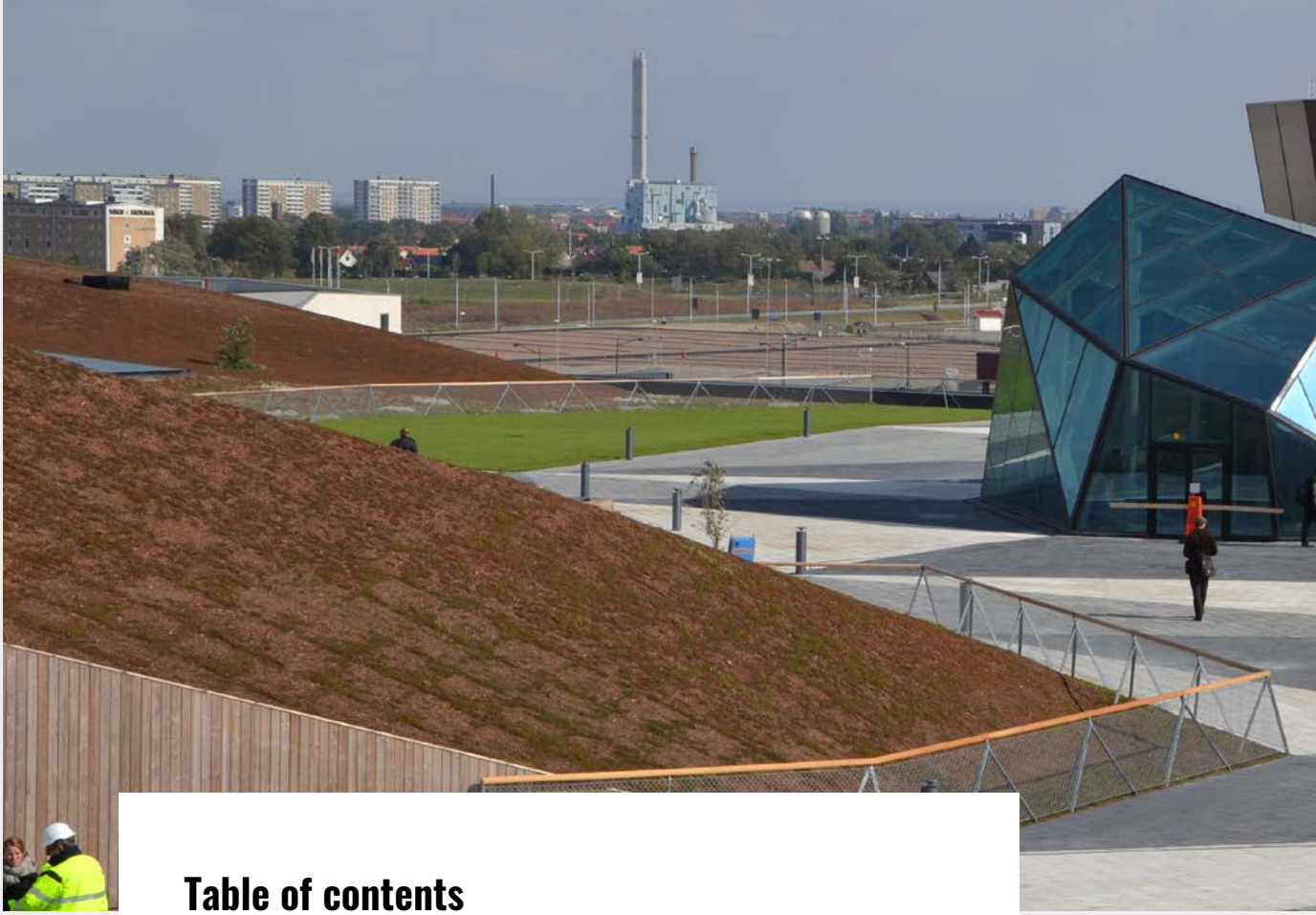


FOAMGLAS® COMPACT ROOF

SAFE, LONG-TERM SOLUTIONS FOR ACTIVITY ROOFS

OWENS CORNING® FOAMGLAS®



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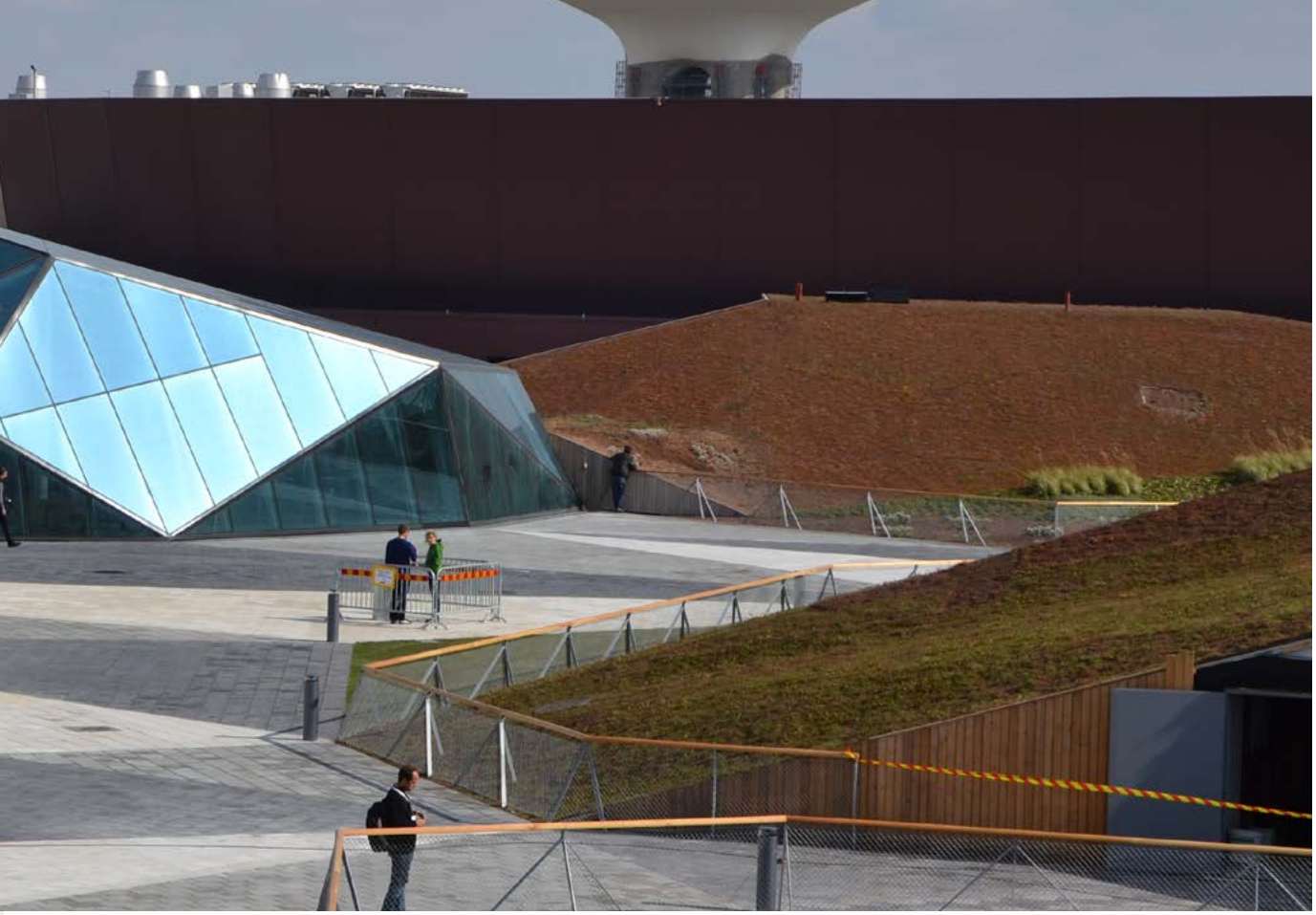


