energocell®

PROPERTIES OF THE ENERGOCELL® FOAM GLASS GRANULES

Thermally insulating

The thermal insulation properties of the material are determined by the large quantities of air enclosed in its pores.

Compression-resistant

It can be used as load-bearing thermal insulation as well (see: Key Properties).

Shape-retaining

No deformation or shrinkage occurs, not even under long-term loading conditions.

Static stability enhancer

By applications in weak soils the load bearing capacity of these types of soils can be increased.

Lightweight

Concrete and stone rubbles are about 8 to 15 times heavier than the foam glass granules.

Capillary barrier effect

The particle-size distribution and the missing fine material particles ensure the capillary break effect. It's non-absorbent and non-swelling because of its closed-cell structure.

Frost-proof

Foam glass is a frost-proof material because of its closed-cell structure.

Non-combustible

The Energocell® foam glass is resistant to fire. Fire protection classification: A1 A1.

Pest-resistant

Rodents and insects do not establish themselves or cause damage in the foam glass.

Sound-insulating

Because of its sound-insulating property it can be used in the construction of noise-absorbent gabions.

Time- and cost-efficient

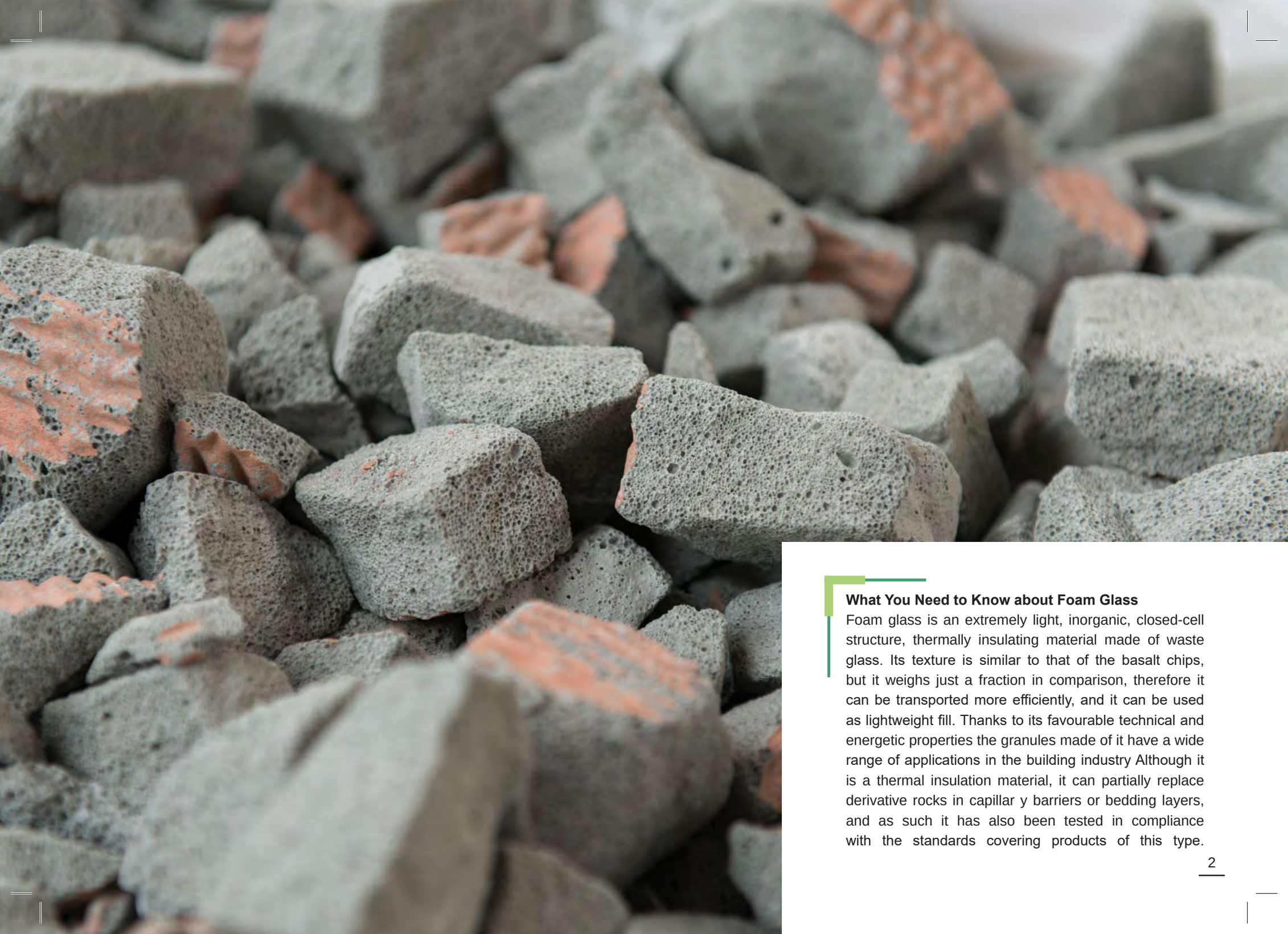
It can replace in a single layer both the gravel and the insulation material.

Environment-friendly

It does not contain toxic substances. It is produced by recycling from container glass waste raw material.

Inert

It does not undergo any physical, chemical or biological transformations. It is generally resistant to organic solvents, and acids.



What You Need to Know about Foam Glass

Foam glass is an extremely light, inorganic, closed-cell structure, thermally insulating material made of waste glass. Its texture is similar to that of the basalt chips, but it weighs just a fraction in comparison, therefore it can be transported more efficiently, and it can be used as lightweight fill. Thanks to its favourable technical and energetic properties the granules made of it have a wide range of applications in the building industry Although it is a thermal insulation material, it can partially replace derivative rocks in capillar y barriers or bedding layers, and as such it has also been tested in compliance with the standards covering products of this type.

KEY PROPERTIES

Thermal Insulation

The thermal conductivity coefficient of the compacted Energocell® is 0.086 W/mK, which means that the recommended 30-cm layer-thickness under buildings complies with the new energy requirements. For passive houses, depending on the dimensioning, the recommended compacted layer-thickness is about 40-50 cm.

Thermal conductivity coefficient	λ ≤ 0.086 W/mK

Water Absorption, Resistance to Freezing

The Energocell® foam glass granules have low water absorption capacity. This is a result of the closed-cell structure, and it means that the material is resistant to freezing.

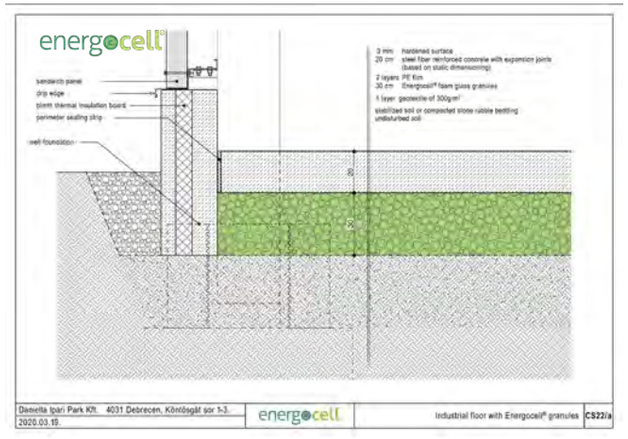
Water absorption (% by mass)	≤ 10.0% (m/m)
Water absorption (% by volume)	≤ 3.5% (v/v)
Resistance to freezing	F_1

