ACE Geosynthetics

CASE STUDY COLLECTION

Safety and Reliability with ACE Solutions

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 provide 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 softwares 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



Earthwork Construction

Roadway and Railway Construction

Marine and Coastal Structures Construction

Riverbank and Channel Protection

Environmental Protection

Earthwork Construction

Slope Stabilization

Slope Erosion Control

Stabilization of Bare Steep Slope, Taiwan

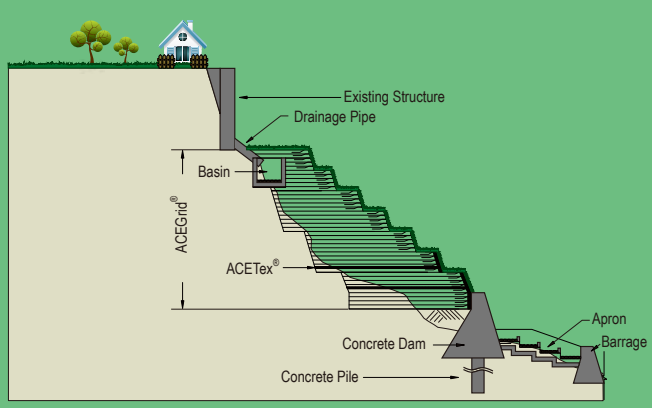
Products: ACEGrid® GG

A devastating earthquake struck the site and caused severe damage to the slope and its drainage system. Large amounts of gushing water coming from heavy rainfall led to surface erosion and slope failure. The collapsed slope was 30 m high and had an over 70° average inclination. The geological formation consists of red clayey silt intermixed with gravel, which is sensitive to its water content variation. The rehabilitation purposes should not only to stabilize the slope and protect it from future seismic damage, but also to prevent surface runoff and groundwater seepage.

Solution

Considering the safety, durability and sustainability factors, reinforced earth slope (RES) composite system was adopted for the rehabilitation. Based on the stability analysis, secant piles and toe berm, a reinforced concrete structural members with higher stiffness, were installed at the toe to provide sufficient base support. Then, 11 tiers of reinforced earth slope (RES), made of ACEGrid® geogrids and in-situ collapsed rubble were placed in sequence up to the crest. The RES was constructed with geogrid wrap-around facing with each tier has 3 m in height and an inclined ratio of 1:2 (H:V). ACEDrain™ S drainage board, pipe, and nonwoven geotextiles (ACETex® NW) were arranged elaborately as the intercept system in RES to prompt seepage dissipation. Longitudinal and horizontal trench systems were also installed to facilitate the drainage of surface runoff. Soil-filled and hydro-seeded sandbags were stacked for slope face protection.

Since installation, the project has visually integrated into the environment through the vegetation growth. The aesthetic appearance, together with a variety of local species observed on site, has demonstrated an eco-friendly capability of the system. In addition, the completed reinforced earth slope has remained in good condition through the deadly Typhoon Morakot in 2009. The result shows that it is indeed a safe, durable, aesthetic, and sustainable solution for slope stabilization.



Construction of MSE Retaining Wall for Residential Safety, Mexico

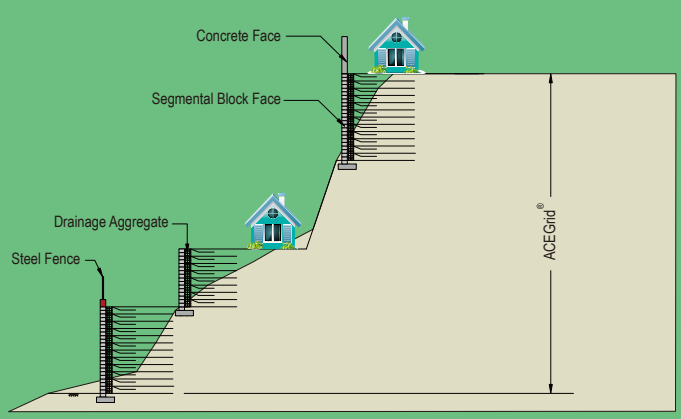
Products: ACEGrid® GG

The project planned to develop a residential housing complex in a mountainous area where rugged terrain was typical. Substantial leveling off the site was required for engineering safety. Multiple level retaining walls or cantilever retaining walls can be constructed as conventional solution to accommodate different housing arrangements. However, multiple level retaining wall demands an enormous amount of cut and fill soil, which make the foundations vulnerable to differential settlement. On the other hand, cantilever retaining walls were costly and susceptible to seismic damage. The construction of reinforced concrete structures also required longer time to complete.

Solution

ACEGrid® mechanically stabilized earth (MSE) wall was introduced to integrate cut, fill, and retaining phase into one step which made the site preparation more precise. Compacted fill reinforced structure with ACEGrid® geogrids satisfied both static and dynamic loads, therefore became a perfect seismic-stable structure. Differential settlement was also mitigated by introducing multi-level reinforcement. The total length of the MSE walls is more than 300 meters and the height varies from 7 to 12 meters in accordance with site terrain. For aesthetical purpose, modular concrete blocks were selected as the facing system.

ACEGrid® MSE wall serves its function perfectly, despite terrain constraint on the site. The reinforced earth system combined foundation leveling and retaining structure construction into one step. Moreover, compacted soil with ACEGrid® geogrids reinforcement eliminates the possibility of seismic damage and differential settlement. ACEGrid® mechanically stabilized earth system has been proved to satisfy engineering demands and worthy being considered as future development model.



Slope Stabilization

Slope Rehabilitation Project after Deterioration, Taiwan

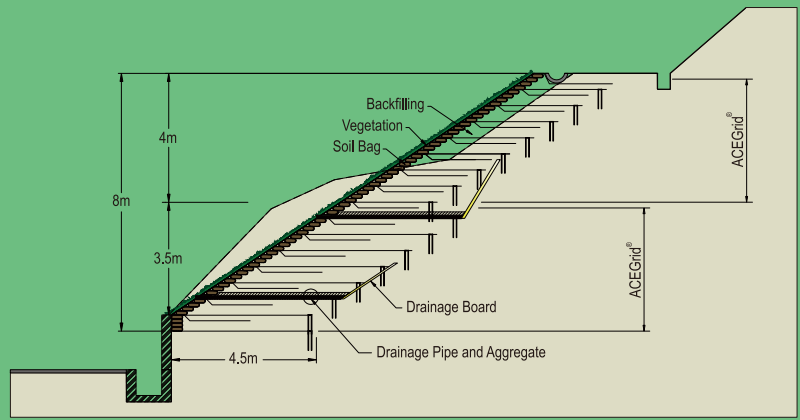
Products: ACEGrid® GG, ACEDrain™ S

Xihu Service Area is located at Taiwan National Freeway No. 3. High rate of transportation in this area demands an immediate treatment for any potential threat, including slope failure. Due to torrential rainfall, soil movement occurred in a slope with 8 m high, near the service area entrance. The deterioration consequently endangered the safety of passengers. The highway authority demanded a sustainable rehabilitation project with aesthetic and eco-friendly purpose. Time-limitation also became another constraint in this project.

Solution

A wrap-around reinforced earth structure (RES) containing ACEGrid® geogrids, soil bags, local soils, and drainage system were chosen to rebuild the slope. There are five reasons for adopting this solution: (1) excellent quality and durability of ACEGrid® ensure the stability of the RES; (2) well-designed integrated vertical and horizontal drainage system; (3) rapid construction time significantly reduces the traffic loss; (4) flexible wrap-around facing system perfectly fits the original topography, whilst maintains 1:1.5 - 1:2 (H:V) slope ratio, and (5) the porous surface of the RES provides a friendly environment for the development of local vegetation and ecological system.

