ACE Geosynthetics

CASE STUDY COLLECTION

Roadway and Railway Construction

Roadway Construction

Slope Rehabilitation, Route 119, Miaoli, Taiwan, ROC

The Background

This project was to rehabilitate a downslope failure for a section of Route 119 in Miaoli County. The engineering properties of the slope were poor, and a torrential rainfall subsequently triggered the landslide. The slope was badly damaged, leading to the loss of partial subgrade. One lane had to be closed, and local traffic was severely impacted.

The Challenges

The site proximity was not accessible for construction and the traffic also must be resumed in a safe and timely manner. Moreover, the managing authority had financial constraints and was unable to provide complete financial support for the rehabilitation project. Therefore, the construction needed to be completed within a tight schedule and limited budget. The construction needed to not only prevent such disaster from happening again, but also provide sound quality to guarantee road safety.

The Solution and Innovation

Since the in-situ gravelly clayey sand could be utilized to cut down construction cost, reinforced earth slope (RES) with ACEGrid® was adopted for this project. It was 10m in height and 34m in length, supporting by a reinforced concrete mat foundation with steel H piles at the toe. The RES was constructed in two tiers with geogrid wrap-around facing setback with an inclined ratio of 1:2(H:V). Stacked soil-filled and hydro-seeded ACEBag™ was used for slope face protection and visual integration with the surrounding environment. For damaged slope below RES, high strength geomat, extending 50m downward was installed and vegetated. It was designed for erosion protection and for scenic improvement at the site. Lastly, intercept trenches and New Jersey guard rails were installed for surface run off drainage and traffic safety.

The Contribution

The project was effectively completed within the limited budget and schedule. In-situ soil was well compacted and wrapped in the structure, contributing to the sound resistance of RES. Vegetation growth to date enhances the performance of erosion control and the natural appearance of the site. ACE products consume low amounts of energy and produce low carbon emissions. They were integrated with local compacted natural soils and finally built together as a completely sustainable structure.

Roadway Construction

Widening and Intersections Improvement, Highway N17, Jempol, Negeri Sembilan, Malaysia

The Background

This project is located in Jempol, Negeri Sembilan in Malaysia. Highway N17 originally had only one lane. To improve the quality and convenience for the regional traffic, County Government called for a highway widening and intersections improvement project for Jalan Dangi, Kepas and Bahau. However, the soft subsurface and the rainy conditions of the proposed site created difficulties for the proposed construction.

The Solution

To solve this problem and help construction operate more smoothly, the contractor first raised the grade to one meter below the design elevation by filling satisfied site material. Then, ACE ground stabilization system was placed to reinforce the weak subgrade. It consisted of a layer of ACETex® and a layer of ACEGrid®. ACETex® was designed for filtration and drainage, and ACEGrid®, a bi-axial high resistance product, was installed for bearing capacity improvement. A 45cm thick compacted fill was then placed and a second layer of ACEGrid® was installed. Geogrids fully interlocked with soil particles created an enhanced composite material with higher performance characteristics. Crushed base course and asphalt concrete surface course was each then placed as those procedures for traditional pavement construction.

