Interior insulation systems

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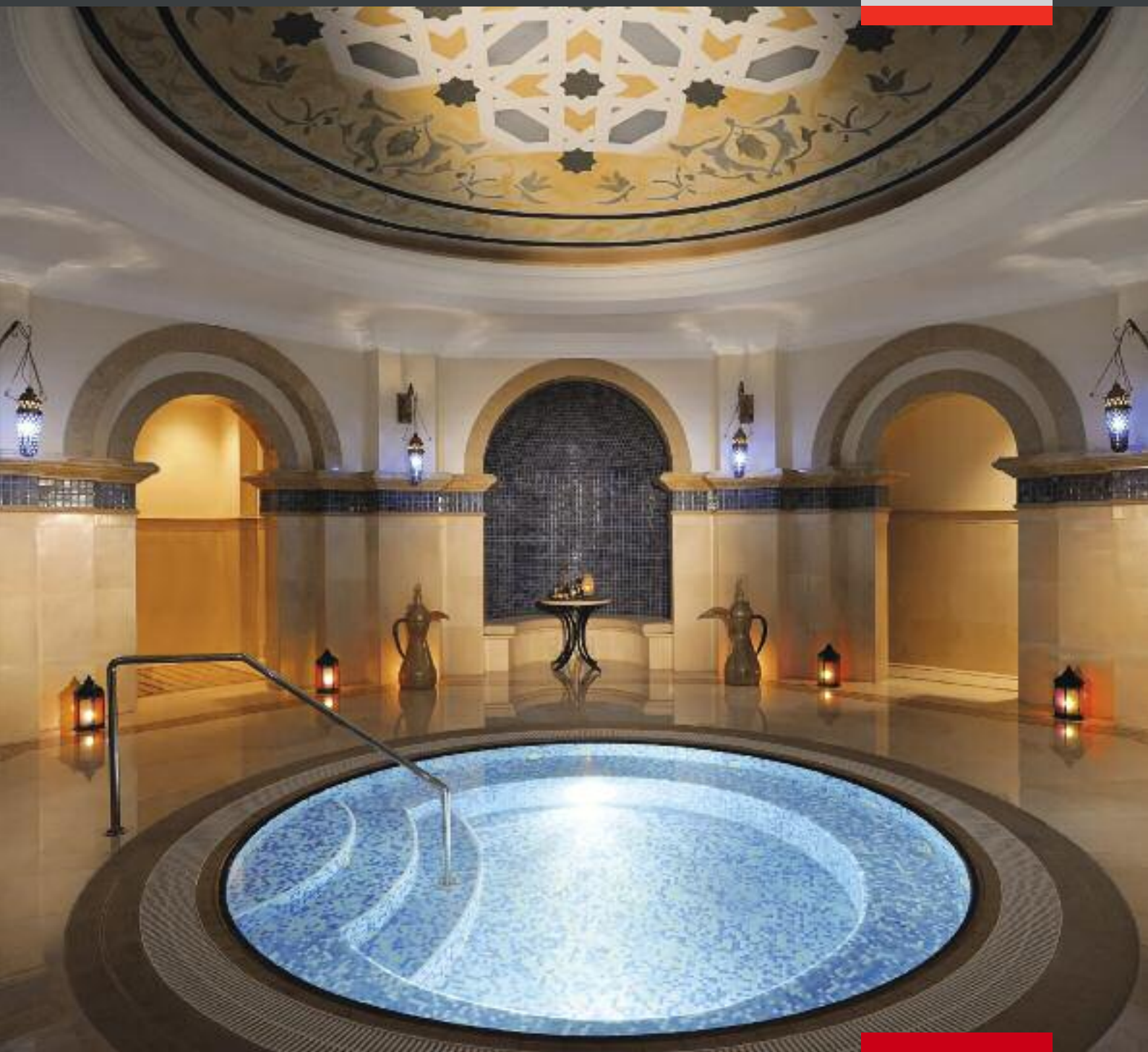
FOAMGLAS®
Building



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Investment in a promising future

Escalating energy costs and acute environmental damage: these are today's challenges. Reducing the energy consumption of buildings by thermal insulation becomes a vital issue which is important for new buildings. For buildings where it is impossible to apply external insulation on the enclosing walls, the use of FOAMGLAS® interior insulation can be the only appropriate choice. These are for example buildings where façades have to be preserved and cannot be retrofitted on the outside. FOAMGLAS® cellular glass insulation is an unrivalled solution, because its "inherent qualities" are one of the best on the market.

Saving energy costs and improving the building performance.

Significantly reducing the energy consumption of a building is, of course, the most beneficial effect of FOAMGLAS® interior insulation. In addition superior

1 Zurich-Kloten Airport, Dock E
2 Restaurant Aux Gazelles, Vienna (Austria).
3 Widder Hotel, Zurich
4 Sports Hall Kreuzbleiche, St. Gallen (Switzerland)

2

3

4

performance characteristics of cellular glass insulation systems ensure optimal protection of the building. Due to the cell geometry with a "build-in" vapour-barrier, moisture cannot enter the material. Damage caused by moisture or mould can be excluded with professional design and workmanship. In addition interior insulation is saving money, because expensive reface and scaffolding works are not needed. Another advantage: in buildings with intermittent heating (rooms which are not permanently used), the heating time is significantly reduced.

Ultimate insulation – essential physical qualities:

- **Dimensionally stable, no deformation**
- **Easily cut to shape**
- **Impermeable to moisture in liquid and vapor forms**
- **fiber-free**
- **capillarity-free**
- **Non-polluting**
- **No solvents in adhesive systems**
- **Constant thermal insulation performance**
- **Inorganic, rot-proof, no decay**
- **Ecologically sound, free from polluting flame-retardants and greenhouse gases, no eco-toxicological components**
- **Acid resistant**
- **Non-combustible (Reaction to fire: EN classification (EUROCLASS A1)**

Increased standards for human comfort

The majority of older buildings or converted levels (basements or attics used as living room) have poor insulation. This results in excessively low temperature in winter and high temperatures in summer. Proper interior insulation can improve comfort and also significantly impact energy costs for heating and cooling.

5 Art Museum Liechtenstein, Vaduz
6 Sihlcity Shopping Mall, Zurich
7 Private pool.

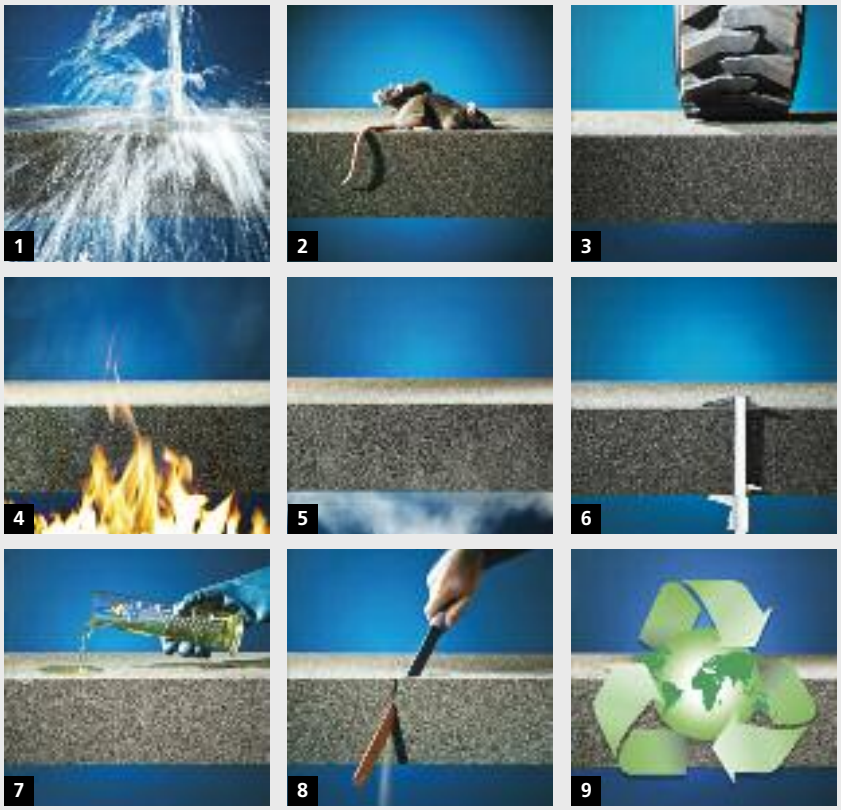
For a healthier environment – inside and outside.

On topic of indoor air quality interior insulation can help to solve problems relating to moisture and mould. Also, FOAMGLAS® insulation is an environment friendly material and does not emit volatile organic compounds to the air. Cellular glass an environmentally sound construction material. It is made from natural raw materials (including 60% recycled glass) and contributes in many ways to a healthy and a clean environment.

For more than 50 years architects, engineers, contractors and owners have chosen FOAMGLAS® interior insulation systems for housing and industrial construction, public buildings, commercial and institutional buildings. The reasons are:

- **FOAMGLAS® solutions are designed for high performance and durability.**
- **Constant thermal insulation value**
- **Low cost due to easy installation and ultra-long service life**
- **Environmental sustainability from cradle to grave (production, use and disposal)**

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-tightbecause 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.

Interior insulation, floor

Museum Tinguely, Bale, Switzerland

Architect Mario Botta, Lugano
Construction 1995
FOAMGLAS® applications
Floor insulation on the inside, about 1,800 m², FLOOR BOARD T4+, 120 mm thick, butt-jointed
Floor finish Parquet flooring in European larch / oak

The Museum on the Rhine by architect Mario Botta creates a unique atmosphere for Tinguely's art objects. The immense central exhibition hall showcases about 20 machinery sculptures. Due to its cell structure FOAMGLAS® maintains high-compressive strength even under a heavy permanent load. The insulation is perfect for use on load bearing floors, and a safety load factor admits for temporary or future changes in workload and, respectively conversion. Floor insulation using FOAMGLAS® slabs or Boards is the best solution to ensure structural stability and functional design, which meets all the needs for thermal and moisture protection, even when materials are in contact with the ground.