RES system implemented in this project has solved the slope deterioration problem, while provides a natural appearance. Additionally, this project also proves that ACE Geosynthetics is capable to provide an innovative and effective solution to meet engineering demands, not only for increasing slope stability, but also developing an eco-friendly environment for the local community and passerby.



Reinforced Earth Embankment for Protection against Debris Flow, Taiwan

Products: ACEGrid® GG

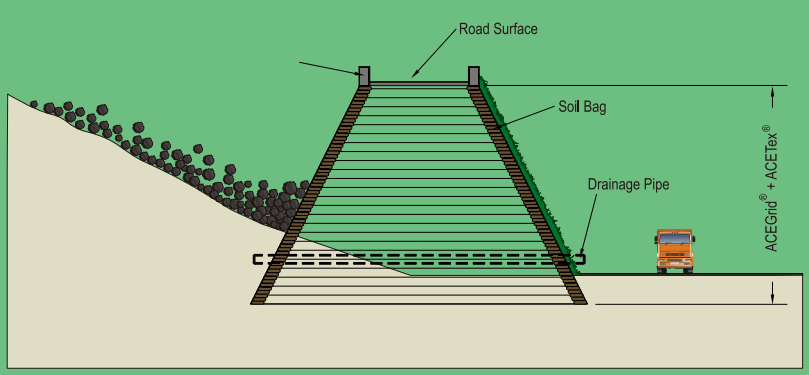
Huoyanshan tunnel in Miaoli was constructed to manage the debris flow passing above the traffic road. However, some debris flow shifted its direction to the tunnel entrance, thus developing in an increased risk for the driver. A conservation area is located adjacent to the proposed construction site, which made the available working space and structure size are limited. According to the site history, gabion and earth dyke were practically proven ineffective. Therefore, Miaoli County Government was looking forward to another effective and efficient solution. Moreover, an access for debris cleaning must be considered in the design.

Solution

Since debris flow is caused by natural phenomenon, it was necessary to find a sustainable solution to solve the problem. In order to preserve the nature of Huoyanshan and ensure the safety of people and vehicles, a reinforced embankment which led the debris into rock detention pond was adopted. Reinforced embankment made of ACEGrid® geogrids also facilitated the maintenance works of the tunnel for debris excavation and transportation.

Since the project has been completed in February 2008, over 15 typhoons and heavy rains invaded the area. Those series of disasters did not affect the structural stability, and the debris flow caused by them can be retained completely. Vegetation growth also can be seen on the structure surface.

Overall performance and recent condition of the structure has proved an adequate implementation of geosynthetic products in this project. The life and property of local people are significantly secured whilst the tunnel still maintain its function properly.



Slope Stabilization

Slope Failure Rehabilitation for Pavement Restoration, Taiwan

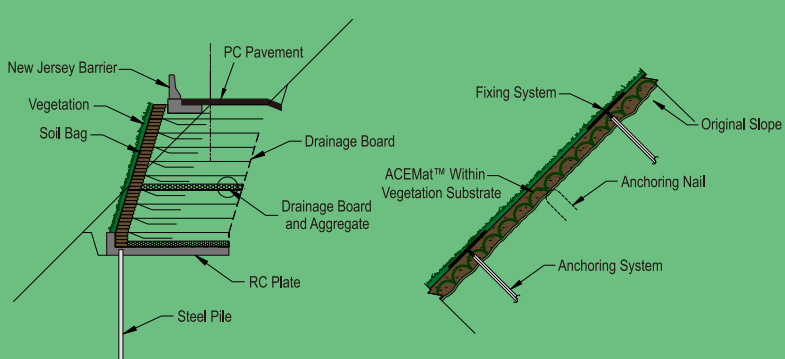
Products: ACEGrid® GG, ACEMat™ R

The site is located in Renai Township, a mountainous indigenous village in Nantou County, Taiwan. It is famous for its aboriginal culture and stunning natural scenery. Due to the poor geological and hydrological conditions, the bottom part of cut-slope, which served as pavement base, was disrupted during torrential rainfall. The slope damaged seriously, with a collapsed depth over 30 m, leading to a total failure of road structures. Because the road is the main access road to Renai Township, the slope failure interrupted local traffic, and was causing inconvenience for the local people.

Solution

A composite system was introduced in this project. In order to restore the access road embankment, a reinforced concrete foundation with steel H toe piles was installed as base support. On top of that, a wrap-around facing mechanically stabilized earth wall (MSEW), which has 5 m in height, and a step back inclined ratio of 1:0.3 (V:H) was built as the embankment. ACEMat™ R high performance turf reinforcement mat (HPTRM), a 3D geomat, was used for the slope surface protection. After steel wire meshes secured onto the slope scar with rock nails and the mixture of seeds and fertilizer was hydro-sprayed, HPTRM was installed with plates to connect it with the rock nails. Longitudinal and horizontal drainage systems were also installed to improve surface runoff.

Both the MSEW and ACEMat™ R improve vegetation growth, which attracts a variety of local species to stay. The system not only provides stabilization for the collapsed slope, but also serves the ecological function. Since the completion of the project, the composite system has been through a series of typhoons and severe rainfalls. However, the system still provides reinforcement to the soil and the slope demonstrates sufficient stability.



Erosion Control and Surface Protection of Tunnel Portal Upper Slope, Taiwan

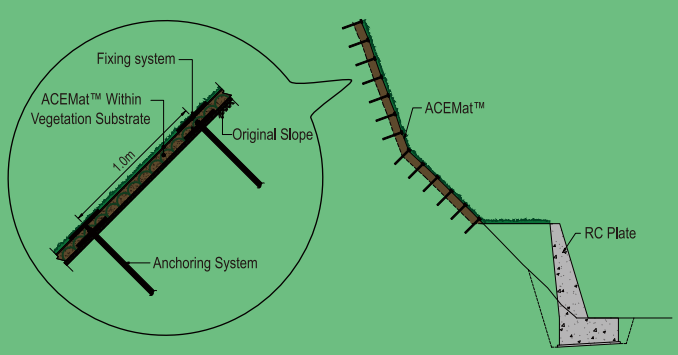
Products: ACEMat™ R

This project is located at the portal area of tunnel No. 9 of a scenic bike path in Taichung. The surface layer of the upper slope at the portal area consists of completely weathered sandstone with 1 to 2 m thick. According to the evaluation from Central Geological Survey, the site has been classified as debris sliding zone which is unstable and vulnerable to any disturbance. In 2006, a torrential rainfall attacked the site, saturated the soil, and leached the cement off from the sandstone. A typical shallow failure plane was triggered and the bedrock slide off. The debris movement increased the risk for any passer-by and driver who was going through the tunnel.

Solution

3D diamond-shaped steel wire mesh with high tensile strength was firstly secured into the slope scar, using grouted rock nails. A layer consists of mixed seeds, fertilizer, and water-bearing material was hydro-sprayed to the wire mesh networks. ACEMat™ R turf reinforcement mat, a 3D cellular - high tensile strength - confinement material, was then fixed together with the steel wire mesh using rock nails for slope protection.

The composite slope protection system not only secures the weathered sandstone, but gives a fresh green looking at the portal area as well. ACEMat™ R provides space for vegetation to grow, and also becomes a habitat for local species. Throughout the year, the structure remains stable with overgrown vegetation after experienced several strong typhoons and torrential rainfall. The outcome proves that composite slope protection system with ACEMat™ R satisfies the demands of slope stability with an eco-friendly environment.



