BUILD

Leca®

A MAGAZINE FROM LECA

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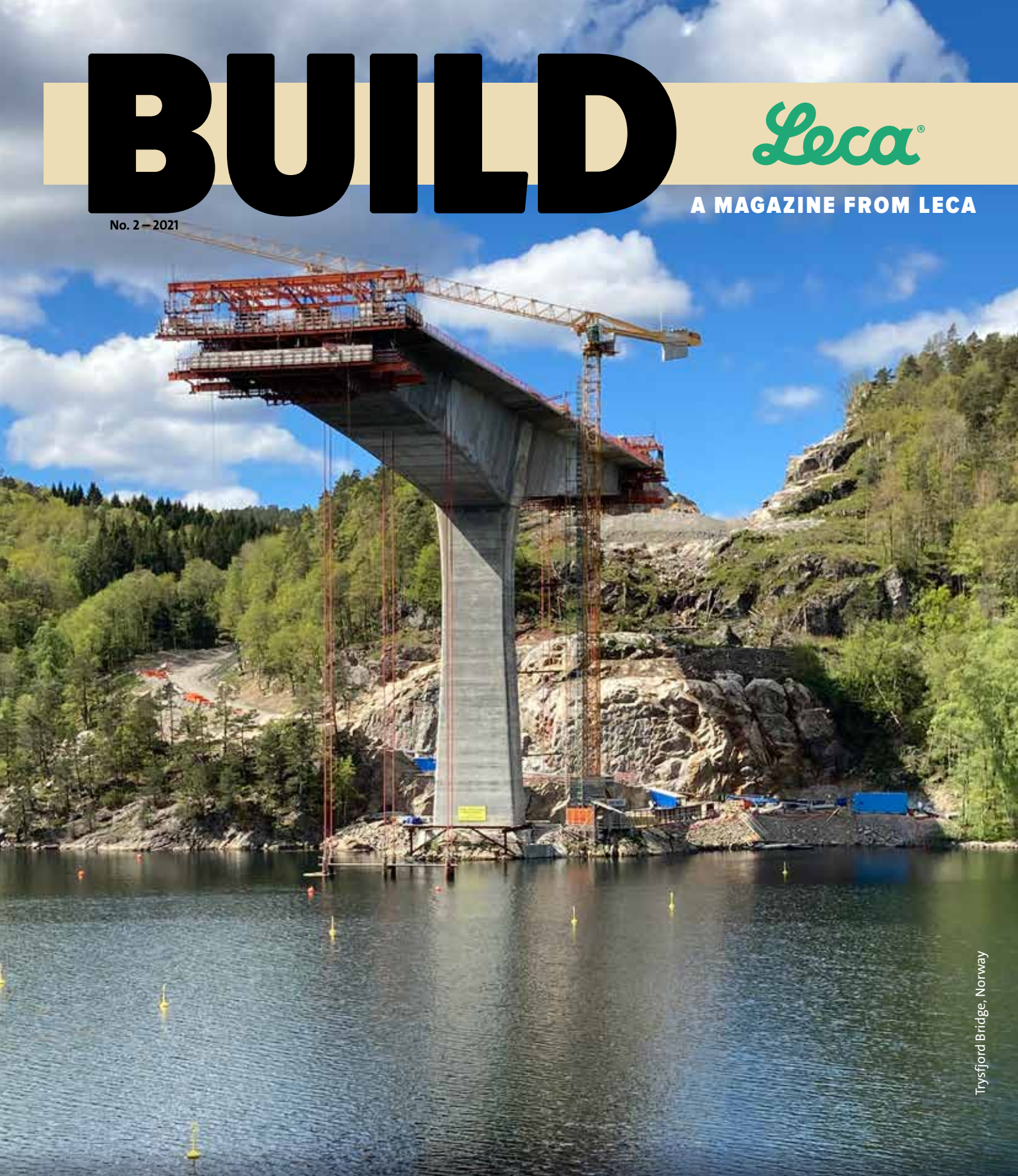

Trysfjord Bridge, Norway

Leca®

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BUILD
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Cover:
Trysfjords Bridge, Norway
Photo: AF Gruppen

1:5

We transform 1m³ of freshly excavated clay into 5m³ of lightweight construction material. Through this highly resourceful return of 1:5, we feel that our production positively impacts the full life circle of a natural resource, from cradle to grave. During the production process the clay pellets expands and pops like popcorn. That creates the porous center and gives the product its lightweight characteristics. The porosity provides some unique draining properties to Leca solutions. Light weight means fewer trucks on the road.

-50%

Gabion baskets are used in various ways within infrastructure construction, e.g. as noise barriers, providing groundwork stability for structures and within landscaping. Gabion baskets are typically large and due to their large weight, their placement on construction sites with soft soil is challenging and often requires significant foundation reinforcement measures. Fortunately, creating a large gabion basket structure is possible with the Leca LWA solution, where construction is quick and easy, and this is through filling the gaps in the stone baskets with lightweight fill (Leca LWA), creating a structure, which is around 50% lighter than gabion baskets using traditional material.

500

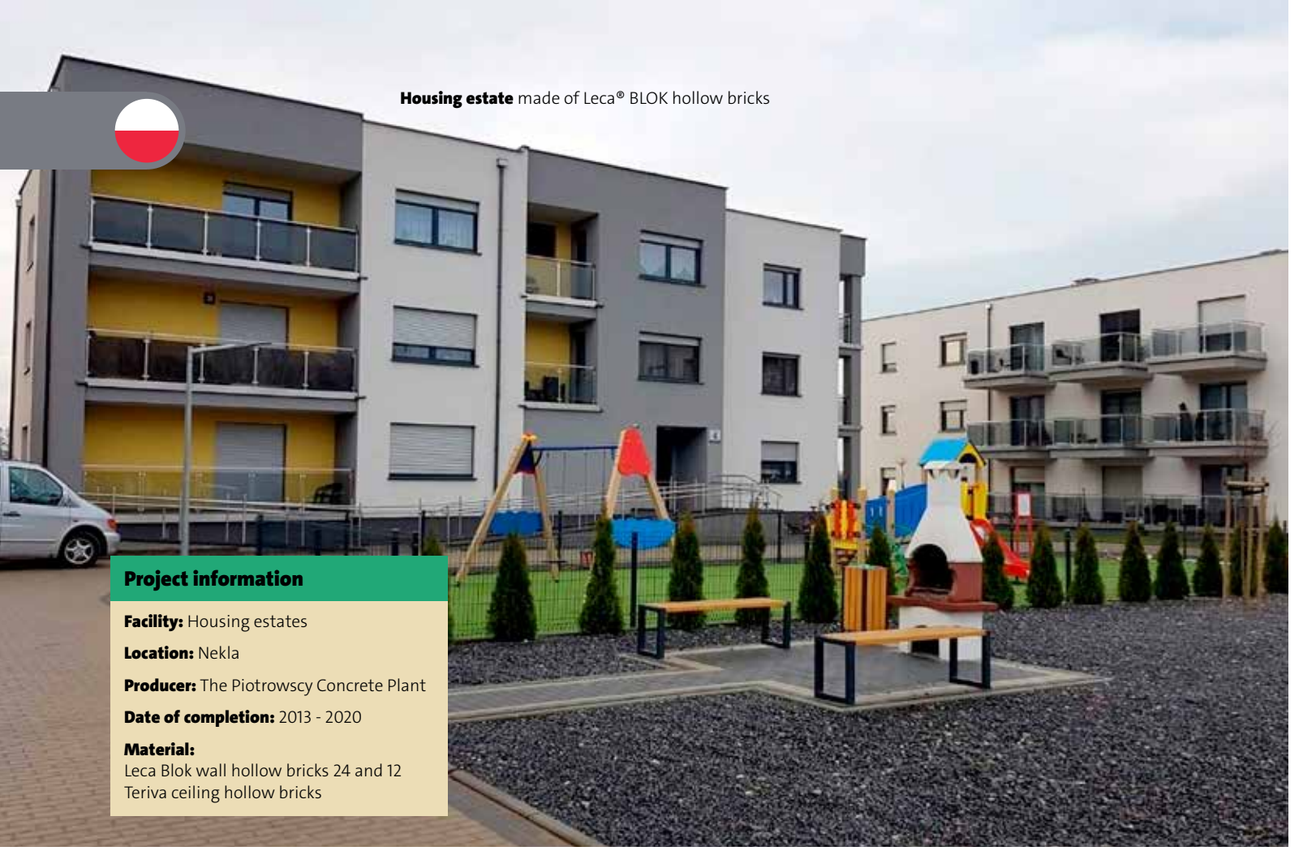
500 liters of water is contained in the 1 m³ inter-grain space of Leca® lightweight aggregate (LWA) (10-20 mm). Thanks to this, it can be used to make efficient underground retention and infiltration reservoirs. One cubic meter of such a reservoir can collect rainwater from a torrential rain with a water intensity of 300 l/(s · ha) over a 15 minute period, which falls on an area of 15 m². The retention reservoir, made with Leca LWA can be covered with almost any surface and adapted to the specific requirements. It can be a green area, a recreation area, a pedestrian path, a parking lot or a road.

