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GRASSCRETE- Re-Usable Former Version Technical Bulletin

Grasscrete cast utilizing the Re-Usable Formers is a pervious concrete product designed to be concealed by a layer of grass. Grasscrete is essentially a 5 1/2" thick welded wire mesh reinforced concrete slab containing a series of voids created in the casting process which are subsequently filled with sand and/or soil that is grass seeded or grass sod covered. Grasscrete offers the end-user the ability to provide year round access for a variety of applications requiring structural paving surfaces with out compromising the aesthetics of their exterior landscaping by having to utilize traditional hard pavements while minimizing the need to control storm water runoff.

Grasscrete can also be employed as a bank stabilization product for areas that experience seasonal runoff such as drainage channels, storm water retaining areas or sloped embankments. Grasscrete works exceptionally well for storm water retaining areas that have a build up of silt that needs to be removed with heavy equipment on a periodic basis. Grasscrete does not contribute to the heat island effect like other hard surfaces such as asphalt, reduces the amount of contaminants allowed to runoff during "first flush" rainfall into potentially fragile ecosystems and allows for tree plantings in close proximity. Grasscrete is a very sustainable product that can employ concrete with a large recycled material content both in the form of aggregate and binder such as fly ash or slag- its lifespan is indefinite and can be recycled itself to form the aggregates for future Grasscrete applications.

The plastic Re-Usable Former utilized to create the void structure is designed to have an indefinite number of re-uses, the strength to accept live loading from workers and concrete carrying equipment, and designed to be removed during the concrete plastic state to create the voids The Re-Usable Former version of Grasscrete is our absolutely greenest version but is designed specifically to be concealed by grass and has a lower production rate in comparison to our Single Use, biodegradable Molded Pulp Former which is more versatile in design- consult the Grasscrete Molded Pulp Former Version Technical Bulletin for information.

FEATURES AND BENEFITS:

- **Structural Cast-In-Place System**
- **Sustainable**
- **Pervious Product**
- **Wide Range of Applications**
- **Exceptional Durability and Strength**

Continuo

Design Principles

Construction

US Standard 6x6wx 2.9xw2.9 wire mesh reinforcement is first laid over a 95% compacted granular sub-base a minimum of 2" thick over the structural sub-base. The 24"x24" plastic formers are laid edge to edge over the mesh in coordination with the voids of the formers to form a continuous layer broken only by a 6" margin to the edge of each bay and at the point of each expansion joint. The mesh is then elevated with chairs to the correct height.

The concrete mix is designed to be placed at a slump fluid enough to be worked into the void spaces of the Re-Usable Formers with stiff brooms. Once the concrete has reached an adequate point of set, the Re-Usable Formers are stiff broomed again to remove excess slurry from the former surface and then pulled from the concrete with a specialized tool by the applicators. This results in a structurally reinforced concrete slab with a distinct pattern at the surface of 53% void and 47% concrete.

Consult Bomanite Technical Services or your local Grasscrete Installer for more information on mix designs incorporating a high recycled content. Baseline mix designs are available to local Ready Mix companies to assist them with the development of a workable mix based on local materials

Approximately 48 hours after installation, the voids are in-filled with clean washed sand or sandy soil blend to within 1" of the concrete peaks and then topsoiled to the top of the concrete peaks if utilizing sod or 1 ½" over the peaks if being seeded. . Where gravel infill is used in lieu of topsoil/seed, we recommend the use of a #89 grading which will be less susceptible to displacement than smaller graded "pea gravel" types.

First trafficking of the surface should be linked to the curing period of the concrete. Under ambient conditions and a normal curing process we would recommend the following guidelines.

After 24 hours	Foot Traffic
After 7 Days	40% of design load
After 14 Days	75% of design load
After 28 Days	100% of design load

Where regular early use is required we would recommend the incorporation of fiber reinforcement in the concrete mix to harden to the concrete peaks.