Slope Erosion Control

Ecological Landscape Park with Flood Detention Function, Taiwan

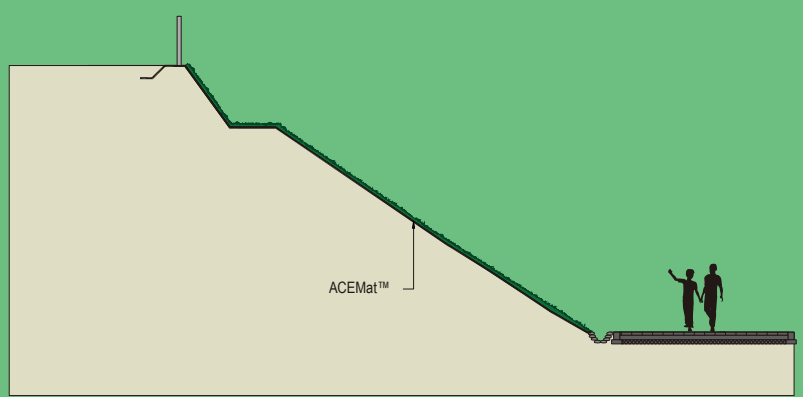
Products: ACEMat™ R

The government planned to reconstruct an old military camp covering about 11.7 hectares as Taichung Pinglin Forest Park, which served as a multifunctional ecological park providing recreational space, scenic environment and water-detention basin. In order to achieve the government's policy objectives and improve the greening level, the owner intends to plan a forest area among 3.7 hectares, with an additional water-detention basin of 3.2 hectares to prevent flood in the adjacent area.

Solution

In this case, Rectangular Pyramidal Geomat, ACEMat™ R High Performance Turf Reinforcement Mats (HPTRM) was chosen to create a green ecological landscape park. Total area covered by the ACEMat™ R is about 8,000 m². ACEMat™ R, which is manufactured by polypropylene yarns, with the three-dimensional structure, can cooperate with soil and fertilizer to support vegetation growth. Furthermore, due to the increase in surface roughness, the amount of soil eroded by rainfall can be minimized. ACEMat™ R can protect slopes and also prevent the erosion ditch formed naturally from expanding. Flexibility characteristic in ACEMat™ R makes installation process easier because it can adjust to the local terrain condition.

The construction of Pinglin Forest Park serves an ecosystem which can conserve water, adjust atmosphere temperatures, provide a biological habitat, and also maintain the current landscape. The utilization of the green engineering materials, ACEMat™ R High Performance Turf Reinforcement Mats (HPTRM), improves the visual appearance, compared to concrete, and forms a multifunctional, ecological, and sustainable ecological park to effectively decrease air pollution.



Roadway and Railway Construction

Traffic Restoration

Base Reinforcement

Pavement Improvement

Complex Reinforced Structure near Fault Zone, Taiwan

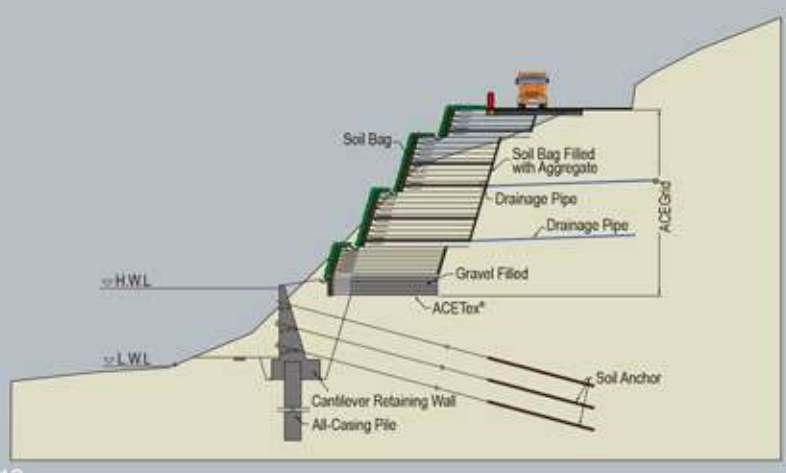
Products: ACEGrid® GG, ACEDrain™ S, ACETex® NW

In 2007, torrential rainstorm caused a landslide with 80 m wide and 30 m deep in the fault zone of Nantou County. The existing anchored slope experienced a structural collapse, leaving a massive soil debris at the toe of the slope. Moreover, the site is located at the edge of Ming-Tan Reservoir, making it vulnerable to erosion due to the water level fluctuation.

Solution

The slope rehabilitation construction consists of two segments. The bottom segment is a pile-supported reinforced concrete wall (8.5 m in height), built for protecting the lower slope from erosion. Ground anchors were also installed in the bottom segment to give an additional resistance. In the upper stage, a wrap-around reinforced earth structure (RES) made of ACEGrid® geogrids, sandbags and ACEDrain™ drainage materials was constructed to restore the original slope landscape. The RES was constructed in 4 sequential layers up to the final height of 17 m, using geogrids with 8 to 10 m long. Each layer was stratified with an average inclined ratio of 0.3:1 (H:V). Internal and surface drainage systems were provided for the RES to effectively drain water seepage and runoff.

The RES provides a simple, fast and cost-effective solution. It can be constructed limitless to topographic constraint, using simple equipment, and without any need for particular skill from the laborers. Debris from the collapsed structure was used to build the RES, thus a significant amounts of waste dumps is reduced. Within the first 6 months, deformation rate at the site has declined from 0.03mm/month to 0.007mm/month, indicating an achievement for controlling the sliding concern.



Complex Reinforced Structure Applied at Hilly Road Repair Case, Taiwan

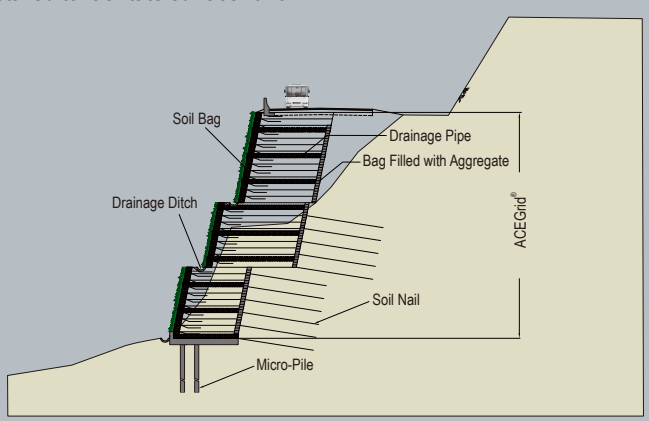
Products: ACEGrid® GG, ACEDrain™ S, ACETex® NW

In 2006, torrential rains continuously attacked Pingtung. The accumulated 1,380 mm precipitation completely soaked the soil and caused a section of County Road No. 35 downslope collapsed. The subgrade of County Road No. 35 was severely damaged and the road had to be closed for safety. Geological investigation indicated that the sliding occurred due to the enormous overflow from the drainage gutters along the pavement. The collapsed area was very deep with a height up to 18 m, and the space available for foundation construction was limited by the terrain.

Solution

A composite system was used for slope rehabilitation. First, concrete foundation with drilled root piles were installed as the base support, then ACEGrid® geogrid is used to build a 3-layers reinforced earth slope (RES) to support the pavement. Additional soil nails, tied up securely with geogrids, were installed to dowel the deep-seated failure plane to ensure slope stability and reduce the required area for foundation. The RES of 16-18 m high was constructed with wrap-around terraced facing for 1:2 (H:V) average inclination ratio. Residual debris from the collapsed slope was used as filling material. Internal interceptor trenches and horizontal drains were aligned to allow the dissipation of groundwater. Finally, longitudinal and horizontal trench were installed to facilitate surface runoff.

Implementation of innovative design overcomes the difficulty in construction. A safe, economic and eco-friendly structure has been completed in 2007. Since then, the structure still remains in good condition through several attacks of strong typhoons, including the deadly Typhoon Morakot in 2009. The completion of this case has proved the value and possibility of complex reinforced structures with ACEGrid® geogrids.



