ANCHORED REINFORCED GRID SOLUTIONS (ARGS)

- Levee Protection & Overtopping
- Stormwater / Scour Protection
- Retaining Walls
- Embankment Stability
- Levee Protection & Overtopping
- Plati-Drain
- Stormwater / Scour Protection

Platipus Earth Anchoring Systems
INTRODUCTION TO PLATIPUS® ANCHORED REINFORCED GRID SOLUTIONS (ARGS)

Stabilizing slopes offer significant challenges. Many times the lack of deep rooted vegetation, excess water, poor drainage, and over steepening make them susceptible to erosion or instability. Platipus® Anchors has over 25 years of experience and has proven that the combination of Percussive Driven Earth Anchors (PDEAs) and a facing material strong enough to support the load generated by the PDEA will stabilize these applications.

To stabilize any embankment, first we must determine if it is a temporary or permanent application and if the face is to be vegetated or hard armored. In our experience, we recommend that every slope is analyzed by a qualified Engineer.

Benefits of Anchored Reinforced Grid Solutions:

- Originators of the AnchorMat / ARVS System
- Over 25 years of experience
- 1000’s of successfully completed projects
- Fast & easy installation
- Immediate & quantifiable loads
- Simple & cost effective
- Low environmental impact
- Can be incorporated with products from most major manufacturers
- Pre-contract site evaluation & anchor testing
- Strong technical guidance, on-site training & support
- Patented ‘Plati-Drain’ solution can reduce pore water pressure within clay slopes & behind retaining walls

CAUTION

Some geotextile manufacturer’s advertise elongation characteristics which can only be used for limited applications (i.e. surface erosion). Even then without the correct anchor system, depth, spacings, on site engineering and re-vegetation, the result could be an ineffective solution. We advise that great care is taken in the selection of both bi / tri-axial geotextiles and their intended application.

The soil conditions on and within the slope, (i.e. angle, compaction and drainage) need to be clearly understood before grid and anchors can be chosen. We appreciate that each project is unique. Great care and consideration should be given to understand all of the parameters of the suspected failure (i.e. re-engineering, choice of anchor design, site testing, grid and Contractor) to ensure the combined efforts provide the Client with long term sustainable results.
There are three steps to the installation of an anchor system:

**STRESS DISTRIBUTION & BEARING CAPACITY**

The stress distribution in front of a loaded anchor can be modelled using foundation theory. The ultimate performance of an anchor within the soil is defined by the load at which the stress concentration immediately in front of the anchor exceeds the bearing capacity of the soil.

Factors that will affect the ultimate performance of the anchor include:

- Shear angle of the soil
- Size of the anchor
- Depth of installation
- Pore water pressure

Platipus® anchors perform exceptionally well in a granular / non-cohesive soil, displaying short loadlock and extension characteristics, a broad frustum of soil immediately in front of the anchor and extremely high loads.

Stiff cohesive soils, such as boulder clays, can also give outstanding results. However, weaker cohesive soils, like soft alluvial clays, can result in long loadlock and extension distances and a small frustum of soil in front of the anchor. Consequently these conditions require a larger size of anchor and if possible a deeper driven depth to achieve design loads.

**TYPICAL ANCHOR BEHAVIOUR**

<table>
<thead>
<tr>
<th>LOADLOCK</th>
<th>COMPACTION AND LOAD</th>
<th>MAXIMUM LOAD RANGE</th>
<th>BEARING CAPACITY FAILURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The first stage is where a load is applied to rotate the anchor into its loadlocked position. Elements of both load and extension are present.</td>
<td>The second stage is where the anchor system is generating a frustum of soil immediately in front of the anchor. At this point load normally increases with minimum extension. The soil type will affect the overall extension.</td>
<td>The third stage is where the anchor produces its ultimate load. As the anchor load approaches the bearing capacity of the soil, the rate of increase in load will reduce until bearing capacity failure of the soil takes place.</td>
<td>Caution: If the mechanical shear strength of the soil is exceeded, the residual load will decrease with continued extension as the anchor shears through the ground.</td>
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</tbody>
</table>
The Platipus® S2 ARGS Percussive Driven Earth Anchor (PDEA) assembly comes in a variety of configurations with up to 1m / 40" of 3mm stainless steel wire tendon, two sizes of HDPE load plate and either a copper ferrule or wedge grip option. The anchor system should be driven through the surface covering material to a minimum depth of 450mm / 18" to provide an ultimate holding capacity of up to 250kg / 500 lbs.

