

Proposed Residential Development At Land Off Brigham Street, Openshaw M11 2JJ

Method statement for Design, Installation and Maintenance of Attenuation Tanks (783)

Site Assessment and Preparation:

A thorough and robust site assessment has been conducted to determine the best location for the tank installation, considering factors such as soil stability, the site topography, proximity to the new and existing drainage infrastructure on the site, accessibility for maintenance, and compliance with local regulations.

The site is to be cleared of any debris, vegetation, or obstructions that may hinder the installation process.

The area of site accommodating the attenuation tanks is to be level and compacted to provide a stable foundation for the tank. (Refer to Carley Daines Drawing Nos 21.B.13127-11H, 21.B.13127-20D, 421.B.13127-24)

Tank Selection and Procurement:

The tank selection has been based on several factors, generally but not restricted to the designed size, material, maintenance requirements and obligations, recyclable credentials of the proposed product along with that of its long-term structural integrity.

Procure the tank from a reputable supplier that adheres to relevant industry standards and regulations.

The structural Engineer has verified that the tank is designed to withstand the anticipated environmental conditions and load requirements.

Selected attenuation tank advantages

- Modular and flexible.
- Lightweight.
- High structural integrity.
- Silt prevention system.
- Woven geotextile on the top and bottom of each block prevents intrusion of fines.
- Lifespan and maintenance considerations
- Simple and quick to install - no assembly or connectors required.

Installation Procedures:

The proposed attenuation tank design requires a total storage volume of 105.0 Cubic Metres. The proposed tank invert level is 66.309 and had a storage depth of 1.04 metres. The top of the tank is at a level of 67.349m, with a ground cover level of 68.150m. The ground cover level (garden level) is .015 metres below the finished floor level of the adjacent residential plots. Sufficient cover within the garden area from finished ground level to the top of tank is provided to prevent accidental damage to the tank.

New foundations to the adjacent Plot Nos 13-16 have been provided using 8.0 - 9.0metre driven precast concrete piles. The installation of the attenuation tank will therefore have no detrimental impact on the adjacent property foundations.

To install the tanks, it is proposed to excavate a trench on the site to the location as indicated on the Consulting Engineers drawings. Suitable clearance is to be provided and maintained around the tank for proper and meaningful maintenance and inspection.

Install a suitable base or foundation to support the weight of the tank and distribute the load evenly across the underlying soil.

Lower the tank units into the prepared excavation using appropriate lifting equipment and techniques, ensuring they are positioned securely and level.

The tank will be connected to the necessary pipework, vents, hydrobrake manhole system, using materials and components compatible with the intended use and the surface water contents of the tank.

Test the integrity of the tank and associated components through pressure testing or other appropriate methods to verify that they meet the required performance standards.

Maintenance Regime

Below-ground stormwater attenuation tanks require regular maintenance to prevent siltation of the throughflow / distribution pipes which are below the Stormcells attenuation units to ensure they function effectively. The following maintenance strategy will be followed by the landlord (registered provider) following scheme completion. The registered provider (One Manchester) has numerous (and a growing number of schemes) with stormwater attenuation systems and the scheme will be added to their asset management maintenance programme.

Inspection: Regular quarterly inspections will be undertaken to identify any signs of damage, blockages, or malfunction. Inspections will include checking access points, inlet and outlet pipes, and the interior of the tank. It is recommended by the manufacturers that the system is inspected monthly arete installation / connection for a three month period and thereafter at 6 monthly intervals.

Cleaning: It is acknowledged that sediment, debris, and pollutants can accumulate in the tank over time, reducing its capacity and efficiency. Periodic cleaning is essential to remove these accumulations. This may involve vacuuming or flushing out sediment and debris, the method of which is determined during the maintenance visit.

Vegetation Control: The landlord will ensure that vegetation around the tank does not obstruct access points or impede the flow of water and any vegetation near the tanks will be trimmed to prevent issues.

Testing: The landlord will conduct regular testing of the tank's components, such as the adjacent hydro brake to ensure correct and optimal operation.

Repair and Replacement: Any damaged components will be promptly repaired or replaced to prevent potential deterioration and maintain the effectiveness of the tank.

Documentation: The landlord will maintain accurate records of maintenance activities, inspections, and any repairs or replacements performed. This documentation will help track the performance of the tank over time and identify any recurring issues.

By regularly performing these maintenance tasks, the below-ground stormwater attenuation tanks will continue to effectively manage stormwater runoff and mitigate the risk of flooding and pollution.

The attenuation tanks have been purposefully designed to be installed within the amenity area of plots 13-16. This communal garden area is for the benefit of the adjacent 4 No social rent units and as such the registered provider retains full control over the area to ensure maintenance can be carried out purposely and effectively.

Subject to a robust maintenance regime the attenuation tanks installed will have a clear life expectancy of 60+ years.

Contingency Planning for Failure or Replacement:

A contingency Plan has been devised should there be any potential tank failure or the need for replacement.

The attenuation tanks are situated below the communal garden area of plots 13-16. Periodic maintenance access can be gained through the proposed pedestrian access gate. In the event of wholesale repair / replacement access can be gained through and along the private parking area associated with plots 13-16.



The registered provider will adopt and where necessary implement emergency response procedures to mitigate the impact of a tank failure on personnel, property, and the environment, including containment measures, evacuation protocols, and notification procedures.

The location of the attenuation tanks has been designed to be clear of any structure, fencing, bin stores, sheds etc and as such access to the entire footprint of the tank unit is below soft landscaped areas, thus making access relatively easy and cost efficient.

The domestic drainage has been designed to avoid installation adjacent to the attenuation tanks, which will prevent damage of the asset should the tank require replacement.

The product specified has been chosen, considering factors such as structural integrity, corrosion, leakage, and environmental impact.

The registered provider landlord will establish protocols for monitoring the condition of the tank and conducting regular inspections and maintenance to detect and address any issues before they escalate. Details of the inspection regime will be clearly listed within the as-built contract requirements and residual risk assessments.

The registered providers asset management team will inventory of spare parts and materials required for repairs or replacements, ensuring that they are readily available when needed.

Environmental Considerations:

The project will ensure compliance with relevant environmental regulations. The attenuation tanks will not store or house any form of hazardous materials or waste, merely surface water.

The product proposed is a polypropylene product manufactured from approved recycled polypropylene. Due to the intended long life and minor maintenance requirements, there is a reduced need for recycling during its life span. At the end of the life cycle, the tanks can be recycled safely at minimal risk to the environment.

Documentation and Compliance:

The applicant will maintain comprehensive records documenting the installation process, including site assessments, design calculations, construction drawings, material specifications, inspection reports, and test results as required.

The designer will verify and ensure that the tank installation complies with all applicable engineering standards, building codes, zoning ordinances, and environmental regulations governing the design, construction, and operation of storage tanks.

Technical Assessment:

See attached Design Data / Technical Assessment from The Stormcell manufacturer / parent company 'Nidaplast.'

Stormcell®

Low-maintenance, modular stormwater and surface water storage

Stormcell® is a high-capacity, zero-maintenance modular stormwater and surface water storage system that can be customised to suit shallow, deep or irregular sites. Its flexible modular structure is light but strong, making it ideal for use beneath areas such as roads, car parks and industrial areas.

With a design that ensures that solids are washed through the pipework rather than into the storage area, the system requires very little maintenance.



Design storage for even the most difficult sites

With standard and shallow sizes, a choice of durable and more lightweight variants and the ability to cut blocks on site, Stormcell® provides designers with the flexibility to customise storage to meet the requirements of shallow, deep or irregular sites.

Reduce your stormwater maintenance

The Stormcell® system is designed to prevent silting and other build-up of solids and debris typically carried in surface water and stormwater, meaning that the system requires virtually no maintenance.

Install quick and easily

Stormcell® requires no assembly or connectors, so installation on site is quick and easy.

Elements of the Stormcell® storage system

- Impermeable membrane wrapped around the Stormcell® blocks - to prevent stormwater from escaping into the surrounding ground.
- Large single size stone - as a support base for the Stormcell® blocks to aid the distribution of stormwater throughout the plan area of the blocks and allow drain down through the outlet.
- Perforated pipes - to further facilitate stormwater distribution when filling and collection and delivery to the outlet when emptying and to avoid unwanted back pressure to the upstream sewer or drain.
- Geotextile on the top of the Stormcell® block - to prevent the migration of fines from above into the vertical voids.
- Granular backfill to the top of the tank - to assist structural loading distribution and the movement of air during filling and emptying.
- Stormcell® blocks.

For reasonable sized volumes, high level perforated pipes may be placed directly on top of the Stormcell® blocks to further aid the evacuation of air during filling and to allow air to return during drain down. For smaller volumes, a more simple venting arrangement can be used.

As with other types of underground stormwater storage, the Stormcell® storage system requires an inlet pipe, outlet pipe, control chambers and a Hydro-Brake® Vortex Flow Control.