Embankment Restoration, Taiwan

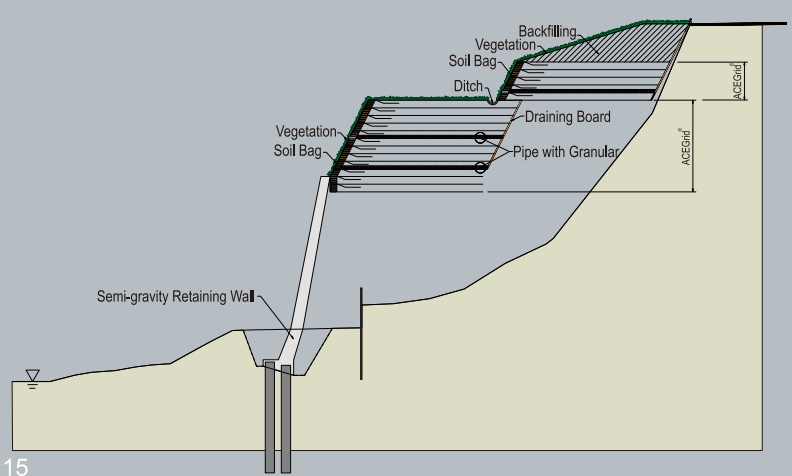
Products: ACEGrid® GG

In August 2013, Typhoon Kongrey struck Taiwan with heavy rainfall, and caused numerous infrastructure damages. The slope beneath Provincial Road No. 9 was totally collapsed due to riverbank erosion by a flash flood from the adjacent Fenggang River. In-situ drainage system was also insufficient to accommodate the enormous overflow from above the site. The collapsed slope led to tons of rubbles left on site. Freeway Bureau, as the management authority, required a sustainable rehabilitation solution by utilizing the rubbles efficiently.

Solution

A composite system was adopted for the slope rehabilitation project. First, a 150 m long, pile-supported reinforced concrete (RC) wall was built for the lower slope below maximum water level. A total of 155 all-casing piles with a diameter of 1.2 m and a minimum length of 10 m were installed in two rows. At the next stage, vegetated wrap-around reinforced earth structure (RES) with ACEGrid® geogrids was constructed for upper slope restoration. The RES consists of two layers, each with 5 m height and inclined ratio 1:2 (H:V). Finally, to prevent a surface overflow from eroding and softening the RES, a drainage culvert was installed below pavement layer to collect surface runoff and discharged it directly to the river.

After four months of construction, this project was completed in May 2014. Since then, it has been through a number of typhoons attacks, and it still remains in good condition. Even though the pavement is subjected to heavy traffic, no evidences of deterioration or instability are found. Vegetated slope presents natural appearance and provides an aesthetic and eco-friendly environment for the site. As with other similar projects which were already implemented, the rehabilitation has been proved successful.



Slope Rehabilitation for Erosion Control and Local Traffic Restoration, Taiwan

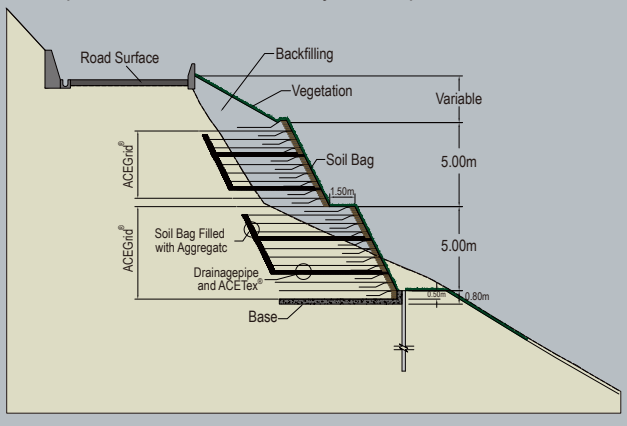
Products: ACEGrid® GG

This project was to rehabilitate a downslope failure in a section of County Road No. 119, Miaoli County. The soil property of the slope was poor, and torrential rainfall subsequently triggered the landslide. The slope was extremely damaged, leading to partial loss of pavement subgrade. After the slope failure was occurred, the road needs to be closed until rehabilitation project is finished. Therefore, the construction needs to be completed on limited budget and within a tight schedule, not only to prevent such disaster from happening again, but also to guarantee the quality of road safety.

Solution

Since the in-situ gravelly sand and clayey sand could be utilized to cut down construction cost, reinforced earth slope (RES) with ACEGrid® was adopted for this project. It is 10 meters high and 34 meters long, supported by a reinforced concrete mat foundation with steel H piles at the toe. The RES was constructed in two tiers with geogrids wrap-around facing setback and inclined ratio of 1:2 (H:V). Stacked soil-filled and hydro-seeded sandbags were used for slope face protection and visual integration with the surrounding environment. For the damaged slope below RES structure, a high strength geomats (also known as turf reinforcement mats), extending 50 meters downward was installed and vegetated. It was designed for erosion protection and scenic improvement at the site. Lastly, interceptor trenches and Jersey barrier were installed for surface runoff drainage and traffic safety.

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 resistance of RES. Vegetation enhances the performance of erosion control and natural appearance of the site. ACE Geosynthetics products consume low amounts of energy and produce low carbon emissions. They were integrated with local compacted soils and were built together as one complete sustainable structure.



Lane Widening and Soft Soil Enhancement, Malaysia

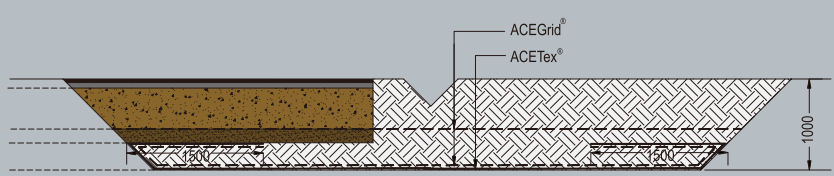
Products: ACEGrid® GG

This project is located in Jempol, Negeri Sembilan, Malaysia. The Highway N17 originally had only one lane. In order to improve the quality and convenience for the regional transportation, the County Government demanded a highway widening and intersections improvement project between Jalan Dangi, Kepas and Bahau. However, saturated soft soil at the proposed site created difficulties to establish the scheduled construction.

Solution

Basal reinforcement was performed by layering an additional higher resistance sand on top of the original soil, raising the subgrade to one meter above from the design elevation. Then, a ground stabilization system was placed to reinforce the weak subgrade. It consists of a layer of nonwoven geotextile and a layer of ACEGrid® geogrids GG100-II. The nonwoven geotextiles were designed for filtration and drainage, whereas GG100-II, a bi-axial high-resistant geogrid, was installed for bearing capacity improvement. Afterwards, a 45 cm thick compacted fill was placed and a second layer of GG100-II was installed subsequently. Geogrids can be fully interlocked with soil particles to create an enhanced composite material with higher performance. Crushed base course and asphalt layer then were placed in traditional pavement construction.

Since the completion of the project, the highway has performed satisfactory. No deterioration or settlement has been observed around the site. The ground stabilization system provides a simple, fast, and cost-effective solution for basal reinforcement. Most importantly, it has been demonstrated to completely meet the demands of the site, and is worthy of being considered as a model for another similar projects in roadway construction.



Ground Improvement for Queensland Motorways Gateway Upgrade Project, Australia

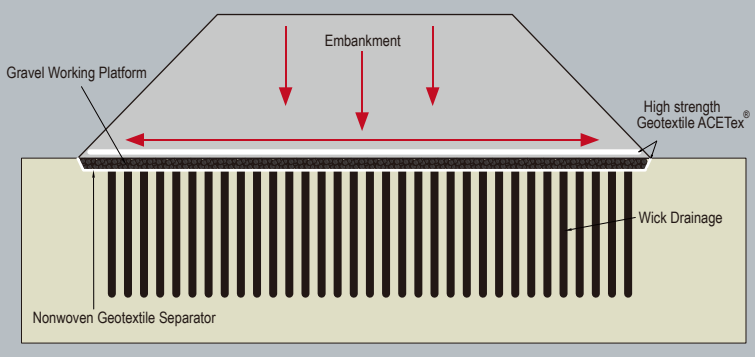
Products: ACETex® PET

The managing authority of Queensland Motorways proposed to upgrade the existing Gateway Bridge River Crossing. The project included a duplication of the Gateway Bridge and an upgrade of 24 km of the Gateway Motorway from Miles Platting Road to Nudgee Road, including a 16 km motorway upgrade (south) and a new 7 km motorway deviation (north). The foundation located on top of soft and saturated fluvial deposit in the flood plain area. Low bearing capacity and differential settlement were the main problems and consequently threatened the stability and safety of constructed facilities.

