



 **PLATIPUS**
EARTH ANCHORING SYSTEMS

ARGS®

Anchored Reinforced Grid Solutions

Brochure

INTRODUCTION TO ARG[®]S

Anchored Reinforced Grid Solutions

Stabilizing slopes offers many significant challenges. Platipus[®] combine Percussion Driven Earth Anchors (PDEA[®]) with a suitable surface or facing material to make an Anchored Reinforced Grid Solution (ARG[®]S). The ARG[®]S System is ideal for stabilizing slopes where over steepening, excess water, poor drainage or lack of deep rooted vegetation have caused erosion or instability.

The ARG[®]S System offers many advantages over traditional solutions:

- Simple and cost effective
- Fast and easy installation
- Immediately quantifiable anchor loads
- Low environmental impact
- Encourages re-vegetation
- Can be used with most surface or facing materials
- Incorporating Plati-Drain[®] can reduce pore water pressure



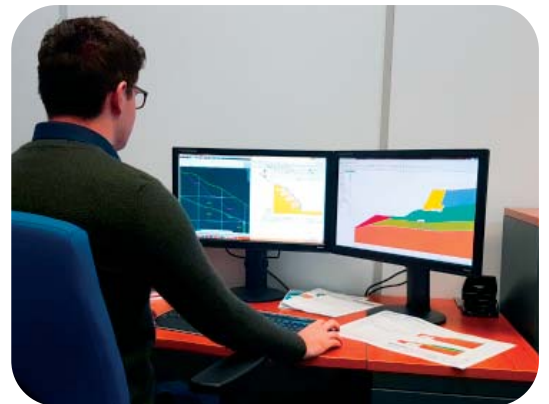
DESIGN LIFE

Platipus ARG[®]S Systems are designed to match or exceed the life and performance of the surface or facing material with which they are integrated to provide both superior corrosion resistance and performance throughout the specified life of the project.



TECHNICAL GUIDANCE & SUPPORT

With over 40 years' experience and thousands of successful projects worldwide we offer pre-contract site evaluation and anchor testing together with on-site training and support. In addition, we are able to provide real time technical guidance at all stages of the design and installation process allowing for greater engineering confidence. As part of our commitment to offer a complete package, a non-chargeable System Proposal outlining possible anchoring solutions/specifications, suitable for your project, can be provided complying to relevant standards. We understand that each project is unique and suggest that the design of every slope is approved by a qualified engineer. To assist we are also able to offer a full Indemnified Design service through our geotechnical consulting team. These comprehensive designs, which are chargeable, are covered by Professional Indemnity Insurance.



'SIMPLY' HOW A MECHANICAL ANCHOR WORKS

There are three steps to the installation of an anchor system:

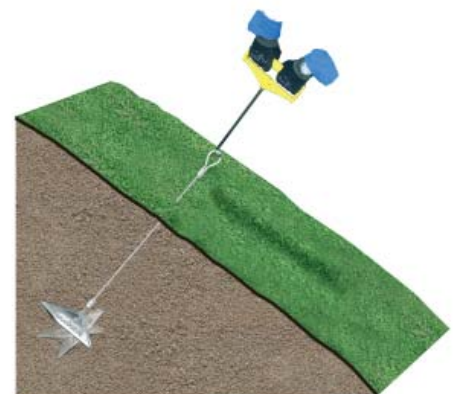
1. DRIVE THE ANCHOR



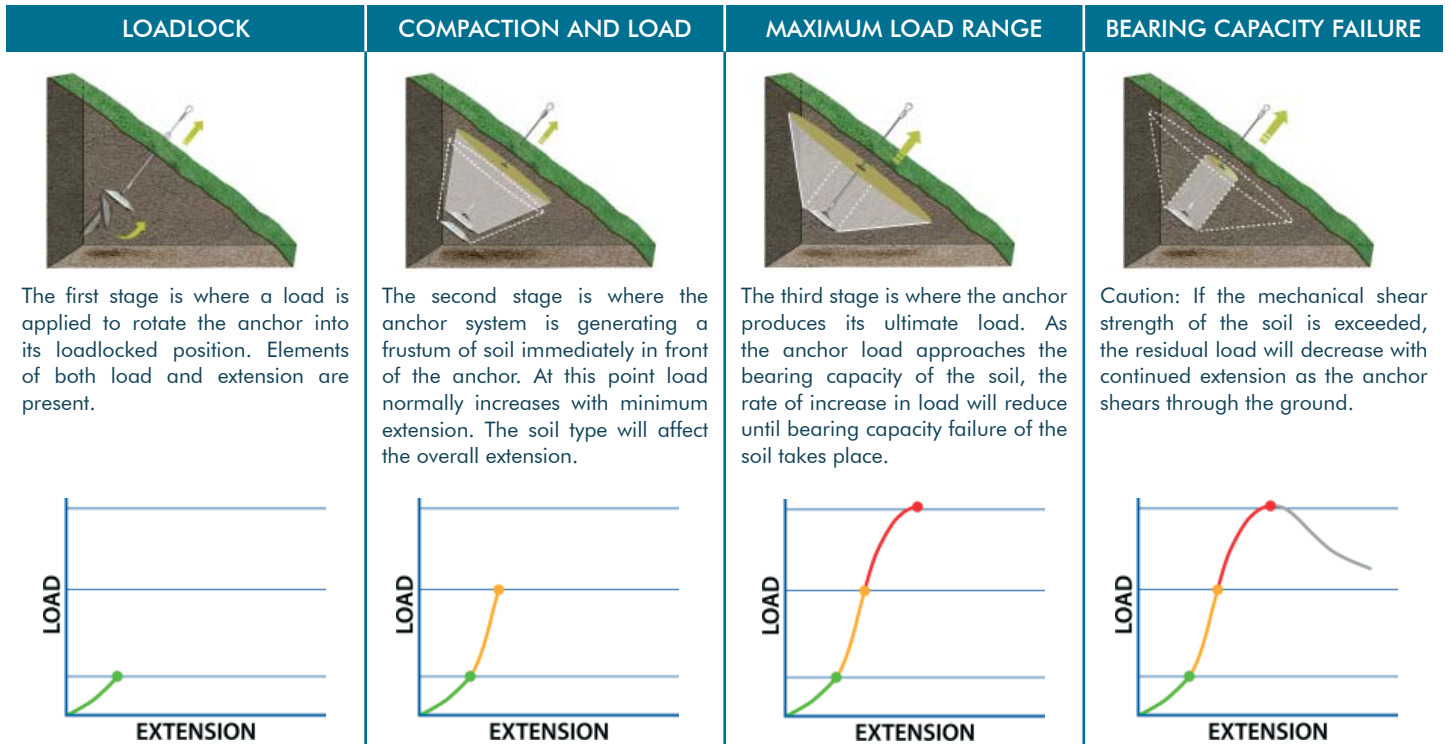
2. REMOVE THE DRIVE ROD



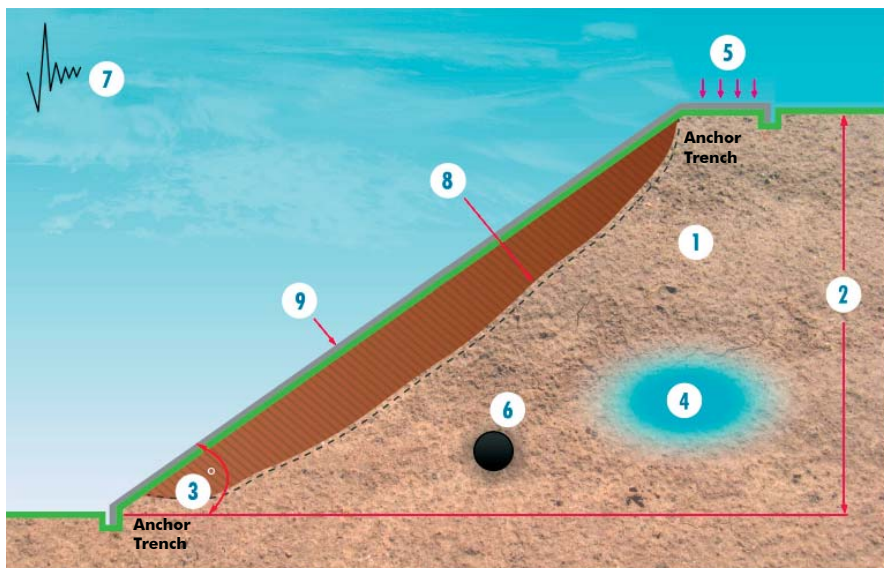
3. LOADLOCK THE ANCHOR



TYPICAL ANCHOR BEHAVIOUR



DESIGN CONSIDERATIONS



- 1 What is the soil type / conditions where the anchor will reside?
- 2 What is the vertical height of the slope?
- 3 What is the slope angle?
- 4 Is the slope affected by pore water pressures or does it have an elevated water table?
- 5 Is there a surcharge affecting the slope?
- 6 Are there any buried services which may obstruct the anchor?
- 7 Is the site within a seismically sensitive area?
- 8 How deep is the critical failure plane and has movement already occurred within the slope?
- 9 What facing material is locally available?
- 10 What is the desired factor of safety for the slope (usually between 1.2 to 1.5)?
- 11 What is the design life?

ARGS® - EROSION CONTROL

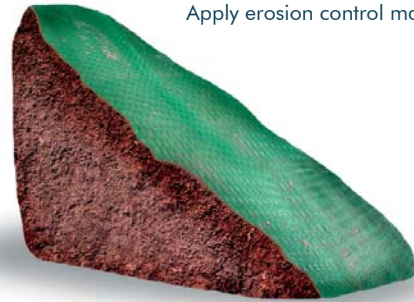
1

Remove rocks / debris and re-profile the slope



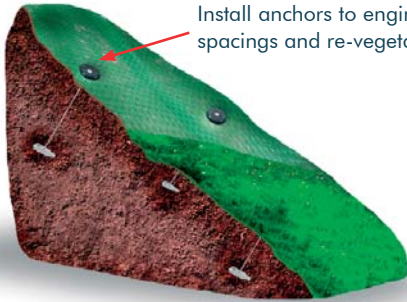
2

Apply erosion control matting



3

Install anchors to engineered depth / spacings and re-vegetate



4



PLATIPUS® S2 ZIP ANCHOR