FOAMGLAS® insulation is a safe and versatile solution
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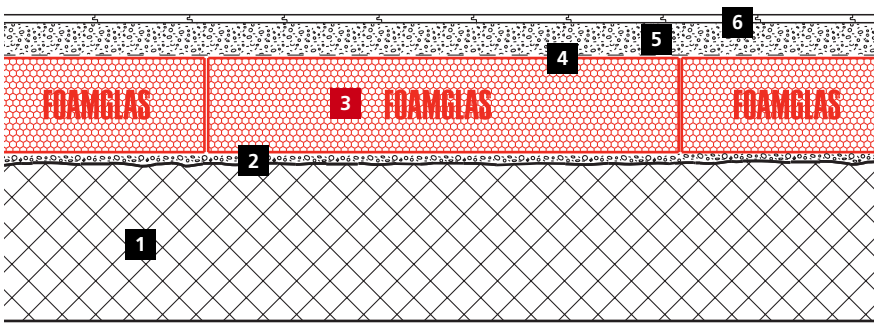
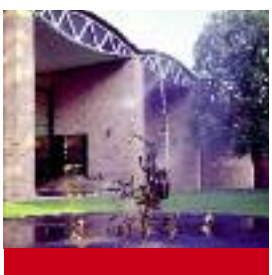


Floor construction
1 Concrete slab
2 Sand levelling course
3 FOAMGLAS® FLOOR BOARD T4+, butt-jointed
4 Separating layer, PE foil
5 Sub-floor
6 Parquet flooring in European larch / oak



Interior insulation, floor

Cold storage, Princess Nora University, Al-Riyadh, Saudi Arabia

Client Ministry of Finance and Ministry of Higher Education
Construction 2010
Consultant Dar al Handasah
Contractor El Seif, Infrastructure Package
FOAMGLAS® application Interior insulation for the floor, type FLOOR BOARD F, 160 mm thick, in two layers, loose laid

In May 2011 Saudi's King Abdullah officially opened the new campus of the $5.3b Princess Nora Bint Abdulrahman University (PNU) less than three years after laying the foundation stone for the university. The new university is the largest women-only university in the world, covering 800 hectares on the outskirts of Riyadh. The new campus includes a 700-bed hospital, 15 colleges, a central library, a conference hall, laboratories and research centres. It also comprises staff housing units, student hostels, infrastructure facilities plus administration buildings. The university is designed to cater for more than 50,000 students. The campus also includes one of the largest cold storages in the Middle East. Accessible directly with trucks, the demands for the floor build up was high. FOAMGLAS® cellular glass thermal insulation is used below a load bearing course to solve the thermal protection and to carry the high load of the trucks at the same time. FOAMGLAS® is a unique thermal insulation with high load bearing capacity without compression. It will never absorb any moisture, is ecological with more than 60 % recycling glass content and is well known as the only real long time solution.

Floor build up with highest load bearing capacity
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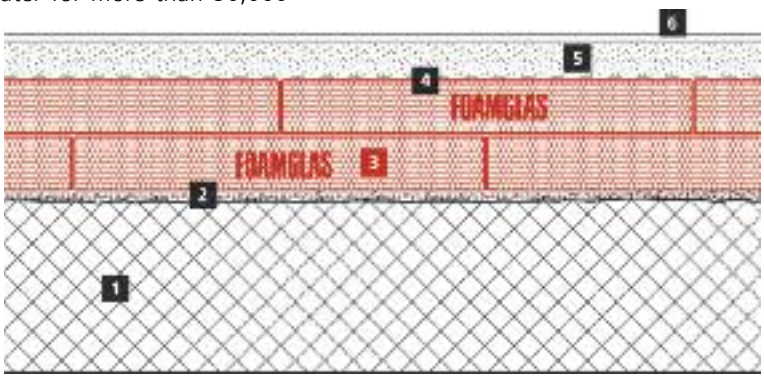


Structure
1 Concrete slab, uneven
2 Sand levelling layer
3 FOAMGLAS® FLOOR BOARD F insulation, loose laid, 160 mm in two layers
4 Separation layer
5 Load bearing course
6 Floor finish

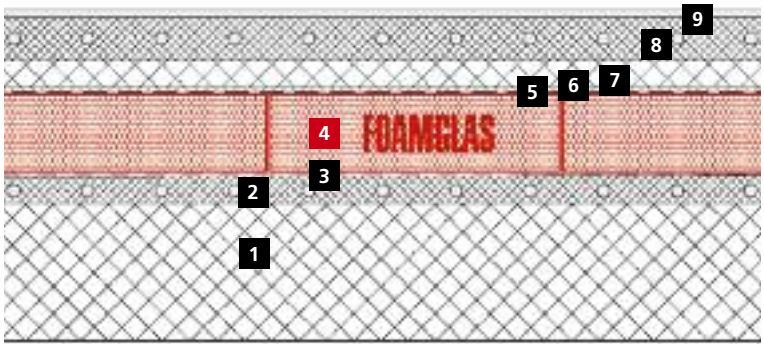
Skating rink, floor

Arena of Ondrej Nepela, Bratislava, Slovakia

Architects Fischer s.r.o.
Reconstruction 2010
Main Contractor INGSTEEL, Bratislava
Subcontractor Špeciálne Izolácie, Bratislava
FOAMGLAS® application Floor insulation, arena and 2 training skating rinks; FOAMGLAS® S3, 5,400 m², 150 mm thick

The Stadium is named in honour of Ondrej Nepela, an Olympic gold medalist and three-time World champion Slovak figure skater in the 1960s. The old ice rink has been converted into a modern mixed-use sports arena with a 10,000 seating capacity. It was one of the oldest open air skating rinks in Slovakia and was originally built in 1940. A major renovation was completed in time for the Ice-hockey World Championship in 1992. The latest refurbishment – where 80% of the existing building was demolished – was carried out between 2009-11.

As this multifunctional arena is the largest in Slovakia, the FOAMGLAS® insulation under main skating rink was a clear choice. FOAMGLAS® can perfectly resist the extreme structural load from the ice, equipment and skaters, but also the constant and severe building physics from contact with the frosted concrete deck. A FOAMGLAS® compact build-up was also chosen for two new training rinks added to this sports area.
The Ice-hockey World Championships in 2011 were the first major event held there following the reconstruction.



Protection of the floor against freezing in skating rinks
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Structure
1 Bearing concrete slab (basement area under the skating rink)
2 Levelling screed with heating system, 10 cm
3 Bituminous primer
4 FOAMGLAS® S3 slabs, 150 mm, laid in hot bitumen
5 Two layers of SBS modified membranes
6 Slip layer (2 x PE foil, lubricated)
7 Protection concrete layer, 5 cm
8 Concrete cooling deck, 15 cm
9 Ice, 3 cm

Interior insulation, floor

Kreuzbleiche Sports Hall, St. Gallen, Switzerland

Architect Architekturbüro Heinrich Graf, St. Gallen
Construction 1984
FOAMGLAS® application Interior insulation for the floor, about 1,750 m², type FLOOR BOARD T4+, 60 mm thick, loose laid
Floor finish Court surface

Floor insulation using FOAMGLAS® slabs and Boards are the optimal solution to ensure high thermal performance in the longterm and moisture protection of components at ground level. Unique physical properties make FOAMGLAS® the perfect insulation. Cellular glass is water- and vapour-proof and keeps out moisture. FOAMGLAS® cell geometry provides high compressive strength and is resistant to point loads from gym equipment. A floor structure including FOAMGLAS® safety insulation has decisive advantages.

FOAMGLAS® insulation keeps feet firmly on the ground
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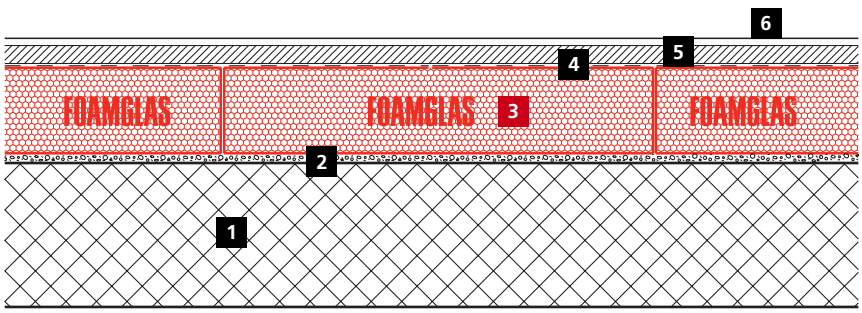


Structure
1 Concrete slab
2 Sand levelling layer
3 FOAMGLAS® FLOOR BOARD insulation, laid loose
4 Separating layer, glass fibre fleece
5 Mastic asphalt layer
6 Court finish

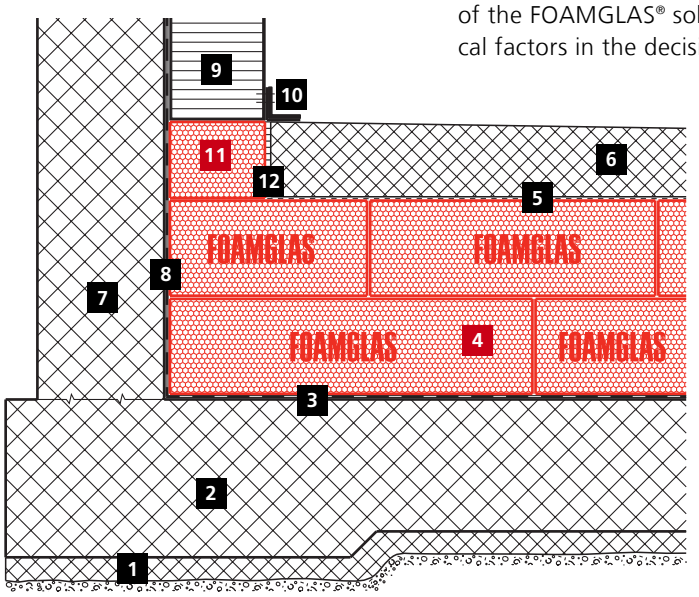
Interior insulation, floor

Logistikcenter Galliker, Freight Forwarders, Dagmersellen, Switzerland

Engineering office Anliker AG, Emmenbrücke LU
Construction 2004
FOAMGLAS® application Floor insulation on the inside, about 3,680 m², type S3, thickness 200 / 300 mm, adhesively bonded
Floor finish Pressure distribution concrete slab

This application for the production and low-temperature storage of baked goods demanded a well-conceived energy strategy, which certainly involved the use of efficient thermal insulation. A critical need was to account for intertemperature differences , but also between the inside and outside. After detailed analysis, the decision was taken to use cellular glass insulation for a variety of areas (roof, façade, floor).