Solution

To minimize the risks caused by soft soils, ground improvement was extremely necessary. Prefabricated vertical drains (PVD) was adopted to accelerate the dissipation of excess pore water from the soil, therefore increasing the shear strength, and decreasing its compressibility. The contractor first placed a layer of ACETex® PET woven geotextiles and a layer of gravel was placed above. ACETex® provided functions of reinforcement, separation and filtration, so that the induced pore water could be easily dissipated without losing any fine particles. PVDs were installed in square patterns (1.5 m center to center distance), covering the whole treatment areas. This method accelerated the consolidation process, which minimized bearing failure and differential settlement.

ACETex® PET has high tensile strength to reinforce soft soil layer, and a unique mesh structure to enhance its function as a filter fabric. It has both high permeability and the ability to retain most soil particles, while allowing clay and fine silts to flow into and out of the drain. ACETex® implementation improved the installation and performance of PVDs. The consolidation period were shortened considerably, while the stability and load carrying capacity were improved significantly.



Pavement Rehabilitation in Response to Increased Traffic and Reflective Cracking, South America

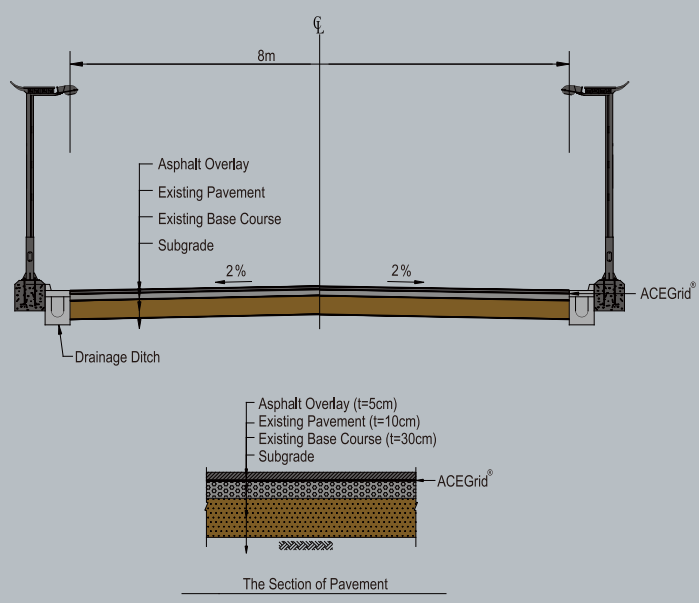
Products: ACEGrid® GA

The highway made of asphalt pavement in Columbia, South America, has been suffering from extensive reflective crack, due to high axle loads and increased traffic loads. Reflective crack in asphalt pavement surface will cause several other problems, such as discomfort for the users, water infiltration to pavement layers, potholes, reduction in bearing capacity, and shortened pavement service life. Therefore, a better solutions in terms of economical and long-term performance needs to be implemented to rehabilitate the pavement distress.

Solution

ACEGrid® GA glassfiber geogrid is used between asphalt and base layer to enhance the overall performance. Asphalt reinforcement with ACEGrid® GA glassfiber geogrid can prevent reflective cracks, due to its capability to distribute axial load along its surface. It also makes installation process easier, resulting in a better time efficiency. In this project, after milling of the previously constructed pavement, ACEGrid® GA glassfiber geogrid is laid directly on base layer, and then is covered with hot mix asphalt.

After the construction is completed, the performance of reinforced pavement shows a significant improvement. There is no reflective crack and pothole discovered. Moreover, the result demonstrates that the depth of ruts has also decreased, which means the pavement has a better performance and a longer service life after implementing ACEGrid® GA glassfiber geogrids.



Marine and Coastal Structures Construction

Breakwaters

Submerged Breakwaters & Artificial Reefs

Pipeline Sleepers, Submerged Breakwaters & Artificial Reefs

Breakwaters

Construction of an L-Shaped, Sand-Containing Breakwater, UAE

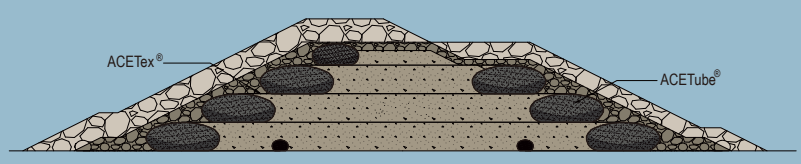
Products: ACETube®, ACETex® PP

This project is located at Ras Al Khaimah coastline, UAE, where a groyne was constructed to protect the navigation channel. The local authority planned to build an L-shaped breakwater, 700 m in length, attached to the groyne. The whole structure should be 9 m high; 2.5 m high is submerged under water, and 6.5 m high above sea level, due to wave height being 3 m. The local authority was looking for an alternative economic solution to replace the high-cost rubbles.

Solution

After a detailed consideration of cost efficiency, construction period, and optimal safety, ACETube® geotextile tubes were chosen to construct the proposed breakwater. Generally, geotextile tube was filled with sand, and used as a core in the breakwater structure. However, this project applied various types of ACETube® as the perimeter barrier structure, which contained and trapped in-situ sand to form the breakwater core. The construction was carried out from bottom to top, which consists of 286 ACETube® geotextile tubes. Externally, ACETube® was covered with an under-layer of aggregates, and further protected by a layer of armor rocks. At the end of construction, the structure's outer appearance was similar to a rubble-mound type of breakwaters.

The innovative application of ACETube® geotextile tubes for breakwater construction significantly reduced the cost, and minimized environmental disturbance. The result has turned out to be better than expected. Moreover, the project even won 2013 International Achievement Award from the Industrial Fabrics Association International (IFAI) for its outstanding performance. This project not only proved an excellence performance for breakwater construction, but also regarded as the ideal model for other similar projects.



Restoration of Eroded Coastline and Promotion of Beach Nourishment, UAE

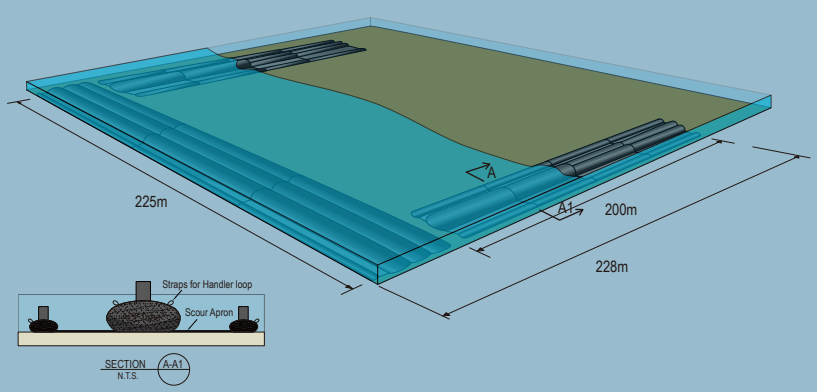
Products: ACETube®

In 2007, a strong tropical cyclone Gonu hit Fujairah, an Eastern province of UAE. It caused a great havoc, and serious erosion in several kilometers of the coastline. Although the South – North longshore current could initiate beach nourishment, the comparison between erosion and sedimentation rate are not efficient. Initially, a riprap groyne, as traditional method, was adopted to protect the beach in the northern and southern shore. Without a solid foundation base, repeated wave actions and annual cyclone attacks caused scouring at the bottom of the groyne, thus submerged it below sea level.

