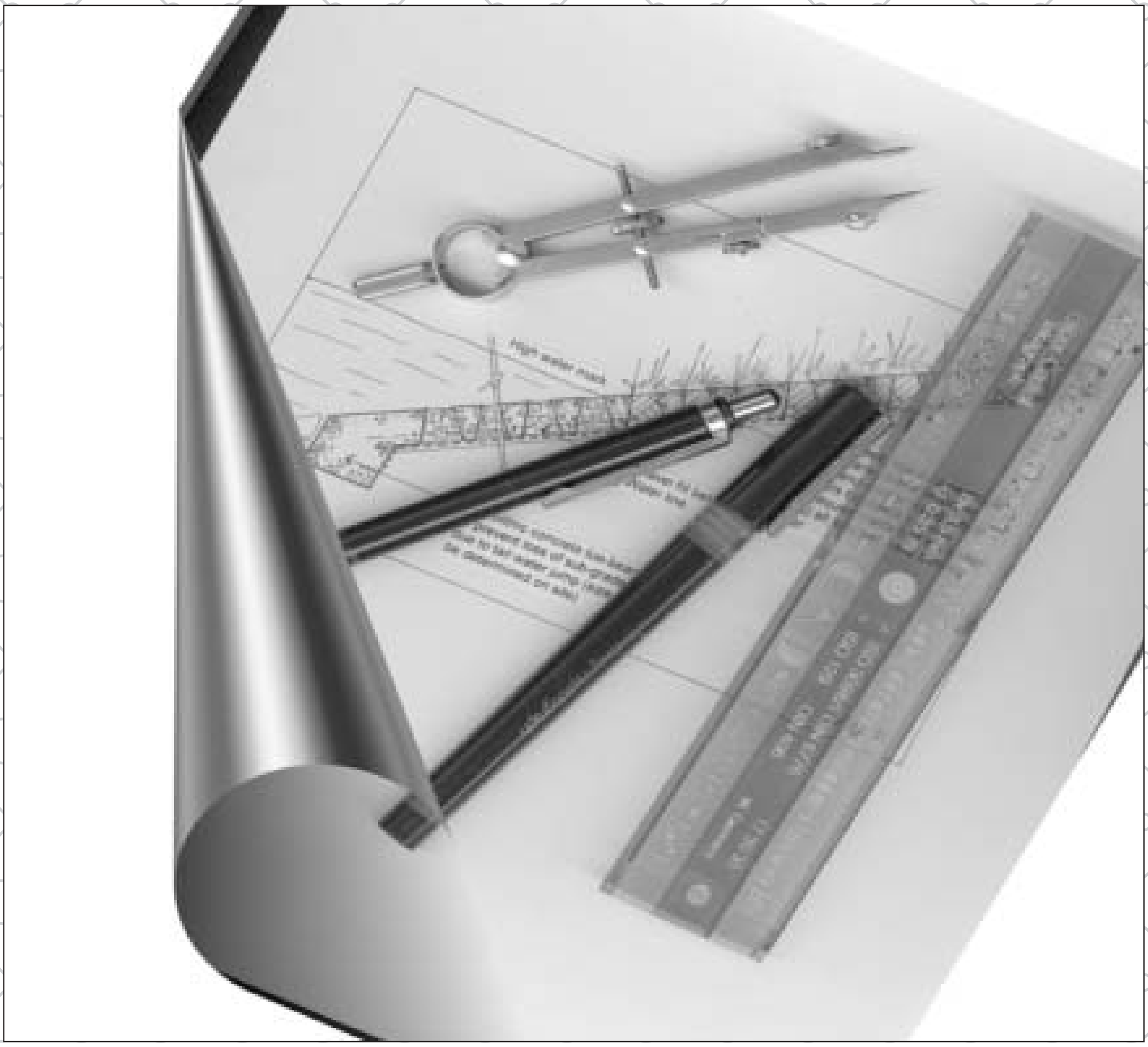
GRASSCRETE®

CAST INSITU PAVING SYSTEM

DESIGN AND SPECIFICATION GUIDE



GRASS CONCRETE LIMITED

PART OF THE GC GROUP OF COMPANIES

INTRODUCTION

So versatile is the GRASSCRETE system that it can often be claimed as a tailored solution to a range of construction problems from heavy traffic applications to high water flow erosion control.

Across the years, GRASSCRETE has become a generic reference to the process of grass and concrete paving. Occasionally however, the unique cast on site system is confused with precast variants.

We hope, with this publication, to provide a definitive guide for GRASSCRETE in all of its major applications which should enable safe specification without confusion.

CONTENTS

CHAPTER ONE – DESIGN PRINCIPLES

PART ONE ~ THEORY

GRASSCRETE is essentially a cellular reinforced concrete slab, the cells being created by casting around plastic void formers.

The plastic former, manufactured from recycled materials is the culmination of many years of study which has perfected the shape of the pocket and the form and draw of the vacuum forming process. It provides crucially, the strength to accept live concrete loads, yet is thin enough to enable the tops to be easily melted to reveal the voids.

Structural analysis of the finished concrete section is based upon the bending moment of the mesh reinforcement contained within the slab, relatively to slab depth, contact area with base and an assumed allowable ground bearing of $45kN/m^2$ for its base. By using combinations of depth and different mesh types, the system can be tailored to provide the most economical solution.

PART TWO ~ CONSTRUCTION

The 600x600mm plastic formers are laid edge to edge over a sand blinded formation to form a continuous layer broken only by a 100mm margin to the edge of each bay and at the point of each expansion joint.

Once the formers are in position the mesh reinforcement is laid over the former upstands, the individual 200x200mm upstands of each corresponding to the grid module of the reinforcement. As the mesh drops over the upstand, it is located in position by a spacer, this integrally moulded feature fixes the position of the mesh.

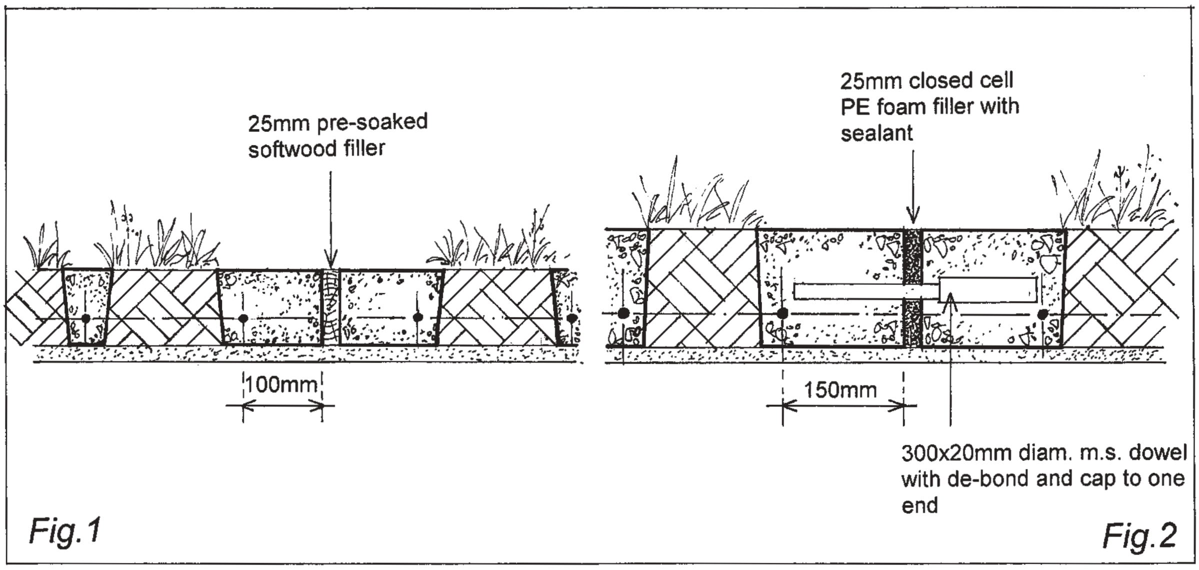
Expansion joints are located at maximum 10x10m centres and can be specified in the 3 following types:-

Type A - Ambient climates (fig.1)
Pre-soaked 25mm wide softwood filler to full depth of system with no sealant.

Type B - Extreme climates (fig.1)
Closed cell 25mm wide polyethylene (PE) foam or bitumen impregnated fibreboard. (It is advisable to seal the latter type to prevent subsequent chafing).

