ACE Geosynthetics

ACE Solutions in Transportation Geotechnics

2022

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 geosynthetic engineering market. We offer a wide range of high-performance products, including geogrids, geotextiles, geotextile tubes, vegetative nets, drainage materials, landscaping, and hydraulic materials. The applications of ACE products include but are not limited to collapse site remediation, slope and retaining wall engineering, weak foundation improvements, slope erosion control, road engineering, environmental protection, maritime engineering, and riverbank protection. In the past ten years, the Company's outstanding performances in the design and service of geosynthetic materials have been repeatedly recognized by International Achievement Awards from Industrial Fabrics Association International (IFAI). The number of awards obtained by the Company is one of the best among global competitors. ACE Geosynthetics exports its products and services span more than 70 countries across five continents. The Company has taken place in the international geosynthetics industry stably.

Our quality management system has been recognized and certified by ISO 9001 and 9002. With the basic guideline of ISO 9001, ACE Geosynthetics further obtained accreditation by other certifying agencies worldwide, such as CE Marking, BBA Approvals, and NTPEP Qualification Report for its final product(s). The Company has become one of the manufacturers with complete global product certification systems. We also have established our laboratory to carry out a series of engineering tests for research and development and product quality control. The government-authorized TAF (Taiwan Accreditation Foundation) has certified the laboratory. In addition, since 2003, ACE Geosynthetics has established a professional team to provide integrated geosynthetic expert engineering services, including planning, design, and construction consultation. With these capabilities available, we are competent to offer integrated services from product development, manufacturing, and processing to engineering performances that meet the requirements of each particular project and further ensure the most extensive overall benefits for customers.

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Professional Services

Engineering Planning and Design

For the practical application of a project, we can establish a special task force to assist our client with site investigation, systematic engineering planning, feasibility study, and initiate proposals according to customer needs. In the design stage, we can also provide preliminary design, detailed final design, materials and construction specifications, safety analysis in line with international design specifications, cost analysis, and additional information such as estimate initial carbon emissions.

Construction Guidance and Support

We help customers to plan the specification and quantity of equipment required for the construction. We can also draft construction documents for our client, including the construction plan, contract drawings, specifications, and guidelines for construction supervision. In addition, our experienced engineers are available to provide on-site support relevant to the construction methods or material performances for our products and systems.

Technical Consultations

For the production of a specific application, we offer economical and reliable solutions for customers. We can develop the material specification, design methodology, construction guidelines, durability concerns, and subsequent maintenance issues. ACE Geosynthetics works with our clients to develop any possible innovative application systems that manage to solve challenging engineering problems.

Geosynthetic Product Testing

Our TAF-certified laboratory provides professional testing services for geosynthetic products. A range of long-term experiments can be conducted to evaluate the required variations of long-term physical property of products in different environments to support our design consulting services.

Professional Services Provided by the Special Task Force of ACE Geosynthetics



ACE Solutions

Landslide Remediation and Slope Construction

- Landslide Remediation and Road Rehabilitation
- Reinforced Earth Slope and Reinforced Earth Retaining Wall
- Slope Erosion Control
- Diversion Dike for Debris Flow Control

Coastline Protection

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

Riverbank and Channel Protection

- Revetment Restoration
- Bridge Pier Scour Protection
- Channel Slope Armor
- Flood Detention Stability

Transportation Geotechnics in Roadway and Railway

- Subgrade Stabilization
- Base Reinforcement
- Pavement Improvement
- Embankment and Abutment /Approach Construction



ACE Solutions in Transportation Geotechnics

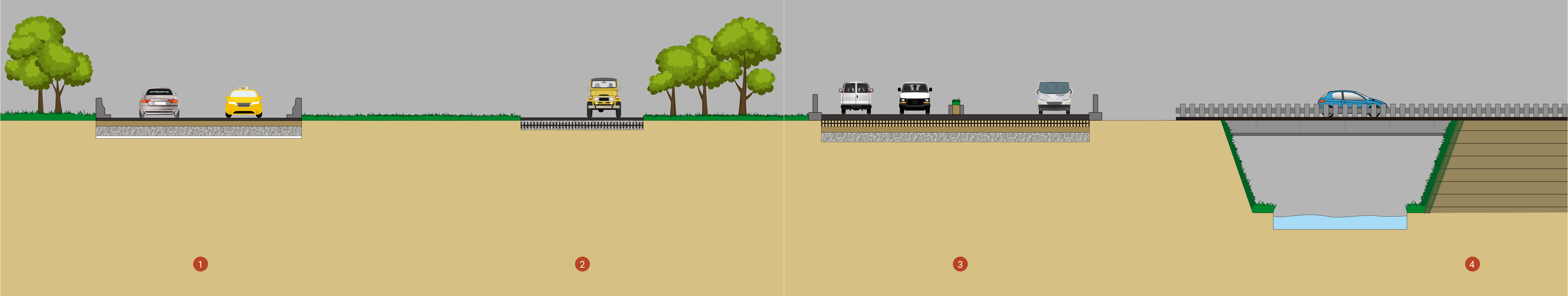
Transportation infrastructure often involves substantial financial investment and prolonged construction time. However, because its construction largely depends on topographic changes, the site's geological, hydrological, and environmental conditions may significantly influence its safety.

Common problematic site conditions encountered are slope instability for excavation and embankment, bearing failure, excessive settlement of weak strata, erosion of surface water or softening groundwater seepage, and the concerns of an eco-friendly environment. The need for innovative solutions for a strong and reliable transportation foundation is more urgent and essential than ever for transportation infrastructure practices. Transportation geotechnics has become more and more critical in responsible for sustainable roadways, railways, airfields and ports, subgrade, or embankments.

Geosynthetics are generally polymeric products with excellent mechanical properties and hydraulic conductivity. The exceptional functions of separation, reinforcement, filtration, and drainage are especially suitable for solving problematic geological and hydrological conditions encountered by transportation infrastructures. Geosynthetics have been widely used in new road construction and road renewal projects. For example, the structure of a typical roadway consists of subgrade, subbase, base course, and surface course(pavement).

Geosynthetics can be beneficially applied to roadway structures for subgrade stabilization, base reinforcement, and pavement improvement, which enhance the overall paving structure as it is constructed by applying appropriate geosynthetic materials. Geosynthetics can also be applied to embankment and bridge abutment constructions, which use geotextile or geogrid reinforced earth structure as the structure's support. In addition, geosynthetics also positively contribute to roadway subsidiary facilities such as slopes, drains, and retaining structures.

When a roadway is built on weak strata, substantial bearing failure or significant settlement becomes unavoidable. Placing the geosynthetics in the subgrade can effectively increase the bearing capacity of the soft soil materials and divert the imposed traffic load. The reinforcement function of geosynthetics also dramatically improves the overall bearing capacity of the subgrade and reduces the stress on the load-bearing area. Geosynthetics also serves as a separate layer to prevent the soft material from intruding into the clean base course. In many cases, geosynthetics replace or reduce the need to use natural aggregate construction materials, providing economic and environmental benefits. The overall improvement of the bearing capacity of the subgrade can be evaluated qualitatively and quantitatively using the equivalent California Bearing Ratio (CBR) method. The effect of increasing the CBR on the subgrade layer due to the geosynthetics reinforcement can be evaluated by conducting model analysis or experimental verification.