Expansion Joints

Expansion joints are located at maximum 50 foot centers and can be specified in the two following types:

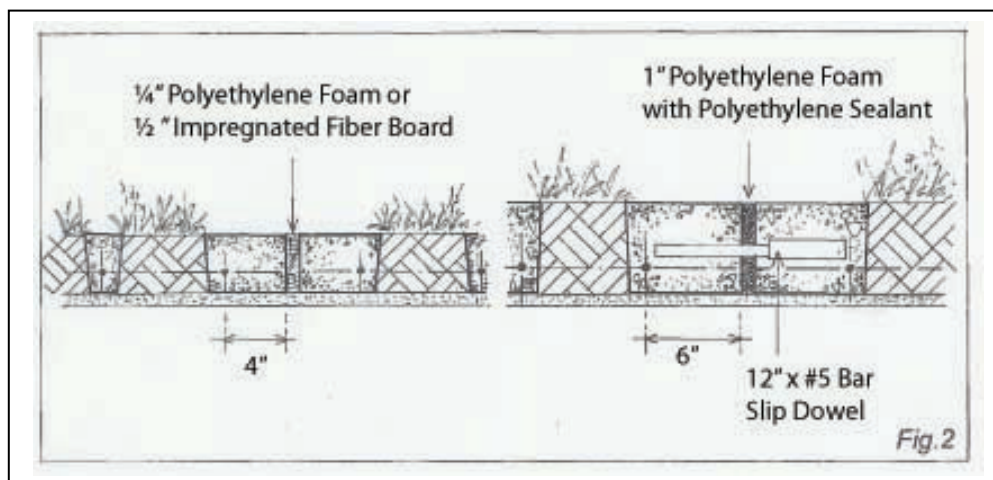
Type 1 - (fig.2)

Closed cell ¼" wide polyethylene (PE) foam or ½" impregnated fiberboard.

Type 2 - Heavy load transference (fig.2)

As Type 1 but incorporating 12" long x #5 bar dowels at 24" centers with cap and de-bond to one end with joint sealed irrespective of filler type

For a Type 1 joint we recommend a minimum 4" wide troweled margin to expansion joints. For Type 2 dowelled joints this should be increased to a 6" minimum.



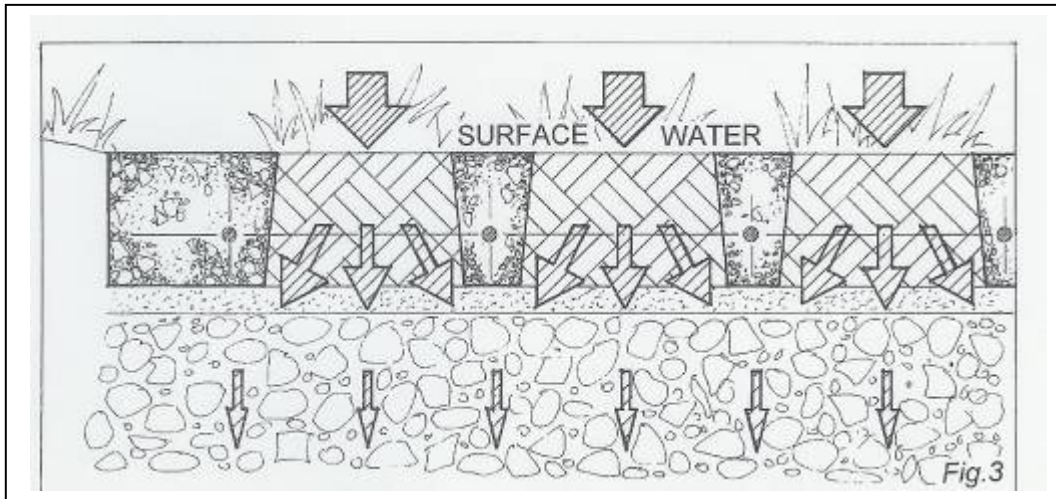
Sub-base Design

The sub-base material the Grasscrete is to be installed on has a structural requirement of a 45kN/m² allowable ground bearing. Where the existing ground naturally provides this, a well graded granular layer of sub-base at a depth of 2-6" over the natural ground compacted to a 95% proctor is normally adequate. With this said, the storage capacity requirements of the specific system will determine the final thickness of the sub-base material and whether a clear layer of crushed stone is necessary rather than the graded material. The no fines sub-base should be a #57 stone which will provide a void space volume of approximately 40%. To limit the possibility of "sub-grade pumping" through the sub-base under load, we recommend the utilization of an underlying geotextile layer where the sub-base is to be heavily trafficked.

