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Installation Guidelines for Segmental Block Wall

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1. INTRODUCTION

This guideline provides the methods and procedures necessary for the correct installation of the **RockGrid®PC/Miragrid® GX** geogrid used as reinforcing for segmental block walls. The generic term "segmental block wall" encompasses all types of concrete blocks used in the construction of retaining walls. This document does not provide details on the merits of the different type of blocks but does reflect minimum industry-acceptable standards and general good practice procedures.

This guideline is to be used only where concrete blocks are used for wall facings that typically range from 60 degrees to near vertical. Shallower wall facings may be possible, but may require additional precautions which fall outside this document. Where **RockGrid® PC/ Miragrid® GX** is used in other applications Kaytech's appropriate *Installation Guidelines* should be referred to.

The installation of **RockGrid®PC/ Miragrid® GX** shall be in accordance with these methods and procedures, and the project drawings provided by the Engineer. Where conflicting information arises between this document and the Engineer's specifications or instructions, the Engineer's specifications or instructions shall govern.

2. MATERIALS

2.1 RockGrid® PC Reinforcement

RockGrid®PC is a factory-manufactured composite geogrid used in reinforcement of soil fills, and consists of high-strength polyester yarns arranged in the machine and cross directions to form a grid which is mechanically bonded to a 150 g/m^2 polyester, non-woven, needlepunched, staple filament geotextile. The following specifications shall apply.

			50/50	**100/100**	**200/200**	
Material		Polyester, staple fibre 150 g/m^2 needle punched, nonwoven / high strength polyester yarns				
Short Term Tensile Strength	Machine	kN/m	50	100	200	ISO 10319
	Across	kN/m	50	100	200	
	Elongation	%	10	10	10	
Long Term Design Strength (LTDS*) 120 Years		kN/m	26	52	105	ISO 10319
Creep Limited Strength 120 Years		kN/m	30	60	120	ISO 13431
Water Flow Rate	Normal to Plane	ℓ/s/m^2	150			ISO 11058
	In Plane 20 kPa	ℓ/s/m/hr	20			ISO 12958
Roll Dimensions		m	5 x 100			ISO 12958

2.2 Miragrid® GX Reinforcement

Miragrid® GX is manufactured from high tenacity polyester (PET) yarns, knitted to form a structured grid, with polymeric coating protection. **Miragrid® GX** is designed for technical applications such as reinforcement of granular soils. The following specifications shall apply.

			40/40	60/30	60/60	80/30	100/30	
Material			High tenacity polyester yarns with polymeric coating					
Characteristic Short Term Tensile Strength (T_u)	Machine	kN/m	40	60	60	80	100	ISO 10319
	Elongation	%	11	11	11	11	11	
	Across	kN/m	40	30	60	30	30	
Creep Limited Strength 120 Years		kN/m	27	41	41	55	68	ISO 13431
Long Term Design Strength (LTDS) 120 Years		kN/m	21	34	34	46	58	*See below
Roll Size	Width	m	5.2					
	Length	m	100					
	Weight	kg	113	125	170	158	185	
Availability			ex stock					

$$* \text{LTDS} = \frac{T_u}{f_c . f_d . f_e . f_m}$$

f_c (creep)	=	1.45	(120 years)
f_d (damage)	=	≤ 2 mm	See table below (yarn facing soil)
f_e (environment)	=	1.10	(pH 4-9)
f_m (material)	=	1.00	

National codes may require application of other specific partial factors of safety or test methods

2.3 Engineered Fill

Fill material shall comply with the engineer's specification in the project drawings and placed in accordance with the *Standard Specification for Road and Bridge Works*, the relevant SANS 1200 or other international or national backfill specification.

2.4 Drainage Medium

Consists of a coarse, clean gravel or stone (19 mm or smaller), wrapped in a geotextile fabric. The drain is constructed vertically behind the engineered fill with a perforated collector pipe and solid outlet pipe to convey any groundwater away from the wall area.