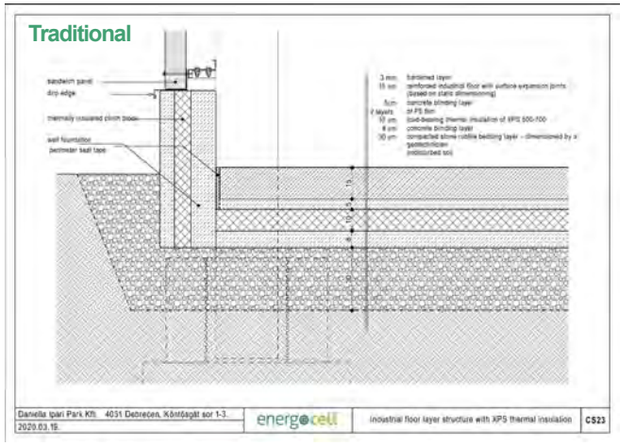
1,900 m² Hall – Pécs

Load-bearing Capacity

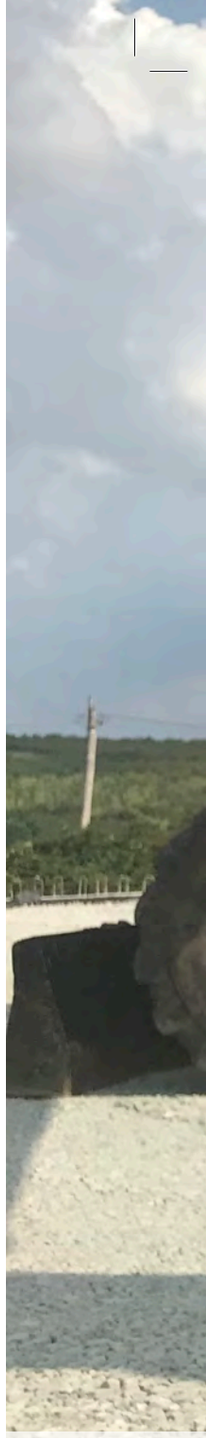
Based on the laboratory and the in-situ tests for the E2 modulus of load-bearing capacity of the material itself (150-175 kg/m³), at a compaction rate of 1.4, we have defined the following value: E2=40-50MPa. In industrial floor applications, the E2 value measured on the foam glass layer may be improved, if a bedding layer with a higher load-bearing capacity is placed under or on it. With the Energocell® granules industrial floors of extreme load bearing capacity can be built.

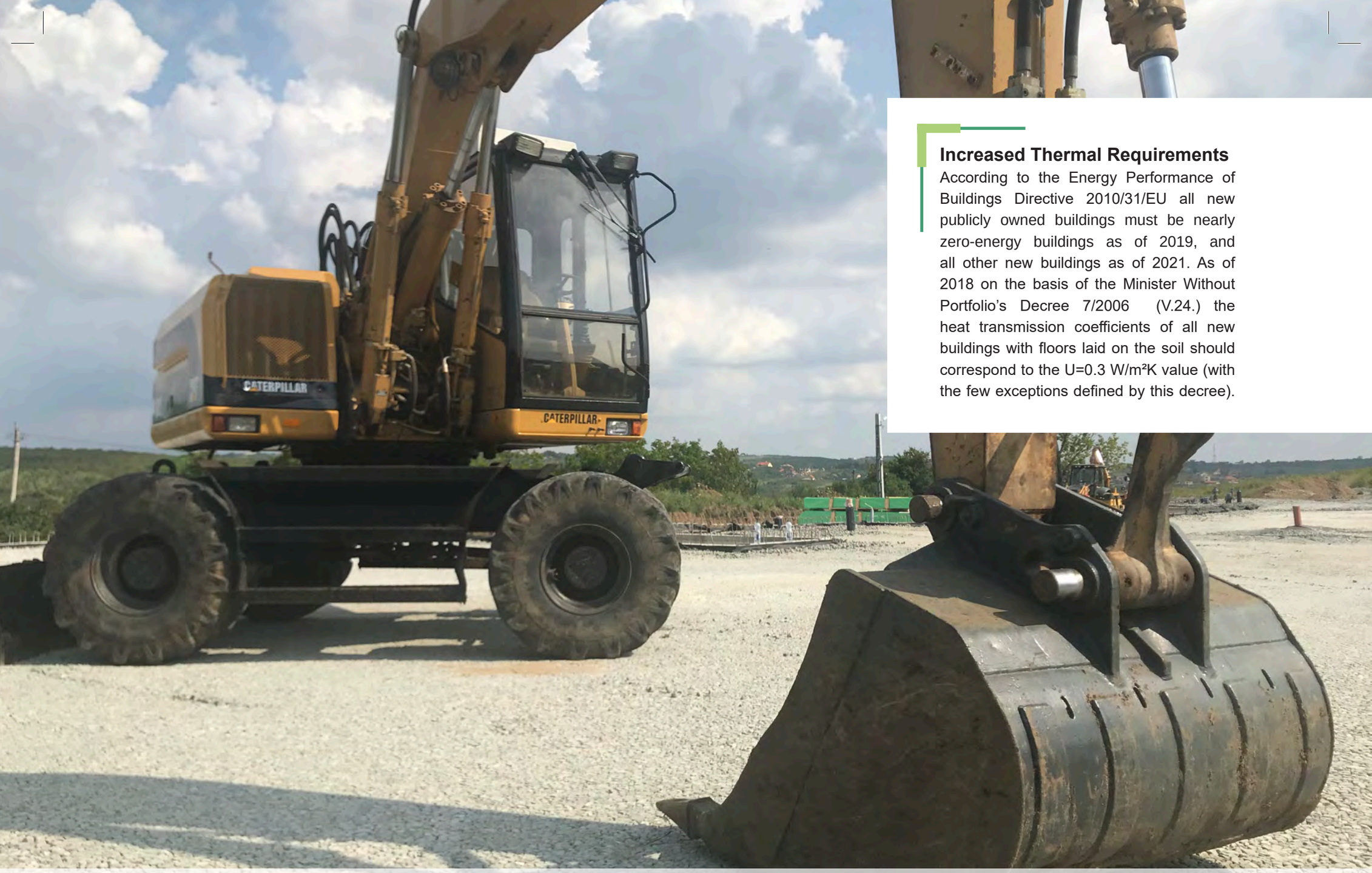
Load-bearing capacity [MPa] *(150-175 kg/m³)*	E_2 = 40-50 MPa





In addition to replacing polystyrene insulations, foam glass can also replace entirely or partially conventional stone rubble and gravel bedding layers – depending on the loads. *(For additional layer structures please refer to pages 23-24.)*





Increased Thermal Requirements

According to the Energy Performance of Buildings Directive 2010/31/EU all new publicly owned buildings must be nearly zero-energy buildings as of 2019, and all other new buildings as of 2021. As of 2018 on the basis of the Minister Without Portfolio's Decree 7/2006 (V.24.) the heat transmission coefficients of all new buildings with floors laid on the soil should correspond to the U=0.3 W/m²K value (with the few exceptions defined by this decree).

Smartware Office Building – Romania

APPLICATIONS OF THE ENERGOCELL® FOAM GLASS

Thermal Insulation

When used for thermal insulation purposes under residential buildings, it can generally replace the entire base layer.Because of its high load-bearing capacity it is an adequate solution for the thermal insulation of industrial floors. When used in flat roof or green roof structures it provides proper water drainage as well.

Lightweight Filling

Because of its low bulk density (150-175 kg/m³) it can be used as filling in floor structures – both in closing and intermediate slabs. In the development of parks on flat roofs, it is ideal for the compensation of the differences in level/ elevation of the growth mediums, and the reduction of loads imposed by the layer structures. In intermediate floor structures it can be used as filling for terraced slabs, and in building services installation housing layers.