The Stormcell® system can be constructed either on-line or off-line and it can be practically any shape or size. Tested design life of 50 years.

Storage Volume

There are a number of methods which can be used to calculate storage volume. Most commonly MicroDrainage and Causeway Flow. Hydro International can provide a Hydrological Analysis service to identify the storage volume for a permissible discharge rate for designers who do not have access to other methods of calculation. This establishes rainfall runoff volumes for a variety of storm events and calculates the optimum storage volume needed. Please speak to us for this service.

Design

The system designer needs to consider the most appropriate and cost-effective siting for the storage facility. The flexibility afforded by Stormcell® allows the system designer to design storage into locations which with other storage systems would be impossible. Very shallow depth of underground storage is achievable. Irregular plan areas offer no obstacles as the blocks of Stormcell® can be cut on site with an ordinary saw to the required shape. Obstructions such as trees, pipework and rock outcrops can be easily circumvented.

The Stormcell® Storage System can be installed practically anywhere including under roads, footpaths, car parks, public open spaces, landscaped areas, gardens, tennis courts and playing fields.

To increase design flexibility and cost effectiveness, there are three different grades of Stormcell® on offer. These blocks can be used in combination within one tank depending on tank loadings and soil conditions around the site. Please discuss this design option with ourselves.

Grade	Long Term Maximum Load	Short Term Maximum Load	Lateral Load	Max. Depth
EP400	90 kPa	300 kPa	15 kPa	3.86
EP500	130 kPa	400 kPa	15 kPa	4.86
EP600	170 kPa	500 kPa	20 kPa	5.86

Note:

Significant cost savings can be achieved by distributing the requisite storage volume at the upper reaches of the catchment (reference 10). The system designer must ensure that the preferred depth of storage is achievable using the depths of Stormcell® blocks available (refer to Stormcell® blocks section).

Excavation and Dimensions

The Stormcell® Storage System is highly flexible and allows the system designer to consider a range of options not normally available with other storage systems. There are, however, several limiting factors which must be considered:

1. Lateral Loadings

Stormcell® has excellent structural properties in the vertical direction, being capable of withstanding occasional loads of up to 500 kPa and long term design loads of up to 170 kPa. It is however, somewhat limited in the horizontal direction, being capable of accommodating only 20 kPa of lateral force. These limitations must be taken into account when deciding upon the cross-sectional area and depth of the Stormcell® system.

Recommended Depth Limits in the Vertical Plane

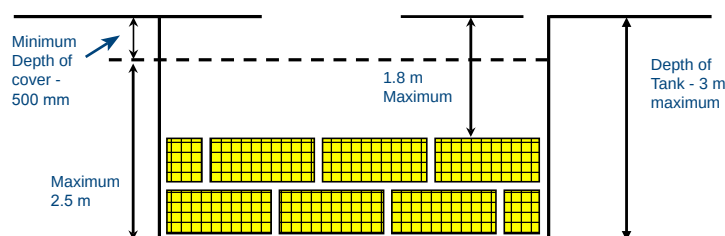


Figure 1

Depth Limitations in Sloped Excavation

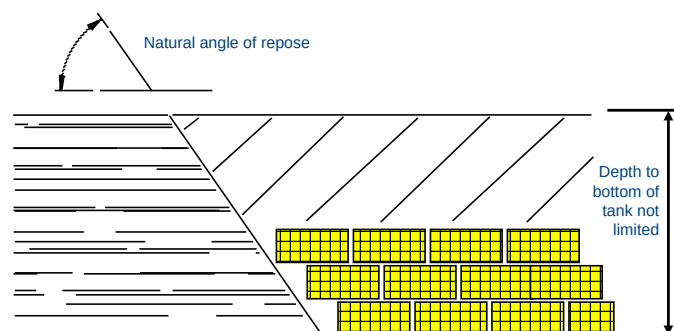


Figure 2

2. Depth of Backfill

The recommended depth of backfill above the top surface of the Stormcell® is 500 mm, particularly for situations in which the system will be subjected to loading from traffic. In situations where there is minimal loading over the Stormcell®, 300 mm of cover could be accommodated. The 300 mm depth of cover allows the dispersion of surface loading (especially of point loads) such that the loading of the top of the Stormcell® blocks is distributed evenly and limited to no more than 170 kPa. Whilst the system can take occasional vertical loads of up to 500 kPa, the maximum long term loading should be no more than 170 kPa to allow an acceptable factor of safety and to avoid problems with creep. For heavy traffic loading, eg. from large trucks, a depth of cover of approximately 1 m is usually required. It will be the designers responsibility to ensure that the depth of backfill is sufficient to disperse the loading safely to the top of the Stormcell®.

An appropriate heavy duty impermeable membrane, typically 460 g/m² (500 micron thick), is required to ensure water tightness. For larger volumes where several sheets are required the sheets need to be overlapped and sealed in accordance with the membrane manufacturer's recommended method.

Distribution and Collection System

The flow rate, and the plan area of the storage system dictate the nature of the distribution and collection system.

It is advantageous in most circumstances for the perforated pipework to be as large a diameter as possible to reduce the headloss associated with smaller diameter pipes.

The following factors need to be considered for the distribution system:

A) Distribution/Collection

The diameters of the distribution/collection pipework should be established by:

- Establishing the capacity required to ensure an even distribution of the flows for pipe length, dependent upon the arrangement chosen (ref. 4.ii.c) and;
- The capacity of the perforated pipes for allowing flows to exit and enter the pipes. The recommendations of the perforated pipe manufacturers must be adhered to.

The gradients of the pipework should generally be a minimum of 1-1.5% to obtain adequate self-cleansing characteristics. Care must be taken for both on line and off line configurations to ensure that the self-cleansing criteria is satisfied.

B) Trenches and Bedding to Pipework

The trenches should be excavated in accordance with the pipe manufacturer's recommendations. In order to minimise the depth of excavation and the volume of single size stone under the Stormcell®, it is possible for the pipes to be constructed in a shallow trench as indicated in Figure 3.

The bedding to the pipework should be in accordance with the pipe manufacturer's recommendations. The design loading to the pipework should assume that the Stormcell® is acting as conventional backfill.

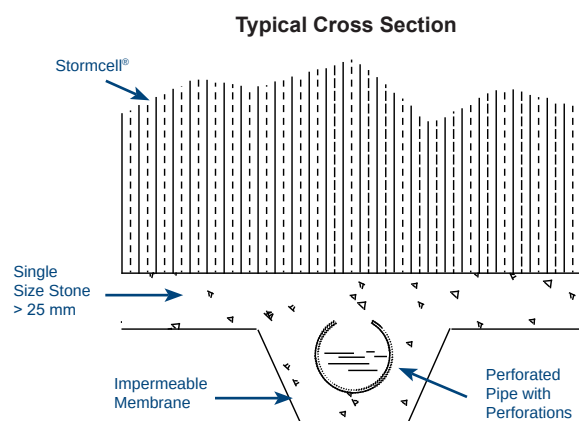


Figure 3

C) Pipework Arrangement

There are several methods of arranging the pipework (ref. Figures 4 and 5). The main underlying principle is to ensure that the flows through the perforated pipes into the single size stone layer do not have to travel more than 2 m from the pipes. This is to ensure an even distribution of the stormwater throughout the Stormcell® media. The most suitable arrangement depends on the available gradients and the dimensions of the tank.

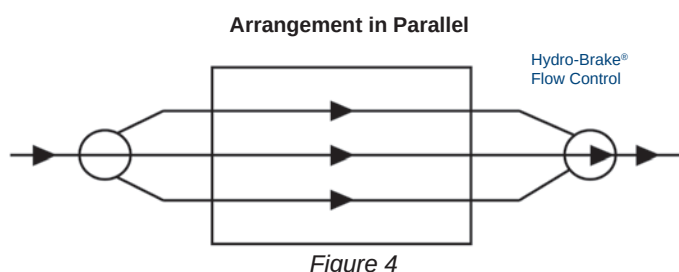


Figure 4

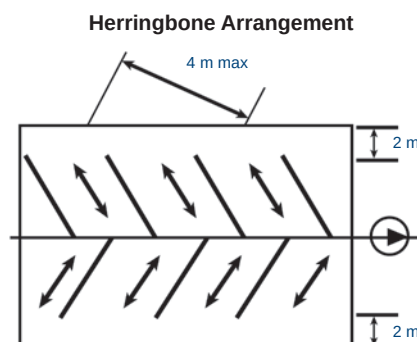


Figure 5

D) Rodding Points

In some circumstances, if there is a likelihood of siltation within the distribution/collection pipework, it may be appropriate for rodding points to be provided at the end of each pipe run. The rodding points can be sited at ground level in suitable locations a short distance from the distribution/collection pipework.