Introduction: a smart solution for the modern city

Cities around the world are bustling with life and getting busier by the day. To accommodate the influx of citizens, our cities need to keep expanding. But there is **only so much space** on the ground to build structures on. That's where roofs come in: the existing and new-build surfaces are just waiting to be put to greater use.

The possibilities are limitless. Activity roofs like parks with intensive vegetation, parking, blue roofs for water retention as well as sport and game facilities are just some of the applications that can be fitted to a roof area.

Repurposing roofs offers many advantages. Building an activity roof on top of an existing structure is a smart use of existing surfaces, **creating additional living space** and making buildings more attractive. Not just for the eyes, but as an investment too. Both new and existing buildings can benefit from this. The location of these roofs is **often very lucrative**, and the views from the elevated platform are lush.

Green and blue roofs have ecological benefits. They improve the microclimate and handle water effectively. In summer, they increase comfort indoors and reduce the need for air conditioning. They also provide natural cooling in cities, adding **a slice of nature in a bustling metropolis.**

This brochure captures all risks involved with acitivity roofs and how FOAMGLAS® insulation mitigates these.

The existing and new-build surfaces are just waiting to be put to greater use.

1 - Important thoughts about green and activity roofs

Green and blue roofs have ecological benefits. They improve the microclimate and handle water effectively. In summer, they increase comfort indoors and reduce the need for air conditioning. They also provide natural cooling in cities, adding a slice of nature in a bustling metropolis.

By adding additional layers of activity roof to a basic flat roof build-up, other factors are introduced which can increase the risk of damaging the roof:

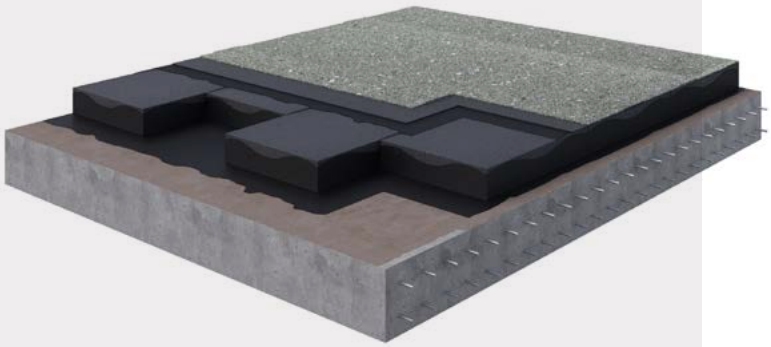
- Increased load from the use, construction and dead weight of roof layers
- Change in condensation conditions in the roof build-up
- Reduced thermal protection over time (due to moisture)
- Root penetration (e.g. in case of vegetation on roofs)
- Higher probability of waterproofing damage
- Inability to locate and repair waterproofing defects
- Problems caused by future changes in roof use

A suitable roof build-up with qualitative building materials and a perfect installation are key to mitigating these risks. How can you as an architect alleviate all of these risks? How can you ensure safe, long-term solutions for activity roofs?

With our FOAMGLAS® Compact Roof and project support services from a to z, you can rest assure.

2 - Mitigating the risks with a FOAMGLAS® Compact Roof system

FOAMGLAS® Compact Roof is a simple, robust and versatile roof build-up with the exceptional properties of FOAMGLAS® thermal insulation. The compact build-up consists of **3 basic layers fully adhered by bitumen or cold glues: a bearing substrate, FOAMGLAS® cellular glass and the waterproofing layer(s).** This technically ideal roof system is easy to construct and minimises all the risks associated with activity roofs.



2a - Higher load on activity roofs

Generally speaking, the insulation underneath activity or green roofs have to bear more loads. To give you an indication on the typical weights of different materials and loads:

10 cm layer of concrete	250 kg/m^2
50 cm layer of water	500 kg/m^2
50 cm layer of ground	1 000 kg/m^2
1m³ pot for a single tree	2 500 kg
SUV car	3 500 kg
Fire truck	30 000 kg

A roof build-up must be able to withstand all types of climatic conditions. Not just daily but seasonally, year after year. At the same time, the functional benefits must remain the same, as mechanical performance is key. The entire roof system must be able to withstand dynamic wind forces and offer complete accessibility, from maintenance to car access.

It is common knowledge that thermal insulation can be influenced by deformation under temperature changes, delamination by dynamic wind forces and creep deformation under high loads. FOAMGLAS® cellular glass insulation guarantees the integrity of the roof and the dimensional stability against t° cycles in all conditions and under any load during the lifetime of your building.

Due to its closed cell structure, FOAMGLAS® thermal insulation is completely watertight and vapour proof, remaining dry under all conditions. This guarantees thermal resistance, meaning you and your clients will never have to worry about water or vapour issues throughout the lifetime of the building.

2b - Change in condensation conditions

The roof build-up of an activity roof behaves very differently to a regular roof. An additional vapour barrier may form in the layers above the waterproofing. This vapour barrier will completely change the condensation conditions of the roof, especially in the winter. During this time of the year, water vapour has a tendency to condense even more in the roof build-up, usually in the insulation layer, greatly reducing its thermal resistance.