Solution

In order to lessen the impact on tourist attractions and environmental aspect, the owner of Le Meridien Hotel appealed an innovative method to reconstruct the groyne and nourish the beach. ACE engineering team designed a U shape structure using ACETube® geotextile tubes, forming a seaward breakwater stretching out for 200 meters long on the southern and northern coastline. The submerged breakwater covering 228 m x 225 m safe zone to reduce wave energy, thus increasing the sedimentation rate. Various types of geotextile tubes, extending from 8.6 m to 17.2 m in circumference, and 52 m to 77 m in length, were designed by the engineering team to adapt the undulating terrain. These geotextile tubes were filled up with pumped up in-situ sand to create a cofferdam.

After the project was completed, ACETube® geotextile tubes effectively manage coastal erosion, and protects Fujarah coast from further cyclones attacks. The result shows that ACETube® represents the best way to reduce impact on our environment, and to reach sustainable development for longer service life of the structure with effective and innovative solution. Instead of traditional riprap construction method, ACETube® offers an economical solution and possesses more ability to associate with natural ecological environment, enhancing the ecosystem development.



Pipeline Sleepers, Submerged Breakwaters & Artificial Reefs

Oil Pipeline Protection and Eroded Beach Nourishment, Mexico

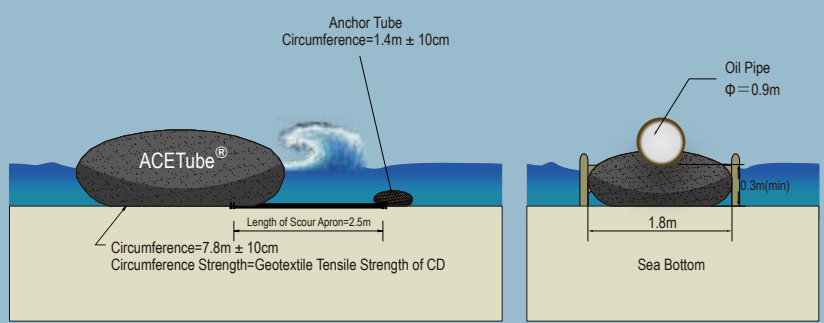
Products: ACETube®

The marine facilities of Dos Bocas PEMEX, a major oil corporation in Tabasco, Mexico, suffered progressive beach erosion caused by numerous annual hurricanes invasion. The sand foundation under the pipelines in the littoral zone was scoured, leaving dangling pipes. Such problem threatened oil conveying and the integrity of the infrastructures. It also increased the potential risks of pipeline failures which would lead to economic loss and environmental contamination.

Solution

In order to deal with the problem, ACETube® geotextile tubes were chosen to support and protect the pipelines. The project was divided into two parts. First, ACETube® of various sizes in circumference was used as pipeline base protection against scouring risk. Afterwards, 30-40 m away from the coastline, ACETube® geotextile tubes with 7.8 m in circumference were filled with in-situ sand and placed beneath the pipelines as supporting system. ACETube® geotextile tubes were also installed as a submerged breakwater alongside the coastline for 1.9 km in length to reduce the wave energy, thus nourish the beach.

In this project, the flexibility and adaptability features of ACETube® geotextile tubes give the pipelines a complete protection and gravity support. It also demonstrates an excellence performance as a breakwater that can withstand the wave impact. Moreover, as an economical and innovative solution, ACETube® geotextile tubes, not only reduced the construction time and costs, but also performed well as an alternative from traditional construction method. As the beach evolution surveys indicated, the beach nourishment outcome is also satisfying.



Riverbank and Channel Protection

Pier Scour Protection System

Revetments

Pier Scour Protection System

Protection of Zhongsha Bridge Pier Foundation, Taiwan

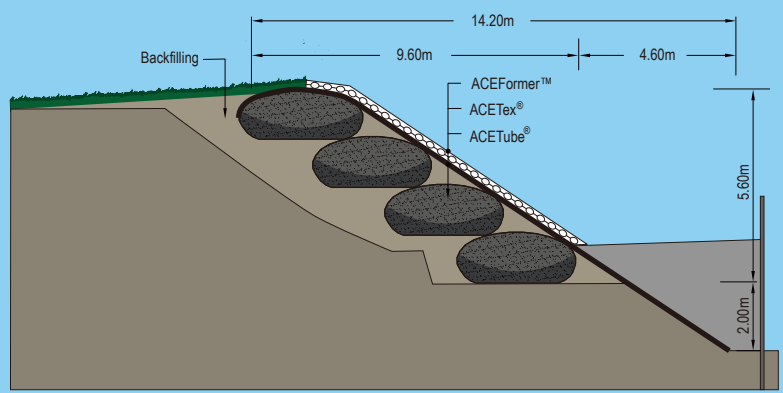
Products: ACETube®, ACEFormer™

Zhongsha Bridge, a traditional pre-stressed concrete structure with 2345 m long, is located at Zhuoshui River, between Yunlin County and Changhua County. As the important link of north and south, the accomplishment of the bridge has finalized National Freeway No.1 construction. However, the river faced continuous impacts of fluvial processes, causing instability and required an immediate remediation for the pier bridge foundations. The remediation, including riverbank revetment rehabilitation, submerged weir groundsill reinforcement, and aprons protection, was mainly to secure bridge stability, traffic safety, and flood prevention.

Solution

ACETube® geotextile tubes and ACEFormer™ geotextile mattresses were adopted in this project. The 5.6 m high protection structure was designed with four stacks of ACETube®. After each ACETube® was filled with in-situ sand, an additional fill was placed above it to make a horizontal surface for the following layer installation. The four-layers structure is covered with concrete-filled-ACEFormer™, in order to increase the impact resistance of the structure, and protect the ACETube® from external damage, caused by driftwood or debris coming down the river. Concrete-filled-ACEFormer™ also enhanced the stability of pier foundations and levees. The uneven surface of ACEFormer™ also helped to reduce flow velocity and slowed down surface erosion process.

Compared to the traditional concrete structure, the ACETube® and ACEFormer™ framework has more advantages, including low energy consumption, low carbon emissions, cost effectiveness, and eco-friendly sustainability. In addition to that, the flexibility features makes them adaptable to different kinds of landforms and site conditions. The structures are beneficial for erosion prevention. Pier foundations scouring is now under control. Lastly, the luxuriant newly-formed land becomes the habitat for vegetation, making the site totally integrate with the scenery.



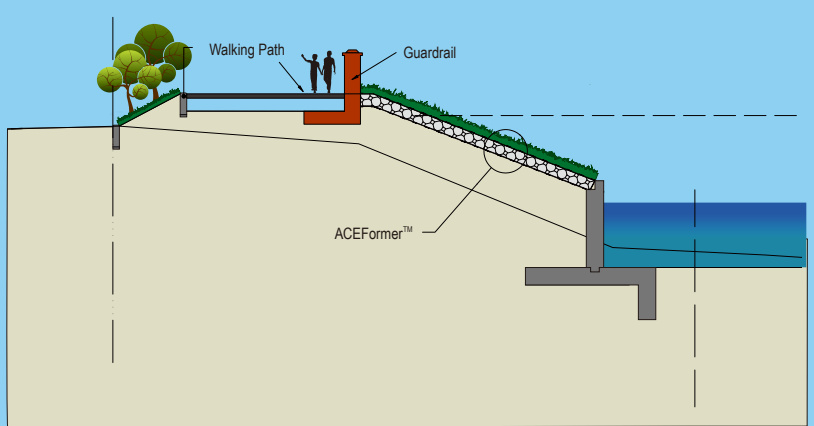
Widening and Improvement of Niaosong Canal for Flood Prevention, Taiwan

Products: ACEFormer™

"Niaosong Canal Widening and Improvement Project" was a part of "Flooding Mitigation for Flood Prone Area in Grand Kaohsiung Metropolitan Area" program, which includes: widening, dredging, and remodeling of the canal to achieve the following objectives. First, regain the discharge capacity of flood control. Second, reduce the risk of flooding. Third, ensure the safety of local residents and their properties. Last, promote favorable land appreciation. In addition, the project also encourages an eco-friendly environment and a water-accessible area of the canal.

