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Maximising the lifespan of polymer geocellular drainage systems

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Introduction

The use of Sustainable Drainage Systems (SuDS) has become a key requirement of the planning process in the UK, as a response to climate change and urbanisation. Put simply, SuDS aim to replicate the natural pathways of water[1]. Impermeable surfaces prevent the infiltration of surface water into the soil and so infiltration takes place in other areas, such as soakaways. Where infiltration is not possible or desirable, surface water is 'held back' (attenuated) and discharge controlled to reduce downstream flooding. Plastic geocellular systems can be used for either infiltration or attenuation and offer advantages for the designer in that they offer high porosity (typically >95%) and are installed underground (i.e. they do not take surface area).

Geocellular boxes can be manufactured by injection moulding (a variety of box structures, with and without internal support columns), extrusion (typically honeycomb geometries) or by joining thermoformed sheets. Materials most commonly used are polypropylene and polyvinyl chloride and can be 100% virgin material, 100% recyclates or a mix of both.

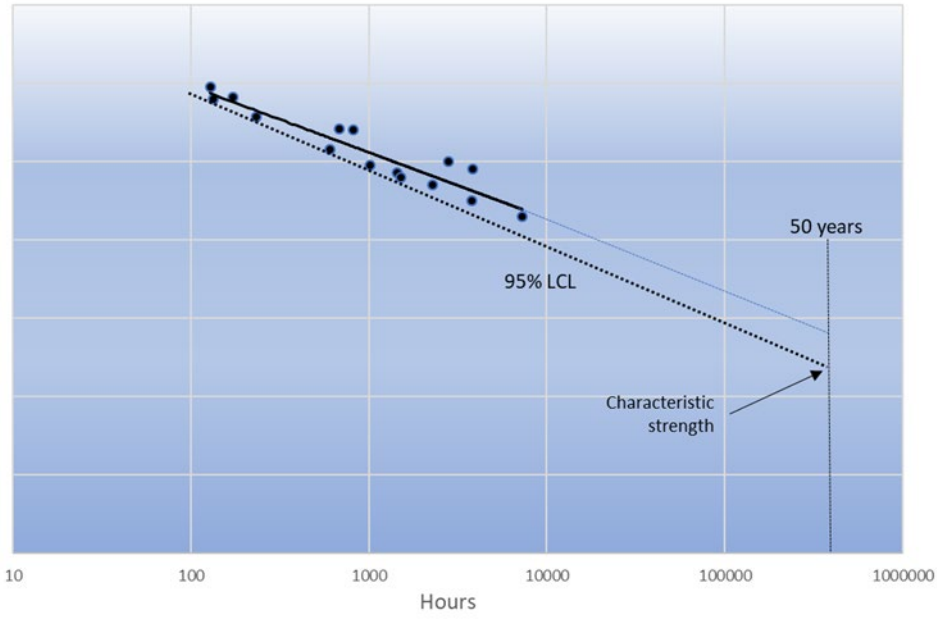
Geocellular systems have been in use since the late 1980's so there is a lot of experience in designing both the products themselves and their application. Design guidance has evolved over time but failure of geocellular units is relatively rare. Most of the failures that have been seen are attributable to poor construction and temporary works or poor understanding of ground or groundwater conditions. A few have been attributed to the boxes having inadequate long term strength for the actual site situation.

Testing procedures to achieve design life

By virtue of being installed underground, geocellular systems can be considered as geotechnical structures. The general principles of designing structures to withstand long-term loads are well established. However, their application is generally for rigid structures such as concrete bridges[2]. The behaviour of thermoplastics is more complex and the reaction to both short-term loading (such as vehicular traffic) and long-term loading (typically soil surcharge) need to be considered.