Due to its superior performance characteristics, FOAMGLAS® insulation is suited for the most demanding situations. Excellent load-bearing capacity, dimensional stability, durability and constant thermal performance are properties required for the insulation of low-temperature storage and dispatching locations of freight forwarders, in particular in the summer. Super long-term performance and proven sustainability of the FOAMGLAS® solution were critical factors in the decision.



No performance and durability problems occur under extreme conditions of use
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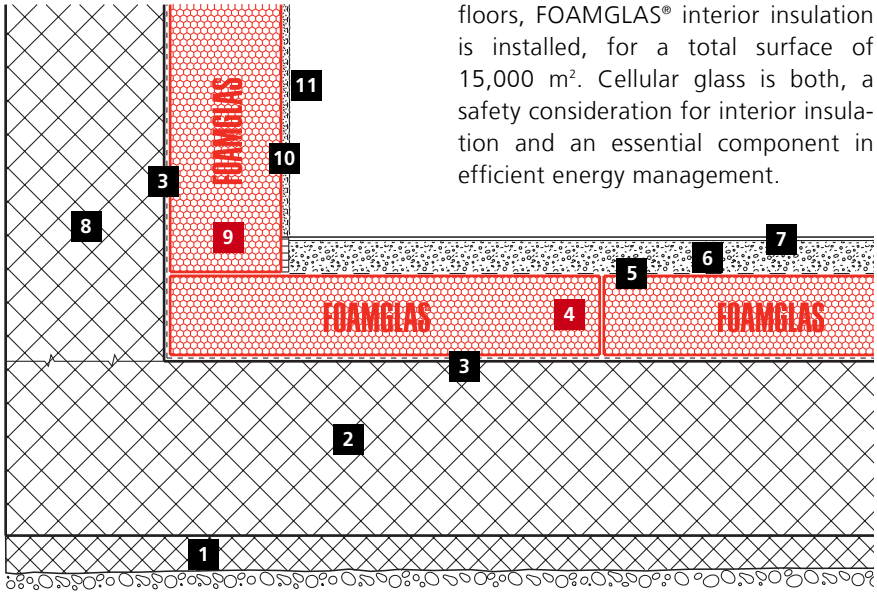
Structure
1 Lean concrete
2 Concrete slab
3 Bituminous waterproofing, 1-layer system
4 FOAMGLAS® S3 slabs in hot bitumen, insulation laid in 2 layers, with hot bitumen mop coat
5 Separating layer, PE-foil
6 Screed to falls load distribution slab
7 Concrete wall
8 Raised on edge waterproofing
9 Metal lightweight wall
10 Corner angle on sealing strip
11 FOAMGLAS® insulation on the periphery
12 Joint with strip of soft insulation (fibre insulation)

Interior insulation for floor and walls

Sihlcity Shopping Mall, Zurich, Switzerland

Architect Theo Hotz AG, Zurich
Construction 2006
FOAMGLAS® application Interior insulation for floor and walls, about 14,540 m², T4+ and S3 slabs, FOAMGLAS® READY BOARD T4+, READY BOARD S3, 30–160 mm thick, laid loose and adhesively bonded
Floor and wall finishes Different materials

Sihlcity is a shopping and entertainment center, the first of its kind in Switzerland. The new development is a visitors attraction and has unique technical and design qualities. Energy efficiency was a central issue for the engineering. The heating for the building comes from gas-fired boilers for the combined production of electricity and heat. Additionally a water-to-air heat pump – groundwater-coupled – is installed. It accounts for more than a quarter of the heat demand. Also the ventilation system with heat recovery keeps the greater part of the heating energy inside the building. Highly efficient thermal insulation plays a key part in resourceful energy management of the building. On walls and floors, FOAMGLAS® interior insulation is installed, for a total surface of 15,000 m². Cellular glass is both, a safety consideration for interior insulation and an essential component in efficient energy management.



A new dimension in energy performance and economy
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Structure
1 Lean concrete
2 Concrete slab, levelled
3 Bituminous primer coat
4 FOAMGLAS® T4+ slabs in hot bitumen, insulation laid in 2 layers, with hot bitumen mop coat
5 Separating layer, PE-foil
6 Subfloor
7 Floor covering
8 Concrete wall
9 FOAMGLAS® T4+ slabs, adhesively bonded with PC 56
10 Base coat PC 164 with reinforcement fabric PC 150
11 Finish coat

Interior insulation, floors

PCT – Potsdam Center for Technology, Potsdam, Germany

Architect Hascher, Jehle Planungsgesellschaft mbH Architekten, Berlin
Construction 2007
FOAMGLAS® application Raised access floors, 1,000 m², T4+ slabs, 80 mm thick, adhesively bonded
Walls, about 570 m² interior insulation, T4+ slabs, 100 mm thick
Floor and wall finishes Various

For a new generation office and commercial building, office automation depends on a concept of flexible, high performance working spaces. Underfloor service voids are the solution to facilitate the delivery of power, voice, data and underfloor HVAC, to the precise point of need.
Ultimate design is aligned with energy efficiency and rapid office layout changes to adapt to future occupier or technology requirements.

Thermal insulation at floor level reduces heat losses, saves cooling energy and improves personal health.
Compression-proof FOAMGLAS® insulation was installed beneath access floors and as interior lining of the outer walls.
FOAMGLAS® insulation has good bearing capability and can be matched with all types of access floors and pedestals. It provides a green design solution.

FOAMGLAS® insulation, the green design solution for access floors
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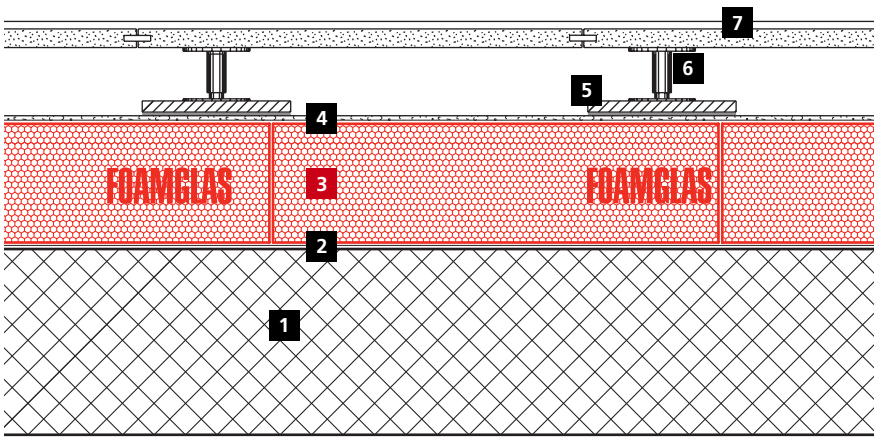

Structure
1 Concrete slab
2 Primer coat
3 FOAMGLAS® T4+ slabs, adhesively bonded
4 Coat of PC® 74 A2 with reinforcing mesh PC® 150
5 Load distribution plates
6 Pedestals
7 Raised access floor panels

Interior insulation, floor, walls, ceilings

Photo, Ger van der Vugt, Amsterdam

Kraanspoor Office, Amsterdam, Netherlands

Architects OTH Architects, Amsterdam
Construction 2007
FOAMGLAS® application Interior insulation for floor, walls and ceiling, T4+ slabs on concrete structure

The old crane track at the former 'Nederlandse Dok en Scheepsbouw Maatschappij' in Amsterdam, dating from 1952, had been abandoned for years when the Dutch architect Trude Hooykaas saved this piece of industrial heritage from destruction. She left the 270-metre crane track almost intact and combined it with a contemporary architectural concept, making the attractive part in glass. The concrete structure was used as a filing room and, to preserve the original appearance, is insulated inside. In addition, as this concrete structure is entirely exposed to humidity and temperature variations, the insulation must meet considerable demands, such as impermeability to water and steam, incombustibility, a low dilation coefficient, very great compression resistance, particularly on the floor, and, of course, long life.
FOAMGLAS® easily meets all these requirements. It was therefore the only logical choice for the insulation of the floor, walls and ceilings of the concrete structure.