Stormcell® Tank and Geotextile Protection

The actual storage section is comprised of Stormcell® blocks, which are placed above the distribution/collection layer. The layout of the blocks should be designed in such a way as to achieve a stretcher bond arrangement wherever possible. Consideration of the depth to invert is important in deciding the number and type of blocks, which are available in 2.4 m lengths, 1.2 m widths and varying depths. The depths of blocks available are:

520 and 120 mm.

The range of block depths allows a high level of flexibility in the design of the depth of the tank. Falls in ground level from inlet to outlet can therefore easily be accommodated thereby minimising the volume of excavation.

The most cost-effective solution would be to use 2.4 x 1.2 x 0.52 m deep blocks. Due to the increased production costs of producing the smaller sized blocks, they are slightly more expensive (contact Hydro International for further details).

A layer of close textured geotextile, typically 95 g/m², should be placed on top of the uppermost layer of Stormcell® blocks to prevent the intrusion of fines from the upper layers of backfill.

Venting

For large volumes the air venting arrangement consists of perforated pipes with typically 100 mm diameter arranged in a regular pattern embedded in a layer single size stone, typically 25/40 or 6/10 on the top of the Stormcell® blocks. The pipes do not need to be laid with any fall and should be placed with their openings facing downwards. They should be connected to the upstream and/or downstream control/inspection chambers.

For smaller volumes the stone above the Stormcell® blocks may be sufficient in itself to act as an air conduit. In this case pipes spanning from the edges of the Stormcell® to the upstream and downstream chambers may be sufficient. Care must be taken with the depth of the stone layer to ensure that the intended loading does not exceed the structural capacity of the air vent pipe.

Backfilling

The backfill to the top layer of the Stormcell® is dependent upon the surfacing above the system. All backfill must be carefully compacted to avoid penetration of the geotextile layer. Backfill is required to the edges of the system between the impermeable membrane and the edge of the excavation to consolidate the and stabilise the structure. The backfill can be either compacted sand, concrete or granular material. A gap of a minimum width of 100 mm should be left between the edge of the excavation and the outer edges of the Stormcell® blocks.

Technical Assessment 17/14-280

Cancels and replaces Technical Assessment 17/11-238

Collection, release and storage of rainwater

Système pour
assainissement pluvial
System for rainwater
System für Nieder-
schlagswasser

NIDAPLAST EP NIDAFLOW EP

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*This Technical Assessment may only
be claimed for CSTBat mark-certified
products, as inventoried in the online
list kept up to date at:*

www.cstb.fr

section :

Evaluations
Certification of products and services

Commission in charge of issuing Technical Assessment
(Decree of 21 March 2012)

Specialized Group No. 17

Networks and Effluent Treatment

Presented on registration on 23 June 2014

*All reasonable measures were taken to ensure the accuracy of this translation but no responsibility can be accepted for any error, omission or inaccuracy.
In case of doubt or dispute, the original language text only is valid.*



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On 3 December 2013, Specialized Group No. 17 "Networks and Effluent Treatment" examined the request submitted by NIDAPLAST relating to NIDAPLAST EP and NIDAFLOW EP blocks. Concerning these components, it formulated the following Technical Assessment. This document, to which the Technical File prepared by the requestor is annexed, reports the Assessment formulated by Specialized Group No. 17 on the product and the installation provisions proposed for its use in the targeted field of application and under the conditions of mainland France and the French Overseas Departments, Regions and Territorial Communities (DROM-COM). The Technical Assessment thus formulated shall only remain valid if the certification referred to in the Technical File remains effective following annual certification follow-up and external auditing.

1. Brief definition

1.1 Brief description

The NIDAPLAST EP and NIDAFLOW EP retention and infiltration system comprises polypropylene blocks made of factory-welded elements.

These blocks can be placed side-by-side or stacked in order to form a rainwater reservoir.

NIDAPLAST EP blocks have no slits on their top and bottom sides.

NIDAFLOW EP blocks have slits on their top and bottom sides in order to facilitate the diffusion of rainwater inside the structure.

The main characteristics of NIDAPLAST EP and NIDAFLOW EP block are as follows:

- Colour : black.
- Length : 2400 mm.
- Width : 1200 mm.
- Height : 520 mm.
- Cell width : 50 mm.

1.2 Identification

In accordance with the CSTBat mark certification reference system, each block is marked with the following statements:

- Name: NIDAPLAST EP or NIDAFLOW EP,
- Identification of the manufacturing plant,
- Material: PP
- Date of manufacture: week, year.
- Direction of installation.



- The logo followed by the reference given on the certificate.

When NIDAPLAST EP and NIDAFLOW EP blocks are used to make a retention or infiltration basin, in accordance with the provisions set out in the Technical File, the basin's inlet or outlet manhole is fitted with an identification plate marked as follows:

- Name: NIDAPLAST EP or NIDAFLOW EP,
- Project identification number,
- Date on which the structure was realized,



- The logo followed by the reference given on the certificate.

2. AVIS

2.1 Application field

NIDAPLAST EP and NIDAFLOW EP blocks are designed to make underground basins, in the absence of groundwater, under the conditions set out in § 7 of the Technical File, so as to enable:

- retention of rainwater when the structure is wrapped in a watertight geomembrane,
- retention and/or infiltration in the underlying soil when the structure is not designed to be watertight.

Note that the presence of a soakaway is mandatory: overflow and connection to a rainwater drainage network excluding infiltration wells forming for individual rainwater drainage systems.

2.2 Assessment of the product

- #### 2.2.1 Compliance with currently enforceable law and regulatory requirements and other aspects of fitness-for-purpose

2.2.1.1 Compliance with currently enforceable law and regulatory requirements

There are no Health and Environmental Safety Declarations ('FDES') for this product. Note that the FDES do not fall within the scope of fitness-for-purpose testing for this product.

2.2.1.2 Other aspects of fitness-for-purpose

NIDAPLAST EP and NIDAFLOW EP Ultra Light Cellular Structures and their installation meet the recommendations of the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management (2011)".

The tests and studies carried out by either the requestor or CSTB during appraisal of the Technical Assessment and the references supplied demonstrate that this product gives satisfactory performances in the application field discussed in 2.1.

Compliance with the design and installation conditions defined in the Technical File is a prerequisite for proper functioning of the system.

The effective volumes of the installed structures limit the amount of earthworks required.

The modular design means the structure can be adapted to fit topographical constraints.

The NIDAPLAST EP and NIDAFLOW EP retention and infiltration system shall ensure certain functions that warrant closer investigation:

Mechanical strength

Knowledge and consideration of the soil's geotechnical properties is vital to the structure's design and production.

The provisions recommended by NIDAPLAST shall be taken into account by the Engineer at the preliminary study phase. These provide for ensuring the structure's stability and its compatibility with any road applications.

Note that the structure's maximum permissible distortion over time shall be fixed by the Engineer. This requirement may limit the structure's height independently of the other factors to be taken into account. The long-term distortion value to be taken into account is 2% of the total height of the blocks.

Furthermore, the means deployed by NIDAPLAST to ensure constancy of the modules' mechanical performance, as well as the factoring in of dynamic effects (according to the recommendations of Fascicule 70), when the structure is installed under a road, can be used to design the structure based on a safety factor γ_M of 1.5.

For climate zones where the subsoil temperature is higher than the values generally observed in mainland France, this value shall be set at 1.6.

Hydraulics

The provisions adopted for the calculation of soil infiltration flows, the sizing of the structures and the general design specifications are set out in the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management (2011)" and in Fascicule 70 Header II.

Hydraulic performance over time is inseparable from compliance with the conditions of maintenance.

2.2.2 Durability – Maintenance

Given the nature of the constituent material, there are no particular issues with component durability.

The structure's durability over time depends mainly on the performance of the pre-treatment system.

Investigation tools shall be accessible at all times.

2.23 Manufacture and quality assurance operations

NIDAPLAST EP and NIDAFLOW EP blocks are produced via extrusion process.

Manufacture of the component parts of NIDAPLAST EP and NIDAFLOW EP blocks is subject to internal quality assurance operations based on NF EN ISO 9001 (2008).

The internal and external quality assurance operations described in the Technical File provide assurances that the system delivers consistently satisfactory quality.

2.24 On-site installation

There are no particular difficulties in product installation provided that this is carried out as indicated in the Technical File.

Installation conditions shall be rigorously monitored.

Special care shall be taken when choosing backfill material and deciding on the conditions for compaction.

The light weight of the blocks facilitates their installation.

2.3 Technical Specifications

2.31 Product characteristics

The characteristics of NIDAPLAST EP and NIDAFLOW EP blocks shall conform to the indications given in the Technical File.

2.32 Manufacture

The manufacturer shall organise an internal quality assurance operation such as that described in the Technical File.

2.33 Design

The details to be collected for the preliminary study are listed in the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management (2011)" and Fascicule 70 Header II.

