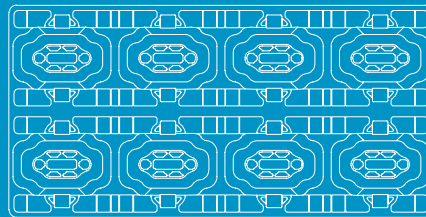
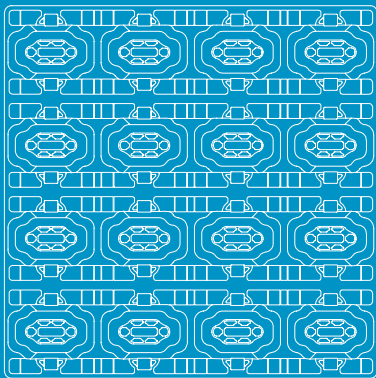


DRAINPANEL TECHNICAL MANUAL

STORMWATER INSPECTABLE MODULES FOR INFILTRATION AND ATTENUATION



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DRAINPANEL TECHNICAL MANUAL

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TECHNICAL DATA

1. INTRODUCTION

1.1 GENERALITIES

DRAINPANEL is a modular system made up of moulded panels in 100% regenerated PP, designed for the creation of underground systems for rainwater management. The system consists of 3 elements, essential for the creation of the structure and must be coated on all sides with a geosynthetic material which differs according to the intended application (retention or release of water in the subsoil).

1.2 USE OF THE PRODUCT

DRAINPANEL is used for the creation of the following systems:

- Basins or trenches for water dispersion in the subsoil or rainwater lamination in the sewer network;
- Rainwater accumulation and reuse basins.

1.3 FUNCTIONS

1.3.1 HARVESTING AND DISCHARGE

The system of modular panels makes it possible to create a high-capacity underground basin, able to temporarily accumulate rainwater from the surface abstraction network.

According to the type of installation and the conditions of the system on-site, it is capable of:

- Facilitating the infiltration of collected water into the subsoil, emptying itself;
- Releasing the accumulated water into a final receptor at a regulated flow rate;
- Storing a defined volume of water, releasing the excess portion into a final receptor.

1.3.2 STRUCTURAL CHARACTERISTICS

DRAINPANEL maintains the intended destination of use of the above surface, that can be paved or left green. According to the use, a suitable installation package entailing the following changes, should be take into consideration:

- A variation in the depth of the chambers;
- A variation in the maximum number of stackable layers;
- An appropriate finishing.

The product is not suitable for installation below buildings.

1.3.3 ACCESSIBILITY

The network of ducts inside the plastic structure allows inspection and cleaning of the system. Access shall be made by providing appropriate inspection wells to intercept the supply/discharge pipelines.

1.3.4 VENTILATION

The structure must allow the air pressure to be balanced during the filling and emptying phases.

1.4 COMPONENTS

1.4.1 DRAINPANEL

DRAINPANEL elements are moulded in just one size with dimensions 112x112xH=23 cm. The panels are provided with 16 truncated-cone elements with elliptical sectioning, laterally reinforced and hollow inside, in order to allow the maximal void ratio. The elliptical section is functional to the overlapping and interlocking of the panels. The base of the panel is perforated in order to let water pass through. The estimated void ratio of the structure is of 96%.



1.4.2 DRAINPANEL HALF

This is an element with the same characteristics of DRAINPANEL, but with dimensions 56x112xH=23 cm. It is produced during the moulding stage by inserting a longitudinal septum into the mould which divides halfway into the moulded plastic material in the injection phase and creates 2 identical elements. It is functional to create a structure through “brick assembling”, to ensure the side connection of the elements.



1.4.3 DRAINPANEL GRID

It is a grid with dimensions 28x112xH=3,8 cm which is installed on the pyramidal truncated elements of the top layer of the panels, in order to create a surface for the installation of the geotextile. In this way, punching can be avoided and loads can be distributed.



2. MANUFACTURING METHOD AND MATERIAL

2.1 MANUFACTURING METHOD

The three elements of DRAINPANEL are produced by injection moulding at the Geoplast Spa plant located in Grantorto (PD), Italy.

Geoplast Spa is a company with UNI EN ISO 9001:2000 quality certification.

2.2 MATERIAL

DRAINPANEL is made of polypropylene (PP), 100% regenerated. The material is 100% regenerated and reinforced with fiberglass 30%. It is chemically inert and does not release substances into the stored water, but it may suffer prolonged exposure to UV. Material properties are listed in the table.

| CHARACTERISTIC | METHOD | U.O.M. | VALUE |
|------------------------------------|-------------|-------------------|-------|
| MFI (230°C / 2,16 kg) | ASTM-D-1238 | g/10' | 5 |
| Izod Resistance | ASTM-D-256 | J/m | 80-90 |
| Tensile breaking stresses | ASTM-D-638 | MPa | 80 |
| Flexible elastic modulus | ASTM-D-790 | MPa | 5500 |
| Softening temperature. vicat b/50n | ASTM-D-1525 | °C | 135 |
| Density | ASTM-D-792 | g/cm ³ | 1,12 |

Information on the safe use of the material is provided in Appendix A.

3. TECHNICAL CHARACTERISTICS

3.1 DRAINPANEL AND DRAINPANEL HALF

The technical characteristics of DRAINPANEL and DRAINPANEL HALF products are shown in the table and dimensional drawings (Figure 1). The product is grey-black in colour, with a smooth surface without cuts, air bubbles or inclusions.

| | | DRAINPANEL | DRAINPANEL HALF |
|-------------------------------|----------------|-------------|-----------------|
| Product code | - | EDRAINP0112 | EDRAINP0056 |
| Dimensions | cm | 112 | 112 |
| Width | cm | 112 | 56 |
| Height | cm | 23 | 23 |
| Height of the installed panel | cm | 20 | 20 |
| Void ratio | % | 96 | 96 |
| Storage capacity | m ³ | 0,24 | 0,12 |
| Weight* | kg | 13,50 | 6,75 |

DRAINPANEL and DRAINPANEL HALF elements connects through a simple vertical interlocking, rotating the panels by 90° in respect to the substrate. The side connection of the element is carried out through the “brick” installation method. No fixing system is required (screws, glues/ silicones, clips).

Elements must never be cut out, reduced or modified. If this happens Geoplast S.p.a. is not liable for the failure of the system.



3.2 DRAINPANEL GRID

The characteristics of DRAINPANEL GRID are reported in the table and in the dimensional drawings (Figure 1). The product is grey-black in colour, with a smooth surface without cuts, air bubbles or inclusions.

| | | |
|--------------|----|---------------|
| Product code | - | EDRAINING0028 |
| Width | cm | 28 |
| Length | cm | 112 |
| Weight* | kg | 2,04 |

The grid must be hooked up by simple interlocking only above the top layer of the panels. The use of DRAINPANEL GRID is mandatory.

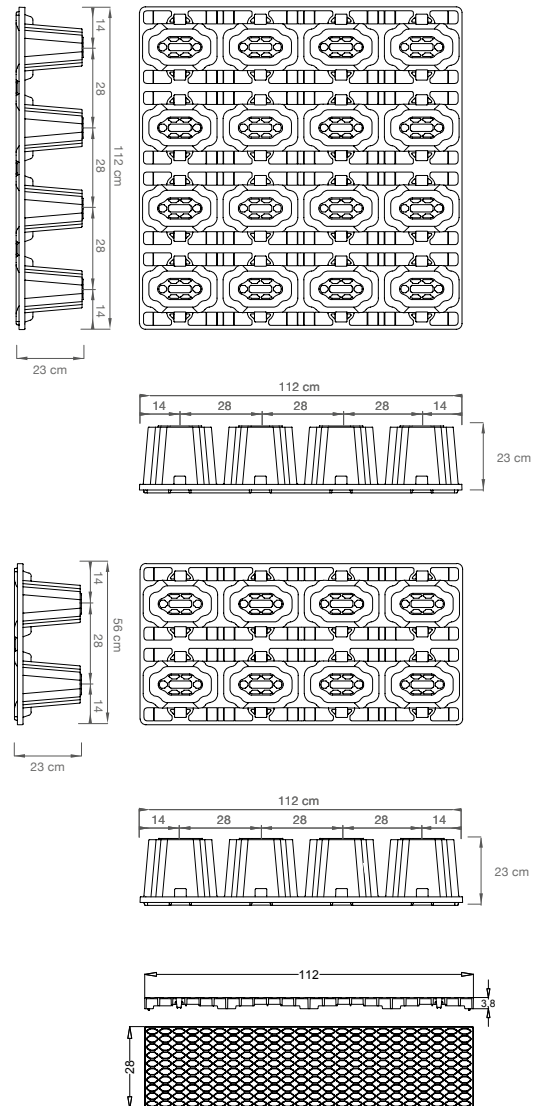


Figure 1 - Dimensional Drawings

The products have margins of tolerance related to environmental factors and the type of material used (the weight may vary by +/- 10%).