1. Subgrade Stabilization

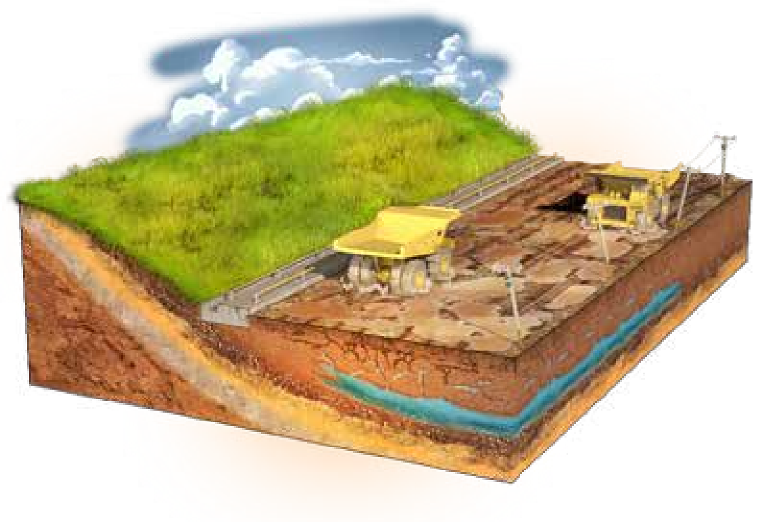
2. Base Reinforcement

3. Pavement Improvement

4. Embankment and Abutment Construction

1. Subgrade Stabilization

Subgrade acts as the foundation in a pavement structure. It supports all the traffic load and then transfers it down to the underlying strata. Problems usually occur when soft soils, such as clay, silt, or organic soil, are encountered. The subgrade is often inadequate to support traffic load if it has a lower bearing capacity. The typical solution for this type of problem is the replacement of soft soil with reliable bearing material. Other common options are ground modifications such as deep compaction, chemical stabilization, or preloading. However, these methods are usually time-consuming and costly.



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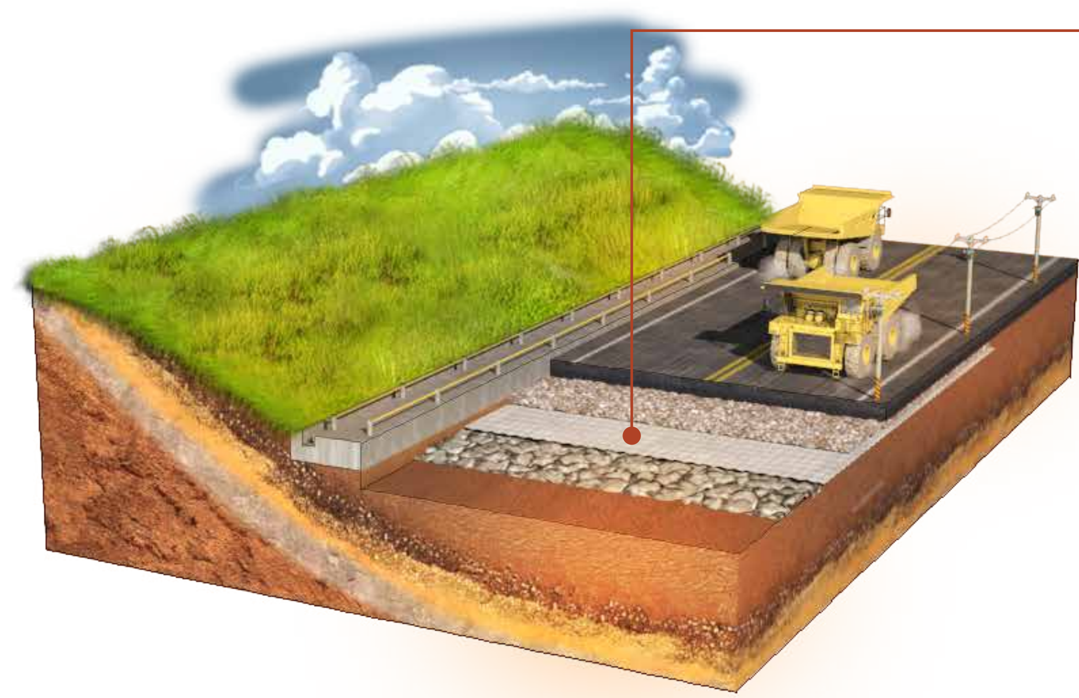


After

ACETex®
High-Strength PET or High-Stiffness ES Woven Geotextiles for Soil Reinforcement

ACEGrid®
Flexible Woven PET Geogrids for Soil Reinforcement

To improve a soft subgrade, the engineer can simply place a layer of ACEGrid® or ACETex® on top of the subgrade. The granular aggregates can then be placed as usual. In this kind of application, both ACEGrid® and ACETex® empower two essential functions: the membrane effect and lateral restraint. The membrane effect is the ability to reduce and spread stress arising from the weak subgrade. Lateral restraint, also called confinement, is the lateral interaction between the aggregate and the subgrade with ACE products. With these functions active, a higher effective angle of shearing resistance is then mobilized, and the subgrade shows improvement in bearing capacity.

In the presence of exceptionally soft soil, ACETex® can be used together with conventional treatment methods, such as preloading or preloading with prefabricated vertical drains (PVD), to accelerate the occurrence of a settlement or to reduce the amount of differential settlement. For this application, ACETex® not only reinforces the subgrade but also serves as a practical drainage pathway to expedite the dissipation of the excess pore water induced by the preloading.

ACEGrid®

ACEGrid® is a polymeric, mesh-like planar product formed by intersecting elements, called ribs, joined at the junctions. The critical feature of geogrid is 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. Because of its flexible structure, ACEGrid® provides more contact with the adjacent soil. Soils pull apart under tension. Compared to the soil, geogrids are strong in tension. Therefore, the primary function of ACEGrid® is reinforcement, which means increasing the strength of a soil mass as a result of its inclusion. Thus it maintains the stability of the soil mass and allows them to transfer forces to a larger area of soil than would otherwise be the case.

ACETex®

ACETex® is a permeable, polymeric textile product in the form of flexible sheets. ACETex®, as a filtration function, allows for adequate flow of fluids across its plane while preventing the migration of soil particles along with fluid flow during the projected service period of the application under consideration. ACETex® also has a function of separation, which means it prevents intermixing adjacent soil layers with different properties during the construction and the projected service period of the geosynthetic-reinforced soil structure. ACETex® ES with low elongation produces a strong reinforcement when subjected to vertical load. The reinforcement provides a shearing resistance against soft soil, thus reducing the deformation.

ADVANTAGES :

- Using geosynthetic materials for pavement construction, specifically in subgrade stabilization, will undoubtedly improve the subgrade's durability and the pavement struc ture's performance. The increased bearing capacity of the subgrade layer will eliminate the necessity of pavement reconstruction in the future, thus extending the pavement's service life.

REFERENCE 1

Subgrade Stabilization, Pan Borneo Highway

Sarawak, Malaysia

2017

ACETex® ES

The local government built a 1,060 km long roadway connecting Telok Melano and Merapok for urban development. This section is seasonally subject to heavy rains and passes through many wetlands with weak soils. Rainwater infiltration frequently tends to undermine the subgrade and damage the pavement structure.