These contain the following details in particular:

- physical environment: ground topography, groundwater height, soil permeability and geotechnical characteristics.
- urbanization: land reuse, presence of a building, water quality and usage, traffic.
- assessment of hydraulic parameters: watershed, active surface, volume and flow rate based on Technical Instruction 77/284.

2.34 On-site installation

Compliance with the installation conditions described in paragraph 9 is a vital prerequisite to the proper functioning of basins made from NIDAPLAST EP and NIDAFLOW EP blocks.

The same applies to the additional recommendations specified by the Engineer that derive from the special conditions applying to each rainwater retention and infiltration basin project.

Conclusions

Overall assessment

For products with a CSTBat certificate delivered by CSTB, the use of NIDAPLAST EP and NIDAFLOW EP blocks and accessories is favourably assessed.

Validity

Until 31 December 2018

*For Specialized Group No. 17
The Chairman*

Christian VIGNOLES

3. Additional comments by the Specialized Group

Note that the Technical Assessment does not cover applications at the scale of single-family homes.

Specialized Group No. 17 would like to draw the designer's attention to the importance of protecting these structures from the introduction of settleable solids.

*The Rapporteur of
Specialized Group No. 17
Abdelkader LAKEL*

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Technical File

prepared by the requestor

A. Description

1. Principle

NIDAPLAST EP and NIDAFLOW EP blocks have been manufactured by NIDAPLAST since 1985.

These products fall within the scope of the manufacture of structures such as those described in the guide "Ultra Light Cellular Structures (SAUL) for rainwater management" published in December 2011 by IFFSTAR.

They are designed to create underground storage structures (basins, swales or infiltration wells) aimed at optimizing the management of rainwater runoff.

NIDAPLAST EP and NIDAFLOW EP blocks are intended for applications in the fields of public works and civil engineering and individual rainwater drainage systems.

NIDAPLAST EP and NIDAFLOW EP blocks are supplied ready-for-use, hand-carryable and cuttable on-site so as to facilitate their worksite installation and assembly.

NIDAPLAST and NIDAFLOW blocks enable adaptation to various project or worksite constraints in terms of mechanical strength and hydraulic flow depending on the nature of basin operation.

Structures made using NIDAPLAST EP and NIDAFLOW EP modules and various accessories ensure the following functions:

Service functions:

The service functions provided by NIDAPLAST EP and NIDAFLOW EP structures involve storage and/or infiltration.

Effluent retention is ensured when the structure is wrapped in a watertight geomembrane.

When the structure is not designed to be watertight, infiltration can occur via the subsoil.

The drainage rate depends on the basin fill rate and the internal diameter of the pipe connecting to the drainage network, or is regulated using a suitable device.

Technical functions:

NIDAPLAST EP and NIDAFLOW EP structures provide the following technical functions:

Collection and Release:

- These two functions are achieved using related components that include access chambers (or inspection boxes - integrated or buried on perimeter), interface parts and channels incorporated into the modules.
- The drainage rate for a watertight structure depends on the basin fill rate and the internal diameter of the pipe connecting to the drainage network, or is regulated using a suitable device.
- Drains are used to distribute the effluent inside the structure.

Structural:

The structural nature of the blocks means surface soil stays useable.

Accessibility:

Accessibility, limited to the drains supplying the structure, is ensured via access chambers (or inspection boxes) and channels.

Ventilation:

The structure shall enable the equalizing of air pressure during filling and draining phases.

1.1 The blocks

NIDAPLAST EP and NIDAFLOW EP are anisotropic products with high strength in the directions of the cells.

NIDAPLAST EP blocks (see Figure 1b) are smooth, i.e. non-grooved.

NIDAFLOW EP blocks (see Figure 1c) are grooved to facilitate horizontal drainage or diffusion (see Figures 1c, 1d and 1e) when there is no accompanying diffusion layer, and are designed for the following applications in particular:

- watertight basins, to prevent introduction of the lower diffusion layer into drainage material (see Figure 5);
- infiltration basins and swales to facilitate tridirectional diffusion of water.

There are 2 types of NIDAFLOW EP module:

- a bottom module with diffusion slits on both sides. Those located in the bottom part have a larger cross-section than those in the top part as they diffuse the water from the drains horizontally across the whole surface of the basin. Those in the top part diffuse water in relation to the overlying block.
- a top module with diffusion slits on just one side. These are used solely to diffuse water in relation to the overlying block between the various layers of blocks and the air in the top part.

Specific marking is used to differentiate these 2 types of block (MB bottom module, MH top module) and their direction of installation.

1.2 Drains

The diffusion system shall include a drain tunnel to DN 200 minimum, conform to NF P 16-351 and with a ring stiffness of 8 kN/m². This drain tunnel injects and diffuses rainwater within the structure.

Its catchment surface area is at least 50 cm²/m.

A catchment surface area of 300 cm²/m helps to optimise the length of the installed drains and, therefore, the structure's operation.

The drain is open along approximately its upper 2/3, thus allowing hydraulic continuity of very low flows between the upstream and downstream areas of the rainwater storage structures.

2. Production method and materials

2.1 Process production

The blocks are produced via extrusion.

The base blocks (see Figure 1a) are extruded and then cut to the following dimensions: 0.4 x 0.3 x 0.54 m.

These blocks are assembled in both directions to form strips and then basic blocks with dimensions 2.4 x 1.2 x 0.52 m (see Figure 1b).

NIDAPLAST blocks with lower heights are cut from the basic blocks.

A highly permeable geotextile is thermofused onto the top and bottom sides of the blocks. This geotextile facilitates the finishing operation on the support surfaces.

2.2 Materials

The material used is a controlled blend of virgin polypropylene and approved recycled materials (loaded or unloaded) of external and internal origin. The characteristics of the virgin material and external recycled material are listed below.

2.2.1 External recycled material

External recycled materials are supplied by a single source (supplier and type of recycled component).

Characteristics	Specifications		Test parameters	Test methods
	Material 1	Material 2		
Density	905 kg/m ³	980 kg/m ³ ±25	T=23 ±2°C	NF EN ISO 1183
Melt flow index	4 to 8 g/10min	6 to 10 g/10min.	T=230°C / 2.16 kg	NF EN ISO 1133
Resistance to tensile force at the creep threshold	25 to 40 MPa	20 to 40 MPa	Speed 50 mm/min T=23 ± 2°C	NF EN ISO 527
Tensile or flexural modulus	≥ 1100 MPa	≥ 1100 MPa	Speed 2 mm/min T=23 ± 2°C	
Thermal stability (OIT*)	8 min.		200°C	NF EN 728

*Measurement on finished product

2.2.2 Virgin material

Characteristics	Specifications	Test parameters	Test methods
Density	905 kg/m ³ ±25	T=23 ±2°C	NF EN ISO 1183
Melt flow index	1 to 8 g/10min.	T=230°C 2.16 kg	NF EN ISO 1133
Resistance to tensile force at the creep threshold	25 to 50 MPa	Speed 50 mm/min T=23 ± 2°C	NF EN ISO 527
Tensile or flexural modulus	≥1200 MPa	Speed 2 mm/min T=23 ± 2°C	
Thermal stability (OIT*)	8 min.	200°C	NF EN 728

*Measurement on finished product

3. Product description

3.1 Appearance, surface finish

The blocks are black.

NIDAPLAST EP or NIDAFLOW EP blocks are free of macro-flaws that could hinder their function.

3.2 Dimensions

Table 1 gives the dimensions of the various block versions. The cells measure approx. 50 mm between flats (see Figure 1a).

Blocks with smaller sizes and thicknesses can be cut at the plant on request. Lengths can vary from 2400 to 1200 mm, widths from 1200 to 800 mm, and thicknesses from 600 to 40 mm.

Groove dimensions are shown on Figures 1c, 1d and 1e.

Depending on the range product, the average nominal thickness of the internal walls varies from 0.8 to 1.3 mm.

3.3 Mass

The mass of the basic block depends on block type and dimensions (see Table 1).

3.4 Effective volume

The void index of the blocks as specified in Table 1 is at least 95% (value based on the mass, the density of the material and the apparent volume of the blocks). This value is used to size the basin's effective volume.

3.5 Mechanical characteristics

3.5.1 Unconfined compressive strength

Compressive strength in the direction of extrusion on an element with thickness 480 X 800 X 600 mm is achieved according to XP P 16-374.

During compressive strength testing, loads are applied at a speed of 5 mm/min.

Maximum permissible distortion in the vertical direction is 4%. The values for mechanical strength under uniaxial compression testing are given below:

	NIDAPLAST EP and NIDAFLOW EP			
	EP 300	EP 400	EP 500	EP 600
R _c vertical (kPa)	250	300	400	500
R _t lateral (kPa)	10	15	15	20

Remark: while the values for mechanical strength under uniaxial compression testing can be used to check the constancy of product manufacture and fitness-for-purpose during the construction phase, they are not sufficient to determine the mechanical dimensions of the finished structure.