Figure 2 - Installation Sequence Drainpanel Grid

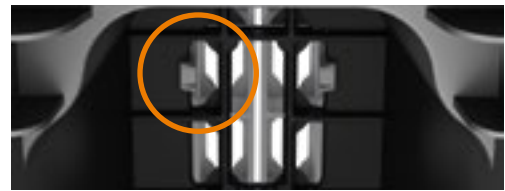


Figure 3 - Drainpanel-Drainpanel Grid interlocking detail



3.3 SAFETY MEASURES

The installation of the product is completely manual, there is no mechanical handling. The installation can be carried out by a single person, because the weight of the elements is lower than the maximum liftable weight under optimal conditions (ISO 11228).

When handling DRAINPANEL elements, attention should be paid to the following risks:

- Possible slipping during the walkaway over the elements in wet weather conditions or in the presence of ice.
- Risk of crushing during the mechanical handling of pallets.
- Risk of crushing during the dismantling of the stacked panels.
- Risk of accidental fall during the installation, especially for systems that develop vertically.



Figure 4 - Drainpanel Handling

4. TRANSPORT AND STORAGE

DRAINPANEL elements are stacked and transported in pallets; The characteristics of the packaging are as follows:

| | Size (cm) | No. elements | m2 surface |
|------------------------|---------------|--------------|------------|
| DRAINPANEL | 112x112xH250 | 75 | 94 |
| DRAINPANEL HALF | 112x112xH250 | 150 | 94 |
| DRAINPANEL GRID | 112x112x h240 | 240 | 75 |

For the pallets unloading and handling it is possible to use mechanical means like forks or cranes, provided with lifting straps.

For a correct storage, it is recommended to choose stable surface area and as smooth as possible; the product must stay away from the possible contact with fuels, lubricants, chemicals or acids. Exposure to UV radiation should be as limited as possible.

The following operations must be avoided once the elements are removed from the pallets:

- Inappropriate storage (superimposition of pallets, stacking of elements in bulk,...);
- Incorrect handling (throwing the elements, dragging,...);
- Contact or impact with sharp or blunt objects (stones, blades,...).

IMPORTANT: Before installation, check that the elements are not damaged or defective (must comply with the characteristics described in paragraphs 3.1 and 3.2.). Avoid installation if there is any damage or defects in the panels or grids.



Figure 4 - Pallets handling



APPLICATIONS

5. RAINWATER DRAINAGE

5.1 PRELIMINARY RESEARCH

It is advisable to carry out geotechnical and geological surveys at the site where the basin will be built in order to verify its suitability. In particular the elements that should be assessed are:

- Soil permeability.
- Load-bearing capacity of the soil.
- Maximum level of free aquifer.

If it is planned to discharge into a surface water body, it is necessary to know:

- The average level.
- Maximum discharge capacity (according to the prescriptions of the Managing Authority).

With regard to the quality of waste water, reference should be made to the legal limits in force for discharge into the subsoil or into a receiving body of water, in order to provide appropriate treatment facilities upstream of the dispersing system.

5.2 POSITIONING

It is generally recommended to adopt the following criteria:

- Distance from buildings: higher than 1.5 times the installation depth.
- Distance from the maximum level of groundwater: not less than 1 m from the bottom of the system (in agreement with most international guidelines). If the distance is shorter, the Competent Authority shall be consulted for approval.
- Distance from tall trees: equal to the maximum width attainable from the tree crown.
- Distance to subservices and other infrastructures: refer to local regulations.

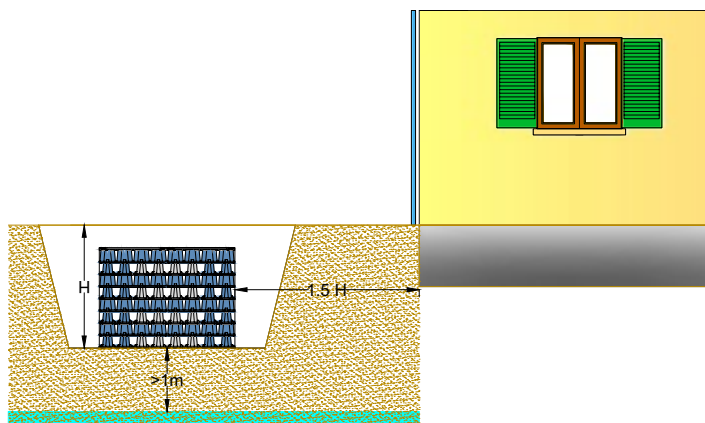


Figure 5 - Positioning of the system

5.3 DIMENSIONING CRITERIA

Geoplast can provide a pre-dimensioning of the dispersant system, based on data provided by the customer. The calculation must be validated by the designer of the work.

5.3.1 NECESSARY DATA

The following data are required for a correct calculation of the system:

- Drainage areas.
- Outflow coefficients: typical values of this parameter are shown in the table below, some local regulations also define the values to be adopted.

| SURFACE TYPE | Φ |
|----------------------------------|-----------|
| Roofs with metal sheets or tiles | 0,9 – 1 |
| Concrete flat roofs | 0,7 – 0,8 |
| Green roofs | 0,3 – 0,4 |
| Paved surfaces | 0,7 – 0,9 |
| Dirt roads | 0,4 – 0,6 |
| Grass surfaces | 0,1 – 0,4 |
| Residential areas | 0,3 – 0,7 |
| Woods | 0,1 – 0,3 |
| Cultivated lands | 0,2 – 0,6 |

- Rainfalls: data given from the rainfall analysis. The recommended parameters are as follows (unless otherwise specified in the regulations):

| | | |
|----------------|---------|----|
| Event duration | minutes | 30 |
| Return Time | years | 50 |

- Infiltration speed: some internationally recognised typical values are shown in the table.

| SURFACE TYPE | INFILTRATION SPEED (m/s) |
|---------------|--------------------------|
| Coarse Gravel | 10^{-3} |
| Coarse sand | 10^{-4} |
| Fine sand | 10^{-5} |
| Silt | 10^{-6} |
| Marl | $10^{-7} - 10^{-8}$ |
| Clay | 10^{-9} |

- Applied loads: depending on the use of the site.

5.3.2 CALCULATION PRINCIPLE

For the dimensioning of the dispersant basin, there are multiple international reference guidelines (Germany: DWA A-138; Great Britain: BRE Digest 365; France: Guide SAUL).

The main passages, essentially common to the documents mentioned above, are the following:

- 1 Determination of the volume to dispose (V_{IN})
- 2 Definition of the basin's dimension specifications:
 - Height H of the system, given by the number of stackable levels.
 - Width B and length L of the basin. One of the two dimensions must be known, while the other must be the unknown.
Example: Width **B=5x1,12=5,6 m**
(5 rows of elements DRAINPANEL)
Width $L=N \times 1,12$ (with N number of panels per row)
- 3 Estimation of the volume of water disposed of during the meteoric event (V_{OUT}), given by the sum of
 - The volume infiltrated in the soil.
 - The volume discharged into the receptor (if provided).

For the calculation of the infiltrated volume, it has to be taken into consideration the dispersant surface, which is equal to the background and side walls of the plastic system.

Some foreign regulations require to consider only the side surface of the basin, calculating it with a height equal to H/2.

- 4 Estimation of the maximum volume that can be accumulated in the system. This volume is equal to: (V_{ACC}).

$$V_{ACC} = (B \times H \times L) \times 0,96$$

5 Budget setting:

$$V_{ACC} = V_{IN} - V_{OUT}$$

With the terms identified in the previous points and resolution of the equation as a function of L.

5.3.3 CHECK OF THE PERFORMED DIMENSIONING

The verification is based on an estimate of the hydraulic residence time. The guidelines mentioned in the previous paragraph provide a 48-hour baseline for the complete drainage of the basin, defined as the average observed time between 2 consecutive intense rainy events. If this value is higher, it is necessary to review the dimensioning:

- The hydraulic residence time is set at 48 hours and the required dispersion surface is determined by inverse formula.
- A constant discharge flow rate in the network is expected, if it has not already been covered previously.

