ACE Geosynthetics

ACE Solutions in Geotechnical Engineering

2020

www.geoace.com

Founded in March 1996, ACE Geosynthetics is now a leader in Taiwan's geosynthetics industry and offers professional and innovative solutions for the global engineering market, including collapse site remediation, slope and retaining wall engineering, weak foundation improvements, slope erosion control, road engineering, environmental protection, maritime engineering, riverbank protection, etc. In the past ten years, the Company's outstanding design and application performance of geosynthetic materials have been repeatedly recognized by International Achievement Awards from Industrial Fabrics Association International, and the number of awards obtained by the Company is among the best among global competitors. Currently, the countries to which the Company exports its products and services span more than 70 countries across five continents. Thus, the Company has taken a place in the international geosynthetics industry stably.

Based on independent research and development capabilities and rich manufacturing experiences, we offer a wide range of high-performance products, including geogrids, geotextiles, geotextile tubes, vegetative nets, drainage materials, and landscaping and hydraulic materials. In addition to the ISO9001 quality management system certification, the TAF (Taiwan Accreditation Foundation) certified laboratory has been further established to strictly control product quality. At the same time, it has actively obtained product certification from various countries and is currently one of the manufacturers with the most complete set of global product certification systems. Meanwhile, in 2003, a professional engineering design team has been established to provide engineering planning and design integration and application services. We continue to strengthen our vertical integration capabilities from product development, manufacturing, and processing to engineering planning and design, and provide geosynthetic materials and services that meet the requirements of the environment and engineering to create the largest overall benefits for customers. At the same time, we hope to deepen customer relationships, and create a team of professionals to provide the best solutions in the global market.

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Engineering Planning and Design

We assist on-site surveys, provide systematic engineering planning, feasibility proposals and plan proposals according to customer needs. We can provide basic design, detailed design, materials and construction specifications, safety analysis in line with international design specifications, unit price analysis and data such as calculation of carbon emissions in the design stage of the case.

Construction Guidance and Support

We provide suggestions on specifications and quantity of construction equipment according to customer requirements, and we provide the construction plans or construction drawings, construction supervision focuses and other information as well. Or, we send experienced engineers to the job sites to guide the construction methods and techniques of using relevant products and systems.

Professional Technical Consultation

For product specifications, applications, design, durability, construction operations and subsequent maintenance, we provide economical and safe solutions for customers, and work with customers to develop new application systems that manage to solve difficult engineering problems.

Geosynthetic Product Testing

Our own TAF certified laboratory provides professional testing services for geosynthetic products. Various long-term tests can also be carried out to evaluate the long-term physical property changes of products in various environments as a reference for design consulting services.

Professional Services Provided by the Professional Technical Team

Civil Engineering | Geotechnical Engineering | Hydraulic Engineering | Marine Engineering | Environmental Engineering | Landscape Engineering

Technical service team composed of more than
40 engineering professionals in different fields

ACE Solutions

Landslide Remediation and Slope Construction

- Landslide Remediation and Road Rehabilitation
- Reinforced Slope and Retaining Wall
- Slope Erosion Control
- Debris Flow Control Embankment

Coastline Protection

- Seawall and Bulkhead
- Groyne and Jetty
- Beach Nourishment
- Sediment Dredging

Riverbank and Channel Protection

- Revetment
- Pier Scour Protection
- Channel
- Flood Detention

Roadway Construction and Base Reinforcement

- Subgrade Stabilization
- Base Reinforcement
- Pavement Improvement
- Road Embankment and Bridge Pier

ACE Solutions in Geotechnical Engineering

Geotechnical engineering forms one of the major area of specializations in civil engineering practice. However, the practice of geotechnical engineering can be applied across other specialized industries which includes but not limited to; tunneling engineering, transportation, environmental, earthquake, slope stability, deep excavation, foundation engineering, ground improvement, field experimentation, materials engineering, etc.

Researches over the past few decades have significantly broaden the field of geotechnical engineering. This is partly in response to more awareness in global warming, climate change and natural disasters which have plagued the world more frequently and to devastating effects. Thus, the prevention and mitigation controls of natural disasters have been instigated with an emphasis on environmental sustainability, eco-friendly solutions and carbon footprint reduction.

Population growth and increase urbanization of cities have fueled widespread infrastructural development such as roads, housing, etc. thereby putting a strain on limited land resources which needs to be maximized to improve the socio-economic livelihood of people. For this reason, it is imperative for highly-efficient and cost-effective geotechnical solutions are needed to diversify engineering approaches due to deterioration of site conditions, and structural functionality. Notwithstanding, regulatory requirements and norms, should be absorbed into existing policy to allow new technologies to flourish. This is important especially in areas where usable land is deficient, resulting in the common practice of land reclamation work but such fails to overcome the problems of land subsidence and high disposal costs, causing safety concerns for the structures above ground.

ACE Geosynthetics offers a wide range of engineering solutions with the use of geosynthetics materials for application across various field of geotechnical engineering. These solutions are generally simple, durable, economical viable, and more environmentally friendly in comparison to other traditional construction methods. The use of reinforcing materials is amongst the most important parts. The main function is to provide reinforcement which compensates for the lack of tensile strength in the soil to form a composite structure containing both reinforcing material and the soil. This approach is similar to a reinforced concrete structure, wherein the steel bar is subjected to the tensile force, and the concrete is subjected to the compressive force, while in the reinforced soil structure, the reinforcing geosynthetics material is subjected to the tensile force, and the soil is subjected to the compressive force. As the soil provides friction between the soil and the reinforcing material, the reinforcing structure is able to resist lateral earth pressure and reduces deformation of the soil.

ACE solutions using geosynthetics offers the following advantages:

Structure–The design specifications and construction technologies are well established, thus the reliability of structural calculation can be well controlled.

Toughness–With excellent toughness, the structure is superior to a rigid RC structure in resisting the lateral deformation of the soil.

Stability–Reinforcing materials are highly durable, and the strength can be adjusted according to structure service life.

Seismic resistance–The reinforcing material has strong tensile strength and uniform stress distribution, so the reinforced soil structure has no stress concentration problems. In addition, the reinforced soil structure is flexible which is specifically suited for areas where earthquakes occurrence is frequent.

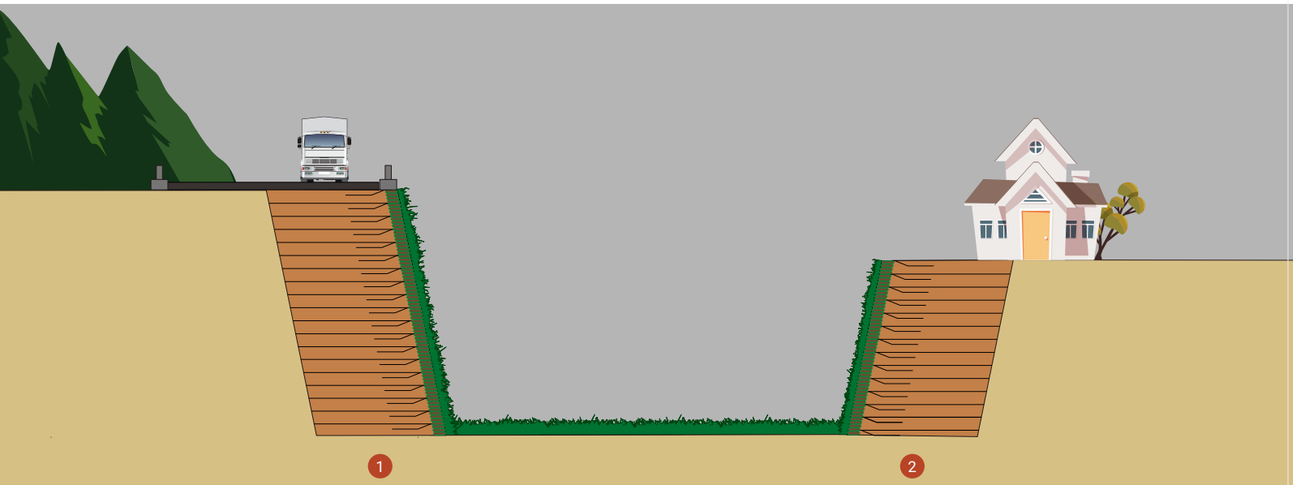
Ability to tolerate settlement–The amount of settlement allowable is 30 cm or more is much larger than the allowable values on other conventional structures. The pre-pressing method or secondary construction method (the structure at the top of the wall is installed after the main compaction is completed) are commonly used to eliminate possible settlement after construction.