Special Fields of Use

Due to its properties, Energocell® provides solutions for unique structural designs as well. These include thermal insulation bedding layers that are not developed for buildings, but for other types of structures, and constructions – like swimming pools, heated ramps. Being lightweight, but very similar to stone in its appearance, it can be used as sound-absorbent or decorative gabion filling too.

Industrial Halls *(pages 6-8)*

New and Old Buildings *(pages 9-12)*

Heritage Renovations *(pages 13-14)*

Floor and Roof Slab Fillings *(pages 15-16)*

Ramps *(page 17)*

Gabions *(pages 17-18)*

Swimming pools *(page 19)*

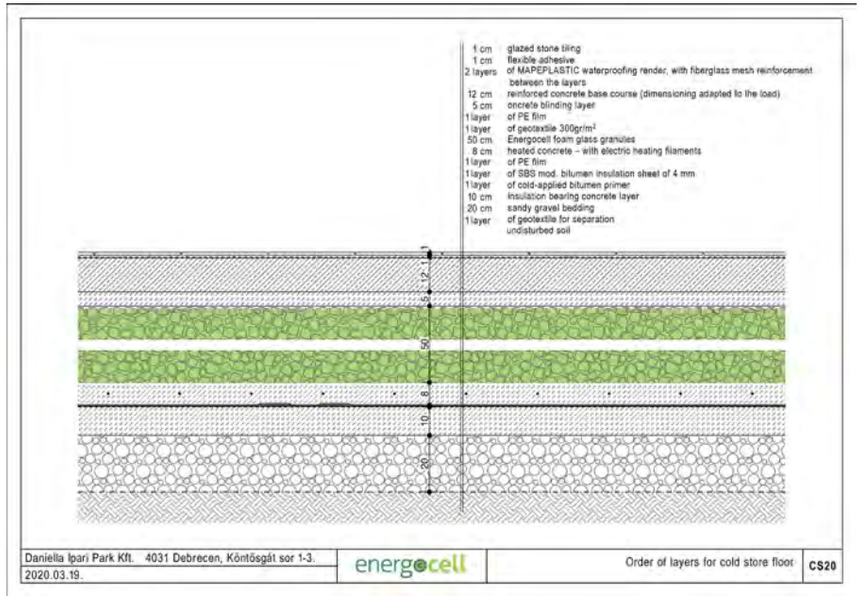
Sports fields *(pages 19-20)*

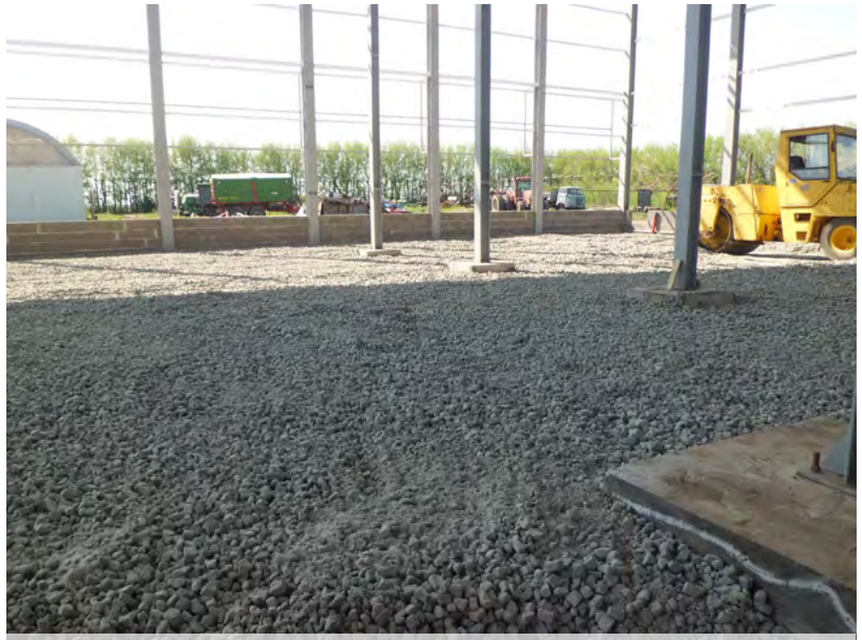
REFERENCE PROJECTS – INDUSTRIAL HALLS

Cold Stores

As for facilities with industrial floors, Energocell® assures a fast and cost-efficient solution for the thermal insulation of the cold store floor too.

Pharmaceutical Cold Store – Körmend

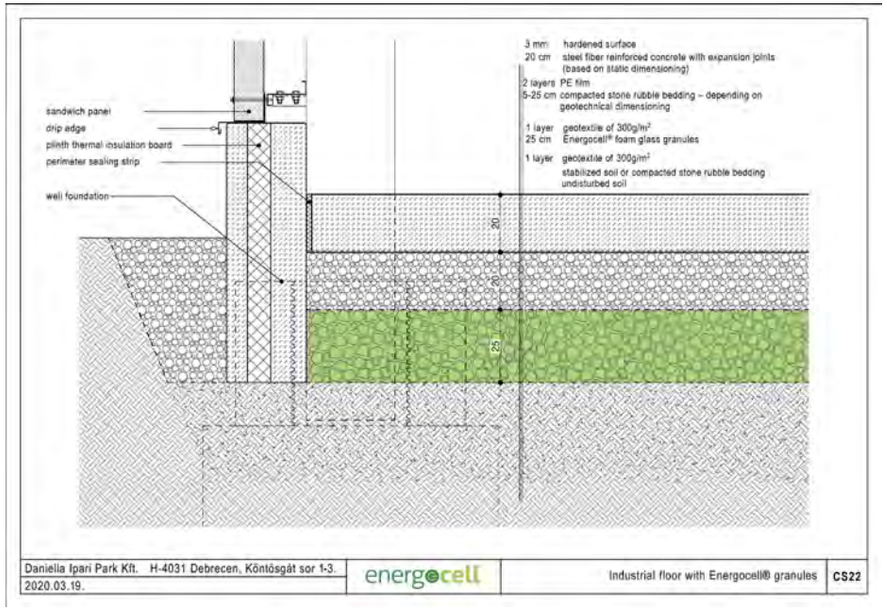




Cold Store – Derecske

Industrial Halls

By adequate compaction (at a rate of 1:1.4) a thermally insulating layer with high load-bearing capacity is created. In case of heavy floor loads, specifically industrial floors that are reinforced with steel or plastic fibre, Energocell® can be used to thermally insulate floors of almost any load-bearing capacity. The coarse-grained bedding layer of 15-20 cm or other required thickness placed on the foam glass can fulfil several functions. First, this protects mechanically the foam glass layer against the loads and mechanic impacts caused by circulation during construction works; second, it increases the load-bearing capacity of the foam glass layer; third, it reduces the stress generated by the floor loads and transmitted to the foam glass layer.