FOAMGLAS® solutions with architectural sensivity
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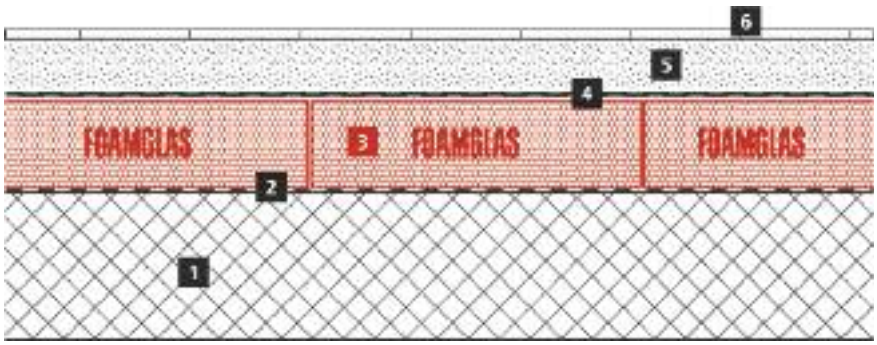


Structure
1 Concrete deck
2 Levelling layer
3 FOAMGLAS® FLOOR BOARD, loose laid
4 Two layers of impermeable PE film
5 Finish

Wall upgrade to high thermal performance

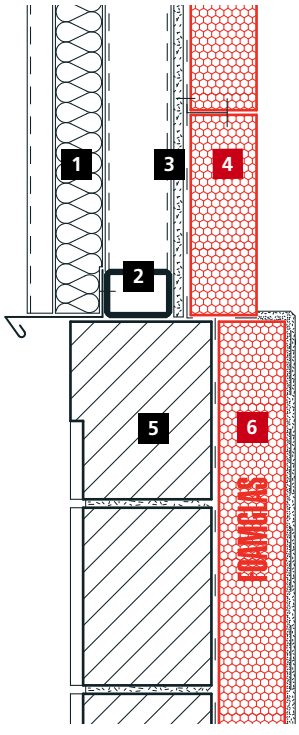
Conversion to Cold Storage, Alsafi Danone, al Kharj KSA

Planning ASG Contracting Riyadh
Construction 2012
FOAMGLAS® application Wall, 2,000 m², T4+ slabs, 70 mm,
partly with render finish
Roof, 3000 m², FOAMGLAS® READY BOARD T4+ slabs, 70 mm / 100 mm

The Alsafi farm in al Kharj KSA is the largest integrated dairy farm world-wide with Guinness World Book of Records entry 1998. The farm is fully integrated from the growing of forage to the final distribution of milk and dairy products and includes factory and storage facilities. Due to the adjustment of the daily need the upgrading of a storage to a cold storage needed to be done.
The client decided to follow a proposal to upgrade the building envelope on the roof and the wall with FOAMGLAS® systems which are FM approved.
The existing PU-panels on the hall were the base for the application of the FOAMGLAS® on the roof.

On the wall FOAMGLAS® was applied directly to the existing brick wall up to 4 m height and received a render finish as protection. Above a cement board was at first fixed to the existing metal frame to serve as a substructure for the FOAMGLAS® application.

Final performance testing of the client showed excellent performance to the full satisfaction of Alsafi Danone.



Upgrade for the next lifetime with durable and fire safe FOAMGLAS® insulation material
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Wall system
1 Existing PU-panel, 50 mm
2 Existing metal frame
3 Cement board
4 FOAMGLAS® T4+, 70 mm, adhesively bonded with PC® 56 and mechanical fixation PC® F anchor
5 Existing brick wall
6 FOAMGLAS® T4+, 70 mm, adhesively bonded with PC® 56 and render finish PC® 74A2 with mesh

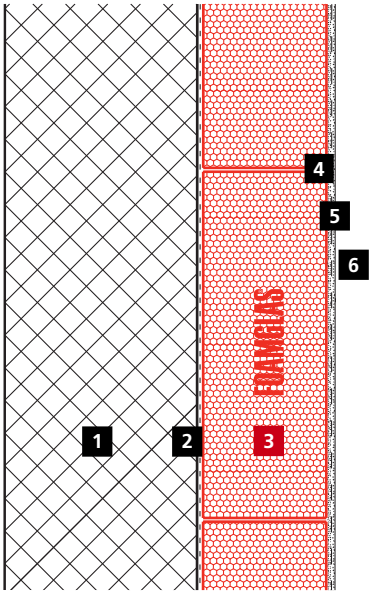
Interior insulation, walls

Parliamentary Offices Paul Löbe House, Marie-Elisabeth Lüders House, Berlin

Architect Stephan Braunfels Architekten, Munich
Engineering HPP Bau- und Projektmanagement GmbH, Berlin
Construction 1997-2001
FOAMGLAS® application Interior walls and ceilings, about 5,000 m², T4+ slabs, 60 - 80 mm thick, adhesively bonded
Wall finish Plasterwork

Paul Löbe House is a parliamentary office block, which houses 550 offices for MPs, 19 conference rooms, 450 offices for parliamentary committees, the Bundestag information service for visitors and a restaurant that is open to the public. This federal building is connected to the Reichstag building by a subway and extends across the River Spree via a footbridge to Marie-Elisabeth Lüders House, containing the parliamentary library and the Bundestag archives.
The two buildings show extensive glazing on the riverside façades and considerably protruding roofs that seem to span the river.

Energy efficiency and low carbon building were prior design missions for all governmental buildings, newly built or redeveloped. More than 5,000 m² of FOAMGLAS® interior insulation were installed and ensure a healthy indoor climate. FOAMGLAS® insulation creates a solid wall structure for a high-grade use.



Use of FOAMGLAS® insulation means energy efficiency and climate protection
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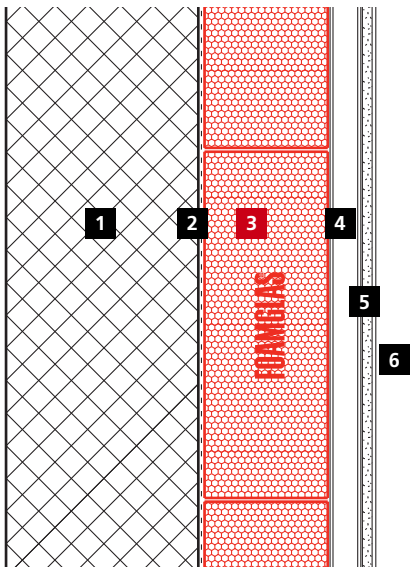
Render system
1 Wall structure (concrete / masonry)
2 Primer coat
3 FOAMGLAS® T4+, adhesively bonded with PC® 56 and mechanically fixed
4 Base coat PC® 164
5 Reinforcement fabric PC® 150
6 Plasterwork Knauf MP 75 L plaster

Interior insulation, walls

Centre for Modern Art & Creativity. U Tower, Dortmund, Germany

Client City of Dortmund, Germany. Special funds
Architect Gerber Architekten GmbH, Dortmund
Construction 2010 redevelopment
FOAMGLAS® application Interior wall insulation; 6,280 m², T4+ slabs, 50 mm thick, bonded and mechanically fastened, using 7,700 PC® F fasteners.
In total 8,300 m² of FOAMGLAS® for different applications
Wall finish Plasterboard and paintwork

"U" Tower in Dortmund is a listed industrial building, where in the past the traditional Union-Beer was conditioned in open pools. Today the building has become a powerful flagship for the region where the shift from an industrial age to the new Media Age is on the way. An ambitious redevelopment scheme was specified. The former tent-shaped roof was replaced by a FOAMGLAS® warm roof with copper standing seam to convert the domed sky hall into an event area. The original brick façade of the 7 storey building had to be preserved. In order to improve the indoor climate within this industrial building with its typically large spaces, interior insulation of the kind was used that could meet the most demanding physical requirements. To large interior areas of the building walls FOAMGLAS® thermal insulation was applied. With optimal insulation performance FOAMGLAS® slabs provide fire safety, moisture protection and green building qualities. In front of the insulated wall a metal framing with steel studs and plasterboards was built to create a cavity for the museum's security services. Prerequisite for this type of build-up is a thermal insulation material which perfectly fits to the shape of the building wall and ensures total impermeability to water vapour and airtightness.



Wall structure
1 Building wall (Concrete/Masonry)
2 Bituminous primer coat
3 FOAMGLAS® T4+, 50 mm thick, bonded with PC® 56 and PC® 62 adhesive; PC® F fasteners
4 Metal stud wall
5 Plasterboard
6 Paintwork

Redevelopment of an industrial building. Indoor climate and Zeitgeist vibe with FOAMGLAS®
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Interior insulation, walls with render

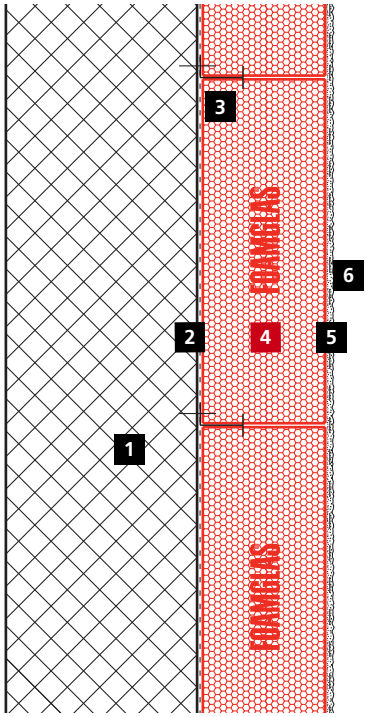
National Convention Center Car Park, Doha, Qatar

Architect WS Atkins and Partners Overseas
Construction 2008 - 2011
FOAMGLAS® application Interior walls insulation, about 3,000 m², T4+ slabs, 80 mm thick, adhesively bonded to the structural wall
Finish PC® 74 A2 render

National Convention Centre Car Park is the biggest car park in Qatar foundation education city, linked to Qatar National Convention Centre. The building was desiged by WS Atkins and Partners who are famous for their innovative and inspirational design.

In NCC car park project, they took into consideration a "worst case" scenario. Accordingly the safety measures were strictly planned to meet all requirements regarding fire prevention.
FOAMGLAS® insulation meets stringent fire safety requirements.
FOAMGLAS® insulation is non-combustible, does not smoulder or develop smoke. FOAMGLAS® insulation prevents fire-spread, allowing for precious time for the fire fighters to rescue people.

The contractor was MAN Enterprise and the building includes 3,110 car parking spaces, 300 m underground passage, linking the car park to NCC.