The two solutions can also be complementary to each other. In any case, the technical feasibility must be assessed.

5.4 LOADS

DRAINPANEL system was designed to bear the loads of heavy means, after the adoption of a correct laying stratigraphy.

In Appendix B, specifications for applied loads are given in terms of:

- Maximum number of stacking levels.
- Minimum and maximum coating thickness of the structure.

If the design requires special specifications, it is advisable to contact Geoplast Spa technical office.

Geoplast Spa is not liable for damage to the system if the instructions provided are not followed.

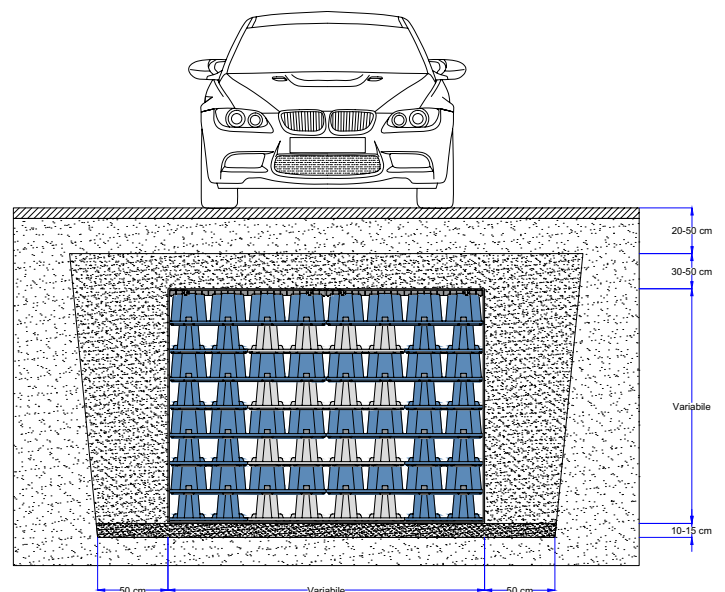


Figure 6 - Laying stratigraphy DRAINPANEL

5.5 INSTALLATION PROCEDURE

5.5.1 EXCAVATION AND PREPARATION OF THE SOIL

The recommended specifications are as follows:

- Dimensions: at least 50 cm between the plastic structure and the excavation wall.
- Laying surface: horizontal, regular and with a minimum gradient of at least 0.1% in the direction of discharge.
- Background: at least 10-15 cm of well compacted granular material 8/16 mm in size. For particularly soft backgrounds it is necessary to carry out an in-depth assessment to adopt the optimal technical solution. It is generally recommended:
- The increasing of the thickness of the substrate using granular material.
- Use of geo-nets or reinforcement geotextiles laid on the bottom of the excavation.

The geo-synthetic to cover the structure must be laid before the creation of the specific background (specifications are given in paragraph 5.5.4) It is recommended that the excavation walls have an adequate inclination or that, in any case, suitable measures are taken to ensure the safety of the operators during installation.



Figure 7 - Excavation and background preparation

5.5.2 DRAINPANEL INSTALLATION

Installation must be carried out manually only. During the positioning it is possible to walk over the elements, but it is forbidden to transit with operating machines, even small ones. The steps for the correct assembly of the system are given in Appendix C.



Figure 8 - Laying Drainpanel (Drainpanel and Drainpanel Half)

5.5.3 HYDRAULIC CONNECTIONS

The system must be connected to the supply and discharge pipelines according to the design specifications. Pipes with a maximum diameter of $\Phi 125$ mm can be inserted into the structure. For specifications on hydraulic connections see paragraph 5.6.

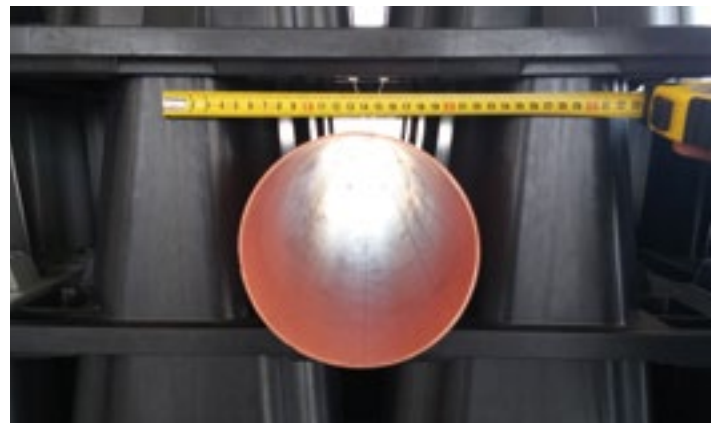


Figure 9 - Pipe diameter for hydraulic connections

5.5.4 COATING WITH GEOSYNTHETIC

The entire structure must be coated with a suitable geosynthetic in order to preserve the capacity of the system, preventing the intrusion of the soil. Depending on the function of the system, different geosynthetic types must be provided:

- **Infiltration:** a weft fabric is used. It is not recommend the use of a non-woven fabric in direct contact with the plastic structure. The minimum suggested specifications are given in the table:

| CHARACTERISTIC | LAW | U.O.M. | VALUE |
|------------------------------------|---------------|------------------|-------|
| Thickness | EN ISO 9863-1 | mm | 0,75 |
| Grammage | EN ISO 9864 | g/m ² | 190 |
| CBR Static punching resistance CBR | EN ISO 12236 | kN | 4 |
| Tensile strength | EN ISO 10319 | kN/m | 40 |
| Holes opening | EN ISO 12956 | µm | 200 |
| Plane normal permeability | EN ISO 11058 | mm/s | 29 |
| Material | - | - | PP |

- **Lamination:** a waterproof sheath is used to prevent water from escaping. Both sides of the sheath must be protected with weft fabric. Sheath specifications are given in the table below, while the geo-textile ones are in the above-mentioned table:

| CHARACTERISTIC | LAW | U.O.M. | VALUE |
|---------------------|---------------|-------------------|-----------------------|
| Thickness | EN ISO 1849-2 | mm | 1 |
| Grammage | EN ISO 1849-2 | g/m ² | 900 |
| Drilling resistance | FTMS 101C | N | >150 |
| Tensile strength | ASTM D4885 | kN/m ² | >1600 |
| Shear resistance | DIN 53515 | N/mm ² | >45 |
| Thermal expansion | DIN 53377 | % | ±3 |
| Permeability | ASTM D | m/s | > 2x10 ⁻¹² |

It is recommended to lay the geosynthetics by overlapping the strips by at least 30-40 cm.

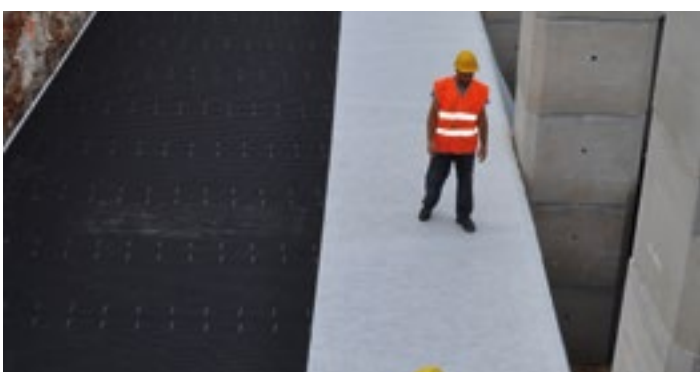
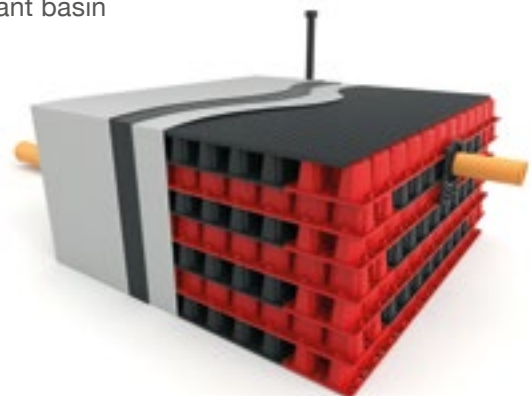


Figure 10 - Geosynthetic installation above the Drainpanel



Dispersant basin



Lamination basin

5.5.5 – BACKFILL AND COVERING OF THE STRUCTURE

The following specifications are recommended:

- **Material:** coarse sand or fine gravel with a particle size of 8/16 mm, compacted with manual compactor for layers, 15-30 cm thick.
- **Procedure:** the edge between the structure and the excavation must be filled at first, rising altitude uniformly. Do not fill one side at time, leaving the others empty. Then, it is possible to fill the upper part, according to the thickness of the project (minimum 30 cm), always applying the layers uniformly over the entire basin and compacting them by hand.
- **Operating machines:** crawler machines can transit over the elements, but they do not have to weight more than 8 t and the granular material over the structure must have a thickness of at least 50.