3.5.2 Long-term properties

The mechanical long-term behaviour of the structures is based on a series of tests involving unconfined, vertical and uniaxial compression testing, carried out over a period exceeding 10,000 h and based on NF ISO 7850.

These tests consist in applying a range of static loads equal to a decreasing percentage of the maximum compressive force in order to determine the total distortion value and to extrapolate maximum permissible strain at 50 years.

These tests were carried out at 20°C and 60°C.

The distortion on rupture over time to be factored in on rupture is 4%.

The extrapolated maximum vertical pressure values are:

- NIDAPLAST and NIDAFLOW EP 300: 60 kPa
- NIDAPLAST and NIDAFLOW EP 400: 90 kPa

- NIDAPLAST et NIDAFLOW EP 500 : 130 kPa
- NIDAPLAST et NIDAFLOW EP 600 : 170 kPa

4. Marking

NIDAPLAST EP and NIDAFLOW EP block marking is conform to the requirements of the Technical Assessment and the CSTBat mark certification reference system.

All blocks are identified by an inkjet marking giving the product reference, date and time of manufacture and the direction of installation.

5. Packaging, handling and storage

5.1 Packaging

NIDAPLAST EP and NIDAFLOW EP blocks are delivered on wooden blocks, generally in stacks of 4 or 5 components, enveloped by NIDAPLAST in a protective stretch film wrapping.

5.2 Handling

There are no particular difficulties in loading and unloading pallets.

The usual precautions, such as use of a fork-lift truck, shall be complied with in order to protect parts from damage. Care shall be taken to avoid products being handled roughly or dropped on the ground.

The film wrapping shall be removed from the pallets just before fitting the blocks, ahead of their installation.

5.3 Storage

Pallets shall be stored in flat areas free of any object that could damage the products.

The maximum outdoor storage time under UV light is one year with the protective film wrapping in place.

6. Preliminary study

The Engineer provides the results of the preliminary study, in particular on the geological and hydrological environment in which the structure is to be installed.

7. Sizing

7.1 Mechanical sizing

Sizing is defined in accordance with the guide "Ultra Light Cellular Structures (SAUL) for rainwater management" published in December 2011 by IFFSTAR.

Depending on the products and provided that there are no special design specifications, the basin can be installed under a roadway, pavement, shoulder or green space within the following limits:

7.1.1 General specifications

- Minimum overlay heights depend on the planned use:
 - at least 0.3 m under a green space,
 - under mobile loads, when under roadways, the sizing shall depend on the planned traffic volume.
- Maximum basin height (SAUL) shall not exceed 3.12 m.
- An oversizing of one or two strength classes may be applied for basins with height between 1.56 and 3.12 m.
- Basin depth shall be less than 5.86 m.
- Generally speaking, the width/height or length/height ratios of a parallelepiped-shaped basin are at least 1.5 and 2 respectively.
- Concerning pollution risks, the basin's lower level (water stream from the block or lower drain) shall be located at least one meter above the highest groundwater level for an infiltration structure.
- The possible application of loads heavier than those affecting the bulk span shall be made at a distance greater than the block's burial depth at the base of the excavation.

7.1.2 Horizontal strength

NIDAPLAST EP and NIDAFLOW EP block strength is greatest in the vertical direction and least in the horizontal direction, which is accompanied by a capacity for distortion when installing backfill, subject to compliance with the installation conditions specified by NIDAPLAST.

The soil and the structure stabilise simultaneously. These assumptions are based on:

- a series of experimental tests carried out at the Centre d'Expérimentation Routière de Rouen that characterise this distortion and then its stabilisation during soil consolidation.
- feedback from over 23 years of experience,

- the quantities, over 1,000,000 m³, installed over the last 23 years under NIDAPLAST-specified conditions.

7.13 Vertical strength

A minimum safety factor of 2.0 is applied to the value of maximum permissible vertical long-term pressure extrapolated to 50 years.

This gives the following maximum permissible vertical strengths:

- NIDAPLAST and NIDAFLOW EP 300: 30 kPa
- NIDAPLAST and NIDAFLOW EP 400: 45 kPa
- NIDAPLAST and NIDAFLOW EP 500: 65 kPa
- NIDAPLAST and NIDAFLOW EP 600: 85 kPa

EP 300 may only be used under green spaces.

Traffic loads (EP 400, 500, 600) or other loads shall be taken in account in according to the conditions of the guide "Ultra Light Cellular Structures (SAUL) for rainwater management" published in December 2011 by IFFSTAR.

Maximum permissible backfill heights in relation to basin heights are:

Basin height	NIDAPLAST EP and NIDAFLOW EP			
	EP 300	EP 400	EP 500	EP 600
$H_b \leq 1.56 \text{ m}$	1.50	2.30	3.30	4.30
$1.56 < H_b \leq 2.08 \text{ m}$	0.98	1.78	2.78	3.78
$2.08 < H_b \leq 2.60 \text{ m}$	0.46	1.26	2.26	3.26
$2.60 < H_b \leq 3.12 \text{ m}$	-	0.74	1.74	2.74

* Between the top surface of the blocks and the open-air soil surface.

H_b = basin height = NIDAPLAST EP or NIDAFLOW EP height

7.2 Volumes

7.2.1 Excavation volume

The excavation volume is determined based on the specifications of the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management" (§5.2).

7.2.2 Effective volume of the structure

The Engineer calculates the hydraulic design value of the storage system.

The Engineer determines the effective storage volume based on the specifications of the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management".

The effective volume corresponds to the volume of the installed blocks multiplied by the void ratio (0.95) less a residual undrained volume (see Figure 6).

Depending on the requested volume, NIDAPLAST can:

- define the number and type of blocks (either NIDAPLAST EP or NIDAFLOW EP).
- supply the Engineer or the company with an indicative installation diagram to ensure correct block installation.
- supply hydraulic drain design based on the data received from the Engineer.

7.3 Sizing the drains

Drains are sized according to the specifications given in NIDAPLAST technical documentation. (see Figure 9).

7.4 Sizing the roadway

This sizing is based on tests carried out at the Centre d'Expérimentation Routière de Rouen. Depending on the road type, roadway layers are determined using ready reckoners (see Figure 10).

8. Operating principles for NIDAPLAST EP and NIDAFLOW EP systems

There are two operating principles for NIDAPLAST EP and NIDAFLOW EP basin systems:

8.1 Bottom inlet

The general inlet principle used for NIDAPLAST EP and NIDAFLOW EP basins is bottom inlet:

- Collected water arrives via one or more access chambers,
- The water is diffused via the drain network in the bottom part, then via a diffusion layer for NIDAPLAST EP, or via diffusion grooves for NIDAFLOW EP,
- Water is stored in NIDAPLAST and NIDAFLOW EP blocks,
- Water is drained via the same drain network.

Figures 2 and 3 illustrate the operation with the various components.

Where applicable, soakaway flows are limited by a suitable system.

Via its self-flushing system, the bottom inlet system (see Figures 3 drains in trench excavations or buried in the diffusion layer) provides the highest level of protection against risks of clogging or accidental contamination, particularly where special devices have been fitted.

It allows the drains to be inspected or cleaned in the event of accidental clogging.

8.2 Top inlet

In certain cases, a top inlet system may be used.

This mainly involves infiltration: infiltration basins, infiltration wells, swales, etc. (see Figure 4). This system shall only be installed in cases where the infiltration water is of sufficiently high quality (risks of clogging or soil contamination).

8.3 Special cases

8.3.1 Swales

In a landscaping project that plans the use of swales, additional storage volumes can be created by placing NIDAPLAST EP blocks at the base of the swale under a minimum backfill height of 30 cm of soil.

For this application, it is advisable to comply with the use limits and installation conditions described above.

The structure can be fed via the top or bottom, as specified above (see Figures 8a and 8b).

8.3.2 Infiltration wells

Infiltration wells recover rainwater for soil infiltration. For this application, it is advisable to comply with the use limits and installation conditions described above.

9. On-site installation

9.1 Earthworks

Earthworks and excavations shall be made in compliance with the requirements set out in Fascicule 70, headers I and II.

General excavation dimensions shall be at least 50 cm wider, on each side, than the basin's unit dimensions and shall take account of ground topography. The length shall also take account of the number and diameter of access chambers (see operating principle Figure 2).

These dimensions shall allow for safe access in accordance with current regulations, and ensure the following operations:

- connecting pipes to the basin,
- installing accessories and access chambers,
- positioning geotextiles and/or geomembranes,
- installing any drains if needed,
- installing backfill and compacting with a suitable material.

For infiltration systems, a minimum distance of 5 meters in relation to the nearest building shall be maintained.

In all cases, the drawings and installation locations defined by the Engineer shall be complied with.

9.2 Diffusion layer or bedding

Blocks are installed on a pre-levelled flat surface with a slope of 0 to 5 ‰.