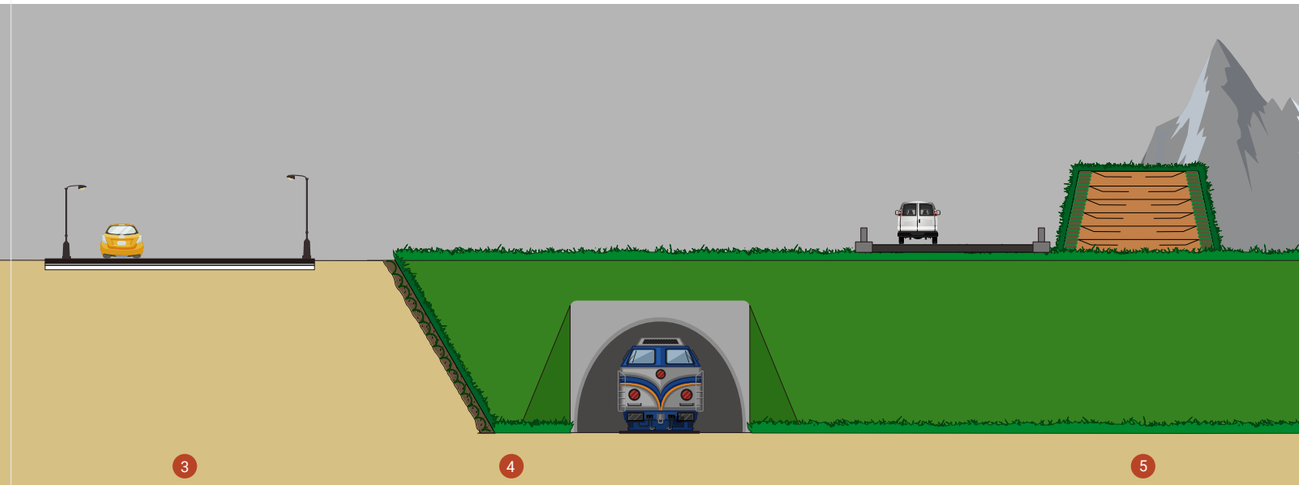
Economy–In-situ materials can be salvaged and re-use in the construction which is economically more advantageous for the construction of permanent structures.

Ecology–It is one of the standard ecological construction methods which meets the requirements of ecological and environmental protection.

Aesthetics–The appearance of lush green vegetation scenery gives a softer tone to the area and notwithstanding it is easy to create a natural landscape.

Rapidity–Construction procedures and methodologies are simple, construction quality control is easy to maintain, and it is more conducive to emergency repair as it shortens the construction period.





1. Landslide Remediation and Road Rehabilitation

2. Geosynthetic Reinforced Slope and Retaining Wall

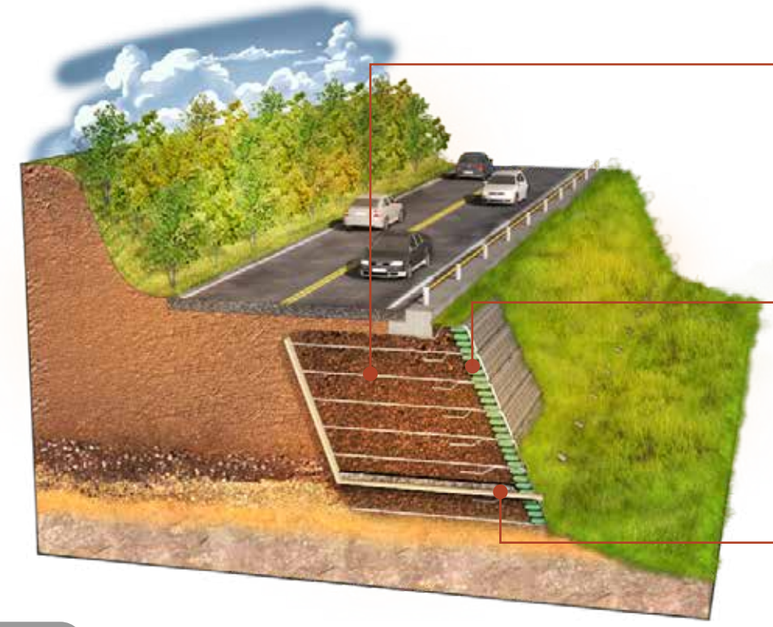
3. Basal Reinforcement

4. Slope Erosion Control

5. Debris Control Embankment

1. Landslide Remediation and Road Rehabilitation

The socio-economy livelihood of people within the society or community is closely linked to infrastructural development which necessitates the construction of the access roads as a requisite to improve the movement of goods and services. However, roads are characterized by numerous upgrades and extension either in lengths and broad widths. These continuous constructions has a profound impact on the environment and ecological balance especially if the right solution is not used. Amongst the main causes of slope failure and related disasters along the mountain roads are directly related to inferior environmental factors and poor geological conditions.



Before

After

ACEGrid®
Flexible Woven PET Geogrids
for Soil Reinforcement

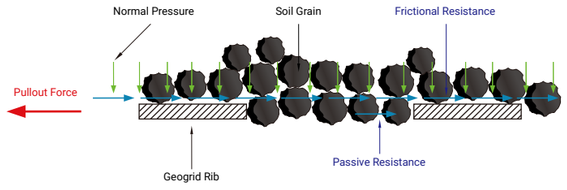
ACESandbag™ EC
Durable Sandbags
for Erosion Control

ACEDrain™ S
Drainage Geocomposites
Consisting

These lack of consideration combined with humanistic features before and during road construction has a negative influence resulting worsen conditions over time thus compromising the safety of the roads. In recent years, the impact of climate change has been keenly felt with heavy rains occurrence more frequently, devastate mountain roads and cause rock-falls that scale up natural disasters. This not only causes serious economic losses to the country but also adversely affect the local people's livelihood and the safety of transportation. Thus, it is imperative to explore factors causing disasters along the mountain roads and propose corresponding improvement measures.

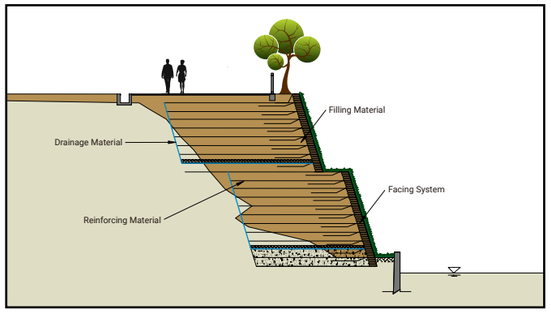
While emergency repairs and countermeasures can be employed after the occurrence of a road slope failure to mitigate against potential disasters by minimizing the degree of hazard, and maintain the basic traffic functions to guarantee security. The use of geotechnical materials in the design solutions is more suitable as the construction method is simpler, and the construction cost is lower than that of the conventional concrete structure. Furthermore, construction period will be much less while able to meet the demands of repair under emergency situations.

Soil reinforcement implies add geosynthetics materials such as the geogrid and/or geotextile with high tensile strength in order to increase the shear strength of the soil to reduce or prevent lateral deformation. The addition of geogrid and/or geotextile to the soil is horizontally laid in single layer of up to 500mm with multiple layers done likewise to the required designated height. This creates a tension and interlocking mechanism through the interaction between the geogrid and/or geotextile with the soil, so that lateral displacement of the soil layer is restrained to increase the strength of the composite. The interaction can be (1) the anchoring behavior between soil and geogrid and/or geotextile mesh, and (2) friction along soil and geogrid/geotextile interface. The interaction is shown in the figure below. It should be noted that compaction to at least 90% MDD base on site condition is also important for every layer of geogrid and/or geotextile.