Ecological and fire safe, a recommended building material
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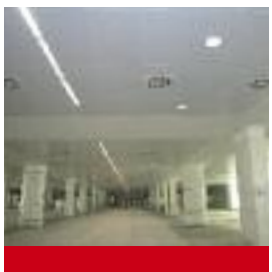
Render system
1 Concrete wall
2 Primer coat
3 FOAMGLAS® slabs, bonded with PC® 56
4 Mechanical fastening with PC® anchors F
5 Base coat PC® 74 A2 with reinforcing mesh PC® 150
6 Final coat of PC® 74 A2

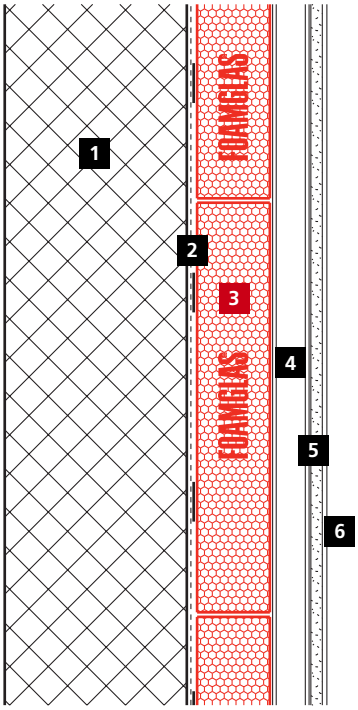


Interior insulation, walls

Housing Estate "Schlosspark", in Boll-Sinneringen, Switzerland

Architect Atelier 5, Architekten und Planer AG, Bern
Construction 1996
FOAMGLAS® application Interior wall insulation, about 7,800 m²
FOAMGLAS® WALL BOARD, 60/80 mm thick, spot bonded
Wall finish Plasterboard and plaster coat

The exposed concrete façades of the "Schlosspark" Estate are a landmark feature. The building design required thermal insulation to be installed inside on the enclosure walls, and FOAMGLAS® WALL BOARD is the ideal material. With optimal insulation performance, cellular glass provides a safe solution and a comfortable indoor climate. The product is totally harmless for health and the environment, because it is free from fibers, binders and CFC / HCFC / HFA. Furthermore, FOAMGLAS® insulation provides fire protection because it is non-combustible and does not contribute to the spread of fire or toxic smoke. Energy-efficiency and unique physical properties ensure the highest performance and ecologically sound construction.



Home comforts, energy-efficiency and a benefit for the environment
www.foamglas.ae

Wall structure
1 Exposed concrete
2 Bituminous primer coat
3 FOAMGLAS® WALL BOARD insulation, bonded with PC 56 adhesive
4 Studs, sub-construction
5 Plasterboard
6 Plaster finish

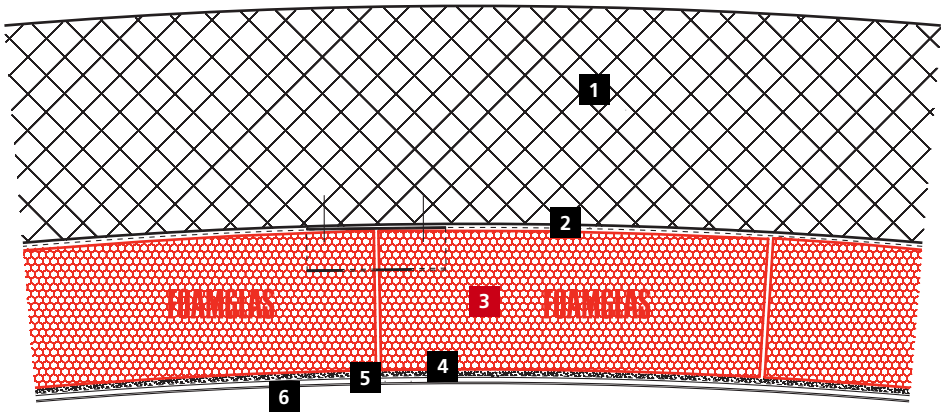
Interior insulation, wall

Zurich-Altstetten indoor Swimming Pool, Zurich-Altstetten, Switzerland

Architect Oetiker Partner Architekten, Adliswil
Construction 2007
FOAMGLAS® application Interior wall insulation, about 250 m², T4+ slabs, 160 mm thick, adhesively bonded
Wall finish Plasterwork and paintwork

For the architect, only a water- and vapor-proof insulation material would achieve the requirements for swimming pools and the material needed to be fully resistant to chlorinated vapors. Another issue was the curved walls; so the insulation should be able to follow any shape and curve of the walls. So, the chosen material was FOAMGLAS® insulation as it can fulfil all physical demands of the building and can easily be adapted and cut to shape. Regardless of whether the sub-construction material is flat, curved or arched, the FOAMGLAS® slabs can fully be bonded to the structural wall with optimal adhesion. Using a grinding tool, cellular glass can be levelled out to follow any shape.

To make big ideas come true
www.foamglas.ae



Wall structure
1 Exposed concrete
2 Bituminous primer coat
3 FOAMGLAS® T4+ slabs, adhesively bonded with PC 56 and mechanically fixed
4 Base coat PC 164 with reinforcement fabric PC 150
5 Primer-sealer
6 Plasterwork and two-component paint

Interior insulation, walls and ceilings

Tourneroches Swimming Pool, Saint-Cloud (92), France

Owner City of Saint-Cloud, France
Architect Agence COSTE Architectures
Construction 2010
Contractor SCGE
FOAMGLAS® application Interior insulation on walls and ceilings, T4+ slabs
Finishes Ceramic tiles, paints

The Tourneroches pool in Saint-Cloud is situated within a dense urban area, overbuilt with an apartment house and a residential garden.
The public pool was subjected to total renovation, which required the elimination of condensation problems on ceiling and walls.

Rotproof FOAMGLAS® insulation, using type T4+ slabs, was identified as the most adequate and resilient interior finishing system.
The insulation surface is at first coated with a thin-bed plaster with fabric reinforcement, before being finalized with ceramic tiles or paints.

FOAMGLAS®, thermal balance on ceilings and soffits
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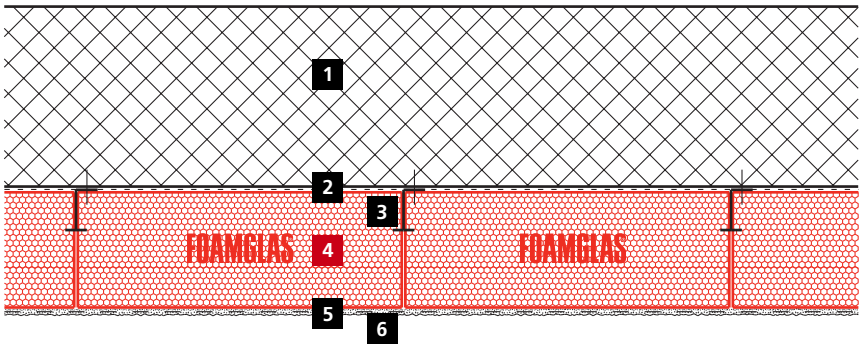


Ceiling structure
1 Concrete deck
2 Primer coat
3 Mechanical fixing, anchor type PC® F
4 FOAMGLAS® T4+ slabs, adhesively bonded
5 Base coat PC® 164 with fabric reinforcement PC® 150
6 PC® 78 plaster coat

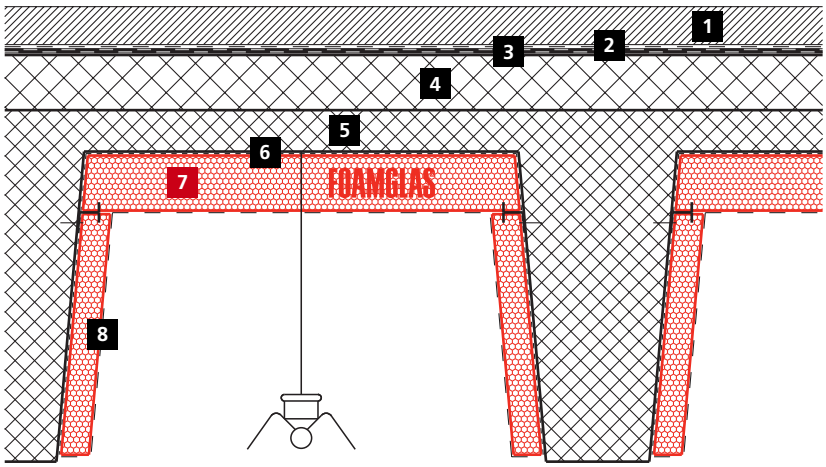
Interior insulation, soffit

Avry-Centre, Avry-sur-Matran, Switzerland

Architect Bureau d'architecture BBA Raphaël Bruegger, Fribourg
Reconstruction 2000
FOAMGLAS® application Soffit insulation, about 18,750 m², T4+ slabs, 40/80 mm thick, adhesively bonded
Ceiling finish Dispersion paint

Customers are very demanding today and search for the Best shopping experience. To meet these expectations, entire rebuilding and extension was done on the Migros Shopping Centre, which had been constructed 30 years prior in the Avry-sur-Matran suburb of Fribourg town. About 4 million clients per year have visited the shopping mall, even during reconstruction. It should be noted that 18,750 m² of FOAMGLAS® cellular glass insulation was used to insulate the soffit of the old parking level transformed into an attractive shopping area. To avoid important losses on the headroom, the space between the binding beams had to be used for lighting a sprinkler system and glass reflectors for the ceiling. The insulation slabs were fitted on the underside of the ribbed slab and directly installed to the concrete units, with a color coating applied as a finish. The high demands on the insulation material regarding fire safety, water- and vapor-resistance as well as dimensional stability, were criteria in choosing FOAMGLAS® insulation.