The S2 Zip Anchor is a reliable low cost solution. It can be installed, in a wide range of soils, using simple hand tools. The system's unique design incorporates Platipus T-Loc technology with a simple 'cable tie style' strap to receive an adjustable self-locking load plate. It's quick to use and offers a much more reliable alternative to traditional pins which can easily pull out.

Surface Materials

- Turf Reinforcement Matting
- Landfill Rain Covers
- Waste Containment
- High Density Polyethylene Liners
- Grass Pavers and Concrete Filled Cloth

S2 ZIP

Strap



Load Plate



S2P Anchor

PLATIPUS® S2 GEO / S2 ARGS®

The Platipus® S2 GEO / S2 ARGS® System comes in a variety of configurations. See individual project details for specifications.

Surface Materials

- | | | |
|---|------------------|----------------------------------|
| • High Performance Turf Reinforcement Matting | • Geotextiles | • Turf Pavers |
| | • HDPE Coverings | • Lightweight Concrete Flexcrete |



S2GEO



S2ARGS

PROJECT EXAMPLES

Erosion Control

SURFACE EROSION



FLOOD PREVENTION



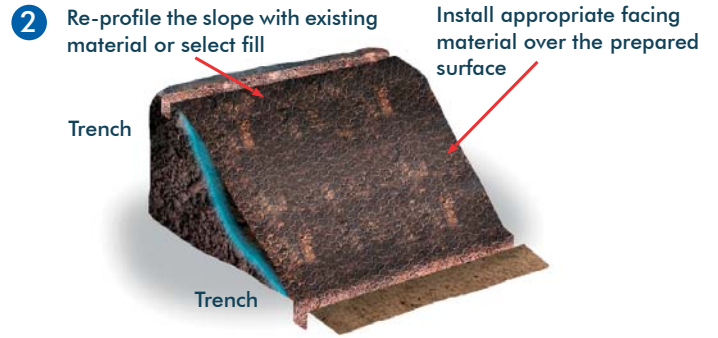
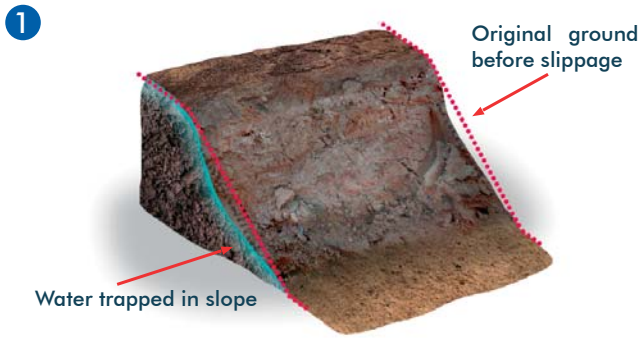
OVERFLOW RETENTION POND



STORM WATER PROTECTION



ARGS® - SHALLOW SLIDE PROTECTION



PLATIPUS® S4 & S6 ARGS®

The Platipus® S4 & S6 ARGS® System assembly comes in a variety of configurations. See individual project details for specifications.