Solution

In order to achieve the objectives of the project, ACE Revetment Composite System was chosen to meet all the requirements in one solution. Reinforced concrete (RC) revetment was used for the area below the water level to deal with scouring problem. Afterwards, the revetment was backfilled with engineered soil-fill, and sloped upward to the pavement grade. ACEFormer™ Vegetation Type (V Type) geotextile mattresses were placed on the backfilled surface to prevent surface erosion from water runoff, and to minimize the possibility of erosion due to overflow or flooding. Compared to traditional concrete structure, ACEFormer™ geotextile mattresses not only provide a durable surface for scouring resistance, but offer spaces for vegetation to grow.



Since 2010, the completion of the project, the original pale-gray surface of the ACEFormer™ has changed into fresh green vegetation, and a variety of local species have observed on site. Although the site has experienced several strong typhoons and torrential rainfalls, the canal stays firm and the flooding damages have ceased completely. The success of this project demonstrated that ACE Revetment Composite System can be beneficial for any site similar to this case.

Revetments

Revetment Construction for Remediation in Anliang Harbor Canal, Taiwan

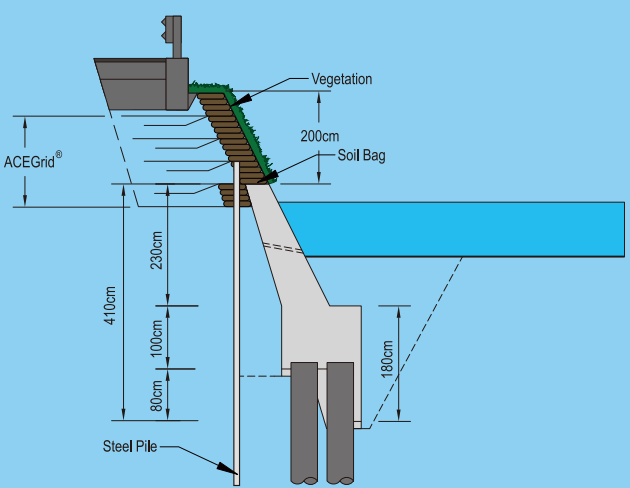
Products: ACEGrid® GG

Anliang harbor canal, one of the most important waterways in Taichung, is responsible for discharging the collected water from the upstream basin of Grand Metropolitan Taichung. Due to the accumulation of silt and trashes and the randomly overgrown weeds, the volume of the waterway had significantly reduced. The discharge capacity of flooding had decreased, leading to the scouring effect more severe with time. Such malfunction not only jeopardized the stability of the canal, but also caused local residents vulnerable to flooding risks.

Solution

Considering the importance of the canal, Taichung City Government called for a remediation project, including dredging, widening, and remodeling of the canal. The first step of the construction was to stabilize the base of the canal by installing pile-supported reinforced concrete revetment for areas below the water level. Then, reinforced earth slope (RES) with ACEGrid® GG geogrids was placed as revetment in the upper portion of the canal. The RES also functioned as the retaining structure for the service road along the canal. It was constructed with geogrid wrap-around facing with an inclined ratio of 1:2 (H:V). Stacked soil-filled sandbags were used for slope face protection; they were hydro-seeded and the vegetation has displayed pleasant greenery with time. Besides, the geogrid and sandbags were integrated with local compacted natural soils to build a sustainable structure.

The construction has taken about four months to be completed in the summer of 2011. Since then, the revetment has been through several attacks of strong typhoons and by far still remains in stable condition. The durable service condition, together with a variety of valuable species and the attractive waterfront scenery on the site, has proved ACE revetment composite system totally meets the demands of the project objectives: safety, durability, aesthetics and sustainability.



Environmental Protection

Sludge Treatment

Landfill Constraction

Sediment Dredging, Sludge Treatment

Slope Stabilization, Slope Erosion Control

Application of Industrial Sludge Treatment, Russia

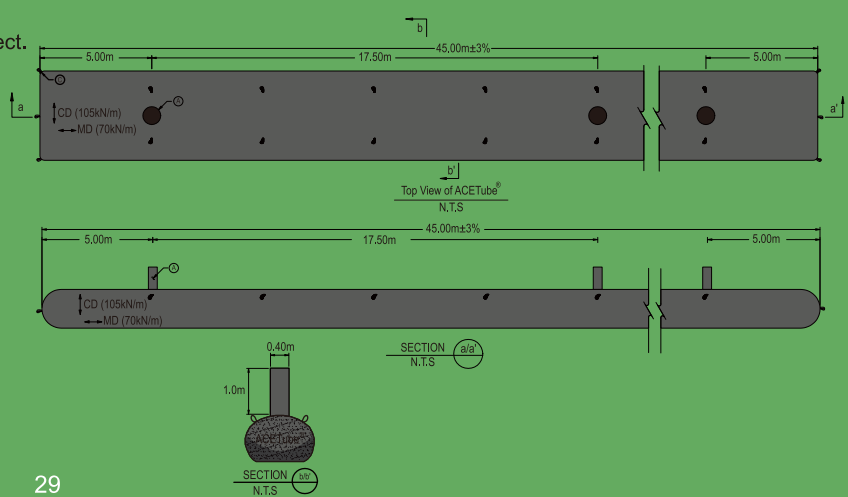
Products: ACETube®

In this case, a sludge buffer pool with 3 meters in depth is used to store sludge for dewatering treatment. When an enormous sludge came, it would cause full load to the treatment plant because of low dewatering efficiency and accumulated sludge volume. Since there is no more space for constructing new buffer pools, and considering the traditional wastewater treatment is high costly, low in efficiency, and emits carbon pollution, another approach should be implemented to provide a better and faster dewatering process for sludge treatment.

Solution

ACETube® geotextile tubes were applied in this case to promote treatment efficiency and capacity compared to buffer pool. There are four stages for dewatering process with ACETube® geotextile tubes: pumping, dewatering, solidification and disposal. In the first stage, a dredging boat with capacity of 230 m³/ hr was used to pump sludge into ACETube®. In order to increase dewatering efficiency, flocculent or polymer were pumped into sludge for keeping them well-mixed during the whole dewatering process. Jar test/cone test should be done beforehand in order to know the best polymer dosage. To meet the project requirements, filling ports and the tube size were customized with 11.5 m in circumference, 45 m in length and 500 m³ of tube capacity. Finally, 30 pieces of ACETube® geotextile tubes in total are used in this project.

The main advantages of ACETube® geotextile tube are that installation and dewatering process can be performed in limited areas. In addition, carbon emissions of ACETube® cause less harm to the environment. Based on the safety analysis, there is no environmental risk emitted during ACETube® usage for a continuous 2.5 months. In this project, ACETube® geotextile tube has a better time and space efficiency compared to the traditional buffer pool.