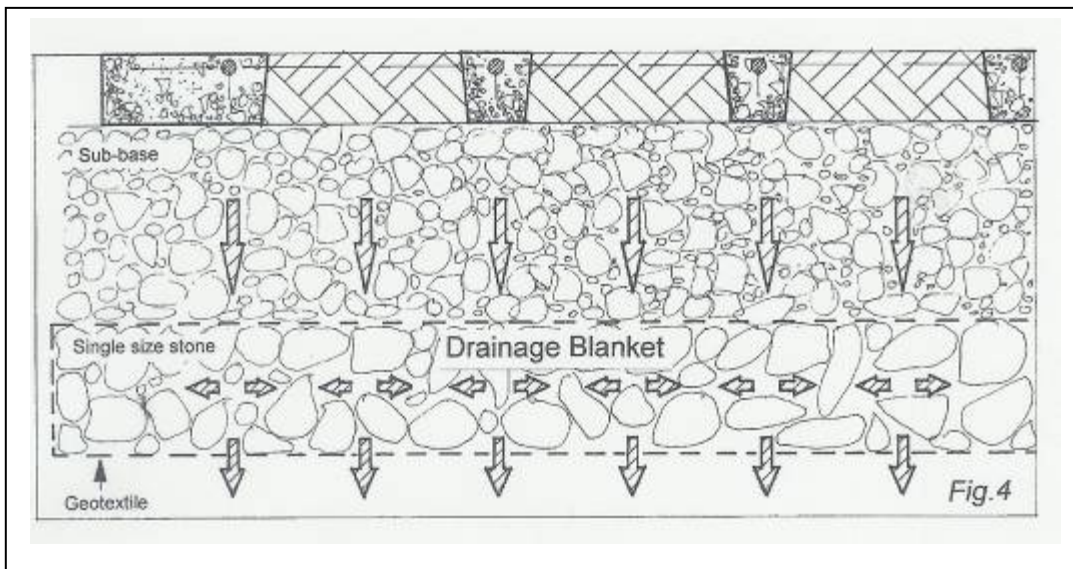
Drainage

On level ground typical seeded Grasscrete can drain at 90% the rate of ordinary grassland. In the early stages of grass germination this figure may be slightly reduced until the root matrix is established. There may also be a natural raising of water table levels where significant site development has recently taken place.

The shape of the Grasscrete void will enable the retention of surface water during periods where the sub-grade is slow to drain (see fig.3).



Where a slow draining sub-grade such as cohesive clay is encountered, consideration can be given to the utilization of an underlying drainage blanket as part of the overall sub-base design. This enables storage capacity to be formed without weakening the ground bearing capability (see fig.4).



Formwork Considerations

The system is designed to be capable of following most profiles either in the plan shape or vertical level. Consideration must be taken that the perimeter of the installation is determined by the fact that the formers are 24" x 24" square. 45 degree or right angles are easily achievable but curves will have a stepped back appearance. Typical gradation changes such as found with standard hardscapes applications are not an issue.

Penetrations

Openings for trees, hydrants, light-rail tracks etc. can typically be taken into consideration with the use of 45 degree or right angle formwork and a 4" wide troweled margin. Irrigation or electrical lines can come up through the cone tops by utilizing a sleeve to isolate the concrete from the conduit. Co-ordination of construction trades people for penetrations such as these are critical to the success of the installation.

Durability and Concrete Technology

The Grasscrete Systems are engineered to provide long term durability, low maintenance and structural strength. The formers and any associated products are factory produced under strict quality control to provide consistent results for our franchise partners and their customers.

Grass Selection

The actual grass seed specification will depend upon the climatic location or intended use Grass types can be individually tailored for individual projects according to climate, use and aspect. Be sure to consult a landscape specialist that is familiar with vegetation appropriate for the region the Grasscrete application is taking place in.

Regularly Trafficked Areas

Such applications are generally associated with parking areas where the grass will be required to grow under aggressive wear conditions. Bomanite would recommend the use of the Molded Pulp version of Grasscrete for this type of installation combined with a robust long bladed grass type in a void filled only application. Review the Bomanite Grasscrete Systems Molded Pulp Former Version Technical Bulletin for further information.

Infrequently Trafficked Areas

The principle types of use under this category are emergency access routes and road medians. A typical emergency access may be located around a high rise building where the grass could be a finer variety but should take into consideration the potential for moisture loss to the concrete. The use of a Polyacrylimide (PAM) soil additive is typically adequate to provide enough moisture retention to support less robust grass types. Normally the concrete ribs are concealed under a layer of topsoil adequate to retain the moisture required as the Grasscrete in this circumstance is intended for periodic use and minimal maintenance.