To treat the weak subgrade, the engineer first placed ACETex® ES geotextiles and a layer of granular course on the surface of the soft soil for preparation. Prefabricated vertical drains (PVD) were then installed to stabilize the underlying weak soils. The consolidation period was shortened considerably, while the stability and bearing capacity were improved significantly with time. Lastly, another layer of ACETex® PET geotextile was placed, followed by staged backfills to the final design elevation. The additional ACETex® PET was to provide further functions of separation, filtration, drainage, and reinforcement.

The ACETex® geotextile used in pavement systems has converted the soft subgrade into a safe and stable traffic supporting structure. It also has saved on large-scale soil improvement processes and significantly reduced material and transportation costs.

REFERENCE 2

Subgrade Stabilization

Poland

2011

ACEGrid® ACETex® PET

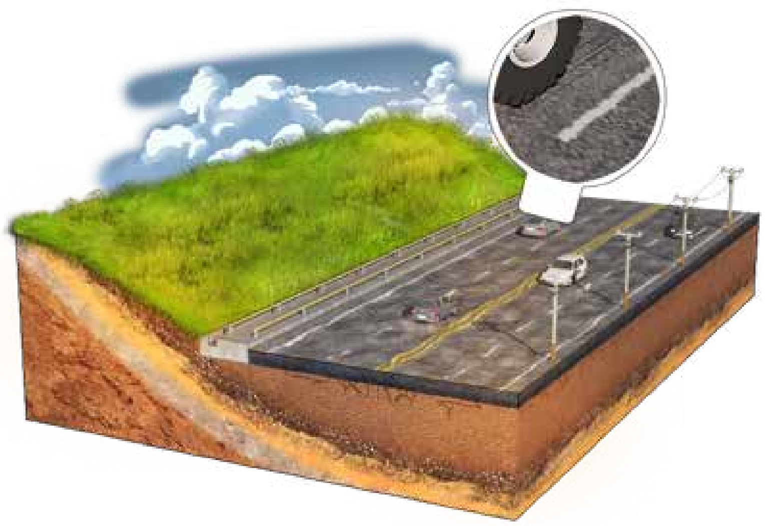
Part of Provincial Highway No.875 passed through a soft soil area with a high groundwater level. The highway has shown seriously rutting damage before reconstruction due to the insufficient bearing capacity of the subgrade and the large number of heavy-duty vehicles moving through this section.

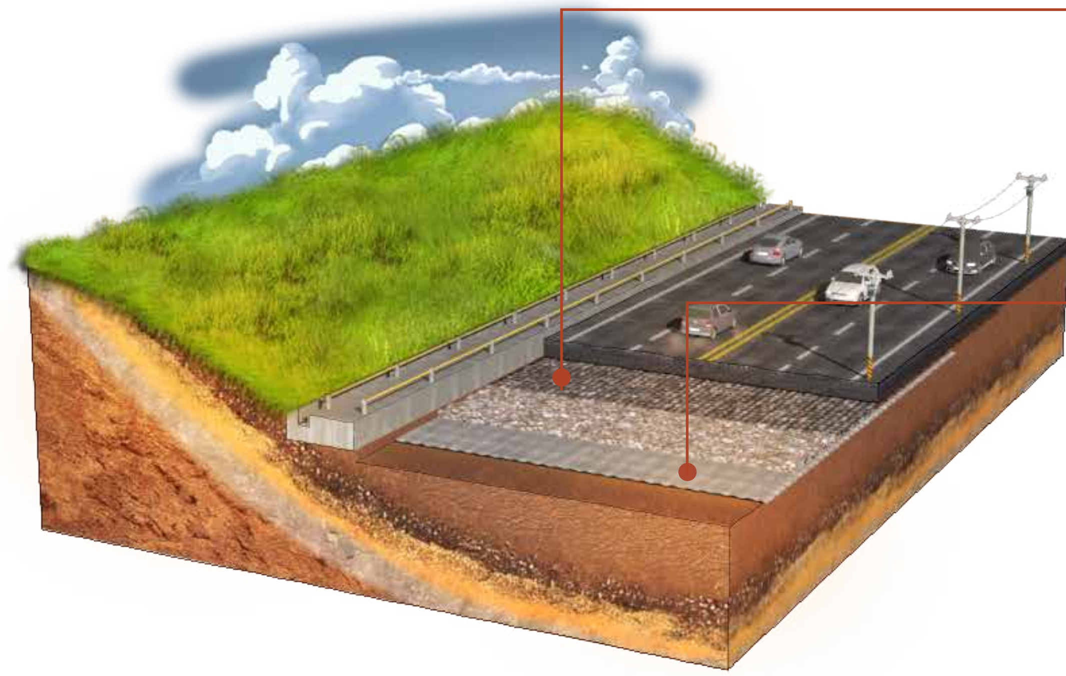
ACETex® PET was used to reinforce the subgrade so that the imposed stresses could be evenly diverted to reduce the differential settlement. It also separated the clean gravel of the base course and the soft subgrade materials. ACEGrid® was then placed in the gravel layer to increase the bearing capacity of the subgrade, thus increasing the service life and reducing the rutting of the subgrade.

ACETex® PET has a high tensile modulus that allows for very low distortion when the roadway carries a higher load. ACEGrid® can be fully interlocked with aggregates to create an enhanced composite material with higher performance. It reduces the amount of gravel used and improves roadway service conditions because of the effect of the interlock mechanism. Since the completion of the project, the highway has performed well. No deterioration or settlement has been observed within the treated area.

2. Base Reinforcement

A transportation infrastructure passes through problematic areas with insufficient bearing capacity, and excessive compressibility often causes significant cost increases and delayed schedules because of the need for site treatment. Furthermore, upon completion of the construction, difficulties such as differential settlements or distortions of pavement may still be underway for long-term or frequent maintenance. Thus, how to use effective and eco-friendly ground improvement techniques to ensure the safety of the transportation infrastructure is an essential topic in question.



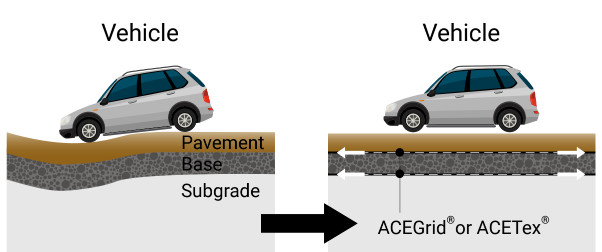


ACEGrid®
Flexible Woven PET Geogrids for Granular Material Reinforcement

ACETex®
High-Strength PET or High-Stiffness ES Woven Geotextiles for Granular Soil Reinforcement

Before | After

Engineers generally apply ground improvement techniques such as replacement, densification, consolidation, and solidification to stabilize the soft soil. All these treatments aim to deplete the soil's excess pore water, leading to an increase in shear strength and a decrease in compressibility.



Conventional Road with unsuitable base - Rut or Differential Settlement

Road with Base Reinforcement - Compare the deformation behavior under the same traffic capacity, base course with reinforced improvement would be more stable.

Compared to those traditional soil treatment methods, laying ACETex® geotextiles or ACEGrid® geogrids in or upon weak soils presents a more efficient and economical solution.