Interaction between the Soil and the Geogrid/Geotextile

The geosynthetic reinforced soil structure is shown in the figure below. The types and characteristics of various components are described as follows.



Facing System
The ACESandbag™ EC is filled with suitable soil. Since the pore size of the ACESandbag™ EC is small, it contains the fill soil to prevent erosion from run-off storm water and allows vegetation growth.

Reinforcing Material
The ACEGrid® is used to create the interlocking effects with the backfill soil, so the requirements for the backfill quality is reduced. ACEGrid® has exceptionally high tensile strength characteristics with low strain and anti-creep performance, which can enhance the long-term service life of the reinforced soil structure.

Filling Material
The general filling materials for reinforced soil structures can be generally divided into four (4) categories: gravel, sand, silt and clay soil. While granular sands and gravels are preferred because of their large particle size, friction angle and their strength are not reduced by water soaking. It is expected that the existing soil may not necessarily be granular sands and gravels, based on the balance of excavation and filling. Therefore, in order to avoid the pollution caused by excessive digging soil, the use of clay or silt or combination of both soil to improve the economic viability and environmental friendliness of the reinforced structure can be utilized as a last resort. Currently, there are various research in that direction and our most recent case is a testament to such efforts. However, it should be noted that the shear strength of clay is greatly reduced owing to its vulnerability to rainwater, thus wherever feasible to use sand or gravel soil as the filling material is advisable especially in highways and high-speed railways unless it can be ensured that the drainage system works well.

Drainage Material
Generally, this is mainly made of gravels or permeable sandy soil or geosynthetic composite (Geo-Composite) can also be included as drainage material.

ADVANTAGES :

- The construction procedure is simple, the quality control is easy to maintain, and construction period is reduced.
- In-situ soil materials are used to reduce construction costs.
- Seismic resistance is enhanced.
- Settlement tolerance is improved.
- The appearance is optional in accordance with the facing systems.

REFERENCE 1

Application of Complex Reinforced Structure near Fault Zone

Nantou, Taiwan
2009
ACEGrid® ACEDrain™ ACESandbag™ EC

2011 IFAI

Due to the heavy rain during the rainy season, about 80 meters roadbed section collapsed with slide height difference of about 30 meters.

The foundation of the structure was made with piles and anchored to the RC cantilever retaining wall, while the Mechanically Stabilized Earth (MSE) retaining wall is used for the slope. The deep underground drainage and surface water intercepting system is strengthened. The slope surface was completed with hydro-seeding to allow lush vegetation growth.

The volume of concrete used is reduced, and the existing in-situ soil and stone materials on site are used for backfilling, thus reducing the material cost, transportation costs, and carbon emissions. The walls can be painted green, and the impervious areas can be reduced. Upon completion of the construction, the vegetation growth provided an excellent habitat for creatures in the area.

REFERENCE 2

Slope Rehabilitation

Taichung, Taiwan
2013
ACEGrid® ACEDrain™ ACESandbag™ EC

2013-2014 Excellent Agricultural Construction Project Award (Mountain Disaster Prevention)

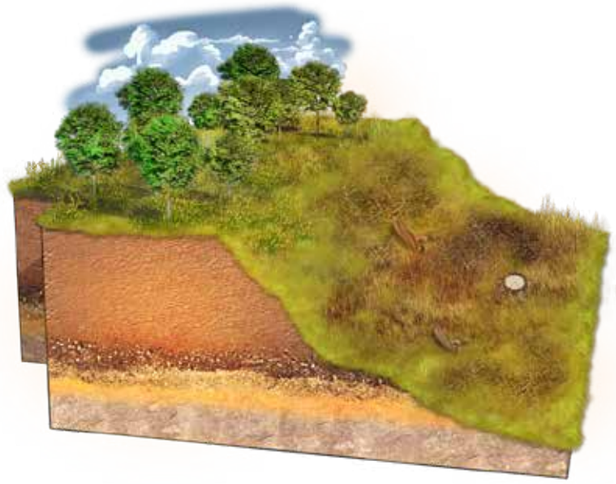
This area is located on the top of the red earth gravel platform. Its slope on the north side of the base is adjacent to Dajia River and subjected to erosion by the wind and rainfall all year-round, thus inducing multiple collapses.

The mechanically stabilized earth construction method is used to complete the reinforced earth retaining wall at a height of 29 meters and the slope top drainage system.

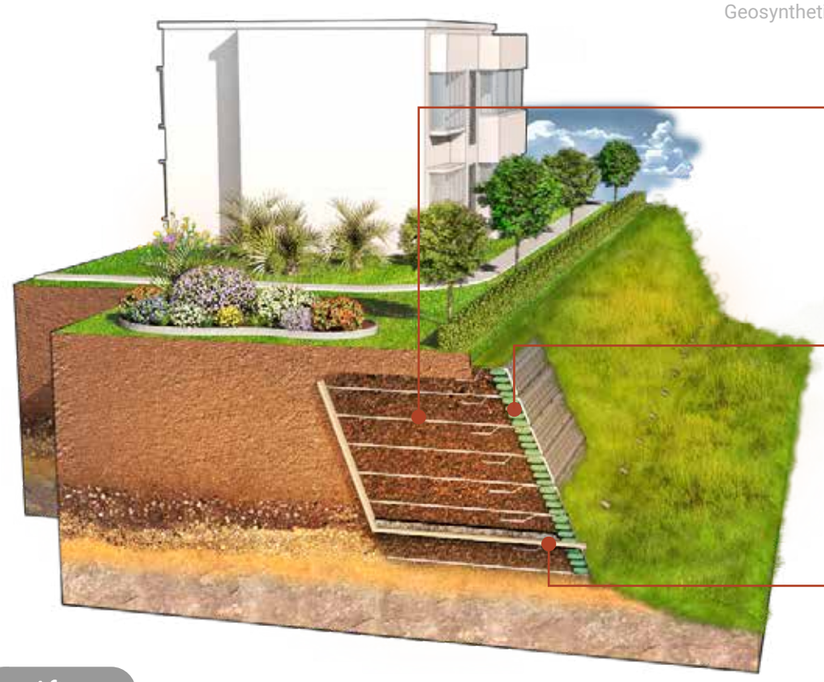
The collapsed earth and stone materials were used for backfilling to reduce the cost of purchasing similar materials. Planting vegetation on the slope increased the stability of the slope, and also help to restore the original ecosystem for ecological conservation and visual aesthetics.

2. Geosynthetic Reinforced Slope and Retaining Wall

Slopes are common geographic features and can be found everywhere with steepness ranging from gentle slope to ultra-steep slope and/or cliff ranges. Most slopes are naturally occurring geological phenomenon through the process of sedimentation, uplifting, and erosion over time. Similarly, other slope formations are engineered as a result of cut and fill human actions from the civil work. While both of the slopes have different origin of formations, their vulnerability to failure when subjected to heavy rains, earthquake or increased loading poses a potential safety hazard. To mitigate against the above earthwork structures are categorized into geosynthetic reinforced slopes and geosynthetic reinforced walls. Geosynthetic reinforced slopes are earthwork structures constructed with a slope face angle up to 80 degrees from the horizontal plane with wrap around facing system to allow vegetation growth to blend into the surrounding environment.



Before



After

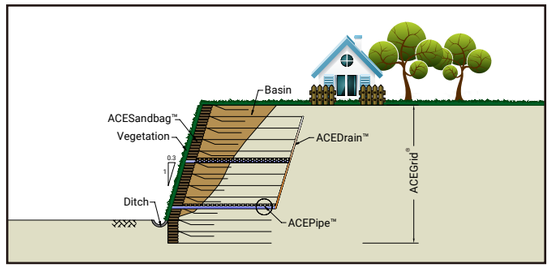
ACEGrid®
Flexible Woven PET Geogrids
for Soil Reinforcement

ACESandbag™ EC
Durable Sandbags
for Erosion Control

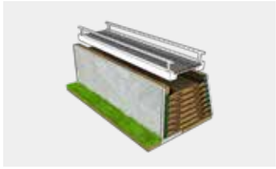
ACEDrain™ S
Drainage Geocomposites
Consisting

Typical unreinforced soil slopes are limited to a slope facing angle of approximately 30 degrees, or less, depending on the angle of repose of the soil or site conditions with similar facing system to geosynthetic reinforced slopes. These solutions provide a cost-effective means to achieve more efficient grade finishes than are otherwise not possible with conventional unreinforced slopes. Geosynthetic reinforced walls are also earthwork structures but constructed with the facing angle close to 90 degrees from the horizontal plane. However, the facing systems more robust and not limited to wrap around system but dependent on case by case field of applications, structure usage or clientele selection. These may include precast concrete panels, dray cast modular blocks, metal facing panels etc. While conventional retaining walls is made up of rigid concrete gravity structures which are usually massive enough to resist the destabilizing forces of the retained fill, reinforced soil walls are flexible gravity retaining structures created out of existing soil to fill itself with geosynthetic reinforcement geogrid and/or geotextile added to the design.