**Surface Materials**

- Turf Reinforcement Matting
- Geotextiles
- HDPE Coverings
- Turf Pavers
- Lightweight Concrete Flexacrete
PROJECT EXAMPLES

SURFACE EROSION

STORMWATER / SCOUR PROTECTION

FLOOD PROTECTION

LEVEE PROTECTION & OVERTOPPING

FLOOD STORAGE POND
The Platipus® S4 ARGS Percussive Driven Earth Anchor (PDEA) is the perfect solution for granular / non-cohesive soil. The larger S6 ARGS should be used in cohesive conditions. Both assemblies include a length of 4mm stainless steel wire tendon, a choice of load plates and a stainless steel conical wedge grip. They should be driven to a minimum depth of 750mm / 30" beyond the failure plane and have an ultimate holding capacity of 1000kg / 2,200lbs. Anchor depth, spacing and loads should be determined by a qualified Geotechnical Engineer.

**Surface Materials**

- High Performance Turf Reinforcement Matting (HPTRM)
- High Strength Geotextiles & Geogrids
- Wire Mesh
- Articulated Concrete Blocks (ACBs)

**Platipus® S4 & S6 ARGS**

Install appropriate facing material over the prepared surface.

Re-profile the slope with existing material or select fill.

Install Plati-Drain.

Install anchors and re-vegetate.

Install anchors and re-vegetate.

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Surface Materials

- High Performance Turf Reinforcement Matting (HPTRM)
- High Strength Geotextiles & Geogrids
- Wire Mesh
- Articulated Concrete Blocks (ACBs)
PROJECT EXAMPLES

SHALLOW SLIDES

SHORELINE PROTECTION

LEVEE PROTECTION & OVERTOPPING

COASTAL EROSION
Deep seated failures can be repaired using larger Stealth and Bat anchors along with a solid geotechnical engineered design. In conjunction with our online Anchor Selector guideline software an Engineer can design a low impact economical solution. Typically this begins with a review of the soils report and installation of a test anchor to prove the holding requirements are met.

**Platipus® Stealth and Bat Anchor Engineered Solutions**

Surface Materials
- High Strength Geotextiles
- Geogrids
- Wire Mesh
- Rockfall protection netting

1. Remove debris, rocks and re-profile the slope
2. Apply geogrid
3. Install anchors as per specification and re-vegetate
4. Remove debris, rocks and re-profile the slope

**ANCHORED REINFORCED GRID SOLUTIONS (ARGS)**

**DEEP SEATED FAILURES**
PROJECT EXAMPLES

TEMPORARY STABILIZATION

REINFORCED EARTH STABILIZATION

PERMANENT STABILIZATION & DRAINAGE

DIFFICULT ACCESS

RAPID DRAWDOWN
ANCHORED REINFORCED GRID SOLUTIONS (ARGS)
CUT FACE SLOPES

Platipus® Stealth and Bat Anchor Engineered Solutions
Cut face slopes can be supported using larger Stealth and Bat anchors along with a solid geotechnical engineered design. In conjunction with our online Anchor Selector guideline software an Engineer can design a low impact economical solution. Typically this begins with a review of the soils report and installation of a test anchor to prove the holding requirements are met.

**Facing Materials**
- Segmental Concrete Blocks
- Poured in Place Concrete Wall
- Vegetated Wire Baskets
- Rock Filled Gabion Baskets
- Sheet Piling
- Timbers
PROJECT EXAMPLES

HYBRID WALLS

DEEP EXCAVATION

ROAD WIDENING

GABION SUPPORT

SHEET PILE SUPPORT / STRENGTHENING
Plati-Drain® is a unique patented solution that reduces pore water pressure within clay slopes and behind retaining walls. Unlike conventional weep holes Plati-Drain® provides deep penetration, this can be in excess of 10m / 33’. It can also help prevent shallow or deep seated slope failures.