An alternative to the coarse gravel or stone is the **Megaflo®** drainage geocomposite, which allows easier installation and material savings.

2.5 Concrete Block

Used as a facing in retaining wall construction, concrete blocks are available in a variety of shapes, sizes, colours and finishes from a number of manufacturers. Blocks, which are manufactured to tight tolerances, have a shear nib and large

surface area to allow for a positive connection between reinforcement and block, and high resistance to crushing is preferred.

2.6 Connection

Ensures a structural connection between the block facing and reinforcement, and can be incorporated into the casting of the block or can come as an add-on after the block casting process. Connections can be in the form of steel, plastic or concrete.

3. HEALTH AND SAFETY ENVIRONMENT

As far as is reasonably practicable, a working environment that is safe and without risk to the health of the employees shall be provided and maintained by the contractor, taking such steps as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to the safety or health of employees, before resorting to personal protective equipment

3.1 Personal Protective Equipment

In the event that personal protective equipment (PPE) is required to mitigate and reduce the risk of injury whilst at work, the following minimum PPE is required:

- Safety shoes with steel caps for handling operations
- Hard hats
- Gloves



3.2 Excavations

All retaining wall excavations are to be suitably shored during construction such that the excavated area is safe and secure for personnel and machinery, and that adjacent structures are not undermined.

All excavations exceeding 1.5 m in depth are to be shored such that all embankments are safe and secure.

Shoring and battering-back remains the responsibility of the contractor.

3.3 Machinery

The contractor shall ensure that work performed and plant or machinery used is under the general supervision of a person trained to understand the hazards associated with it, and who has the authority to ensure that precautionary measures taken by the employer are implemented.

4. HANDLING

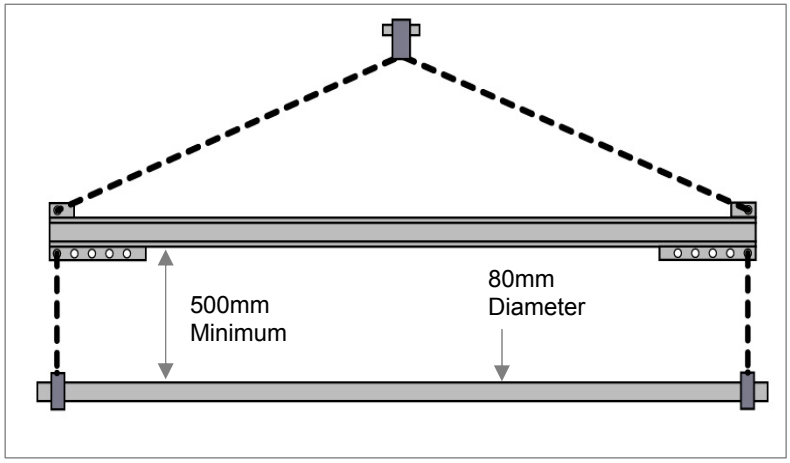
If the handling procedure for **RockGrid®PC** differs from that specified in this document, then Kaytech shall be contacted and notified immediately prior to shipment and transporting of the material to site. **RockGrid®PC** is supplied to site in full roll lengths.

4.1 Offloading Equipment

During offloading operations **RockGrid®PC/ Miragrid® GX** must be supported to avoid product damage and worker injury. Workers handling the offloading operation must have the correct PPE. Suitable handling equipment is described below.

4.1.1 Spreader Bar Assembly

A spreader bar assembly includes both a core pipe / bar and a spreader bar beam. When inserted through the PC core, the core pipe uniformly supports the roll, while the spreader bar beam prevents chains and straps from chafing the roll edges. A typical layout of a spreader bar is shown here.