Surface Materials

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



PROJECT EXAMPLES

Shallow Slide Protection

SLIDES



SLOPE REMEDIATION



LANDFILL CAPPING

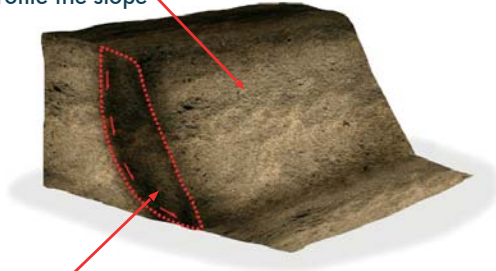


LEVEE PROTECTION & OVERTOPPING



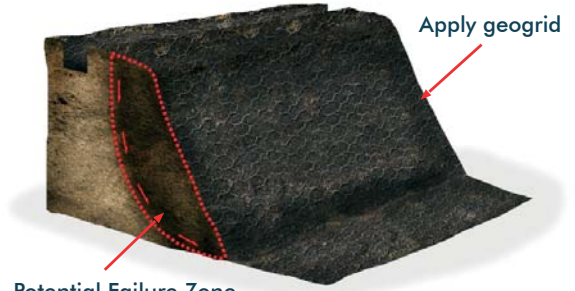
ARGS® - DEEP SEATED FAILURES

- 1 Remove debris, rocks and re-profile the slope



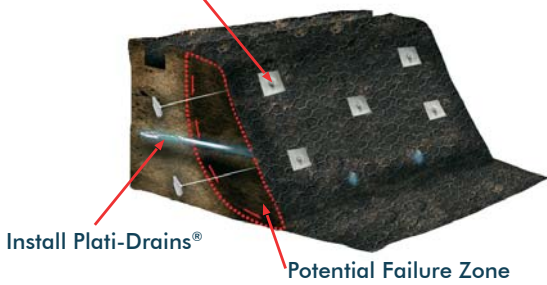
Potential Failure Zone

- 2



Potential Failure Zone

- 3 Install anchors as per specification and re-vegetate



Install Plati-Drains®

Potential Failure Zone

- 4



PLATIPUS® STEALTH & BAT ANCHOR SOLUTIONS

Deep seated failures can be supported using larger Stealth and Bat anchors along with a solid geotechnical engineered design. In conjunction with our online Anchor Load Indicator 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.