Figure 11 - Drainpanel system covering and re-filling phase

5.5.6 FINISH

Depending on the intended use of the area, the system will be backfilled to the project level and the finish will be completed.

Please note that Geoplast Spa is not liable for any damage to the system if the above regulations are not observed.



Figure 12 - Completion with parking finish

5.6 HYDRAULIC CONNECTIONS

5.6.1 INLET WATER TREATMENTS

The water entering the basin must be as clean as possible in order to avoid clogging of the system and contamination of the final receptor.

The degree of purification to be achieved depends on:

- The quality of incoming water.
- The in force regulations (Legislative Decree 152/2006 and local implementing regulations).
- The final receptor.

In the absence of regulatory requirements:

- Systems should be provided for the removal of coarse solids (sediment traps). It is possible to predict an increase in the depth of the input wells in order to facilitate sediment settling.
- Install an oil separator if the system disposes of run-off water from a parking lot and the final delivery is underground.

5.6.2 INTAKE PIPELINES

The sizing of the collectors is the responsibility of the designer of the work.

The maximum pipe diameter that can be plugged into the structure is Φ 125 mm. If the collector has a larger diameter:

- Branches of the line with the coupling into the system by means of a reduction in diameter Φ 125 mm must be provided. The number of branches will depend on the expected input flow rate.
- Alternatively, the tubes will support the plastic structure (see Appendix D for details). Typical diagrams for hydraulic connections are given in Appendix D.



Figure 13 - Drainpanel supply collectors

5.6.3 DISCHARGE PIPELINES

The adoption of a system discharge line must be evaluated at the design stage. As a rule, it is common practice to provide for regulated discharge at regulated flow rates in cases where:

- The soil is weakly draining and its drainage should be facilitated within a reasonable period of time.
- The basin must work for pure lamination of the flow rates.
- We want to guarantee maximum hydraulic safety in case of exceptional events.

An emergency by-pass may also be provided for in the event of a drainage system crisis. It is recommended to interrupt the drainage system with one or more wells for basin cleaning operations.

5.7 MAINTENANCE

It is necessary to provide for regular inspection and maintenance of the basin in order to maintain its full functionality.

Specific studies have shown that in a time span of 50 years, without adequate maintenance of the system, it is possible to lose up to 10% of the basin capacity due to sedimentation of the fine fraction of solids (limonites and clays) which are difficult to remove from the upstream treatment units.

5.7.1 INSPECTION

The inspection of the system can be carried out by means of “push-in” micro-cameras that may be inserted inside a flexible tube shirt.

System access points must be provided during the design phase. It is recommended to carry out inspection wells that intercept the supply pipes to facilitate the entry of the instrumentation.

5.7.2 CLEANING

Cleaning can be carried out by means of “push-on” nozzles normally used for cleaning the sewerage pipes, accessing inside the system through the supply pipes and the foreseen wells. Cleaning operations must start with washing the fuel lines and upstream wells, especially if they also act as a sediment trap. It is also advisable to provide a well downstream so as to facilitate the inlet of the washing water suction pipe.



Figure 14 - Example of cleaning with push-on nozzles

5.7.3 PERIODICITY OF INTERVENTIONS

It is advisable to draw up a system inspection and maintenance plan in order to carry out a systematic periodic inspection.

System control is essential during the following periods:

- Completion of worksite operations;
- After particularly intense weather events;
- In case of failure or malfunction of pre-treatment units;
- At least once a year.

6. RECOVERY AND REUSE OF RAINWATER

6.1 PRELIMINARY INQUIRIES

It is advisable to carry out geotechnical and geological surveys at the site where the basin will be built in order to verify its suitability. In particular, they should be assessed:

- Carrying capacity of the ground
- Maximum level of free aquifer.

In order to discharge excess flow rates into a receptor, it is necessary to know:

- Average level and maximum discharge flow rate (according to the requirements of the managing body) if it is a surface water body;
- Permeability of the ground in the case of an underground discharge.

6.2 POSITIONING

The following criteria are recommended:

- Distance from tall trees: equal to the maximum reachable width from the tree crown;
- Distance to subservices and other infrastructure: refer to local regulations. The system can also be installed under buildings or in the presence of water table, taking the necessary precautions.
- The system is not suitable for installation below buildings.

6.3 DIMENSIONING CRITERIA

Geoplast Spa can provide a pre-dimensioning of the dispersant system, based on data provided by the customer. The calculation must be validated by the designer of the work.

6.3.1 NECESSARY DATA

The following data are required for correct system calculation:

- Surfaces to be drained;
- Outflow coefficients: typical values of this parameter are indicated in the table; some local regulations define the values to be adopted.

| SURFACE TYPE | Φ |
|---------------------------------|-----------|
| Roofs with sheet metal or tiles | 0,9 – 1 |
| Flat roofs in concrete | 0,7 – 0,8 |
| Flat green roofs | 0,3 – 0,4 |
| Paved surfaces | 0,7 – 0,9 |
| Land roads | 0,4 – 0,6 |
| Grass areas | 0,1 – 0,4 |
| Residential areas | 0,3 – 0,7 |
| Woods | 0,1 – 0,3 |
| Cultivated lands | 0,2 – 0,6 |

- Rainfalls: the average annual value, obtained from rainfall analysis or studies at local level, is considered.
- Rainfall frequency: obtained from local studies. Alternatively, the average dry weather data should be searched.
- Water consumption.

| | Daily consumption per capita [l/ab/d] | Year consumption [l/m ²] |
|--|---------------------------------------|--------------------------------------|
| Domestic bathrooms | 24 | |
| Office bathrooms | 12 | |
| School bathrooms | 6 | |
| Irrigation of green areas | | 60 |
| Irrigation of sports fields (6 months) | | 200 |
| Watering lawn with light soil (6 months) | | 100-200 |
| Lawn irrigation with heavy soil (6 months) | | 80-150 |

- Loads applied: Variable depending on the use of the site.

6.3.2 PRINCIPLE OF CALCULATION

The system calculation is left to the designer of the work. The sizing can be carried out according to the criteria of EN DIN 1989:2000-12, concerning the sizing of tanks for rainwater recovery.

The basic steps are as follows:

- 1 Estimation of the maximum cumulative VACC volume.
- 2 Estimated water demand F.
- 3 Evaluation of the average dry time[dd] by means of the relation

$$TSM = (365 - FR)/12 \text{ with FR rainfall frequency}$$

- 4 Calculation of tank volume with relation

$$V_R = TSM \times (F/365)$$

Valid if $F < V_{ACC}$

If $F > V_{ACC}$:

- Replace the **F** relationship with V_{ACC} .
- Or use the average value between **F** and V_{ACC} .

- 5 Calculation of the number of elements making up the structure dividing the volume obtained by the volume V_r for the container of 1 single panel (240 l).

6.4 LOADS

The DRAINPANEL system has been designed for heavy-duty vehicles, after the adoption of a correct laying stratigraphy.

In Appendix B, specifications for applied loads are given in terms of the following:

- Maximum number of stacking levels;
- Minimum and maximum coating thickness of the structure;

If the design needs require special specifications, it is advisable to contact the Geoplast Spa technical office.

Geoplast Spa is not liable for damage to the system if the instructions provided are not followed.

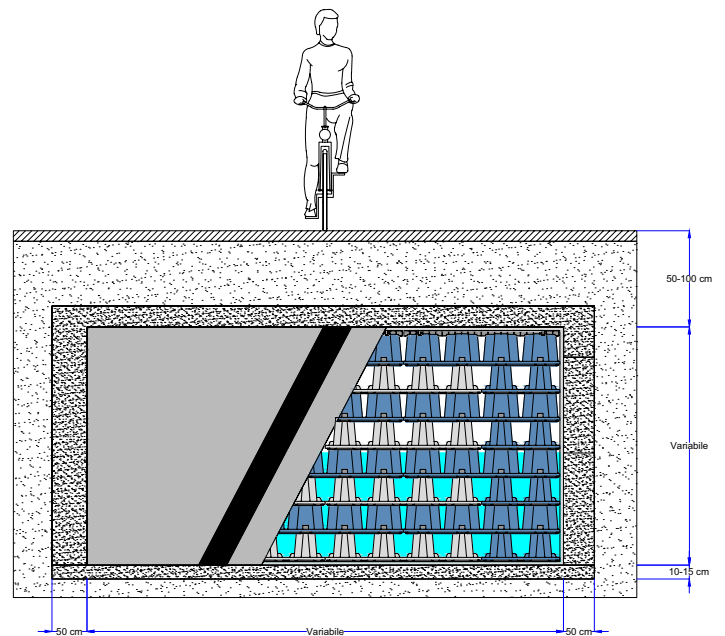


Figure 15 - Stratigraphy of laying, recovery of rainwater.