Available as a ‘Passive’ or ‘Active’ solution. The ‘Passive’ system uses a sacrificial anchor head to drive the Plati-Drain® into its optimum position providing an immediate channel for water to drain. The ‘Active’ system has an additional wire tendon attached to the anchor which allows it to be loadlocked, providing simultaneous draining and restraining capability.
PROJECT EXAMPLES

DEEP SLOPE PENETRATION

PASSIVE PLATI-DRAINS

INCREASE SLIP PLANE FRICTION

EMERGENCY REPAIRS

ACTIVE DRAINING & RESTRAINING
The Platipus® ARGS has been used successfully throughout the world in post cyclone flood defence reconstruction work. Applications include securing high strength turf reinforcement matting within the flood bank, wave and overtopping zone. This prevents erosion due to wave attack and scour due to flow velocities of up to 5.5m/s on the back face. Turf reinforcement treatment can allow design overtopping depths of up to 0.7m for more than 8 hours, removing the need to add height to flood banks which may often be subject to bearing capacity failure and continual settlement.

In addition to our standard ARGS, bespoke anchoring solutions for interlocking concrete revetment mats allow high velocities to be accommodated without uplift, ideal in spillway and wave attack situations.

Benefits of the Platipus® ARGS System:–

- Provides immediate protection against wave erosion and overtopping
- Offers significant cost savings compared to alternative engineering solutions
- Extremely effective in situations where access is difficult
- Quick & easy to install, in most cases, requiring only hand-held equipment.
- Minimal impact on the environment
Case Study

US HIGHWAY 98, MOBILE ALABAMA

Client: ALDOT
Consultant: TTL Inc. Geotechnical Engineers
Main Contractor: Bridge Creek Construction

PROJECT SPECIFICATION
The Alabama Dept. of Transportation’s Geotechnical Engineering units tasked TTL Inc to perform a temporary shallow plane failure repair while engineering a permanent embankment stability solution. This site was suffering from shallow plane failures, rill erosion, regressive failures and tension cracks. Through solid engineering practices and on site preliminary anchor testing provided by Platipus it was determined that TTL could provide a solution the would solve the immediate concerns as well as providing the long term 50 year design with the use of Platipus anchors and a permanent surface protection material.

SOLUTION
The slope was re-graded and 7000 Platipus Anchors / Plati-Drains were installed by Bridge Creek Construction, a certified Platipus installer, to a depth of 20’ with a working load of 4,000 lbs and a proof load of 6,000 lbs. The surface of the slope was then covered with a permanent UV stabilized geogrid and re-vegetated. The Anchored Reinforced Grid Solution provided the opportunity for the Engineer to model the failure and determine the necessary anchor capacity and spacing. In process load testing verified the design through the entire process. The site was then able to be vegetated and put back to an aesthetically pleasing environmentally sound state.
Case Study

FEDERAL BUREAU OF PRISONS, WILLIAMSBURG, SC

Client: Federal Bureau of Prisons  
Consultant: ECS  
Main Contractor: Hensel Phelps

PROJECT SPECIFICATION

This shooting range back stop was constructed with a 25’ vertical height on a 1:1 slope. The embankment was stabilized in 1’ lifts using GeoGrid. With the onset of a wet summer, the saturated embankment encountered a 1’ shallow plane failure. The contractor, Hensel Phelps, could not line a firing range with a standard rip rap solution so the Platipus® Anchored Reinforced Grid Solution (ARGS) was chosen to stabilize the embankment.

SOLUTION

Geotechnical firm ECS of Greenville, South Carolina was introduced to Platipus® ARGS. As the pull out resistance of the anchor could be field tested to meet the stabilization requirements, the Engineers felt comfortable incorporating it into their design. Using Platipus® S4 ARGS Percussive Driven Earth Anchors (PDEAs) driven through High Performance Turf Reinforcement Matting (HPTRM) to 2½’ beyond the failure plane, the embankment was stabilized and the surface was protected against erosion.

This low impact solution allowed the contractor to use lightweight hand held equipment to install the system. It also eliminated the need for heavy equipment that would have been required to rebuild the berm.
The Alta Vista pipeline is over 100 years old. It is the main water source for the City of Montara, located 10 miles north of Half Moon Bay, on the Pacific coast. This Pristine Coastal Area falls under the jurisdiction of the Coastal Commission, Water Board and the California Department of Fish and Game. The pipeline sits on a steep slope which rises 30’ and has a history of instability and ground movement. Due to its age, the pipeline was falling apart and needed to be replaced. Initial proposals to replace the pipeline also included the construction of two geosynthetic reinforced walls for repairing the slope. These walls were rejected by the authorities due to the requirement of heavy installation equipment, environmental disturbance and potential impact on the local wildlife.