Surface Materials

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



PROJECT EXAMPLES

Deep Seated Failures

TEMPORARY STABILISATION



PERMANENT SLOPE REINFORCEMENT



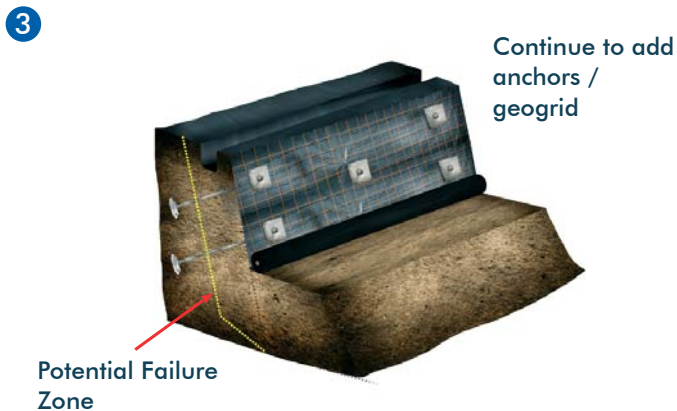
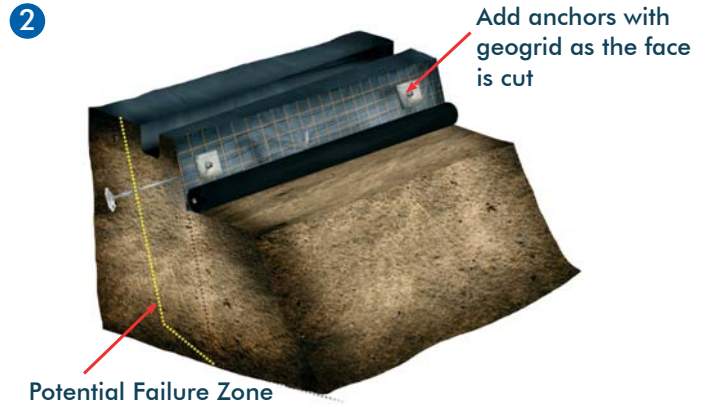
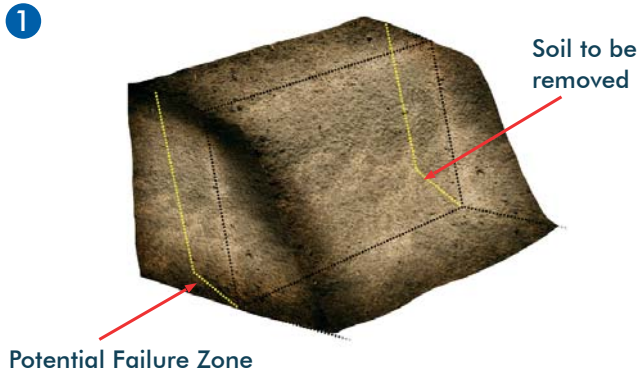
PERMANENT SLOPE REMEDIATION



DIFFICULT ACCESS



ARGS® - CUT FACE SLOPES



PLATIPUS® STEALTH & BAT ANCHOR 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 Load Indicator 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

Cut Face Slopes

HYBRID WALLS



TEMPORARY WORKS



DEEP EXCAVATION



GABION SUPPORT



DRAINAGE SOLUTIONS

1



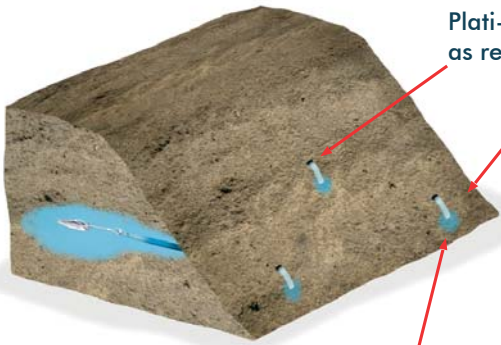
Water trapped in slope

2



Drive Plati-Drain® into optimum position

3



Install further Plati-Drains® as required

Drainage from Plati-Drain®

4



PLATI-DRAIN®

Water saturation, due to heavy rainfall and insufficient drainage, leads to the softening of clay soils within slopes and increases hydraulic forces behind earth retaining structures.

Plati-Drain® is a unique patented solution that reduces pore water pressure within clay slopes. It can provide deep penetration in excess of 10m / 33' and can also 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

Drainage Solutions

DEEP SLOPE PENETRATION



EMERGENCY DRAINAGE



INCREASE SLOPE STABILITY



PASSIVE PLATI-DRAINS



CASE STUDY

Mariscal Sucre International Airport Access, Quito - Ecuador



Project Specification

Steep cuts along the newly constructed access road to the airport required surface protection against deep erosion and shallow surface sliding. Traditional shotcrete methods were used on much of the easy access areas. The extremely high slopes posed difficulties for traditional methods so Platipus introduced the Anchor Reinforced Grid Solution (ARGS®) to protect the surface. The solution was employed and recently withstood a 5.1 earthquake on August 12th 2014 while other unprotected areas experienced some failures.

Solution

The cut slopes were first protected with 2 layers of erosion control materials. The first provided the erosion protection and kept the surface soil from sliding down the slope. The top layer provided the strength to handle the load generated by the Percussion Driven Earth Anchor (PDEA®) as well as UV protection.