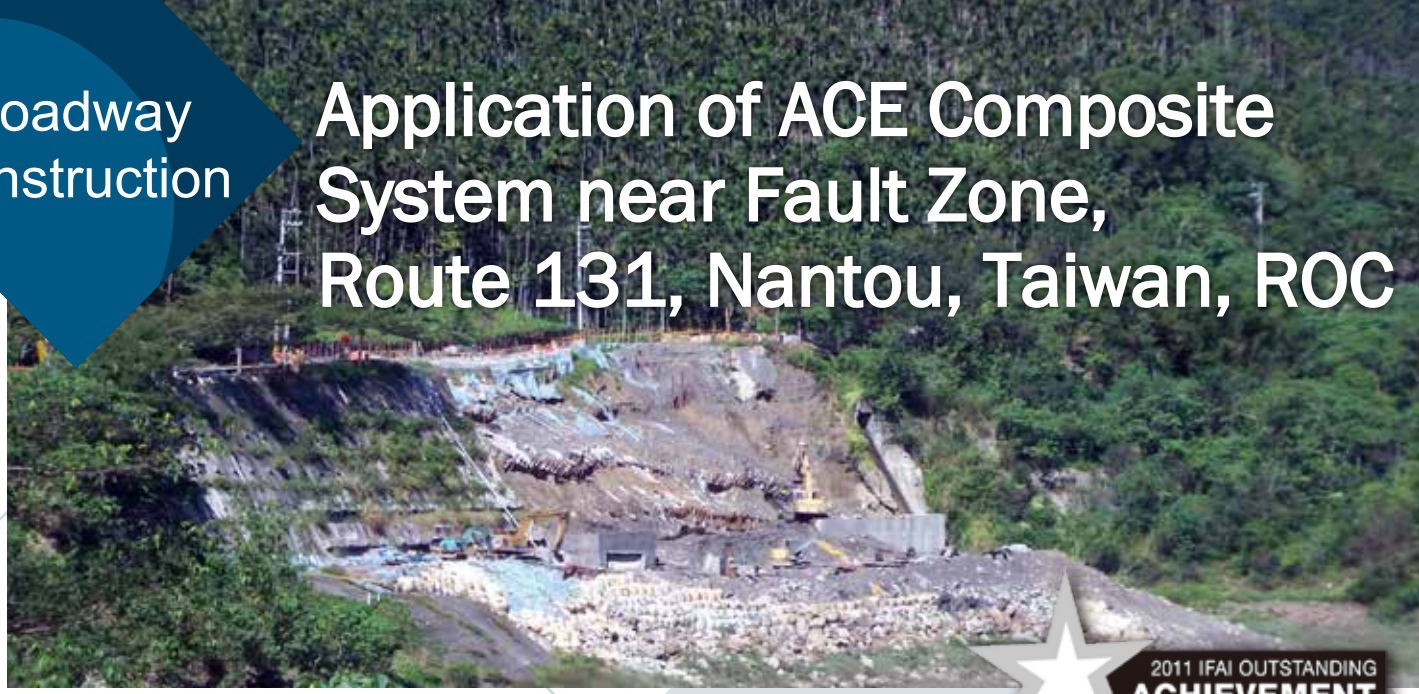
The Contribution

Since the completion of the project, the highway has performed well to date. No instability or settlement has been observed around the site. ACE ground stabilization system provides a simple, fast, and cost effective solution for ground reinforcement.

The system has been demonstrated to completely meet the demands of the site and is worthy of being considered as a model for other similar projects.

Roadway Construction

Application of ACE Composite System near Fault Zone, Route 131, Nantou, Taiwan, ROC



2011 IFAI OUTSTANDING ACHIEVEMENT
International Achievement Awards

The Background

This project is located in Route 131 in Nantou County. Based on the investigations of regional geologic survey, there are several fault zones pass through the site. As a result, the geological conditions are very poor, and the rock formations are fractured and weak. In 2007, a significant landslide up to 80m wide and 30m deep occurred due to a torrential rainstorm. The existing anchored downslope was severely damaged with the main structure being pulled out and exposed after the landslide, forming a massive heave at the toe of the slope.

The Challenges and Solution

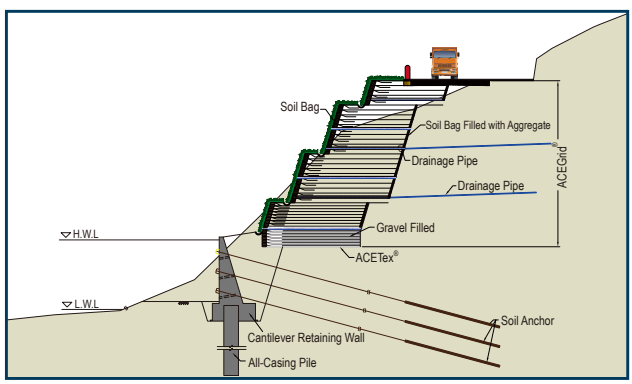
The site is located in the water supply reserve area of Ming-Tan Reservoir. The toe of the slope was vulnerable to scouring due to water level fluctuation in the reservoir. After careful stability analysis, a composite protection system was adopted. To meet all the requirements of the project, the rehabilitation consisted of two stages. In stage I, a pile-supported reinforced concrete (RC) waterfront protection wall was built for the lower slope below the highest water level. Drilled concrete piles (1.5m in diameter, 20m to 30m long, 2.5m in space) were used to support the protection wall (8.5m in height). Ground anchors also were installed to give additional tie-back resistance. The durable RC structure was designed to prevent any possible instability from scouring. In stage II, a wrap-around reinforced earth structure (RES) containing ACEGrid®, ACEBag™, and drainage materials were chosen to restore the slope above the protection wall. The RES was constructed in 4 sequential tiers up to a final height of 17m using geogrids 8 to 10m long. Each tier was setback with an averaged inclined ratio of 0.3:1 (H:V). Stacked soil-filled ACEBag™ was used for slope face protection. It also functioned as the medium of planting as vegetated slope was not only good for an aesthetic appearance but also for an eco-friendly environment. Interior and surface drainage systems were also installed properly for the RES to effectively drain the seepage and run-off.