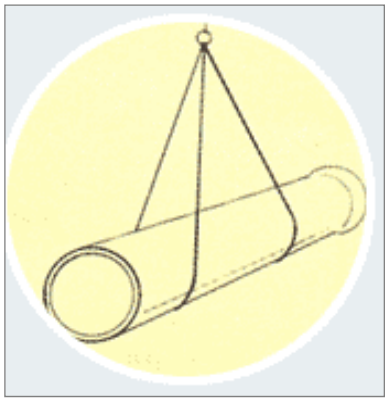


4.1.2 Carpet Spike

A carpet spike is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment, and the other end rounded off to allow easy insertion into roll material cores.

4.1.3 Roller Cradles

Roller cradles consist of two large diameter rollers spaced approximately 75 mm apart, which both support the **RockGrid® PC/ Miragrid® GX** roll and allow it to unroll freely.



4.1.4 Straps

Straps may be used to support the rolls of material but caution must be exercised as straps may damage the **RockGrid® PC/ Miragrid® GX** when wrapped around the roll.

Under no circumstances should the **RockGrid®PC/ Miragrid® GX** rolls be:

- dragged;
- lifted from one end;
- lifted with only the forks of a lift truck; or
- dropped onto the ground from the delivery vehicle.

5. CONSTRUCTION SEQUENCE

Individual characteristics of various sites, installers and project specifics may dictate subtle differences and necessitate minor modifications in the construction sequence. However, all segmental reinforced block walls must follow these basic steps in the construction process. Significant deviations from these procedures shall be pre-approved by the project Engineer or other designated party.

5.1 Site / Base Preparation

Site preparation and good construction is the key to proper wall construction. It is very important to make sure that foundation soils are competent and have not been disturbed.

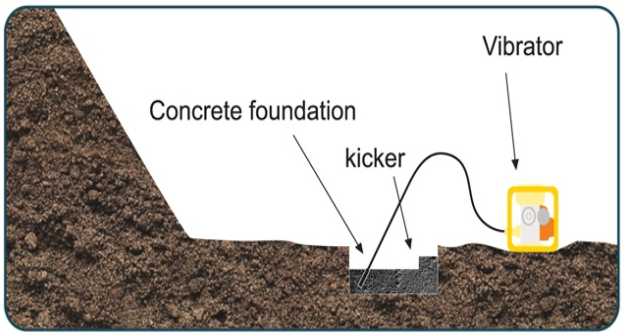
The plan area of the reinforced soil structure should be excavated to provide a level base foundation. The in-situ soil should be compacted before placing any engineered fill or reinforcement. Soft spots should be removed and replaced with well graded fill

5.2 Excavate Trench

After determining the wall location and layout, excavate a trench to accommodate the concrete footing. The depth of the trench should be sufficiently deep to allow the burial of at least 1½ blocks or as determined by the embedment depth (min.$^{H}/_{20}$), but not less than 0.45 m, plus the depth of the concrete footing.

5.3 Place Concrete Footing

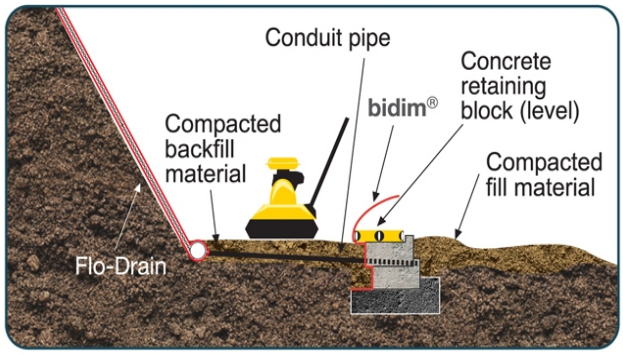
Place a good quality concrete, usually 15 MPa to 20 MPa strength, in the trench and vibrate. Ensure that the required base thickness is achieved and that the top of the concrete footing is level. If the foundation requires stepping, ensure that the steps are in increments of the block height.