CASE STUDY

M4 Motorway Widening, Sydney - Australia

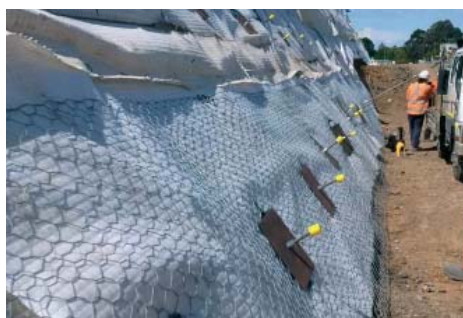


Project Specification

An 11m high steep slope supporting the M4 Motorway required stabilizing as part of the WestConnex infrastructure project which aims to reduce the journey time between Sydney Airport and Parramatta. 7.5km of the M4 Motorway is being expanded to 4 lanes and a temporary works embankment was used to enable the construction of a permanent concrete panelled wall.

Solution

The Platipus Percussive Driven Earth Anchor (PDEA®) stabilized the temporary embankment using B6 and B8 anchors driven to 8m. Cirtex Australia provided both design and installation support. The Platipus anchors were installed using locally available equipment and were loadlocked and set with immediately quantifiable loads offering significant cost savings to the contractor and client over alternative methods.



CASE STUDY

US Highway 98, Mobile Alabama - USA

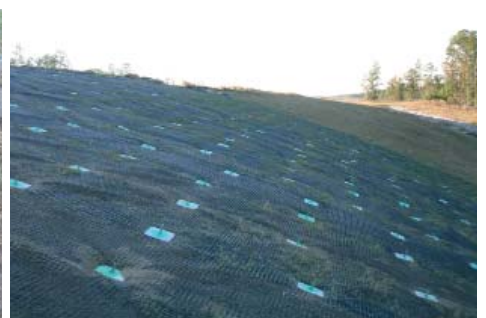


Project Specification

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 that 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 Platipus Anchors / Plati-Drains[®] were installed by Bridge Creek Construction, a certified Platipus installer, to a depth of 20' (6m) with a working load of 4,000 lbs (18kN) and a proof load of 6,000 lbs (27kN). The surface of the slope was then covered with a permanent UV stabilized geogrid and re-vegetated. The Anchored Reinforced Grid Solution (ARGS[®]) 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

Savièse Slope Stabilisation - Switzerland



Project Specification

Soon after this 14m high slope had been excavated for a new building, a section of the slope failed due to unforeseen ground conditions leading to the immediate closure of the site. Before construction could continue an urgent solution was required to permanently secure the entire slope. Platipus Percussion Driven Earth Anchors (PDEA®) were proposed through their partner, Anteq SA, and were selected due to a number of key factors: suitable granular material, easy installation in extremely limited space & immediate availability of products.

Solution

This 500m² slope was safely secured in two main anchoring stages: Firstly the lower half, which consisted of 4 rows of B4 anchors driven to a depth of 9m, installed using a 'spider' excavator and proof tested to 90kN each. Secondly the top half, where 5 rows of the smaller S6 anchor were installed using a handheld pneumatic hammer from a mobile platform to a depth of 4m, each proof tested to 30kN. The 55° re-profiled slope was completed using a Maccaferri geomat providing a secure and smart finish to the project.



CASE STUDY

A1 Autostrada, Majiejow, Piekary - Poland

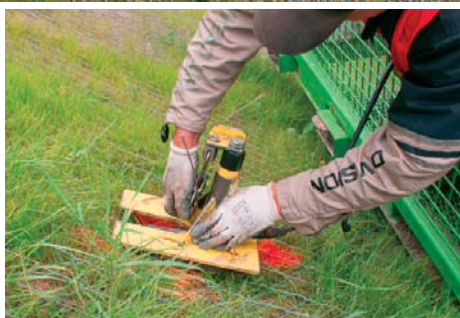


Project Specification

The A1 Autostrada is a north-south motorway that runs 568km through central Poland from Gdansk, on the Baltic Sea, through Łódź, to the Polish border in Gorzyczki where it connects to the Czech D1 motorway. As part of an upgrade a new section of motorway was constructed between Piekary and Maciejów which required an anchoring solution to secure all of the facing materials to three large new slopes.

Solution

Early site testing revealed that the compacted granular fill was ideal for the Platipus mechanical anchor confirming that the small S6 anchor would easily achieve the 10kN ultimate load required by the Designer. Once construction of the motorway section was complete, soil was imported to create a new slope profile. A hydroseed mix was then sprayed over the freshly imported soil and a combination of coir mat and Geobriigg Tecco Mesh was secured tightly in place, by the Platipus S6 ARG^S anchor system, to encourage immediate vegetation of the slope. Due to the height and gradient of the slope a hydraulic work platform was used to allow quick installation of the anchor system; using simple hand held equipment. On average a total of 130 anchor systems were installed each day which was much more than initially expected.