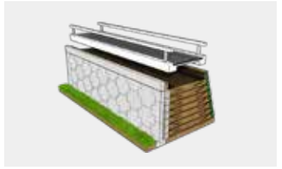
It is common for geosynthetics reinforced structures (slopes or walls) to have a combination of rigid and flexible composite body structures. The rigid structure are usually mass concrete gravity wall, reinforced concrete slab or reinforced concrete cantilever walls with variations depending on functionality, usage, application and load consideration. The addition of steel H-piles and/or reinforced concrete piles may also be required in areas wherein the sub-soil layer is expansive clay and soil replacement is not possible and/or high pore water pressures and/or along coastal/water channels. This avoids scouring of the beneath the earthworks structures and/or allows to the rigid structure to be anchored into the bedrock soil layer thereby provided a stable platform for the earthwork structure to be built.



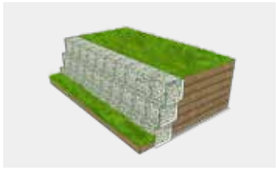
Similarly, flexible structures requires the addition of geosynthetics materials such as the geogrid and/or geotextile with high tensile strength in order to increase the shear strength of the soil to reduce or prevent lateral deformation. It should be noted that there is a huge emphasis on compaction up to at least 90% MDD according to on site condition for every layer of geogrid and/or geotextile while stepping the face of the slope back at an angle. Notwithstanding, the incorporation of drainage systems to increase water seepage and reduce pore water pressures is also important. In addition, the facing system to protect from erosion by vegetation or other protective systems ranging from concrete slabs to geocell walls and including a wide variety of systems should also be selected properly.



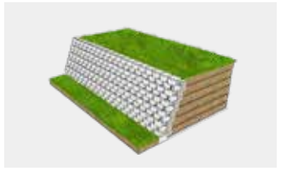
Cast-in-place Concrete Facing
(Reinforced Railroad/Road with Rigid Facing, RRR Method)



Segmental Precast Concrete Panel Facing



Gabion Facing



Modular Block Facing

Design and construction of stable slopes and retaining structures within space constrains are aspects of major economic significance in geotechnical engineering projects. The following are the geosynthetic products used in the reinforced slope/wall system:

ACEGrid®
ACEGrid® is a polymeric, mesh-like planar product formed by intersecting elements, called ribs, joined at the junctions. The key feature of geogrids are the openings between the longitudinal and transverse ribs, called apertures. The apertures are large enough to create interlocking with the surrounding soil particles. The ribs of geogrids are often quite stiff compared to the fibers of textiles. Also, the junction strength is important in the case of geogrids because, through these junctions, loads are transmitted from one rib to the other rib when geogrid layers are installed within the soil. The main function of ACEGrid® is reinforcement is to increase the strength of a soil mass as a result of its inclusion, thus it maintains the stability of the soil mass.

ACETex®
ACETex® is a permeable, polymeric textile product in the form of flexible sheets of ACETex® . As a filtration function, it allows for an adequate flow of fluids across its plane while preventing the migration of soil particles along with fluid flow during the service life and period of construction. ACETex® also has a separation function, which means it prevents intermixing of adjacent soil layers with different properties during construction and the life service period of the geosynthetic-reinforced soil structure.

ACESandbag™ EC
Containment function, ACESandbag™ EC encapsulates or contains a civil engineering related material such as soil, rock or fresh concrete to a specific geometry and prevents its loss.

ACEDrain™
Drainage function, allows for adequate flow of fluids within its plane from surrounding soil mass to various outlets during the life service period of application under consideration.

ADVANTAGES :

- Geosynthetic reinforced slope provides a stable resistance against slope failure, incorporating with the nature and adjacent slope.

REFERENCE 1

Reinforced Earth Wall, Central Taiwan Science Park

Taichung, Taiwan
2011
ACEGrid® ACEDrain™ ACESandbag™ EC

The drainage on the original slope is poor, causing erosion of the slope soil due to the impact of heavy rain, which seriously affects the stability of the slope.

The traditional reinforced concrete retaining wall is replaced with the reinforced earth retaining wall to create a beautiful factory environmental friendly scenery with the vegetation on the slope.

The plants and vegetation can grow fast on the Wrapped Around. Reinforced Earth Retaining Wall, which replaces the stiff and lifeless gray cement wall and provides a good habitat for animals and plants.

REFERENCE 2

Reinforced Earth Wall, Lotus Bed Mountain Buddhist Temple

Miaoli, Taiwan
2012
ACEGrid® ACEDrain™ ACESandbag™ EC

In order to build a temple on the top of the slope, the reinforced earth retaining structure was proposed to be constructed on the slope to stabilize the area surrounding the site of the building and create a green and beautiful atmosphere.

Based on the topography of the area, landscape planning and construction requirements, Wrapped Around Reinforced Earth Retaining Wall was constructed on the slope.

In addition to meeting the safety requirements of the project, it also creates a beautiful landscape in natural harmony.

REFERENCE 3

ACEGrid® Utilized on Chilpancingo Retaining Wall

Chilpancingo, Mexico
2007
ACEGrid®

2007 IFAI

To build the residential housing complex in a mountainous area, substantial leveling off the site was mandatory. For a conventional solution, multiple tiered retaining walls have to be built to accommodate different housing arrangements.

The ACEGrid® MSE wall allowed engineers to integrate cut, fill, and retaining structure into one step which made the site preparation much straightforward. Compacted fill reinforced with ACEGrid® satisfied both static and dynamic loads and therefore becoming a perfect seismic-stable structure. For aesthetic requirements, the designer specifically selected modular concrete blocks as the face of the MSE wall to match well with the appearance of the surrounding housing complex.

The reinforced earth system integrated earth construction and retaining structure into one step, and perfectly match with the appearance of the surrounding housing complex.
Compacted fill reinforced with ACEGrid® geogrid eliminated the possibility of seismic damage and differential settlement.

REFERENCE 4

Reinforced Earth Wall, Taiwan Pavilion Expo Park

Hsinchu, Taiwan
2012
ACEGrid® ACEDrain™ ACESandbag™ EC

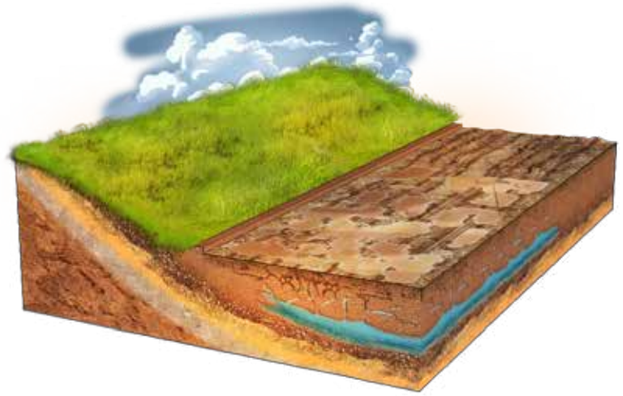
To rebuilt the park of the Taiwan Pavilion of the Shanghai World Expo. Due to the space requirements and road construction, it was proposed that a reinforced earth retaining wall will be designed on the slope below.