3500

Over 3,500m³ of Leca lightweight fill has been specified and delivered for the Lea Viaduct section of the new Preston Western Distributor Road (PWDR) development - providing a robust lightweight solution for a bridge abutment section over delicate ground conditions.

Over 100

Mall of Tripla is a combination of a shopping center, train station, hotel and office towers located in Helsinki. Most of its roof area, or about one hectare, is green roofs. The thickness of the Leca® lightweight aggregate (LWA) layer in Tripla's green structures varies between 10 and 70 cm. Leca LWA was used in Tripla's green roofs both as part of the growing media and in the structures below the growing media. The vegetation of Tripla's green roofs is diverse, dynamic and varied. There are over a hundred different plant species and varieties. Traditional Finnish varieties and wild plants are popular in the plantations.



Housing estate made of Leca® BLOK hollow bricks

Project information

Facility: Housing estates

Location: Nekla

Producer: The Piotrowscy Concrete Plant

Date of completion: 2013 - 2020

Material:
Leca Blok wall hollow bricks 24 and 12
Teriva ceiling hollow bricks

COMFORTABLE LIVING IN LECA® BLOK HOUSES

POLAND ***The Leca® BLOK system consists of only a few hollow bricks and blocks. However, these materials allow for the construction of many different objects.***

The wall element system under the Leca BLOK brand has been on the Polish market for over 20 years. Simultaneously, in Poland houses are built in other systems introduced by local producers such as Betard, CJ-BLOK and Leier. These and many more systems are linked by one basic raw material for the production of wall elements, Leca® lightweight aggregate (LWA). In total, wall and ceiling elements are produced by over 40 plants all over Poland. Products made of this aggregate are used in the construction of detached, terraced and semi-detached houses as well as in the construction of multi-family buildings, industrial and public facilities.

Different houses - the same material

Nekla is a town located in central Poland, about 40 km east of Poznań. Housing estates built of expanded clay aggregate and concrete hollow bricks in Leca BLOK system were built in this town. In the first stage of works, in 2013-2015, complexes of two-storey terraced buildings were built. Each house has four apartments. In total, there are 36 apartments in this cosy housing estate.

In another part of Nekla, a housing estate of three-storey multi-family houses was built. The buildings were built in 2018-2020. There are 73 apartments in three buildings with cellars.

Another housing estate of terraced houses with fifteen separate single-family houses is currently under construction.

What these investments have in common is the Leca BLOK system and the manufacturer of these products. All wall and ceiling hollow bricks have been made in Piotrowscy Concrete Plant from Leca LWA.

"We have been producing ceiling and wall elements in our family company for over 60 years." Adam Piotrowski, the co-owner of the company says. "The company was founded by my father, Józef Piotrowski. My brother and I, as little boys often accompanied him at work. Now we are the second generation to run this facility and our children may soon help us. My father still often visits the plant and helps us at work, although as a senior he enjoys his well-deserved rest more whilst being retired. In the factory, we produce wall, ceiling, chimney and ventilation products. We also deliver concrete with concrete mixers and pumps at construction sites. Having such possibilities, we fully support construction sites, providing structural concrete and products for the construction of walls and ceilings".

Adam Piotrowski, one of the co-owners of the Piotrowscy company.

Waldemar Pęczak, the Head of Production, is responsible for the production and delivery of materials at the plant in Nekla. He shares his observations on the implementation of construction sites. "All construction sites are located in the vicinity of the plant. The delivery time of materials is very short. That is why, we are able to significantly reduce delivery costs. Additionally, we used the help of the Technical Department of Leca Polska. At the first construction site, we together conducted acoustic tests of the Teriva ceiling. After the tests, we were able to present a reliable result to the designers who also designed these ceilings on the remaining buildings. In this way, we confirmed the fact that Teriva ceilings commonly used in single-family housing can also be used in multi-family buildings."

The opinions of people living in the houses made of Leca BLOK products are very good". Marcin Piotrowski, the co-owner of the plant, adds. "The walls of the buildings effectively insulate against the cold in winter and heat in summer. Apartments use little energy for heating and cooling. Moreover, a quiet neighbourhood with a few neighbours, as it happens in large housing estates, is the best recommendation for this type of construction."

A terraced building under construction.

A completed building after five years of use.

INTERVIEW

When industry meets nature

When you arrive at a Leca factory, at first glance you see a heavily industrial area with large, smoking chimneys. But when you get closer, firstly you will learn that most of the "smoke" is actually water vapor, and secondly by looking at the surrounding countryside you will observe a symbiosis between nature and industry. An industry which has respect and accommodates nature.

We sat down with Susanne Bay Jensen, Leca International´s Operations Director, to talk about Leca's actions and plans for preserving biodiversity.

During the manufacturing of Leca LWA, how do you take nature into account?
When we have to open a clay pit, we always conduct open discussions and agree with the local authorities on how it should be operated and how it should be returned. It is during these discussions, that if necessary, the plan can be amended and corrected along the way.

Within the last 10 years, there have been major changes with how we leave our pre-excavated clay pits. In the past, people usually wanted a flat landscape, which in some cases had to be seeded and planted with certain trees and plants.

Today we most often leave the clay pit as it is, and then nature is allowed to regenerate itself and we believe that the wilder and the more natural the better! When we come back around 5-10 years later, it is almost unbelievable that clay pits have ever been operation in the area. You see large trees, shrubs, flowers and lakes with lots of wildlife.

For each clay pit, there is a plan for how the return should be

How do you leave a finished clay pit?
It is of course different from country to country how one wants the clay pit to be given back. In Norway, the authorities would like the land to be set aside for agricultural purposes.

A good example is the former clay pit areas next to Lake Øyeren. Here, according to an agreement between landowners, authorities and Leca Norway, agricultural land has been created but in a manner that corresponds to the original natural settings.

In Finland the authorities want more wild nature and recreational areas. The lakes are maintained and retained and we see a large variety of bird life in the areas.

In Poland, some areas are left for agricultural space and some for natural areas depending on what the needed locally.

In Portugal the clay pit used to be an olive grove. Once it has to be returned, the area becomes a recreational area.

In Denmark, the clay pit is left as it is, and nature is left to its own natural development through planting.

A clay pit is in operation for a minimum of 5-7 years, but sometimes it is also 25 or even 50 years. We do not excavate the whole area in all this time but we continuously return it back to nature. For each clay pit, there is a plan for how the return should be. These plans have been agreed in collaboration with landowners and authorities.

Susanne Bay Jensen, Leca International´s Operations Director.

But you remove a raw material from nature, isn't that an issue?
The raw material we extract becomes 4-5 times greater as finished material. So our inroads into nature's resources seem smaller than, for example, sand, stone or limestone, where the raw material rate of return is 1: 1. We add alternative raw materials, which contain the same elements as clay, from other industries and thus get a more finished and resourceful product from the initial raw material.

You mentioned that there has been a change in the past 5-10 years, can you elaborate?
There has clearly been a change in attitude, and the way of thinking has become greener and again there is a big difference from country to country. We must constantly keep track of where the focus is locally - and that is constantly changing. The authorities want to create more nature everywhere possible. What used to be agricultural land will, after years as a clay pit, end up as wild and sustainable natural areas.

In some cases, we have found special species of eg amphibians in the water holes. In Denmark we had in our current clay pit a few water holes with Great Water Salamander. Now they are seen everywhere in the local waters of the clay pit.

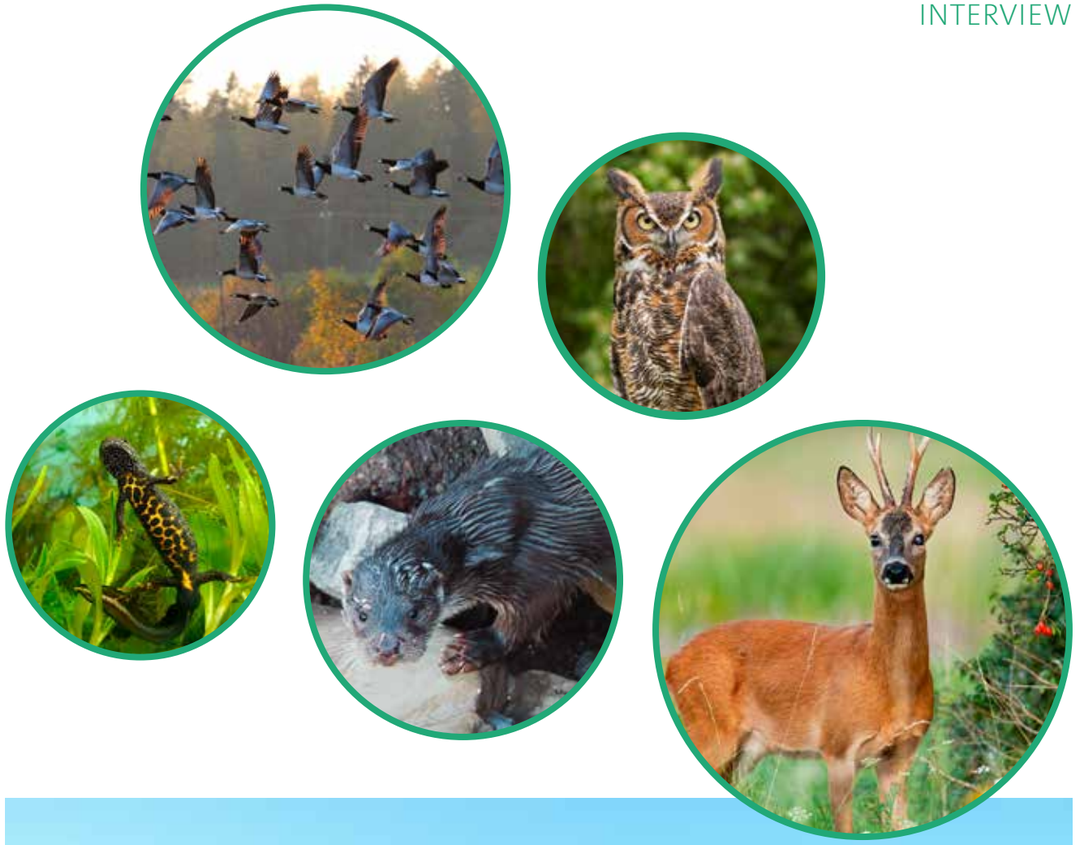
In the area, the rare great horned owl has also been seen - even with cubs - so it does not seem that the animals take much notice of us working around them.