Efficient thermal insulation allows for conversion to new use
www.foamglas.ae



Ceiling structure
1 Mastic asphalt
2 Separating layer, glass fibre quilt
3 Bituminous waterproofing, two layers
4 Concrete protection layer
5 Prefabricated ribbed concrete floor
6 Bituminous primer coat
7 Foamglas® T4+ slabs, bonded with PC 56 adhesive and mechanically fixed
8 Dispersion paint

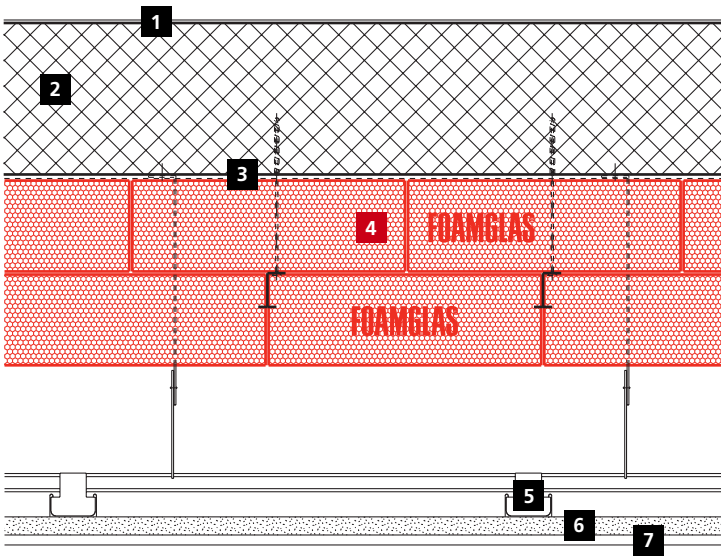
Interior insulation, soffit

Bellevue Restaurant, Ittigen / Bern, Switzerland

Architect Architektur- und Designbüro Pia Maria Schmid, Zurich
Friedli & Genoux Architekten GmbH, Berne
Construction 2007, conversion and extension
FOAMGLAS® application Interior insulation for floors, soffits and walls, about 270 m², T4+ slabs, 140 / 180 / 300 mm thick, adhesively bonded
Soffit, wall and floor finishes Acoustic ceiling, parquet flooring

FOAMGLAS® insulation does not contain or emit formaldehyde, styrene, flame retardants, fibers etc. As an environmentally friendly material, FOAMGLAS® insulation is ideal for all indoor situations, where pure air is required and has inherent qualities when hygienic and aseptic conditions are needed. This is true for the catering and hotel industry. FOAMGLAS® interior insulation systems do not need additional protective layers as vapour control layers. All glass FOAMGLAS® geometry of the insulation keeps moisture in liquid and vapour forms out. The wall assembly remains free from condensate and ensures a permanent thermal performance level in the long-term.

Solidly built – healthy living conditions
www.foamglas.ae



Ceiling structure
1 Liquid plastics waterproofing
2 Concrete decking
3 Bituminous primer coat
4 FOAMGLAS® T4+ slabs, adhesively bonded with PC 56 and fixed mechanically
5 Double cross iron for suspended ceiling
6 Plasterboard
7 Acoustic ceiling, jointless

1 Interior insulation, hotel swimming pool.
2 Beauty spa.

Valuable total protection

The study of building physics has gained in importance over the years and decades due to cost-efficiency and environmental considerations. On the one hand, the depletion of non-renewable resources leads to an increase in energy prices. On the other hand, climate-protection goals are the newest challenge. This explains the growing interest for FOAMGLAS® cellular glass insulation which maintains long-term effectiveness, even in the most demanding situations.

From storage room to classroom or living space

The conversion of basements or attics into living spaces has become incredibly popular. Insulation is necessary but cannot always be installed to the rooms exterior due to construction issues or high costs. However today insulation technology, allows for effect retrofit insulation of living spaces in basements with the insulation layer being laid at the inside to enclosure walls. Specific requirements need to be met to ensure full moisture protection and best thermal performance.

Thermal insulation up to standard

Insulation of walls is essential for economical heating of rooms in the basement or on ground floors. A perfect solution is FOAMGLAS® insulation, cellular glas insulation – which is composed of millions of all glass closed cells, keeps the wall assembly free from condensation and ensures high thermal performance.

Air tightness guaranteed

Architects and home-builders have chosen FOAMGLAS® insulation for protection against heat losses by transmission (thermal conductivity) and from air leaks which carry a two-fold risk: heat loss and formation of condensation and mould. The risks of air leaks and, in consequence, thermal bridging, persist mainly in the area of building services, at recesses and pipe penetrations. Energy efficient houses require a perfectly sealed building envelope. The theory of "breathing walls" is to be abandoned and belongs in the past. FOAMGLAS® insulation provides an effective barrier, and no additional vapor control layer is required.

The ultimate moisture protection

For remodelling of basement units moisture protection is of highest priority for two reasons. The building must not only be protected from groundwater but also water-vapour transport. Build-up of condensation in the wall section must be eliminated.

Outside moisture protection

A frequent cause of damage is from seepage due to insufficiently drainage on the underground walls. An efficient drainage system allows to eliminate most of the moisture in the ground but this alone is not enough to dehumidify the building.

Also action needs to be taken if the presence of moisture is related to capillary action due to the absorbency of construction materials, or caused by shrinkage cracks, joints, or wall openings.

In the case of absorbing water the interruption of the wall capillarity is the solution, i. e. a non-absorbent layer has to be added. In the case of the latter causes the method of waterproofing chosen should provide sufficient resistance to water pressure.

In general vertical dampproofing membranes can be applied to the exterior or interior side of a structural wall. Exterior dampproofing is the standard practice, in particular for new construction, with accessible underground walls. Interior dampproofing is, technically speaking, a less-than-ideal solution and used as a second option. As an analogy, it would be as if someone wears his raincoat under his jacket. Of course he protects himself against moisture, but the clothes covering the raincoat will still get wet.

Dampproofing on the interior should only be used if the outside wall is not at risk of damage from wet soil and harmful substances, such as salts.

In some cases with old buildings dampproofing membranes can only be applied at the inside of the building, either because the building cannot be accessed externally or because excavation is too expensive. With vertical interior dampproofing a barrier against humidification is achieved, however certain conditions require additional protection against dampness in the wall: this means horizontal dampproofing by means of mechanical procedures or pressure grouting.

Dampproofing methods

Exterior dampproofing systems on underground walls provide protection against:

- **moisture ingress**
- **rising dampness**
- **water ingress and protection of the construction against humic acids**

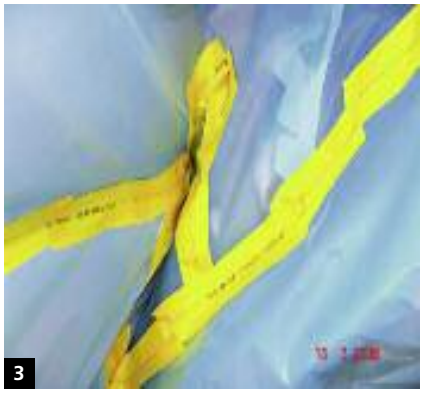
Vertical dampproofing: The transformation of basements to living spaces needs thorough preliminary examination of the moisture situation. For interior vertical dampproofing the following proven systems are used:

- **Water-repellent finishes**
- **Cementitious grouting compounds**
- **Shotcrete**

Horizontal dampproofing: Mechanical procedures, as for instance the wall sawing method or the chrome steel sheet method have the disadvantage to be expensive and to expose the building to considerable stresses. Therefore one of the following grouting methods are generally preferred (injection of liquid dampproofing with or without pressure):

- **Solidification of porous wall areas with filling compound**
- **Fill in (obstructing injection)**
- **Hydrophobing injection**
- **A combination method**

1 Conditions for air leaks
2 Moisture protection neglected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Moisture protection from the inside

Moisture damage can be caused by condensation due to water-vapor transport and/or air leaks in the wall assembly. Preliminary conditions for construction to be condensation free:

- **The insulation value of the construction components increase from inside to outside, i.e. the lambda-value becomes smaller,**
- **The resistance to water-vapor diffusion of the construction components decreases from inside to outside, i.e. the SD-value becomes smaller**

Wall construction with conventional interior insulation shows at first sight, that none of these principles is observed. The structural layer (concrete/masonry) with a bad insulation value and high water-vapour resistance is situated on the outside.

This is why, for conventional constructions, a so-called vapor control layer/vapour-barrier is placed in front of the insulation, in general a film layer. For the surface, this is generally problem-free. However, at the overlaps of the film and at connections to walls, openings etc. opportunities for moisture and damage are predigtable. Where joints are not perfectly sealed, air flows from room into the construction due to vapour pressure differences. The effects of air flow can transport much higher quantities of water vapor than produced by diffusion processes; there is saturation in the circulating air which introduces condensation moisture into the insulation. The negative effects are heat losses due to air permeability and loss of insulation performance due to condensation – aside from probably more extensive damage on the construction.

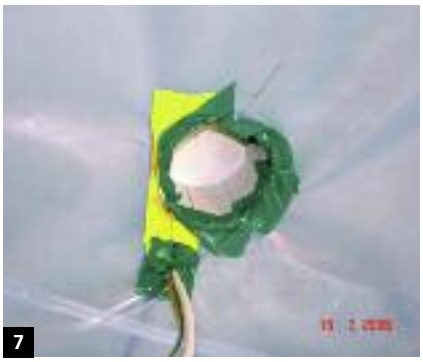
FOAMGLAS® insulation – all in one moisture and thermal protection

For indoor air quality and energy efficient underground walls and basement slabs should be protected against rising dampness. Exterior walls enclosing heated rooms should as well be protected, i.e. insulated, against heat losses. By using FOAMGLAS® insulation on floors, walls and ceilings, both requirements can be met. Cellular glass insulation acts as a protective barrier against moisture by capillary action and also water-vapor diffusion directed from inside to the outside of the wall. This makes FOAMGLAS® insulation the perfect solution. The material structure with millions of closed glass cells forms a natural, integral vapor control layer which keeps the wall assembly free from condensation and hence ensures high thermal performance.

Thermal insulation and vapor control layer

Due to its close- cell geometry, FOAMGLAS® insulation will not absorb water. FOAMGLAS® insulation serves various functions including thermal insulation, vapor control layer and support for the finish layer. When installed according to the compact installation method, the insulation acts in three directions as a solid protection screen against diffusion processes and airflow, which performes much better than a thin vapor control film.

5 Insufficient dampproofing in the floor area and at the base of the wall
6 Insufficient dampproofing in the floor area and at the base of the wall
7-9 On vapor control layers, problems arise at perforations and connections because the system is not sealed air tight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10 Interior insulation, Hubschmied building in Nesselnbach, Switzerland
11 Air- and vapor-proof sealing of FOAMGLAS® slabs
12 Floor insulation on concrete floor slab, Hofwies School in Appenzell, Switzerland

By sealing the joints of the FOAMGLAS® slabs, the system achieves full vapor- and air-tightness.