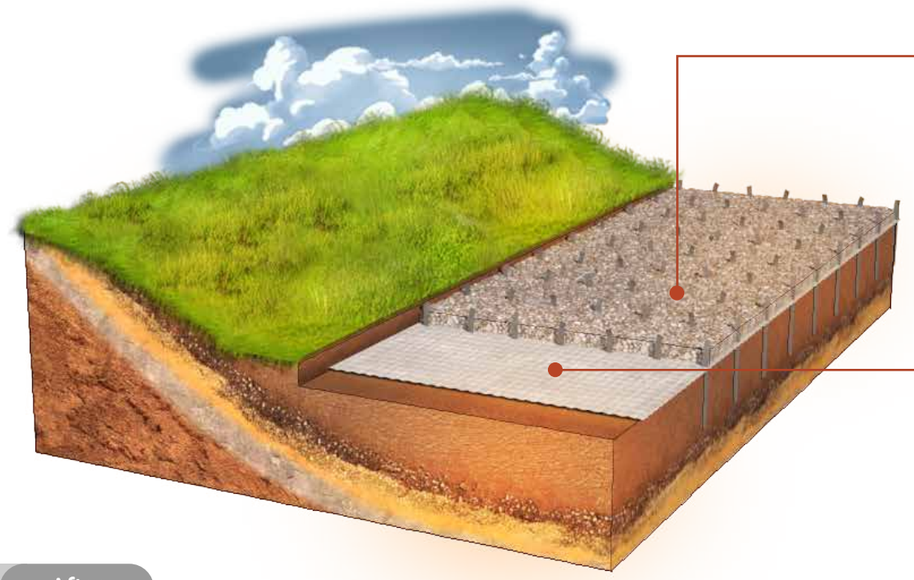
A 10m high-strength earth-retaining wall with a total length of more than 250m was built, and the top of the reinforced earth structure was used as a 15m-wide composite contact road.

The use of reinforcing materials in conjunction with existing soil and sands for construction significantly reduces material and transportation costs while reducing carbon emissions. It also provided an optimized configuration that is practical, safe and environmentally friendly.
The construction procedure was simple and fast, which helps to shorten the construction period and advantageous to the opening schedule of the park.
The reinforced earth structure is stable for planting and water-retaining bed. After planting, it can echo the river below, and weave a quiet and recreational atmosphere.

3. Basal Reinforcement

Owing to factors such as site selection, environmental protection, and land acquisition, the construction of public works is often built upon weak soil layers with insufficient bearing capacity and excessive compression volume. Therefore, for the foundation of the structure to be dealt with, it is often necessary to invest a lot of financial resources, material resources and time. Upon completion of such engineering, there is still the risk of uneven settlement. Cognizant of this, the use of effective, environmentally friendly and economical site improvement technologies to take care of soft ground and ensure the safety of foundation becomes a subject that civil engineering personnel must face cautiously.





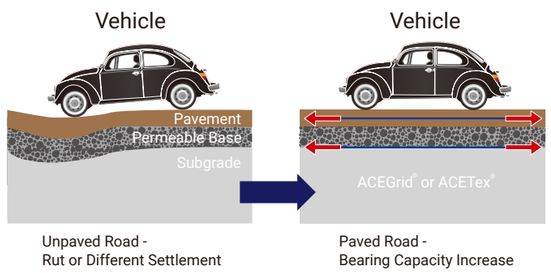
ACEDrain™ S
Drainage Geocomposites Consisting

ACETex®
High-Strength PET Woven Geotextiles for Soil Reinforcement

Before | After

In response to the challenges, soil replacement, compaction, consolidation, and other principles are used to improve the loading capacity at the site. This increases the shear strength, reduces the amount of subsidence and water permeability, while also and improving the physical and mechanical properties of the site. The purpose is to: (1). Increase the load-bearing capacity of the soil. (2). Prevent soil liquefaction. (3) Improve the effectiveness of water seepage and drainage. (4). Prevent slope failure and reduce soil loss. (5). Prevent shear damage and reduce shear deformation. Also, during earthquakes, groundwater and sand are mixed into the mud, which generates huge water pressure. The mud water releases pressure to the ground, causing mud pumping upward and soil piping, resulting in uneven subsidence on the surface and causing tilting of the building and rupture of the road surface. Thus, solving uneven subsidence and soil piping caused by the liquefaction of the soil are very important.

Compared to cumbersome soil treatment methods or comprehensive soil replacement, laying ACETex® geotextiles and/or ACEGrid® geogrids in or upon weak soils can increase their loading capacity more quickly and effectively and reduce uneven subsidence.



As shown in the above figure, if the soil foundation contains clay or fine-grained soil, it may cause uneven subsidence due to the influence of the upper load. If ACEGrid® or ACETex® is used in the soil layer, when the upper structure or the loaded vehicle pushes down, ACEGrid® and ACETex® will be able to exert the reinforcement function with its high tensile strength, thereby enhancing the loading capacity of the soil layer. At the same time, the loading capacity can be distributed onto the geotechnical material to reduce uneven subsidence. On the other hand, ACETex® has separation and filtration functions to stratify the soil, which helps avoid the mixing of fine-grained soil and coarse-grained soil and also reduce the chance of soil piping.

Reinforcing material
ACETex® or ACEGrid® is used to increase the loading capacity of the soil and reduce uneven subsidence. Therefore, using geosynthetic material with high tensile strength laid to provide the lateral restraining force and to disperse the tensile stress, so the loading capacity of the base layer is increased to reduce the settlement of the soil layer.

Separation and filtration materials
ACETex® geotextile having good permeability with adequate opening sizes is used to separate soil layers but allow water to pass through.

Drainage filter
Generally, it is mainly made of permeable grade or sandy soil, and the geosynthetic composite (geo-composite) can also be used as a water-permeable material.

ADVANTAGES :

- It reduces the total cost of the project.
- Construction procedures are simple, quality control is easy to maintain, and the construction period can be reduced as well.
- Reduce uneven subsidence and backfill thickness.
- Avoid soil pumping with separation and filtration functions.

REFERENCE 1

Ground Improvement, Queensland Motorways Gateway Upgrade Project

Brisbane, Australia
2008
ACETex®

The Gateway Bridge and connecting road expansion project is located on the alluvial plain of Brisbane River, which is mainly composed of weak and saturated sedimentary soil, hence the low bearing capacity and large subsidence which can result in serious engineering safety issues.

When the Prefabricated Vertical Drains (PVDs) are used along with the ACETex® PET geotextiles, the PVDs can accelerate the excess pore water dissipation in the soil, while the ACETex® PET have separation and reinforcement effects. This can increase the soil shear strength, reduce the amount of compression, and increase the bearing capacity upon completion of the construction work.

It can significantly shorten the soil consolidation time and increase the bearing capacity of the soil so that the project can be completed smoothly within the scheduled time.

REFERENCE 2

Upgrading Unstable Ground Prone to Subsidence

Texcoco, Mexico
2013
ACEGrid® ACETex®

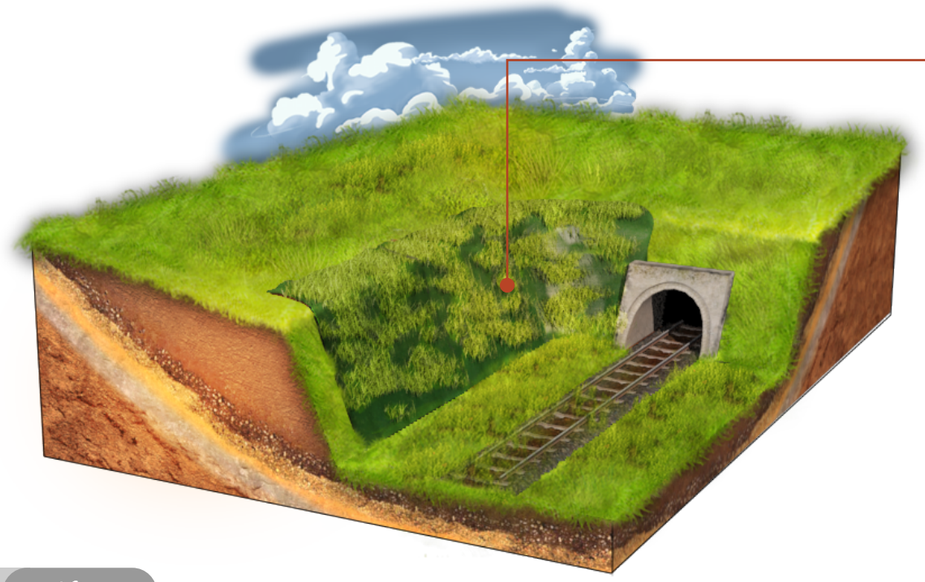
In the Texcoc area in Mexico, there was a proposed plan to build a new international airport. However, the surrounding area would gradually sink due to groundwater overdraft., thus it was necessary to take effective measures to avoid damage to the airport structures.

