

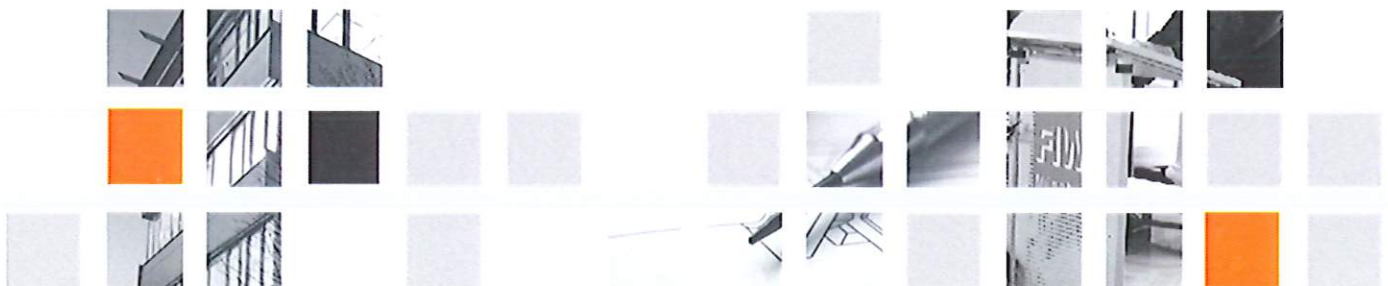
## **Case study: Durability of cellular glass in building applications – Testing of Foamglas® insulation**

### **Sampling: Hospital in Kristianstad, Sweden (flat roof built in 1973)**

Max Engelhardt

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Responsibility for the content of the report lies with the authors.



# **FIW München**

**Report: E3.3-2017/09a**





Notified body for testing, surveillance and certification of building materials and components  
Research and development in the field of heat and moisture protection



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This report includes

10 pages  
4 figures  
2 tables

Gräfelfing, 21 December 2017

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## 1 Introduction

This summary gives a short review on one of many sampling and testing operations conducted in 2017 which is part of an ongoing study on durability of cellular glass for Pittsburgh Corning Europe. General aim of the study is to increase the knowledge about the long-term behaviour of cellular glass insulation in different types of building applications and determining factors influencing the stability and expected useful life. The project focuses on specific applications for building insulation materials e.g. external wall and flat roof insulation.

The building site of the herein described sampling operation was selected by the applicant. The sampling procedure was supervised by a third party commissioner.



Figure 1: View of the probed building / flat roof construction

## 2 Sampling operation

FOAMGLAS® insulation material was sampled by the applicant under third party supervision from the flat roof of the hospital "CSK – Centralsjukhuset Kristianstad" in Kristianstad, Sweden on 13<sup>th</sup> of June 2017.

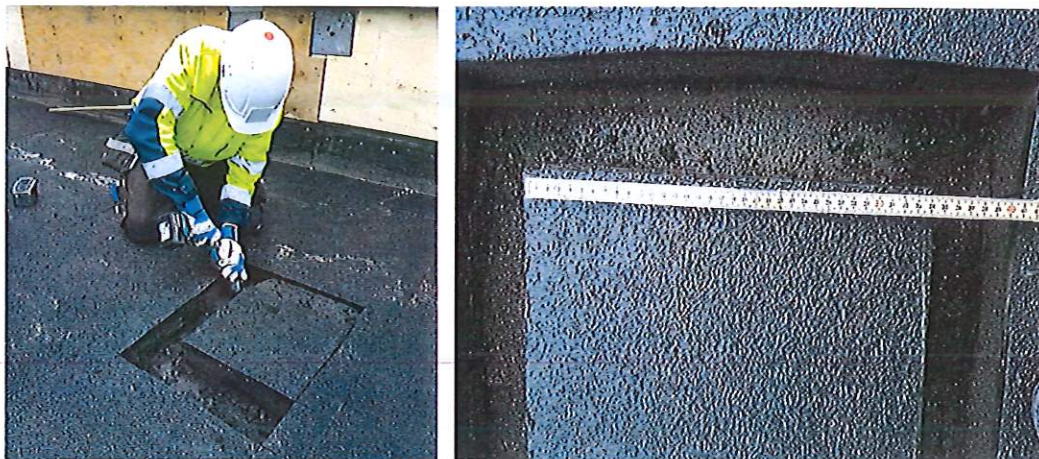


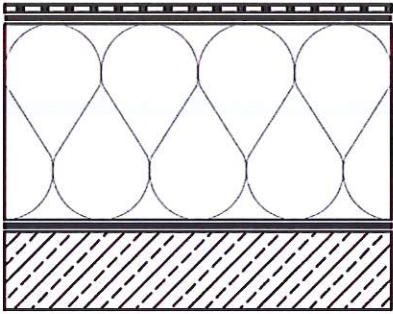
Figure 2: During the sampling operation on site

The sampling operation was conducted following a comprehensive sampling guideline issued by FIW. This guideline defines the standards of operation within the project for third parties, assigned by Pittsburgh Corning to supervise and document a sampling operation of cellular glass specimens. It includes instructions for the inspections of buildings and FOAMGLAS® cellular glass products, the documentation, sampling, and shipping.