In the former clay pits, lakes will often appear, and there we see a very rich wildlife. In Finland there are large flocks of birds and in Portugal a beaver lives in one of the lakes.

At the factory in Denmark, a nesting box has been set up for the peregrine falcon, as ornithologists believe that the tall buildings will be an ideal breeding ground with good feeding opportunities for the bird. The box was set up a year ago, but it can take several years before a couple settles down.

It does not seem that the animals take much notice of us working around them.

So we do not experience disappearing of wildlife because of our industrial activity, on the contrary, more species actually live here because of the wild and natural setting. As a factory, we are open to interaction with both local and national authorities to find the best solution so that we do not leave a scar on nature. And thanks to the authorities' focus on returning to wild nature, we find that after a few years, the former clay pits have a more sustainable and diverse nature than when we started excavating.



SETTING THE FOUNDATION FOR A NEW TRACK AND FIELD ATHLETICS ARENA

SWEDEN ***On the island Hisingen, in Gothenburg, a long-awaited athletics arena is being built. The department for sports and athletic clubs within the City of Gothenburg funded this new and exciting sporting project. With the new facility, the local council wants to give the city a modern athletics arena that will be used by athletic clubs as well as local communities including schools.***

On the development location for this new arena, there was more or less nothing but a large meadow. The entire space allocated for this new project measures at around 55,000 square meters. The locally based Betonmast Gothenburg are the contractors that won the project from the City of Gothenburg to build the new arena.

In order to be able to develop the new facility on the land, a load compensation assessment had to be carried out. It was discovered early on the project that there was a poor load-bearing capacity on the existing soil in the area, creating potential groundwork instability. To compensate for the extra load in the settlement-sensitive area, the existing soil was replaced with Leca® lightweight aggregate (LWA). The aggregate's low weight properties significantly reduces the load on the ground, and in this way, the risk of settlements can be reduced and sufficient stability can be achieved. This is a simple and common usage of Leca LWA, that has been used in Sweden for geotechnical engineering for decades.

Easily tipped on the spot

VästMark Entreprenad is a subcontractor in the project for the ground works and is well acquainted with the material. A total of 7,000 cubic meters of Leca LWA was placed over the entire surface on which the arena will be standing.

In the first instance, a layer of geotextile was placed and the lightweight aggregate could then be installed directly on top of the fabric. The material was easily tipped out from the truck and placed directly to where it was needed and this could be distributed across the area and suitably compacted with the help of a crawler excavator. The layer thickness of the filling varies, but at the highest points it reaches around one-meter high.

A classic outdoor facility

The facility is a classic track and field facility with all the sports facilities required in a modern sporting area, such as running tracks, jumping pits and throwing fields. The arena is planned to be completed in the spring of 2022. 500 people will be able to sit in the stands and spectate in all exciting competitions in the future. And unbeknown to them is a layer of Leca pellets underneath them that ensures that the pitch lasts for many years of sprints, throws, jumps and sporting competition.

This sketch illustrates how the arena will look when finalized in 2022.

Project information

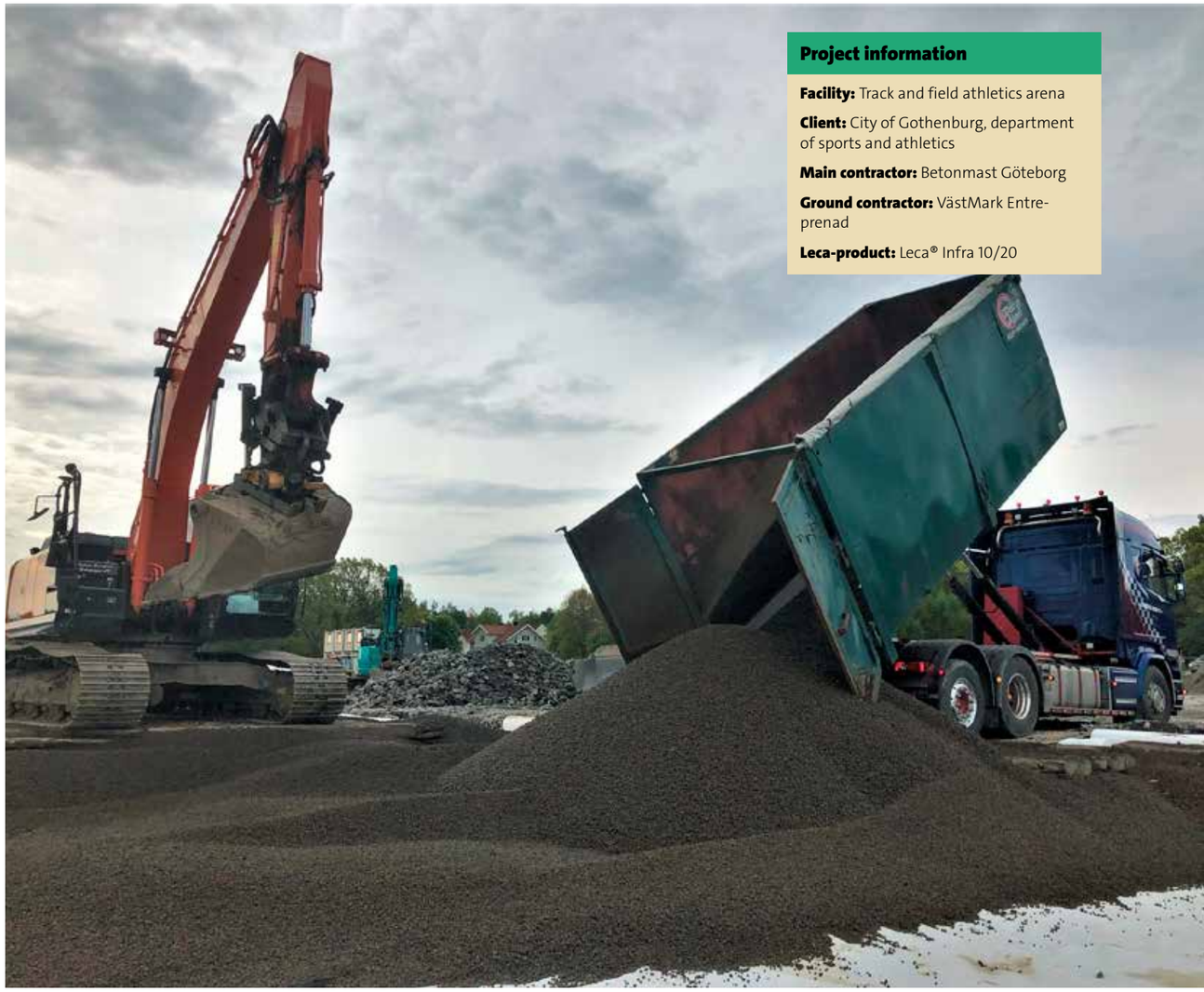
Facility: Track and field athletics arena