**SOLUTION**

Kleinfelder Inc., Biological Consultant, and Olivia Chen, Civil Engineering Consultant, re-designed the slope repair using The Platipus® Anchored Reinforced Grid Solution (ARGS) because it was low impact, required only hand held equipment for installation and provided an instantly attractive finish to the slope. It also meant that permits, that had proved so difficult to obtain from the authorities, were no longer required. The S6 ARGS Percussive Driven Earth Anchors (PDEAs) were driven through High Performance Turf Reinforcement Matting (HPTRM), on a checkerboard grid pattern, stabilizing the slope and preventing the risk of future erosion. The contractor, Granite Construction of Watsonville, CA, was particularly impressed with the speed and simplicity of the Platipus® ARGS completing the entire installation in just two days.
Case Study

HIGHWAY 26 IN CALAVERAS COUNTY, CA

Client: Caltrans  
Main Contractor: Thunder Mountain Enterprises

PROJECT SPECIFICATION
During the heavy rainy season of 2004/2005 a 1:1 cut slope along Highway 26 in Calaveras County, California became saturated creating a shallow slope failure. Caltrans District 10 Maintenance, the department responsible for the repair, considered two possible solutions: Platipus® Anchored Reinforced Grid Solution (ARGS) and Rock Slope protection.

SOLUTION
The Platipus® ARGS was specified because it was low impact, required only hand-held equipment for installation and provided an instantly attractive finish to the slope. It also meant that there was no need to purchase additional right-of-way or close the lane of the highway making it the most cost effective option. The design included Platipus® S4 ARGS Percussive Driven Earth Anchors (PDEAs) driven through High Performance Turf Reinforcement Matting (HPTRM), on a checkerboard grid pattern, at 5' centers. Thunder Mountain Enterprises, Inc. of Sacramento completed the installation in July of 2005. By early September 2005 vegetation was starting to emerge. Platipus® ARGS with the Geogrid trapped the morning dew providing moisture for the seed germination. Caltrans were particularly impressed by speed and simplicity of the construction eliminating the need for heavy equipment that would have been necessary to install the Rock Slope protection.
This steep slope located alongside the River Eden has a history of instability and ground movement dating as far back as 1990. Further ground movement was observed in a previously untreated section of the slope approximately 50m wide. This led to loss of vegetation, an increase in shallow failures and accelerated weathering. Soil nailing was discarded as washout water and grout could not be allowed to contaminate the river, a Class 1 Special Area of Conservation, so an alternative solution was required.

SOLUTION
Alongside managed planting, two unique Platipus solutions were specified using a total of 274 anchors. The Platipus Anchored Reinforced Grid Solution (ARGS) system combines two proven technologies, mechanical anchors and reinforced geogrid and was used to stabilize the slope and prevent further ground movement. 86 ‘Active’ Plati-Drains® were also incorporated into the design to provide simultaneous restraining and draining of the slope, reducing pore water pressure, soil lubrication and weathering. Future planting and an annual winter inspection is now all that is required to maintain this environmentally friendly scheme.
The US Army Corps of Engineers needed to stabilize an access road on to Santa Rosa Island. During tropical storms and hurricanes the road would overtop and eventually washout. The original solution was to drive steel sheet piling on each side of the road. In areas where the sheets were not parallel a concrete deadman was to be installed as a tie-back for the sheet piling.

**Case Study**

**EGLIN AIR FORCE BASE, SANTA ROSA ISLAND, FL**

**Client:** US Army Corp of Engineers  
**Consultant:** CTT Engineering, Wilmington, NC  
**Main Contractor:** CW Roberts Contracting

**PROJECT SPECIFICATION**

The US Army Corp of Engineers needed to stabilize an access road on to Santa Rosa Island. During tropical storms and hurricanes the road would overtop and eventually washout. The original solution was to drive steel sheet piling on each side of the road. In areas where the sheets were not parallel a concrete deadman was to be installed as a tie-back for the sheet piling.