As shown in the figure, if the subsoil beneath a transportation infrastructure contains a soft geological formation, it may cause bearing failure or intolerable differential settlement upon the application of service loading. Because of the effect of reinforcement given by the geosynthetics, they can be used for treatment. Therefore, ACEGrid® or ACETex® can be applied in this case and significantly improve the unstable situation. The differential settlement also can be well controlled due to mechanical stabilization. In addition, the functions of separation and filtration of ACETex® can prevent the mixing of unsuitable soft, fine-grained soil and competent coarse-grained soil, further ensuring the base's overall long-term quality.

1. Reinforcing material
ACETex® or ACEGrid® has a high tensile strength to reinforce soft soil and thus can be used to increase the bearing capacity of the soil and reduce the amount of differential settlement. When compacted granular material is laid on these geosynthetics, the resulting mechanically stabilized aggregate layer exhibits improved load-bearing performance. In addition, the improved load-bearing characteristics significantly reduce the requirements for high-quality, imported aggregate fills, thus reducing the construction's carbon footprint.

2. Separation and filtration materials
ACETex® can separate different sizes of soil layers to ensure the competence of suitable material for reliable pavement support. ACETex® also is permeable to filter water but retains fine particles from passing through, thus eliminating the risk of foundation instabilities such as piping or pumping for the pavement.

3. Drainage filter
ACETex® permits in-plane and cross-plane water flow, thus allowing moisture dissipation out of the system. It can be used extensively in a wide range of drainage applications for transportation geotechnics such as underdrains for the base course, intercept drains for bridge abutments and retaining walls, replacing porous coarse-grains filters, or other conventional filter/drain materials.

ADVANTAGES :
- Avoid soil instability with separation, filtration, and drainage functions.
- Reduce uneven subsidence and backfill thickness.
- Construction procedures are simple, engineering quality is easy to control, and the construction period can also be reduced.
- Reduces the total cost of the project.

REFERENCE 1

Ground Improvement, Queensland Motorways Gateway Upgrade Project

Brisbane, Australia

2008

ACETex®

The Gateway Bridge and the connecting road expansion projects are primarily located in the alluvial plain of the Brisbane River. The subsurface at the site is mainly composed of weak and saturated soft deposits. The low bearing capacity and unwanted settlement, therefore, can result in severe issues against engineering safety.

The authority introduced geosynthetics, prefabricated vertical drains (PVDs), and the ACETex® PET geotextiles for ground improvement. The PVDs combined with preloading can accelerate the soil's dissipation of excess pore water.

The ACETex® PET presented separation and reinforcement effects, which ensured the quality of sound aggregate and thus increased the overall bearing capacity of the base course upon completion of the construction work. Using ACE geosynthetics, the engineer has significantly shortened the soil consolidation time, eliminated the differential settlement, and reinforced the foundation soil. The project has been completed smoothly within the schedule.

REFERENCE 2

Railway Improvement

New Taipei City, Taiwan

2011

ACEGrid® ACETex®

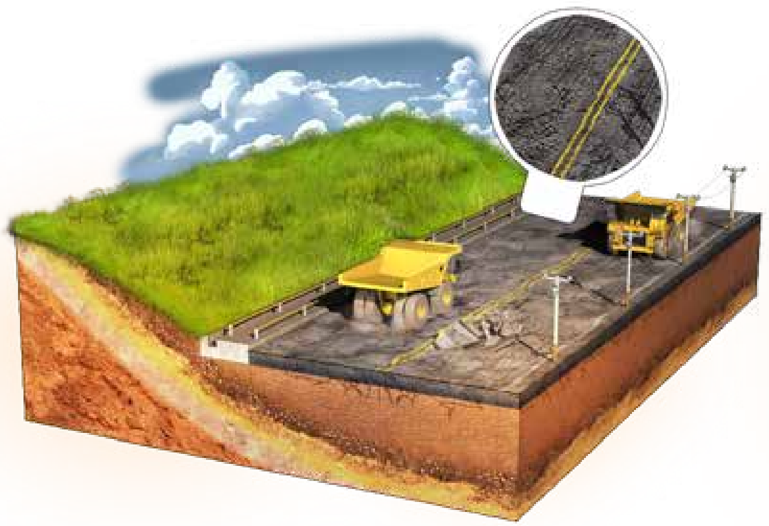
Taiwan railway plays a critical role in north-south passenger communications and freight transportation. However, some sections of the railway presented unsuitable subgrade problems because of the early outdated design. The drainage system at the site did not function properly. When the train passed through, it induced excess pore water pressure quickly.

In this case, the site has a higher groundwater level; the repeated load, therefore, has caused severe subgrade pumping and weakened the bearing capacity, triggering differential settlement of the railway track bed or distortion and deformation of the railway. The advantages of geosynthetics were made the best use of in this case. ACETex® geotextiles and ACEGrid® geogrids were used to filter out water, separate the ballast and soil, and reinforce the subgrade to improve the bearing capacity of the foundation and avoid differential settlement. Sheet drain and perforated geopipes with suitable permeability were also used to accelerate drainage.

The rail foundation's axial and lateral bearing resistance can be increased to avoid contamination of the load-bearing layer by the fine-grained soil below. ACE geosystem also prolongs the service life of the track ballast and effectively reduces the maintenance times and costs. Generally, the frequency of ballast replacement is 2 to 6 times yearly. This case has been completed for about ten years, and there has not been a need for replacement.

3. Pavement Improvement

Asphalt concrete (AC) is a composite material used to build flexible pavement for roads, parking lots, and airports. A typical flexible pavement system includes four layers: surface course, base course, subbase, and subgrade. The surface course is a structure between the vehicle tire and the bearing strata of granular materials. Its primary function is to resist the traffic load on top of the surface course. As the pavement flexes under the load, stresses are redistributed over a greater area than the tire footprint. The imposed stresses would reduce layer by layer through the pavement structure and transmit and distribute the wheel loads to the natural subgrade.



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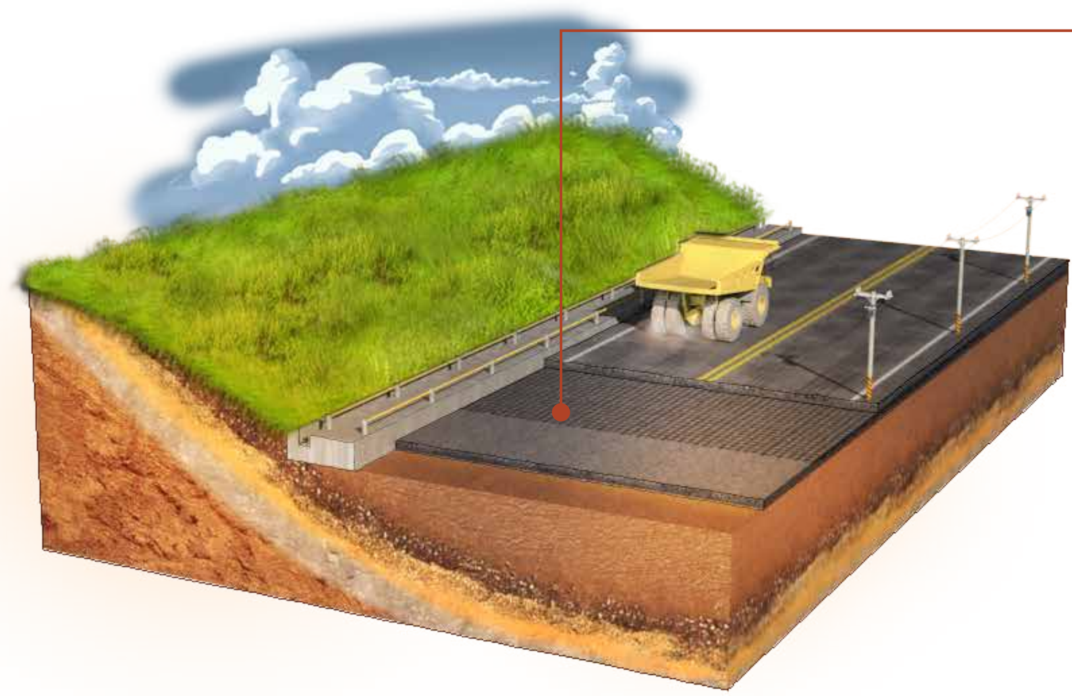