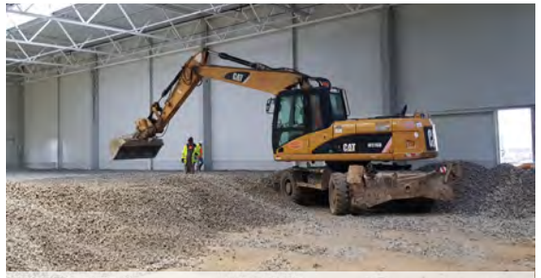


6,000 m² Hall – Pécs

Hübner Hall – Nyíregyháza

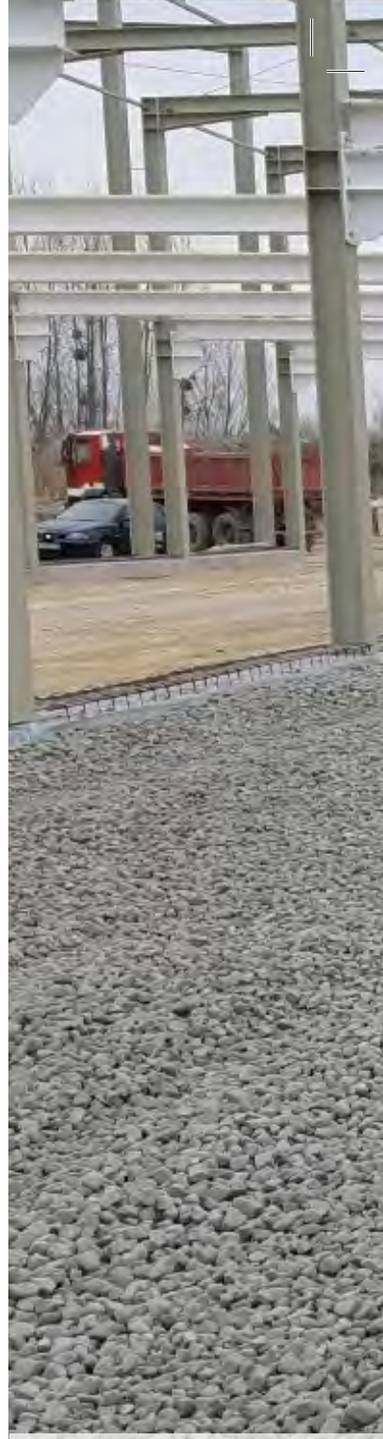
Otex Production Hall – Debrecen

R-M Logisztika Hall – Cserkút



New production hall – Devecser

New Hall – Oradea



New Intertech Hungary Production Hall – Kapuvár

Storage Space Extension at Laurastar Hungary – Kapuvár

Industrial Hall with Perimetral Insulation

Energocell® can be used in perimetral insulation applications as well. In these cases, the floor is usually insulated in a 1.5-2-m wide band along the building envelope. After the preparation of the stepped bedding layer the Energocell® foam glass granules are placed on it.

More industrial reference projects:
https://www.energocell.hu/ipari-csarnok/

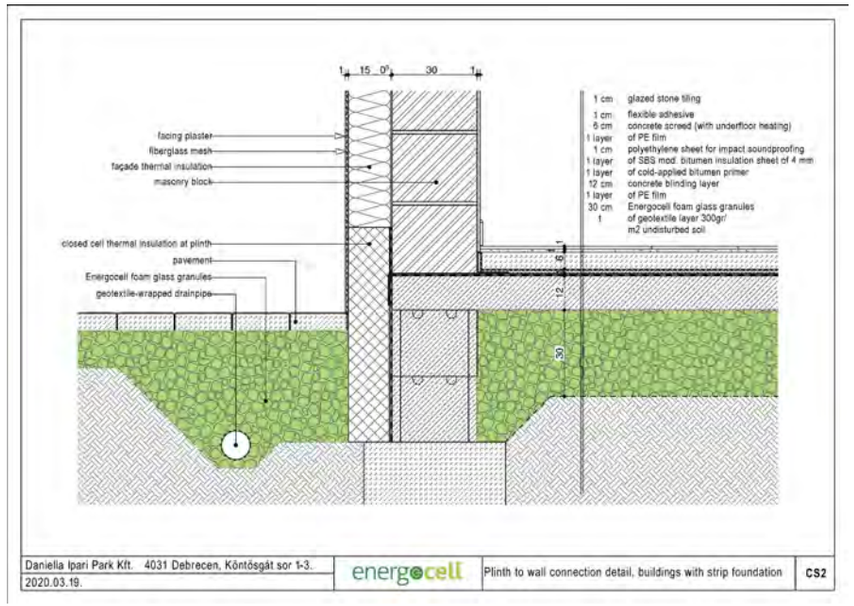
REFERENCE PROJECTS – NEW AND OLD BUILDINGS

Building with Strip Foundation

The granules can replace the stone rubble or the gravel layer under the concrete blinding layer, so that one layer of foam glass granules provides both the bedding and the thermal insulation under the floor. This way the polystyrene thermal insulation can be omitted, or its thickness can be reduced to a minimum (e. g. for service installations). This is a cost-efficient solution, since an entire work process is omitted.

Straw House – Győr

Family Home – Temesvár

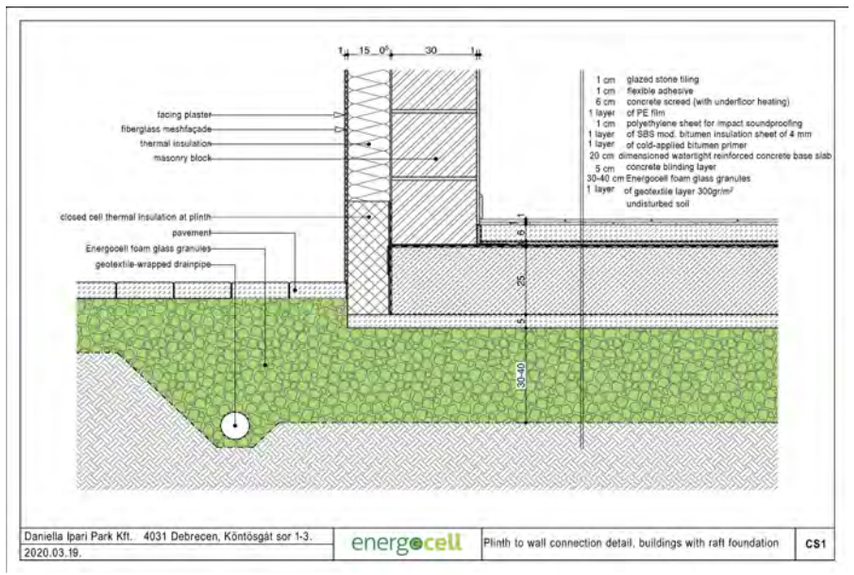


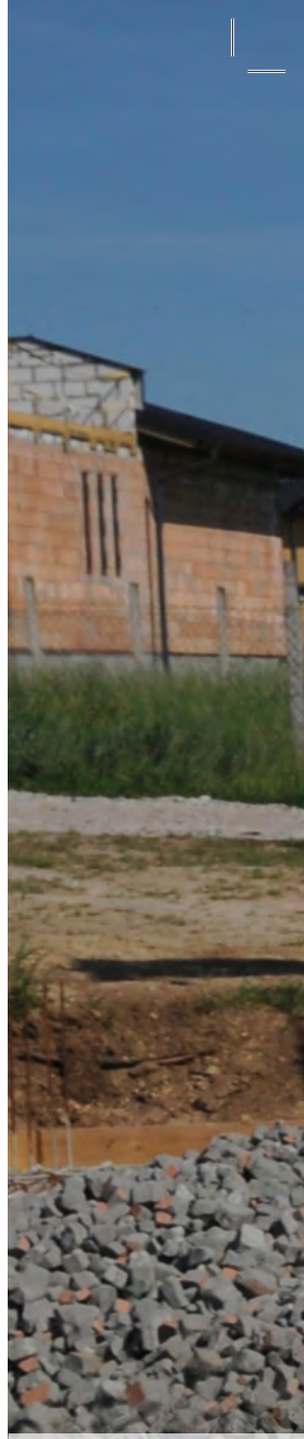
Building with Raft Foundation

Buildings on raft foundations can be provided with thermal bridge free insulation, if the insulation is incorporated under the foundation body. This is especially suitable for passive houses. In these applications only thermal insulation of increased compressive strength can be used under the foundation body. The thermal insulation bedding made of foam glass granules, compacted with a vibratory plate or a road roller is an adequate and cost-efficient solution for these constructions.