The product standard BS EN 17152-1[3], along with material tests, requires product testing to determine characteristic short-term strength[4] and characteristic long-term strength[5]. In the case of the latter, a series of creep rupture tests are carried out to determine when failure occurs at different loadings. A regression analysis is then carried out to extrapolate the results to 50 years, and a 95% Lower Confidence Limit (LCL) is then declared as the characteristic strength at 50 years (see figure). This determines the long-term load that can be applied without failure over the design life of the installation. Note that 50 years is a design point, common across many products, and is not the same as the expected lifespan.

Figure 1 Regression analysis showing characteristic strength at 50 years



A designer can compare the characteristic strengths with the expected loads (with many safety factors included) to ensure that the installation does not fail, either by collapse or by deflecting more than allowed at the surface.

Depending on the intended land use above the tank, a box with additional testing outside of the European Standards may be required. A prime example being cyclic or fatigue testing for boxes that are installed under highways or heavily trafficked areas. However, as these types of installations are generally avoided, most boxes are not tested to such a level.

Once the design has been made to ensure no failure within the design life, how do we maximise the lifespan of the installation?

Design considerations

There are several variables to consider when undertaking the design of geocellular systems. Design characteristics change considerably from site to site, depending on permanent and temporary loads, soil characteristics, and depth of installation. Until 2025 there were different design methods that could be used in the UK, and across Europe. Adopted in the UK as PD CEN/TS 17152-4[6], design guidance, developed by European technical experts specifically for geocellular systems, is now considered 'state of the art'.

Members of the BPF Pipes Group would generally recommend the following is observed during the design process.

- Design to be carried out by competent engineers.
- Use recognised design guidance along with the manufacturer's recommendations.
- Investigation of ground conditions on site to determine soil types and groundwater level.
- Ultimate limit state analysis to check all loads potentially acting vertically and laterally on the tank.

  - Short term loads caused by traffic movement above.
  - Long term loads applied by soil pressure or semi-permanent objects like construction stockpiles and temporary buildings.
  - Accidental loads if heavy traffic or construction plant unintendedly travel nearby.
- Compare calculated loads against the most current product information from the manufacturer.
- Apply suitable safety factors to the applied loads and product strengths.
- Serviceability limit state analysis to check tank deflection does not cause unacceptable differential movement to the surface above.

