Polystorm is a modular water storage cell with a high void ratio. The Polystorm system can be used for either attenuation or infiltration of stormwater.

The modular nature of the system facilitates quick and easy assembly on site. Multiple configurations, of either attenuation or infiltration storage, can be formed from standard stock items.

**Introduction**

- BBA certification pending
- 95% void ratio
- High surface permeability
- Lightweight and easily assembled
- Modular

**Features**
Standard Specification

Unit dimensions  
- Length - 1m  
- Width - 0.5m  
- Height - 0.4m  

Weight  
9 Kg / Unit

Void ratio  
95%

Storage Volume  
0.190 m³ / Unit

Surface perforated area  
45%

Key Performance Criteria

Ultimate compressive strength

Min 400 kN/m²  (Tested in accordance with BS EN 124:1994, Section 8)

Durability

When installed in accordance with Polypipe recommendations it is anticipated that the life of the Polystorm unit will be in excess of 50 years.

Resistance to chemicals

The components of the Polystorm system are suitable for use in contact with chemicals likely to be found in rainwater. Polystorm products are also resistant to all compounds occurring naturally in soils. Contact Polypipe for specific guidance on the use of Polystorm in soils contaminated with industrial waste.

Installation

Control of stormwater runoff from impermeable areas may be achieved in two ways:-

a) Attenuation

b) Infiltration

By slightly differing the installation, Polystorm may be utilised to achieve both of the above control methods. The main difference between the two control methods is the geosynthetic material used to encase the Polystorm units.

Attenuation

The Polystorm system is used to retain surface water during rainfall events and release it at a pre-determined rate, through a flow control device, into an appropriate outfall. The peak flow of water discharging from a site and downstream flood risk are thereby reduced. The attenuation system must have sufficient capacity to avoid the risk of upstream flooding.

The Polystorm units require a sealed geomembrane wrapping to create an attenuation storage tank and prevent:

- The release of surface water into the surrounding ground; and
- Inflow of groundwater that may overload downstream systems and contain pollutants on contaminated sites.

Selection of an appropriate geomembrane requires careful consideration. Refer to the “Specification of Geosynthetic” section.

The Polystorm attenuation tank must be ventilated to ensure proper hydraulic performance.

Infiltration

The system is used to facilitate the infiltration of surface water into the ground. The subsoil permeability and volume of rainwater runoff generated by a rainfall event dictate the size of the Polystorm system. This system effectively deals with surface water “on-site”, reducing or even eliminating the requirement for an off-site outfall.

The Polystorm units require a geotextile wrapping when used as an infiltration device to prevent:

· Silt that may be contained in the surface water runoff from contaminating the surrounding soil, in addition to reducing its permeability; and
· Surrounding soil from entering the units.

Selection of an appropriate geotextile requires careful consideration. Refer to the “Specification of Geosynthetic” section.

When designing the drainage system a Polypipe silt trap must be specified for connection into the drainage system just upstream of the Polystorm units. Polypipe are able to supply a range of silt traps that reduce the maintenance requirements of the Polystorm system and ensure it delivers the best possible performance.
Installation procedures should be carried out in accordance with the Health and Safety at Work Etc. Act (1974) and any other relevant legislation. Special attention should be paid to temporary work requirements in excavations.

Excavate to the required plan dimensions and level, ensuring that the excavation orientation will allow easy installation of connecting pipework. Consideration should be given to maintaining construction plant access for reinstating around the installed Polystorm units.

Ensure that the ground bearing capacity at the formation level is sufficient for the proposed operational loads. The base of the excavation should be smooth and level, free of large stones and soft spots. Any soft spots should be excavated and replaced with suitable compacted granular material.

The type of geosynthetic material used to encapsulate the Polystorm units will determine the installation requirements. Please note the following information is generic and advice from the geosynthetic manufacture should be sought to ensure that the appropriate protective measures are taken to comply with any proprietary requirements.

Place and compact a 100mm thick bedding layer of coarse sand. If required, line the base and sides of the excavation with a protective geotextile before placement of the impermeable geomembrane. Install the geomembrane, forming sealed joints in accordance with the manufacturer's recommendations, making an allowance for the connection pipework or adapters. To ensure that the integrity of the geomembrane has been maintained, it is recommended that an inspection of the material and joints is carried out.

**Attenuation application**

Place the Polystorm units in accordance with the construction drawings or as detailed in typical system arrangement on page 5. Ensure units are arranged so that they are in the correct alignment with the adjoining pipework. Polypipe clips connect horizontally adjacent units while vertical connections are formed with the Polypipe shear connector. Alternate layers of Polystorm units may be laid at 90° overlap with shear connectors being placed in the aligned corners of the unit. 160mm EN 1401-1 pipes connect directly into the convenient knock-out incorporated in the end of each cell. Connection to 110mm EN 1401-1 pipes or other products is accommodated through the use of standard Polypipe adapters. Polystorm units require ventilation (attenuation application only) to ensure proper hydraulic performance. Consideration should be given as to how this ventilation is to be installed.

