



GEA 2H Water Technologies Ltd



Storm Water Control

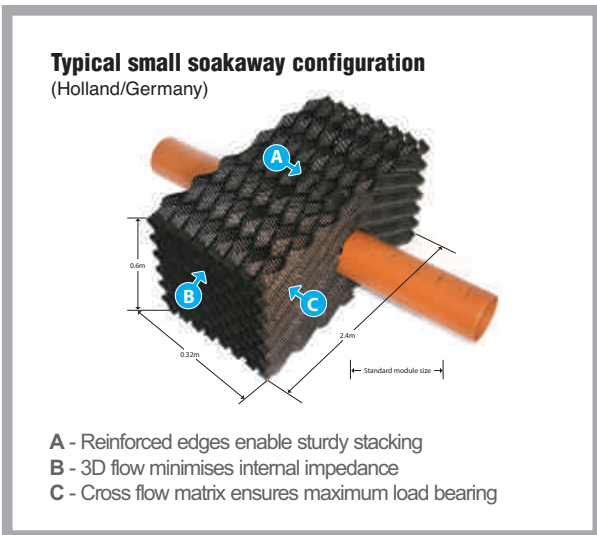
Design and Installation Guide



Sustainable Urban Drainage Systems (SUDS)

What is the impact of SUDS on Storm Water Control?

Systems based on modular box structures are increasingly being specified as they offer a high level of flexibility in terms of size and load bearing capacity. They are also simple, rapid and cost effective to install in all locations using basic civil engineering plant and as few as two groundworkers.



GEA 2H's SUDS Solution

GEODEK™ The most flexible solution

- Easiest and most cost effective to design and install
- A custom design as standard – the optimum mix of weights and sizes
- Options to match specific load bearing requirements
- Modular, lightweight and versatile
- Suitable for all applications from small, domestic to the largest commercial developments
- Produced from environmentally friendly PP

Why are SUDS important to building projects?

Storm Water Control is increasingly important in all building projects because:

1. Significant increase in water run-off rates

“Urban development has led to a large proportion of the land being covered by impermeable surfaces such as roofs, car parks, and roads. When rain falls on these areas, the surface water run-off rate rapidly increases resulting in potentially damaging water flow. There is, therefore, a need to re-channel this water flow in order to replace the natural flow control of the open landscape. SUDS are the means by which these water flows are re-channelled back to natural water storage areas such as aquifers.” [CIRIA C697]

2. Requirements to control storm water

Regulators (*Environment Agency, Scottish Environment Protection Agency, local authorities & European legislators*) are keen to promote the wider use of SUDS, which reduces the impact of surface-water run-off.

Two key reference documents are:

- *Building Regulations April 2002 (Part H3)* which introduced the requirement for storm water to be dealt with at source, rather than letting it travel to end of line areas.
- *Government Planning Policy Guidance Note (PPG25)* which states that “all new developments should collect, treat and, ideally, re-use storm water where it falls.”

Controlling storm water at source not only eases pressure on conventional drainage systems, but also benefits the environment both through the re-use of water as grey water and economically by allowing multiple use of development land, for example rainwater.





How do SUDS modular structures work?