With FOAMGLAS® interior insulation, there are no doubts about effective moisture protection and the essential condition of a totally air tight and vapor-proof system – quite a contrast to thin conventional vapour control layers, installed with great efforts and time. FOAMGLAS® insulation blocks moisture transport of any kind, be it water or water vapor. The dewpoint temperature is kept inside the closed-cell insulation layer. This is why, in terms of building physics, FOAMGLAS® insulation is indestructible when it comes to moisture impact.

1 Sihlcity Shopping Mall, Zurich
2 Hotel Widder, Zurich

Urban development measures on "reserve assets"

The principle of urban development requires the economical and considerate use of land. In general a number of "reserve assets" can be found and are appropriate for conversion and expansion projects. With minimal expenditure on local public infrastructure, additional residential, commercial and workspace can be developed. It is essential that: transformation and expansion project be planned with care. This also applies to thermal insulation and, for the majority of cases, the use of FOAMGLAS® insulation is the best choise .

Interior insulation with just minor decrease in useable space

FOAMGLAS® insulation is the ideal solution for floor slabs contacting the ground. Additional protective layers for dampproofing against rising moisture is not needed, because cellular glass will not absorb water and is impermeable to water-vapor. Another advantage is the high compressive strength of FOAMGLAS® insulation, which allows the use of rather thin subfloors on top of the insulation. This means that the losses of useable headroom can be kept to a minimum.The system is also cost effective due to fast installation and energy cost savings.

Safe and leak-proof in the long term

Expansion possibilities and enlargement of floor spaces may come from annexes, storage space under pitched roofs and basement rooms. Modern waterproofing and insulation technologies allow for the conversion of basements into living spaces. The use of FOAMGLAS® insulation systems, for the interior allows owners and architects to achieve design and performance objectives.

FOAMGLAS® insulation turns to account

Regerdless of the application, FOAMGLAS® cellular glass insulation ensures a durable solution. Ceilings, walls and floors furnished with the correctly applied insulation are impermeable to moisture: from both the outside, and inside. Even under extreme conditions, as wet rooms, the system is extremly reliable. Shower rooms in schools and gyms for example, can perform after 20 years and more without any deterioration and needs for repair. Which other insulation product can claim this?

Protection of building structure

The best building investment is to use construction materials and systems providing a long service life. To achieve the highest efficiency, the following criteria should be considered for a building project:

- **Operating costs (especially energy)**
- **Costs for maintenance- / and long-term maintenance of value**
- **Amortization / renewal cycles**
- **Assessment of damage risks.**

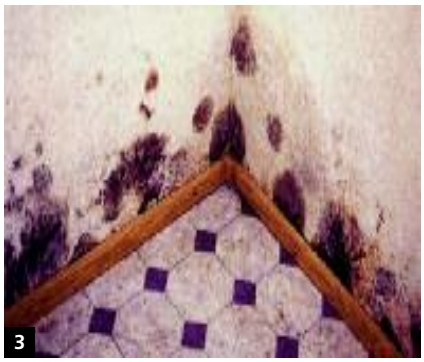
It cannot be overstated: Due to its outstanding product characteristics, FOAMGLAS® insulation provides the optimal insulation solution for the longevity and protection of the building investment.

3 Showers – FOAMGLAS® insulation protects against leaks
4 Training room in the basement
5 Trois Couronnes Hotel in Vevey, Switzerland
6 Beyeler Museum, Riehen

1 Iramali Kindergarten, in Balzers, Switzerland
2-4 Mould infestation in living rooms and wet rooms

Well-designed – healthy living environment

Today, people spend much more time indoors in their house than outdoors. This is why the issues of wellbeing have become a question of vital importance. There is a great demand for information on residential biology or residential hygiene. To contribute to good residential hygiene, proper heating, cooling and ventilation, free from dust and radiation, is the key. FOAMGLAS® insulation – a product without adverse impact on health and the environment reduces the risks of potential household hazards such as moulds and radon radiation.



Pull the plug on moulds

Mould infestation can become a serious problem in occupied buildings. It does not only infringe on the appearance of the rooms, but also on the health of the occupier. In general, old and renovated buildings can be affected by mould. The prime cause is too high of a moisture level coupled with too low surface temperatures at the inside of external walls. In this case,

FOAMGLAS® interior insulation is a corrective solution. The insulation contributes to a rise in temperature on the interior face of the enclosure wall. Condensate does not form, and the development potential for moulds is eliminated. This means healthier home living, better hygiene conditions for the building itself and a better quality of life. With comparably low efforts, a great beneficial effect is achieved.

What is radon?

Radon is a radioactive gas formed in the ground by decay of naturally occurring uranium. It is dangerous for people because of its disintegration products which, by breathing, accumulate in the lungs. As uranium can be found in many parts of the Earth's crust, radon is also released from the soil.

Which effect does radon have?

By breathing radon enters the lungs and exposes them to radiation, which means that the risks for pulmonary cancer are increased.

Which radon levels are tolerated?

For new construction and refurbishment, a radon concentration level of 400 becquerel / m³ (Bq / m³) is stipulated. For higher concentrations, the Federal Office for Health (Switzerland) recommends measures to reduce the radon levels in homes. Nobody should be exposed in the long term to radon concentration levels above 1000 Bq / m³. Retrofit measures are compulsory for the following limit values:

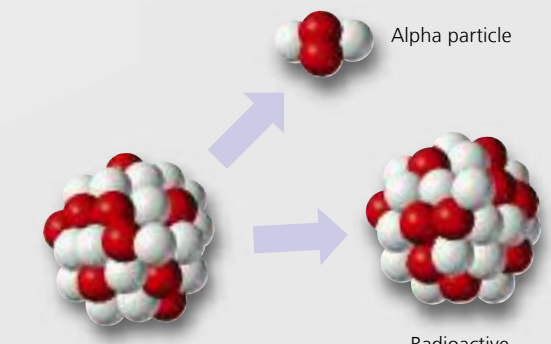
- **Living spaces 1000 Bq / m³**
- **Workspaces 3000 Bq / m³**

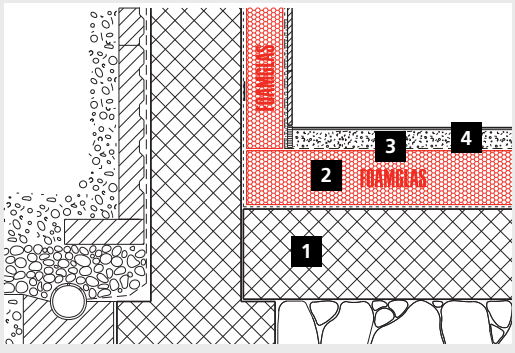
Radon may enter buildings through leaks and cracks in the foundation or the brickwork. What many people do not know: it is the second most common cause for lung cancer. With FOAMGLAS® insulation placed without interruptions and joints sealed on walls and floors of the basement level, the radon problem can be solved. This constructive measure allows the reduction of more than 95 % of the radon exposure. No other solution provides the twin effect of optimum protection against radioactive radon and heat loss at the same time.

A way to healthier living and indoor area hygiene

For the preservation of health, a conscientious selection of materials, which are ecologically safe, is most important. FOAMGLAS® insulation is such a product. Cellular glass insulation meets the requirements and contributes to good residential hygiene, comfortable temperatures, wellbeing and healthy

5 Radon, a radioactive gas, is considered to be a health hazard





1 Foundation slab
2 FOAMGLAS® insulation
3 Separating layer
4 Subfloor

living. The product does not release toxic or harmful pollutants into the environment.

Recommended for indoor area hygiene

FOAMGLAS® insulation does not emit harmful substances like formaldehyde, styrene, fire or flame retardants, fibers and so on. Cellular glass meets high safety and environmental standards and does not contain any alkyl halides (CFCs/HCFCs/HFCs).

As FOAMGLAS® insulation is considered to exert no adverse impacts on health and the environment, the insulation offers the perfect solution for rooms which are subject to the most demanding clean air requirements (museums, hospitals, schools, offices, waiting rooms, high-tech production sites etc.). It is ideal for all living and workspaces, because a healthy living environment is vital.

After field research by the World Health Organisation, more than 30 % of employees working in air-conditioned offices suffer from the so-called "sick-building-syndrome" with accompanying symptoms including: headache, mucosal irritation, fatigue or feeling of discomfort with dry air.

The following pollutants may be the cause:	**Emission sources (among others):**
Formaldehyde	chipboards, plastic foams
Solvents	paints, varnishes, coatings
Benzo4 Toluol, Xylole	paints, varnishes, adhesives
Pesticides, biocides	wood preservatives, chipboards
Polychlorinated biphenyls (PCBs)	fire retardant impregnations
Isocyanates	spray in place soft foam insulation, insulation boards
Asbestos	insulation and protection boards, foams
Proliferation of microorganisms	air conditioning systems, wet walls and surfaces

6 Avry-Shopping Centre, Avry-sur-Matran (CH)
7 Zurich-Kloten Airport, Terminal E

6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Fire prevention

Heated discussions have arisen about the responsibilities regarding fire prevention. One of the key issues is the role of thermal insulation. Field research makes this clear: FOAMGLAS® insulation can make a significant contribution to fire safety and control. It is not only non-combustible, but it does not contribute to fumes or toxic smoke.

Prevention starts with the right choice of materials

Fire disaster, Indication that fire safety prescriptions were grossly violated, Rapid spread of the fire was facilitated, A sea of flames: Headlines of this type bring home the message: Despite fire safety planing, in many buildings it is very difficult to conduct fire-fighting operations.

Because of this it is essential to be attentive to fire prevention. By choosing adequate construction materials and systems, the risks of fire propagation and the spread of fire via voids and flammable materials can be significantly reduced. FOAMGLAS® insulation, the safe cellular glass insulation solution, has achieved this in many cases.