Type C - Heavy load transference (fig.2)
As Type B but incorporating 300mm long x 20mm diameter dowels at 600mm centres with cap and de-bond to one end with joint sealed irrespective of filler type (we recommend this type of joint for use only in the 150mm thick systems and only for regular load transference.

To Type A & B joints we recommend a 100mm wide trowelled margin to expansion joints. For Type C dowelled joints this should be increased to 150mm.



The concrete mix is of a readily available readymix type and can be identified by the following design mix description –

Cement type	:	Ordinary Portland (sulphate resisting may be used for extreme exposure)
Minimum cement content	:	350kgs/m^3
Maximum water/cement ratio	:	0.55
Maximum size aggregate	:	10mm
Ratio sand/total aggregate	:	0.45
Control/ batch slump	:	100mm general applications 50mm steep slopes
Site added admixtures	:	Superplasticiser to manufacturer's recommended dosage levels.
Final slump	:	Flowing:- general applications 75-100mm:- steep slopes
Air content	:	3% +/- 1$^1/_2$% (higher values can be considered for compliance with highway related specifications)

The type of superplasticiser used can vary and may slightly increase or decrease the air content depending upon the formulation.

The concrete mix is designed to self compact around the plastic formers. Only when laying to the very steepest slopes where the slump is markedly reduced should any form of compaction be considered.

During pouring the concrete is drawn level to the tops of the formers by use of rubber bladed squeegees. This should be the only finish applied. Tamping or brushing is not required.
The system is designed to be capable of following most profiles either in the plan shape or vertical level. The former is simply cut to allow the incorporation of curves etc without stepping to the edges.

In respect of tolerances, the depth of the concrete is limited by the depth of the plastic former. The level at the surface will therefore generally reflect that of the prepared sub-base.

After the concrete has set and hardened (generally after 48 hours), the former tops are removed. This is carried out by use of LPG or paraffin (Kerosene) flame guns. Waving the burner across the top of the mould removes the top allowing the side walls to melt down to harmless residue deposited in the base of the void.

Please note that the melting out process does not emit any CFC's and there is only a small quantity of CO_2 evident, the operation being similar in it's emission levels to wood burning.

Following the melting operation the voids are infilled with topsoil and then seeded. Consideration should be given to the potential settlement of the topsoil which should be allowed to naturally take place. The seed can therefore be incorporated within a fine topsoil overlayer if the surface is not to be used immediately.

Alternatively, where immediate use is required the soil levels can be topped up at a later stage after initially striking flush to the upper concrete level.

For types of seed mix please see the appropriate chapters elsewhere in this publication.

Where gravel infill is used in lieu of topsoil/seed, we recommend the use of a 20-5mm 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 fibre reinforcement in the concrete mix to harden to the pocket walls.

CHAPTER TWO – TRAFFIC APPLICATIONS

PART ONE ~ EARTHWORKS & SUB-BASE DESIGN

As stated in Chapter One the surfacing has a structural requirement of a 45kN/m^2 allowable ground bearing. Where the existing ground naturally provides this, a sub-base depth of 150mm is normally adequate. For infrequently used parking, this can possibly be reduced.

In any event, consideration should be given to the access requirement for plant and deliveries during the construction process. This temporary works loading may therefore dictate the actual depth adopted.

To limit the possibility of “sub-grade pumping” through the sub-base under load, we recommend the utilisation of an underlying geotextile layer where the sub-base is to be heavily trafficked.

The sub-base specification for UK applications should relate to a Specification for Highways and Bridges Clause 803 Type 1 granular sub-base. For applications elsewhere in the world this relates to a free draining granular material of low plasticity and non frost susceptibility.

The cellular nature of the surface allows the release of frost heave pressure and this can be witnessed by the soil levels rising an falling under a freeze/thaw cycle. This feature enables the often stipulated guidelines of a frost free 450mm of construction to be relaxed enabling the surface to be laid over chalk sub-strata without additional sub-base depth.

PART TWO ~ DRAINAGE

On level ground 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 pocket will enable the retention of surface water during periods where the sub-grade is slow to drain (see fig.3).

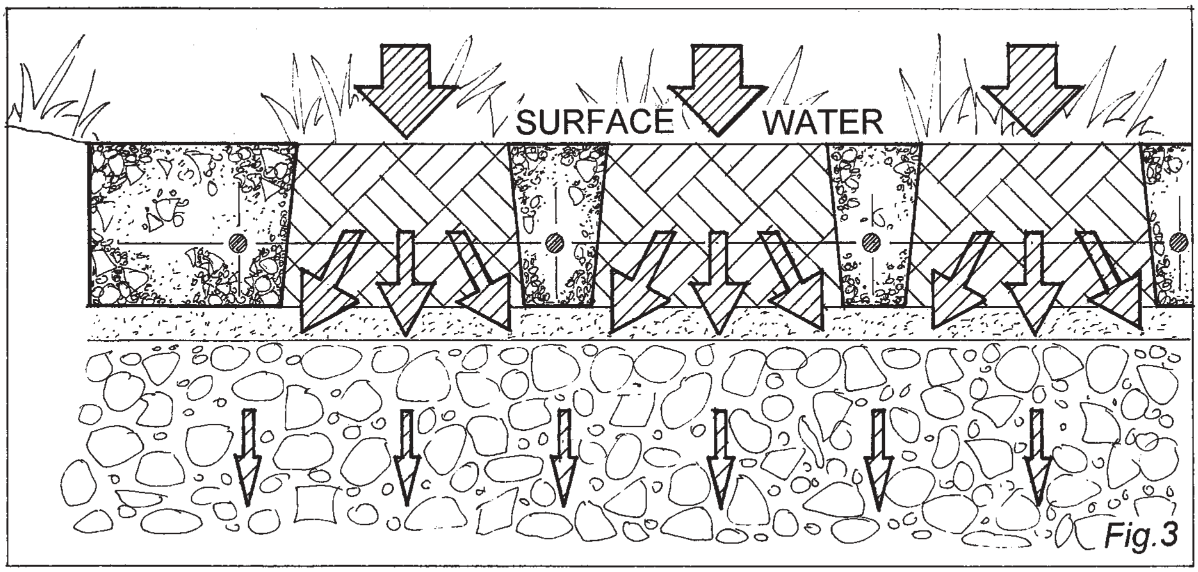


Fig.3

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

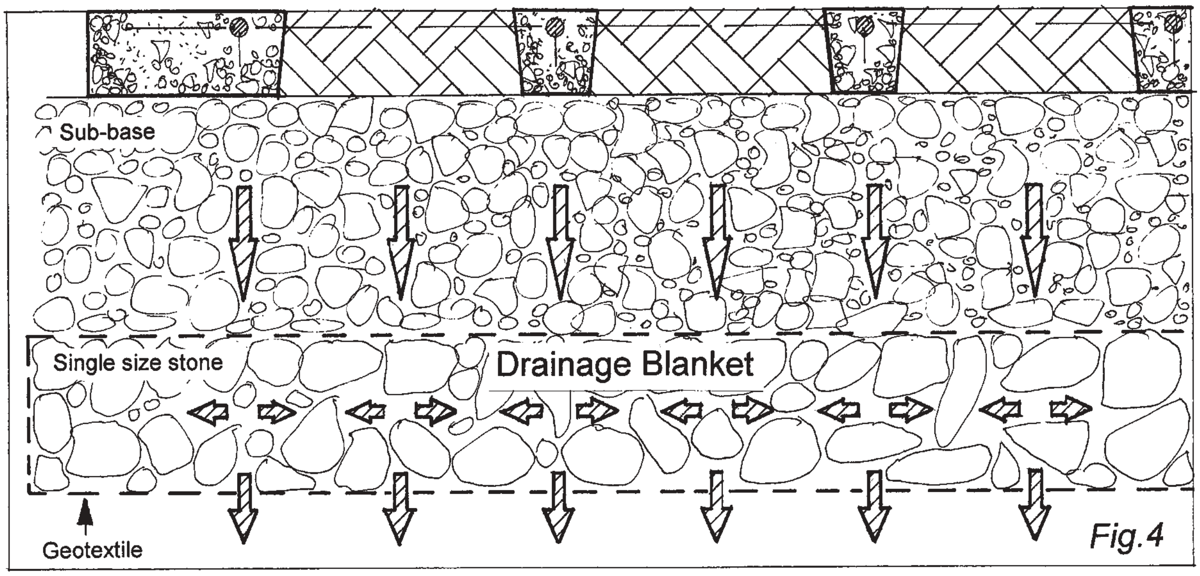


Fig.4

Please see our separate publication "GRASSCRETE STORM WATER MANAGEMENT- THE CASE FOR A POROUS PAVING SYSTEM" which details the advantages of a sustainable self-draining paving system on new developments.