- When using NIDAPLAST EP, a diffusion layer is laid down consisting of 20/40 grade gravel, preferably pea-shaped and washed, with a minimum height of 5 cm under the blocks.
- When using NIDAFLOW EP for infiltration, horizontal drainage is ensured by the grooves.
- In the specific case of infiltration, the bedding consists of a drainage material forming the subgrade.
- When using NIDAFLOW EP for a watertight basin, blocks are installed in accordance with the SAUL guide using a protective geotextile between the blocks and the membrane. The subgrade is adjusted under the DEG (geomembrane seal). Every possible precaution shall be taken to ensure that the soil under the membrane does not risk damaging it.

No fixing accessories are needed to install the blocks.

9.3 Installing the geotextile / sealing system

9.3.1 Choosing the geotextile

The installation conditions and characteristics of the geotextile and the sealing system are chosen and realised according to the baseline specifications of the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management" published in December 2011.

Its characteristics shall be adapted to fit basin configuration. The use of a geotextile with a high modulus is recommended with heterogene-

ous soils so as to ensure the tight inter-block locking needed to guarantee that the SAUL structure functions as a monolithic entity.

9.32 Infiltration basin

Concerning infiltration, use of a geotextile with a filtration slit corresponding to the soil infiltration coefficient shall be the preferred option. The values characterising the various mechanical and hydraulic properties and functions shall be adjusted to fit the specific project case.

The characteristics specific to infiltration basins are:

- permeability perpendicular to the plane (NF EN ISO 11 058): > 0.02 m/s,
- filtration slit (NF EN ISO 12 956): > 63 µm and < 100 µm.

9.33 Retention basin

The geotextile will be placed on the bedding and drawn up against the basin's lateral surfaces, and then fixed onto the upper surface of the blocks once installation is complete. The geotextile strips shall overlap by at least 30 cm.

A retention basin comprises a soakaway with a regulated outlet flow. It may be watertight or not depending on the requirements of the prime contractor in relation to local constraints, especially regarding protection of groundwater.

The integrity of watertight basins is achieved through good professional practice and, when using impermeable membranes, in accordance with the recommendations of Leaflet 10 of the French Committee for Geotextiles and Geomembranes "General recommendations for making watertight using geomembranes".

9.4 Installation of drains if needed

9.41 Diffusion

Bottom drains are systematically installed when using the bottom inlet principle.

Sized according to ready reckoners 7a and b, they are installed as shown in figures 2 to 5.

They are distributed evenly and laid in granular drainage materials. They ensure hydraulic continuity upstream and downstream of the structures via inspection chambers.

9.42 Impermeable soil

When installing a basin made watertight by a membrane, it is good practice to lay a drainage layer with soakaway at the base of the excavation.

9.5 Installing the blocks

9.51 Preparation

The diffusion layer or bedding shall be carefully adjusted to ensure correct placing of the blocks.

9.52 Placing the blocks

Blocks are placed side-by-side and superimposed by interlocking joints in all 3 directions. Some blocks can be cut vertically to do this.

Special care shall be taken when placing the first layer of blocks, which will provide the base for all subsequent layers.

9.6 Ventilation

To avoid any overpressure in the structure, an air vent shall be fitted in-between the retention structure and the adjoining access chambers (access chambers shall be fitted with ventilated covers).

- NIDAPLAST EP (see Figure 7a):

Installation of a ventilation layer above the final layer of blocks:

- The last layer of blocks is covered with an anti-puncture geotextile,
- A layer of drainage material is connected to the upstream and/or downstream access chamber by a vent (drain tunnel with DN 100 at 50 cm²/mL of slits perforated over 360°),
- The basin is covered by an anti-puncture geotextile and/or geomembrane.

- NIDAFLOW EP (see Figure 7b):

Installation of a drain tunnel with DN 100 and a catchment surface area of 50 cm²/m (slits perforated over 360°) directly above the last layer of blocks and connected to the access chamber.

The surface of the basin (including the vent) shall then be covered by an anti-puncture geotextile and/or geomembrane depending on the type of basin involved.

9.7 Lateral backfill and overlay of the structure

For the backfill, any material listed in the "Guide to Road Earthworks" [SETRA, LCPC, 1992] classification can be used excluding materials with diameters greater than 60 mm and clay materials.

The recommendations of Fascicule 70 and NF P98-331 shall be complied with.

When necessary, compacting is carried out by successive layers according to the recommendations of the current SETRA/LCPC guide.

9.71 Lateral backfill

- Care shall be taken to avoid damaging the geosynthetics and/or the DEG (geomembrane seal).
- Depending on the type of backfill used:
 - Any necessary compacting shall be carried out over successive 30 cm layers using low-power engines.
 - For sand backfill: hydraulic compacting carried out according to the specifications set out in Annex 5 of Fascicule 70 is appropriate.
 - Other types of backfill, such as 20/40 grade pea gravel, are laid without compacting.

9.72 Overlay

- Backfill above the basin with progressive layers at least 30 cm thick so as to be able to pass over the top with the appropriate vehicles.
- Use light shovels or loaders to redistribute the backfill.
- Use compacting engines of an appropriate power level so as to ensure continued basin integrity.
- In the event of vehicle traffic or compacting, the pressure at the blocks' upper interface shall not exceed 75% of the vertical unconfined compressive strength (XP P 16-374).

10. Care -Maintenance

The general conditions of use and maintenance of the structures are realized according to the Technical Guide "Ultra Light Cellular Structures (SAUL) for rainwater management (2011)".

As with any filtering drainage system, NIDAPLAST access chambers and inlet drains shall be inspected twice a year, as well as after heavy rain or accidents. Any macro-waste shall be evacuated.

Via its self-flushing system, the bottom inlet system (see Figure 3, *drains in trench excavations or buried in the diffusion layer*) provides the highest level of protection against risks of clogging or accidental contamination.

Honeycomb cell structures are thus considered as non-clogging under normal operating conditions.

When necessary, the inlet and drainage pipes of the NIDAPLAST system can be cleaned using high-pressure jets (up to 120 bars).

Upstream deployment of specific treatment limits the frequency of cleaning operations.

11. Marketing method

NIDAPLAST blocks and their accessories are marketed through a network of distributors.

12. Internal quality assurance checks

12.1 Inspection of raw materials

Concerning virgin materials, a conformity certificate of the type 3.1 as specified in NF EN 10204 is provided by the supplier(s) of each batch (corresponding to a delivery).

The laboratory inspection carried out by the suppliers mainly checks the melt flow index, while also checking certain mechanical properties (modulus, strength, etc.)

Material approvals are issued on the basis of the supplier(s) conformity certificates and technical data sheets together with the specifications for internal blends.

12.2 Inspection of the production process

Production parameters and inspections are covered by specific procedures.

12.3 Inspection of finished products

The following tests are carried out:

Type of inspection	Frequency	Sampling
Dimensions	Once per workstation	1 module
Weight	Once per workstation	1 module
Appearance	Continuously (recordings made once every 4 hours)	All blocks
Vertical compressive strength	Once a week	4 test pieces
Lateral compressive strength	Once every two weeks	4 test pieces
Melt flow index	Once per year	1 sample for each type of material
OIT	Twice a year	1 sample from the finished product
Pallet appearance, marking, packaging	Once per workstation	1 pallet

A statistical analysis is carried out on the results of tests performed on raw materials and finished products.

13. Certification

13.1 Quality assurance system

The quality assurance system set up at the production plants is certified to ISO 9001 (2008).

NIDAPLAST is also certified to ISO 14001 (2004) and OHSAS 18001 (2007).

13.2 Certification

NIDAPLAST and NIDAFLOW EP blocks are certified as denoted by the CSTBat mark that certifies, for each production site, the regularity and satisfactory outcome of the internal quality assurance inspection.

Products with a valid certificate are marked with the CSTBat logo.

The certified characteristics are as follows:

- Dimensional characteristics (see § 3.2),
- Determination of unconfined compressive strength on a block (see § 3.31).

The inspections carried out by CSTB include:

- An annual inspection of the production centre in order to validate the quality assurance system,
- Sampling of a block and testing of the sample at the mark's laboratory (dimensional, mechanical strength, OIT and melt flow index checks).

The results of these inspections are examined by the certificate Assessment Committee.

B. Results of experiments

The following tests were carried out on NIDAPLAST blocks:

- Plate testing, lateral compression testing, 10/2009 (CER Rouen)
- Uniaxial compression testing 2008-2010 CETE de l'EST
- Feedback from a project run by the CETE de l'EST 2005 (Gomez-Wagner)
- Sheffield University on the risks of clogging in a NIDAPLAST EP structure -2003

Internal NIDAPLAST testing:

- Long-term creep testing in the vertical direction.

CSTB carried out the following tests on NIDAPLAST blocks:

- dimensional characteristics,
- material characteristics,
- uniaxial compression testing in the vertical and lateral directions.