ACETex® geotextiles and ACEGrid® geogrids are used together, as the former separates the weak strata, while the latter reinforces and stabilizes the strata. ACETex® geotextiles and ACEGrid® geogrids can jointly disperse the building load and avoid soil subsidence to stabilize the strata.

It provides a simple, rapid and economical countermeasure for buildings constructed in the subsidence area of the stratum.

4. Slope Erosion Control

Due to the scouring of the bare slope caused by the rain resulting in the loss of soil on the slope, the vegetation will not grow easily. Hence, erosion grooves will be formed over time causing large amounts of earth and rocks to collapse. Therefore, it is necessary to protect the slope, by reducing the erosion on the slope from the storm water flow, to restore the vegetation on the slope. In addition to being beneficial to the ecological environment, the foliage and roots of the plant will add excellent benefits for slope erosion control.



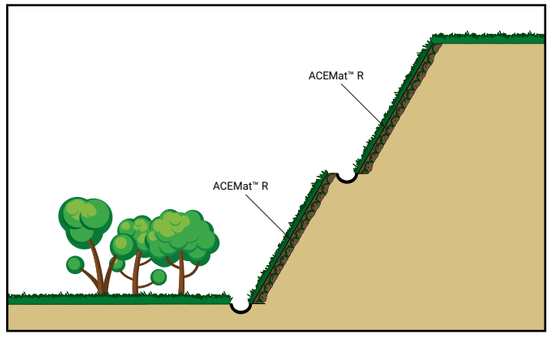
ACEMat™ R
Three-Dimensional and High-Strength Woven Mats for Erosion Control

Before

After

The primary goal of erosion control on slopes is to minimize the erosion caused by rainwater and surface runoff, with balance construction, economy, and environmental friendliness solution. Laying the erosion control mat on the slope can effectively reduce the anti-scour effect on the slope thereby increasing the stability. The erosion control mat forms a protective layer on the slope to avoid the scouring force of rainwater and surface runoff while also assisting in plants and vegetation growth. This can be applied to different terrains, including the high-steep slope. In comparison to other methods such as spray grout concrete or shotcrete, it also has the advantage of construction expediency, cost-effectiveness, and it can greatly reduce the impact on the environment and ecology. With regards to different local environments, traditional drainage methods can also be used to accelerate surface runoff discharge, or the spray artificial hydro-seeding can be used in combination to enhance the effect of erosion control.

As ACEMat™ R 3D High-Performance Turf Reinforcement Mats are stable and homogeneous. The thickness and three-dimensional woven structures can be applied to the slopes to increase the surface roughness, protect the soil surface from being eroded by rainfall and retain seeds and plants, and increase the vegetation area on the slope after being laid and anchored on the slope surface. Also, ACEMat™ R has very high tensile strength which offers effective and efficient solutions for severe erosion control problems in steep slopes, barren areas, riverbanks, channels, and heavy rainfall areas.



ACEMat™
ACEMat™ R erosion control mats are fabricated by PP woven yarns with high tensile strength and UV resistance.
The 3D-pyramid design effectively enhances the retention capacity of soil and vegetation, thereby protecting the slope.
U-shaped reinforcement bar (No.3): for anchoring ACEMat™ R to the slope is used during installation.

ADVANTAGES :

- High erosion control performance over a long-term period increases cost-efficiency.
- Simple and quick installation which reduces construction time.
- Environmentally and ecologically friendly.
- Wide ranges of applications, including normal to steep slope vegetation, slope vegetation in rainy area, dense hydro-seeding in barren area, protection for shallow slope of fragmental geology, etc.

REFERENCE 1

Treatment and Erosion Protection, Upper Slope of Tunnel Portal

Taichung, Taiwan
2006
ACEMat™ R

The collapsed site is located on the hillside of the left side of the tunnel. It collapsed due to the abundant rainfall from the typhoon in 2006, which endangered the safety of bridges, tunnels, and tourists.

The three-dimensional ACEMat™ R with diamond-shaped wire mesh composite was used to replace the traditional concrete slope which induces significant loading on the slope. Also, soil nail is used along the fractured zone to stabilize the slope surface, control the erosion of the collapsed ground and facilitate re-vegetation.

The ACEMat™ R stabilizes the planting substrate to avoid erosion by scouring. It can increase the roughness of the slope surface, slow down the flow velocity of the runoff, and prevent the erosion of the slope surface.

REFERENCE 2

Slope Protection, Lingyun Cliff

Nantou, Taiwan
2014
ACEMat™ R Soil Nail

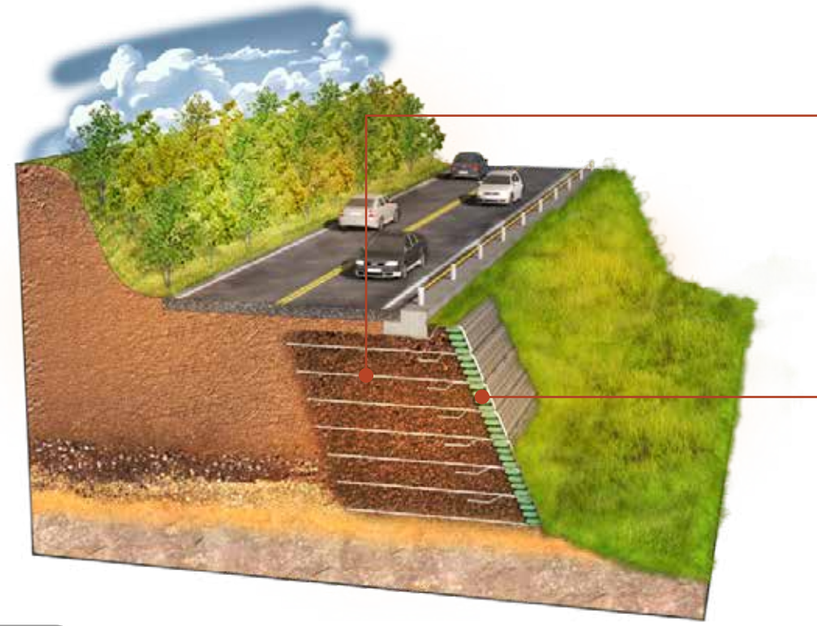
During the 2013 earthquake, the soil layer on the slope was significantly fractured and loosen causing the incessant rock fall on the road beneath, resulting in damages. The original anti-falling stone barrier poses a serious threat to the road traffic safety below.

Self-drilling soil nails in combination with the anti-falling ACEMat™ R to stabilize the slope surface and the loosen/fractured soil layer to prevent falling rocks and improve the driving safety along the road.

The construction is fast and rehabilitate the slope efficient.

5. Debris Control Embankment

In the face of natural disasters such as falling rocks, debris flows, landslides, avalanches, etc., active slope stabilization systems may be used, or blocking devices may be added. However, in some areas where the local conditions are more severe (for example, the slopes are too wide or unreachable), the aforementioned disaster prevention methods may not be adequate, or the effect may be limited.