Single-family Home – Vecsés

Office Building – Hegyközszáldobágy





Fehérlófia Waldorf School and Preschool – Nemesvámos

Building with Spot Footing

In buildings with spot footing, the foam glass surrounding the foundation body, and the foam glass layer under the reinforced concrete grade beams reduces to a minimum the thermal bridging resulting from the foundation structure.

More References:
https://www.energocell.hu/referenciak/

Family Home with Strip Foundation – Sopron

Building with Basement

Under the basement area Energocell® is used in compacted state. Along the basement walls the filling fulfils drainage and thermal insulation purposes. In order to achieve efficient thermal insulation, construction of a drainage system around the building is recommended.

Single-family Home – Debrecen

Earth House, Dome House

Dome houses are generally environment- and energy-conscious buildings, therefore, thermal insulation made of recycled materials fits naturally into this system. The Energocell® foam glass granules are an ideal option for the thermal insulation of dome houses, because they are frost-proof, have closed cell structure, and capillary barrier effect. Each structure of the dome house envelope (floor, wall, roof) can be thermally insulated with the granules.
For separation from the soil geotextile needs to be used.

Single-family Home – Etyek

Single-family Home – Nyúl

Residential Building Renovations

In building renovations Energocell® is a good solution for the replacement of floor layers. The properly compacted foam glass layer of adequate thickness provides thermal insulation and provides a stable bedding for the blind concrete. Its further advantage is that where needed vapour permeable floor layers can also be made with it.

Single-family Home – Debrecen

Period Apartment – Debrecen

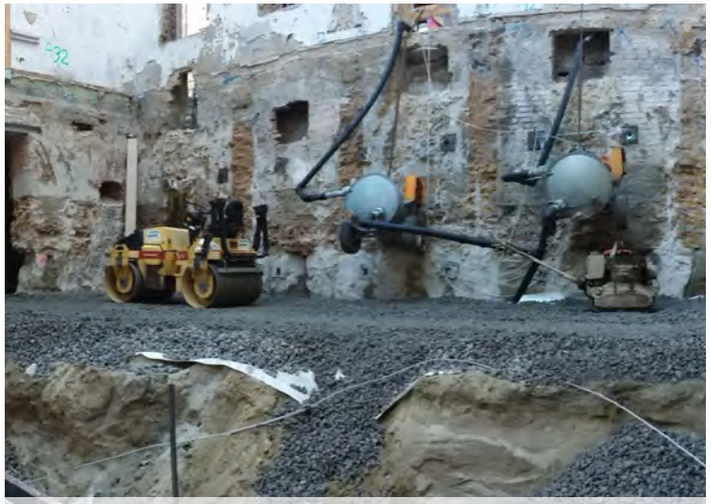
Apartment Building – Budapest

Adobe House – Erdősmecske

REFERENCE PROJECTS – HERITAGE RENOVATIONS

As it is a light material, the foam glass is suitable for filling the spaces above vaulted ceilings. Moreover, it can be used for the replacement of the floor layers laid on the soil, as a thermally insulating bedding, in which installation pipes may easily be lain.

Sándor-Metternich Castle – Baja



Károlyi-Csekonics Palace – Budapest

Szent András Hospital for Rheumatic Diseases – Hévíz

REFERENCE PROJECTS – FLOOR FILLING

Lightweight Fillings

Thanks to its light weight the material can be used as a filling in new buildings, for example in floors, and building service installation layers. In these applications, if the Energocell® layer is covered with an adequate screed, the compaction may be performed at a lower rate, or even manually.

József nádor Square – Budapest

Ferenc Puskás Stadium – Budapest

Etele Pláza Shopping Center – Budapest

Elite Apartment Park – Budapest

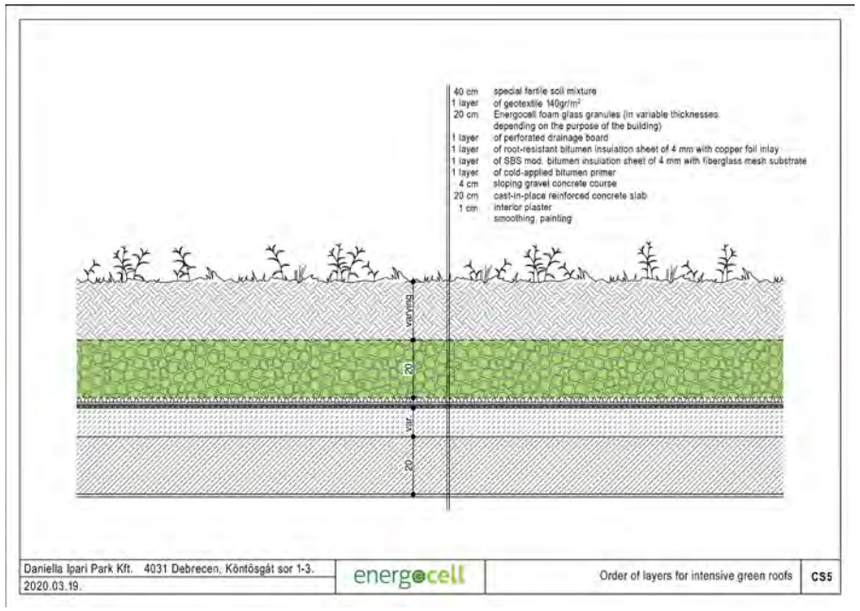
The House of Hungarian Music – Budapest

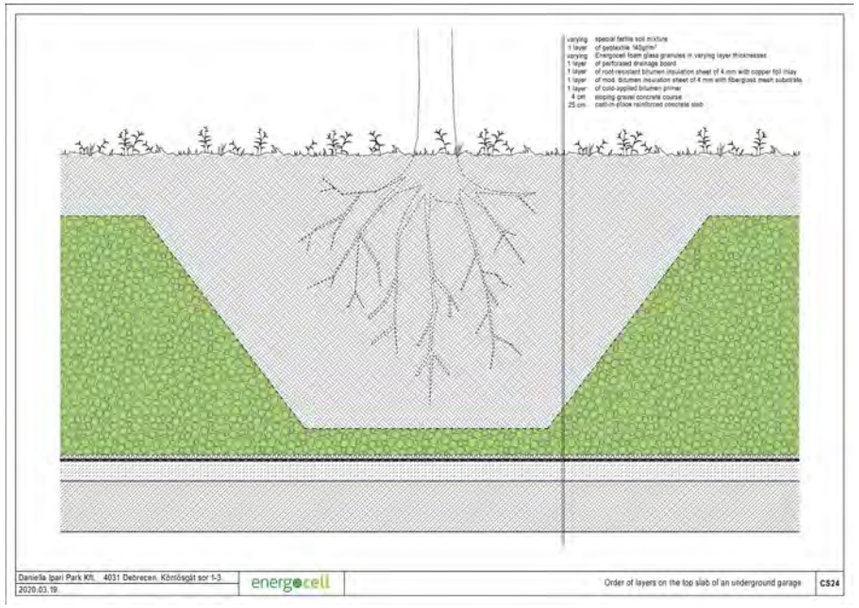
Green and Walkable Roofs

Our material can be used for the thermal insulation of green and walkable roofs. In these applications, when using bitumen sheets, the waterproofing needs to be protected. The walk surface (paving stones, pavement flags) needs a fine fraction bedding, separated from the foam glass layer by a geotextile. The granules can be incorporated in green roof structures for drainage purposes as well. To avoid the washing in of the planting medium placed on the granules, the use of a geotextile separation is recommended.