Meanwhile, in the summer months, the upper layers of the activity roof protect the basic roof build-up from the sun very well, but prevent the roof build-up from warming up in the summer and evaporating the interstitial condensation formed during winter. The result? A gradual accumulation of condensation in the roof build-up.

FOAMGLAS® thermal insulation in a compact roof build-up can withstand high compressive loads and bear all loads permanently, safely and without affecting its insulation properties. It is also resistant to any kind of deformation. This ensures that the waterproofing and all layers of the build-up can stand the test of time.

More detailed information can be found on page 14-21

2c - Reduced thermal protection over time
The impact of interstitial condensation in the winter and the lack of evaporation in the summer mean that the insulation properties of activity roofs deteriorate greatly over time. Considering condensation can occur every winter, thermal insulation loses its efficiency at a rapid rate, resulting in a significant reduction of thermal protection.

> **FOAMGLAS® thermal insulation has proven its durability and long-term thermal protection over time. The insulation properties remain unchanged even after decades of service because it cannot become wet. An impressive feature that gives you complete peace of mind.**

2d - Root ingrowth
Plants require water to grow. It's a fact of life, and one that causes roots to grow everywhere, including rocks, to get to a source of water. If moisture occurs in the roof layers below the waterproofing in thermal insulation, root ingrowth is inevitable and damage will occur.

> **FOAMGLAS® thermal insulation remains 100% dry in all possible conditions throughout the lifetime of the building, effectively guaranteeing zero root penetration.**

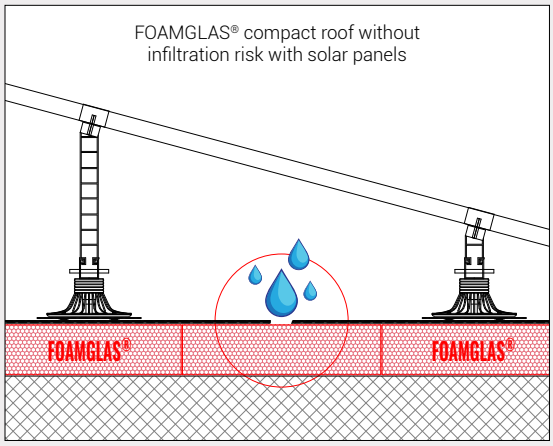
2e - Waterproofing damage when applying additional layers
Any construction activity carried out on a roof, including the implementation of additional layers of activity roof, increases the risk of damage to the roof. This is especially true for waterproofing, which can be greatly damaged during work. The rigidity of this sub-construction has a great influence on the potential damage that can be done: the more compressible the thermal insulation is, the higher the risk.

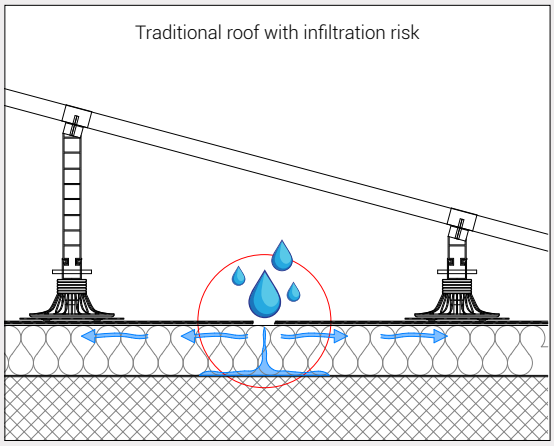
> **FOAMGLAS® thermal insulation can bear high loads with zero risk of deformation, forming a rigid and stable layer under waterproofing systems, minimising the risk of damage. Even if the waterproofing is damaged on one m^2, you can rest asure as our compact roof will do its job.**

2f - Inability to locate and repair waterproofing defects

Regardless of whether the substrate is perfect, local waterproofing failure can still occur. For activity roofs, this poses a problem: how do you locate and repair waterproofing failure? Even with sophisticated, expensive equipment, a leakage is often impossible to detect because the infiltrated water 'travels' across the roof.
The result? A complicated search that requires you to remove all the layers above the waterproofing. An expensive, frustrating endeavour!

FOAMGLAS® Compact Roof insulation is vapour tight and non-absorbent. Any waterproofing failure remains local and is easy to detect and cheap to repair.





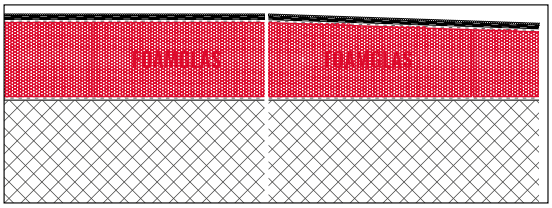
2g - Future changes in roof use

When constructing a roof for the first time, consider this: will the terrace remain a terrace forever? Will a jacuzzi or swimming pool be added in the future? Life brings changes and it's important to be flexible for these changes. What if due to climate change you want to add air-conditioning systems to your building.
Well, with our FOAMGLAS® Compact Roof these constructions can easily be placed on top of our system.
Any future replacement of the layers of activity roofs greatly increases the risk of damaging the waterproofing.
Always keep in mind: can the original roof build-up handle the intended new load?

FOAMGLAS® Compact Roof insulation is vapour tight, non-absorbent and able to handle extreme loads. Practically any activity roof can be built upon the core compact roof build-up, and the use of the roof can easily be changed in the future.

3 - What you can accomplish with FOAMGLAS® Compact Roofs

The following case studies demonstrate just how versatile FOAMGLAS® Compact Roofs can be. Considering the advantages, the possibilities are literally endless and all starts from 1 standard Compact Roof build-up:



Parks with extensive and intensive vegetation
Geschafthauser Opus, Zug, Switzerland