PART THREE ~ CAR PARKS

A common feature of precast systems is their susceptibility to "elephant track" under regular loading often rendering them unsuitable for all but the infrequently used car parks. GRASSCRETE however, places no reliance upon grass for stability - a drawback with precast. It can therefore be specified in a wide range of applications.

Another factor in the specification of a grassed car park is the tyre rumble under use, a factor associated with precast units, which on large areas in particular, can be uncomfortable and cause displacement of units due to the resulting vibration. With its reinforced structure GRASSCRETE does not suffer from such problems.

A typical car park module is 4.8 x 2.4 metres with a 6.0 metre wide access aisle for two way traffic flow. Long strip casting enables bays of 4.8/5.0 metres and 6.0 metres wide can be constructed utilising the 100mm wide solid concrete edge as a subtle bay delineation (see fig.5).

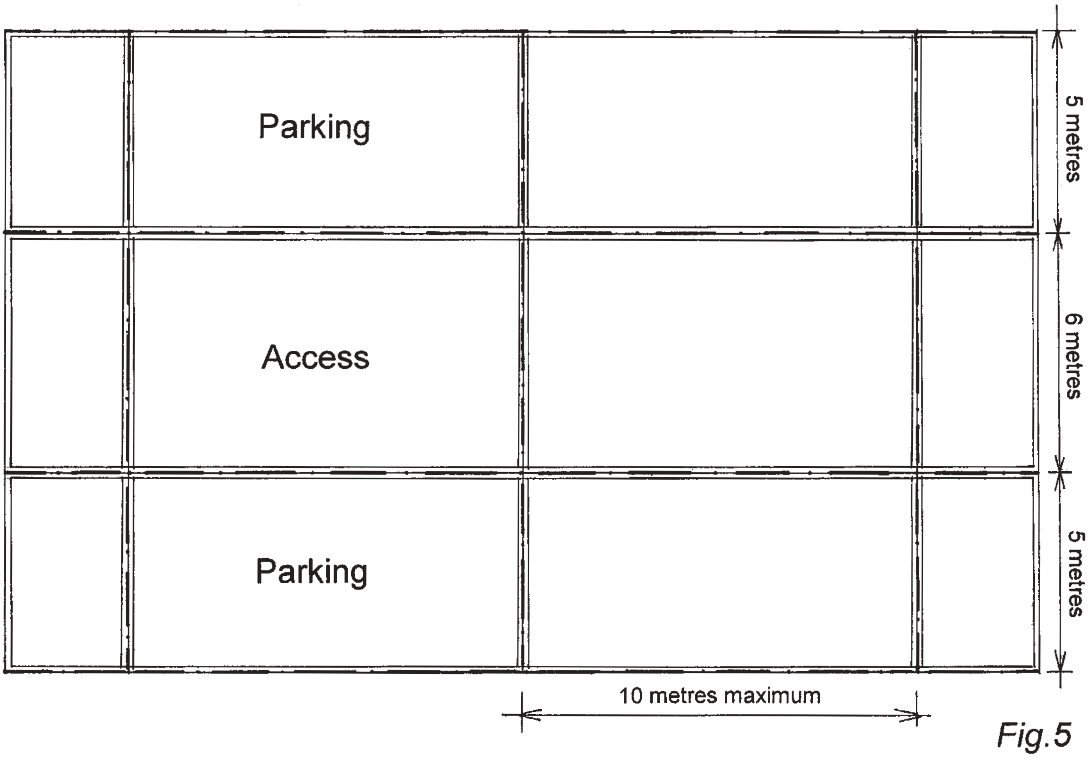


Fig.5

In addition to the general parking provided under fig.5, further delineation can be provided by transverse strips of concrete formed by the omission of a 200mm part segment of a former. This can be either to the full width of a bay or in a truncated 'tee' format (see fig.6).

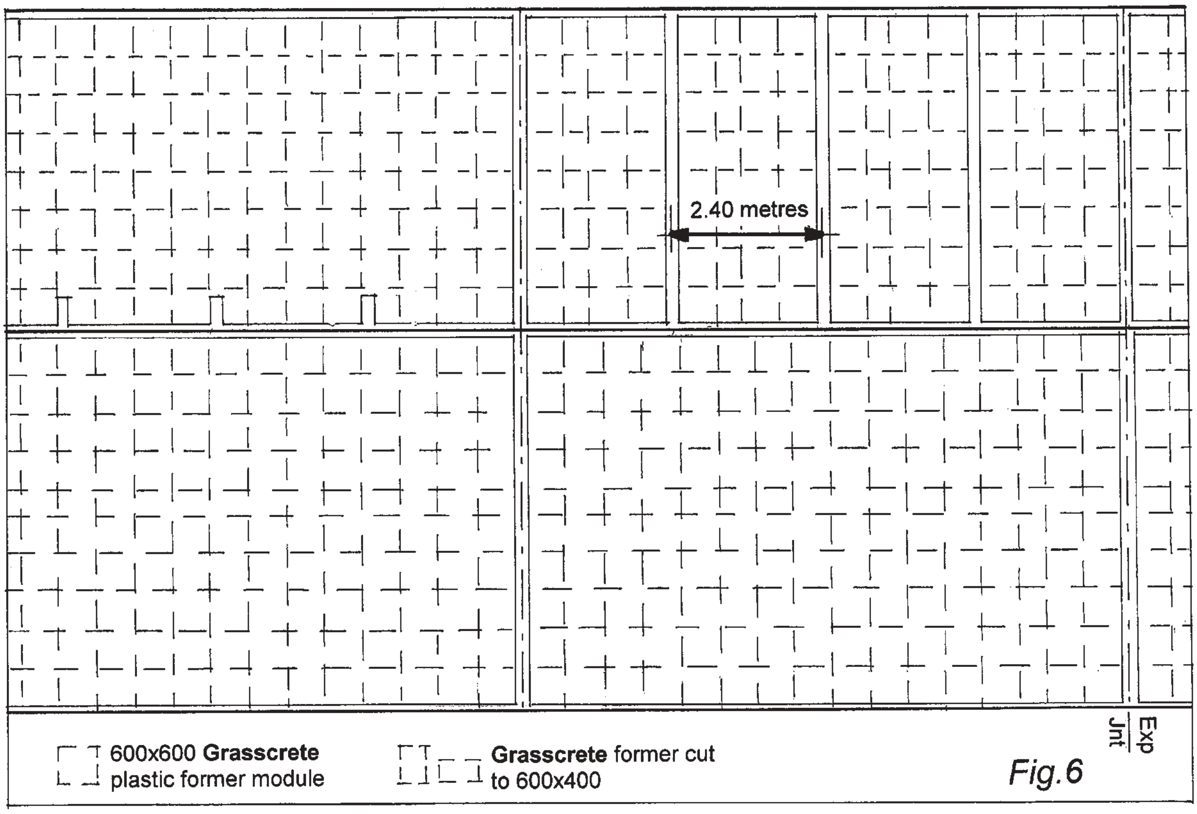


Fig.6

With a natural grassed appearance for the car park, it is also possible to eliminate elements of an otherwise hard landscape. With no requirement for kerb edges the surface can blend into the natural landscape. With no need for surface water drainage falls, the surface level can follow contours which may be contrary to normal requirements. Taking the natural appearance a step further, shrubs and trees form a softer natural marker than bollards and can be easily incorporated into most paving layouts. With its self-draining nature GRASSCRETE can be cast to within 600mm of mature trees. Further advice on root training is available on request.

As an alternative finish, GRASSCRETE can be specified with a 20-5mm gravel infill to the pockets without affecting the structural performance of the system, as the pocket fill does not influence its load bearing capability.

With no requirement for underlying drainage and no need for perimeter kerbs, existing GRASSCRETE car parks can be extended without worrying about drainage falls. This factor enables car parks to be constructed on profiles which would be otherwise unsuitable for a sealed paving system.

PART FOUR ~ ACCESS ROADS

i) <u>General Access</u>

GRASSCRETE is often specified for access routes required to have low ecological or visual intrusion. Its self-draining nature limits surface water run off and enables roads to be constructed with minimal infrastructure work.