B. References

C1. Health and environmental safety data (1)

There is no Health and Environmental Safety Declaration ('FDES') to file for NIDAPLAST EP and NIDAFLOW EP products.

The data from FDES files serves to calculate the environmental impacts of engineering structures in which the products (or processes) targeted will foreseeably be employed.

C2. Other references

A product volume in excess of 1,000,000 m³ has been installed in Europe. A list of 50 French references dating from 1986 to 2013, ranging from 100 to 6000 m³, has been submitted to CSTB.

(1) Not examined by the Specialized Group within the scope of this Technical Assessment.

Technical File tables and figures

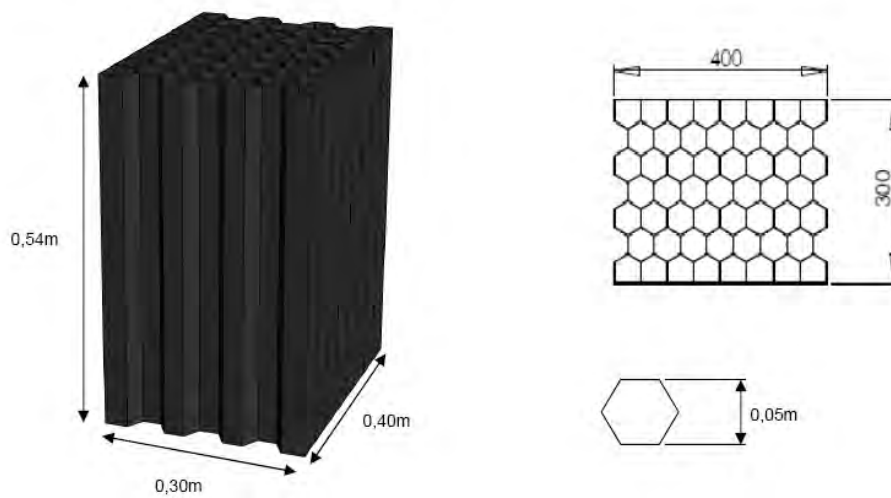


Figure 1 a – basic extruded block

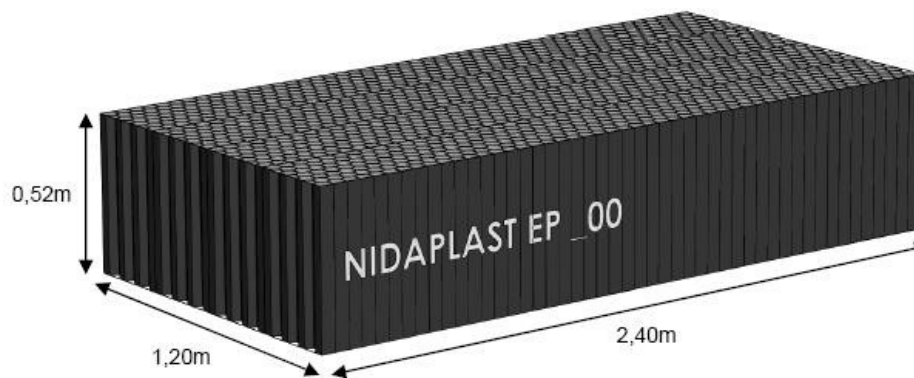


Figure 1 b – basic block NIDAPLAST EP



Figure 1c – basic block NIDAFLOW EP grooved on 1 side



Figure 1d – basic block NIDAFLOW EP grooved on 2 sides

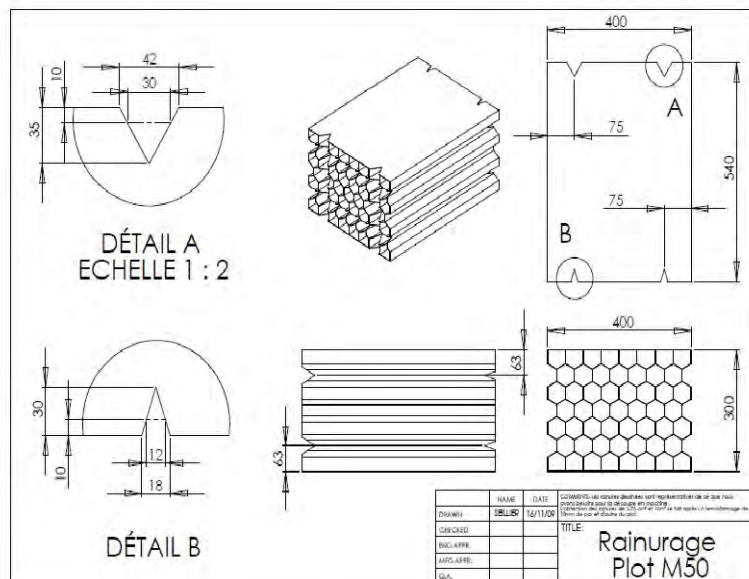


Figure 1e – extruded grooved block

Table 1: NIDAPLAST-NIDAFLOW range - Dimensions and characteristics of the various block versions

Characteristics and tolerances	NIDAPLAST EP				NIDAFLOW EP			
	EP 300	EP 400	EP 500	EP 600	EP 300	EP 400	EP 500	EP 600
Dimensions (m) $\pm 1.5\%$	2.4 $\times$ 1.2 $\times$ 0.52							
Mass of the block (kg) $\pm 2.5\%$	47.0	52.0	59.0	66.0	52.0	59.0	66.0	73.0
Bulk density of the block (kg/m ³)	32.0	35.0	40.0	44.0	35.0	40.0	44.0	49.0

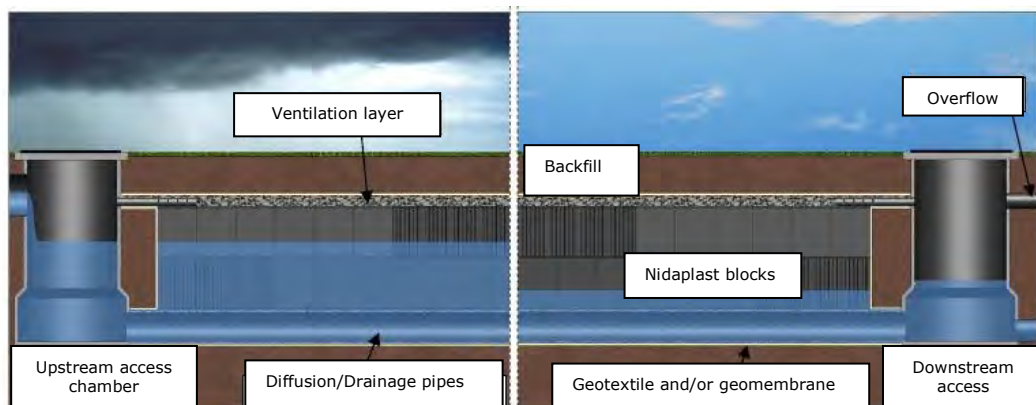


Figure 2 – Schematic diagram of a basin made using NIDAPLAST EP

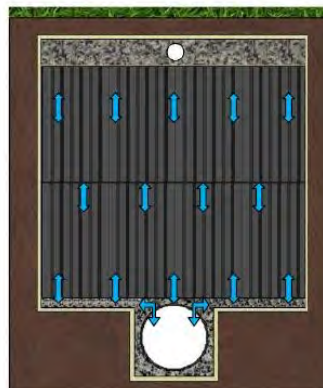


Figure 3 – Schematic cross-section of a basin made using NIDAPLAST EP

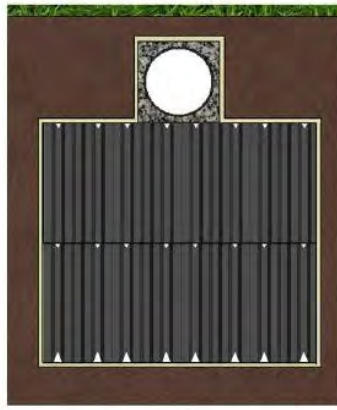


Figure 4 – Cross-section the case of a top-inlet using NIDAFLOW EP (special case see § 6.2)