**SOLUTION**

1250 Platipus Anchors were installed to a depth 25’ by Bridge Creek Construction, a certified Platipus Installer as an alternative to the tie-backs. Each anchor was loaded and certified to 40,000 lbs.
INSTALLATION TOOLS

Over many years we have developed a wide range of bespoke equipment to provide Contractors with well engineered, high quality, durable and practical installation tools designed for sustained use.

Light Installation

Our range of stealth anchors up to the S6 can be installed using simple hand tools. The S2, S4 and S6 variants need only a Drive Rod, Plati-Hook (PH1) and optionally Rod Removers (RR1). The anchors can be installed using a sledgehammer or postrammer which can be sourced locally. In multiple anchor installations electric, light air or hydraulic hammers make higher production rates fast and easy.

Medium Installation

The installation of the S8, S10 and B4 anchors typically require larger installation tools. Manual or Hydraulic Stressing equipment and Rod Removers are useful accessories.

The Manual Stressing Jack will provide up to 15kN uplift to loadlock and proof test the anchors. For multiple installations the use of hand or powered Hydraulic Stressing equipment is advised.

Heavy Installation

The B6, B8 and B10 Bat anchors will normally be used in either Deep Seated Failures or Cut Face Slopes. Installation equipment will be varied from portable Hydraulic to Machine Mounted Hammers, Drive Rods, Rod Removers and Hydraulic Stressing equipment. In all cases let us advise you of our recommendations for equipment choice based upon your project’s criteria.
S4 & S6 Anchored Reinforced Grid Solutions (ARGS)

The S4 / S6 ARGS is a combination of components put together to provide a flexible engineered solution for stabilizing Shallow Slide Failure embankments. The HPTRM will protect the slope face from erosion as well as spread the load of the drive anchors across the slope face. The anchors must be driven and loadlocked in place beyond the failure plane at an engineered depth and spacing to provide a secured embankment. Once installed the system can be easily vegetated.

1. Using the Platipus® Hand Drive Rod (HDRS4ED/HDRS6) or Power Drive Rod (PDRS4ED/PDRS6) drive the anchor system into the ground to the required installation depth.

2. Remove the Hand Drive Rod or Power Drive Rod from the body of the anchor by hand.

3. Using the Platipus® Plati-Hook (PH1) loadlock the anchor into its full working position by applying a load to the wire tendon.

4. Place your foot on the plastic plate and conical wedge grip assembly pushing it down firmly. Using the Platipus Plati-Klein (PHK) loadlock the anchor into its full working position by applying a load to the wire tendon. When using the Stressing Jack (SJ1) ensure that the plastic plate and conical wedge grip assembly is secure against the HPTRM, using the bobbin, before releasing the load from the Stressing Jack.

5. Cut off excess tendon at the ferrule and discard accordingly.

6. The HPTRM should be visibly tight between one anchor and the next. As a test, the material between them should not be easily lifted maintaining intimate contact between the HPTRM and the soil below. If this does not occur install an additional anchor.

S2 Anchored Reinforced Grid Solutions (ARGS)

The S2 ARGS is typically used for Surface Erosion and is usually spaced at 1 anchor per sq. m / yd. Field adjustments can be made according to site conditions and anchor holding capacity. If the grade is smooth and raked free of rocks and debris, the anchor spacing may be increased slightly. Maximum holding capacity of the system is 250kg / 500 lbs.

1. Using the Platipus® Hand Drive Rod (HDRS2) or Power Drive Rod (PDRS2) drive the anchor system into the ground to the required installation depth.

2. Remove the Hand Drive Rod or Power Drive Rod from the body of the anchor by hand.

3. Secure the plastic plate and conical wedge grip assembly tight against the HPTRM. Slide the bobbin over the wire tendon.

4. Cut off excess tendon at the ferrule and discard accordingly.

The HPTRM should be visibly tight between one anchor and the next. As a test, the material between them should not be easily lifted maintaining intimate contact between the HPTRM and the soil below. If this does not occur install an additional anchor.

INSTALLATION INSTRUCTIONS
1. What is the soil type / conditions where the anchor will reside?
2. What is the vertical height of the embankment?
3. What is the slope angle?
4. How deep is the failure plane?
5. Is there pore water pressure within the embankment?
6. Using a standard geotechnical embankment stabilization program, how much load needs to be applied to the surface to stabilize the slope?
7. What is the factor of safety (usually between 1.2 to 1.5)?
8. What is the design life?
Platipus’ anchor technology is protected by many international patents.