Its low visual intrusion is a virtue which sees it regularly specified on defence projects where satellite or aerial identification is often to be avoided.

Another virtue lies in its 'continuous slab' structure which defies vandalism, thereby making it ideal for use in prison establishments where an alternative precast type could be lifted for inappropriate use.

A particular advantage over precast concrete and plastic systems is the lack of differential settlement or surface shear under load. This eliminates the need for kerb edge restraint and enables slimmer sub-bases to be considered.

The plan profile of access roads can be varied without stepping to the outer edge, this being achieved by simply cutting the plastic formers tangental to the edge alignment (see fig.7).

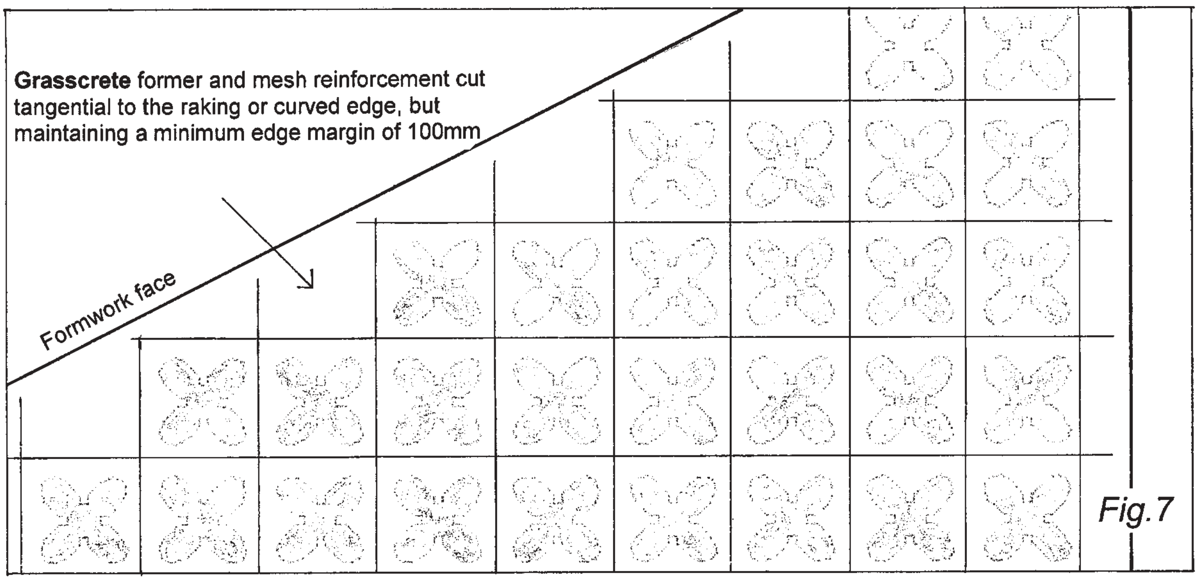


Fig.7

ii) Emergency Access

A fire and 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 as a haul road during construction. Under such circumstances it is often subjected to much higher loads than a fire appliance would otherwise apply.

A rule of thumb design suggests the specification of a fire pumping appliance for buildings of up to 3 storeys in height. A typical special equipment tender will now have a gross vehicle weight of up to 13.3 tonnes.

For 3 storeys and above or in intensive residential circumstances, access is likely to be required for a hydraulic platform which are for UK applications 17 or 22 tonnes in gross vehicle weight. Much larger platforms are however found throughout the world although the point load in operation is likely to be similar.

The point load is an important feature of platform use where, in the presence of saturated ground conditions, the appliance will be supported on jacking legs. Under such conditions a paving layer of low tensile strength such as a precast system is likely to be punched into the sub-grade causing a loss of stability (see fig.8).

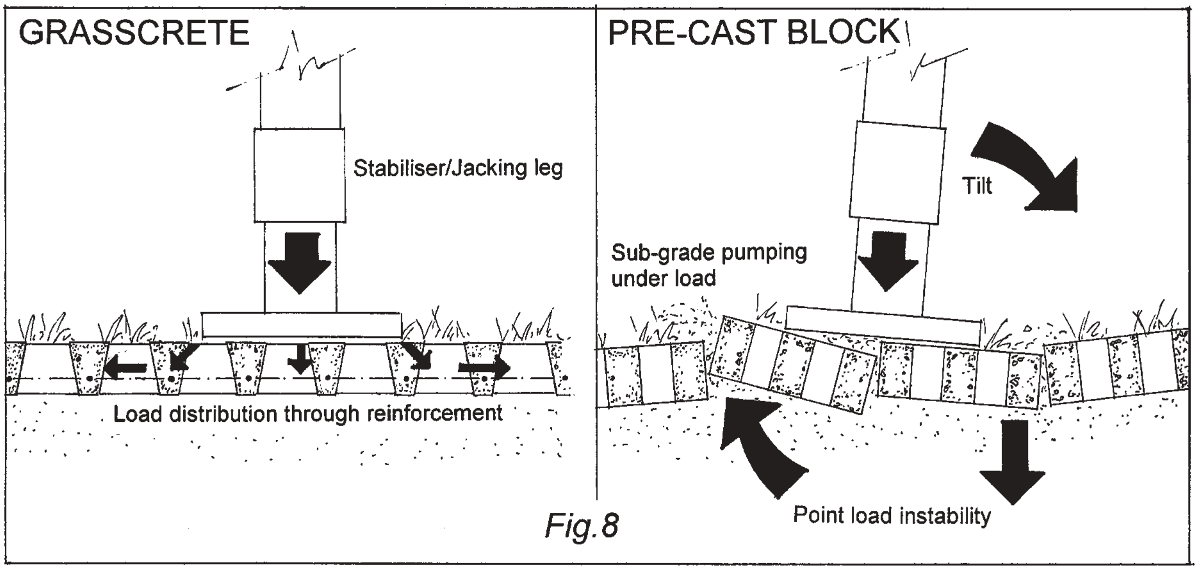
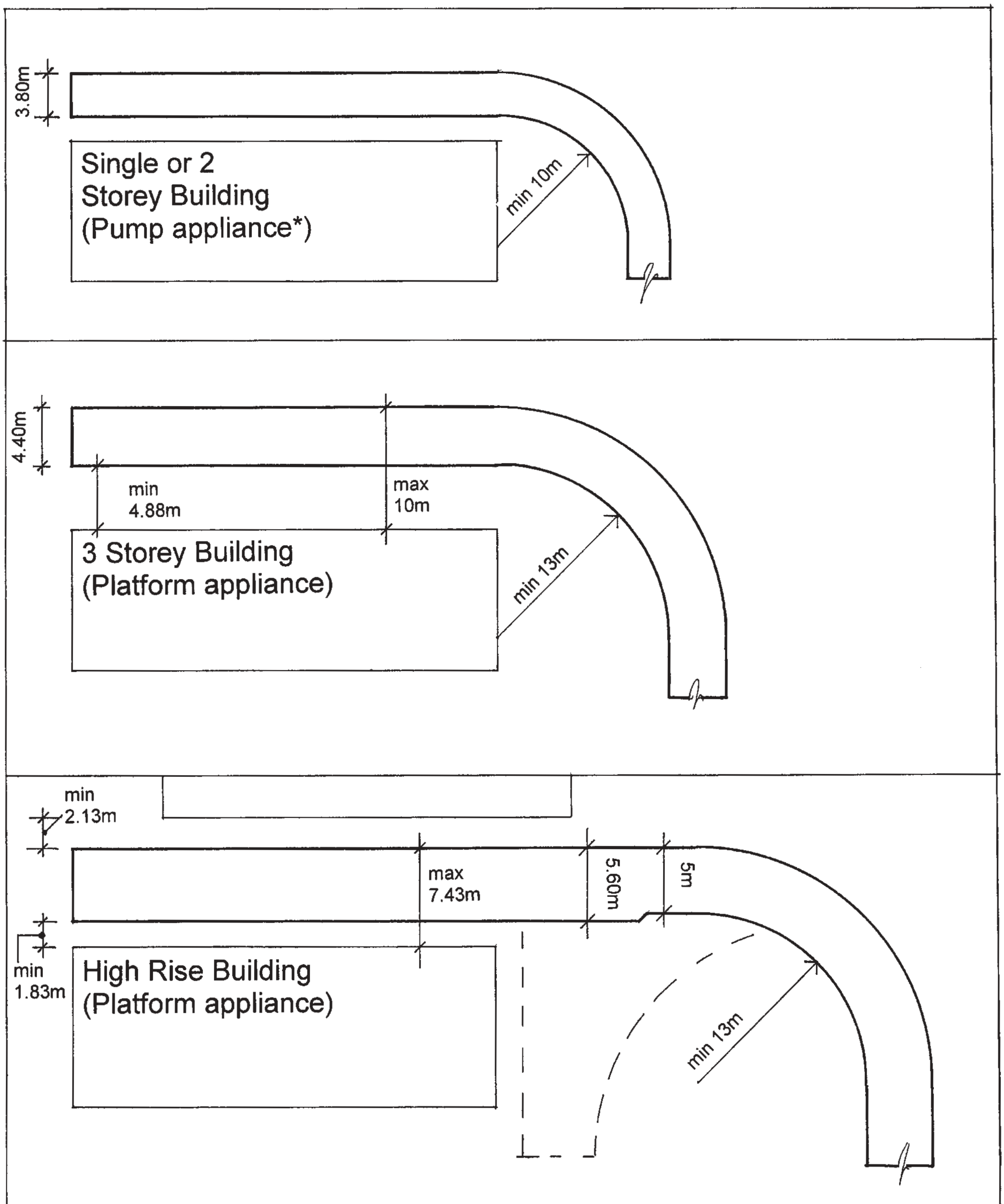