After

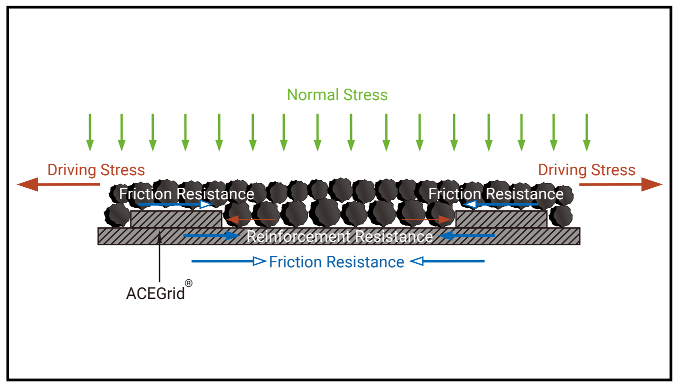
ACEGrid®
Fiberglass Geogrids coated with Bitumen for Asphalt Concrete Pavement Reinforcement

The pavement structure must provide relevant stability and quality to achieve safe, fast, reliable, convenient, and large-scale service performance. Two critical considerations must be taken into account for the stability of pavement structure: (1) the horizontal tensile strain at the bottom of the asphalt layer should be minimized to prevent fatigue cracking, and (2) the vertical stress on the top of subgrade should be minimized to reduce settlement. The structure and function of the pavement will directly affect the vehicle's driving speed, comfort, safety, and running costs.

During its service life, a flexible pavement may experience two different types of failure modes: structural and functional. Structural failure leads to the collapse of the pavement. Functional failure, on the other hand, renders the pavement incapable of carrying out its intended function, causing discomfort to passengers. Structural failure requires complete rebuilding of the pavement, whereas functional failure can be remediated by maintenance.

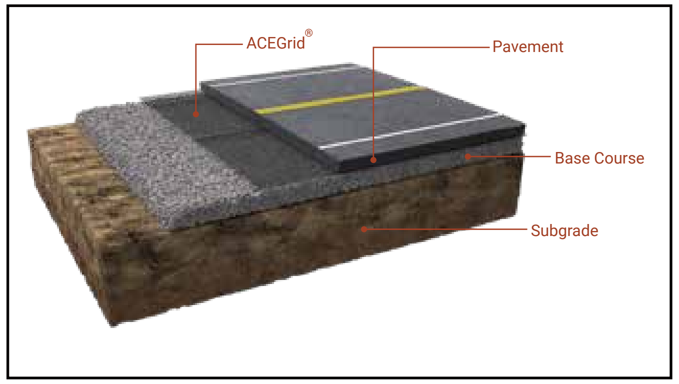
As a result, pavement failures may occur due to traffic or environmental loads. Therefore, it is essential to find engineering solutions that can ensure the most proper performance, enhance comfort and safety, reduce the cost of maintenance, and extend the life of the pavement. Among all the techniques, the engineer considered that geosynthetic reinforcement is one of the most suitable techniques adopted to minimize the malfunctions of pavements.

The engineer usually places ACEGrid® GA asphalt-coated fiberglass geogrids or ACECompo™ geocomposites in the surface course to improve the flexible pavement performance. They can suppress the formation of cracks by the stress of the horizontal dispersion of the vehicle load and the soil expansion caused by the environmental changes. When the pavement material is deformed under the actions of external loading or self-weight, the soil and the reinforcing material will interact along the interface, thereby exerting the reinforcement effect. The attached figure shows that the interaction can be (1) the anchoring behavior between the pavement layer and geogrid mesh and (2) friction along the soil and grid interface. At the same time, it can disperse the upper load and reduce rutting in the pavement layer.

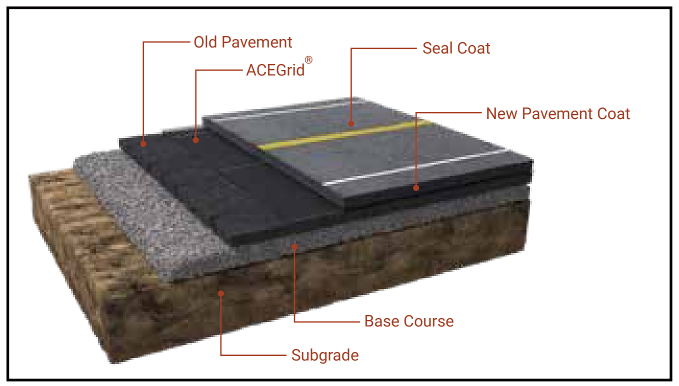


The Interaction between the Soil and the Geogrid

The beneficial use of ACEGrid® for pavement structure:



For new asphalt concrete pavement



For asphalt overlay

The fiberglass geogrid has high tensile strength, elastic modulus, and low elongation in longitudinal and transverse directions. It can withstand high and low temperatures and improve the pavement's service life. The fiberglass geogrid can enhance the bearing capacity of the road while suppressing the reflective cracks and reducing the formation of rutting.

ADVANTAGES :

- Reduce the thickness of asphalt concrete.
- Decrease the formation of rutting.
- Increase the service life of pavement.

REFERENCE 1

Asphalt Pavement Rehabilitation

Chile

2012

ACECompo™

To ensure the quality and safety of the road, the Authority carries out road renovation every 5 to 10 years for routine maintenance. Common problems encountered for pavement weaknesses are alligator cracking, reflective cracking, longitudinal cracking, transverse cracking, potholes, and rutting that are load-associated structural failures or climate changes related distress.

In this case, ACECompo™ has proven to be effective for the repair of reflective cracking. After removing a depth of 5 cm from the road surface, the tack coat was first applied, an ACECompo™ geocomposite was laid, and finally, the pavement layer was completed. ACECompo™ can strengthen the asphalt pavement and enhance its resistance to cracking.

The rehabilitation time is short, and the traffics can be resumed to normal momentarily. Vehicles can be driven directly on the road upon completion of the construction. It can extend the pavement's service life and reduce the incidence of reflective cracks under cyclic traffic loads.