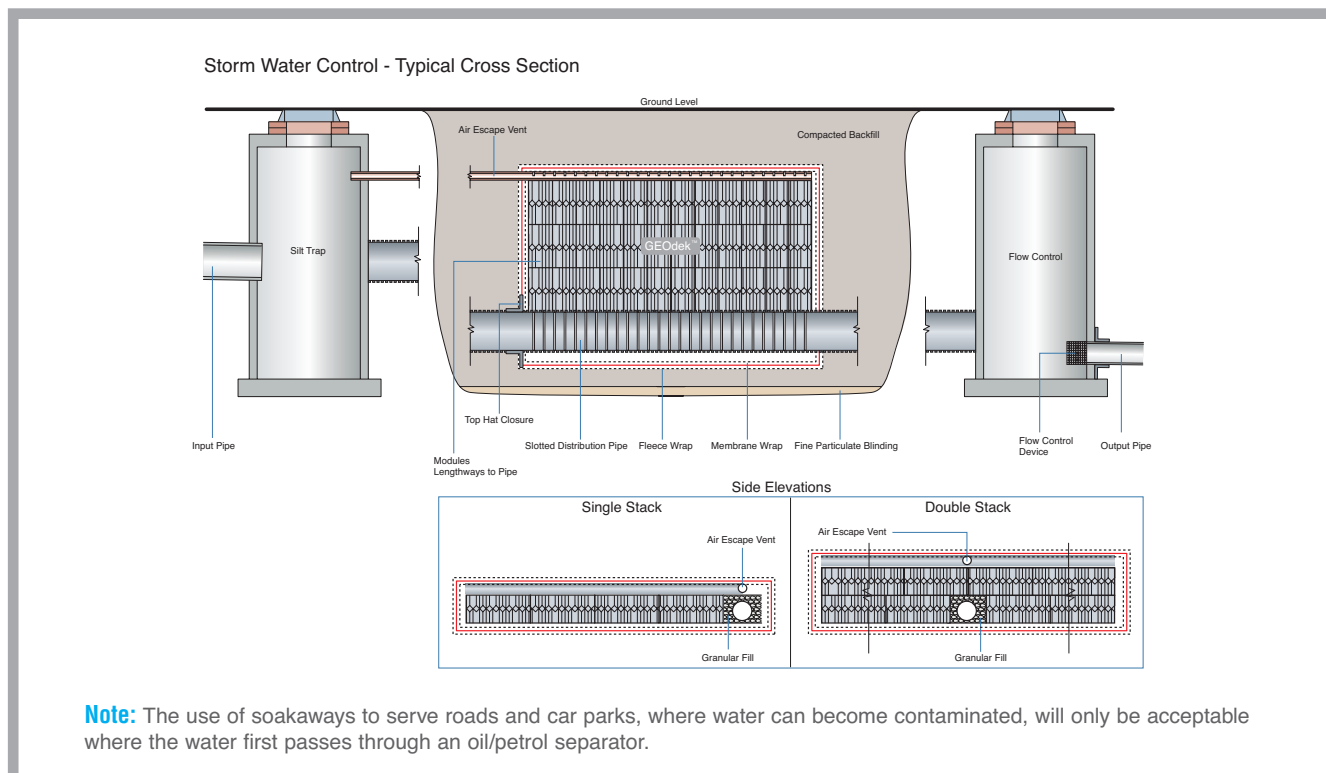
There are two methods of control:

1. Attenuation

Temporary water storage capacity that holds excess surface water during periods of peak rainfall. This water is then released in a controlled manner into the sewer system.

2. Soakaways

These structures store surface water run-off and gradually release it into the surrounding ground.



The GEOdek™ range

The most reliable and sustainable SUDS modular solution

GEOdek™ modular system is a tried and tested drainage system for underground storage and managed dissipation of storm water. Units comprise of individual, infiltration modules assembled to form underground storage structures for storm water attenuation or soakaways.

Manufactured from corrugated PP sheets, GEA 2H's unique technology permits the creation of boxes with a wide range of load bearing capacities tailor-made to each specific application. The units are assembled as a three dimensional matrix with a 95% + void rate, high compressive strength and low resistance to water flow.

The GEOdek™ Modular Range

The best modular SUDS technology

- High compressive strength - ideal for car parks and amenity areas: vehicular weights up to 60ton mgw (see typical stacking configuration diagram)
- Excellent Hydraulic Characteristics - high permeability offers low resistance to water flow
- Ability to be self flushing - as water enters GEOdek™'s laminar structure turbulence is created which disturbs any settled sediment promoting self flushing
- 95% + free volume compared to normal max 40% for standard soakaways
- The laminar design is not conducive to rodent infestation
- Proven vertical and lateral loading





To which building applications does this apply?

New and refurbishment requirements

Architects, Planners and Consulting Engineers must ensure that any new or refurbishment building project complies with run off water best practice. The proven qualities and performance of the GEOdek™ module range enables the creation of SUDS, an essential element of a developer's planning application.