Fig.8

Typical access layouts for operational equipment can be viewed in fig.9.



*Check with local Fire Department, as certain residential buildings may receive a Platform appliance irrespective of the height of the building

Fig.9

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. Precast 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 programming the works.

GRASSCRETE on the other hand can be used immediately once its initial curing period has elapsed (see page 3). If construction activity is likely to introduce deleterious material on to the surface, the melting of the former tops, soiling and seeding can be held over for a more appropriate stage in the programme with the surface still usable in the meantime.

PART FIVE ~ LAYBYS

Highways often require laybys to be constructed, which are strictly not for public parking. These can be found in a variety of locations such as – CCTV kiosks, camera and lighting columns, petrol interceptors, police surveillance pads, wide load contra flows and sky cradle platforms.

The loading criteria may vary for each application though in the case of the latter two mentioned uses, the loading is significant and for such purposes, our GRASSCRETE GC2sc variant has been designed, permitting high point loads.

With its continuously reinforced structure, GRASSCRETE does not suffer from the lateral spread and settlement encountered with precast systems particularly under the turn in and turn out operation in using a typical trapezoidal layby.

The cast in place process also enables a total flexibility in the layout without the need for a kerb edge restraint. Manhole and inspection covers can be easily incorporated as can the jointing up to road kerbs or channels.

The comparatively low surface vibration provided from the level upper surface permits vehicles to quickly turn on to the area or merge back at speed where busy highways dictate such a need.

PART SIX ~ LOADING TABLES

SYSTEM	DEPTH	REINFORCEMENT (200 x 200)	POINT LOAD (150x150m contact)*	TYPICAL G.V.W. *
GC3	76mm	A142 (6mm diam.)	8.5kN	3.4 tonnes
GC3	76mm	A193 (7mm diam.)	10.8kN	4.3 tonnes
GC1	100mm	A193 (7mm diam.)	13.5kN	10.6 tonnes
GC1	100mm	A252 (8mm diam.)	16.7kN	13.3 tonnes
GC2	150mm	A252 (8mm diam.)	28.8kN	30.0 tonnes
GC2sc	150mm	A393 (10mm diam.)	41kN	40.0 tonnes

*Assumed minimum allowable ground bearing of $45kN/m^2$, and an interpolation based upon typical numbers of tyre contacts.

CHAPTER THREE – EROSION CONTROL

PART ONE ~ RESERVOIR/FLOOD DEFENCE

A significant advantage in the specification of a cellular revetment can be found in the venting of hydrostatic pressures in an earth slope. This enables much slimmer paving sections to be utilised than would be required for ‘solid’ paving.

The performance of steeper reinforced grass waterways has been studied at length in the CIRIA Report 16 which identifies a number of key elements to be considered in the design criteria for a suitable revetment.

From information provided, we can broadly categorise armour layers as follows:-

LIGHTWEIGHT ~ geotextiles/geogrids

INTERMEDIATE ~ non-tied precast concrete blocks

HEAVYWEIGHT ~ cable tied precast blocks and GRASSCRETE

Causes of failure under hydraulic load can be associated with one or more of the following factors:-

Change of embankment profile, causing turbulent flow

Loss of grass cover where systems rely on grass for stability

Tail water jump at the base of spillways

Lack of an underlying geotextile layer

Displacement of individual units by vandalism

With Grasscrete’s continuously reinforced structure, an even upper surface is provided which offers a consistent flow signature with no focal points for erosion. There is also no risk of vandalism to the surface and as such, maintenance inspections can be minimised.

With all waterborne applications we would recommend the use of an underlying geotextile to prevent sub-grade scour in the event of a loss of soil filling to the individual pockets. It should be noted that with a continuously reinforced structure, the deadweight of the armour layer means that a relatively inexpensive geotextile can be utilised as opposed to the high flow variants required to prevent precast units from lifting under hydrostatic pressure load. For a typical reservoir cross section (see fig.10).

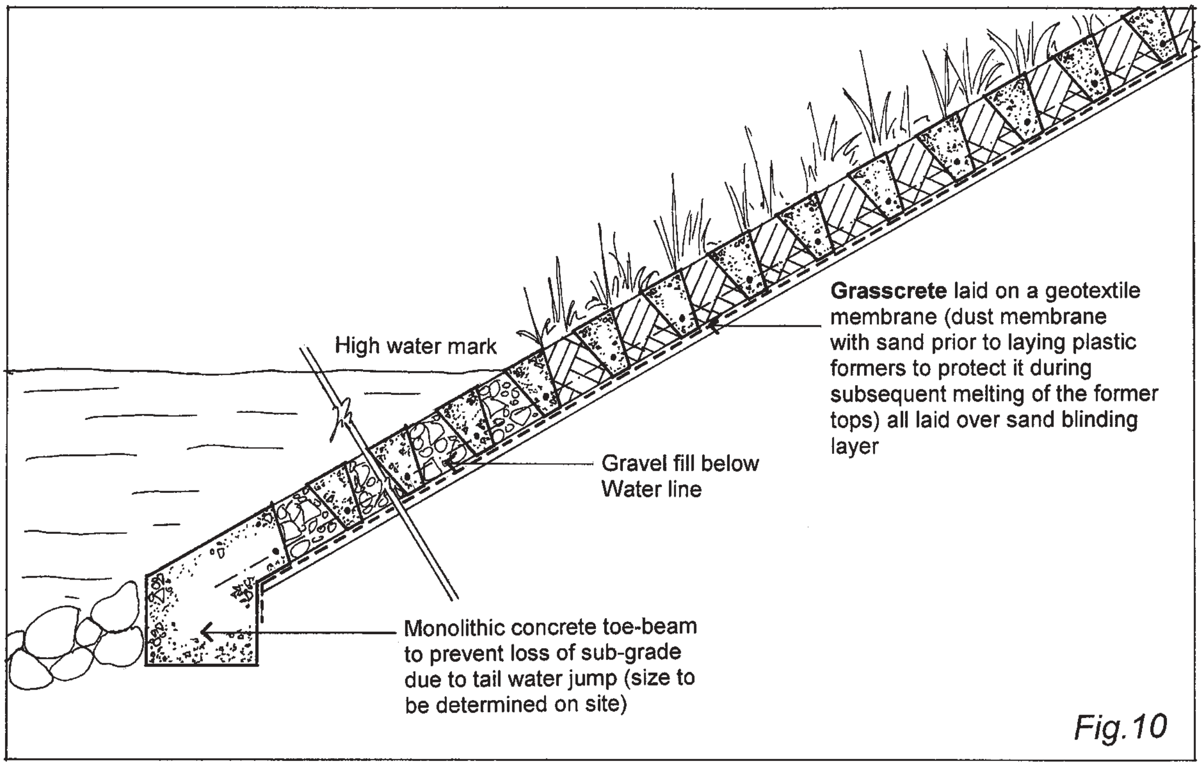


Fig.10

With its traffic bearing capability, GRASSCRETE can be specified as a 'total' armour layer to reservoir bunds with crest access for heavy vehicles being accommodated.