Blue roofs
Walterbos Complex, Apeldoorn, The Netherlands

Solitary greenery
TU, Delft, The Netherlands

Heliports
Children Hospital,
Brno, Czech Republic

Photovoltaic roofs
Océanopolis, Brest, France

Sport and gaming surfaces
Angel Schule Sportplatz, Freiburg, Germany

Accessible for pedestrians and cyclists
Hotel The Fontenay, Hamburg, Germany

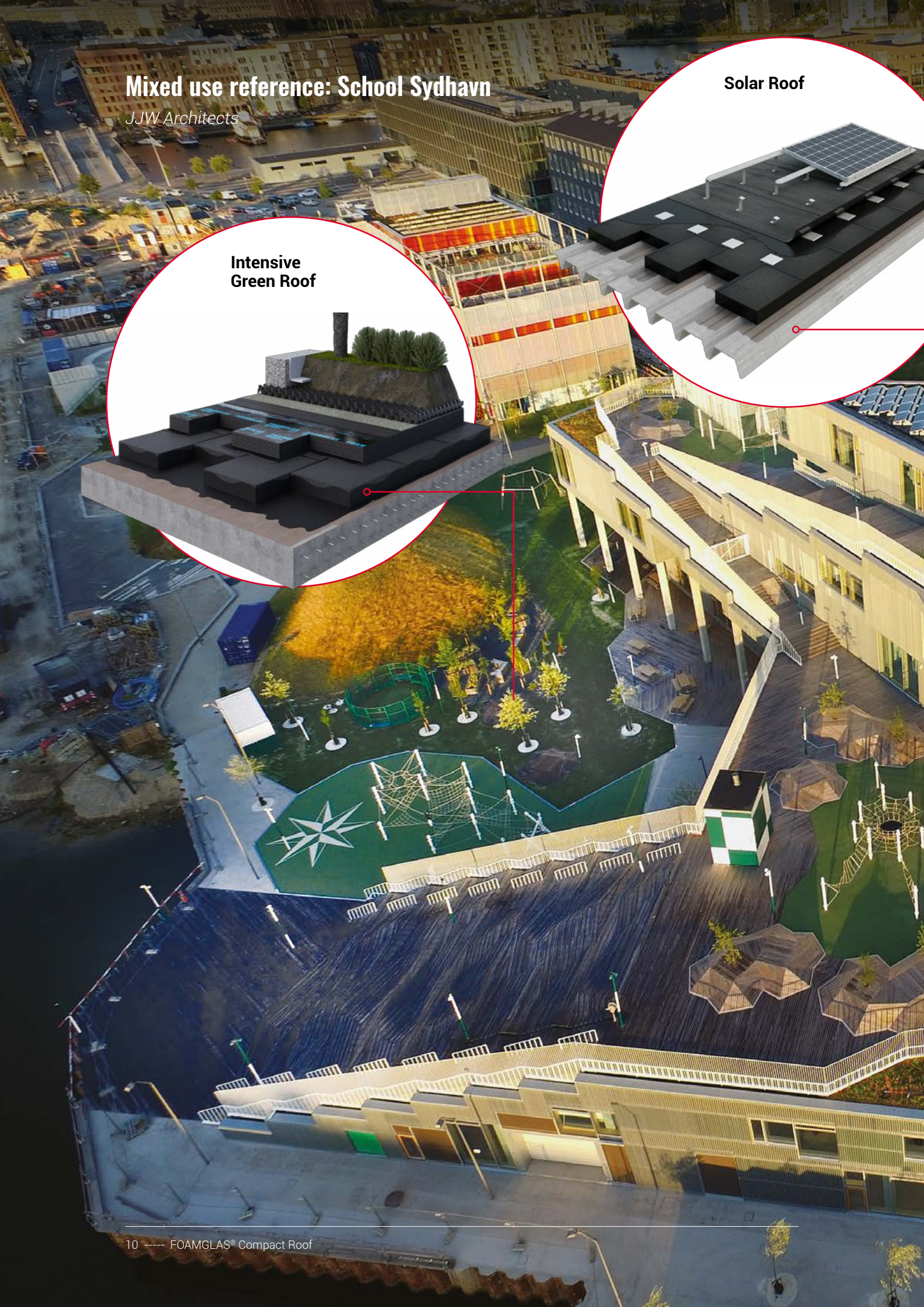
Extensive vegetation
Casa Sant'Agnese, Muralto, Switzerland

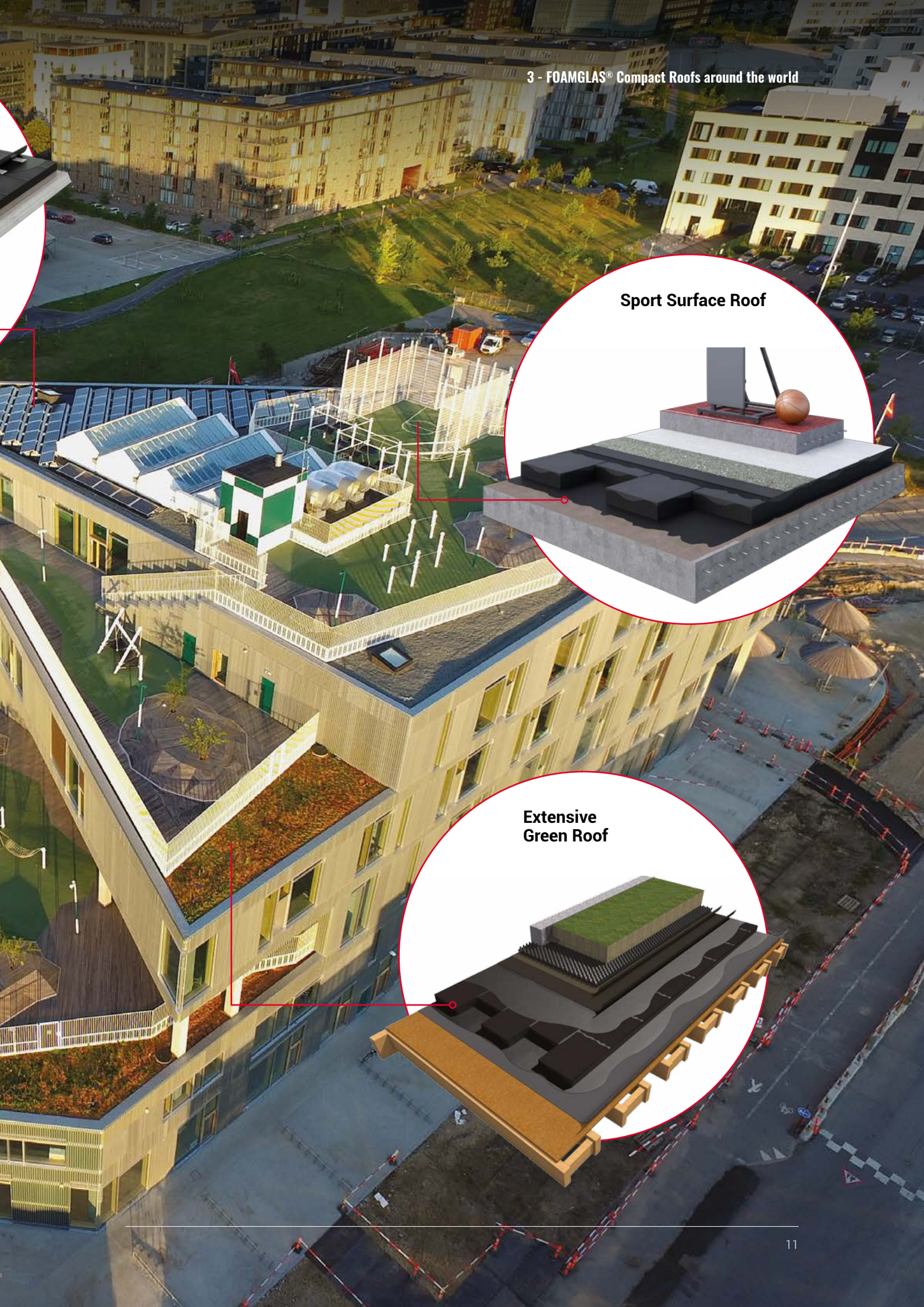
Technological roofs
Metroalde, Bilbao, Spain