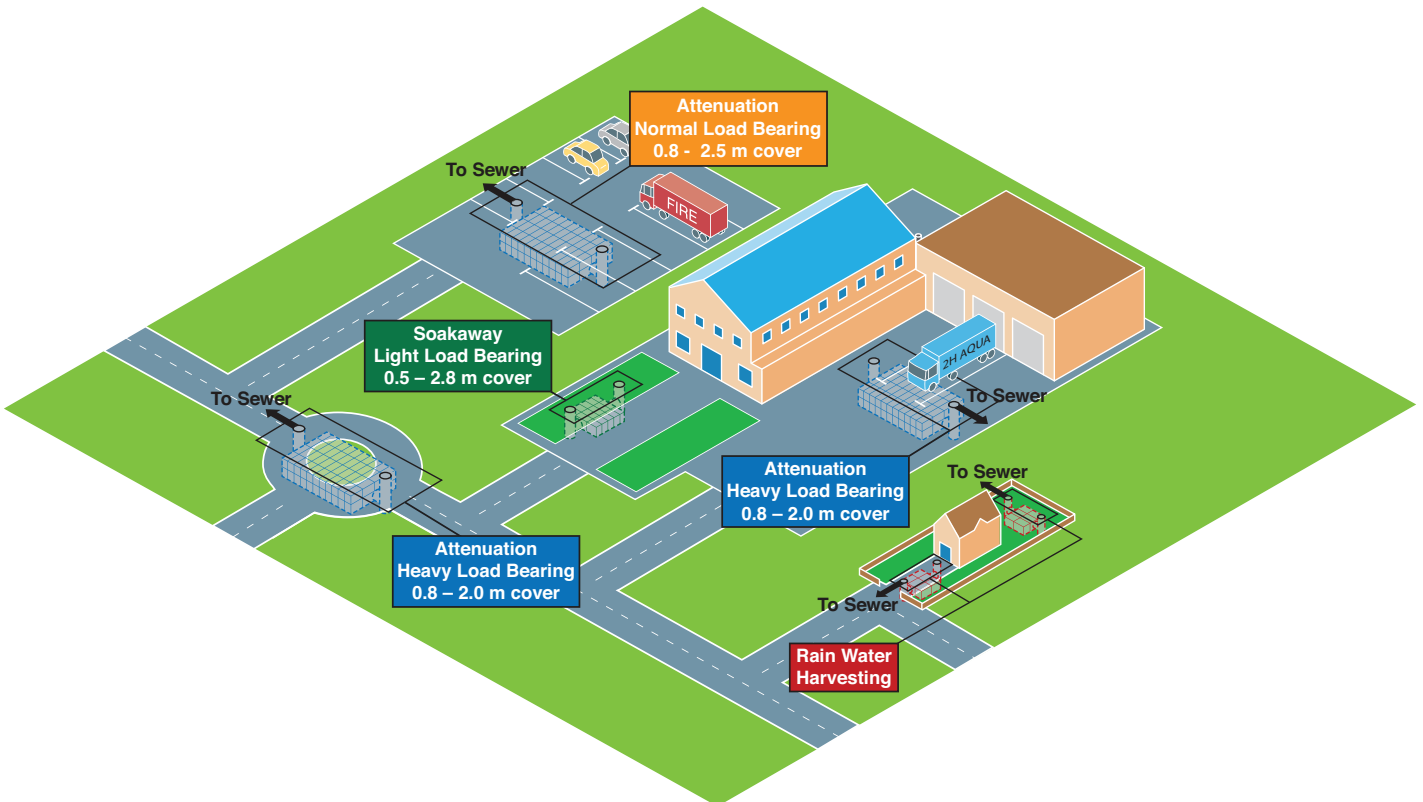
Applications can be grouped into two main categories:

1. Weight bearing or highly loaded traffic sites

- Car parks
- Residential developments
- Access Roads with slow moving traffic
- Industrial/commercial loading bays

2. Landscaped and domestic sites

- Roundabouts
- Domestic back gardens
- Grassed and leisure areas
- Domestic driveways