In environmentally sensitive areas such as salt flats etc. the GRASSCRETE pockets can be either sown with natural flora seed mixes or planted with indigenous rushes.

GRASSCRETE'S cast on site process often suggests a limitation in the angle to which the system can be laid, with the notion of concrete loss during pouring. On the contrary, the ribbed cruciform shape of the plastic former is designed to limit the flow of live concrete enabling slope angles of up to 45° to be accommodated.

PART TWO ~ STORM CHANNELS

Increasing urbanisation makes increasing demands upon the process of controlling storm water run off. Nowhere is this more evident than in tropical and sub-tropical climates where heavy rainfall leads to intense run off and the spectre of downstream flooding under inadequate control

It would be encouraging to think that the universal specification of porous paving systems will be a feature in years to come. The mitigation of run off at source being the best possible cure. In the absence of this approach, there will continue to be a need to accommodate high volumes of storm water.

In temperate climates the use of storm channels will tend to be associated with overflow channels for swollen rivers. In such circumstances, the armour layer will be designed according to the anticipated erosion, with maximum protection adjacent to the spillway or weir.

In tropical or sub-tropical climates, the demands are much greater with a prolonged intense flow being encountered throughout the channel's length. To assist in the specialised design we have compiled a publication - "GRASSCRETE; PAVING DESIGN FOR RIVER AND STORM CHANNELS" which is available on request.

A principle design consideration in developing a channel section is the hydraulic roughness of the armour 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,a Mannings 'n' value of 0.03 can be achieved under such conditions (see fig.11).

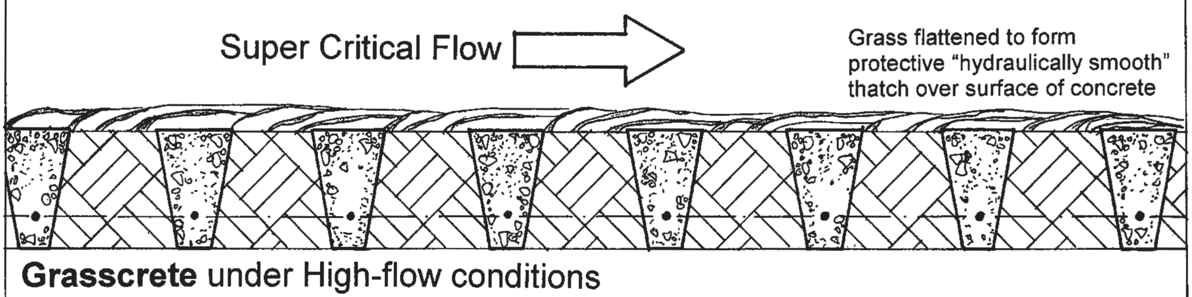


Fig.11

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.

PART THREE ~ FLOW RATES

The CIRIA Trials of 1986 detailed in Part One 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 GRASSCRETE GC2 (150mm thick) 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 for each of the Grasscrete variants (see fig.12).

SYSTEM TYPE	REINFORCEMENT	DEPTH	MAXIMUM FLOW RATE
GC3	A142/A193 *	76mm	4.5m/sec
GC1	A193/A252 *	100mm	6m/sec
GC2	A252 *	150mm	8m/sec

* Relates to British Standard BS4483 References

A142 = 200x200mm grids x 6mm diameter wires weighing 2.22kgs/m^2
A193 = 200x200mm grids x 7mm diameter wires weighing 3.02kgs/m^2
A252 = 200x200mm grids x 8mm diameter wires weighing 3.95kgs/m^2 Fig. 12

CHAPTER FOUR – OTHER APPLICATIONS

Tailored Projects

Throughout GRASSCRETE'S long history, there have been numerous occasions where the system has been called into use for previously unspecified roles. GRASSCRETE'S unique adaptability has enabled the product to rise to these new challenges, a few of which are detailed here.

1) Light Rail Engineering

The ability to tone down the environmental impact of a light rail network through city suburbs is compromised by the engineering considerations in the design. Whilst a grassed track encourages an environmental solution, a number of important factors need to be considered.

- The potential for vandalism if precast elements are used
- The need to provide access for maintenance vehicles
- Percolation of surface water when overlaying impervious stage 1 and 2 concrete bases
- A surface which requires little or no maintenance

Our response to such a brief was the following design which was subsequently incorporated into a city centre project (see fig.13).

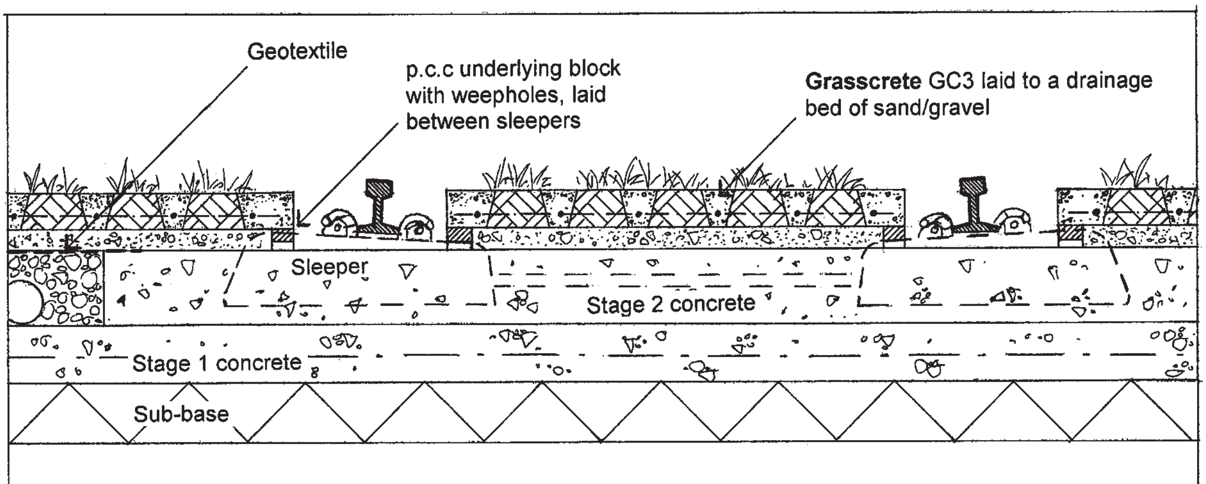


Fig.13

Helicopter Landing Pads

Using the essential criteria of a level stable surface and a natural grassed appearance, GRASSCRETE is the ideal solution to the provision of low intrusion helipads. Further benefit is gained by forming the 'H' monolithically within the surface by the elimination of the corresponding part sections of void former (see fig.14).