Luxury Apartment Building – Balatonberény

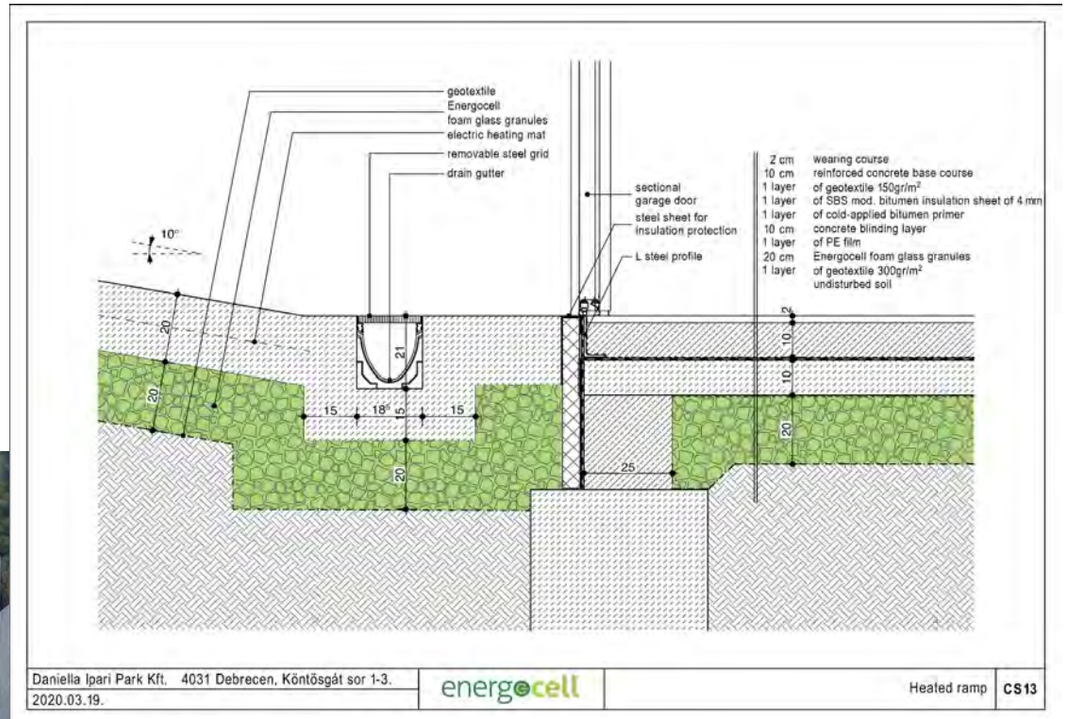
Underground Garage – Nagykanizsa





REFERENCE PROJECTS – RAMPS

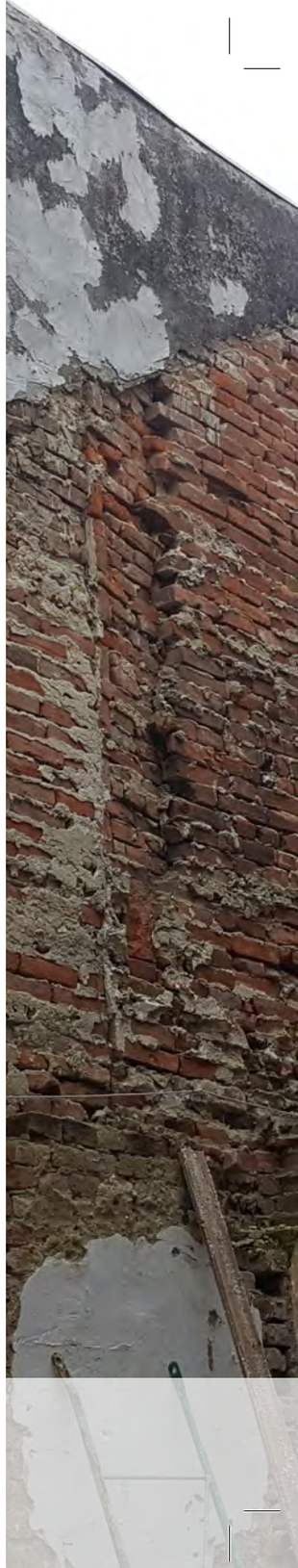
At a family house in Debrecen our material was incorporated under the basement garage access ramp. The 20-cm compacted foam glass layer ensures the more efficient heating of the ramp.



Garage ramp – Debrecen-Pallag

REFERENCE PROJECTS – GABIONS

Due to its relatively large and homogeneous granule size (40-60 mm) it is suitable for gabion filling. These applications are supported by the ultralight weight (150-175 kg/m³) of the material, which makes incorporation much easier. Also, due to the close-cell structure of the foam glass the gabion structures made with it attain sound absorbing properties.



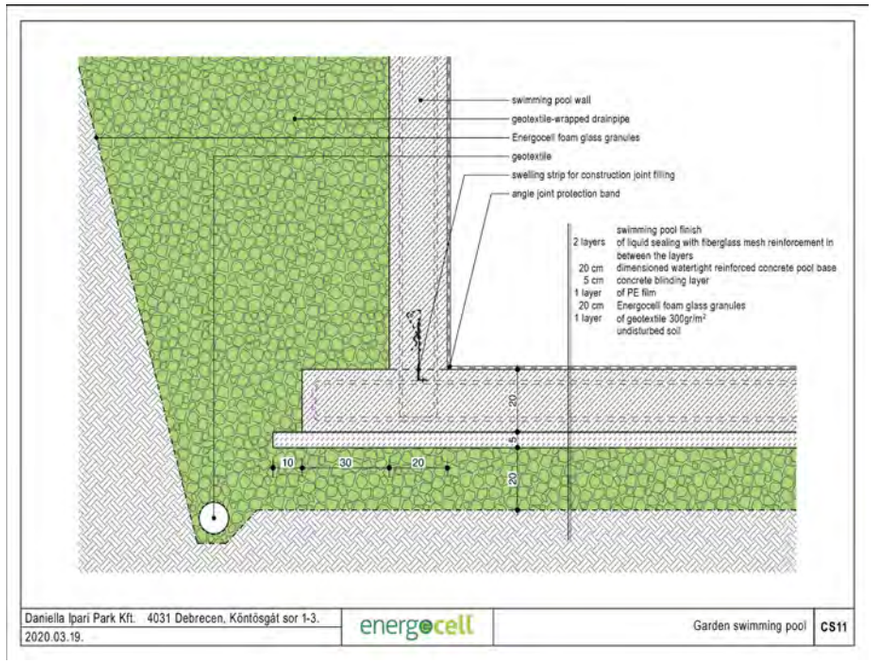
Facade Covering – Nagykanizsa (before and after)

REFERENCE PROJECTS – SWIMMING POOLS

The thermal insulation of the pool structure is highly recommended in the case of warm pools. In addition to this the Energocell® can also be used as a replacement of the pool bedding. Also, if foam glass is used as backfill around the retaining walls, it not only insulates the pool, but also prevents subsidence, because with Energocell® settlement over time can be excluded, and the pavement around the pool subsides neither.