GEOdek™ modular system

Custom solution as standard

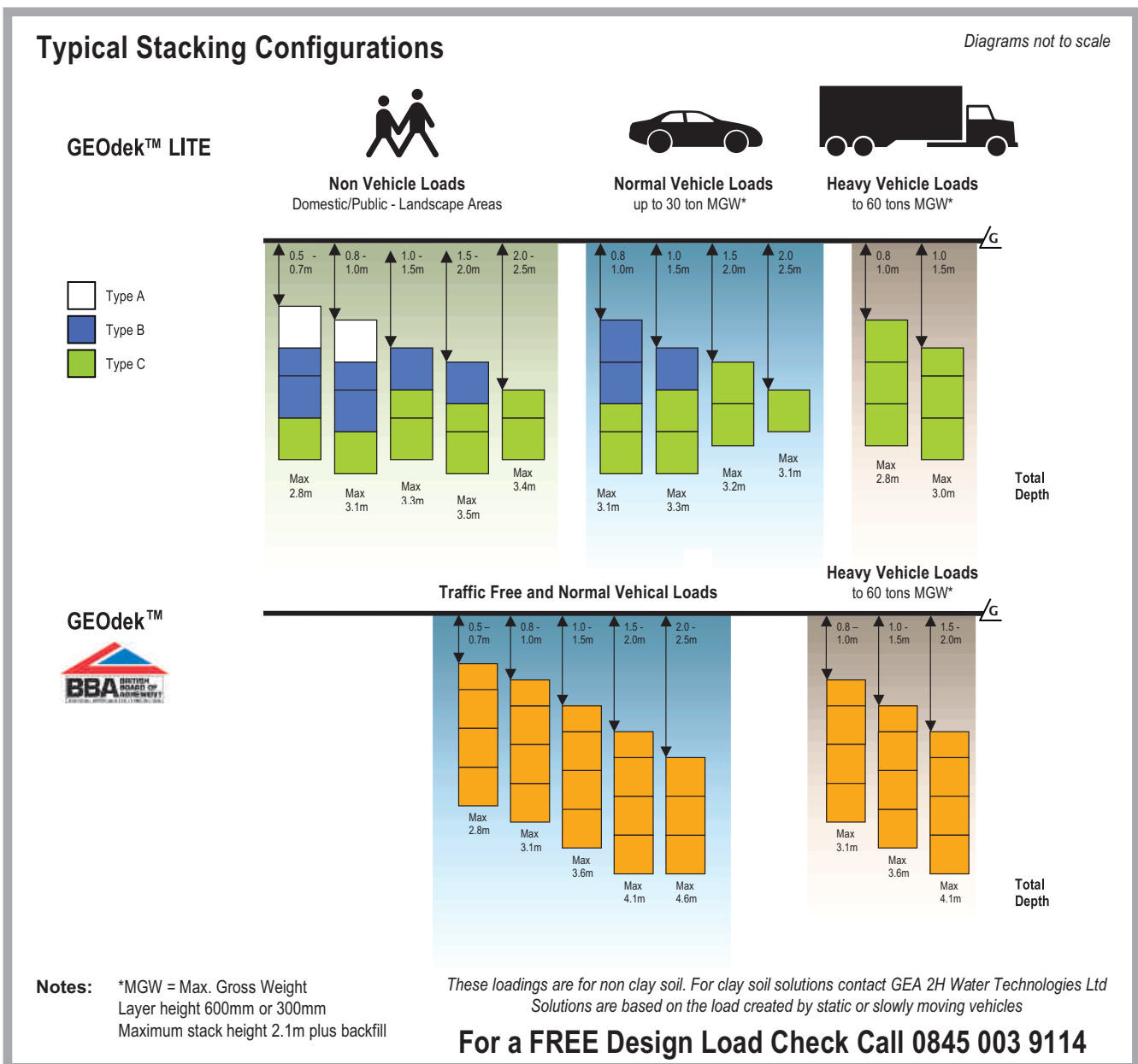
Total design flexibility

Whatever the application, the GEOdek™ range can provide a custom solution where the load bearing characteristics of the modules match the requirements of the site, and the application. This means that the developer is not limited to the fixed mechanical characteristics or cost of a particular box.

Only the GEOdek™ range can deliver this level of customisation to give you the design flexibility you require

- **GEOdek™** for all types of vehicles including commercial and articulated. BBA compliant.
- **GEOdek™ LITE** for landscaped or domestic sites, cars and light goods vehicle parks. German TÜV compliant.
- **GEOdek™ custom builds** for specific applications such as extra heavy loads or under roadways.

To guarantee structural integrity, any module design must have appropriate, proven top (vertical) and side (lateral) load bearing capacity and deflection characteristics. GEA 2H's solution allows the designer to choose GEOdek™ or different strength GEOdek™ LITE modules to match the type of vehicle load, catchment area, depth of cover and invert levels. The figures below show applications for static load bearing areas like car parks. These are based on standard GEOdek™ range modules.