Storm Channels/Storm Water Retaining

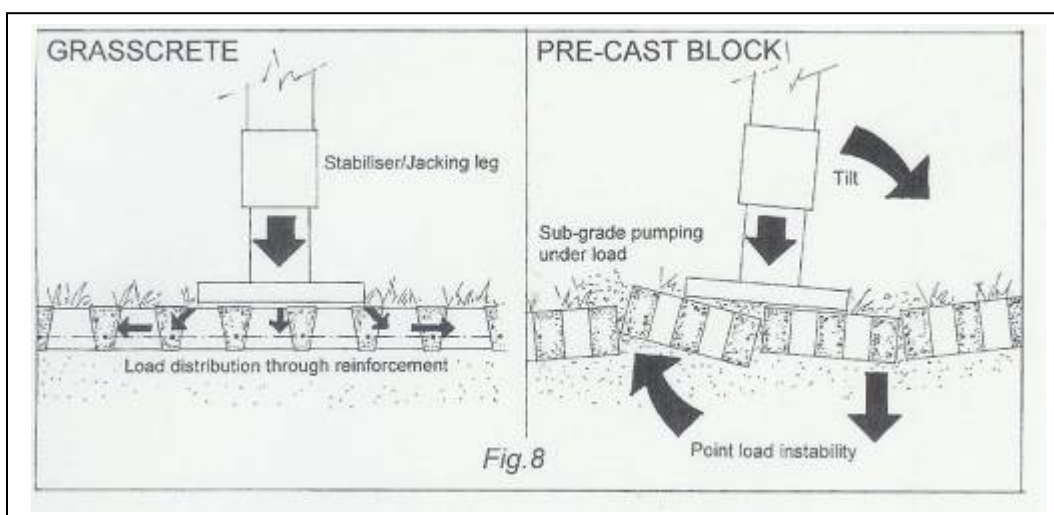
A number of different robust grass variations can be considered. The mix should generally provide good root anchorage to prevent pull out. In continuously waterborne conditions the grass will be required to lay prostrate to create a protective thatch that performs a functional role. Such a mix will therefore call for a higher proportion of smooth stalked meadow grass. Maintenance of this type should be geared towards the period of maximum impounding, to achieve the maximum thatching effect, the grass should be left long during the wet season.

Applications

Traffic Applications

An emergency access road fulfils an essential function and should not be compromised in design by its possible infrequent use. Indeed, it is often the case that a fire access is much more regularly used than its designed intent. A common feature is the contractor's use of the surface for access during construction, window washing equipment or general maintenance. Under such circumstances it is often subjected to much higher loads than a fire appliance would otherwise apply when utilized for an emergency only.

The point load is an important feature of platform use where, in the presence of saturated ground conditions, the equipment will be supported on jacking legs. Under such conditions a paving layer of low tensile strength such as a pre-cast or plastic system is likely to be deformed into the sub-grade causing a loss of stability (see fig.8). The current Grasscrete testing takes into consideration equipment with a gross vehicle weight of up to 66,000 lbs with a 100' boom containing 800 pounds in the basket extended 90 degrees.



A further factor in the specification of a fire access route is the intended first use, particularly when considering possible temporary construction activity or routine maintenance requirements. Pre-cast concrete or plastic systems will generally require a full season's growth before a loading capability is achieved. This can often be a significant hurdle to overcome in the construction scheduling process. Grasscrete on the other hand can be used immediately once its initial curing period has completed.

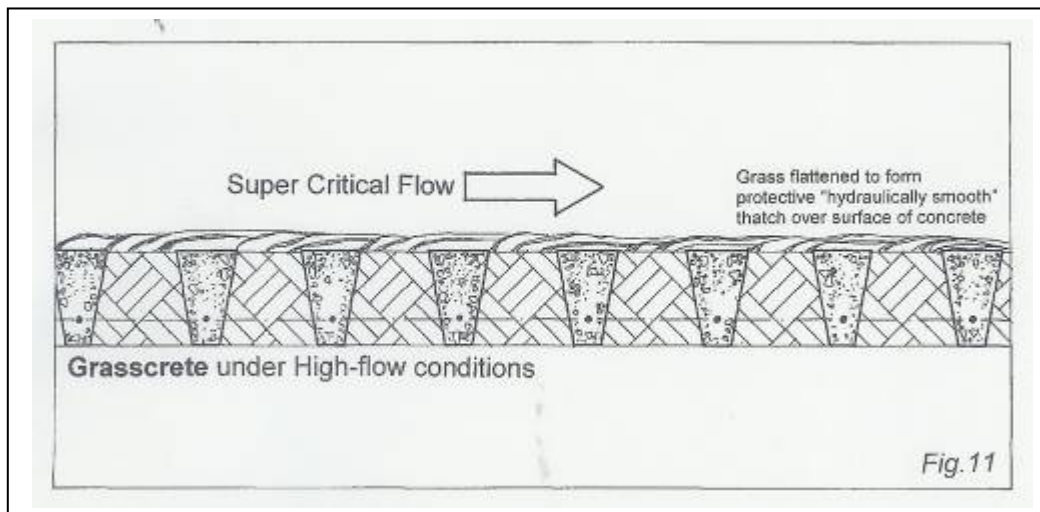
A common feature of pre-cast systems is their susceptibility to settle under regular loading often rendering them unsuitable for all but the infrequently used areas. Grasscrete however, places no reliance upon grass for stability - a drawback with pre-cast. It can therefore be specified in a wide range of applications.