Roofs accessible by trucks and trams
Gallery Šantovka, Olomouc, Czech Republic

Mixed use reference: School Sydhavn

JJW Architects




Sport Surface Roof
Extensive
Green Roof

4 - Protecting what matters most with FOAMGLAS® cellular glass

At Owens Corning FOAMGLAS®, we believe in protecting what matters most. All of our products and solutions adhere to this principle. FOAMGLAS® cellular glass is a thermal insulating material with a combination of exceptional properties: it protects against pressure and heavy loads, fire, corrosion, water, heat and cold and doesn't give off any toxic fumes. We use only the highest quality materials in all of our applications.

5 - Designing a FOAMGLAS® Compact Roof

Find out how simple it is to design and execute an activity Roof with FOAMGLAS® Compact Roof.

How to design a compact roof correctly
The design of a FOAMGLAS® Compact Roof is always the same: a load-bearing construction combined with FOAMGLAS® insulation and a waterproofing system, fully-bonded and adhered by bitumen over the entire surface. Depending on the size and conditions of the project and your experience you can choose either hot bitumen or cold bituminous based adhesives. Or you can combine them both successfully.

Using hot bitumen as an adhesive
Hot bitumen is the oldest but still the most commonly used technology today. Bitumen is heated to a temperature of 200 °C and used to bond naked FOAMGLAS® slabs to the substrate for rapid, high quality compact bonding. Hot bitumen is also recommended to bond the first bituminous membrane to the top surface of the FOAMGLAS® insulation slabs.

> **Note that the use of hot bitumen may be prohibited for safety reasons or considered inappropriate in small, cramped areas and large roof slopes.**

FOAMGLAS® Compact Roof construction formula: load-bearing construction + FOAMGLAS® insulation + waterproofing system, fully-bonded and adhered by bitumen over the entire surface.

Using cold adhesives
For all of those times when hot bitumen is not an option, Owens Corning FOAMGLAS® has developed a range of compact roof systems using cold adhesives. In our portfolio, there are several adhesives that can be used depending on the substrate and the gradient of the bonded surface. FOAMGLAS® insulation slabs are then bonded to the supporting structure and to each other using the right cold adhesive.

Depending on the situation, there are two possibilities

1. **The first** is to use naked FOAMGLAS® slabs glued with cold bitumen adhesive and adhere the first bituminous membrane with cold adhesive.
2. **The second**, more frequent approach is the use of FOAMGLAS® READY slabs with a thin layer of asphalt pre-applied on the upper surface. The first bituminous membrane can then be fully torched on FOAMGLAS® material. Depending on the technology of application of the bituminous membrane, you will then need to select the right type of separation layer on the reverse side: for flame torching it is possible to use a separating layer of burn-off PE foil; for bonding to adhesives separation sandblasting is more suitable. The main modified bituminous membrane is then no longer glued to the compact build-up but torched over the entire surface by flame, typical for this membrane type.

> **Hot bitumen**

> **Cold adhesive**

> **First membrane**

6 - FOAMGLAS® Compact Roof properties

Vapour tight

The bonding of FOAMGLAS® vapour tight slabs with hot bitumen or bituminous based cold glues on the substrate and in the joints results in a homogeneous thermal insulation layer, making it vapour tight throughout its thickness and across the entire surface. In the FOAMGLAS® Compact Roof build-up, no interstitial condensation of water vapour can occur, regardless of the humidity or direction of diffusion.

Let's get technical
Explaining the principles of building physics related to water vapour condensation.

Moisture, diffusion and condensation

There are many causes of moisture in a construction: construction moisture, rain during construction, condensation, and suchlike. At any time, nature will always search an equilibrium by transferring from a high condition to a low condition until it reaches its balance. This also applies to vapour diffusion which occurs in every roof: transmittance from a warmer and humid environment to a cooler environment. Depending on the vapour tightness of a material the vapour can pass through a material. Vapour seams a rather innocent gas but with vapour diffusion there is always risk of condensation (liquification due to cooling). Most often this happens in the thermal insulation layer as the temperature drop is the most significant in this layer. **As water is known to be a great heat conductor, condensed moisture deteriorates the insulating properties significantly. The basic physical categories and related processes are briefly described below.**

Absolute and relative humidity of air

The Earth's air contains a certain amount of moisture, so called water vapour. What the maximum moisture content of the air can be depends on the air temperature: the higher the air temperature, the more water vapour it can contain. We refer to this as the "maximum absolute humidity" and is expressed in g/m³.

For example:
1 m³ of air at +22 °C can hold a maximum of 19.4 g of water vapour, at that point it is saturated. This state of maximum air saturation, at a certain temperature by water vapour, is called 100% relative humidity for the given temperature. Relative humidity (RH) describes the amount of water vapour present in air expressed as a percentage of the amount needed for saturation at the same temperature. By exceeding the limit of 100%, the air can no longer hold the water vapour and it will condensate.

If the air is completely free of water vapour, its relative humidity is 0%. Most often RH will be used instead of -the maximum absolute humidity, when talking about surrounding conditions.

For example:

Air -10 °C, 100% RH = 2.1 g/m³
Air +10 °C, 100% RH = 9.4 g/m³
Air +22 °C, 100% RH = 19.4 g/m³

Dew point and condensation

As explained previously, exceeding the 100% RH or when the maximum absolute humidity is exceeded, condensation will happen as the air can no longer contain the water vapour. Condensation can occur in the air, on a cold surface or in a construction. The dewpoint is the temperature corresponding to a RH of 100%.

