LECA® GREEN ROOFS

Leca is a natural lightweight product with good colonization capacity and easy handling

THE PROBLEM

Heavy rain causing floods and extensive damage to cities has become an increasing problem in recent years.

THE SOLUTION

Green roofs with Leca Lightweight Aggregate (LWA) can help by retaining and even cleaning the water.

Green Roofs have become popular in recent years.
This is essentially the result of its versatility within urban development, creation of open spaces, ecological uplifts and the economic/protective elements they create.

INTRODUCTION

The growth of our cities and the loss of open spaces have led to a considerable deterioration of living standards. In many areas we are able to learn from the mistakes of the past and plan for large green areas in residential, commercial and industrial complexes, designed to improve living and working conditions.

Green areas

The use of rooftops as gardens has meant that additional green areas can be created in property developments. Areas that were not previously utilised can be made useful and green. The result is a direct improvement of where we live and work and furthermore, increases our sense of well-being.

Habitat and biodiversity

The ecological benefit of a verdant rooftop is partially the result of the storage of rainwater and its reintroduction to the natural water cycle, of the increased humidity of the air, of dust control, of the improvement of the microclimate and of the creation of a habitat for plants and animals.

Building physics

In addition, an important aspect of the green roof for the designer or owner of the building is the protection of the construction that lies under the roof. The vegetation over the roof provides acoustic insulation as well as thermal insulation, both against summer heat and winter cold. There is also the benefit of a minimization of the ageing of the roof caused by UV rays.

Water Management

A well designed green roof will provide a run off drainage system facility for rain water and reduce the likelihood of flooding.

Green roofs store rainwater in the plants and growing mediums and evaporate the water back into the atmosphere. The amount of water that is stored on a green roof and evaporated back is dependent on the growing medium, its depth and the type of plants used. In the summer, green roofs can retain 70-80% of rainfall and in winter up to 25%. This retention could make a huge difference in water management systems.

Planting grass, shrubs, flowers and even trees over the roof slab can transform a forgotten area of the building into a private garden.

Green roofs cool down the surroundings

“Planting trees and arranging green areas will, alongside creating a beautiful living environment, cool down the surrounding area. Projects have proven that by covering London with green roofs, green areas and correct water elements, the temperature can drop by 8°C. Furthermore, if you add the impact from eliminating dark construction surfaces, the temperature impact will be even greater.”
Bjørn Lomborg, “Cool it” and reference “Greater London Authority, 2006”

LECA® IN GREEN ROOFS

It is possible to apply Leca LWA on every type of flat or slightly sloping roof of a building, underground car parks, etc. There are two types of green roofs, extensive and intensive, differentiated mainly by the cost, depth of growing medium and the choice of plants. There are numerous reasons for choosing Leca for this purpose:

- Natural, light-weight product
- Neutral and inert
- Lends support to root growth
- High air conductivity
- High hydraulic capacity
- Resistant to freezing
- Structurally stable
- Good thermal and acoustic characteristics
- Fire resistant

Leca® lightweight aggregate can be blown directly into place from blowing trucks with a hose and then manually spread to form the landscape. This makes delivery and placement easy, even when working at a height where the delivery can be a challenge.

GREEN ROOF LANDSCAPING

When developing a green roof as an area for recreation, very often it will be built over difficult roof angles and delicate terrain. Lightweight solutions are preferable to avoid limiting extra load on the underlying structures. A well proven and efficient solution is to use Leca lightweight aggregate (10-20 mm).

Leca LWA can be installed through pneumatic blowing and then covered with a geotextile and reinforcement mesh to stabilise the whole structure. The remaining layers can then be designed for extensive or intensive green roofs.

Under walkways and other traffic areas it might be necessary to do a light vibration with a small vibrating plate. The final cover of the walkway could be paving stones or fine gravel.

Ventilation shafts and other technical installations on the roof top can be covered in Leca layers, transforming the roof area into a nice and green public area or private garden.

Case Study:

Roof garden Emporia Malmö

Volume: 10,000 m^3 Leca 10-20 mm

Location: Malmö, Sweden

Solution:

At the top of the shopping centre Emporia is a lovely roof garden. In addition to magnificent views around Malmö, the green roof also has many technical and environmental advantages. It suppresses noise, slows stormwater downfall and reduces the need for stormwater systems. Additionally, it insulates the roof and acts as a heat buffer. This reduces the required energy to keep a balanced temperature.

Why Leca?

Expanded clay provided both the drainage and light weight properties required for the construction. In addition the possibility to pneumatically blow the material meant it could be delivered directly into the place of installation without any further handling on the building site.

Experience:

The solution proved to be cost effective during installation. The drainage properties worked according to expectations. The pneumatic blowing facility required a blowing distance of 150 m and almost 240 m^3 was blown during one working day. Transporting 10,000 m^3 of aggregate onto a roof was a challenge, but the choice of Leca LWA handled this issue and provided additional benefits to the whole logistics process.