Shrubs and trees form a softer natural marker than curbs or bollards and can be easily incorporated into most trafficked applications as delineation for vehicles. With its self-draining nature Grasscrete can be cast to within 24" of mature trees.

Erosion Control

Storm Channels

A principle design consideration in developing a channel section is the hydraulic roughness of the wear layer. The rougher the surface, the slower the flow, the greater the cross-section required. A common misconception is that a grassed surface will increase the hydraulic roughness in comparison to plain concrete. Whereas it is true to say that a sub-critical flow will be slowed by grass stems, such a flow is not the determining factor in the design. By contrast, a super critical flow will see a different situation occurring. Heavy impounding of grass stems will cause them to lay prostrate in a surface thatch, rather than being rougher than plain concrete. (see fig.11).



A Grasscrete channel design can therefore provide the twin features of a natural grassed environment during dry season, low flow and a hardened wetland water course for peak season demand.

Flow Rates

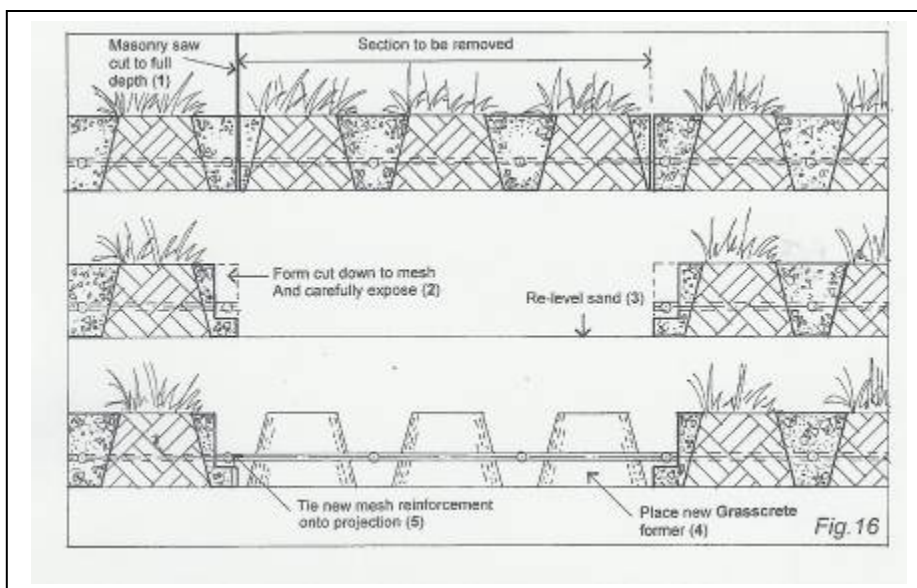
The Construction Industry Research and Information Association trials undertaken in 1986 were intended to assist in the production of a definitive guide for grass reinforcement systems. The subsequent guide-Report No. 16-was produced to create a benchmark for the hydraulic capabilities of available systems.

Under trial was our standard 5 1/2" thick reinforced Grasscrete system which was structurally unaffected by the maximum flow rate available to the trial. From the information provided, we have been able to interpolate the results into a recommendation of a capacity of 25 feet per second.

Maintenance

Grasscrete is not a miracle system – it grows natural grass. The maintenance of Grasscrete is comparable to that of a grassed lawn.

Occasionally it may be necessary to cut out sections of Grasscrete to allow, for example, a new service trench to be constructed. Occasionally, damage may occur due to inappropriate use. Under such circumstances, a remedial repair can be easily accommodated (see fig. 16).



Warranty

This product is warranted to be of uniform quality within manufacturing tolerances. Since control is not exercised over its use, no warranty, expressed or implied, is made as to the effects of such use. Seller and manufacturer obligations under this warranty shall be limited to refunding the purchase price of that portion of the material proven to be defective. The user assumes all other risks and liabilities resulting from use of this product.