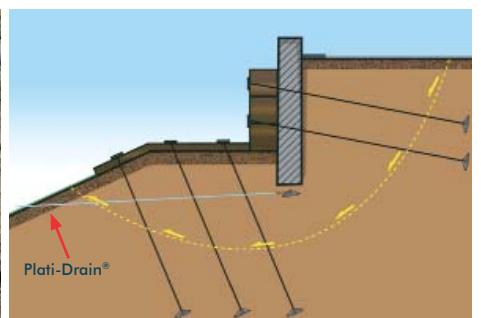
Project Specification

A landslip along a 100m stretch of the A57 Manchester Road just outside Sheffield resulted in a partial road closure whilst remedial solutions were considered.

Solution

Platipus Anchors were approached by Amey Consulting to work with them developing an anchored solution for remediation of what the Engineer deemed to be a deep seated failure. Starting with a simple conceptual cross-sectional sketch and a Ground Investigation report, Platipus carried out extensive site testing to prove the performance and 'drivability' of a range of anchor systems.

Amey were responsible for the global design while Platipus Geotechnical Engineers designed and indemnified the Anchor specification to meet the Engineer's requirements. A row of Plati-Drains® were introduced towards the toe of the slope to reduce pore water pressure.



CASE STUDY

BGC Greenway Park Slope Protection, Manila - Philippines

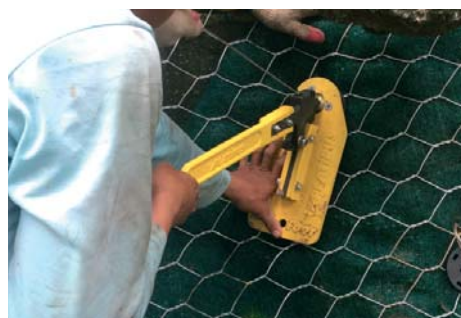
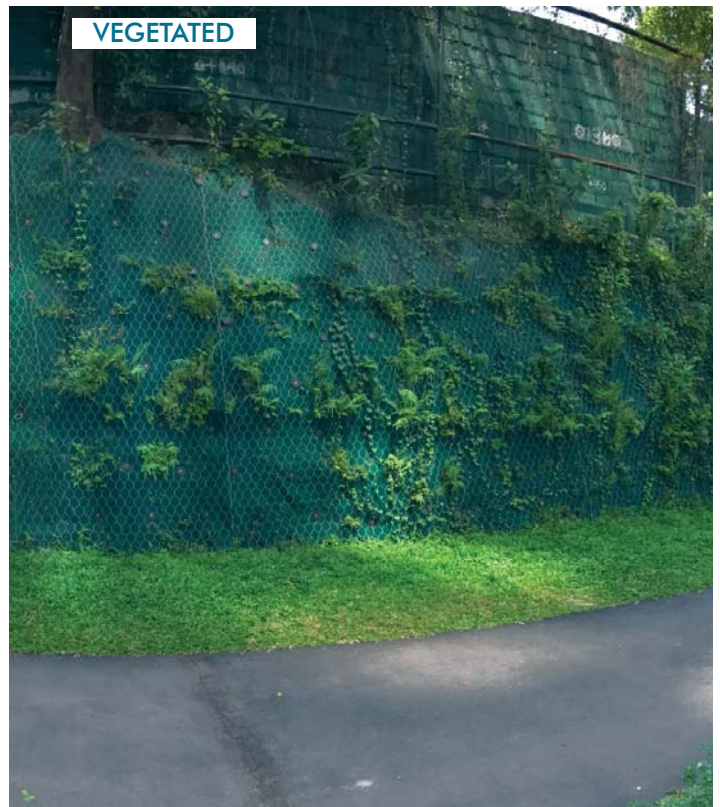


Project Specification

This 90m long slope, cut to 70 degrees, ran adjacent to a new jogging track and needed protection against surface erosion particularly from storm water run-off and to support the concrete hollow block wall above. Site access for any plant machinery was very restricted and the client wanted the slope to be re-vegetated ruling out traditional sprayed concrete methods. The slope consisted of soft soil at the top, weathered granular material with the lower section made up entirely of weathered adobe rock. A 60 year design life was specified.