REFERENCE 2

Asphalt Pavement Rehabilitation

Colombia, South America

2013

ACEGrid® GA

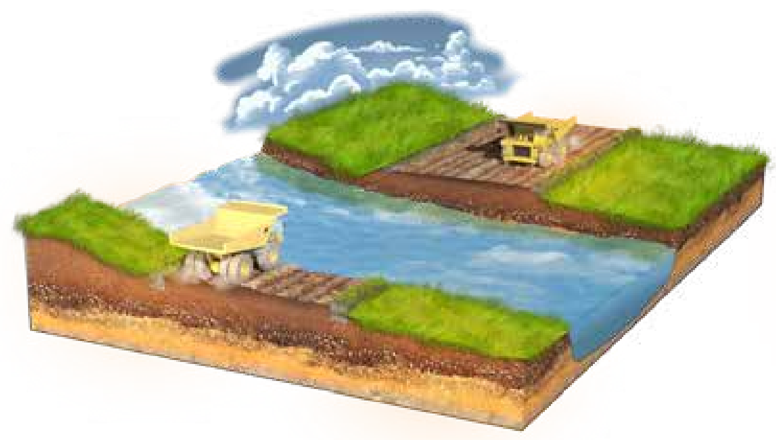
The asphalt pavement of the main street has been showing extensive reflective cracking. The damages have caused discomfort in traffic and jeopardized traffic safety.

ACEGrid® GA fiberglass geogrid has been increasingly used at asphalt overlay base level to enhance the overall pavement performance. Asphalt reinforced with ACEGrid® GA has the advantage that it can be easily placed in the asphalt layer to confine the development of reflective cracks.

In this project, after milling the existing pavement, ACEGrid® GA was placed directly after the applied tack coat, and then a layer of hot mix asphalt concrete was overlaid. After the construction was completed, the performance of the reinforced pavement was in excellent condition. No reflective cracking and potholes have been observed. On the other hand, the depth of ruts was also eliminated, and the pavement resumed serviceability.

4. Embankment and Bridge Abutment Construction

An embankment is the main component of transportation infrastructure. It is built from large amounts of earth fill, and its construction and quality are highly dependent upon the site conditions of geology and environment. For a site with underlying weak materials, the embankment is prone to intolerable settlement under the influence of its self-weight and the traffic load and presents an adverse impact on the stability and the safety of the pavement structure.



Before

After

ACEGrid®
Flexible Woven PET Geogrids
for Soil Reinforcement

ACESandbag™ EC
Durable Sandbags
for Erosion Control

An abutment is a substructure at the ends of a bridge span supporting its superstructure. It is essentially a retaining wall supporting the ends of a bridge and generally retaining or supporting the approach embankment, which will be the most critical connection between the bridge superstructure and the embankment. However, because of the structural characteristics of the abutment/approach, settlement or differential settlement has become the most common engineering problem for this type of facility. Bridge approach settlement can be caused by several factors, including settlement of foundation soils, loss of backfill material by erosion, poor construction practices, and high traffic loads. In addition, the traditional abutment built with reinforced concrete also presents drawbacks such as longer construction time, higher cost, occupied larger space, poor aesthetic, and not being eco-friendly.

The improvements of embankment or bridge abutment/approach usually require significant investment and a more extended construction period. However, both embankment and the abutment/approach are structures made up of enormous amounts of fills, which are very suitable to be constructed using the mechanically stabilized earth construction method. In such a case, ACEGrid® Geogrid can be used to serve as the tension members to build a reinforced earth structure. The principle is similar to combining rebars with concrete material, both examples of the reinforcing mechanism.

ACEGrid® Geogrid used in the soil creates tension and an interlocking mechanism through the interactions between the geogrid and the soil. Therefore, the lateral displacement of the soil layer can be restrained to increase the strength of the overall structure. It dramatically improves the stability and reduces the deformation of the targeted facilities. In addition, the reinforced earth structure for the embankment or abutment/approach can also increase the slope of both and thus reduce the demand for land in use. The reinforced earth retaining method has the advantages of simple construction, suitability for various topographic changes, better seismic resistance, more considerable deformation tolerance, an eco-friendly environment, and an attractive aesthetic. Furthermore, using on-site earth materials for the project dramatically reduces the total construction cost and time.

The types and characteristics of the components of the reinforced soil structure are described below:

1. Facing System

The functions of the facing system for a reinforced earth structure are mainly to prevent surface erosion due to rainfall or runoff. Other contributions are for landscape, aesthetics, and an eco-friendly environment. ACESandbag™ EC is made of high tensile strength and UV resistance geosynthetic woven material, specially designed to protect against erosion. ACESandbag™ EC is easy to handle and can be filled with in-situ soil and then stacked up to serve as the facing of a reinforced earth structure. Because of the confinement of geosynthetic materials, ACESandbag™ EC can provide sufficient resistance to erosive force from rainwater or flowing water, thus preventing underneath materials from being washed away. ACESandbag™ EC has adequate mesh size to retain filled materials and improve vegetation. They are suitable for applications in slope erosion control and building wrap-around facing of geogrid reinforced soil structures.

2. Reinforcing Material

Reinforcing materials are the main component to provide tensile strength to keep the steep earth structure remains stable. ACEGrid® GG is a flexible geogrid made of high molecular weight and low-creep polymeric yarns, to a wide range of ultimate tensile strength for different applications. When combined with compacted fill based on a qualified design and construction, ACEGird® GG geogrids will present sufficient interlocking effects, which provide excellent tenacity, high strength, and long-term durability to satisfy the requirement of overall performance for a reinforced earth structure.

3. Filling Material

After careful assessment by the engineer, in-situ soil compacted effectively can usually be used as a filling material for the reinforced earth structure. However, the quality of compacted fill will be a critical issue for the stability and the safety of the reinforced soil structure.

4. Drainage Material

Seepage cutoff and pore water pressure dissipation are essential for the safety of a reinforced soil structure. Suitable drainage materials are therefore a mandatory component. Generally, it mainly consists of gravels or permeable sandy soil, and the geosynthetic composite (Geo-Composite) can also be included as drainage material.

ADVANTAGES :

- Construction procedures are relatively simple, engineering quality is easy to control, and the construction period can also be reduced.
- In-situ materials are highly likely can be used for construction.
- Settlement tolerance can be improved.
- Seismic resistance is enhanced.
- Sustainable and an eco-friendly environment with various aesthetic appearances.

REFERENCE 1

Road Embankment Construction, Route 46-2,

Nantou, Taiwan

2010

ACEGrid® and ACESandbag™ EC

Route 46-2 is the main highway in Nantou County, directly connecting the urban living circle and the scenic area with the interchange of National Freeway No. 3 to avoid local traffic congestion.

Tourism is a vital economic lifeline of Nantou, and the landscape is a factor that must be considered in constructing a scenic road. In addition, Nantou is also a strong earthquake zone in Taiwan. Therefore, highway structures must have excellent earthquake resistance. For the embankment construction, the engineer was finally in favor of the reinforced earth technique, mainly because of its advantages compared with the traditional RC structures. The Wrapped Around Reinforced Earth Method is adopted to construct the embankment, which consists of ACEGrid® for the reinforcement and ACESandbag™ for the face erosion resistance.

The embankment has been stable since its completion, and its aesthetic green landscape strongly promotes the scenery along the highway.