In normal building interior conditions, the air has a temperature of +22°C and a RH around 50%.

However, what would happen if this air is cooled down to +10°C?

> From previous example we know: air of 22°C at 100% RH can contain a max of 19.4 g/m³ moisture. In this example the RH is at 50%, which means that the air of 22°C contains 9.7 g of water vapour in each 1m³. This amount of water vapour in the air does not change during cooling, it will remain 9,7 g/m³.

However, whilst cooling down the temperature of the air, the amount of vapour it can contain does drop. At 10°C, the maximum absolute humidity is 9.4 g/m³. With other words, whilst the amount of water vapour does not change during the temperature drop, the RH will change and increase.

Going back to our example:
Initial conditions: +22°C – 50% RH = 9.7 g/m³
Cooled down to +10°C the maximum (100%) = 9.4 g/m³

> The maximum absolute humidity or the 100% RH is exceeded, and condensation will happen. There is an excess of 0.3 g water vapour which is liquified in each 1m³ at 10°C.

A very simple example to illustrate this: In summer period when you take a bottle of soda out of the fridge, immediately you will get surface condensation on the bottle. This is the same phenomenon, the air surrounding the bottle cools down and exceeds it dewpoint and condensation will occur on the surface of the bottle.

Vapour pressure and water vapour diffusion
The more water vapour is in the air the higher the water vapour pressure is. That is why vapour pressure is always expressed at a certain temperature and a certain relative humidity. When the air reaches its maximum content capacity, at a certain temperature, we say the air is saturated. By exceeding this limit, the air can no longer hold the water vapour and it will condensate (transition from gas into liquid). The water vapour pressure that corresponds with the maximum absolute humidity at a certain temperature is the saturated water vapour pressure.

These saturated vapour pressures are stated in the national norms and are identical for all countries.

We mentioned it previously, but nature has a way of balancing any imbalance. That's why the different partial pressures of water vapour in the interior and exterior strive to equalise. Water vapour is practically pushed from an environment with a higher partial pressure to an environment with a lower partial pressure (usually from warm to cold). This migration and interchange of gaseous moisture is called the water vapour diffusion effect and is caused by the difference in partial vapour pressures between the interior and exterior. The speed of water vapour diffusion depends on the type of material, but it occurs very slowly, continuously (as long as the equilibrium is not reached) and strongly.

Interstitial condensation can occur when water vapour passes through a building construction and somewhere in this build-up lies the dewpoint. Because the biggest temperature drop between

the outside and inside will happen in the insulation layer, the dewpoint is often situated in this layer. To prevent this interstitial condensation in roof build-ups, vapour barriers often are applied under the thermal insulation as they reduce the vapour diffusion. By installing this highly water vapour tight material on the warm side of the insulation, water molecules cannot pass through the construction and diffusion is thus impossible. Theoretically condensation is therefore excluded.

However, proper onsite application of the sheet is almost impossible and with improper installation, these vapour barriers lose their function over time. In such cases, vapour will penetrate through the membrane and condensate in the thermal insulation layer.

This phenomenon most likely will occur during winter period. At that moment the interior is warm and vapour pressure is high, whilst outside it is cold and the vapour pressure is low. Vapour diffusion will transmit from the inside to the outside and if the vapour barrier is not installed 100% right, condensation will happen in the insulation layer (if this is not vapour tight). The condensation causes the insulation to become wet and significantly decreases its insulating ability. This at a moment when you need it the most, you can compare it to a wearing a wet sweater outside in winter, it will no longer protect you from the cold.

Regarding activity roofs

Compared to roofs that are finished with only waterproofing on the upper surface, activity roofs have a significantly different condensation regime, as their build-up is different. As part of the green roof a geotextile is often used and is an additional vapour tight layer. As a result of the vegetation, a continuous water layer may be formed above the waterproofing. The presence of a 'spontaneous' vapour barrier like this in the external part of the roof significantly increases the tendency of condensation in the roof build-up.

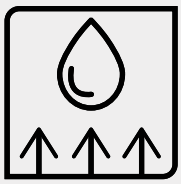
In a simple roof build-up the condensation, building up during the winter period, has the tendency to evaporate during a warm summer.

Amount of condensed moisture within the roof build-up can be enormous

With an activity roof there is often a minimized heating of the hidden insulation layers (waterproofing and thermal insulation). This means that the moisture condensed during the winter months cannot completely evaporate during the summer. This "condensation and evaporation balance" of water vapour is obviously negative in case of insufficient evaporation in the summer. Thus, this negative imbalance causes a gradual increase in the moisture content of the roof build-up every winter season. It also leads to dramatic decreases in roof insulation efficiency and other undesirable effects such as corrosion and root penetration into thermal insulation.

FOAMGLAS® cellular glass is fully vapour tight and widely used in activity roofs, even in humid environments. In all cases, our compact roof build-up is the most secure solution and will give you peace of mind. With the sealed joints and the entire FOAMGLAS® surface adhered by bitumen or bituminous adhesive, this build-up is vapour tight throughout the thickness and across the entire surface.

100% waterproof



In a FOAMGLAS® Compact Roof system, the waterproofing and the insulation are fully and perfectly adhered to each other and to the supporting layers. FOAMGLAS® insulation does not absorb moisture and is both waterproof and water vapour tight. This build-up ensures that moisture cannot migrate above, below, between or inside the thermal insulation slabs. With these properties, FOAMGLAS® insulation provides additional security as an additional waterproofing layer in the overall build-up.

Let's get technical
Explaining waterproofing safety and reliability.

By fully closing and sealing the joints between FOAMGLAS® slabs with hot bitumen or bituminous adhesives, a non-absorbent layer is created and compactly connected to the support below and the waterproofing membranes on top. FOAMGLAS® thermal insulation is, beside water vapor tight, also watertight and therefor also helps to increase the waterproofing reliability.

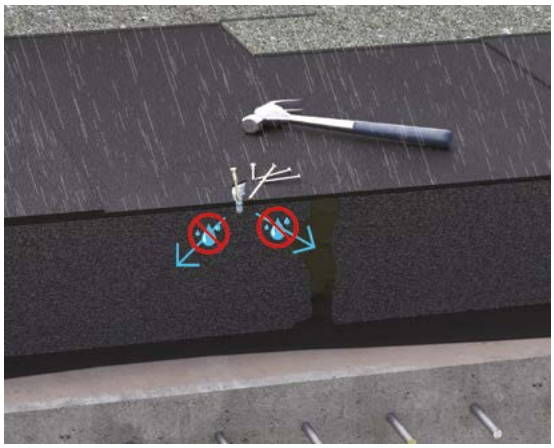
In case of local membrane malfunction, the compactly adhered waterproof FOAMGLAS® thermal insulation takes over its function and prevents the spread of leaked moisture into the larger roof area. Any waterproofing failure remains local, is easy to find and cheap to repair.