ACEGrid®
Flexible Woven PET Geogrids
for Soil Reinforcement

ACESandbag™ EC
Durable Sandbags
for Erosion Control

Before

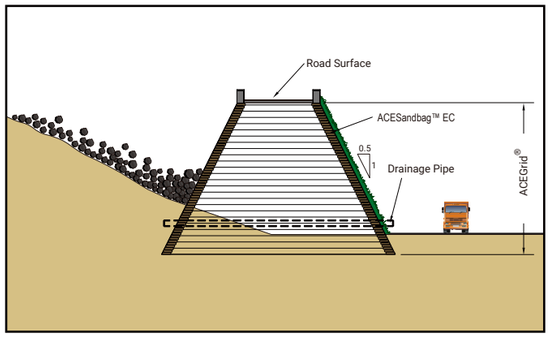
After

Debris flow controls can be generally divided into source treatment, transportation management, and sedimentation management. The source treatment mainly aims to prevent or reduce the loss of soil and sand materials based on the topography and current conditions. With regards to transportation management, it aims to reduce the flow velocity of the earth-rock via engineering or vegetation, thereby reducing the damage caused by the earth-rock flow. For sedimentation management, it aims to effectively treat the silt that accumulates on the stream bed when the earth and rocks flow to the estuary dominated by flat or nearly flat terrain. It should be noted that source treatment and transportation management are likely to be located in the mountainous areas which poses construction inconvenient resulting in higher treatment cost, sedimentation management is more common. Sedimentation management is mainly conducted based on accumulation and drainage.

The commonly used preventive treatment methods are usually not cost-efficient and do not necessarily suppress the recurrence of debris disasters effectively. On the contrary, the reinforced earth embankment is a fairly good alternative choice. With the surrounding gravel that is in the local area, it provides excellent material for the civil structure though it lacks the cement-like cohesive force. If sufficient cohesion can be provided for such gravel, the gravel will become the best structural material for engineering. Moreover, the structure is more tolerant to deformation than the rigid reinforced concrete, which will greatly reduce the long-term risk of the overall retaining structure.

Rock-fall embankment is a passive disaster prevention system. It can be installed at the foot of the slope to block the falling rock, so as to alleviate any potential safety hazard to passing vehicles or cause obstruction of traffic flow. The solution can also limit the area where the rock-falls are likeliest to occur and/or frequently to save time in clearing the rocks. Using reinforced earth embankment in Debris Control has significant advantages such as withstanding huge impact force from landslides or collapse earth and stone within a short time. Compared with the RC structure, the reinforced earth structure is less rigid and more flexible structure composed of reinforcing materials and soil thus, it has a higher modulus of toughness and larger deformation and settlement tolerance. In other words, it has better buffering and energy absorption capacity which makes it excellent earth and stone control measure that is simple and fast to implement.

The schematic diagram in this section of rock-fall embankment prevention is shown below. Apart from the aforementioned energy dissipating function and earth retaining capability, another important aspect of earth embankment is that it can be constructed with debris material from the disaster and used as backfill material so that the local disposal cost and the working hours can be greatly reduced.



ADVANTAGES :

- The structural function and safety can be greatly improved, and the energy absorption and drainage effect are good.
- It can be constructed with debris materials form the collapse or landslide to reduce the construction costs.
- Construction procedure is simple, quality control is easy to maintain, and the construction period can be greatly reduced.
- The slope surface of the embankment can be used for vegetation to make the appearance more natural and the scenery beautiful.

REFERENCE 1

Debris Flow Disaster Restoration Project

Miaoli, Taiwan

2008

ACEGrid® ACEDrain™ ACESandbag™ EC

Huoyan Mountain is an unstable slope topography, and the rock formation is seriously exposed. Most of the frequently occurring debris flows are often caused by typhoons and heavy rains. The project site is located at the west side exit of the Huoyan Mountain Tunnel in Miaoli, and it is proposed to solve the hazards of the debris flows from the Huoyan Mountain to the Miaoli County Road 140.

The stiffened earth embankment is used as the main structure for earth and stone treatment as it blocks and guides the earth and stones into the temporary accumulation area. A dredging channel is setup at the top of the embankment in order to transport and accumulate earth and rocks for reuse.

The debris that might harm and/or disrupt traffic is converted into usable earth and stones, which is cost-effective. Upon completion of the work, the surface of the structure has been reinforced, and it has been integrated with the regional landscape based on a large number of existing vegetation and plants.

Structural Design

In this case, the design of Wrapped Around Reinforced Earth Embankment is adopted, and the geogrids with a longitudinal tensile strength of 200 kN/m or more would be used to wrap up the local soil and sands layer with the spacing of 50cm between each layer. The design elevation of the reinforced earth embankment varies from Elev. = 163m to Elev. = 176.6m. The total length is 177m, the average slope is 7.69%, the maximum slope is 8.91%, and the width at the top of the embankment is 6.6m. Reinforced concrete pavement and blocking guardrail with a net width of 6m is set for the dredging vehicles to use in the future. The slope V : H = 1 : 0.5 extends down to the base, and the base width is up to 20m.
In the detailed design, the reinforced earth structure has a higher permeability than the RC (reinforced concrete) structure. However, in order to be more effective in reducing the high pore-water pressure generated by the earth and rock flow, a 10 cm-diameter HDPE drain pipes with a spacing of 5 m are set up at the bottom of the reinforced earth embankment. In addition, a double-row 60 cm-diameter cement culvert pipes are also used as the drainage pond discharge facility. Similarly, for ecological effects, the outer side of the reinforced earth embankment is Wrapped-Up Soil bags to facilitate vegetation planting, while the inner side also adopts wrap-up design to maintain its modulus of toughness as it will be in contact with the earth and stones. Moreover, to increase the anti-wear and energy-absorbing effects of the contact surface, a layer of geotextile is also wrapped as shown in Fig.1. The design length of the wrapped-up section maintains the pre-tension force applied to the geogrids of the wrapped up section by the implement/machines and tools for a longer period of time. Also, in the construction, the anchoring grooves, the length of the wrapped-up section is designed to be 2.5 m or more.

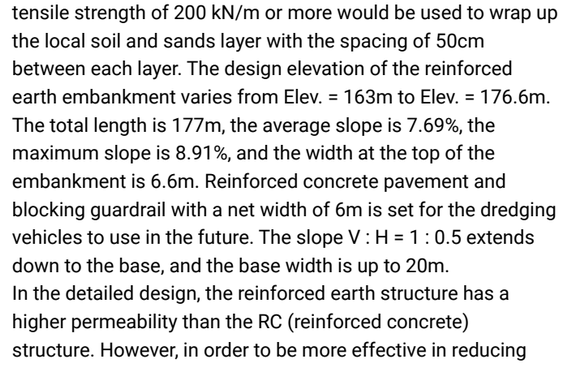


Fig.1 Laying of the Geotextile on the Inside of the Reinforced Earth Embankment

Structural Stability Analysis

Since the design is based on permanent structural positioning, long-term reduction effects need to be considered, the longitudinal comprehensive reduction factor of the geogrid is 3, whereas the allowable tensile strength is 66.7 kN/m, and the tensile modulus is 2300~2900 kN/m2. The analysis is carried out by using the limit equilibrium method and finite element method (strength reduction method SSR). The analysis using the limit equilibrium method is shown in Fig. 2, Fig. 3 and Fig. 4 while the results of the safety factors under normal, earthquake and heavy rain conditions are shown 2.08, 1.22 and 1.41, respectively. Similarly, the results obtained by the finite element method are shown in Fig. 5 and Fig. 6, and what have been considered are as follows: a) When the dam is empty and receives the 1st blow of earth and rock flows, it is loaded with a full load, and the road load is simulated as the external load on the top of the embankment. As a result, the overall safety factor is >1.5, and the maximum tensile force for the stiffened grid is 49 kN/m, which is less than the design strength of 66.7, so the structure is safe and the analysis results are shown below in Figure 5. b) To determine the safety of the empty dam when the largest earthquake occurs, the calculated safety factor is >1.5, and the maximum tensile force for the stiffened is 42kN/m, which is less than the grid design strength of 66.7, so the structure is safe and the results of the analysis are shown below in Figure 6.