6.5 INSTALLATION PROCEDURE

6.5.1 EXCAVATION AND PREPARATION OF THE GROUND

The recommended specifications are as follows:

- Dimensions: at least 50 cm between the plastic structure and the excavation wall;
- Laying surface: horizontal, regular and with a minimum slope of at least 0.1% in the direction of discharge;
- Background: at least 10-15 cm of granular material 8/16 mm in size, well compacted.

For particularly soft substrates (cutting resistance <40 kPa or CBR<t) a thorough evaluation is required to adopt the optimal technical solution. It is generally recommended:

- Increase the thickness of the substrate using granular material;
- Use of geo-networks or geotextile reinforcements laid on the bottom of the excavation.

Before laying on the substrate, the geosynthetic covering of the structure must be applied (the specifications are given in paragraph 6.5.4).

It is recommended that the excavation walls have an adequate inclination or that, in any case, suitable measures are taken to ensure the safety of the operators during installation.



Figure 16 - Excavation phase and background preparation

6.5.2 INSTALLATION OF THE DRAINPANEL STRUCTURE

Installation may only be carried out manually.

During installation, you can walk over the elements. The passage of operating machines, even small ones, over the structure is forbidden.

The steps for correct assembly of the system are given in Appendix C.



Figure 17 - Installation of Drainpanel

6.5.3 HYDRAULIC CONNECTIONS

The system must be connected to the supply and exhaust pipes according to the design specifications.

Pipes with a maximum diameter of Φ 125 mm can be inserted into the structure.

For specifications on hydraulic connections see paragraph 6.6.

6.5.4 COATING WITH GEOSYNTHETIC MATERIAL

The entire structure must be covered with a suitable geosynthetic covering in order to preserve the capacity of the system, preventing the intrusion of the tamping ground. A waterproof sheath must be used to prevent water from escaping. Both sides of the sheath must be protected with weft fabric. The specifications of the sheath and geotextile are shown in the following tables:

GEOTEXTILE

| CHARACTERISTIC | LAW | U.O.M. | VALUE |
|------------------------------------|---------------|------------------|-------|
| Thickness | EN ISO 9863-1 | mm | 0,75 |
| Grammage | EN ISO 9864 | g/m ² | 190 |
| CBR Static punching resistance CBR | EN ISO 12236 | kN | 4 |
| Tensile strength | EN ISO 10319 | kN/m | 40 |
| Opening holes | EN ISO 12956 | µm | 200 |
| Normal Permeability to the floor | EN ISO 11058 | mm/s | 29 |
| Material | - | - | PP |

WATERPROOF SHEATH

| CHARACTERISTIC | LAW | U.O.M. | VALUE |
|---------------------|---------------|-------------------|-----------------------|
| Thickness | EN ISO 1849-2 | mm | 1 |
| Grammage | EN ISO 1849-2 | g/m ² | 900 |
| Drilling resistance | FTMS 101C | N | >150 |
| Tensile strength | ASTM D4885 | kN/m ² | >1600 |
| Shear resistance | DIN 53515 | N/mm ² | >45 |
| Thermal expansion | DIN 53377 | % | ±3 |
| Permeability | ASTM D | m/s | > 2x10 ⁻¹² |

It is recommended to lay the geosynthetics by overlapping the strips by at least 30-40 cm.



Figure 18 - Drainpanel recoating with geosynthetic material

6.5.5 BACKFILL AND COVERING OF THE STRUCTURE

The following specifications are recommended:

- Material: coarse sand or fine gravel with a particle size of 8/16 mm, compacted with manual compactor for layers of 15-30 cm thickness;
- Procedure: the margin between the structure and the side of the excavation must be filled at a uniform level. Then proceed with the upper covering, according to the thickness of the project (minimum 30 cm), always spreading the layers evenly over the whole basin and compacting them with a manual medium;
- Operating machinery: Track-mounted machinery of a maximum weight of 8 tonnes may pass through if there is at least 50 cm of material above the structure.



Figure 19 - Compacting phase of the covering material

6.5.6 FINISHING

Depending on the intended use of the area, the system is backfilled up to the project level and the required finish is realized. Please note that Geoplast Spa is not liable for any damage to the system if the above regulations are not observed.



Figure 20 - Green finishing

6.6 HYDRAULIC CONNECTIONS

6.6.1 INLET WATER TREATMENTS

The water entering the basin must be as clean as possible in order to avoid clogging of the system and potential contaminations linked to the reuse of the water collected. It is recommended:

- The development of systems for removing coarse solids (filters or sediment traps). It is possible to foresee an increase in the depth of the input wells in order to facilitate sediment settling;
- The installation of an oil separator if the system collects run-off water from a parking lot.

6.6.2 INLET PIPELINES

The sizing of the collectors is the responsibility of the designer of the work.

The maximum pipe diameter that can be plugged into the structure is $\Phi 125$ mm. If the collector has a larger diameter:

- Branches of the line with the coupling into the system by means of a reduction in diameter $\Phi 125$ mm must be provided. The number of branches will depend on the expected input flow rate;
- Alternatively, the tubes will support the plastic structure (see Appendix D for details).

Some typical hydraulic connection diagrams are given in Appendix D.



Figure 21 - Point of access to the inspection system

6.6.3 DISCHARGE PIPELINES

The adoption of a discharge line is necessary for the disposal of incoming flows in excess of the expected storage volume.

It is recommended to interrupt the drainage system with one or more wells for basin cleaning operations.



Figure 22 - Manholes for basin cleaning operations

6.7 MAINTENANCE

It is necessary to provide for regular inspection and maintenance of the basin in order to maintain its full functionality.

Specific studies have shown that in a time span of 50 years, without adequate maintenance of the system, it is possible to lose up to 10% of the basin capacity due to sedimentation of the fine fraction of solids (limonites and clays) which are difficult to remove from the upstream treatment units.

6.7.1 INSPECTION

The inspection of the system can be carried out by means of “push-in” micro-cameras that may be inserted inside a flexible tube shirt. System access points must be provided during the design phase. It is recommended to carry out inspection wells that intercept the feed piping to facilitate the entry of the instrumentation.



Figure 23 - Microcamera for inspection

6.7.2 CLEANING

Cleaning can be carried out by means of “push-on” nozzles normally used for cleaning the sewerage pipes, accessing inside the system through the supply pipes and the foreseen wells.

Cleaning operations must start with washing the fuel lines and upstream wells, especially if they also act as a sediment trap.

It is also advisable to provide a well downstream so as to facilitate the inlet of the washing water suction pipe.

6.7.3 PERIODICITY OF INTERVENTIONS

It is advisable to draw up a system inspection and maintenance plan in order to carry out a systematic periodic inspection.

System control is essential during the following periods:

- Completion of worksite operations;
- After particularly intense weather events;
- In case of failure or malfunction of pre-treatment units;
- At least once a year.



APPENDIXES

APPENDIX A

MATERIAL SAFETY DATA SHEET

COMPOSITION / POLYMER INFORMATION

| INGREDIENTS | N° C.A.S. | % |
|----------------------|---------------|----|
| Polypropylene Random | 9010-79-1 | 70 |
| Glass fibre | Not available | 30 |

HAZARDOUS COMPONENTS

This product does not fall within the definition of hazardous material provided by EEC 1999/45 and subsequent regulatory measures.

Physical state: Solid.

Problem: If the polymer is subjected to temperatures close to the melting point, it can produce irritating vapours to the respiratory system and eyes.

FIRST AID MEASURES

Inhalation of decomposition products: Keep patient calm, move patient to fresh air and call for medical help.

Skin contact: parts that come into contact with molten material must be quickly brought under running water and the doctor must be contacted.

Eye contact: flush eyes for at least 15 minutes under running water while holding eyelids open. Contact with material particles does not present any particular danger, except for the possibility of abrasion wounds. Fine particles can cause irritation.

Ingestion: No particular measures to be taken.