ACE Eco-Materials

Geogrids (ACEGrid®), Soil Bags (ACEBag™), Geotextiles (ACETex®)
ACE drainage system (Drainage Board, Drainage Pipe, Drainage Ditch)

The Contribution

The reinforced earth structure with ACE products provides a simple, fast, and cost effective solution. It can be constructed without topographic constraint and using common equipment with lesser skilled laborers. The RES here also was built using local collapsed rubbles and thus greatly reduced the amounts of waste dumps. Because ACE system has shown a sound performance, the deformation rate observed at the site declined from 0.03mm/month to 0.007mm/month within the first 6 months. The gathered information of instrumentation clearly indicated that the sliding has been successfully controlled. Based on the site conditions, ACE solution, a custom made system for this project, has proved to be beneficial for this type of slope rehabilitation and is worthy of being considered for other similar conditions.



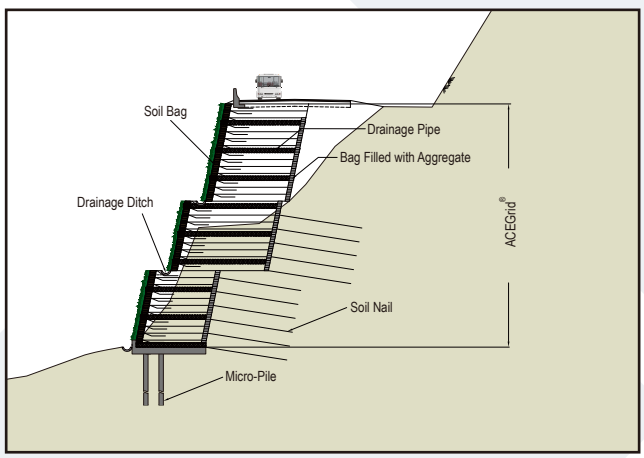
Roadway Construction

Slope Rehabilitation, Route 35, Pingtung, Taiwan, ROC

2009 IFAI Award of Excellence
International Achievement Awards

The Background

From July 7 to August 9, 2006, torrential rainfalls continuously attacked Pingtung; a county contains the oldest and the largest national park at the southernmost part of Taiwan. The accumulated 1,380mm precipitation completely soaked the ground and therefore caused a section of downslope collapsed in Route 35. As a result, the subgrade was damaged badly and the highway had to be closed for safety. Forensic investigation indicated that the sliding was mainly due to the enormous surface overflow out of the drainage gutters along the highway.



Durability and Sustainability

In addition to the engineering issues, sustainability also is a major concern of the County Government. Through the innovative ACE composite protection solution, a safe, economic, and eco-friendly system has been built. The flourish green vegetation on the RES not only has given the site a natural appearance but also has become a favorable place for many local species. It appropriately maintains the traffic safety for the residents and warrants the site to be an eco-friendly environment as well. Since the completion of the project in 2007, the site has remained in good condition through several attacks of strong typhoons, including the deadly Typhoon Morakot in 2009. The successful of the ACE composite system in this project has proved its values for this type of applications to ensure the demands of safety, durability, and sustainability.

The Solution

Considering cost, efficiency, sustainability, and site conditions, the designer introduced a composite protection system for the rehabilitation. Firstly, a reinforced concrete mat foundation with drilled root piles were installed as base support. Then, the designer contracted representatives of ACE and adopted ACEGrid® as the reinforcing material to build a 3-tier reinforced earth slope (RES) to support the highway. Additional soil nails, tied up securely with geogrid, were installed to dowel the deep-seated failure plane to ensure stability. RES was constructed with geogrid wrap-around facing set back with an averaged inclined ratio of 1:2 (H:V). It was built in layers using the collapsed residues on site. Fill materials were placed and geogrid installed at a vertical spacing of 50cm and they were piled up until reaching the final height of 16~18m. Soil-filled and hydro-seeded ACEBag™ was stacked for slope face protection. They also functioned as the medium of planting as a vegetated slope not only provides an aesthetic appearance, but is also an eco-friendly environment. Interior intercept trenches and horizontal drains were also arranged to prompt the dissipation of groundwater. Finally, longitudinal and horizontal trench systems were installed to facilitate the drainage of surface run-off.