REFERENCE 2

Embankment Construction Access Road, Taiwan High-Speed Rail Miaoli Station

Miaoli, Taiwan

2008

ACEGrid® and ACESandbag™ EC

As the Miaoli station of the High-Speed Rail has been established, it was necessary to build an access road that connects the Dashan Interchange of National Freeway No. 2 and Provincial Highway No. 1 to the station to improve the convenience of traffic for passengers.

The embankment for the access road was constructed in 2 tiers. It has a maximum full height of 12 m, a length of about 1,100 m, and a total surface area of about 6,080 m². It was reinforced with the ACEGrid® geogrids with a wrap-around facing setback and an inclined ratio of 0.3:1(H:V). Stacked soil-filled and hydro-seeded ACESandbags™ EC were used for slope face protection and to promote a natural green aesthetic landscape.

The reinforced earth structure has been stable since its completion, and the pavement conditions and quality for traffic are sound. The vegetation grows very well. It enhances the performance of erosion control and the natural appearance of the site.

REFERENCE 3

Reinforced Earth Embankment Access Road Widening

Pataya, Thailand

2009

ACEGrid® and ACESandbag™ EC

The owner planned to widen the existing driveway from 3m to 6m to facilitate vehicular traffic and material transportation. However, the construction was forbidden to damage the existing fence and encroach on the right-of-ways.

Due to the limitation of the adjacent boundary, the designer decided to adopt the reinforced earth embankment for the driveway because its slope can reach as steep as 80 degrees, saving the land and meeting the owner's requirements.

The embankment was reinforced with the ACEGrid® geogrids to a height of 5m using the wrap-around method. Considering the surface erosion and the need for vegetation, the engineer selected ACESandbag™ geobags to improve the erosion resistance of the structure's surface. Under the constraints of proximity and budgets, the traffic capacity has been improved to exceed the original expectations. A few months after the construction, the slope surface of the reinforced earth embankment was fully integrated into the environment owing to the natural blooming of the local vegetation.

REFERENCE 4

Reinforced Earth Abutment Structure Highway Extension Project

Taichung, Taiwan

2018

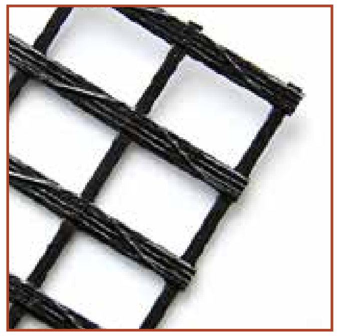
ACEGrid® and ACESandbag™ EC

Because of the terrain at the site, a 20m high abutment must be built to connect the bridge, which is under the threat of seismic attack. It is located in a strong seismic zone and near an active fault; thus, the tall abutment structure will be vulnerable to severe damage during earthquakes. The overall stability of the structure and the slope will be a critical consideration.

To satisfy the safety requirement, the designer adopted a reinforced earth containment to contain the abutment to ensure acceptable seismic stability during an attack of a strong earthquake. The effectively compacted earth structure minimized the highly probable differential settlement at the approach. The system also provided sufficient protection around the abutment to prevent possible scouring. The steeper slope thus consumed the excess soil, saved the amount of earth fill and construction cost, and shortened the construction schedule.

The reinforced earth structure was constructed in 4 tiers with ACEGrid® wrap-around facing setback and an inclined ratio of 0.3:1(H: V). Because of the highly probable differential settlement at the approach, the placements of ACEGrid® geogrids were specially reinforced using back-to-back integration to improve the earth's strength and bearing capacity. Drainage boards, geotextile filters, and pea gravel were placed inside each tier to intercept rainfall infiltration or seepage effectively. Stacked soil-filled and hydro-seeded ACESandbag™ EC were used for slope face protection and to promote a natural green aesthetic landscape.

ACE Products



ACEGrid® Geogrids

ACEGrid® is woven from high-strength polyester fiber bundles (PET) specifically for soil reinforcement. ACEGrid® is a flexible geogrid with mesh size and structure 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

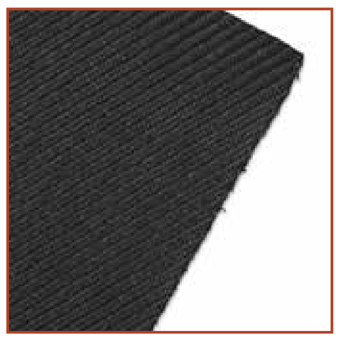
ACETube® is generally a geotextile tube fabricated with woven geotextile (ACETex® PP or ACETex® PET) to be filled with sand or appropriate local materials to form a gravity structure for shoreline or environmental protection. With careful geotextile selection, proper engineering design, and quality seaming techniques, ACETube® can be customized effective solution to fit the different project needs of customers.

ACETex® PET Geotextiles

ACETex® PET is a woven geotextile made of high tenacity and high molecular weight polyester to provide functions of reinforcement and separation and can be widely used for soft soil improvement, base stabilization, and weak foundation reinforcement. With experience and know-how, ACE Geosynthetic can produce extraordinarily high-strength woven geotextile for customized engineering applications.

ACESandbag™ Geotextile Bags

ACESandbag™ is a highly robust geotextile bag for forming temporary or permanent structures in hydraulic, geotechnical engineering, and erosion protection. ACE can customize the sizes and shapes of ACESandbag™ to satisfy the desired purpose. The bag material is UV-resistance, water permeable, and durable. It is generally stacked according to the design drawing, filled with sand, pea gravel, or local site material, and seeded for vegetation appearance.



ACETex® ES Geotextiles

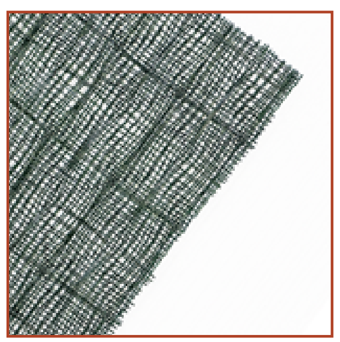
ACETex® ES is woven into a particular structure with self-developed polypropylene (PP) yarns. It has high stiffness and high water permeability. Case studies have shown that ACETex® ES performs exceptionally well in separation, filtration, and reinforcement. With these functions, ACETex® ES can be an ideal solution for subgrade stabilization and base reinforcement. It can improve road safety and extend its service life.

ACEFormer™ Geotextile Mattresses

ACEFormer™ consists of two-layer and high-strength PP or PET geotextile mattresses grouted with cement mortar or concrete that can accommodate different landforms for coastal erosion control, channel construction, and pipeline protection. With the consolidated filling material, the ACEFormer™ system provides adequate armor protection against erosion and reduces the impact of hydraulic attacks on the applied surface.

ACETex® NW Geotextiles

ACETex® NW is nonwoven geotextile made from either polyester continuous filament yarns by a needle-punched manufacturing process; or polypropylene staple fiber by needle-punched manufacturing process with a thermally bonded surface. With a small opening size, high permittivity, and high permeability characteristics, ACETex® NW geotextiles are suitable for efficient and cost-effective filtration, drainage, and separation applications.



ACEMat™ R High Performance Turf Reinforcement Mats

ACEMat™ R High-Performance Turf Reinforcement Mats (HPTRMs) are made of dark green high-strength polypropylene (PP) monofilament. They are woven together to form firm, flexible mesh structures with quadrangular pyramidal patterns interlock the soil, protect the soil surface from erosion, and retain plant seeds and roots to promote planting. It provides an efficient solution for erosion control in exposed steep slopes and heavy rain areas.