Client: City of Gothenburg, department of sports and athletics

Main contractor: Betonmast Göteborg

Ground contractor: VästMark Entreprenad

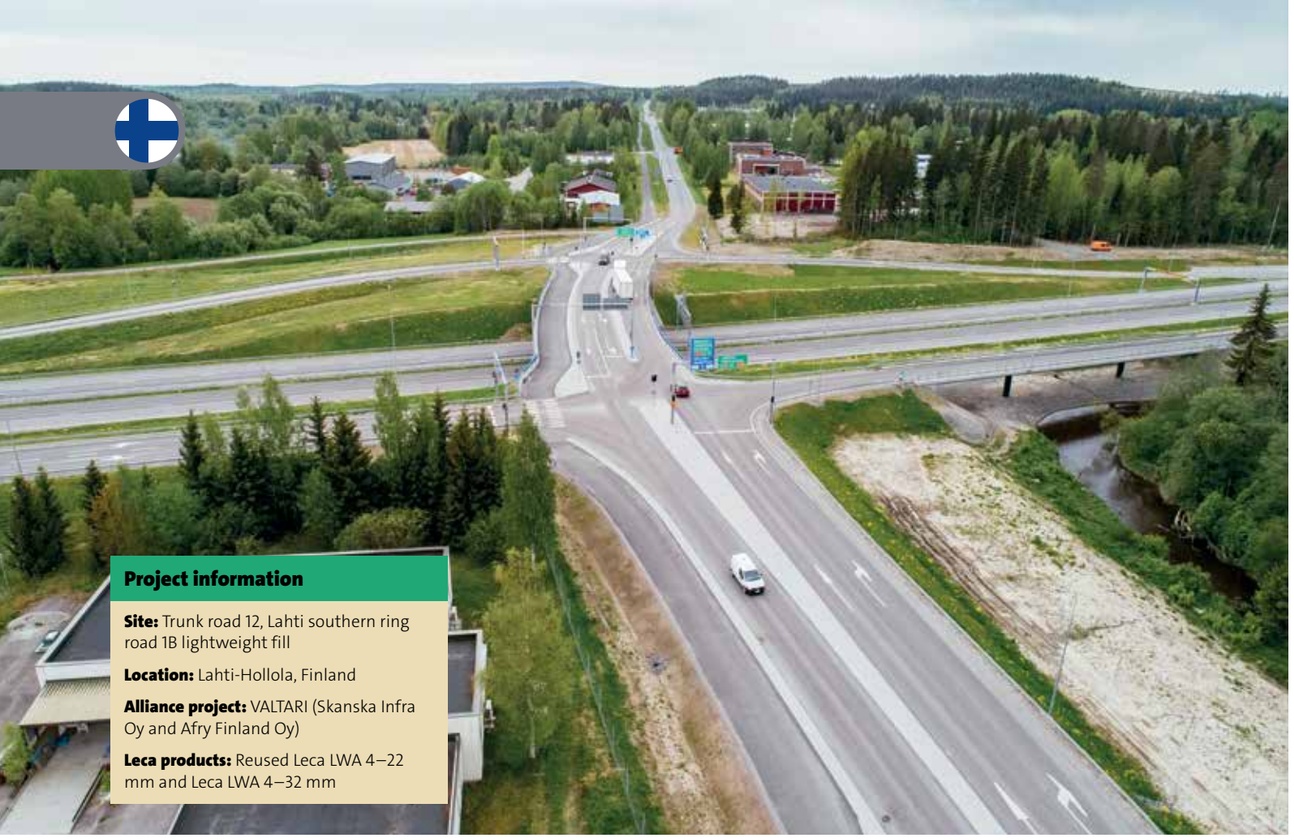
Leca-product: Leca® Infra 10/20



Quick and easy installation of 7000 cubic meter was possible by truck delivery.

A layer of geotextile is first layed out before installing the Leca LWA.

A solid foundation on the soft soil that will reduce the risk for settlements.



Project information

Site: Trunk road 12, Lahti southern ring road 1B lightweight fill

Location: Lahti-Hollola, Finland

Alliance project: VALTARI (Skanska Infra Oy and Afry Finland Oy)

Leca products: Reused Leca LWA 4–22 mm and Leca LWA 4–32 mm

In project 1B, Helsingintie (road 140) took a new route and had to reshaped because of the new bridge.

THE REUSE OF LECA® LIGHTWEIGHT FILL HELPED TO SUSTAIN THE ENVIRONMENT

FINLAND ***Previously installed Leca LWA was excavated from a historic highway development and reused in a new geotechnical development which required new lightweight fill. The excavated lightweight fill was installed cost effectively and in an environmentally friendly way.***

Text: Dakota Lavento

The Lahti southern ring road is the largest road construction project in the south of Finland, creating a new logistical region in Lahti. It is less than an hour's drive to Helsinki Airport and Vuosaari Port, and creates better infrastructural connections to all parts of the country.

The construction of the southern ring road of Lahti, trunk road 12, was divided into two projects and three contracts. Project 1B was carried out using the alliance model in which the Finnish Transport Infrastructure Agency's partners were Skanska Infra Oy and AFRY Finland Oy, forming the VALTARI provider consortium.

New route for the road

In project 1B, Helsingintie (road 140) took a new route and had to be reshaped because of the new bridge. The road embankment had to be made lighter for increased stability. However, the material for lightweight filling did not have to be ordered, or even transported from any great distance. There was material resource hidden in the old road's lightweight fill structures.

"The Helsingintie bank had collapsed into Porvoonjoki river sometime in the 1990s. Archived plans showed that the road structures had been repaired in the late 1990s with Leca LWA," says Risto Ketonen of Afry Finland Oy, who was in charge of the project's geotechnical planning.

Usable lightweight fill material was available right next to the current construction site. It just had to be excavated and reused.

And furthermore, digging up the Leca LWA could be done without causing any disruption, because traffic on the road could be diverted.

Enni Mälkönen was pleased that they were able to re-use the old lightweight fill material.

Excellent condition

There was no exact information on the quantity and quality of the excavated recycled Leca LWA l – and since the previous road was heavily used, there was little chance to examine it. Once the road was excavated, the Leca LWA was found to be both in good condition and dry – thus maintaining its original engineering properties.

"It was a surprise how well the lightweight fill material has lasted after a couple of decades. On the other hand, the lightweight fill had been properly designed and installed, complete with drying and underground drains," says Ketonen.

To determine the quality, samples were taken of the excavated Leca LWA in three places and sent to the laboratory to be tested for granularity, grain size distribution, moisture content and dry bulk density. The samples fulfilled the requirements set for Leca LWA used in lightweight fill.

The grain size of the Leca LWA in the former road embankment was just somewhat smaller (4–22 mm) than the Leca LWA currently made by Leca Finland Oy (4–32 mm).

"To be on the safe side, Leca Finland tested a batch of the old Leca LWA in its own laboratory. In terms of crushability, grain size distribution and un-compacted bulk density, the samples corresponded to the current 4–32 mm earth construction aggregate, with a CE marking in accordance with EN 15732:2012," says Ketonen.

Conveniently to the new location

But it wasn't quite that simple: it was not possible to just take the Leca LWA that was excavated up to the new destination. Fortunately, there was a storage facility close by, where it could be temporarily stored.

Enni Mälkönen, former site supervisor in the VALTARI project, says that as traffic was being diverted, the material could be stored on the asphalt of the old Vanha Helsingintie road.

The old lightweight fill structure contained almost the amount of Leca LWA as the archived designs had stated. The amount of LWA in the new lightweight fill is approximately 2,500 cubic metres. Mälkönen says that re-using the Leca LWA resulted in cost savings. "In reality the project saved almost the total cost of the reused material expenses, that is, tens of thousands of euros."

Savings were also made on CO2 emissions and resources, because we didn't have to take away the material in the removed structure and there was no need to produce so much new material, also reducing transportation costs.

Mälkönen says that their experiences were good. In similar future projects, old Leca lightweight fill structures can be put to good use, provided the material is already in the development area or close to it, and it fulfils the quality requirements.

Work on trunk road 12 began in spring 2018 and was completed as planned. The road opened to the general public in late 2020.

The old fill material was in perfect condition.

The casting of 260 meters long spans straight into the air, 64 meters above Trysfjorden, is right up to the limit of what is possible.

ON THE VERGE OF THE IMPOSSIBLE

NORWAY ***It is about perfect equilibrium 64 meters above sea level. The Trysfjord bridge will soon be an important piece in the four-lane motorway that will halve the travel time on the Kristiansand-Stavanger section.***

Text: Håkon Bonafede
Photos: AF Gruppen

Even during the ride up along the outside of the western bridge tower in the temporary Alimak elevator, you get an idea of how spacious the bridge construction is. Leaving the clattering lattice elevator, we step out onto something resembling a huge concrete aircraft carrier deck. The unfinished construction currently looks like a huge T.

At an altitude of 64 metres above Trysfjorden, between Kristiansand and Mandal, a 100 km/h, four-lane motorway is currently being built. In autumn 2022, the bridge will be opened to form an important link in the E39 motorway between Kristiansand and Ålgård.

One of the largest in Norway

The two bridge towers took around 15–20 days to build in one continuous slip-form casting, which is incidentally the same method that was used to build the Condeep concrete platforms that can be found on the Norwegian Sea. Their elegant hourglass figures are not just a source of pride for the engineers. Trimming the towers in the middle without compromising on strength also saved concrete and made a positive contribution to the environmental accounts.

The T-shaped bridge deck is already 126 metres long on the western tower and is expanding by 20 metres a month on each side. The bridge is one of largest in Norway built using the cantilever method. This means that each of the four ends has a formwork trolley that rolls further out along the bridge deck each time a five-metre section is reinforced and fully cast. The method also ensures that the bridge is entirely self-supporting during construction. However, it does require casting work to be performed at exactly the same pace at each end for the construction to maintain equilibrium.