5.4 Laying First Row of Blocks

Set the first row of blocks in the concrete. As the wall height progresses ensure that the top of the blocks is level, to avoid vertical and horizontal misalignment.

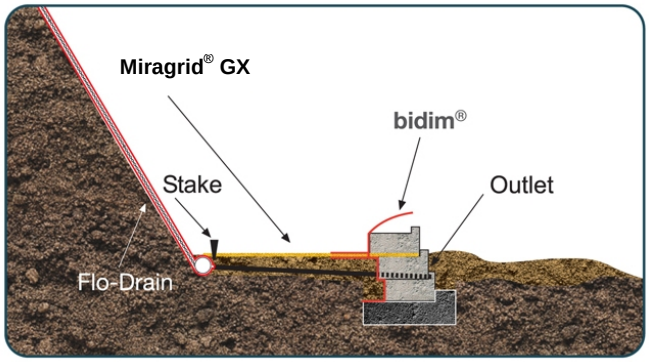
Always start wall construction at the lowest wall elevation. On a straight wall, placing a string line against the back of the units helps maintain alignment.



5.5 Backfill and Compact

Once the bottom row of blocks has been placed carefully fill the voids of the blocks with selected fill and hand compact.

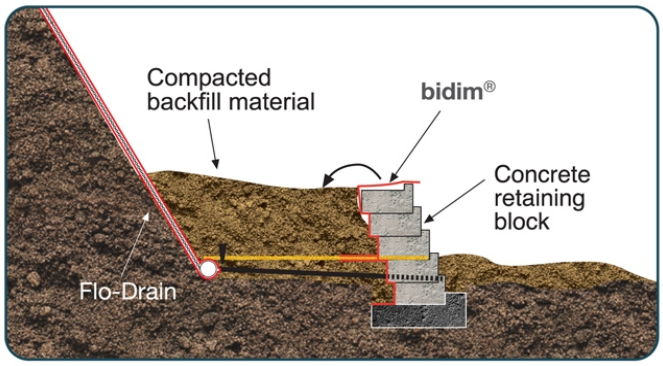
Block walls constructed in-fill will require large volumes of engineered fill material, whereas walls built in-cut require less fill material. In general fill should be deposited, spread, levelled and compacted in horizontal layers of no more than 200 mm thickness and compacted to a minimum of 95 % Mod AASHTO at an appropriate moisture content. Avoid organic or clay material for engineered backfill. Ride-on compaction equipment should operate a minimum of 2 m away from the back of the wall. Walk-behind compaction equipment can be used directly behind the wall. Test soil for correct compaction and avoid over compacting. The spreading, levelling and compacting operation is usually carried out in the direction parallel to the wall face. Sheep foot drums are prohibited.



The rear of the reinforced soil structure should be adequately supported to ensure that contemporaneous deposition of the retained fill.

5.6 Cut-off Drain

It is good practice to install a subsurface cut-off drain behind the block wall, as moisture behind a block wall increases the lateral pressure on the wall. The position



of the cut-off drain or drainage medium will differ between block suppliers. However, as a minimum, a cut-off drain to intercept, collect and convey ground water away from the compacted engineered fill behind the block wall is recommended. The cut-off drain can consist of a 300 mm wide, free-draining granular material (typically 19 mm stone), encasing a 100 mm diameter collector pipe all wrapped in a **bidim®**.

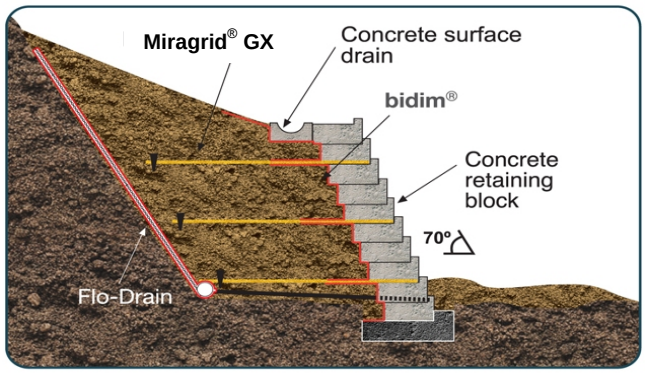
Outlet pipes from the cut-off drain through the engineered fill and wall face discharge water in a controlled manner to existing stormwater systems.