Case Study:

Roof garden Copenhagen

Volume: 1,000 m^3 Leca 10-20 mm

Location: Copenhagen, Denmark

Solution:

The green roof was constructed with four-and five sided sloping areas. From the centre is a decrease of 120-150 cm out toward the corners. From the centre and out to each corner are mounted steel rails which forms a sharp edge in the grass coating. The green roof is placed on top of a parking facility two floors up. Geotextile and 30 cm of soil was placed on top of Leca light-weight aggregate. A watering system was constructed and a pre-grown lawn was delivered and installed.
Areas designated as footpaths were constructed with a 30 cm layer of Leca lightweight aggregates and this was completed with an asphalt finish.

Why expanded clay:

Leca lightweight aggregate was chosen for this project for a number of reasons. The product is light weight, but could also be pneumatically delivered. This made installation and placement easy, even when working at a height where the delivery posed a real challenge.

The Leca lightweight aggregate was pneumatically blown into place and was then manually spread to form the landscape and was then compacted with lightweight vibrating plates. The drainage properties created by Leca lightweight aggregate also provided a significant advantage for the project.

Experience:

Even though the gardeners had never worked with Leca light-weight aggregates previously, the pneumatic blowing delivery and manual handling of Leca lightweight aggregate provided a very positive experience.

Case Study:

Roof garden Liverpool

Volume: 9.000 m^3 Leca 10-20 mm

Location: Liverpool, UK

Solution:

As part of the regeneration of the Liverpool waterfront, a multi-storey car park and number of high street stores was constructed deep beneath an existing green scape set amongst futuristic new buildings. As part of the plan, the park would remain to hold future function and a place for relaxation, how-ever the significant loads above the new structure needed to be considered.

Why expanded clay:

To reduce loading on the new structure, Leca LWA was used throughout the site to form new landscape features. At only one seventh the density of traditional crushed fill and freer draining than soil, the expanded clay provided a lighter, easier to handle solution, particularly when forming green features at the centre of the development. The added advantage of moisture retention within the pellet when used within the feature raised floral beds will help maintain moisture in the soil and feed the vegetation. Expanded clay is free draining and assisted in the eco-friendly plan to recover water during wet weather ready for recycling through irrigation across the park during dry periods.

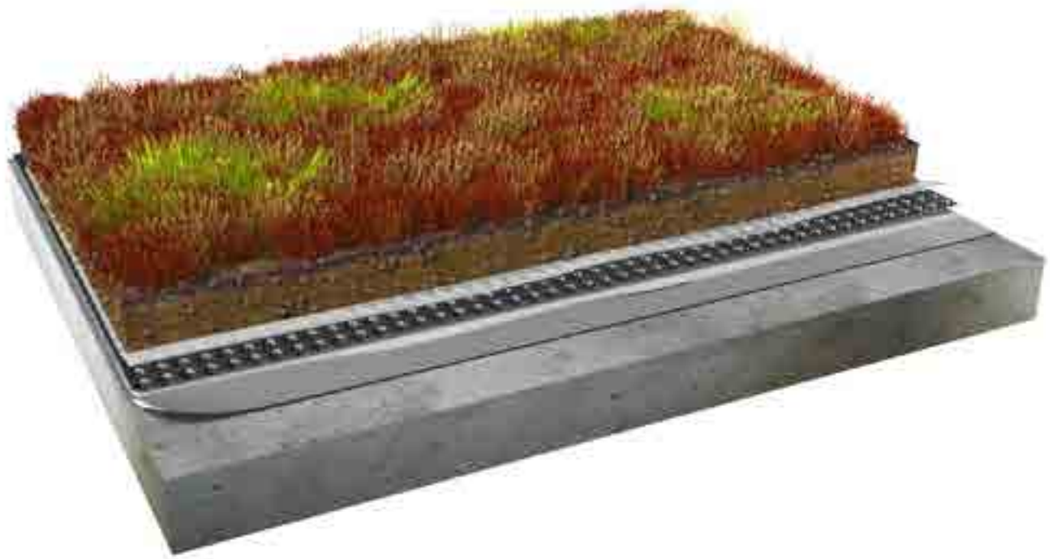
Experience:

An estimated 9,000 m^3 of Leca LWA was used during the project, which was completed in spring 2008, as the city celebrated its year as the European Capital of Culture. The park, shopping complex and car park is fully operational, encompassing 46 individually designed buildings providing 200,000 m^3 of shopping, including many of the major names in UK retail.

EXTENSIVE GREEN ROOFS

Extensive green roofs are characterized by their low weight due to limited thickness (typical 50 – 150mm growing media thickness) and very special plants which must be low and hardy, typically alpine, dry land, or succulent plants. Sedum type plants are commonly used. The growing medium, typically made up of a mineral-based mix of sand, Leca and peat is designed for the chosen plants.

Typically the plants are watered and fertilized only until they are established, and after the first year, maintenance consists of two visits a year for weeding of invasive species, safety and membrane inspections.