Reinforced Soil Dike of Class B Landfill Expansion Project, Taiwan

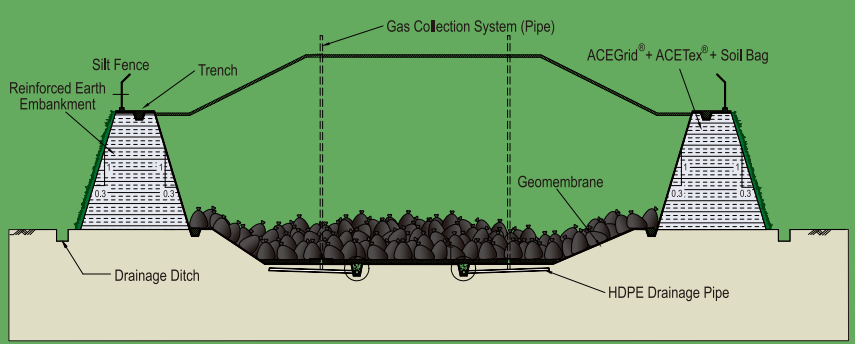
Products: ACEGrid® GG, ACEDrain™ S, ACETex® NW

Over the years, population increase has reduced the capacity of Kaohsiung Class B Waste Landfill. Therefore, a facility expansion project was issued by the managing authority. Landfill construction was required to build a new containment system to accommodate future additional refuse. In order to reach a maximum capacity of the landfill, the perimeter dike slope must be built as steep as possible.

Solution

Based on site investigation, the in-situ silty sand could be utilized as fill material for dike construction. The excavation of pre-existing materials also led to an increase in the capacity of the containment. Considering the requirement of service volume, the designer finalized a reinforced earth structure as the perimeter for the containment. ACEGrid® geogrids were adopted as the geogrid reinforcement to construct a steep slope with ratio of 1:03 (V:H). Geogrids also provides the necessary friction for geomembranes to be securely fixed on the interior slope surface as impermeable liner. Soil-filled and hydro-seeded soil bags were stacked and ACETex® NW nonwoven geotextiles were placed as the face protection of exterior slope.

Within five month, the construction of seven hectares landfill area has been completed. The landfill has been operated since January 2011, and for over seven years, it still serves its function perfectly. Vegetation has grown to make a pleasant greenery and eco-friendly environment for local species habitat. The overall performance has proved an accomplishment for geosynthetic implementation in this project.



Sediment Dredging, Sludge Treatment

Dredge Materials Disposal of Wan Chai Development Phase II Project, Hong Kong

Products: ACEContainer™

Victoria Harbor is a natural landform harbor, located between Hong Kong Island and Hong Kong Mainland. The daily shipping maintenance determines the success of Victoria Harbor's service. One of the major managing difficulties for port authority is the clean-up of oil mixed solids and sediment disposal from the upstream rivers. Environmental concerns have been expressed about the dredged sludge materials disposal, in terms of water quality and natural habitat loss.

Solution

In order to dredge and dispose the sludge materials, ACEContainer™ with a custom-made dimension of 28 m circumference, 12 m length, and a filling capacity up to 300 m³ was adopted for Victoria Harbor's Wan Chai Development Phase II Project. ACEContainer™ is a geotextile container, designed to fit in split barge and contains the sediment or sand dropped from clamshell bucket. Once the ACEContainer™ was filled, its openings were sewn shut and reinforced with rope ties. The barge was moved to the designated location, and then ACEContainer™ was dropped to the seabed. ACEContainer™ has been specially designed to withstand hydraulic impact in marine environment for a period of time.

There is no damage and leakage found during the installation of ACEContainer™. ACEContainer™ delivers high performance and achieves an effective solution for dredging construction, compared to traditional techniques. It is helpful for the improvement and maintenance of ports, harbors, and waterways, as well for avoiding environmental pollution during disposal. Moreover, after ACEContainer™ is laid down on the seabed, it can also be adopted as the core of underwater marine structure, like a breakwater or shoreline protection.

Recreational Park with Flood Detention Function at the City Center, Taiwan

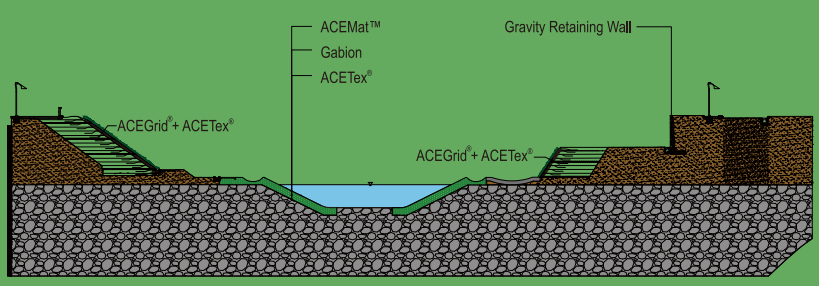
Products: ACEGrid® GG, ACETex® PP

Maple Garden is the first recreational park below ground level in Taiwan. With a land area of 30,000 square meters, it was originally the proposed site for the Taichung International Expo Center. However, the project was terminated after excavation procedure, leaving a broad boomerang-shaped open-pit with a depth about 20 meters. The unprotected depression zone presents structural threat to the adjacent building. Local government was put under pressure from public community, so an efficient solution should be made in a short time and within the budget.

Solution

The idea of this project is to utilize the landform to build a multifunctional park below ground level including: flood detention, recreation, and improving air quality of the city. The surrounding slopes were constructed as vegetated wrap-around reinforced soil slope (RSS) with ACEGrid® geogrid. An ecological detention pond of 200,000 cubic meters was built at the center of the park. Detention pond basement was made of compacted gravels, covered with ACETex® PP woven geotextiles as filter layer. Lastly, ACEMat™ erosion control mat and gabion were installed on top of geotextiles to prevent erosion, and arrange the landscape.

This project has successfully converted a problematic open ground to an attractive and environmental friendly scenic site. It not only provides a recreational place for the community, but also serves as an urban drainage system to prevent flood. Moreover, the vegetation planted throughout the garden has increased the city's green coverage by 28,000 square meters, which contributes to the decreased urban heat island effect. This creative solution of turning a problem into a masterpiece has gained many awards and recognitions in Taiwan.



Would Like to Know More about Geosynthetics?

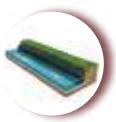
Come to Explore and Learn Geosynthetic Applications in ACE Geosynthetics Ecopark!

ACE Geosynthetics Ecopark is organized and constructed by ACE Geosynthetics with total area 10,000 m² to demonstrate various geosynthetic applications in civil engineering. The concept of considering the sustainability of both engineering and environment is influencing the contemporary engineering methods. As issues of traditional engineering methods and environmental impacts keep arising, geosynthetics is gradually becoming the preferred solution for the broad civil engineering application. It is proven that constructions can be easy and environmentally friendly with geosynthetics.
When visiting our educational Ecopark, you are capable to find out over 20 applications built in actual dimensions (1:1) with vivid demonstration. This Ecopark is not only to demonstrate the geosynthetic applications but also to achieve the educational purpose to make more people realize the benefits of applying geosynthetics to our environment.

Welcome to visit ACE Geosynthetics Ecopark to explore more about geosynthetics!
http://www.acegeosyntheticsecopark.com/

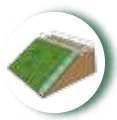
Reinforcement

1. Segmental Precast Concrete Panel Facing
2. Cast-in-place Concrete Facing
3. Modular Block Facing
4. Gabion Facing
5. Wrap-Around
6. Wire Mesh Facing



Shore Protection

16. Ecological Tank
17. Geotextile Tube
18. Geotextile Mattress
19. Sand Bag
20. Modular Block
21. Masonry Block
22. Riparian Tank
23. Gabion with Geotextile Bag
24. Reinforced Levee

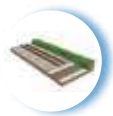


Erosion Control

13. Geomat
14. Rectangular Pyramidal Geomat
15. High Strength Geomat

Landscape

25. Footpath Pavements
26. Landscape Facility



Other Applications

7. Basal Reinforcement of Railway
8. Monitoring System
9. Pavement Reinforcement
10. Waste Landfill
11. Rainwater Harvesting System
12. Ecological Pond







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ACE Geosynthetics
www.geoace.com sales@geoace.com

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