Design Considerations

The storage capacity of SUDS is determined by the:

- Maximum outflow permitted, (set by the Water Company or Environment Agency)
- Impermeable area of the site
- Rainfall return period – normally either 1 in 30 or 1 in 100 years, (or as set by Water Co.)
- Soil type

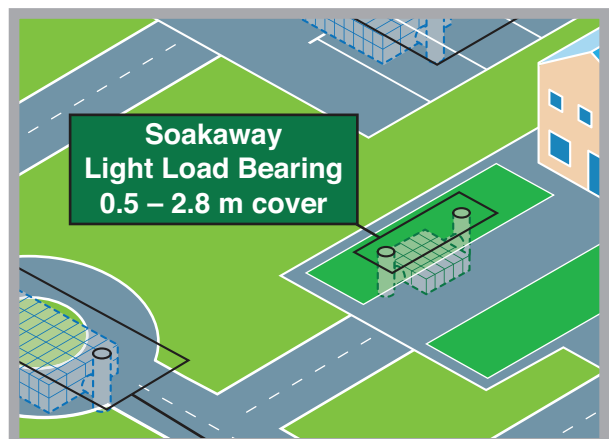
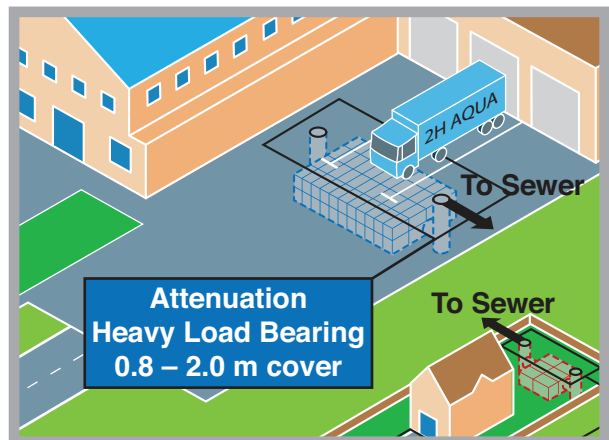
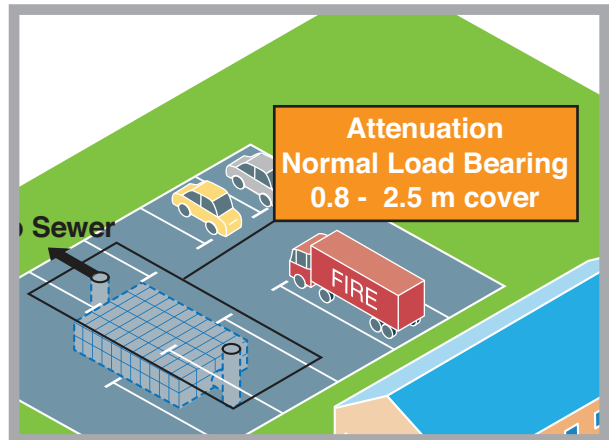
When designing a modular system the first matters to consider are:

- Type of traffic/loading
- Storage capacity
- Depth of cover
- Groundwater presence
- Desired invert levels

This information will determine:

- Whether to use the attenuation or soakaway method
- Overall dimensions of the tank
- The strength requirement of each GEOdek™ layer needed to achieve structural integrity

Design soakaways to BRE Digest 365(1) or CIRIA Report 156(2)





GEOdek™ - The facts

Vital statistics

GEOdek™ is a structural matrix formed from corrugated polypropylene (PP) sheets welded together by a GEA 2H patented process.

Size and weight

GEOdek™ is supplied as blocks, each nominally 2400mm long x 320mm wide x 600mm high with a nominal volume of 0.475m³. There is >95% free volume in each block or, for design purposes, >0.437m³/block. Each block weights ~ 21.4kg.

Tank Heights

Although GEOdek™ blocks can be stacked to minimise the tank's footprint the usual limit for load bearing SUDS structures is 2.1m due to stacking considerations. Consult with GEA 2H's technical department should block stack heights greater than 2.1m be required. To increase the designer's options on height a 305mm high block is available at no extra cost.

Cut to Fit

GEOdek™ can also be cut on site to conform to irregularities in the tank shape or to avoid structures which intrude into the body of the soakaway or attenuation tank. Only hand tools are required.