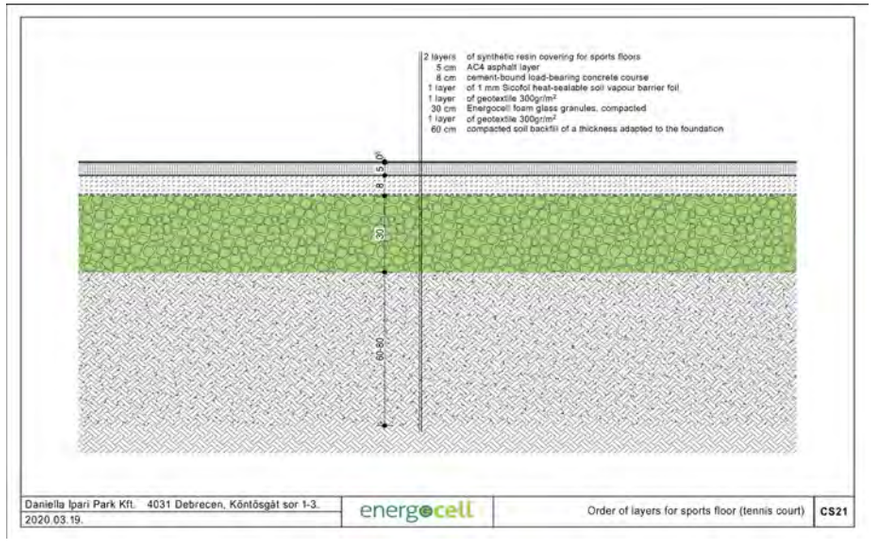
Swimming Pool – Temesvár

Swimming Pool – Hegyközszáldobágy



REFERENCE PROJECTS – Sports Fields

The large floor surfaces of sports facilities can be insulated faster with foam glass granules than with the conventional polystyrene boards. The base layer and the thermal insulation are finished in this application too in one work process.



Tennis Centre – Debrecen

WORKABILITY STUDY

The EFERTE Mérnöki Tanácsadó és Szolgáltató Kft. (Hungarian engineering service and consultancy firm) conducted a study for our company, to determine the elasticity modulus of the Energocell® foam glass, and to assess its workability. As agreed, our partner performed the following:

1. Assessment of the elasticity modulus of the foam glass granule (150-175 kg/m³) material.
2. Laboratory test for assessment of deformation and break-up caused by static and dynamic loads. Conduction of 10 unconfined compression tests, 10 compression tests and 9 dynamic triaxial tests in the laboratory on prismatic specimens.
3. Assessment of the elasticity modulus of foam glass granule material assembly. Conduction of 10 unconfined compression tests, 12 compression tests and 9 dynamic triaxial tests in the laboratory on assembly of particles.
4. Preparation of the workability study.
   Conducting on-site load-bearing capacity measurements by plate-load testing, and particle size distribution tests.
   Preparation of extensive modelling assessment by using 4 types of compaction equipment (vibratory plate, footpath roller, vibratory roller and rubber roller), to assess the efficiency of each equipment regarding incorporation, and the break-up caused by incorporation.

The assessment consists of testing the effect of stone rubble cover layer incorporation – the stone rubble covering is incorporated on the foam glass layer in two separate layers, to assess its effect regarding load-bearing capacity improvement and break-up reduction. EFERTE subcontracts the Department of Engineering Geology and Geotechnics at the Faculty of Civil Engineering of the Budapest University of Technology and Economics for the evaluation of the laboratory tests and results. In the study numerous laboratory and on-site tests have been performed.

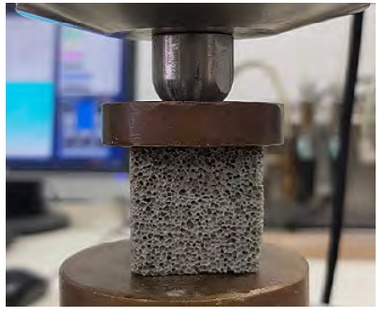
Pictures of the incorporations and the equipment used for workability testing:

The spreading of the foam glass with an excavator

Combination vibratory roller with steel drum shell

Footpath roller

Pictures of the workability testing:



Unconfined compression test of elementary prism

Compression test of material assembly

Performance of unconfined compression test on foam glass assembly

Compaction with combination vibratory roller

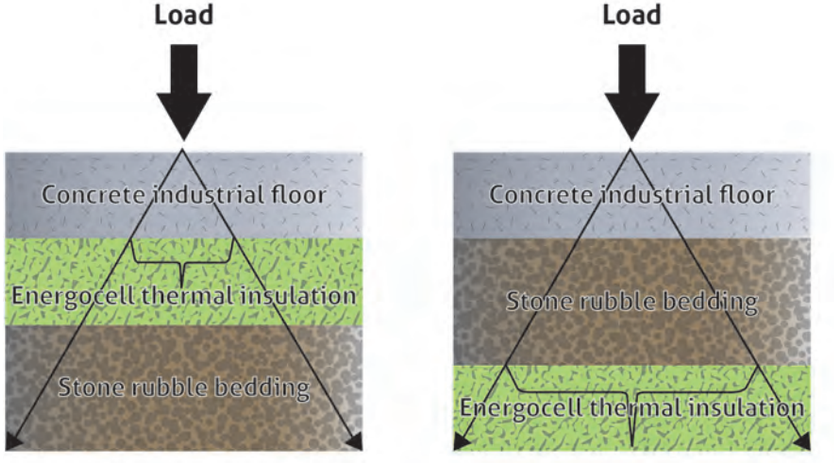
Heavy vibratory plate and light vibratory plate

View of compacted surface after excavation

Short summary:

Based on laboratory and on-site measurements, we have established, that the value of the E2 load-bearing capacity modulus of the 150-175 kg/m³ granular foam glass material is E2=40-50 MPa at a 1.4 applied compaction rate. We determined an approximate value of Tt~3.0 for the compaction factor to be expected on the top of the foam glass and the infill layer. The previously applied Tt~2.2 values, in the case of bedding layers built on foam glass, also remain applicable. To limit the loads imposed on the layer, and to create highly resistant, less compressible beddings under industrial floors, we recommend that the foam glass layer be covered with stone rubble or sandy gravel bedding.

First, this protects mechanically the foam glass layer against the loads and mechanic impacts caused by circulation during construction works; second, it increases the load-bearing capacity of the foam glass layer; third, it reduces the stress generated by the floor loads and transmitted to the foam glass layer, thereby the load capacity of the floor system can be significantly increased.



Prepared by:

FERTE MÉRNÖKI ÉS SZOLGÁLTATÓ KFT.

BUDAPESTI MŰSZAKI ÉS GAZDASÁGTUDOMÁNYI EGYETEM
Építőmérnöki Kar- építőmérnök képzés 1782 óta
GEOTECHNIKA ÉS MÉRNÖKGEOLÓGIA TANSZÉK

INSTALLATION GUIDE

Guaranteed durability of the foam glass can only be achieved if the material is properly incorporated, according to this guide. During the spreading of the foam glass granules there may be dust in the air and wearing a dust mask is recommended to prevent dust inhalation.

Soil Preparation

Preparation of the building pit and placing of the building service installation infrastructure according to the plans.

Geotextile Fabric Laying Process

It is recommended that the geotextile fabric be dimensioned and laid with at least 20-cm edges for overlapping, and enough to overlap the foam glass that extends beyond the building area.

The Spreading of the Foam Glass

Depending on the transportation method, the material can be spread directly from the big-bag or poured from the front-end loader. In order to attain proper compaction, the granules need to be spread in one or more layers of up to 20 cm. After compacting one layer the procedure is repeated until the final layer thickness is achieved.

Levelling Out the Layer

The easiest method for levelling is raking over the layer (in industrial halls rubber-tracked front-end loaders may be used). In order to obtain a levelled surface, a levelling instrument should be used.

Compaction

For compaction a vibratory plate (of 50-100 kg) or a roller (on larger surfaces) should be used. The recommended compaction rate is about 1:1.3-1.4. Higher compression ratios are recommended for higher load capacity.

Placing the Separation Layer and the Concrete

After compaction, a polyethylene separation membrane is laid on the foam glass, with about 20-cm edges for overlapping, to entrap the cement slurry.