Regarding activity roofs
The benefit of the FOAMGLAS® Compact Roof composition becomes even more apparent when combined with layers of activity roofs. In case of local membrane malfunction, the entering water cannot spread across the compact roof build-up as FOAMGLAS® thermal insulation temporarily takes over its function and prevents the spread of leaked moisture into the larger roof area.

The location of this type of damage will always reveal itself over time as a small and local leak in the interior.

Thanks to the compact roof build-up the damage can immediately be located above this spot where as with other compositions the leakage will spread and can be anywhere.

At all times, the remaining part of the FOAMGLAS® Compact Roof remains fully functional and dry. This effect of the water resistivity interaction of the FOAMGLAS® slabs, compact adherence with the bituminous waterproofing membranes gives the waterproofing a higher level of reliability than if applied to another type of thermal insulation.



High compressive strength, zero deformation

The bitumen layer on FOAMGLAS® bearing surfaces ensures a perfect load transfer between the waterproofing, thermal insulation and construction. A thin layer of bitumen fills the surface cells of the cellular glass, increasing the compressive strength and adhesion of the roof build-up to the bearing structure without any deformation. Try it out for yourself: simply take a few steps on the rigid FOAMGLAS® Compact Roof and be convinced that it feels as if the waterproofing is applied directly to the concrete substrate, making it an ideal base layer for activity roofs.

Let's get technical
Explaining compressive strength and incompressibility.

FOAMGLAS® thermal insulation offers excellent compressive strength and is virtually incompressible, offering an incredible advantage for compact roof solutions. The guaranteed compressive strength of FOAMGLAS® slabs for building roof applications varies from 0.5 to 1.6 MPa depending on the insulation grade. This represents loads of 50 to 160 tons per m².

The structure of cellular glass, combined with its rigidity, dimensional stability in all conditions and its high compression strength without deformation, guarantees that thermal resistance is maintained over an extended period of time.
Imagine this for a second: how much could a FOAMGLAS® type F slab (area 45x60 cm) bear if its compressive strength, at break, is 1.600 kPa (1.6 N/mm²)? Is this why roof parking lots are insulated with FOAMGLAS®?

Laboratory experiment

If the experiment is carried out in the laboratory according to the test method of the standard ČSN EN 826-A to create a pressure of 1,600 kPa on an area of 0.27 m², we would need a force of 432 kN. Translated to conditions on Earth, this weighs an incredible 43 tons! And FOAMGLAS® thermal insulation deforms less than one tenth of a percent at such a pressure.

Regarding green roofs and the majority of active roofs

The new generation cellular glass FOAMGLAS® T3+ is more than sufficient in terms of compressive strength for green roofs and the majority of active roofs. Considering the declared compressive strength of "only" 500 kPa and its reduction by safety coefficient of around 3.0 due to jobsite application conditions, FOAMGLAS® T3+ reliably carries a load of over 15 tons / m². This is significantly more than a layer of soil with a thickness of 5 meters. An incredible asset for a green roof.

Zero deformation

The incredible compressive strength of FOAMGLAS® thermal insulation is only half the story. The lack of deformation of the slabs, the so-called "rigidity" of this thermal insulation, is just as impressive. The test method EN 826 describing the determination of the compressive strength of thermal insulation has a special methodology in Annex A for cellular glass slabs for which the

For loadbearing constructions, stability and design, compressive strength is key.

deformation at break is almost 1mm due to a collapse of a lateral layer within the weakest cells. All other thermal insulations are characterised by compressive stress and deformation levels between 3 - 5%, 10% and up to complete plastic deformation.

In other words, the compressive stress with 10% deformation is completely unusable for any loadbearing function and is only used to numerically indicate the "strength class" of a given thermal insulation. For example, for some thermal insulation a strength class 500 for compressible insulations corresponds to 500 kPa when the sample is compressed by 10%.
For FOAMGLAS® products with a compressive strength of 500 kPa at break, the deformation is only 1 mm due to a lateral collapse of closed cells.

The rigid, robust compact FOAMGLAS® roof build-up is the most load bearing and reliable solution for an activity roof. When adhering the cellular glass slabs in compact build-up, it is necessary to consider the jobsite conditions (unevenness of the substrate and especially the human factor) and implement it to the structural calculations by reducing the declared compressive strength by safety coefficient. Even when the design strength is reduced to about 1/3 of the values declared, the cellular glass slabs remain the highest load bearing thermal insulation available in the building industry.

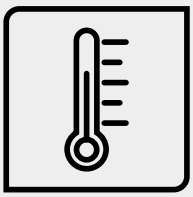
The design of the correct grade of FOAMGLAS® insulation and its assessment in loaded applications should always be carried out by an authorised structural engineer. Our technical consultants will happily provide you with relevant values for these calculations and help you design the optimal build-up for a particular load. Don't hesitate to reach out to them in case of questions.

FOAMGLAS® Compact Roof is an ideal base for parking decks for traffic of any kind

Fire safety first

FOAMGLAS® insulation slabs are, by nature, non-combustible and classified in the reaction to fire class A1. In the event of a fire, no smoke, toxic fumes or airtightness can occur, because the insulation slabs are impermeable to air. And without oxygen, even the bitumen adhesive cannot burn. Compared to mineral fibre insulations, the FOAMGLAS® compact build-up significantly slows the spread of flames, nor does it contribute to the fire spread.

Time-tested thermal insulation



FOAMGLAS® cellular glass insulation was first produced in Europe in 1965, being put to use shortly after. In 2016, the German Institute FIW Munich *(Research Institute for Thermal Protection)* took samples of FOAMGLAS® slabs from roofs constructed between 1973 and 1989 and tested them thoroughly. The test results showed that after nearly half a century, the insulation properties and compressive strength had not deteriorated. FOAMGLAS® insulation stands the test of time.

Let's get technical
Explaining time-tested thermal insulation.

Thermal insulation is by far the most vulnerable material used in roofing structures. Compared to other building materials, they can be softer, more absorbent and often more flammable. **When it comes to a roof build-up, the following is a golden rule: the chain is only as strong as its weakest link.**

Functional lifetime of thermal insulation

It is very difficult to determine the functional lifetime of the thermal insulation in a roof. **Most thermal insulations will be affected by the compression or condensation effects** described above at some point, no longer offering the insulation measured in the initial laboratory tests after manufacturing.