Case Study:

Roof garden Cete Nancy

Volume: 25 m^3 expanded clay (total surface of the green roofs = 600 m^2

Location: Nancy, France

Solution:

The French public organization for research on civil engineering and environment, the Regional Laboratory for Civil Engineering in Nancy (Laboratoire Régional des Ponts et Chaussées - LRPC) has renovated some of the roofs of its buildings and built 6 roof gardens to be used for experimental set-ups over a couple of years. The objective was to test 9 different types of green roof structures to analyze their impact on :

- Thermal insulation for the buildings
- Heat buffer
- Water quality
- Development of vegetation and biodiversity

Leca LWA was installed on 5 of the 6 roof gardens as a drainage layer

Why expanded clay:

Expanded clay is widely used today in green roofs, because it provides both drainage and light weight properties. The objective was to analyze its impacts compared to other lightweight synthetic structures and in association with different substratum and vegetation.

Experience:

The water quality from the experimental scheme has been studied for over 2 years on the 6 roof gardens. Expanded clay in combination with various substratum and vegetation is able to filtrate heavy metals like cadmium, chromium, copper and lead from rainwater. The results have shown that this filtration capacity will go on for more years.

- Designer: LRPC of Nancy
- Owner/Builder: Ministry of Research and Ministry of Ecology

INTENSIVE GREEN ROOFS

Intensive green roofs are characterised by their use as a 'garden' in much the same way as people would use a garden at ground level. In having an increased soil depth (20 – 200 cm), plants can be more diverse and utilize trees, shrubs and other landscaping aspects. This allows for the development of a more complex ecosystem. Requirements for maintenance - especially watering - are more demanding and ongoing, and irrigation systems are usually specified. Structural and horticultural consultation and an experienced installer are recommended.

Leca LWA can be used in the growing medium mix and as an efficient drainage layer. By using different types of Leca aggregates, the drainage or retention of rain water can be optimised.

Case Study:

Roof garden Bjørvika, Oslo

Product: Leca 10-20 mm and 4-10 mm

Location: Oslo, Norway

Green roofs and roof gardens are helping to make the city greener even when it is built amongst tall and close proximity buildings.

Using Leca LWA on the roof is very practical. The light weight properties make it easy to work with and gives a good basis for crops and plants, says Jostein Sundby, gardener at Vital Vekst AS, a Norwegian company that specializes in the construction of green roofs on apartment buildings.

The method is widely used elsewhere in Europe, and has in recent years become more popular in Norway. In Bjørvika, a new and modern city centre of Oslo, the authorities have made a requirement that half of the roofs must be green.

Retention

The main reason for the green roofs in new construction is that it often disrupts and destroys the natural drainage in the area. To remedy this problem green roofs are used for drainage, water storage and retention. The water is held back to avoid overloading the drainage system, this prevents damage and flooding on the ground level.

At only one seventh the density of traditional crushed fill and freer draining than soil, the expanded clay provides a lighter, easier to handle solution.

LECA® AGGREGATES FOR GREEN ROOFS

Leca lightweight aggregate is available in a number of types. The table below gives some examples of the variety; please contact Leca UK for more information.

The properties listed in the table (Fig. 2) are the key properties for materials to be used in the drainage layer of a green roof and other systems for water management, according the German FFL-guideline (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e. V.; Guidelines for the Planning, Construction and Maintenance of Green Roofing 2008).

Water retention characteristics

A vital characteristic is the material's ability to retain water, and hence delay the run-off from a green roof. The coefficient of discharge as listed in the table is tested according to FLL. The graph (Fig. 2) clearly shows the variation in retention effect depending of the type of Leca material used. The values is based on a test setup of a roof with 2% inclination and layer of 200 mm Leca aggregates.

Runoff intensity

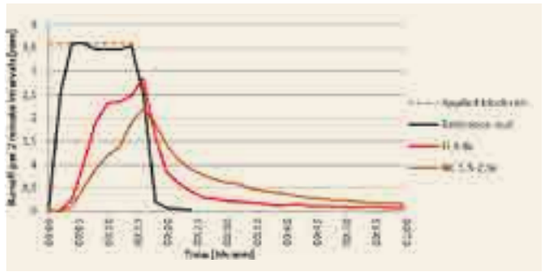


Fig 1: Runoff intensity the first 60 minutes

Total runoff

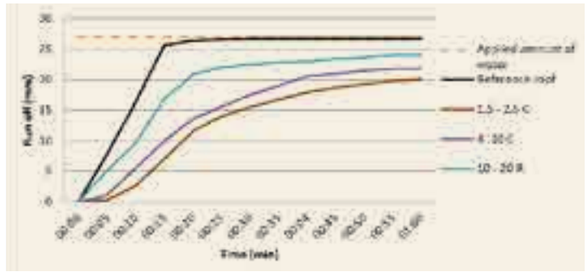


Fig 2: Total runoff the first 60 minutes

Fig. 2 is showing the total runoff the first 60 minutes after a defined amount of rain is applied. In the test setup 27 mm rain was added during 15 minutes. E.g. by using the aggregate size 1,5 – 2,5 the total runoff after 20 minutes is less than 50 % compared to the reference roof. This delay could make a huge difference to manage water in the downstream water management systems.

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