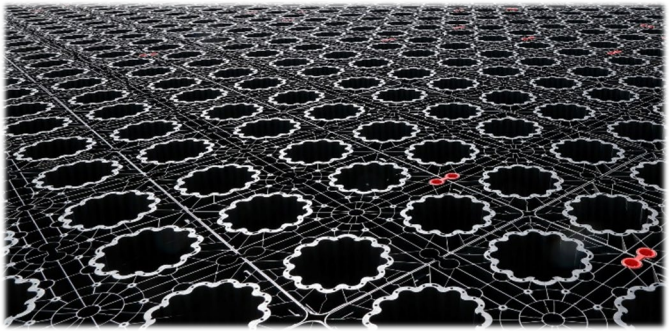


Image courtesy of ACO Technologies

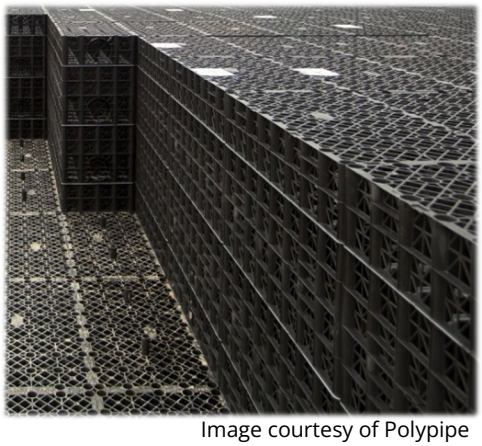


Image courtesy of Polypipe Civils and Green Urbanisation



Image courtesy of REHAU Water Technologies

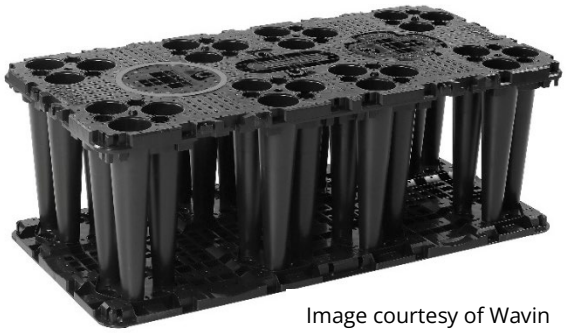


Image courtesy of Wavin

Installation

All geocellular systems should be installed as per the manufacturer's instructions. By doing so, all the original testing and subsequent design work remains valid. Also, as each system has its own nuances, there may be specific installation instructions that need to be followed. In addition to the boxes, membrane selection is very important. Not only for the tank to attenuate or infiltrate water as intended, but because a leak in the membrane can shift the surrounding backfill and concentrate the loads on the tank. There are also many other common installation factors that can help reduce the risk of failure.

- Installation to be carried out by capable installers.
- Items handled with care to avoid damage before use.
- Keep components within temperature limits by storing them away from direct sunlight and off frozen ground.
- Install on a flat and level surface.
- Avoid connecting custom made parts and stick to approved components from the manufacturer.
- Weld impermeable geomembrane joints and test for water tightness.
- Wrap geomembranes in a protective geotextile fleece.
- Backfill with the specified material and compact as per the installation instructions.

Further guidance on installation can be found in PD CEN/TR 17159[7].


Image courtesy of Wavin


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Maintenance

Maintenance is required to keep the tank operating as intended throughout its service life. If left unchecked the tank can lose storage volume through siltation and can also be left vulnerable to damage. Due to the different types of tank structures, some are better suited to prevent silt entering the tank, whereas others allow direct access to the tank for CCTV inspection. The product specific O&M Manual from the manufacturer will help ensure maintenance is carried out correctly. As for all SuDS systems, maintenance should be considered early in the design process, and there

are specific maintenance considerations that can help maximise the lifespan of a geocellular system

- Design tanks off-line rather than on-line.
- A siltation management plan that allows for storage capacity loss in the tank and includes silt treatment upstream.
- Pipe work entering the tank to be accessible for CCTV inspection.
- Not planting trees and shrubs above the tank without mitigative measures in place such as root barriers.
- Warning signs and barriers to prevent heavy vehicle access if not accounted for in the structural design.
- Location of the tank clearly defined on the maintenance plan, and on site, for easy future identification.

Sustainability

Geocellular systems used as part of SuDS contribute to the sustainability of developments, by mitigating negative impacts of water on the surrounding environment and ecosystem.

They can be used for rainwater storage as part of a water reuse system, reducing the demand for potable water for non-potable uses, thereby reducing the carbon footprint.

Plastic geocellular systems align with circular economy principles by virtue of their longevity. They are not so-called single use plastics but are engineered systems designed to last more than 50 years. However, should the installed system need to be removed for whatever reason, the polypropylene or PVC can be easily recycled and used, either in different products or to make new geocellular boxes, thus ‘closing the loop’.

References

1. The SuDS Manual CIRIA C753, 2015
2. BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design - General rules
3. BS EN 17152-1:2019 Plastics piping systems for non-pressure underground conveyance and storage of non-potable water – Boxes used for infiltration, attenuation and storage systems; Part 1: Specifications for storm water boxes made of PP and PVC-U
4. BS EN 17150:2019 Plastics piping systems for non-pressure underground conveyance and storage of non-potable water — Test method for determination of short-term compression strength of boxes
5. BS EN 17151:2019 Plastics piping systems for non-pressure underground conveyance and storage of non-potable water — Test method for determination of long-term compression strength of boxes
6. PD CEN/TS 17152-4:2025 Plastics piping systems for non-pressure underground conveyance and storage of non-potable water — Boxes used for infiltration, attenuation and storage systems: Part 4: Guidance for structural design of modular systems
7. PD CEN/TR 17179:2018 Thermoplastics piping and ducting systems - Rainwater infiltration and storage attenuation systems - Practices for underground installation