Solution

Following site testing by FW Nicol Philippines Inc., the Platipus Anchored Reinforced Grid Solution (ARGS®) was specified using S2 aluminium anchors on 1m long stainless steel tendons securing Tensar P300 and triple twist rock fall netting. The anchors were installed using hand held tools and quickly loadlocked with the SJ5 stressing jack. Installation continued through wet weather conditions and was completed in 9 days with Platipus Anchors Ltd and FW Nicol Philippines Inc. providing on-site installation advice and support to the contractor.



CASE STUDY

Midshore I Landfill - Easton, MD - USA



Project Specification

Maryland Environmental Service (MES) owns and maintains the Midshore Regional Solid Waste System in a region that serves 140,000 residents on the eastern shore of Maryland's Chesapeake Bay. The 175 acre (708,200m²) Midshore I closed in 2010 after operating successfully for 20 years. MES chose to cover the landfill with an Exposed Geomembrane Cover (EGC.) Designed to protect the environment and minimize the need for ongoing maintenance, the EGC also allows for future use of the landfill.

Solution

The EGC design specified an HPDE 60mm geomembrane liner secured with Platipus Percussive Driven Earth Anchors (PDEA[®]) as a cost effective and easily installed alternative to traditional vertical trenching. The Platipus anchor assembly was manufactured with components to meet the holding capacity and 20-year design life required by Geosyntec Consultants/MES in this highly corrosive environment. The anchor was driven through the liner and into 4-5 feet (1.2 – 1.5m) of compacted waste. The pull out resistance was then field tested to meet the engineered wind and LFG uplift requirements of 1,800 lbs (8kN). Once the anchor assembly was fully installed and tested, a HDPE patch was placed over to create an impermeable system.





Project Specification

The Orford Estuary Defence Levee protects the town of Orford and surrounding farmland. It also carries a public footpath along its crest. The defences, which have dried and cracked, have also, during the last sixty years, settled into the soft silts below by more than 0.5m. Following on from its application in Louisiana, for the US Army Corps of Engineers during the post Hurricane Katrina flood defence improvement, the Orford levee provided another opportunity to trial this innovative method to increase flood resistance. The landward slope is particularly important for the resilience of levees. Experience has shown that prolonged over-topping of the crest will initiate a breach in the defence.

Solution

The solution was to apply double twist rockfall netting to the back and crest of the defence, which was folded back on itself and infilled with engineered clay taken from the adjacent farmland to heighten the defence. The landward side of the defence was protected by continuing the double twist rockfall netting towards the toe of the slope and securing it with two horizontally offset rows of Platipus S6 ARGs anchor assemblies. These were installed on 2m horizontal centres and driven to a depth of 1.2m. Combining Platipus anchors with double twist rockfall netting in this way significantly increases the duration of overtopping that can be withstood without damage to the turf. In addition to turf reinforcement, a substantial improvement to the factor of safety against rotational slips has been achieved by the use of the anchors. The whole of the defence was seeded using a native grass mix, which grows through the anchored rock fall netting. Since its successful installation, the system has been used as a model for costing defence strengthening for the remainder of the estuary.



INSTALLATION TOOLS

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

LIGHT INSTALLATION



Our range of stealth anchors up to and including the S6 can be installed using simple hand tools. The S2, S4 and S6 variants need only a Drive Rod, RR1 Rod Removers (optional), Plati-Hook (PH1), Plati-Klein (PHK), SJ5 or Setting Plate / Bobbin.

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 easily achievable.

The Manual Stressing Jack (SJ1) will provide up to 10kN of uplift to loadlock and proof test the anchors.



The Stressing Jack (SJ3) is an extremely compact solution for loadlocking / stressing multiple anchor installations particularly on steep slopes up to 10kN.

MEDIUM / HEAVY INSTALLATION



The installation of the S8 and B4 anchors typically require larger installation tools. Manual or Hydraulic Stressing equipment and Rod Removers are useful accessories. For multiple installations the use of hand or powered Hydraulic Stressing equipment is advised.

The B6, B8 and B10 Bat anchors will normally be used in either Deep Seated Failures or Cut Face Slopes. Installation equipment will vary 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.



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