Complete the geosynthetic encapsulation of the entire Polystorm structure, using the same materials in the bedding layer, forming joints where appropriate. Re-examine the geomembrane and/or geotextile for damage and joint integrity.

Backfill around the sides of the encapsulated units, forming a 100mm thick layer of coarse sand or Class 6H selected granular material immediately adjacent to the units as appropriate. Where required, remaining excavated areas around the units should be backfilled with Class 6N or 6P selected granular material, in accordance with MCHW, Volume 1, or similarly approved specification.

Above the wrapped Polystorm units, place and lightly compact a minimum 100mm thick layer of either coarse sand or Class 6H selected granular material (with 100% passing the 5mm sieve), in accordance with MCHW, Volume 1, Series 600.

Final backfilling of the installation and surfacing is dependent on the expected operational loads. (NB Compaction plant over and immediately adjacent to the Polystorm units shall not exceed 2300 kg/m width).

- **Field conditions (eg landscaped areas)**

  The backfill material that lies within 300mm above the Polystorm units should be free from particles exceeding 40mm in diameter, in accordance with Class 8 material to Series 600, Volume 1, MCHW.

  Final backfilling up to finished ground level may be achieved using selected as-dug material. Backfill material should be placed and compacted in layers no greater than 300mm, or in compliance with the approved specification.

- **Lightly trafficked (eg restricted access car park)**

  Backfill with Class 1 or 2 material in accordance with MCHW, Volume 1, Series 600. Backfill material should be placed and compacted in layers not greater than 150mm. Where the Polystorm units are installed beneath a paved area, the pavement sub-base may form part of the backfill material.
provided that minimum cover depths are maintained.

- Heavily trafficked (eg service areas or roads)

Contact Polypipe Technical Services for further information and guidance.

It should be noted that infiltration systems are not generally installed under roads due to the reduction in load bearing capacity of saturated soils. Specialist advice should be sought where this type of installation is proposed.

Complete pavement construction or landscaping over the Polystorm system.

## Structural Considerations

Loading design parameters for the Polystorm units have been derived from finite element analysis. Where Polystorm units are used for large-scale storage or infiltration structures the designer must consider all expected dead and live loads. Determination of the maximum allowable installation depth and minimum cover depth requirements may then be calculated.

Table 1 gives typical minimum depth requirements, when considering certain standard load conditions. Maximum burial depths are dependent on soil and water conditions. Consult Polypipe for additional advice and standard installation details for deep burial conditions.

### Table 1

<table>
<thead>
<tr>
<th>Live load Field</th>
<th>Light traffic</th>
<th>Car park with vehicle mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min cover depth</td>
<td>&lt;2500kg</td>
<td>&gt;2500kg</td>
</tr>
<tr>
<td></td>
<td>0.50m</td>
<td>0.60m</td>
</tr>
<tr>
<td></td>
<td>0.60m</td>
<td>0.75m</td>
</tr>
</tbody>
</table>

### Specification of geosynthetic

Careful consideration should be given to the selection of an appropriate geosynthetic. A recognised design methodology is to follow these steps:

1. Define the application filter requirements

   Retention (attenuation storage) or permeability (soakaway)

2. Define boundary conditions

   Site investigation to establish in-situ soil parameters, enabling lateral earth pressures and water flow conditions to be calculated.

3. Determine soil retention requirements

   Using the in-situ soil parameters, determine if additional bed and surround measures should be specified.

4. Determine geosynthetic permeability requirements

5. Determine anti-clogging requirements (Infiltration Only)

   Ensure that the porosity of the geotextile, in conjunction with the specified bed and surround, is sufficient to prevent the geotextile from prematurely clogging.

6. Determine survivability requirements

   Is the geosynthetic sufficiently robust to survive installation activities?

7. Determine durability requirements

   Will the geosynthetic be subjected to a significant chemical exposure, either present in the ground or rainwater runoff?

8. Miscellaneous design considerations

   - Intrusion of geosynthetic into drainage layer
   - Biological and bio-chemical clogging factors
   - Safety factors

Please note that the designer / installer should confirm with the geosynthetic manufacturer that the specification of the proposed material is suitable for the application and site conditions by following the above design methodology. Typical geosynthetic specifications follow.
Typical system arrangement
Attenuation

<table>
<thead>
<tr>
<th>Impermeable Geomembrane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Properties</strong></td>
</tr>
<tr>
<td>Thickness</td>
</tr>
<tr>
<td>Density</td>
</tr>
<tr>
<td><strong>Mechanical Properties</strong></td>
</tr>
<tr>
<td>Tensile strength, at yield</td>
</tr>
<tr>
<td>Elongation at break</td>
</tr>
<tr>
<td>Puncture resistance</td>
</tr>
<tr>
<td>Tear resistance</td>
</tr>
<tr>
<td>Stress crack resistance</td>
</tr>
<tr>
<td>Permeability coefficient</td>
</tr>
<tr>
<td>pH</td>
</tr>
<tr>
<td>Chemical / biological resistance</td>
</tr>
</tbody>
</table>

Please note, site conditions may require the use of thick protective geotextile to prevent puncture or excessive strain in the geomembrane. Please consult with the geomembrane manufacturer for further advice.