Functional lifetime FOAMGLAS® cellular glass

However, in the case of FOAMGLAS® cellular glass, which has been produced in Europe since 1965, many compact flat roofs with original thermal insulation are still in operation after more than 50 years.

We decided to verify the condition of the original FOAMGLAS® thermal insulation. Between June 2016 and August 2017, the FIW Munich conducted a series of tests to evaluate the long-term functionality and performance of FOAMGLAS® thermal insulation.

Several samples of FOAMGLAS® insulation were taken from roofs of buildings that were 30 to 45 years old in various locations across Europe: Belgium, the Netherlands, the UK and Sweden. Sampling was supervised by an authorised third party and tested in FIW Munich laboratories according to the current valid EN test methods based on the following parameters:

1. Thermal conductivity coefficient (EN 12667, in taken and dried conditions)
2. Compressive strength (EN 826)
3. Moisture content (oven-drying method)

The results of the tests were then compared with the given technical datasheets available at the time of construction of these buildings.

Based on these comparisons, FIW found that in all cases where waterproofing was still working at the time of sampling, FOAMGLAS® products still provide high thermal insulation even after decades of performance in flat compact roofs.

In every single sample, the test results were very close to the values declared in the original technical certificates.

The test results did not show any significant difference in thermal conductivity. All samples showed high mechanical stability with a compressive strength exceeding 500 kPa.*

* The results of all the tests of FIW Munich are available on www.foamglas.com.

This study confirmed another exceptional feature of FOAMGLAS® insulation: that thermal insulation properties remain virtually unchanged even after decades of operation in flat compact roofs. The thermal insulation contributes to the lifetime of the entire roof and enables unprecedented solutions.

Many buildings have already been modernised and their energy efficiency optimised, which also required an increase in the original thickness of the thermal insulation of the roof. This too posed no problems: the waterproofing of the compact roof was simply removed using a peeling method, leaving the original but still fully functional FOAMGLAS® thermal insulation layer in place.

An additional layer of this thermal insulation was then adhered to it and the compact build-up was completed by attaching the waterproofing. Thanks to its extremely long functional life, FOAMGLAS® thermal insulation is not only a very economical solution, but also significantly contributes to sustainability and environmental protection.

Excellent ecological profile

FOAMGLAS® insulation systems have stable parameters in all conditions and protect the building users from unexpected energy costs or costly insulation replacements or extensive renovations. FOAMGLAS® protect the environment in many ways. It enables to save energy for long uninterrupted operation of the building and by maximising the share of green electric energy to reduce the ecological footprint of the production.

Environmentally friendly production

The raw materials used for FOAMGLAS® production have a natural mineral origin and therefore do not burden the environment. The main raw material is recycled glass.

Thanks to improvements in the technology of FOAMGLAS® material production and the consumption of green electric energy, a significant reduction in air pollution, greenhouse gas emissions, energy consumption and raw materials has been achieved.

Extremely long service life

Thanks to its extraordinary properties (mineral origin, impermeability to water and vapour, non-flammability, resistance to high temperatures and constant insulating properties), FOAMGLAS® insulation is a very durable material. The long service life of this thermal insulation has a very positive effect on the whole building, both from the ecological and financial point of view. The EPD (Environmental Product Declaration) documents declares the service life of FOAMGLAS® insulation as 100 years.

In addition it can be ecologicaly recycled at the end of the service life.

FOAMGLAS® thermal insulation meets the requirements for health safety and the quality of the indoor environment. In the case of demolition of the building, its meaningful ecological recycling is possible. In addition to the very positive ecological declaration EPD, FOAMGLAS® insulation has also the prestigious NATURE PLUS certificate.

7 - Our FOAMGLAS® personal project support and TAPERED services

Personal project support. Every step of the way.

When it comes to your sustainable activity roofs, FOAMGLAS® supports you from start to finish. During the **design phase**, we will gladly help you with thermal insulation calculations, detailed drawings and tailor-made solutions specific to your project. We will also assist you with cost price calculations, the preparation of cutlery texts, project-specific TAPERED plans and technical advice.

Before and during the execution of your activity roof, we offer theoretical and practical training for the installers, onsite start-up and training as well as a site visit and monitoring. Everything to ensure a flawless execution of your activity roof.

Our TAPERED services. A versatile solution for every type of roof.

Correct water evacuation is a challenge for any building project. Our **FOAMGLAS® TAPERED insulation layer** adds water evacuation directly into the insulation rather than the structure of the building. Meanwhile, our team of experts calculate the perfect slope for your surface, taking all specifications of your project into account. The result? Excellent water drainage, plenty of time saved on the job site and a reduced risk of incorrect execution.

What is FOAMGLAS® TAPERED?

FOAMGLAS® TAPERED is a high-quality insulation and water evacuation solution in one. It offers **optimal insulation** and **protection against moisture** for generations to come. FOAMGLAS® TAPERED **protects your valuable assets, guarantees minimal maintenance costs, is non-flammable, can withstand high pressure and is resistant to fungi and vermin.**

How does FOAMGLAS® TAPERED work?

First, our **sales engineer will cooperate closely with you, making sure all details needed to design the TAPERED surface for your project are perfect.** This includes information about the circumference of the surface, sills, eaves and the height restrictions of the roof and water drains. The required slope, optimal discharge direction and desired thermal performance are also discussed. Secondly, our expert **TAPERED studies team** will guide you through every step of the process, examining all of your needs and taking into account every single detail of your project. They will provide you with visual drawings and a detailed installation plan for a high-quality insulation solution that will stand the test of time.

What's in it for you?

FOAMGLAS® TAPERED offers complete **peace of mind:** proper drainage and watertight insulation alleviate the risk of any future leaks, guaranteeing a long lifetime with no standing water. The high compressive strength will also prevent any deformation, with **no risk of flaws or damage**. Unlike alternative solutions, the gradient of FOAMGLAS® TAPERED can be reduced. The result? Less total thickness and less material required. FOAMGLAS® TAPERED is also **cost efficient:** durability guarantees maximum value and minimal maintenance costs.

8 - Ready to get started?

Now that you know all about the benefits of FOAMGLAS® thermal insulation in activity roofs, we hope you feel inspired to design your next project with our closed cellular glass insulation in mind.

Do you have any questions about our Compact Roof system?
Don't hesitate to contact our technical consultants who will propose the perfect solution for your project and train your people for the correct application.

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