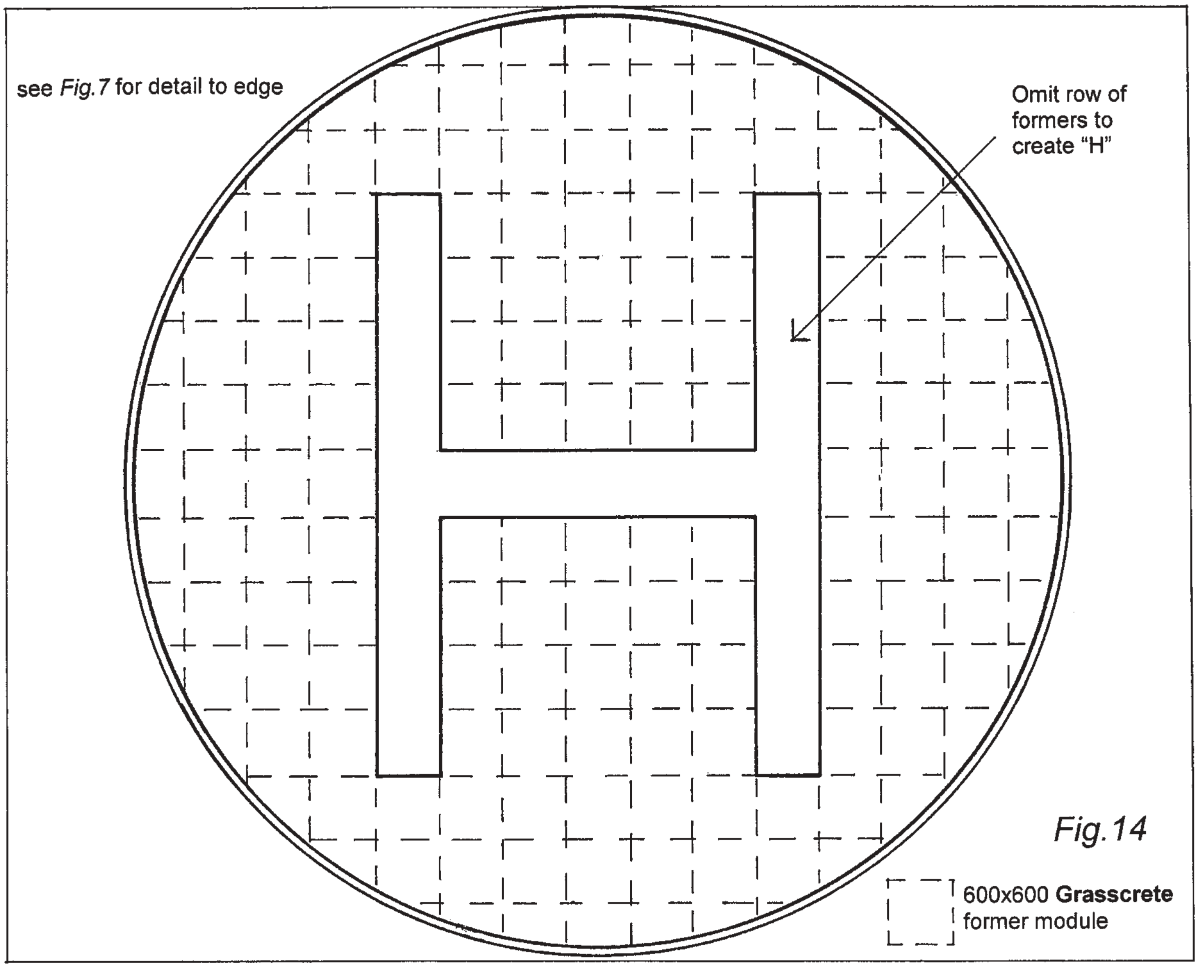


Fig.14

Sludge Cake Drying

Perhaps not the most glamorous application for GRASSCRETE and not one for our brochure photographs. Nevertheless, this particular application proved to be a successful result for the GRASSCRETE system.

In this instance, GRASSCRETE was designed to act as a drainage slab for residual moisture contained within sludge removed from waste water treatment plants. Using a controlled filtration, the system allowed the sludge to dry prior to its removal for blending into screened topsoils (see fig.15).

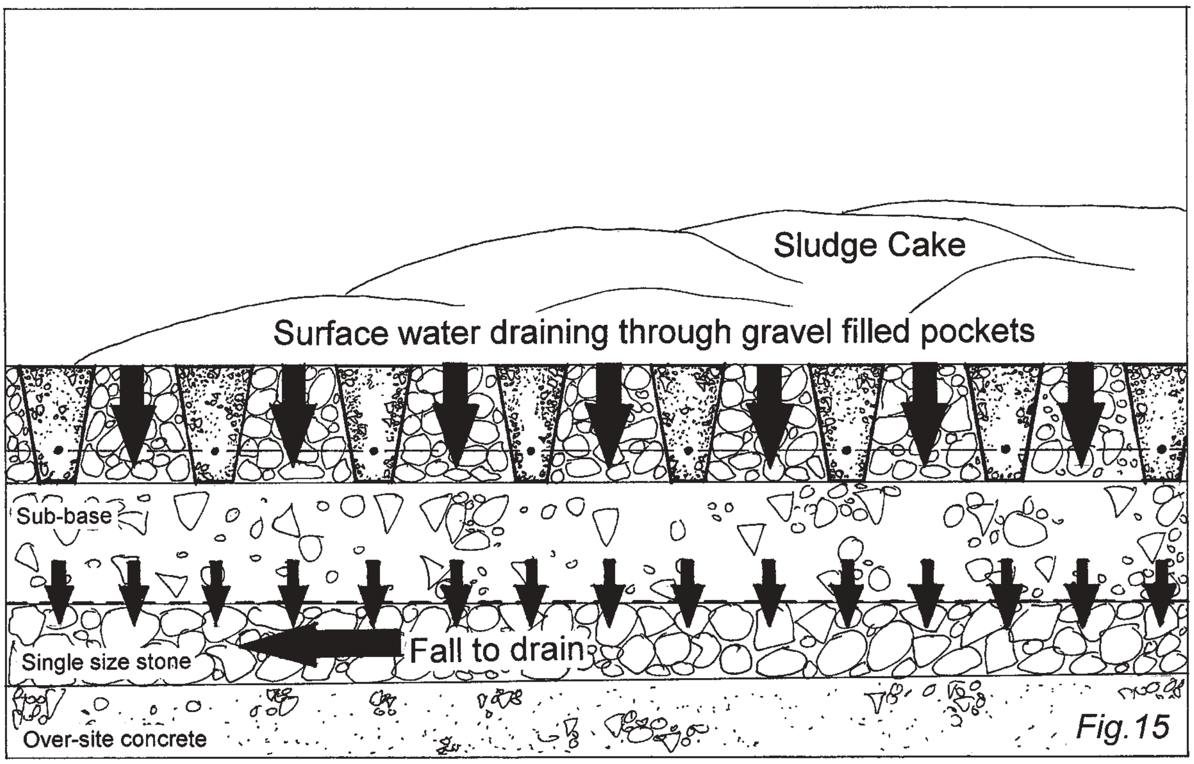


Fig.15

CHAPTER FIVE – USE AND MAINTENANCE

PART 1 ~ USE

A question often asked is one relating to the ease of use for both vehicles and pedestrians. Often the questions are influenced by previous experiences with other forms of grass reinforcement.

Vehicular Use

With a flat upper profile and a pocket shape designed to prevent tyre intrusion, vehicles have little difficulty in using the surface. The tyre rumble encountered is perhaps the lowest found amongst concrete systems and is in marked contrast to castellated precast units where the studded upstands cause discomfort in use and block displacement under vibration.

The integral solid edge margins to each bay prove a subtle definition for the user and is particularly important for fire access routes. This detail, together with the optional car bay markers, enables a fully delineated car park to be constructed without the need for painted lines.

Pedestrian Use

It cannot be expected that a grass and concrete surface will be as easy to walk on as a solid pavement system, particularly for high heel users. That said, the GRASSCRETE system is probably the easiest grass reinforcement system to walk on. The same advantages that hold for vehicles apply equally to pedestrian use, the plan shape of the pocket allowing feet to sit predominantly on concrete. The optional use of bay divisions also aids the process of disembarking from vehicles where the first foot is placed on a solid concrete surface.

PART 2 ~ MAINTENANCE

GRASSCRETE is not a miracle system – it grows natural grass. Just as a grassed lawn requires maintenance, then so will GRASSCRETE albeit to a lesser degree.

Regular vehicular use will trim the grass level down flush to the upper level of the concrete. In a typical car park application, the access routes may show a greater level of grass wear. It is advisable therefore to apply a routine maintenance programme, particularly to the access locations.

A simple maintenance programme can be described as –

1. Routinely cut areas subjected to infrequent use to even out growth levels
2. Apply liquid based fertilisers as follows – Spring : nitrogen based formula
   Autumn : phosphate based formula

   Powder or granule based fertilisers should be avoided due to potential for wind drift and build up on the concrete ribs which can result in scorching of the grass.
3. Regular trafficking may result in the soil levels falling slightly in the pockets. It is advisable to top up levels which are a potential trip hazard. Over filling should be avoided however as should compaction of the pocket fill which can injure grass growth.
4. After the construction of the pavement layer and if the surface is not to be used immediately, there is benefit to be gained from placing a fine layer of topsoil over the surface of the concrete. This will enable soil levels to be naturally replenished after settlement as well as providing a barrier against solar gain over the newly cast concrete.

PART 3 ~ GRASS TYPES

The actual grass seed specification will depend upon the climatic location or intended use. As GRASSCRETE is laid throughout the world, the type of indigenous grass will therefore vary with both rhizome or stolon growth types being encountered.

Grass types can be individually tailored for individual projects according to climate, use and aspect. For temperate climates, three amenity based mixes can be utilised to provide flexibility and economy.

<u>Regularly Trafficked Areas</u>

Such applications are generally associated with car parks where the grass will be required to grow under aggressive wear conditions. Normally, the concrete ribs are required to be visible to provide a surface which is less likely to slurry under use. The combination of these two factors suggests the specification of a ryegrass based mix which offers erect growth and excellent wear resistance. Our Mix No 1 suits this purpose.