FIRE-FIGHTING MEASURES

Extinguishing materials: water, foam or dry extinguishing materials.

Unsuitable extinguishing materials: none.

Substances released in the event of fire: carbon dioxide (CO₂) and mainly steam. Other substances that may form: carbon monoxide (CO), monomers, other degradation products.

Special protective equipment: Wear breathing apparatus in case of fire.

Other requirements: Dispose of contaminated combustion slag and fire extinguishing material in accordance with local regulations.

ACCIDENTAL RELEASE MEASURES

It is not classified as a hazardous material. It can be recycled, incinerated or disposed of in landfills in accordance with local regulations.

STORAGE AND HANDLING

When the product is ground, the applicable dust regulations must be taken into account.

Keep it in a dry place

EXPOSURE CONTROL/PERSONAL PROTECTION

Respiratory tract protection: if non-breathable dust forms, P1 filters (DIN 3181) must be used.

Skin protection: no special precautions.

Eye protection: safety glasses in the presence of free particles.

PHYSICAL-CHEMICAL PROPERTIES

| | |
|------------------------------|---|
| Shape | Panels |
| Color | Dark grey-black |
| Odour | Soft |
| Change in physical state | Melting temperature above 145°C Combustion temperature above 400°C |
| Flammable properties | None |
| Density | 1,12 kg/dm ³ |
| Solubility in water | Insoluble |
| Solubility in other solvents | Soluble in aromatic solvents |

STABILITY AND REACTIVITY

| | |
|------------------------------|---|
| Conditions to Avoid | Do not overheat to avoid thermal decomposition. The process begins at around 300°C. |
| Thermal degradation products | Monomers and other sub-products. |

TOXICOLOGICAL INFORMATION

Acute toxicity: data not available (no animal experiments due to impossibility related to product conformation). Insoluble in water.



ECOLOGICAL INFORMATION

Degradation in nature: no data available.

Insoluble in water.

Behaviour and environmental purpose: the product is environmentally friendly because it is made of recycled plastic. It is not apparently biodegradable due to its water insolubility and consistency.

DISPOSAL CONSIDERATIONS

Product 100% recyclable. It can be disposed of in landfills or incinerated in accordance with local regulations.

TRANSPORT INFORMATION

It is not classified as dangerous for transport purposes.

REGULATORY INFORMATION

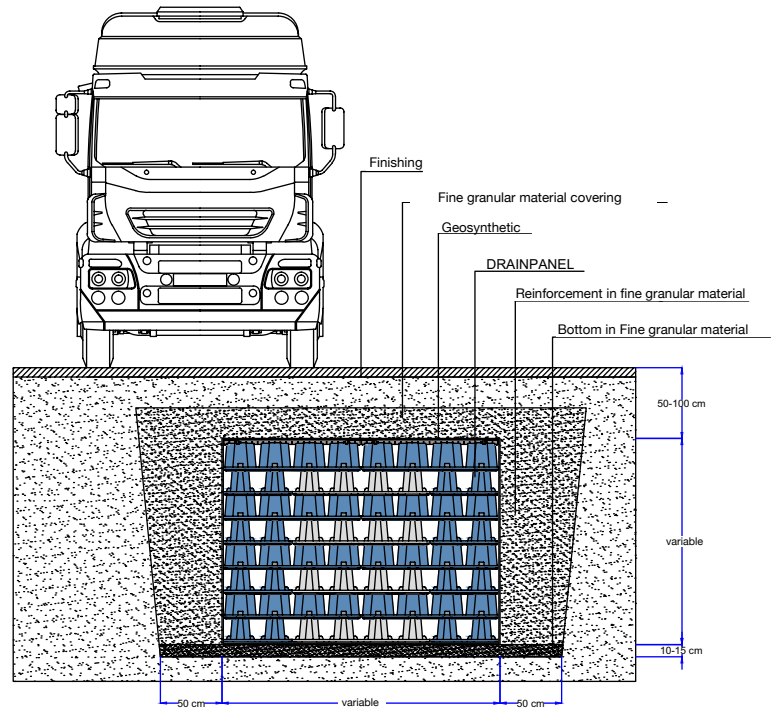
It is not subject to the CE marking.

APPENDIX B

APPLICABLE LOADS

The maximum permissible load above a Drainpanel structure depends essentially on the height of the system, i. e. the number of layers superimposed. In essence, it decreases in a non-linear way as the height of the "column" in plastic material increases.

Below are some reference values for coating thicknesses and maximum installation depths depending on the number of vehicle levels and loads applied. For conditions that deviate from the basic instructions, please contact Geoplast Technical Office.



5-6 levels: System's height = 1,06-1,26 cm

| APPLIED LOAD | MINIMUM COVERING THICKNESS | MAXIMUM COVERING THICKNESS | MINIMUM DEPTH | MAXIMUM DEPTH |
|-----------------------------------|----------------------------|----------------------------|---------------|---------------|
| Pedestrian | 0,3 m | 3,0 m | 1,36-1,56 m | 3,06-3,26 m |
| Lightweight traffic, cars | 0,5 m | 2,9 m | 1,56-1,76 m | 3,96-4,16 m |
| Heavy commercial vehicles traffic | 0,75 m | 2,4 m | 1,81-2,01 m | 3,46-3,66 m |
| HGV service traffic | 1,0 m | 1,95 m | 2,06-2,26 m | 3,01-3,21 m |

10-12 levels: System's height = 2,06-2,46 cm

| APPLIED LOAD | MINIMUM COVERING THICKNESS | MAXIMUM COVERING THICKNESS | MINIMUM DEPTH | MAXIMUM DEPTH |
|---------------------------|----------------------------|----------------------------|---------------|---------------|
| Pedestrian | 0,3 m | 2,5 m | 2,36-2,76 m | 4,56-4,96 m |
| Lightweight traffic, cars | 0,5 m | 2,4 m | 2,56-2,96 m | 4,46-4,86 m |

For systems with a depth of more than 3 m, it is advisable to carry out an accurate evaluation of the lateral thrust of the soil on the system, especially in the presence of particularly cohesive soils.

7-9 levels: System's height = 1,46-1,86 cm

| APPLIED LOAD | MINIMUM COVERING THICKNESS | MAXIMUM COVERING THICKNESS | MINIMUM DEPTH | MAXIMUM DEPTH |
|-----------------------------------|----------------------------|----------------------------|---------------|---------------|
| Pedestrian | 0,3 m | 2,75 m | 1,76-2,16 m | 4,21-4,61 m |
| Lightweight traffic, cars | 0,5 m | 2,65 m | 1,96-2,36 m | 4,11-4,51 m |
| Heavy commercial vehicles traffic | 0,8 m | 2,0 m | 2,26-2,66 m | 3,46-3,86 m |
| HGV service traffic | 1,05 m | 1,75 m | 2,51-2,91 m | 3,21-3,61 m |

APPENDIX C

INSTALLATION PROCEDURE

Only install the plastic structure when the bottom of the excavation has been completed:

- By applying a layer of at least 10 cm of fine granular material 8/16 mm well compacted;
- With the application of geosynthetic that will envelop the entire structure.

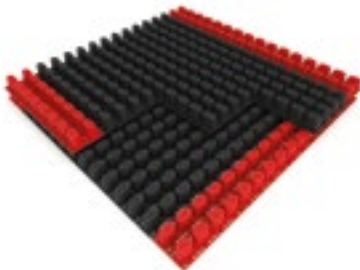
DO NOT install elements that are damaged or that do not meet the requirements of paragraphs 3.1 and 3.2, or the product data sheet.

The DRAINPANEL HALF elements are coloured red in the drawings only for the purpose of describing the assembly steps. The real color is the same as DRAINPANEL, dark grey-black.

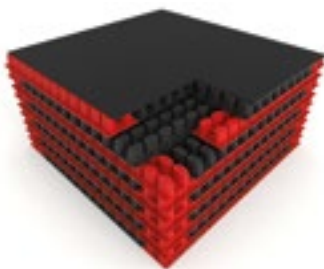
The main steps for assembling the system are as follows:



- 1** Install the first layer, taking care that all DRAINPANEL elements are oriented in the same way, with the cones facing upwards. Place two rows of DRAINPANEL HALF (red elements in the figures) along the two opposite sides of the basin.



- 2** The elements of each subsequent layer shall be rotated 90° to the previous layer. Always place two rows of DRAINPANEL HALF along the two opposite sides of the basin, in order to allow the interlocking by “brick” technique.