A fire hazard – smouldering fires

Fires of this nature generally develop inside a construction unit and may go undetected for a long time. Sometimes hours can pass between covert ignition and blazing of the fire. The specific structural and chemical characteristics

1 Fire and toxic gases: The fire disaster at Düsseldorf Airport caused 17 casualties
2 Extra hazardous: Fumes and toxic effluents

of many insulants increase the risk of smouldering fires. **With FOAMGLAS® insulation the closed-cell geometry of the all glass insulation creates an efficient barrier to the effects of air flow.**

Plastic foam insulation, polystyrene or polyurethane for instance, has considerable ignition potential. This leads to burning, dripping and dropping material. In public buildings and meeting places such as office buildings, hotels and restaurants, the use of inflammable material should be prohibited.

FOAMGLAS® insulation:
No fumes, no fire, no smoke

It must not always be a "sea of flames" when there is talk about fire disasters. Have a flashback to the events on Düsseldorf Airport (1995) with 17 casualties and the fire in the Montblanc Highway Tunnel (1999), which caused the death of 39 people. In both cases toxic effluents from insulation materials, that were not fire safe, were considered responsible for the fatality (polystyrene in Düsseldorf, polyurethane at the Montblanc rock).

By contrast FOAMGLAS® insulation, does not give off fumes or toxic gases. Regarding fire safety FOAMGLAS® insulation performs unlike other insulation materials which are classified as non-flammable. One of the issues is that FOAMGLAS® insulation does not glow or smoulder, and accordingly, reduces the risks of fire spread.

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 glas 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.

3 Conclusion after test procedure: FOAMGLAS® melting point > 1000 °C

3

FOAMGLAS®
insulation offers superior fire-safety performance

- **FOAMGLAS® insulation is a safer insulation product as it is made of totaly non-combustible cellular glass. Reaction to fire classification: Non-combustible, EN standard, Euro Class A1.**
- **Closed cell FOAMGLAS® insulation prevents oxygen from passing through the material to tease the ignition source.**
- **FOAMGLAS® insulation is gas-tight. The passage of hot gases through the insulation and their development inside the insulation is nonexistent. FOAMGLAS® insulation is a safety insulation that forms a barrier against the spread of fire.**

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 60 %+ 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_2) 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

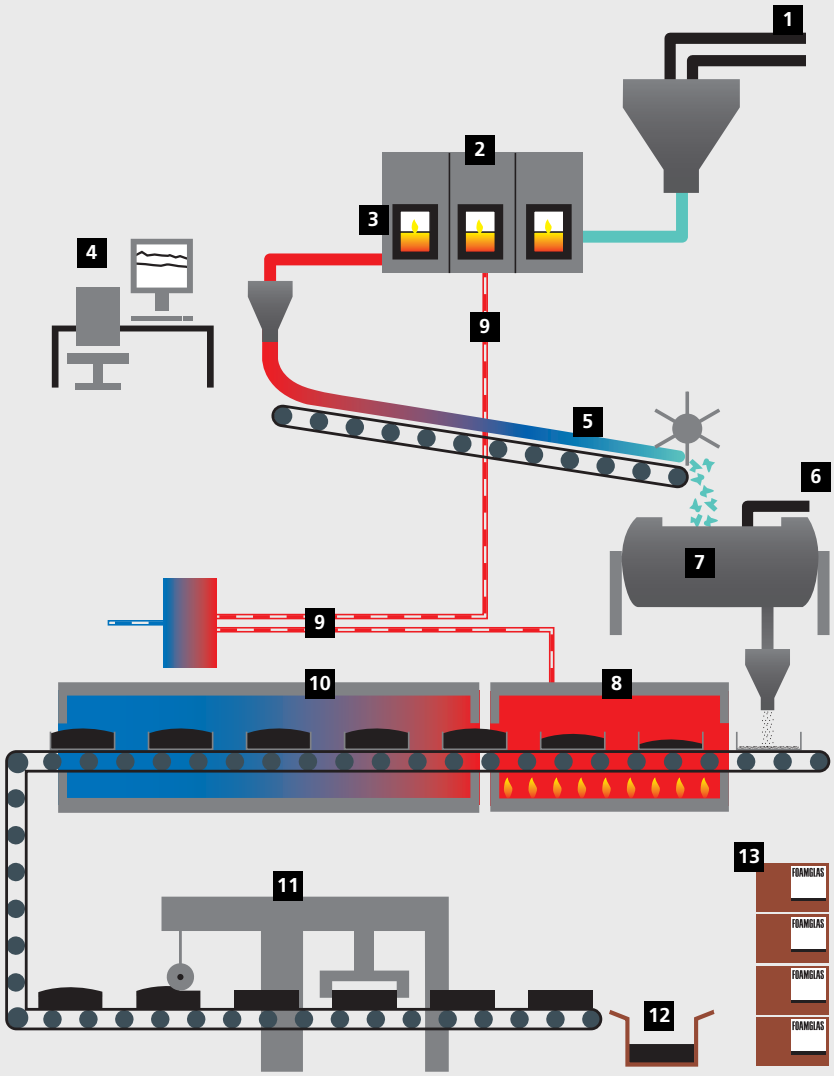
Due to improvements in process engineering and in the energy supply (coming from hydro electric energy and wind turbines) significant progresses has been achieved in recent years regarding air pollution, greenhouse gas emissions, consumption of energy and resources:

- **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 60 %.**
- **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 melting 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 Addition of "carbon black".

7 Ball mill grounds all ingredients into a fine powder before putting into stainless steel moulds.

8 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.

9 Energy recovery of heat.

10 The FOAMGLAS® blocks pass through an annealing oven to allow carefully controlled cooling of them without thermal stress.

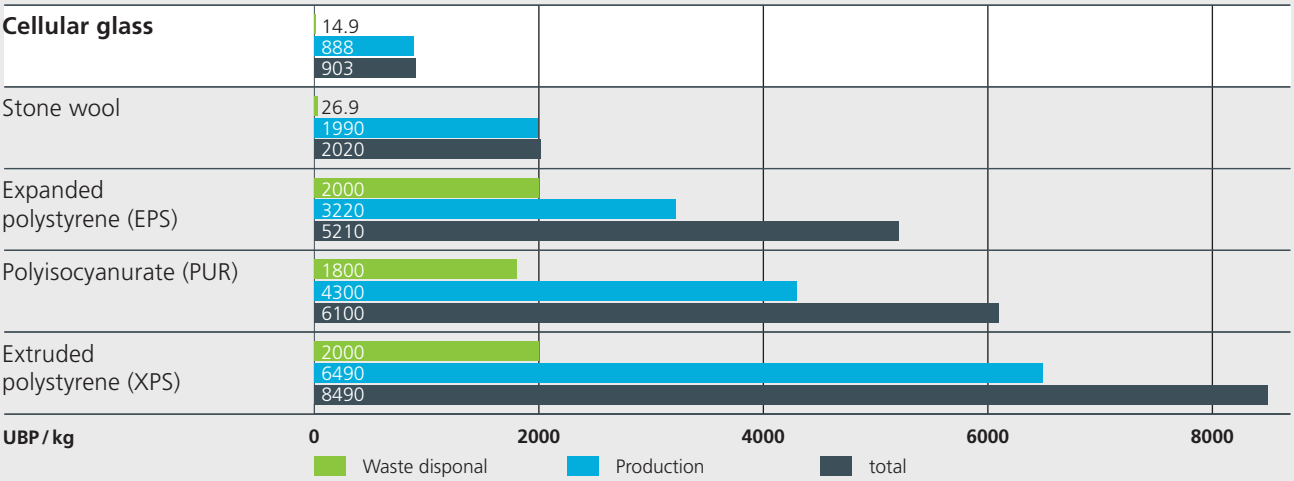
11 The blocks are cut to size and sorted by batch. Production waste is recycled.

12 FOAMGLAS® slabs are then packaged, labelled and palletized.

13 Finished FOAMGLAS® products are stored and prepared for transport.

FOAMGLAS® stands comparison

The environemental 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/m²K, 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	?	?D*	d	weight per m²	UBP* per kg	UBP per m²
	kg / m³	W / mK	m	kg / m²	UBP / kg	UBP / m²
FOAMGLAS® T4+	**115**	**0.041**	**0.21**	**24.15**	**903**	**~ 21 807**
FOAMGLAS® W+F	**100**	**0.038**	**0.19**	**19.00**	**903**	**~ 17 157**
Polyisocyanorate (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 environemental 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 selected recycled glass (in the past the main raw material was silica sand). The supplies 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.

FOAMGLAS® cellular glass insulation products now with natureplus label

Natureplus, an international organisation for the development of a culture of sustainability within the building sector, has selected cellular glass thermal insulation from Pittsburgh Corning Europe SA as a green building product and awarded the natureplus quality label. "Cellular glass thermal insulation by Pittsburgh Corning Europe SA ideally meets the quality requirements for a sustainable construction product", noted Uwe Welteke-Fabricius, president of natureplus e.V., when handing-in the certificate. The natureplus quality seal is the symbol of recognition for building products with a high level of quality in the areas of health, the environment and functionality. Pittsburgh Corning's FOAMGLAS® types W+F, T4+, S3 and F from the Tessenderlo plant (Belgium) are tested and certified successfully.

Service life

Having outstanding qualities (mineral, impermeable to water and vapor, resistant 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 building. 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 environment. 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 instructions are followed, cellular glass insulation 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 environment, even in small quantities. In particular plastic foam materials are classified as harmful. In the case of burning of these materials high levels dangerous emissions are released than in combustion 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 combustion in a waste incineration plant, there is high impact to the environment, 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.

natureplus – The European quality seal for approved green building products.

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							
Stone wool							
Cellulose insulation							
Pure expanded cork							
Expanded polystyrene							
Extruded polystyrene							
Polyurethane (PUR)							
FOAMGLAS®							

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 umweltvertraglich Dammen.] 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 60 %+ 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.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3 The percentage of recycling glass in the FOAMGLAS® production is from 30 to 60 %.
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

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