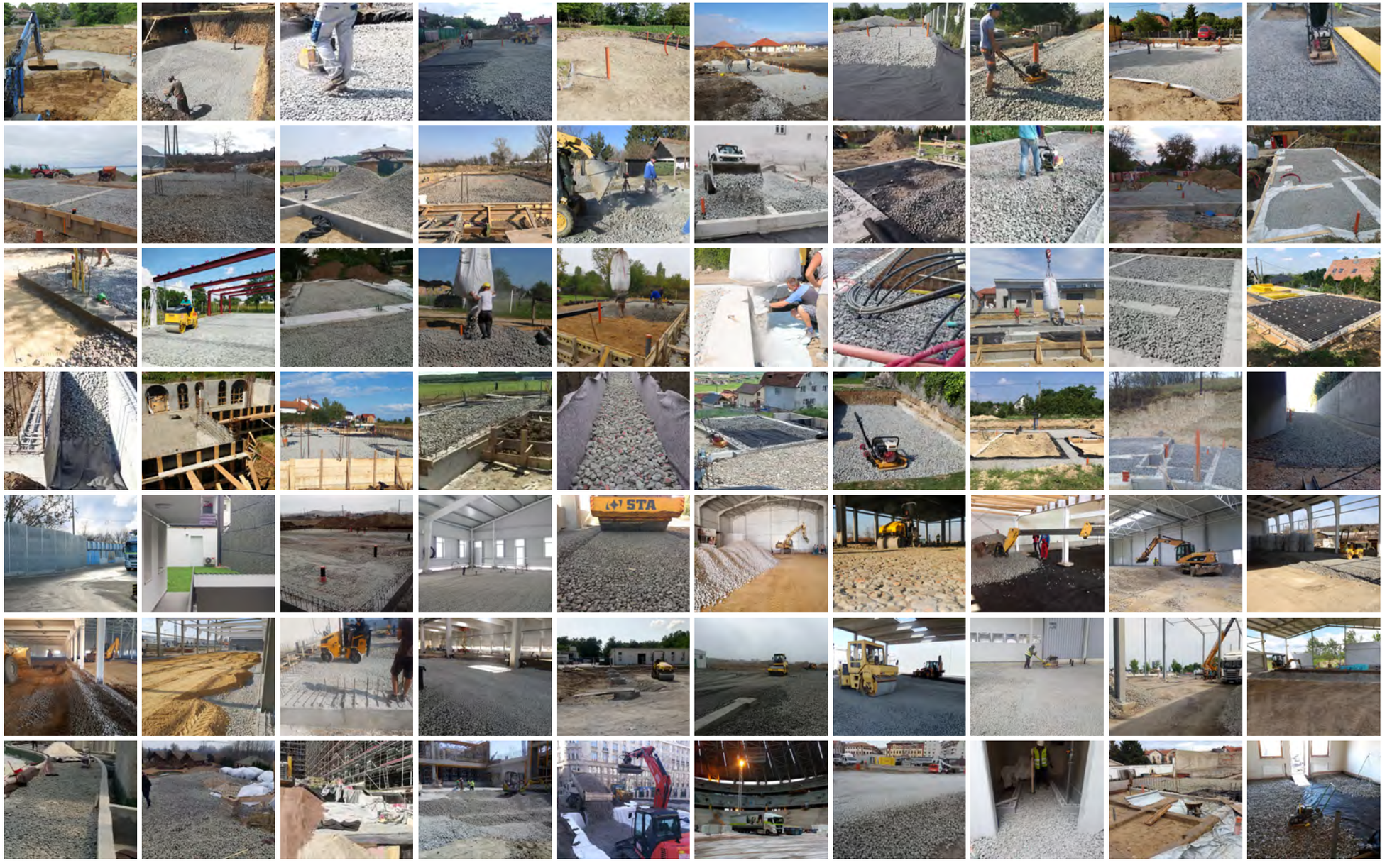
The concrete blinding layer is then placed on this membrane.

Observation:

In ground water or capillary zones directly above ground water Energocell® cannot be used! On the surface of the compacted layer rubber-tracked machinery may occasionally circulate.

Transportation

Deliveries are carried out with two heavy vehicles, a tipping semi-trailer of 80-m³ cargo capacity, and a moving-floor semi-trailer of 90-m³ cargo capacity (side loadable, suitable for palletized goods). Two types of delivery are available for the product sold: in bulk and in 3-m³ big bags with discharge spouts. If the granules are delivered in big bags, 20 bags fill one articulated vehicle, and in such packaging, they are sold with pallets.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ENERGOCELL®

THERMALLY INSULATING FOAM GLASS

The pictures you see here illustrate reference projects in which ENERGOCELL® foam glass granules were used.
You may find more references here: www.energocell.hu/referenciak

energocell.hu

DECLARATION OF PERFORMANCE

NO: TNY/05/2021	On the basis of Article 4 of Regulation (EU) No 305/211 of the European Parliament and of the Council, the Commission Decision No 99/91/EC, and the Government Decree No 275/2013.				
1.	Name of the product	ENERGOCELL GR factory made cellular glass granules			
2.	Type number	150-175			
3.	Intended uses	Thermal insulation, filler or bedding layer			
4.	Name of the manufacturer	Daniella Ipari Park Kft.; 4031 Debrecen, Köntösgát sor 1.-3.			
5.	Certification system according to Annex V of Regulation (EU) NO 305/211 of the European Parliament and of the Council:	System 3 ÉMI ÉPÍTÉSÜGYI MINŐSÉGELLENŐRZŐ INNOVÁCIÓS NONPROFIT KFT A-44/2017			
6.	Bulk density [kg/m³]	150-175			factory data
	Particle density [mg/m³]	ρ_a 0.31	ρ_{rd} 0.29	ρ_{ssd} 0.34	EN 1097 -6:2013
	Static load-bearing capacity modules				
	1 m thick compacted foam glass granule layer	E2 ≥ 50 N/mm²*			e-UT 09.02.35 (ÚT 2- 2.124:2005) [Road Technical Specification] MSZ 2509-3:1989
	1 m thick compacted foam glass granule layer + 0.25 m concrete rubble + cover layer of 0/22 stone rubble mixture	E2 ≥ 80 N/mm²*			
	1 m thick compacted foam glass granule layer + 0.25 m thick cover layer of 0/22 stone rubble	E2 ≥ 75 N/mm²*			
	Compacted dry bulk density (r_d) [kg/m³] at 1:1.4 compaction rate	≥ 220 kg/m³ (245 kg/m³ - 10%)*			ASTM D 2167-08
	Thermal conductivity	λ ≤ 0.086 W/mK			EN 1934:2000
	Water absorption [%] (% by mass)	≤ 10.0% (m/m)			EN 1097-6:2013
	Resistance of freezing	F_1			EN 1367-1:2007
	Reaction to fire classification	A1			EN 13501-1:2007+ A1:2010
	Magnesium sulfate soundness	MS_{18}			EN 1367-2:2010
	Aggregate type, particle size distribution, fine particle content	broad-range, G_A85, f_3			EN 933-1:2012
	Test for flakiness index	FI_{20}			EN 933-3:2012
	Resistance to fragmentation - Los Angeles coefficient	LA_{60}			EN 1097-2:2010
	Resistance to wear - Micro Deval Test	$M_{DE}75$			EN 1097-1:2012
	Classification of constituent materials	RG_{100}			EN 933-11:2009
	Water- soluble sulfate content [%]	$SS_{0.2}$			EN 1744-1:2009+ A1:2013
	Acid- soluble sulfate content [%]	$AS_{0.2}$			EN 1744-1:2009+ A1:2013
	Total sulfur [%]	S_1			EN 1744-1:2009+ A1:2013

*NR: non-required.

The performance of the product defined in section 1.2. of the National Technical Assessment NO A-44/2017 is in conformity with the performance declared.
Variations in product colour and colour tone do not influence the quality of the prodeuct.
This declaration of performance is issued under the sole responsibility of the manufacturer (or their authorized representative) identified above.

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