The guideline provides instructions and templates for the assigned sampling commissioners to meet the project's specifications and to harmonize the procedures for all inspections/samplings. Necessary data, which has to be gathered on site and manners of documentation for a proper evaluation within the framework of the ongoing durability study, is specified.

Important sampling documentation information on the building, the product, and construction gathered by the sampling commissioner (as stated by the applicant) is summarized below.

**Table 1: Sampling operation in Kristianstad, Sweden (based on sampling protocol)**

Building	CSK – Centralsjukhuset Kristianstad (hospital)
Location	J A Hedlunds väg 5 29185 Kristianstad Sweden
Year of construction	1973
Product	FOAMGLAS® S3 (50 mm) Cellular glass slabs 450 mm x 600 mm
Service Life	Since 1973 (43 years)
Sampling point	Top roof, normal heating assumed.
Construction build-up	<p>Compact roof build-up with 2 bitumen cover layers, underlayer and concrete substructure. Layers fully adhered to cellular glass. Cellular glass slabs are joined with bitumen.</p>  <p>2 layers bitumen roofing FOAMGLAS insulation bitumen roofing underlayer concrete substructure</p> <p>No slope.</p>
Condition	<p>The inspection showed an even surface, water accumulation and water stagnation. Membrane leakages caused water penetration at several places. Upper cells damaged due to freeze-thaw conditions. The concrete substructure was in good condition.</p>



### 3 Measurements

The samples were delivered in water- and vapor proof packaging to FIW München on 19<sup>th</sup> of June 2017 by the applicant. The laboratories at FIW performed several measurements on the specimens.



Figure 3: Sample as arrived in the FIW laboratories (left); specimens for measurement of compressive strength (right).

The thermal performance was determined in "as-is" condition as well as oven-dry condition in a "heat flow meter apparatus" according to ISO 8301.

The structural durability was assessed by measurement of compressive strength by means of a universal materials testing machine. The measurements were conducted according to the special requirements for cellular glass as stated in Annex A of DIN EN 826:2013.

Additionally moisture content and dry density of the samples were measured.

### 4 Results

The specimens from the flat roof of the hospital in Kristianstad, Sweden show the following quality characteristics:

Table 2: Results of measurement for FOAMGLAS® insulation installed 1973 in Kristianstad

<b>Thermal conductivity</b> (DIN EN 12667:2001-05)	0.053 W/(m·K) (condition as sampled) 0.052 W/(m·K) (dry condition)
<b>Compressive strength</b> (DIN EN 826:2013-05)	567 kPa (dry condition)
<b>Moisture content</b> (DIN EN ISO 12570:2013-09)	0.2 % by mass / 0.03 % by volume
<b>Density (oven-dry)</b> (EN 1602:2013-05)	128 kg/m <sup>3</sup>

## 5 Conclusion

According to our best knowledge from the time and location of the product installation (1973 in Sweden), for the sampled product no technical approval was valid or existent. In the country of manufacture (Belgium), the sampled product was approved by the Belgian "Institut National Du Logement", see technical approval N° 1074 of February 1971. It states a thermal conductivity for FOAMGLAS® S 3 of 0.042 kcal/m/K which equates to 0.049 W/(m·K) and a compressive strength of 500 kPa (according to the then valid standard ASTM C 240-61).


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<p>MEMBRE DE L'UNION EUROPÉENNE POUR L'AGRÉMENT TECHNIQUE DANS LA CONSTRUCTION (UEAtc)</p>	<p>TOITURES ISOLANTES</p> <p>FOAMGLAS®</p> <p>S.A. PITTSBURGH CORNING EUROPE avenue de Tervuren 32-38 1040 BRUXELLES (Tél. : 02/35.90.36, telex : 22277)</p>	<p>TOITURES DAKEN ROOFS</p> <p>DÉCISION N° 1074</p>

Figure 4: Header of Belgian technical approval for FOAMGLAS S3 valid 1973

Factory made cellular glass, is considered vapour tight and does in principal not absorb water, even after accidental contact during prolonged periods of time. Nevertheless surface water retention at the skin of the slabs can adsorb moisture. In fact the skin has cut cells, since the slabs are sawed within the production to its thickness & dimensions.

According the FOAMGLAS® installations rules for roofs or for building elements positioned between ambient environment and high-humidity environments, FOAMGLAS® shall always be installed in full adherence with closed joints. The applied glue and the sealants must have a high vapour resistance.

According to the inspection on site, it can be stated, that the sampled insulation material was exposed to moisture over long periods of time leading to moisture accumulation in the cellular glass boards. The assumed increase in thermal conductivity (compared to design value declared in above mentioned approval) is presumably caused by water penetration due to the unrenewed but damaged roof membrane.

Considering the stated period of use (43 years) the tested samples of cellular glass showed good thermal performance. The compressive strength of the samples was still higher than the value stated in the approval of 500 kPa.



## 6 Liability

Measurements results are valid only for the described materials, properties and dimensions. The report is based on the current knowledge from research in thermal transport. Liability can only be accepted within the scope of this knowledge.

Warranty for analysis results and expert opinions of FIW München e.V. is limited to the limitations of claim in § 634a BGB for buildings.



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