At the very top

Next summer, the two bridge sections are due to meet in the middle of the fjord. The completed bridge will be 537 metres long, with a span of 260 metres between the bridge towers. The cantilever construction method is effective for spans up to 300 metres, which means that the engineers are pushing the limits for what can be achieved with this type of construction here.

“What is unique here is that the long concrete sections become elastic. Due to their weight, they gradually sink towards the centre before we can connect them. As the western bridge lane will be completed first, we have to perform four-dimensional planning, where time is also a factor,” explains Asbjørn Stålesen, Project Manager at Kruse Smith.
Were it not for the stays on each side, which are anchored on land and in the seabed, the wind would cause the structure to sway half a metre in a figure-of-eight pattern. That shows how elastic the concrete structure is.
“We call the stays the “sea-sick stays”. Without them, it would have been impossible to work at height,” he adds.

Millimetre margins

When the two bridge spans are joined in the middle of next year, having extended 130 metres from their respective bridge towers, the margin of error will be less than 40 millimetres – even though the bridge has been constructed with no paper drawings at all. *Continues on page 16*

WHAT IS THE FREE CANTILEVER METHOD?

The free cantilever method is balancing the growth in steps of about 5 meters from the towers on each side. After casting and hardening the train is moved to next step and made ready for the casting. The bridge decks are growing in total 130 meter from each tower to meet at exact place in free air with a tolerance of 40 mm.

This require exact construction pace and balance by tailor making concrete density. During the construction the bridge deck will see severe wind load. The construction phase is the most critical phase of the bridge life. To stiffen the bridge during construction and to manage the wind loads and exact meeting the construction is supported by steel support braces which will be removed after construction.

One of the challenges for such construction is to position the towers at the optimum site. A smaller distance between the tower will reduce the main span and obviously reduce the costs, but that would mean positioning the towers in the sea. Light weight concrete will enhance the length of the main span and therefore reduce construction costs considerably. Another issue is the balance of the bridge span growing in two directions from each tower. Light weight concrete makes it possible to balance the main span with the side span more easily. The third reason for using LWAC is the reduced moment and force to be absorbed in the towers while cantilever the span. A normal density concrete due to higher weight will impact considerably higher moment which will increase the size of the cantilever box at the tower.

In general, the use of LWAC will create a slimmer and more cost effective construction with lower total use of concrete and therefore also a greener construction. Norwegian constructors are so familiar with using LWAC for long span bridges that the alternative NDC was not even calculated for the mid-span.

Total length:	537 m
Main span length:	260 m
Reinforcement:	4000 t
Concrete C 55:	10000 m³
Concrete C 65:	2000 m³
Concrete LB 50:	8000 m³

Properties of concrete

Concrete C 55 and C 65 with normal aggregate and LWAC LB 50 with light weight aggregate were used. The strength refers to cubes 100x100 mm.

Mix design:		Mechanical properties LWAC:	
Cement (STD FA)	430 kg/m³	Mean strength $f_{c,mean}$	70,4 MPa
Silica	38 kg/m³	Characteristic strength f_{ck}	64,1 MPa
Sand (dry)	750 kg/m³	Standard deviation	4,4 MPa
Leca 800 4-12 mm	500 kg/m³	Density 28d cubes	1940 kg/m³
Water	180 litres.	Demoulded density	1931 kg/m³
Superplasticizer	3 kg/m³	Bulk density Leca 800	825 kg/m³
Air-entraining admixture	0,3 kg/m³	Particle density Leca 800	1450 kg/m³
Retarder	1 kg/m³		
w/(c+2s) (effective)	0,36		

Bas Øystein Austjore does not allow himself to be affected by the fact that there is just over 60 meters of air under him.

"We've built it twice. The first time in a three-dimensional digital model before we started the actual work at the end of 2018," says Stålesen.

The principle is called Building Information Modelling (BIM). In the digital model, all the building actors can share information and stroll around a virtual model of the completed structure.

BIM Engineer Herman Horsle from AF Gruppen has connected his mobile phone to a GPS antenna that pinpoints the position within two centimetres' accuracy. On the screen, the finished virtual bridge floats as a semi-transparent layer on top of the actual construction. Where the bridge ends, he can see how the virtual motorway continues out into the sky towards the other side.

"It is much more cost-effective to be able to identify any discrepancies at such an early stage, and it significantly reduces the risk of errors and omissions," he says.

Concrete cathedral

A total of 15 men work long shifts up here at height. Some anchor steel to the reinforcement, while a group from as far away as Laos handle the formwork trolleys. As the bridge span is extended, the concrete is transported out to the cast using wheel loaders. They will be the first vehicles to have the honour of driving up here.

The challenges of travel restrictions and long quarantine periods have been overcome by longer shifts and less travel. Polish reinforcement workers have been here for five months without a break, and they are now waiting for the next team to finish their quarantine and take over. The Laotian workers are away from home for up to a year at a time.

The site manager and the formwork contractor, who we meet at the very end, on the other hand, speak the Telemark dialect. Neither Øystein Austjore from Bykle nor Per Stian Hanstveit from Drangedal are afraid of heights. They are quite happy to work on a platform just over 60 metres above sea level.

"Working at height presents some challenges. You have to think very carefully about safety – including inside the bridge construction," he says with a broad grin, as he peers over to the twin construction on the east side.

We balance on swaying rebars that emerge from the concrete like taut strands of spaghetti before disappearing into the actual bridge pier. Here on the edge, we can see the end of all the thick steel wires that are cast into the bridge body. Just like a traditional suspension bridge, they carry the weight, only here they are hidden inside the actual concrete.

Inside, the bridge resembles a tall concrete cathedral. It narrows towards the middle, but inside the bridge tower, the ceiling height is 13 metres.

"Beauty is in the eye of the beholder, as they say, but the whole bridge is a jewel as far as I'm concerned," says Asbjørn Stålesen, as we wait for the elevator to take us back down to solid ground.

Project information

Poject: Trysfjordbrua - E39 Kristiansand vest – Mandal Øst

Client: Nye veier

General contractor: AF Gruppen

Design: Norconsult

Bridge Contractor: Kruse Smith

Construction time: 48 months - completed October 2022

Product: Leca 800 4-12 mm

Each bridge tower grows by 20 meters a month. Next summer, the bridge will be completed.

Nye Veier's E39 project between Kristiansand and Stavanger is Norway's largest road project.

Improved traffic safety

It currently takes 3.5 hours to drive from Kristiansand and Stavanger by car. A 280-kilometre journey on a hilly, winding and at times landslide-prone road will be replaced by 170 kilometres on a motorway that will take half the time.

The developer, Nye Veier, is a state-owned company that was set up five years ago tasked with becoming a lean and efficient organisation and constructing motorways and major road projects more cheaply and quickly. The same developer is also responsible for the improvement of the E18 through Southern Norway, which will halve the travel time between Kristiansand and Oslo.

For Nye Veier Project Manager Harald Solvik, the Trysfjord Bridge is the largest building block on the motorway between Kristiansand and Mandal, and one of nineteen bridges to be constructed in the same number of months. The bridges account for a quarter of the total budget of NOK 4 billion.

"We are working more quickly and cheaply than before due to large contracts and the construction of longer sections that provide a more consistent driving experience. Experience shows that four-lane motorways significantly reduce traffic fatalities. This particular section has experienced multiple accidents," concludes Solvik.

The formwork trolleys are used to cast five meters of bridge span at a time, at each of the four ends simultaneously.

The LWA was delivered with tipper truck.

ELEVATING A HIGHWAY TO PREVENT FLOODING

DENMARK ***A busy road often had to be closed due to flooding which was very inconvenient for the commuters. The solution to that problem was Leca® lightweight aggregate (LWA).***

Tåstrupvej in Solrød Municipality has been flooded several times in recent years, and as a consequence it has been closed off for periods. Tåstrupvej is an important and busy road for the residents living nearby, and when it is closed, it creates many problems. So the municipality had to find a solution to avoid future road floods, floods that would only be more and more common as we experience heavier rainfall.

The engineering company Moe A/S chose a solution to the problem, where they wanted to raise the road 1 meter on the affected section. Contractor Gorm Hansen A/S removed the existing asphalt and then they had to install a lightweight filling material. The lightweight properties of the filling material were essential to ensure, that future settlements of the road section would be limited, and it was through these factors that the adviser Moe A/S chose Leca LWA 10-20, which only weighs 245 kg/m^3.

Delivered by Tipper Trucks

To begin the development, a geotextile was rolled out across the length of the road, leaving enough to fold over the compacted and finished Leca layer.

Leca LWA 10-20 was delivered with tipper trucks that could tip off the aggregate into site, which was near the development for optimizing the logistics. On top of the Leca LWA layer, iron vehicle access mats were placed to allow the trucks to drive all the way to the tipping point. A hydraulic excavator with an adjusting bucket was used to distribute the Leca material, and its belts were used as a compaction tool for a 10% compaction of the Leca LWA layer.