- 3** Proceed as described until the height specified in the project is reached. It is convenient to proceed by assembling the “stepped” structure in order to reach easily the upper levels, especially for basins rather developed in height. Once all layers have been laid, install the DRAINPANEL GRIDs by interlocking 2 rows of adjacent cones.



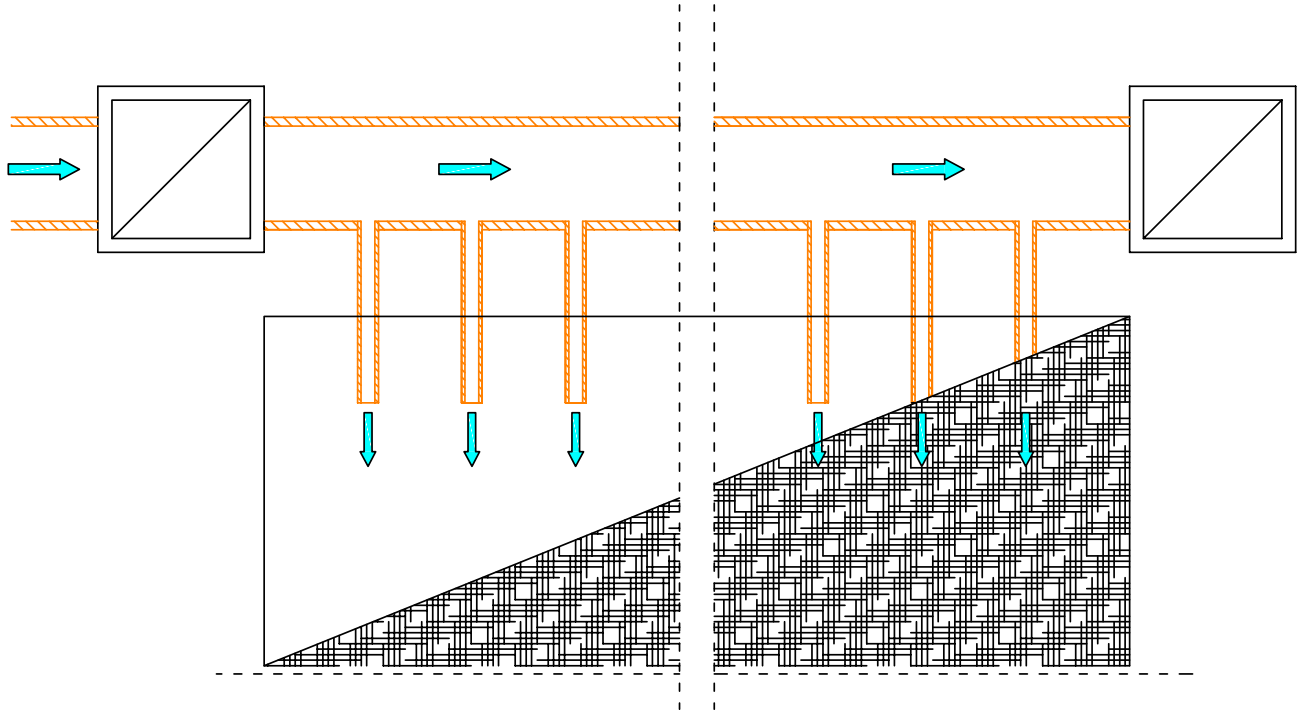
Detail of the interlocking of Drainpanel Grid

It is possible to request the Geoplast Technical Office for the installation scheme based on the shape and size of the basin, indicating the composition of the different layers.

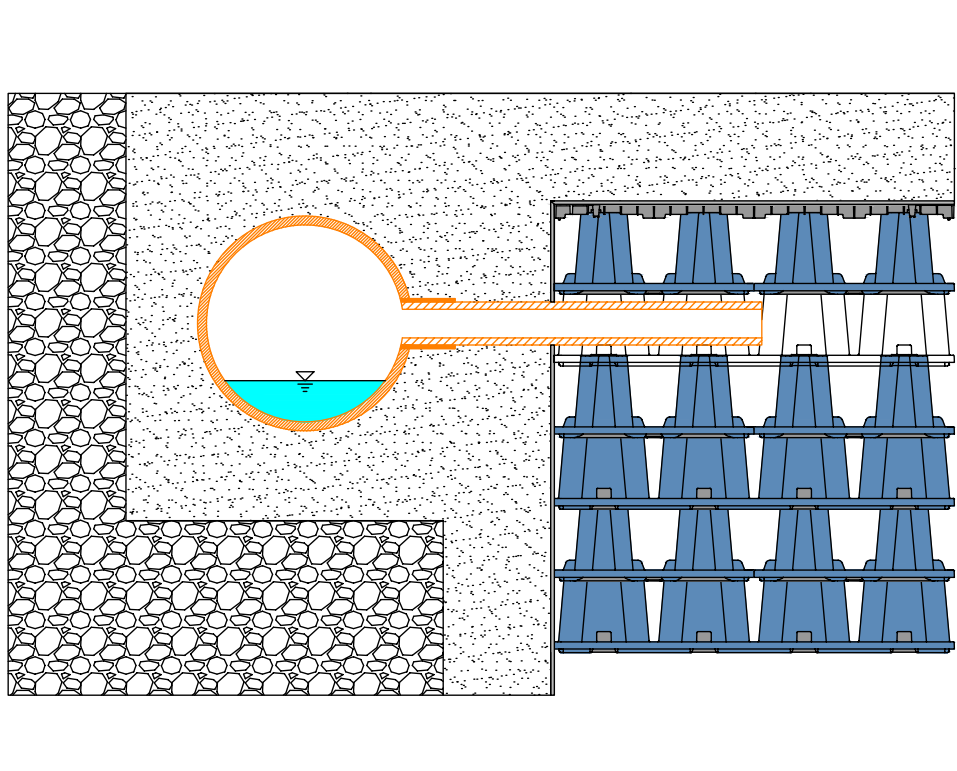
APPENDIX D

HYDRAULIC SCHEMES

SOLUTION N°1: Feeding with large diameter main manifold and “comb” branches with Ø125 mm tubes.