Roadway Construction

Slope Rehabilitation, Tai-Route 9 Pingtung, Taiwan, ROC

The Background

Tai-Route 9 is the most important arteries in connecting Pingtung County and Taitung County. It has world-famous natural scenery along the line in southern Taiwan. In August 2013, Typhoon Kongrey hit the island with heavy rainfall and caused numerous infrastructure damages in these areas. The project reported herein located at Sta. 470k+500 of Tai-Route 9 where its downslope was totally collapsed due to the riverbank breach which was smashed by the rushing flooding of the adjacent Fenggang River. The in-situ drainage system also insufficient to accommodate the enormous overflow came from the upper land of the site. The highway was completely disrupted and the rehabilitation was immediately necessary to resume the normal livelihood of residents and minimize the loss of local tourism productions.

The Challenges

The depth of the slope was over 20m and the toe was vulnerable by the attack of the adjacent river. There were tons of rubbles on site because of the collapsed debris and the highway managing authority required the rehabilitation should be a sustainable solution. It must use up these materials as much as possible and also the final completed structure should be durable, aesthetic, and eco-friendly. In addition, the owner also required the construction must be completed within a limited schedule.

The Conventional Solution

To build a staged cast-in-place retaining wall and then backfilled in layers with qualified imported materials to the height of the original pavement. Pile foundations also must be used to support the structure so that it can stand firmly on the steep slope and provide sufficient protection for river scouring. Such design was costly and took longer time to complete. The appearance of concrete structure also was not favorable for the site.

Performance Evaluation

After four months of construction, this project was completed in May 2014. Since then it has been through a number of typhoons attacks and by far still remaining in good condition. Although it has always experienced heavy traffic, no evidence has been observed for deterioration or instability. Vegetated slope presents natural appearance and provides an aesthetic and eco-friendly environment for the site. As many other similar projects already in use, the rehabilitation has been proved successful.

Taiwan is world-famous in its natural scenery but it also has experienced numerous record-breaking natural disasters. For such a beautiful but vulnerable environment, man-made structures should be built as much as possible to satisfy the requirements of durable, aesthetic, sustainable, eco-friendly, and seismic-resistant. The project reported herein proved ACEGrid® RES system to be the novel solution to totally meet the demand of the country.

ACE Innovative Application

To meet all the requirements of the project, the rehabilitation consisted of two pars. In part I, a 150m long, pile-supported reinforced concrete (RC) waterfront protection wall was built for the lower slope below the highest water level. The piles were designed with a diameter of 1.2m and a minimum length of 10m. A total of 155 piles, each spaced 2m, were installed in two rows with all-casing drilling technology and seated into the bedrock for at least 2m. The durable RC structure was used to prevent the instability from river scouring.

In part II, a wrap-around reinforced earth structure (RES) containing ACEGrid®, ACEBag™, and drainage materials were chosen to restore the upper slope. The RES was constructed in two stages using collapsed debris piled on-site. Each stage has a height of about 5m with an averaged inclined ratio of 1:2 (H:V) so that a sufficient width of the highway can be maintained. Considering the safety and the cost, stage I applied stronger ACEGrid® (Type A geogrid) as the reinforcing material for a total area of 1,326m² for the lower part of the RES. Another 995m² of ACEGrid® (Type B geogrid) with lesser strength was used for the upper part of the RES. Each layer of the fill material was installed with a vertical spacing of 50cm.

To prevent the surface overflow washing and softening the RES, a 2m X 2m approximately, drainage culvert was installed below pavement to collect all the possible surface run-off and discharged it directly to the river.

Stacked soil-filled ACEBag™ was used for slope face protection. It also functioned as the medium of planting as vegetated slope was not only good for an aesthetic appearance but also for an eco-friendly environment.

Soft Soil Stabilization

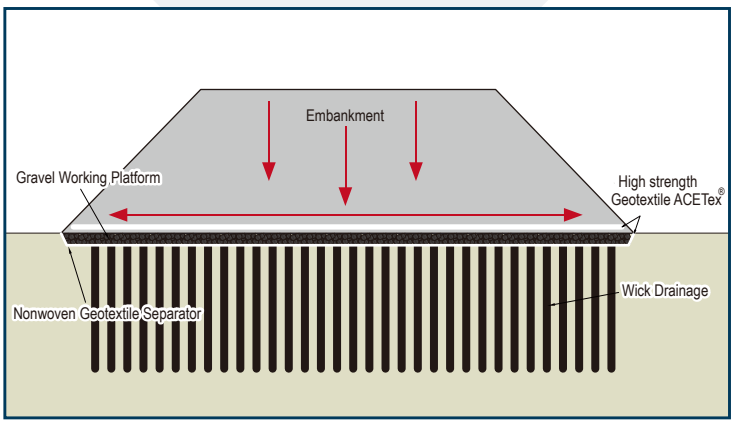
Ground Improvement, Queensland Motorways Gateway Upgrade Project, Brisbane, Queensland, Australia