"This is the first time that we have used Leca LWA in a road construction development," says project manager assistant Frederik Holmberg from Gorm Hansen A/S and continues: "But this has not posed an obstacle. On the contrary, it has been a good, fun and a learning experience for us. We are always trying to strengthen our knowledge, and now we can add a new method to our competencies".

Above the Leca layer, the contractor built the highway with asphalt the traditional way.

An excavator spreads out til material.

Iron vehicle access mats were placed to allow the trucks to drive all the way to the tipping point.

The LWA was laid in a 1 meter thick layer and compacted with crawler excavator.

Project information

Client: Solrød Municipality

Adviser: Moe A/S Infrastructure

Main contractor: Gorm Hansen A/S

Leca® product: Approx. 3200 m^3 Leca® 10-20

The specific compaction rates of Leca® LWA and the reduction in bearing pressure at base.

LECA® LIGHTWEIGHT AGGREGATE (LWA) SPECIFIED FOR THE EDINBURGH TRAM DEVELOPMENT

UNITED KINGDOM ***Over 11,000m³ of Leca LWA has been specified for the continuation of the existing Edinburgh Tram Network, which has been developed by the main contractor Sacyr Farrans Neopul (SFN) on behalf of the City of Edinburgh Council. The project is due for completion in 2023.***

The aim of the Tram development is to create a sustainable solution for clean, green and accessible public transport, significantly reducing the impact on air quality through the reduction in vehicle congestion, with a move towards a net zero carbon emission future for Edinburgh. In addition, it is expected to deliver significant social and economic benefit to the immediate area and to Edinburgh as a whole.

For this development, Leca LWA was specified as a lightweight solution to provide a robust foundation support for the track bed between two existing retaining walls whilst not applying excessive pressure to the ground and adjacent retaining walls, it reaches up to 4m high over variable ground conditions, including loose sand and soft clay/ silt. The Leca LWA has allowed the project to move forward whilst maintaining the existing structures previously installed by others and minimising the ground consolidation.

Leca LWA Provides the Key Groundwork Properties

Based on a historical Tram Project in Murrayfield, where Leca LWA was successfully applied to provide lightweight ground support. The specific compaction rates of Leca LWA and the reduction in bearing pressure at base provided a key property for the specification of the material, with the design specification requiring a Type 1 fill to be placed over the Leca LWA.

11,000m³ of Leca LWA was delivered by ship directly into the Port of Leith in Edinburgh - helping to minimise the carbon footprint of delivery – reducing the number of trucks required to travel and deliver onto the project site in Edinburgh.

Positive Feedback from Contractors Sacyr Farrans Neopul

Sacyr Farrans Neopul, Neil Fullerton, Construction Manager, said "Through past relationships and projects, it was a clear advantage to engage and collaborate again with Leca UK when faced with the groundworks design challenge on the project. The need to maintain the use of the existing retaining walls and minimise any further ground consolidation was critical to delivering this area of the track without causing any undue effect on the walls. The need for the supply of the key product on programme was vital to SFN as these works were on the critical path, it was then delivered on time efficiently via ship to the quayside only a few meters from the worksite."

Reducing Carbon Emissions with Leca LWA

Leca UK Technical Sales Manager, Robert Branford, said "We are delighted to have been specified for this continuation of the Edinburgh Tram development and working with the contractors Sacyr Farrans Neopul Construction team. We are pleased to see that the unique properties of Leca LWA have been a decisive factor by the designers in being specified for this significant project."

"We have worked with Farrans Construction on many geotechnical projects in the past including bridge, highways and rail developments - so it has been a pleasure for Leca LWA once again to be considered as a groundwork solution and to engage with a fantastic team on this development. The fact that this project aims to reduce the carbon emissions in the city centre, is something that as a Saint-Gobain company, we truly value in terms of a sustainable future. We hope the residents of Edinburgh enjoy this historical development for many years to come and the sustainable benefits are embraced for the future."

11,000m³ of Leca® LWA was delivered by ship directly into the Port of Leith in Edinburgh.

Leca LWA was specified as a lightweight solution to provide a robust foundation support for the track bed between two existing retaining walls

Project information

Location: Edinburgh, Scotland

Amount of material: 11,000m³ of Leca® LWA (10-20mm)

Delivery Method: Walking Floor

Main Contractor: Sacyr Farrans Neopul (SFN) on behalf of the City of Edinburgh Council

The final outcome, cobblestones square for holding events.

DEVELOPING A NEW EVENTS AREA IN MADRID WITH A LIGHTWEIGHT SOLUTION

SPAIN ***Iberdrola is a leading global energy supplier championing the energy transition towards a low-emissions economy.***

This ambitious geotechnical project involved the modification and redesign of a central square of the IBERDROLA offices in Madrid. Initially in this square there was a small pond with a water depth of approximately 20-40 cm, which was located on a parking slab.

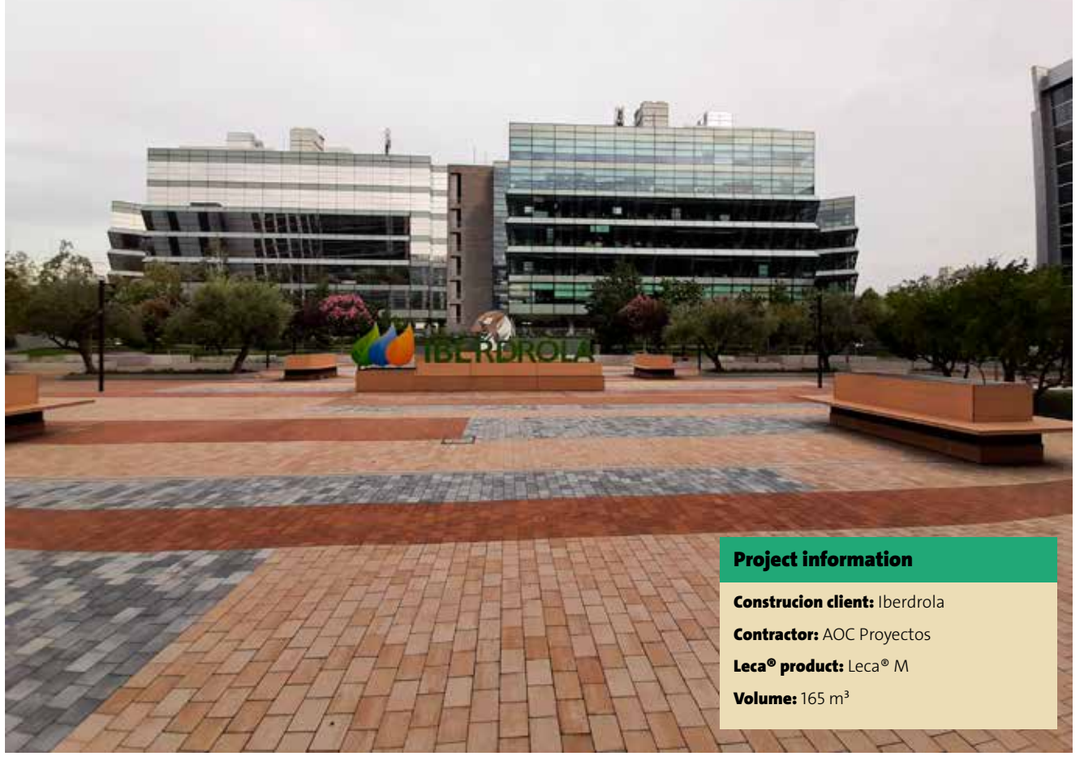
AOC Proyectos was the engineering and construction company that carried out this project. They contacted Arlita because they were looking for a lightweight solution that minimised loads on the slab, whilst also offering a high drainage capacity, capable of managing rainwater on the surface.

The solution found was Leca lightweight aggregate (LWA) which could be pneumatically delivered. Following the delivery, spreading and compacting, a small layer of mortar was placed on top of the Leca LWA, where the sand and cobblestones that make up the new development were spread.

165m^3 of Leca LWA was pneumatically delivered over a 6-hour period, over 3 separate deliveries and at a rate of around 55m^3 per delivery. This solution not only provided a lightweight and effective solution to water management (SUDS: Sustainable Urban Drainage System), but was also fast and efficient (no additional materials were required such as cement and required reduced manpower for delivery), and therefore offered a reduction in impact on the carbon footprint for the project.

Through the specification of Leca LWA, which offers a natural, sustainable and recyclable solution, the result of this project was the creation of a new space for workers to rest, connect with nature and to meet in an open and safe environment.

Iberdrola, a leading global energy supplier championing the energy transition towards a low-emissions economy.



Project information

Construcion client: Iberdrola
Contractor: AOC Proyectos
Leca® product: Leca® M
Volume: 165 m^3

The result of this project was the creation of a new space for workers to rest and connect with nature.

Interview with Sustainability Specialist Ana Raquel Fernandes

Ana Raquel is Sustainability Specialist at Leca International, is 27 years old, based in Portugal and has a Master's Degree in Chemical Engineering with Specialization in Environment, Process and Energy from the University of Coimbra – Portugal. Following her University degree, she completed a post-graduate degree in Economic and Industrial Management.