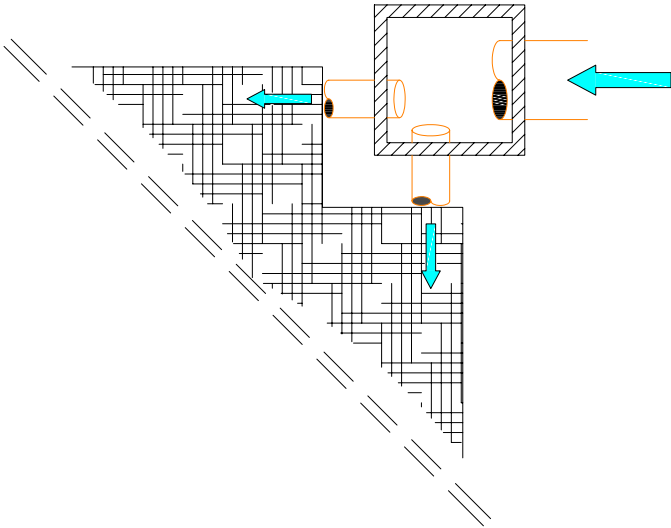


Detail of the ramification and pipe insertion in the system

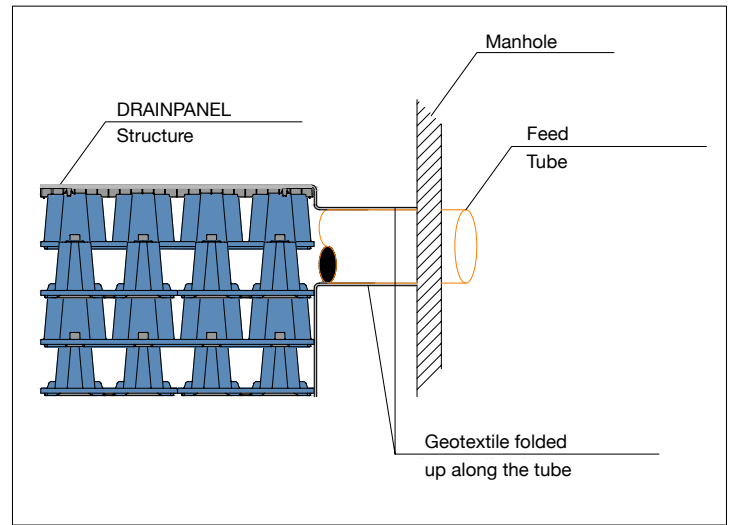
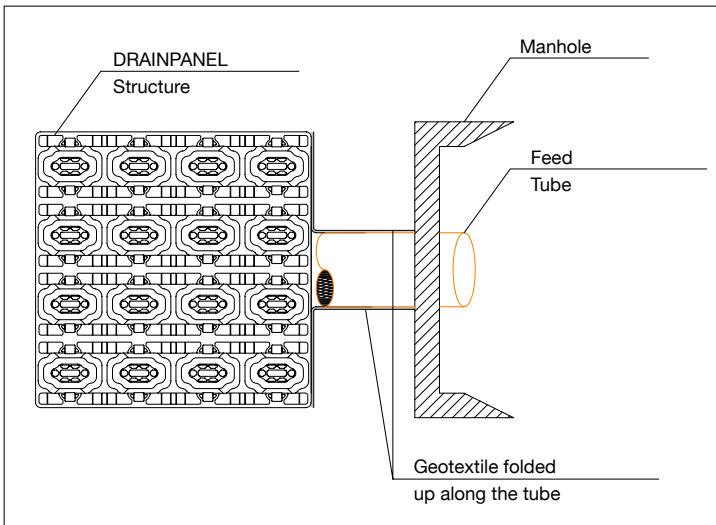
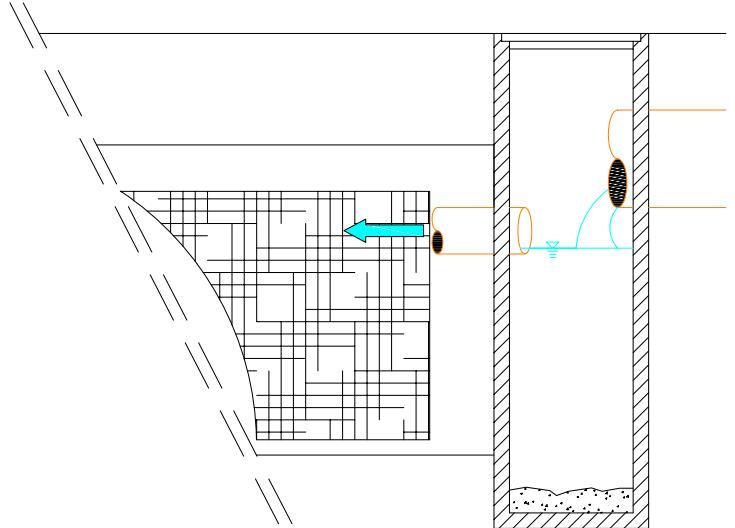


SOLUTION N°2: Piping in support of the plastic structure.

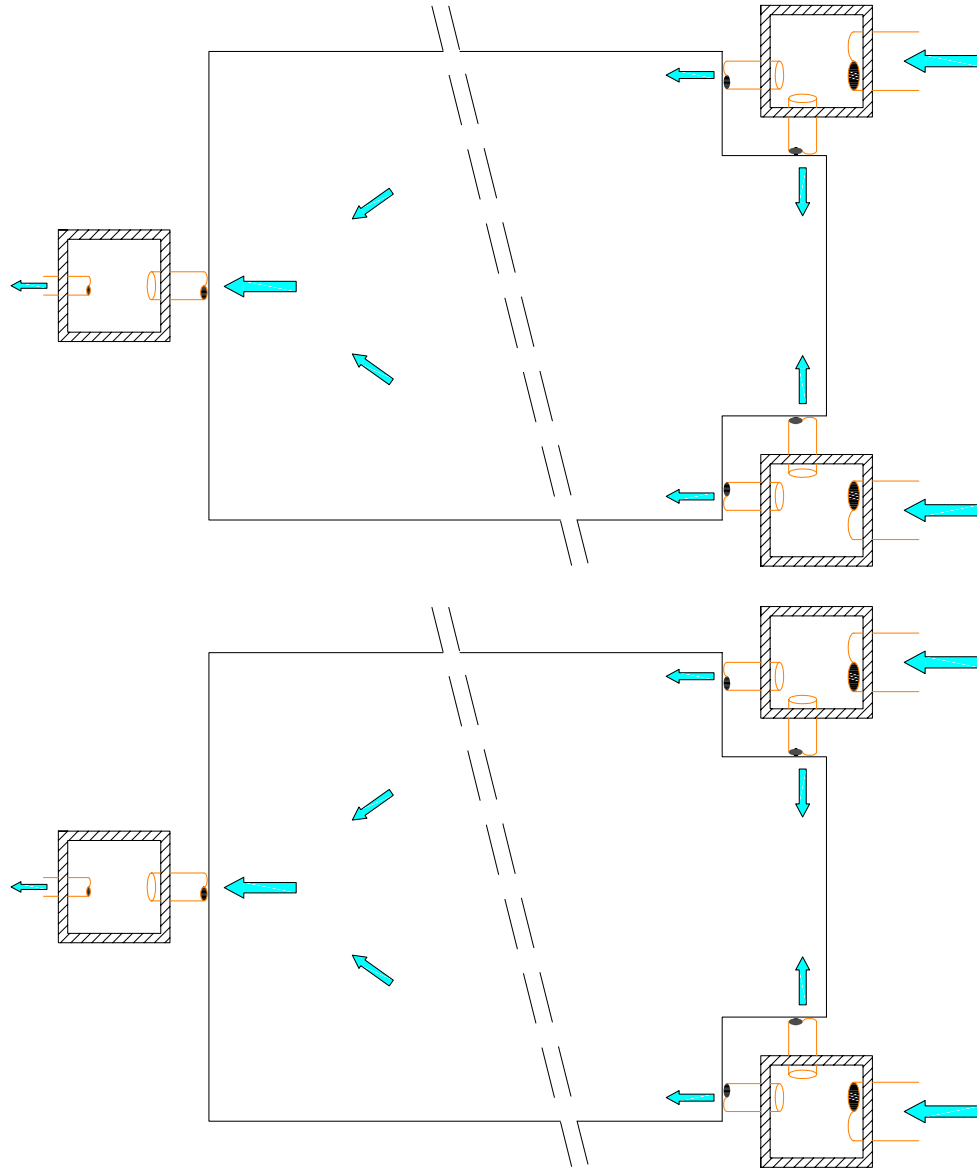
Plant



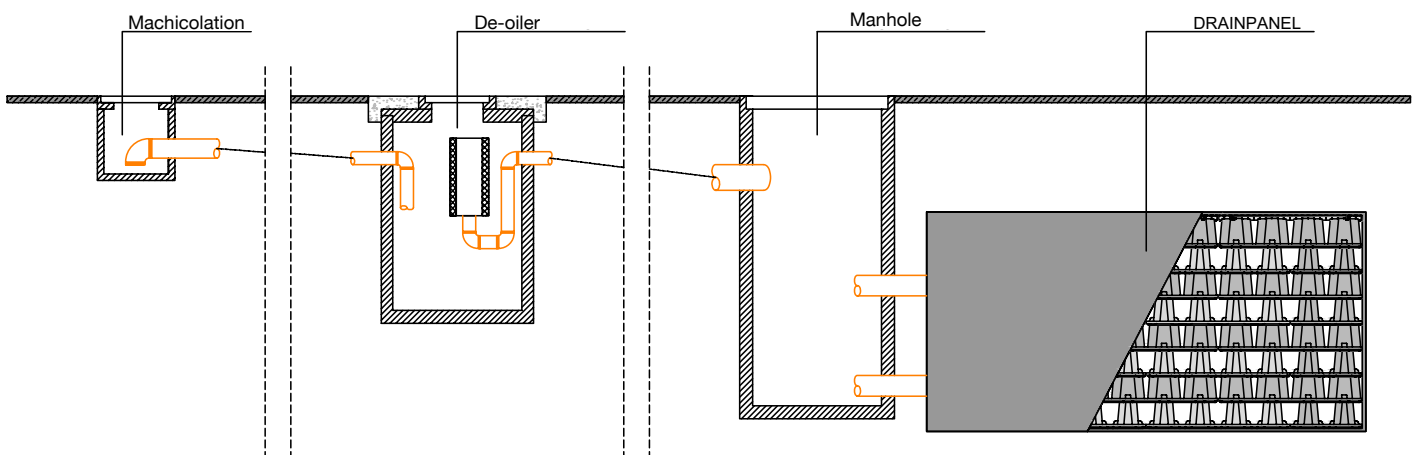
Prospect



POSSIBLE DIAGRAMS FOR INLET / DISCHARGE



LAYOUT OF A DISPERSANT SYSTEM RECEIVING WATER FROM A PARKING LOT





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