Mechanical property assurance

Solely virgin polypropylene polymer and internal process recyclings are used in the manufacture of GEOdek™. Only by using essentially virgin polymers can the consistent mechanical properties of the GEOdek™ range be assured.

Multiple strength options

Because GEA 2H's extrusion technology is used to form the sheets it is possible to vary at will their thickness and hence, their load bearing capability. This property moves GEA 2H away from the usual "One Size Fits All" product towards a "Horses for Courses" range of design solutions. This is the basis of the GEOdek™ LITE range.

By varying the strength of the PP sheets GEOdek™ LITE can be produced, in theory, in an infinite range of load bearing types. In practice, most situations are covered by four standard types:



• **GEOdek™** suitable for all situations up to and including articulated trucks (44 tons mgw)

• **GEOdek™ LITE** a range of strengths of which there are three standard types generally suitable for:

- Type A - Domestic applications and home rainwater harvesting systems
- Type B - Cars and vans (12 tons mgw)
- Type C - Light trucks and service vehicles (30 tons mgw)

Very heavy load options

Special grades can support vehicles up to 60 ton mgw when installed according to GEA 2H authorised procedures. Call the GEA 2H technical support team for design advice on exceptionally heavy loads.

Load bearing quality assurance

All GEOdek™ LITE grades have been independently accredited by the TÜV, the government sponsored, independent testing organisation in Germany, as suitable for 30 year working lifetimes under their appropriate load categories and when installed according to GEA 2H procedures.

GEOdek™ The Simplest & Fastest

SUDS modular box system installation...

- Economical, less expensive than concrete vessels
- Reduced excavation costs
- Easy and light to handle
- Simple rapid installation of blocks – 400+ m3 often takes only 1 day for a 3 man team
- Modular format offers total design flexibility
- Simple to cut to fit on site, exactly to your requirements
- Can be used in conjunction with rainwater harvesting systems for water storage
- Helps eliminate pollution when used with specialist oil/petrol separators
- Able to accommodate ground movement



NB. Depth of cover and stack height can influence the choice of module strength.





Installation, Material and Equipment Guide

Delivery:

The tank units are delivered to site on pallets. The weight, size and dimensions will depend on the type of unit being delivered. Deliveries should be unloaded using mechanical handling equipment eg forklift.

Storage:

Position the pallets on stable, level ground. Stacking of pallets is not recommended. Store the pallets away from direct sources of heat or ignition.

Excavation and preparation:

Excavate to tank formation level as specified on the drawings (formation is the ground that the tank is to be placed on). The sides of the excavation should be cut to the profile shown on the design drawings to ensure that excessive earth pressure is not placed on the sides of the tanks.

The formation should be smooth and free of sharp projections such as rocks, etc.

When excavation is completed the contractor should trim the surface to shape the formation and immediately compact with one pass of a smooth-wheeled roller having a mass per m width of roll not less than 2,100 kg or a vibratory roller having a mass per m width of roll not less than 700 kg or a vibrating plate compactor having a mass per m² of not less than 1,400 kg.

The excavation shall be kept free of water and appropriate ground water control methods shall be used if necessary. This is to prevent water reducing the strength of the formation and to allow construction of the tank.

Note: that if groundwater is present in surrounding ground the tank designer shall be advised to ensure that the tank has been designed to carry the horizontal water pressure.

Pockets of soft soil or loose rock shall be removed and the resulting voids and any natural voids shall be filled with Type 1 sub base material placed and compacted in accordance with the Specification for Highway Works.



Contractors are responsible for ascertaining that the substrate has suitable load bearing capabilities for the use to which the area is intended. Blind the formation with not less than 100mm of suitable graded granular material (e.g. zone II sand in accordance with Annex D of BS 5733: 3: 2005) & compact to provide a smooth bed finished to the design gradients & tolerances, free from sharp objects & projections.

It is the contractor's responsibility to ensure that the soil is suitable for a Soakaway.



Geotextiles and membranes

- Geotextile type is filter/protection fleece type (Fibertex F4 or similar)
- Impermeable geomembrane type is 0.8 - 1.00mm pvc/or elastomeric type
- Geotextiles and related products should conform to BS EN 13252(2001)

Lay down the geotextile protection fleece if required in the design and join all seams in accordance with the manufacturer's recommendations.