Ana Raquel has practical experience from working for many years as laboratory manager at Leca's manufacturing facility in Avelar, Portugal. During this period Ana Raquel has gained substantial insight and knowledge in the industrial manufacturing process from inception to completion.

What does sustainability mean to you?

For me sustainability is more than a concept or a new market driver. For many years, I have been conscious about living my personal life for a better future without compromising the resources that I am using. When I was actively searching for my first job, I searched for an organization that mirrored my mind-set; creating resource efficiency and consistently searching for improving their sustainability targets day-by-day – these were the reasons why I started my professional journey with Leca Portugal.

Our goals are to go beyond these goals and present even more aggressive targets.

All activities we are proceeding during the day are ultimately processes. If these processes are efficiently optimized, we will consume less resources - using less energy to produce the same goal without compromising the environment or our social communities – for me this is sustainability.

I believe sustainability is one way of living – one-way of growth.

Why did you decide to go into the field of sustainability? What makes it interesting for you?

My first job at Leca Portugal was as laboratory manager where I first encountered sustainability within Leca, although on a small scale. The responsibilities were, amongst other things the analysis of raw materials and combustibles to optimize production. Our goal was to improve the efficiency of the kiln process through the analysis of the economic and environmental pillars of sustainability.

At college I was focused on sustainability taking a Master degree in Chemical Engineering with a Specialization in Environment, Process and Energy from the University of Coimbra – Portugal. So you might say that I have been working with sustainability ever since.

But why does sustainability raise my interest? Well, today the majority of the population in the Western world has access to education and information; to health care; improved living and working conditions. For example, you can travel from Lisbon to Paris in two hours,

Our focus is to establish the roadmaps for all the manufacturing plants to decrease excess emissions.

while the same trip would take several day's generations ago. So, the wheel was already in motion a long time ago? So now we must improve and optimize "the wheel". Of course the accessibility and comfort we have today – like travelling from Lisbon to Paris in two hours, creates its own problems that we witness today; pollution, emissions of CO2, more traffic, increased industry and unfortunately more inequalities. This is the interesting part of the sustainability issue and is what makes me happy in my work - to be part of the optimizing processes and creating sustainability. Sustainability is a way of thinking which makes sense in all processes.

What most excites you in your new role as Sustainability Specialist for Leca International?
That I will be part of the new opening sustainability chapter for the business, taking an integral part in new ways of optimizing resources to create efficient processes and to demonstrate this to our community and customers.

IN AVELAR, PORTUGAL WE WILL START THE INSTALLATION OF A SOLAR PLANT TO PRODUCE ELECTRICITY, THAT WILL BE FUNCTIONAL IN 2021.

Are you familiar with the company's strategy on sustainability and do you feel it is in line with the vision of the company?
The company's strategy and vision needs to be aligned to achieve the fundamental target to improve the company's sustainability targets. Our vision is to improve living conditions and to protect the environment, this is a clear statement of sustainability. Sustainability needs to be the heart of the company, supported fully by the top management, which is the case for both Leca and the parent company Saint-Gobain.

Can you mention any sustainability projects that Leca is already working on?
Yes, Leca is already working on sustainability for a number of years. For example, in our manufacturing plant in Kuusankoski, Finland, the plant developed in 2004 a heat recovery installation that allows the residual heat from the kilns to be used in the district heating network for the region (not in operation today). In Hinge, Denmark we have the SPIR project running (Sustainable Production & Innovative Recycling) which will reduce the use of fossil combustibles in our manufacturing process, through using biomass. In Avelar, Portugal we will start the installation of a solar plant to produce electricity, that will be functional in 2021.

What do you see as the main challenges in the scope of sustainability within the construction market and within the company?
First, we need to understand the market requirements which shows different needs and requirements even down to country specific levels. An example of this includes the Nordic region, where it is necessary to have materials with a lower CO2 footprint or/and a high component of recycled material already today. So the principal challenge is to achieve these product standards now and to continue to work on new innovative investments and provide continuous and necessary changes in the production proves. The main challenge will be the time frames of requirements.

Have you already defined the activities how to lower the company environmental footprint?
We are already aware of the environmental impacts of our products; the high energy in transforming 1 m^3 of clay into 5 m^3 of lightweight expanded clay. Right now, our focus is to establish the roadmaps for all the manufacturing plants to decrease excess emissions within the scope set by Saint-Gobain.

What will be your main tasks / focus in the near future?
The main focus is to evaluate all our manufacturing facilities and to establish the roadmaps to define how we can decrease our environmental footprint. At the same time, I'm working on the input data to Saint-Gobain – defining and decreasing our direct and indirect emissions, as well the emissions that are released during the supply chain. This is a huge work – but importantly, to evaluate all aspects of our sustainable impact on the full value chain - we are using the GHG protocol approach together with all companies within Saint-Gobain.

Furthermore, my tasks will be to develop and maintain our sustainability section in our new internet site, which I invite everyone to access and to understand the work we are doing to achieve our mission and vision on sustainability.

Saint-Gobain have set their sustainable goals as Net Zero Carbon by 2050 – Has Leca International the same goals and how to achieve them?
The goals of Saint-Gobain are filtered to all the companies, so the global goals for Leca International are the same. In this moment we need to translate that to goals per country and per plant and see how they can be applied and "fit to us" because we need to adapt them into our daily reality. The Saint-Gobain mid-term goals are reducing the CO2 emissions by 33% within 2030 - Our goals are to go beyond these goals and present even more aggressive targets.

Our strategy is to evaluate the past regarding raw materials, recycling materials in the process, energies and combustibles, to see what we need to change and how we'll do it. These changes will be step by step, aligning to the needs from the markets. And we must not forget that this type of change will require investment and change.

LECA® AGGREGATE FACILITATES RAINWATER MANAGEMENT IN A BIOSWALE PROJECT

PORTUGAL ***Urban stormwater management is currently a vitally important issue, given the extreme rainfall we are witnessing more and more frequently. In response to this issue, Guimarães' Municipal Council has adopted an innovative solution in Portugal, using expanded clay to manage runoff in a rational, sustainable, and economical way.***

In the city of Guimarães, what would have been a project intended to solve a road issue, turned into an opportunity to create a "green bay" that delays, collects, infiltrates and filters rainwater. Leca LWA was chosen as the retention and drainage solution for this system.

"It was an underdeveloped urban area with many problems," explains Eunice Pinto, an architect from Guimarães Municipal Council and team member responsible for the project. She then names a few: lack of safety in pedestrian and vehicle movement, disorganised public spaces, large amounts of paved surfaces, lack of green elements, and deficient rainwater drainage.

Beyond finding a quick and immediate answer for redeveloping the road and overcoming the traffic problem, the team wanted to design a solution for the future that also considered the environmental perspective. "We started with the premise of 'how can we intervene in the urban fabric by designing the redevelopment of the public space, while taking environmental sustainability into account," continues Eunice Pinto.

Bioswales: an environmentally responsible solution

The solution was to create a bioswale system on the median strip of the road that can collect rainwater and surface runoff whilst accelerating drainage to avoid floods.

Bioswales mimic natural drainage systems, simultaneously reducing the rainwater impact on the surrounding environment and creating green urban areas that promote biodiversity. "We adopted a conscious solution that considered all the existing variables at the site: proximity to the waterline, the lack of green structures, and the increasing sealing of the surroundings," the architect explains.

The team opted to apply expanded clay on the drainage ditch bed. Eunice Pinto explained the reasons for this choice: "apart from its filtering and biofiltering properties - vital in the project due to the proximity to the waterline - Leca LWA is a porous material capable of delaying and reducing peak intensity runoff. It therefore decreases the probability of urban and riverine flooding, an important aspect when looking for natural, local and sustainable rainwater drainage solutions."

A total of 192 m³ of expanded clay was used in the project. A mixture of 2/3 of garden soil with 1/3 of Leca® S was applied in the first layer (30 cm), and 60 cm of Leca® L was used in the second. A layer of geotextile fabric was also applied between the two layers to prevent them from mixing. In terms of retention capacity, the bioswale can retain 115 m³ of water, equivalent to 23,000 5-litre water bottles.

Close collaboration with Leca

Leca Portugal and Leca International's technical and development department supported the team throughout the entire project. "Thanks to Leca Portugal, we felt more secure with the project and its viability during the initial architectural design phase. They provided examples and explanations of different structures built in line with water sensitive urban design principles", outlines the architect. "They later supported us with all the necessary data to calculate the profile dimensions for the hydraulic engineering", she adds.

As this pilot project in the municipality has only recently been concluded, the team prefers to perform a global evaluation of the system after some time has passed to understand whether it should make adjustments to the initial concept. Yet they do believe that nature-based solutions for urban stormwater management, such as Leca LWA, will become more of a reality.