ACE's Quality Assurance

1.Expertise

ACE Geosynthetics has more than 40 engineering experts with professional knowledge covering civil, geotechnical, hydraulic, marine, environmental, landscape, mechanical, chemical, material, textile, and construction management. These professionals are the primary quality assurance of all production and operation at ACE Geosynthetics to ensure all incoming tasks are well interpreted, evaluated, processed, and produced.

2.Certificated Quality Management

The essential quality management system of ACE Geosynthetics has been recognized and certified by ISO 9001 and 9002. With the basic guideline of ISO 9001, ACE Geosynthetics further obtained accreditation by other certifying agencies worldwide, such as CE Marking, BBA Approvals, and NTPEP Qualification Report for its final product(s).

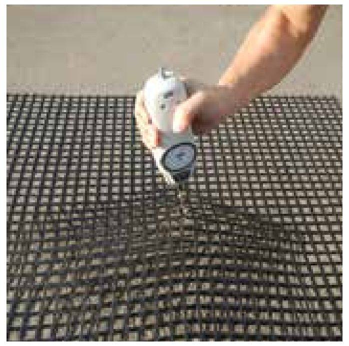
3.Certified Laboratory

We established our laboratory to conduct engineering tests for research, development, and product quality control. The laboratory has been certified by government-authorized TAF (Taiwan Accreditation Foundation) and is further recognized with the ILAC Laboratory Combined MRA Mark as shown below:

Civil Engineering Laboratory
2285

FACTS

With premium-grade yarns and a careful production process, ACE products' physical and mechanical properties are as good as expected. Besides regular tests in the laboratory, various long-term and short-term experiments for the product's inherent physical properties, mechanical properties, and long-term performance also have been conducted. Tests such as UV, chemical resistance, seawater immersion, cement soil burial, PVA geogrid anchoring, adhesion, asphalt pavement, oxidation, filtration, abrasion test, and many other tests have been done (or are 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

GMA Since 2006

IGS Since 2003

Participation in relevant associations

International awards

6 Continents

70 Countries

Countries where our products are sold

Patent Portfolio

Journal publications, exhibitions, seminars

Issued Patents 60+

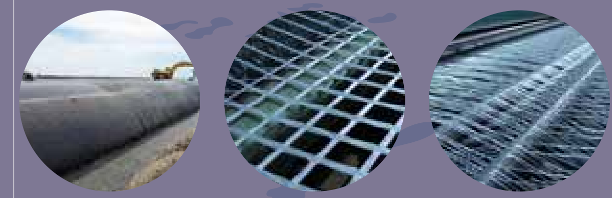
Countries 25

Published Papers 98

Annual Participation 10+

A diverse team with 20 years of experience

From product development/ manufacturing to processing

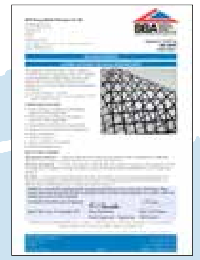


Professional Ability

Integration Ability

Quality Assurance

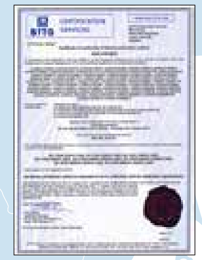
From engineering planning and design analysis to construction


BBA


GOSTR


TAF

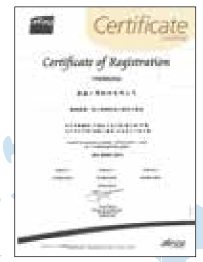

ISO9001


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?

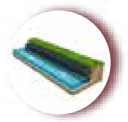
Come to Explore and Learn Geosynthetic Applications in ACE Geosynthetics Ecopark!

ACE Geosynthetics Ecopark is designed and constructed by ACE Geosynthetics with a total area of 10,000 m² to demonstrate various geosynthetic applications in civil engineering. Because sustainability has become an essential issue for engineering and environmental projects, geosynthetics are gradually becoming the preferred solutions for sustainable civil engineering applications. It has been proven that construction can be more uncomplicated and environmentally safe with geosynthetics.
When visiting our educational Ecopark, visitors are capable of finding out over 20 geosynthetic applications built in actual dimensions (1:1) for a tangible demonstration. This Ecopark is not only to demonstrate the geosynthetic applications but also to achieve the educational purpose of making more people realize the benefits of applying geosynthetics to our environment.

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

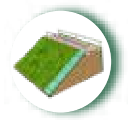
Reinforcement

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



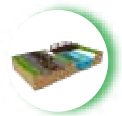
Shore Protection

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



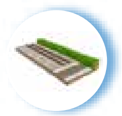
Erosion Control

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



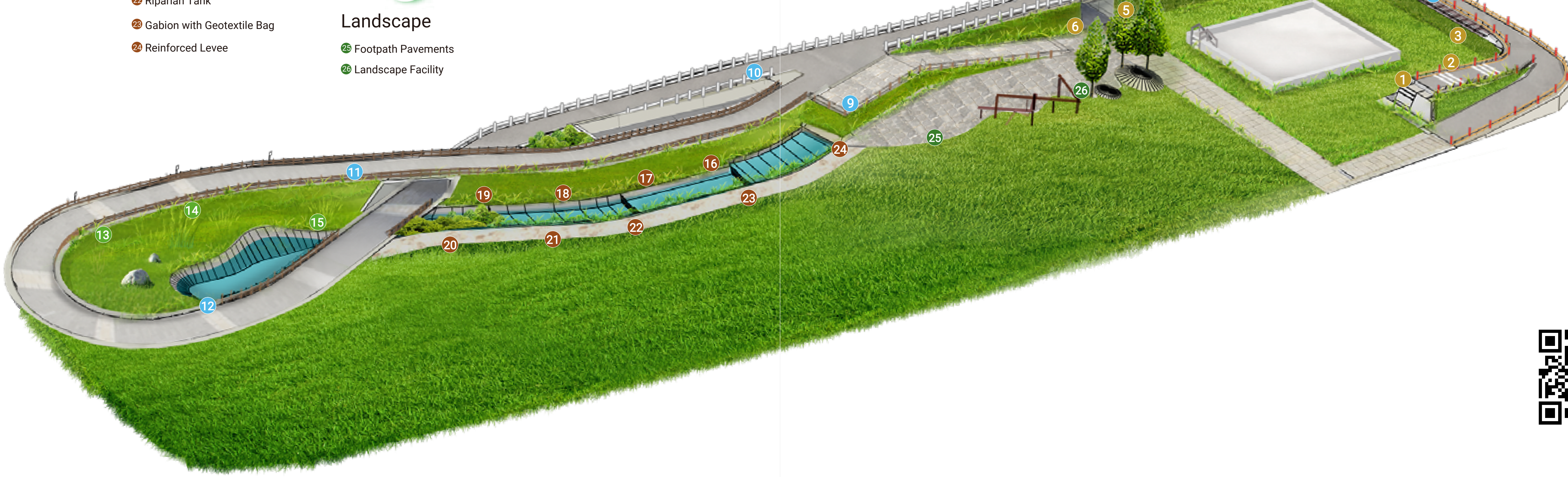
Landscape

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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