<u>Infrequently Trafficked Areas</u>

The principle types of use under this category are fire access routes and road verges.

A typical fire access may be located around a high rise building which could place the roadway in shade. The seed mix should therefore be shade tolerant

A road verge for European applications will be subjected to surface water run off containing rock salt treatment applied to carriageway in winter months. The mix should therefore be saline tolerant.

Such applications call for minimal maintenance with a carpet of cover generally being required. The combination of these factors suggests the use of a mix with a high proportion of creeping red fescue. Our Mix No 2 is such a type.

Embankment/Slope Protection

A number of different variations upon a common theme can be considered. The mix should generally provide good root anchorage to prevent pull out.

A dry slope may call for a more manicured approach with a closer grass mix provided by creeping red fescues. Consideration should be given however to the potential for the surface to become slippery under wet conditions.

In waterborne slopes the grass will be required to perform a functional role. Our earlier chapters have described how a stemmed grass can form a protective thatch when laid prostate by heavy water flow. 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, our Mix No 3 is designed for such applications.

SEED SPECIFICATIONS

MIX	SOWING RATE	SPECIFICATION	APPLICATION
No 1	50gms/m^2	45% Creeping Red Fescue 5% Browntop Bent 50% Perennial Ryegrass	Vehicular Parking Amenity Areas
No 2	50gms/m^2	20% Chewing Red Fescue 45% Creeping Red Fescue 5% Browntop Bent 30% Hard Fescue	Fire Access Shaded low maintenance areas
No 3	50gms/m^2	52% Creeping Red Fescue 5% Smooth Stalked Meadow Grass 3% Browntop Bent 40% Perennial Ryegrass	Embankments

The difference between a good mix and a poor one is likely to be pence per m? on sowing but a much greater cost on failure. We would therefore recommend the selection of quality cultivars selected from the upper levels of the Sports Turf Research Institute's tables relative to the required function.

PART 4 ~ REMEDIAL WORKS

Occasionally it may be necessary to cut out sections of GRASSCRETE to allow for example, a new service trench to be constructed. Very occasionally, damage may occur due to inappropriate use. Under such circumstances, a remedial repair can be easily accommodated as shown in fig.16.

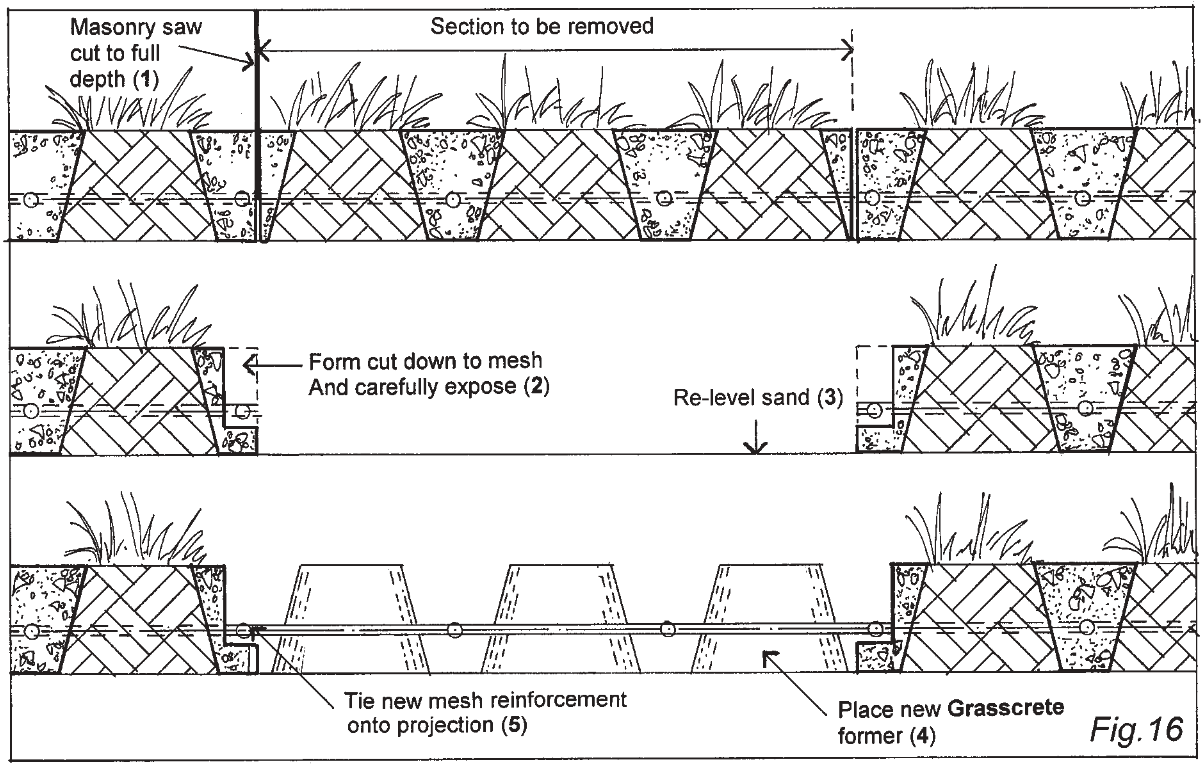


Fig.16

CHAPTER SIX – INFORMATION FOR THE QUANTITY SURVEYOR

PREAMBLE

(TRAFFIC)

GRASSCRETE® cast on site reinforced cellular paving. GRASSCRETE® formers type GC…….*, …….*mm deep laid on a consolidated sub-base with a 10/20mm sand blinding layer of sand. Steel mesh reinforcement to BS4483 reference ……..*, weighing ……*kgs/m^2 shall be seated upon the integrally moulded spacers. Concrete 30MN/m^2 @ 28 days with air entrainment of 3%. 10mm maximum size aggregate and a ……*mm slump shall be placed around formers and mesh and levelled to tops of formers. After 48 hours (can be reduced under suitable conditions), melt exposed tops of formers and fill with soil. Following settlement, sow GRASSMIX No ……* at a rate of 50gms/m^2 and top up with fine friable topsoil, apply fertiliser as necessary.

(EMBANKMENT ~ DRY)

GRASSCRETE® cast on site reinforced cellular paving. GRASSCRETE® formers type GC……*, ……*mm deep laid on a 10/20mm blindng layer of sand over a trimmed earth sub-grade with loose debris removed and depressions filled with selected granular material. Steel mesh reinforcement to BS4483 reference ……..*, weighing ……*kgs/m^2 shall be seated upon the integrally moulded spacers. Concrete 30MN/m^2 @ 28 days with air entrainment of 3%. 10mm maximum size aggregate and a ……*mm slump shall be placed around formers and mesh and levelled to tops of formers. After 48 hours (can be reduced under suitable conditions), melt exposed tops of formers and fill with soil. Following settlement, sow GRASSMIX No ……* at a rate of 50gms/m^2 and top up with fine friable topsoil, apply fertiliser as necessary.

(EMBANKMENTS ~ WATERBORNE)

GRASSCRETE® cast on site reinforced cellular paving. GRASSCRETE® formers type GC……*, ……*mm deep laid on a fine dusting of sand over a woven polyester geotextile (see separate specification), on a 10/20mm blinding layer of sand over a trimmed earth sub-grade with loose debris removed and depressions filled with selected granular material. Steel mesh reinforcement to BS4483 reference ……..*, weighing ……*kgs/m^2 shall be seated upon the integrally moulded spacers. Concrete 30MN/m^2 @ 28 days with air entrainment of 3%. 10mm maximum size aggregate and a ……*mm slump shall be placed around formers and mesh and levelled to tops of formers. After 48 hours (can be reduced under suitable conditions), melt exposed tops of formers and fill with soil. Following settlement, sow GRASSMIX No ……* at a rate of 50gms/m^2 and top up with fine friable topsoil, apply fertiliser as necessary.

EXPANSION JOINTS

Expansion joints shall be incorporated at 10x10m centres and shall consist of a 25mm pre-soaked softwood filler (25mm close cell foamboard for high temperature zones); for **GC3**, **GC1, GC2 and GC2sc.**

Or

Expansion joints shall be incorporated at 10x10m centres and shall consist of a 25mm wide close cell foamboard filler with 20mm diameter x 300mm long sawn mild steel dowels at 400mm centres with cap and de-bond to one end. Joint shall be sealed with a cold applied sealant; for **GC2sc – load transferable slabs**.

GRASS
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