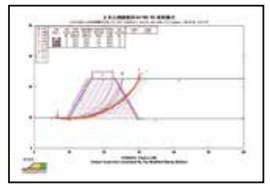


Fig. 2 Mechanical stability analysis using the limit equilibrium method for the reinforced earth embankment (normal mode)

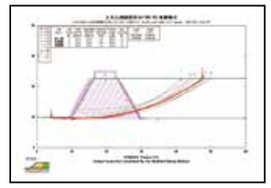


Fig. 3 Mechanical stability analysis using the limit equilibrium method for the reinforced earth embankment (earthquake mode)

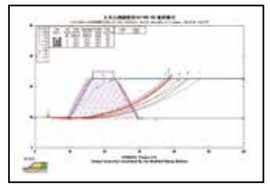


Fig. 4 Mechanical stability analysis using the limit equilibrium method for the reinforced earth embankment (storm mode)

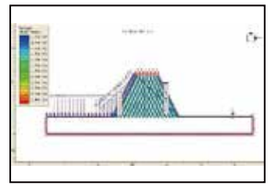


Fig. 5 Mechanical stability analysis using the finite element method for the stiffened earth embankment (full load)

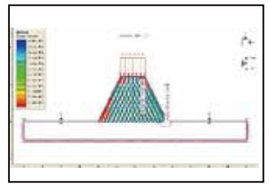
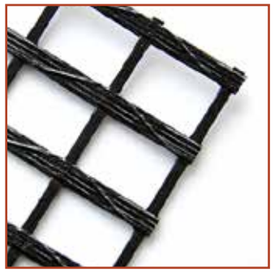


Fig. 6 Mechanical stability analysis on the stiffened earth embankment (earthquake)

From the above comprehensive analysis results, the reinforced earth embankment designed in this case is sufficient to provide the resistance required by the embankment for remediation of the debris flow.



ACEGrid® Geogrids

ACEGrid® is woven from high-strength polyester fiber bundles (PET) for soil reinforcement. The mesh size and structure are adjusted according to the product specifications. In addition to the anti-UV protective film, the outer layer may also be added with flame retardant components to improve fire resistance and durability.

ACETube® Geotextile Tubes

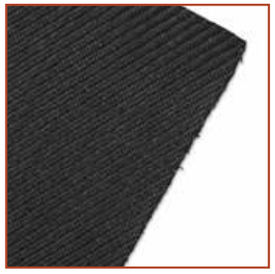
ACETube®, a large-sized tubular bag made of the polypropylene (PP) geotextiles, can be filled with sand and stones to form a gravity structure, which is usually used to construct various types of structures for shoreline protection. The bag material has good durability, good water permeability, sediment retention efficiency, and good workability, and as it can be filled with in-situ materials, it can also greatly reduce the construc-tion cost.

ACETex® PET Geotextiles

ACETex® PET is woven from high-strength polyester fiber bundles (PET) to exhibit high tensile strength at low strain. It has the functions of reinforcement and separation, and can be widely used for soft soil improvement, base stabilization, and weak foundation reinforcement, etc.

ACESandbag™ Geotextile Bags

ACESandbag™ is highly robust geotextile bag for forming temporary or permanent structures in hydraulic and geotechnical engineering, erosion control and facility protection. The sizes and shapes of ACESandbag™ can be customized to satisfy the desired purpose. The bag material is resistant to ultraviolet rays, water permeable, and easy for construction, and the filler can be taken locally.



ACETex® ES Geotextiles

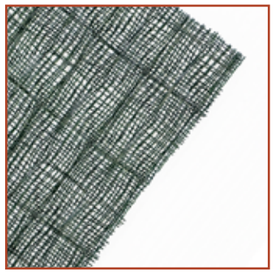
ACETex® ES is woven into a special structure with self-developed polypropylene (PP) yarns. It has high stiffness and high water permeability. It can also have excellent separation, filtration and reinforcement functions. It is especially suitable for road subgrade stabilization and base reinforcement. It can improve road safety and extend its service life.

ACEFormer™ Geotextile Mattresses

ACEFormer™ consists of two layers of high-strength geotextiles for slope, river bank and pipeline protection. It is filled with cement mortar, and a rigid protective layer can be formed after consolidation. Different types can be designed according to environmental requirements, and all will have the advantages of easy construction and good adhesion to the protected object.

ACETex® NW Geotextiles

ACETex® NW is nonwoven geotextile made from either polyester continuous filament yarns by needle-punched manufacturing process; or polypropylene staple fiber by needle-punched manufacturing process with thermally bonded surface.



ACEMat™ R High Performance Turf Reinforcement Mats

ACEMat™ R is a three-dimensional fabric woven from high-strength polypropylene (PP) yarn has a quadrangular pyramid structure that interlocks with the soil, protects the soil surface from erosion, and retains plant seeds and roots to promote planting. It provides an efficient solution for erosion control in exposed steep slopes and heavy rain areas.

How Quality is Achieved?

1.Expertise

ACE Geosynthetics has more than 40 engineering experts with different professional knowledge covering geotechnical engineering, hydraulic engineering, marine engineering, environmental engineering, landscape engineering, construction management, mechanical engineering, chemical engineering, material engineering, textile engineering, and so forth. These professionals are primary keepers of all production and operation at ACE, to ensure all in coming tasks are well interpreted, evaluated, processed, and produced.

2.Quality Management

The fundamental quality management system of ACE Geosynthetics is recognized and certified by ISO 9001 and 9002. With the basic guideline of ISO 9001, ACE Geosynthetics further obtained CE Marking, BBA Approvals, and NTPEP Qualification Report for its final product(s).

3.In-house Certified Laboratory

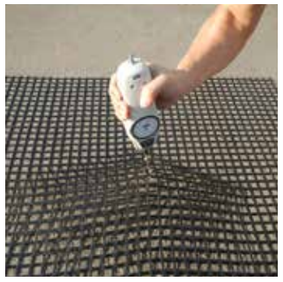
There is an in-house civil engineering laboratory to carry out a series of professional tests for research and development and product quality control purposes. The laboratory is certified by TAF (Taiwan Accreditation Foundation), and is further recognized with the ILAC Laboratory Combined MRA Mark as shown below:

ilac-MRA

TAF
Civil Engineering Laboratory
2285

FACTS

With premium grade yarns and cautious production process, the physical and mechanical properties of ACE products are as good as expected. Besides regular tests in the lab, various long-term and short-term experiments for the inherent physical property, mechanical property and long-term design property of product are also carried out. Tests like UV test, chemical resistance test, seawater immersion test, cement soil burial test, PVA geogrid anchoring test, adhesion test with asphalt pavement, oxidation test, filtration test, abrasion test, and many other tests have been done (or in the process of doing).



Adhesion Test

Filtration Test

Outdoor Exposure Test

Anchoring Test

Cement Soil Burial Test

Oxidation Test

Seawater Immersion Test

Chemical Resistance Test

Why Choose ACE Geosynthetics?

2017 IFAI AWARD OF EXCELLENCE
2016 IFAI AWARD OF EXCELLENCE
2015 IFAI AWARD OF EXCELLENCE
2013 IFAI OUTSTANDING ACHIEVEMENT
2011 IFAI OUTSTANDING ACHIEVEMENT
IFAI Award of Excellence
IFAI Outstanding Achievement
BEST IN CATEGORY — GEOSYNTHETICS — IAA 2017 - NEW ORLEANS, LA

Since 2006

Since 2003

Participation in relevant associations

International awards

6 Continents

70 Countries

Countries where our products are sold

A diverse team with 20 years of experience

Professional Ability

Integration Ability

Quality Assurance

Patent Portfolio

Journal publications, exhibitions, seminars

Issued Patents 60+

Countries 25

Published Papers 56

Annual Participation 10+

From product development/ manufacturing to processing





From engineering planning and design analysis to construction


BBA


GOSTR


TAF


ISO9001


CE


NTPEP

International Certification


ISO14001


ISO50001


ISO14064


Geogrid Carbon Footprint Assessment


Geotextile Tube Carbon Footprint Assessment


Reinforced Embankment Carbon Footprint Assessment

Would Like to Know More about Geosynthetics?

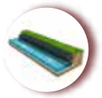
Come to Explore and Learn Geosynthetic Applications in ACE Geosynthetics Ecopark!

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/

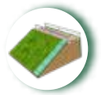
Reinforcement

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

ACE Geosynthetics

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Note: The information provided herein is accurate to the best knowledge of the company and is given out in good faith. All the information contained is intended as a general guide only to use of such products and we do not accept liability for any loss or damage however arising, which results directly or indirectly from use of such information. ACE Geosynthetics has a policy of continuous development thus information and product specification may change without notice.

2020/07