In addition for an attenuation application, lay down geomembrane and join all seams in accordance with the manufacturer's recommendations. The membrane should be a robust flexible impermeable membrane with high resistance to puncture and elongation. Preferably it should be capable of being welded. The final membrane selection will be dependant on site-specific conditions.

Other methods of joining geomembranes such as gluing or taping should only be undertaken strictly according to the manufacturer's recommendations.

The geotextile and/or the geomembrane should be laid flat and free from any folds or creases. Ensure the liners are dry, clean and free from debris before installing the stormwater storage modules.



GEOdek™ module fitting

Check the design drawing and details to confirm the installation requirements.

Install the first layer of units making sure that individual units are placed tight against each other and cannot move. The water distribution holes in the lower layer should be aligned together through the whole tank.

For more than two layers the boxes in each layer should be placed at right angles to those below to form a bonded structure.

For tanks with more than one layer all the units must be fully supported by the layer below with no overhangs and no units spanning over gaps in the lower layer.

Whilst assembling the tank, it may be necessary to walk on top of previously laid blocks; care should be taken not to damage the edges. On completion, the tank should form a stable and robust structure that does not move.





Completion of membrane and geotextile

The membrane and/or geotextile should be wrapped up and over the tank and joined or sealed in accordance with the manufacturer's recommendations. The membrane and/or geotextile should be free of creases or folds and be wrapped as tightly as possible to the units.



Pipes and connections

Where a slotted inlet pipe runs through the tank and is surrounded by pea gravel, care should be taken to avoid voids. It is recommended that a light compacting of the pea gravel should be undertaken.

Care should be taken to provide sufficient length of a slotted pipe to dissipate the maximum flow within the media. For example, manufacturer's data for a 600mm diameter pipe indicates a maximum flow of circa 450l/s. In this case a 6.5m pipe run would be required. When necessary all penetrations through the membrane or geotextile should be sealed.



In attenuation applications

An impermeable seal should be formed around the inlet and outlet pipes using preformed 'tophats' manufactured from compatible material to the main membrane. These are then encapsulated and heat sealed and strapped tightly round the pipe, again in accordance with the manufacturer's recommendations. Air escape pipes, venting to atmosphere, should be laid between the GEOdek™/GEOdek™ LITE and the membrane.



For soakaway (infiltration) applications

A correctly sized aperture for the inlet pipe should be neatly cut out and the loose edge sealed with a manufacturer approved water resistant tape. The minimum tape width should be 100mm.





Backfilling

Sides

For attenuation applications (sealed tank) the backfill to the sides of the tank shall comprise Class 6N material in accordance with the Specification for Highway Works. Compaction should be carried out with a non-vibrating roller in accordance with the Specification for Highway Works. The weight of the roller shall not exceed 0.3 tons.

For soakaway (infiltration) applications the backfill to the sides shall be Type B filter material in accordance with the Specification for Highway Works.

Top

Backfill over the top of the tanks should be placed using an excavator with suitable reach. Excavators and other plant should not travel over the tank when it is uncovered. Do not allow trucks or dumpers to travel onto the boxes to tip material.

Note: For GEOdek™ LITE Type A units the backfill shall be placed to a maximum depth of 1.0m and the backfill shall not be compacted. **Type A units are designed for pedestrian and other domestic use only.** No traffic shall be allowed to pass over Type A units regardless of the depth of fill placed over them. Backfill with an even layer of Class 6N material in accordance with the Specification for highway works up to 300mm depth. Compaction should be carried out with a non-vibrating roller in accordance with the Specification for Highway Works. The weight of the roller shall not exceed 0.3 tons. Continue to backfill in 150mm layers using material shown on the design drawings and compacting with a roller not exceeding 300kg weight.

Do not allow:

- Trucks or dumpers to travel onto covered boxes to tip material.
- Traffic to travel over the backfilled tank until the minimum level of fill shown on the design drawings has been reached.
- Heavier vehicles than those stated on the design drawings to travel over the units.
- Cranes to place any wheel or spreader plates over the units.

If the tank has been designed for use below an area without any traffic loading, fence off the area of the tank to prevent accidental trafficking by site vehicles.

Pavement or landscaping construction

Pavement or landscaping construction shall be to the Architects or Engineers design and specification. Any landscaping or pavement design alteration should not change the design thickness of fill over the tank without the prior written approval of GEA 2H.