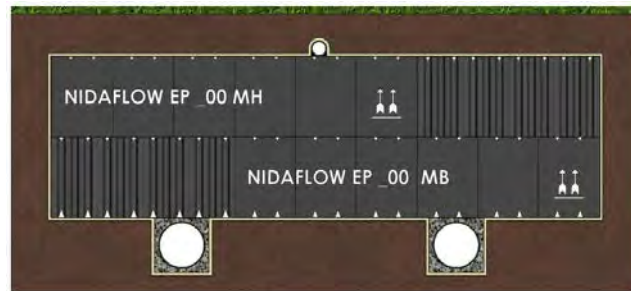


Figure 5 – Schematic cross-section of a basin made using NIDAFLOW EP

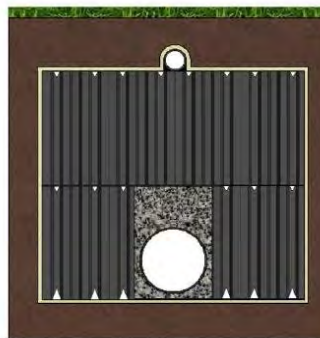


Figure 6 – Special case of drain positioning

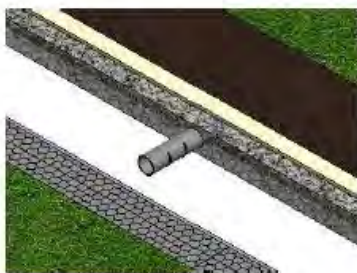


Figure 7a – NIDAPLAST EP ventilation system

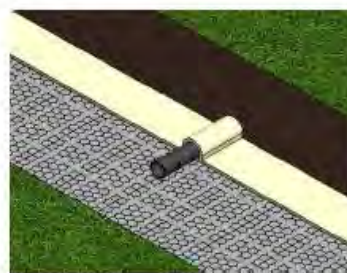


Figure 7b – NIDAFLOW EP ventilation system

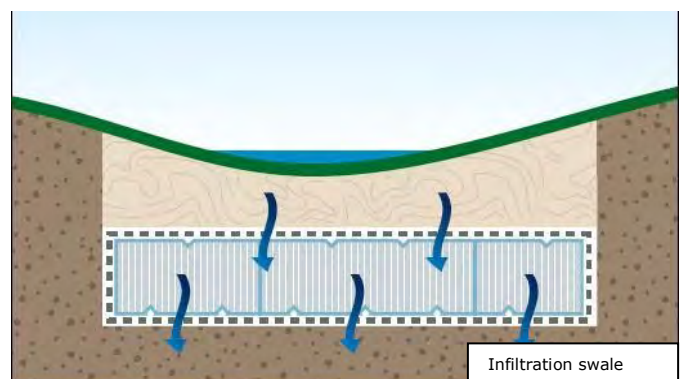
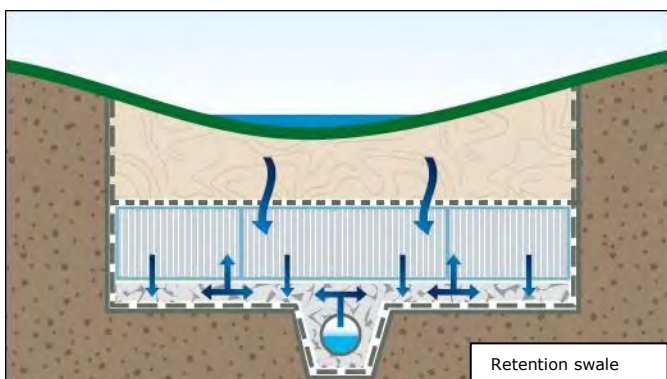


Figure 8a and 8b: Swales

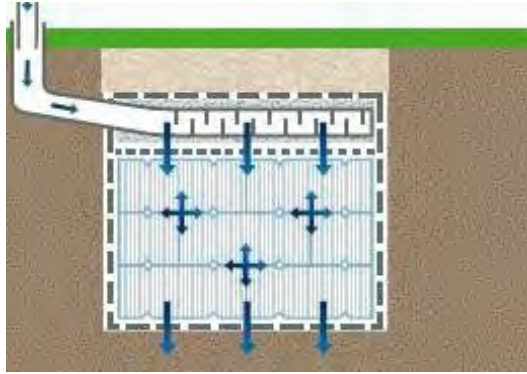


Figure 8c: Infiltration wells

Where:

- **Qc** maximum speed of the flow entering the basin given by the DO in charge of the project or estimated by a hydrological computation that mainly factors in the paved surface, the return period, the diameter and slope of the header (Manning Strickler formula)
- **Qd** maximum permissible flow rate in drains according to hydraulic load of the number, type and cross-section of drains
- **Qf** drain diffusion flow capacity according to hydraulic load of the number, type, cross-section and width of the slit
- **Qe** authorised flow rate ("outflow rate") of the storage basin.

To avoid swamping the rainwater header tank, the following two flow rate conditions shall be met simultaneously:

- The drains shall have the capacity to receive the peak flow i.e. **Qd ≥ Qc**
- All water collected in the drains that does not outflow directly downstream shall be diffused via the slits, i.e. **Qf ≥ (Qd - Qe)**

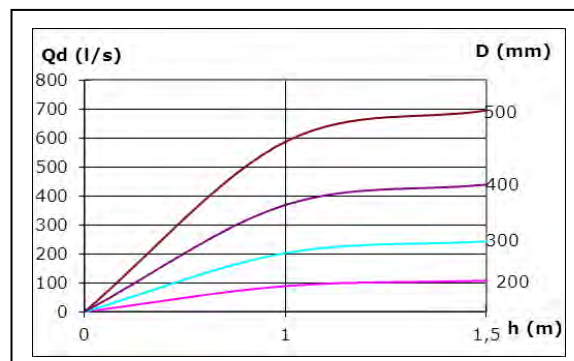
NIDAPLAST advises of a safety factor of 2 to take account of the nature of the effluent.

$$\text{For each drain } Q_d = 2100 \times D^2 \sqrt{h + D/2}$$

Where Qd = drain flow capacity, in L/s

D = internal drain diameter, in m

h = half-height of the basin, in m



$$Q_f > \alpha \times (Q_c - Q_e)$$

For 1 mL of drain, flow diffusion is: $Q_f = 0.133 \times S \times h^{1/2}$ and $Q_f = L \times q_f$

S = slit areas in cm²/mL

h = half-height of the basin, in m

α = safety factor, generally equal to 2

L = drain lengths in m, $L = \alpha \times (Q_c - Q_e) / q_f$

Qf = drain diffusion flow rate, in L/s

Qe = permissible drainage rate, in L/s

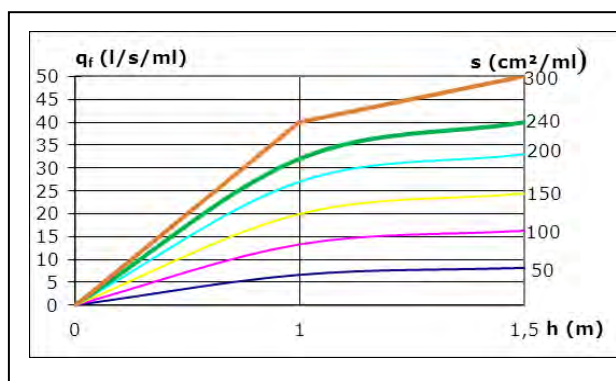


Figure 9 : Ready reckoners for drain sizing

1. ROADWAYS WITH AVERAGE TO HIGH TRAFFIC VOLUME

The tests carried out by the Rouen C.E.R. demonstrate that 55 cm of backfill (gravel D2 – 0/20 mm crushed) provides a PF2 platform grade.

The following table gives a few examples of standard structures using bituminous binders on a PF2 platform. ("Guide to French road surface specifications")

Type of traffic	T0	T1	T2	T3	Material
Wearing course	8	8	8	8	BB
Road base layer	18	15	12	12	GB
Foundation layer	18	18	15	12	GB
Subgrade	> 55	> 55	> 55	> 55	GNT

BB: asphalt concrete - GB: Road base asphalt - GNT: Untreated graded aggregates
Thicknesses are estimated in cm

2. ROADWAYS with LOW TRAFFIC VOLUMES

The following tables give a few examples of standard structures using untreated graded aggregates ("Design handbook for roadways with low traffic volumes")

Type of traffic	T4	T5		Material
Wearing course	6 – 8	4	Surface dressing	BB
Road base layer	20	20	20	GNT
Foundation layer	20	22	30	GNT
Subgrade	> 25	> 25	> 25	GNT

BB: asphalt concrete - GNT: Untreated 0/31.5 graded aggregates
Thicknesses are estimated in cm

A few examples of structures comprising treated graded aggregates with bituminous binders.

Type of traffic	T4	T5	Material
Wearing course	4	4	BB
Foundation and base layer	22	15	GB
Subgrade	>	>	GNT

BB: asphalt concrete - GB: Road base asphalt - GNT: Untreated graded aggregates
Thicknesses are estimated in cm

3. CASE of PARKING AREAS

These may be pre-sized using the ready reckoner that links platform performance to the thickness of the granular backfill material and the "Design handbook for roadways with low traffic volumes" based on the following assumptions:

- traffic equivalent: T5
- cumulated traffic N less than 10^4

Based on these assumptions, structures comprising untreated graded aggregates (GNT) are to be implemented as follows:

Type of traffic	T5 and $N < 10^4$	Material
Wearing course	4 –	BB
Foundation and base layer	15	GN
Subgrade	> 25	GN

BB: asphalt concrete - GNT: Untreated 0/31.5 graded aggregates
Thicknesses are estimated in cm