An alternative to the 300 mm wide subsoil drain are drainage geocomposites such as the **Flo-Drain®, MegaFlo®** or **WickDrains®** , spaced at regular intervals, all tying into a collector pipe. The same outlet pipes are used through the engineered fill and wall face to discharge ground water in a controlled manner to existing stormwater systems. Drainage geocomposites are available through Kaytech.

5.7 Installing Geotextile

If the block wall is constructed with an open face (as opposed to a closed face where no open spaces are left between adjacent blocks) it is vital to install an A4 geotextile behind the blocks to avoid loss of soil material.

5.8 Installing Additional Block Courses



Sweep off the blocks ensuring that the tops of the units are free from any debris. Construct the second row of blocks directly above the vertical joints of the course below, to create a running bond pattern. Depending on the type of block and whether an open or closed face wall construction is undertaken, this may not be possible, in which case the block manufacturers guidelines should be consulted.

Continue with steps 5, 6 and 7 until the height of where the reinforcement needs to be placed is reached. The geogrid reinforcement needs to be installed progressively within the engineered fill as construction of the block wall proceeds.

5.9 Geogrid Reinforcement

Ensure that the correct geogrid reinforcement is delivered to site. Ascertain at which levels the geogrid reinforcement is required. Cut the required length from the roll. The geogrid needs to be laid with the main tensile axis perpendicular to the face of the wall. In plan, the geogrid covers 100 % of the area. As a minimum, reinforcement should be installed every third row.

Generally, the **RockGrid®PC** type geogrid is placed with the geotextile component face up, to minimise damage to the grid component during installation.

Some block manufacturers provide a physical connector to ensure a structural capacity or tie-in between block and grid (referred to as a *Positive Connection*). Avoid using blocks that have no provision for adequate connection capacity between block and grid.

Prior to backfilling, reinforcement should be pulled taught and be free of wrinkles and slack. To assist with the tensioning of the reinforcement a 150 mm deep tensioning groove can be excavated. Compacting the fill material will force the geogrid into the tensioning groove, thus tensioning the geogrid further.

Fill may be placed on the geogrid reinforcement by using an advancing track dozer to push material out in front or by carefully placing it with a loader. The fill should be deposited, spread, levelled and compacted as described in step 5. Sheep foot drums are prohibited. Under no circumstance should vehicles (including rubber tyred) drive directly on the geogrid reinforcement. The use of construction machinery operating directly over the geogrid is strictly prohibited Only where the geogrid reinforcement is covered with a compacted layer exceeding 150 mm may vehicles drive at slow speeds of less than 15 km/hr. Sharp turning sudden starts, stops and braking must be avoided.

Reinforcement joints or overlaps in the direction parallel to the face of the slope are strictly prohibited.

Continue with steps 5, 6, 7, 8 and 9 until the final height of wall is reached.

5.10 Surface Drainage

Stormwater runoff can infiltrate the upper surface unless effective sloping and sealing details are provided.

The compacted fill should be rolled and graded away from the slope face at the end of each workday to prevent ponding of water.

A surface drain should be provided at the top of the wall and every wall tier to collect and convey runoff to an existing stormwater system.

6. MONITORING

All reinforced wall structures should be subjected to a regular programme of inspection and maintenance when completed. Records of inspections and any maintenance should be kept. Of particular importance when inspecting reinforced soil structures are:

- Excessive settlement, even or differential;
- Horizontal displacement of the block face;
- Damage to the facing;
- Evidence of drainage problems;
- Cracks in the embankment on top of the reinforced block wall structure.