Project information

Construction project: Re-profiling a stretch of the N207-4 with a drainage ditch solution

Promotor: Guimarães Municipal Council

Building contractor: Public tender

Project team:

Eunice Pinto, architect

Sofia Nogueira, engineer (hydraulic)

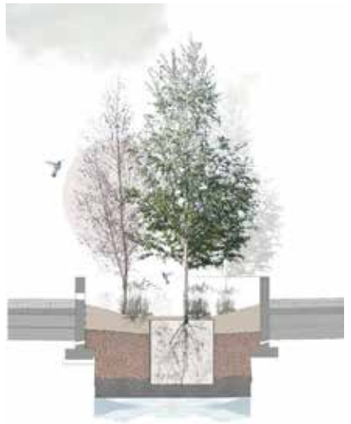
Reinaldo Cunha, engineer (stability)

Catarina Ribeiro, engineer (electrical)

Joaquim Sampaio, quantity surveyor

Leca® products: Leca® S; Leca® L

Quantity used: 192 m³



WHY BIOSWALES?

Bioswales are nature-based systems that offer numerous advantages when compared to traditional stormwater management systems, as they:

- Integrate easily with urban design,
- Reduce building costs, as fewer building materials are required,
- Have high absorption capacity, reducing and delaying flood peaks,
- Increase the number of green spaces and biodiversity in urban areas,
- Decrease the urban heat island effect,
- Help to mitigate the effects of climate change,
- Promote soil permeability in urban environments and balance pre- and post-urbanisation,
- Filter debris and pollutants from surface runoff,
- Reduce construction waste and generate less waste at the end of the system's life cycle.

This is what it looks like today. A versatile agricultural area.

THE RECOVERY PROCESS:

From useless terrain to first-class agricultural area.

The Leca factory at Rælingen started production in 1972. The factory was built in a location where the soil was rich in first-class clay. In every aspect of production that supports our way of life, soil dominated by high density clay represents a disadvantage. For Leca, however, this created an adventure of exploring the properties of clay and ways to utilize a seemingly worthless natural resource. Leca enjoyed the area for decades, and created the different Leca products that has been an important contribution in tens of thousands of buildings and facilities in Norway.

What when the clay field runs out?

A few years ago, however, the resources of clay in Rælingen came to an end. There was no more clay left in the soil. This created a challenge for us in Leca, as we had to search for new areas to access clay. However, the results of our industry of utilizing the soil in Rælingen, laid a foundation for great opportunities for the local agriculture. As we had extracted clay from the soil, the clay was replaced by fertile soil excellent for agriculture. The steep, rugged and rather inaccessible terrain developed into a versatile and accessible area for agriculture and new infrastructure; completely different from what the area looked like a few decades ago.

This is "Borrowed from nature" in practice. We borrow a (worthless) area, and return a valuable area to nature many years later.

FLOOD RELIEF – FIBO EXCLAY PROVIDES SUPPORT WITH EXPANDED CLAY DONATION

The flood disaster in the federal states of North Rhine-Westphalia and Rhineland-Palatinate in Germany has hit the local residents hard. Photos and videos of helpless families, as well as destroyed roads, bridges and houses, are repeatedly being presented in the media.

In times like these, the cohesion of society is crucial. For this reason, Fibo ExClay Deutschland GmbH, together with its customer i&M Bauzentrum Hieronimi, have decided to send two truckloads of expanded clay to the flooded region.

A total of 48 big bags, each containing 1,5 m^3 of crushed expanded clay with a grain size of 0-2mm, are to be used in the affected areas as protective binders for oily liquids.

The free transport of the "flood relief" was provided by the company Pape Logistics GmbH & Co. KG from Hollern-Twielenfleth.

ECOLOGICAL LIVING IN FINNISH MINI-HOMES

In the autumn of 2021, a completely new type of detached house complex was completed for a new residential area near the center of Tuusula in Finland. Trendy, ecological and well-designed mini-homes offer the comfort of a single or studio homes in the heart of nature. The housing association, which consists of separate wooden mini-houses, consists of eight 42 m^2 two-bedroom apartments and seven 21.5 m^2 studio apartments. The lightweight fill foundation and frost protection of the mini-houses were implemented cost-effectively from Leca® lightweight aggregate, and the choice was also influenced by good experiences with the material and material supplier.

REDUCING VERTICAL LOADING IN GEOTECHNICAL ENGINEERING

Did you know Leca Lightweight Fill is extensively used by engineers and designers to reduce vertical loading? When applying Leca® lightweight fill against retaining walls, weight can be significantly reduced on the rear of the structure by at least 75%, when compared to traditional fill materials.

NORTHERN EUROPE'S LARGEST GREENROOF PARK COMES TO LIFE

The roof park is full of Leca LWA. It is mixed into the soil to reduce weight and to improve growth conditions for the plants. With an area of almost eight thousand square meters are five thousand of them soil, where various herbs, berry varieties, fruit trees and grape vines have been planted, Økern Portal is Northern Europe's largest roof garden.

A sustainable community between industry and the local environment. The planting of the roof ensures natural storage of water, in addition to binding dust, equalizing temperature fluctuations and delaying the drainage of rainwater. The building has so far achieved a BREEAM-NOR certificate to Excellent level for the design phase. It requires holistic environmental thinking in all phases of the project.

ONE SINGLE CLAY PELLET DOESN'T REPRESENT A LOT
BUT MANY CLAY PELLETS CREATE A BETTER FUTURE

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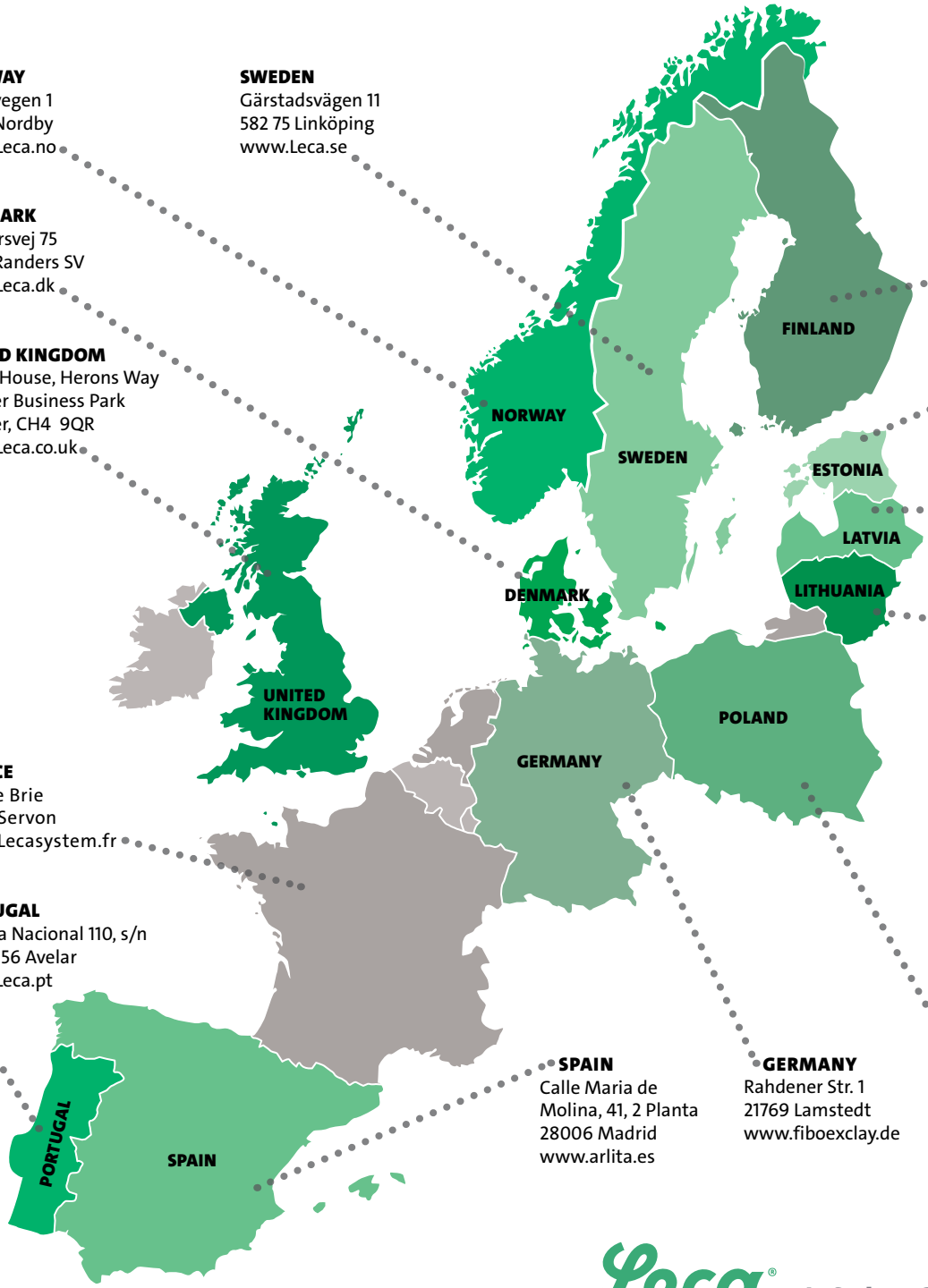

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