The Scope

Managing authority of Queensland Motorways proposed to upgrade the existing Gateway Bridge River Crossing. The project included the duplication of the existing Gateway Bridge and the upgrade of 24km of the Gateway Motorway from Miles Platting Road to Nudgee Road. There were virtually three projects in one: the Gateway Bridge duplication; a 16km motorway upgrade (south) and a new 7km motorway deviation (north). However, many of the constructions sat on the flood plain area of the Brisbane River which underlain mostly by soft and saturated fluvial deposits. Low bearing capacity and excessive settlement were highly likely to occur and consequently jeopardize the stability and safety of the constructed facilities.

The Solution and Innovation

To minimize the risks caused by the soft soils, ground improvement was extremely necessary. The designer adopted prefabricated vertical drains (PVD) to accelerate the dissipation of excess pore water in soft deposit and therefore to cause an increase in shear strength and a decrease in compressibility. The contractor first placed a layer of ACETex® drainage blanket and a layer of gravelly platform on the surface of the ground. ACETex® provided functions of separation, filtration, and drainage so that the induced pore water could be easily dissipated without losing of fine particles. Then, PVDs were installed in square patterns (spaced 1.5m center to center) to cover all the treatment areas. As a result of this method of accelerating the consolidation process, bearing failure and excessive settlement can be virtually eliminated.



The Contribution

ACETex® has a unique structure that enhances its function as a filter fabric. It has both high permeability and the ability to restrict the movement of most soil particles, while allowing the very fine silts to flow into and out of the drain. With the use of ACETex®, the installation and the performance of PVDs have been greatly improved. The period of settlement and consolidation were shortened substantially; the stability and load carrying capacity were improved significantly. ACETex® together with PVDs will be beneficial for embankments constructed on soft ground for roadways, railroad tracks, or runways which must be functional in an extremely tight schedule.

Pavement Reinforcement

Glassfiber Geogrid

— Main Traffic Road in Colombia, South America

The Problem

The main road surface had been damaged due to high axle loads or increased traffic in Colombia, South America. The original pavement carriageway was showing extensive reflective cracking, which is major drawback of asphalt pavements. Commonly a paved road becomes a candidate for maintenance when its surface shows significant cracks and potholes. Reflective cracking in the pavement surface cause numerous problem, such as discomfort for the users, lower safety, added the infiltration water and reduction of bearing capacity. Therefore, the government would like to choose economical and long-term performance way to solve the cracks on the pavement.

The Solution and Contribution

ACEGrid® GA is being increasingly used at asphalt overlay base level to enhance the overall performance. The asphalt reinforcement with ACEGrid® GA has advantage that it can be placed in the asphalt layer to restrict reflective cracks and ease of installation. In this project, after milling of the original pavement, it can be installed directly and overlaying with hot mix asphalt.

After the construction is completed, the performance of reinforced pavement showed very good condition. No reflective cracking and pothole are discovered. On the other hand, the depth of ruts is also decreased and has well serviceability.

ACE Geosynthetics, established in 1996, is a leading geosynthetics manufacturer and solution provider headquartered in Taiwan. We develop, manufacture and supply a wide range of reliable geosynthetic products that are approved and certified by CE, BBA, NTPEP. We also customize products to meet clients' various needs. In our company are more than 40 experts in civil, geotechnical, marine, hydraulic and environmental engineering who provides professional technical service and cost-effective solutions that help clients realize projects with success and efficiency.

What We Offer

Structure design and analysis

Our experienced engineers design and conduct analysis with professional engineering software such as MSEW, ReSSA, Reslope, Stedwin and GeoCoPS, and provide drawings or advice to help clients install materials properly.

Technical Consultation

We work closely with clients and provide advice in every stage throughout the entire process, including selecting optimal products, proposing solutions and giving advice on material installation.

Product customization

We customize products for clients. Many of our products including ACEGrid®, ACETex®, ACETube®, ACEFormer™ and ACEBag™ can be made according to individual specifications to fulfill particular requirements.

Construction Assistance

We offer on-site technical support on request during construction to ensure proper installation of products and structural stability.

Our experience and achievements:

- Reinforced walls and slopes
- Soil stabilization
- Ground stabilization
- Pavement reinforcement
- Erosion control
- Sewage and sludge dewatering
- Shoreline remediation
- River / wetland remediation
- Coastal protection
- Harbor dredging

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