Site Safety

Effectiveness after Completion...

- The display of maximum vehicle weight signs around the tank area is advisable.
- The fencing off of the area during the construction phase is strongly recommended.
- The excavation shall at all times be kept free of water and all ground water control methods shall be used if necessary. This is to prevent water reducing the strength of the formation and to allow construction of the application.
- It is the responsibility of the owner/operator of the site to ensure that the tank is used for the purpose for which it was intended and designed.
- Restrictions to access and clear signs prohibiting unsuitable vehicles are recommended. Failure to do so can invalidate any warranty which may be in place.

References

Government Planning:

PPG 25 Part 3: April 2002 - Government planning policy guideline

Highways Agency:

Manual of contract documents for highway works, specification for highway works. (1998) (Also covering, Scottish Executive, National Assembly for Wales and Department for Regional Development Northern Ireland)

- BD12/01 Volume 2, Section 2, Part 6
- BD21/01 Volume 3, Section 4, Part 3
- BD37/01 Volume 1, Section 3, Part 14
- BD86/01 Volume 3, Section 4, Part 19

CIRIA:

- C698: Handbook for the construction of SUDS
- C698: CIRIA Report 156(2)

Building Regulations:

- BRE Digest 365(1)

British Standards referred to:

- BS7533: Part 3: 2005 - Pavements constructed with clay, natural stone or concrete pavers - Code of Practice for laying precast concrete paving blocks & clay pavers for flexible pavements.
- BS6399: Part 1: 1996 - Loading for buildings - Code of Practice for dead and imposed loads

DIN Standards:

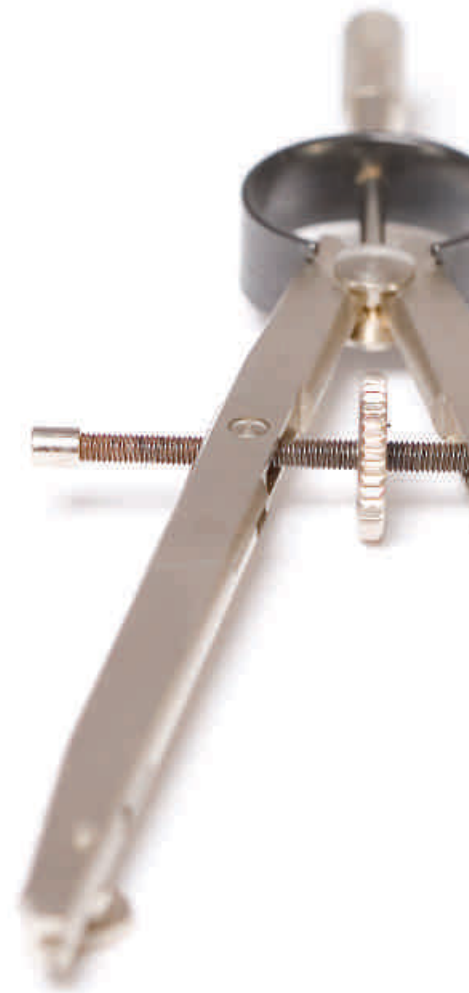
- DIN 1072 Roads and Footbridges - Design Loads
- DIN 8078 Types 1,2 & 3 polypropylene (PP) Pipes - Quality and Testing

Accreditation Bodies:

- British Board of Agreement Certificate Number: 08/4605
- TÜV - Germany

Independent Publication:

- Engineers Reference Book: 3rd Edition: L.S.Blake



GEA 2H Quality Assurance

- GEOdek™ - BBA accreditation for required strength and hydraulic capabilities
- GEOdek™ LITE - 30 year lifetime TÜV accreditation for 3 dimensional flow of water and air
- Global market leader of plastic media
- Certificates of conformity on all products
- Can meet NHBC technical requirements
- GEA 2H is accredited to ISO 9001 : 2000 – Certificate No. GB06/69223

Your local GEOdek™ Stockist:

GEA 2H Support

- Technical advice
- Design support
- Commercial and availability matters

Tel: +44 (0)845 0039114
Fax: +44 (0)845 0039115

Email: sales.2h.uk@geagroup.com
Web: www.gea-2h.co.uk



GEA 2H Water Technologies Ltd - Sketty Close, Brackmill Industrial Estate, Northampton NN4 7PL

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