Infiltration

<table>
<thead>
<tr>
<th>Permeable Geotextile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Properties</strong></td>
</tr>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Mass</td>
</tr>
<tr>
<td><strong>Mechanical Properties</strong></td>
</tr>
<tr>
<td>CBR puncture resistance</td>
</tr>
<tr>
<td>Peak tensile strength</td>
</tr>
<tr>
<td><strong>Hydraulic Properties</strong></td>
</tr>
<tr>
<td>Water flow rate normal to plane</td>
</tr>
<tr>
<td>Pore size D₀₉₀</td>
</tr>
<tr>
<td>pH</td>
</tr>
<tr>
<td>Chemical / biological resistance</td>
</tr>
</tbody>
</table>

The figures quoted above are typical values. The steps in the design methodology should be followed to ensure that the geosynthetic material is suitable for site conditions.

All joints should be sealed, using proprietary methods recommended by the manufacturer. Please refer to CIRIA SP 124 - Barriers, liners and cover systems for containment and control of land contamination, for advice on seam testing procedures.
Hydraulic Design

There are various reference documents that may be consulted when designing the surface water drainage system. These include:

- The Building Regulations, Part H3 - Rainwater drainage
- BS EN 752-4:1998 Drain and sewer systems outside buildings, Part 4 Hydraulic design and environmental aspects
- Flood Studies Report (FSR)
- Flood Estimation Handbook (FEH)

The above design guidance is to ensure that the surface water runoff from developments does not increase flood risk within the catchment area.

Part H3 - Section 3 of the Building Regulations gives a typical design rainfall intensity of 0.014 litres/sec/m$^2$ for normal situations. However, this should not be used where low levels of surface flooding would cause flooding of buildings. A more rigorous design will be required under the circumstances based on the meteorological data for the design storm event. Typically this may range from 1 in 30 years, in accordance with Sewers for Adoption, to as high as 1 in 200 years for critical services such as hospitals.

The two main elements that affect the volume of runoff generated, and therefore the size of the Polystorm system required, are:

- Size of catchment area
- Imposed outflow restriction

Depending on whether infiltration is allowed on the site, the water flow from the Polystorm structure may take two forms:

a) Attenuation

When discharging into an existing drainage system, or watercourse, it is common for the relevant approving authority to impose a discharge limit. Use of a flow control device typically results in the requirement for attenuation storage.

b) Infiltration

The outflow from the Polystorm unit is typically limited by the permeability of the surrounding ground. Reference should be made to either BRE Digest 365 Soakaway Design or CIRIA Report 156 Infiltration drainage - Manual of good practice when determining the permeability of soil and an appropriate infiltration design.
The Polystorm unit is manufactured to allow a connection to be easily formed by insertion of 160mm diameter BS EN 1401-1 pipes into the convenient knock-out incorporated in each cell. Connections with 110mm EN 1401-2 pipes, 100mm Ridgidrain or other systems are made using standard Polypipe adapters. The capacity of a single connection is limited and may be insufficient for the anticipated design flow, therefore a manifold connection may be required in order to achieve the required design flow, illustrated in Figure 1 and detailed in the table below.

Typical hydraulic properties of a single 160mm diameter BS EN 1401-1 pipe

<table>
<thead>
<tr>
<th>Gradient</th>
<th>Roughness 0.06mm</th>
<th></th>
<th>Roughness 0.6mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Velocity (m/s)</td>
<td>Flow (l/s)</td>
<td>Velocity (m/s)</td>
</tr>
<tr>
<td>40</td>
<td>2.036</td>
<td>35.974</td>
<td>1.596</td>
</tr>
<tr>
<td>60</td>
<td>1.648</td>
<td>29.126</td>
<td>1.302</td>
</tr>
<tr>
<td>100</td>
<td>1.255</td>
<td>22.183</td>
<td>1.003</td>
</tr>
<tr>
<td>150</td>
<td>1.013</td>
<td>17.899</td>
<td>0.817</td>
</tr>
<tr>
<td>200</td>
<td>0.68</td>
<td>15.330</td>
<td>0.705</td>
</tr>
</tbody>
</table>

0.6mm is the design value recommended in Sewers for Adoption.

NB: The hydraulic capacity of the pipe may be altered be changing its gradient. Further reference can be made to the hydraulic tables published by HR Wallingford and D. I. H. Barr.

Each Polystorm unit is able to form a single 160mm diameter connection. Therefore, the limiting factor on the number of pipe connections from a manifold system is dependent upon the layout of Polystorm units.

**Integration of Polystorm into Drainage System**

![Typical Manifold System Diagram](image)

Figure 1
Ancillary Items

Polypipe is able to offer a complete solutions package, including custom fabricated components to meet individual site requirements. Ancillary items include:

- Rainwater guttering and downpipe systems
- Adaptors and specialist fittings
- Catchpits, inspection chambers and manholes
- Flow control chambers
- Silt traps