Ece®
EMPRESA DE CONTROL DE EROSIÓN

STRATA
OFFICIAL REPRESENTATIVE IN PARAGUAY



SOIL REINFORCEMENT · STABILISATION · CONFINEMENT

Geosynthetics Strata

StrataWeb® geocells, StrataGrid™ SGU · SGB geogrids, StrataBase® rigid geogrids, StrataTex™ nonwoven geotextiles and StrataDrain™ drainage geocomposites — the engineering that turns weak soils into durable infrastructure. With design support included.

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01 A GLOBAL MANUFACTURER

Strata is a global leader in geosynthetic manufacturing and geotechnical engineering, founded in 1994, with plants and offices in the USA, India, Brazil and the United Kingdom. Its products are made to international standards and are backed by globally recognised design and engineering support services.

Ece® is its official representative in Paraguay: we supply the material, support the design with the manufacturer's technical backing and carry out the installation with our own specialist crews.

> **Verifiable quality:** products tested in GAI-LAP accredited laboratories — TRI (USA), BTTG (United Kingdom), BTRA (India) — NTPEP certified and compliant with ASTM, ISO and GRI standards.

1994
YEAR FOUNDED

4
COUNTRIES WITH PLANTS AND OFFICES

+400
ASSOCIATES · 200 ENGINEERS

ISO·CE
NTPEP · GAI-LAP

Solution	Function	Typical application
Vertical	Reinforcement	Retaining walls on motorways, developments and landfills
Horizontal	Stabilisation	Dykes, load support, pavements, crane platforms
Inclination	Confinement and reinforcement	Erosion control, reinforced slopes, walls <70°



StrataWeb® geocells protecting the slopes of the Alberdi approaches — 57,000 m² installed by Ece

02 STRATAWEB® — GEOCELLS

StrataWeb brings the structural form of the three-dimensional honeycomb to soil reinforcement: strips of extruded polymer welded at intervals which, when expanded, form a cellular matrix. Filled, it transfers the tensile and compressive forces of heavy loads and offers a **a bearing capacity higher than any other geosynthetic**.

It works both for **load support** as well as for **channel lining and slope protection**, and it takes different fills — soil, topsoil, granular material or lean concrete — with the finish the project calls for: **soil, stone, concrete or vegetation**.

- Perforations with deep texturing for drainage and friction
- Different weld strengths according to the demand of the site
- ESCR performance of up to 5,000 hours
- Custom heights and cell sizes
- It is installed on slopes even steeper than 1H:1V, and even protects geomembranes in channels and reservoirs

APPLICATIONS

Unpaved roads over soft soils · Slope erosion control · Channel and pond lining · Working and drilling platforms · Load support in container yards



57,000 m² of slope lined with StrataWeb® — Alberdi approaches

Ece projects in Paraguay: protection of the **approaches to the city of Alberdi** (57,000 m² — reinforcement, protection and revegetation of the approach slopes) · **integrated slope protection for the Paraguayan Navy**, Remanso Bridge base, Mariano R. Alonso (23,000 m² finished with revegetation) · **forestry road reinforcement** with 100 mm StrataWeb® in the department of **Concepción**.



Forestry road reinforced with 100 mm StrataWeb® within the plantation: the cell is filled with the material from the site itself — Concepción

03 STRATAGRID™ — GEOGRIDS

StrataGrid is a **reinforced polyester (PET) geogrid** high performance, woven from high tenacity, high molecular weight yarn into a dimensionally stable mesh. Its patented UV-stabilised coating compound offers mechanical and chemical durability — during installation and in aggressive soils — and a **a structural life of more than 100 years**.

It offers industry-leading elongation and stress-strain values: it makes unusable land usable, with mechanically stabilised earth (MSE) systems that save space and cost.

- Vertical and horizontal reinforcement of soils and earthworks
- Up to **20% cost reduction** vs. conventional retaining methods
- Up to **50% increase** in the structural performance of railways, flexible and rigid pavements, rural roads, cobbled and gravel roads
- Or the other way round: **25 to 50% less granular thickness** for the same design life — less quarrying, less freight, less earthmoving

Range	Tensile strength	Roll widths
StrataGrid SGU uniaxial	40 – 180 kN/m grades 40 · 60 · 80 · 100 · 120 · 150 · 180	1.9 · 3.8 · 5.7 m × 100 m
StrataGrid SGB biaxial	20 – 150 kN/m (MD = CMD) grades 20 · 30 · 40 · 60 · 80 · 100 · 150	5.0 m × 100 – 200 m

APPLICATIONS

Mechanically stabilised earth (MSE) walls · Reinforced slopes · Load transfer platforms over piles · Embankment base reinforcement · Pavement and railway reinforcement · Landfill closure

Ece service: we size the StrataGrid grade from the stability check of each project, with support from engineers in our own company and at the manufacturer.



StrataGrid™ biaxial geogrid laid over the subgrade, before the granular fill

04 STRATABASE® — RIGID GEOGRIDS

StrataBase® is a geogrid **rigid biaxial extruded polypropylene**: integral ribs and junctions that confine the granular material and introduce tensile elements, increasing bearing and load support capacity. Its strength is **stiffness, aperture stability and interlock** with the aggregate.

The **lateral spreading** of the base aggregate is the most common failure of pavement structures. StrataBase reduces it — and with that saves thickness or multiplies the service life of the package.

- Up to **50% less aggregate thickness** for the same design life
- An economical alternative to **excavating and replacing** the soft soil
- Junction efficiency of **93%** (GRI-GG2) across the three grades
- Standardised use by **AASHTO R 50** for base reinforcement

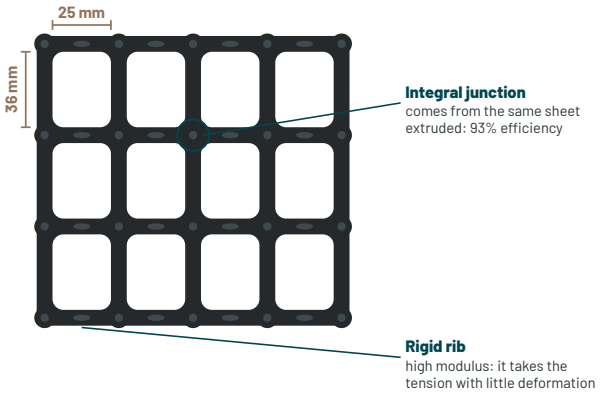
Grade	Ultimate MD/CD strength	Aperture
SB11	12.4 / 19.0 kN/m	25 × 36 mm
SB12	19.1 / 28.7 kN/m	25 × 36 mm
SB30	30.0 / 30.0 kN/m	36 × 33 mm

APPLICATIONS

Flexible pavement base reinforcement · Subgrade and foundation improvement · Haul roads · Industrial yards and hardstands · Airport runways · Embankments over soft soils · Platforms over saturated soils

Ece project: 60,000 m² of biaxial geogrids supplied for the reinforcement of at-grade transitions at sub-base level on the **Route PY12**.

WHAT THE GRID LOOKS LIKE



The rectangular aperture and the stiffness of the rib lock the aggregate: it enters the cell and stays confined. Nominal dimensions of grades SB11 · SB12.



The aggregate is spread straight onto the geogrid: the confinement starts with the first pass · photo: Strata

05 STRATATEX™ — NONWOVEN GEOTEXTILES

Nonwoven geotextiles **StrataTex™** are manufactured by **needle punching** from polypropylene fibres or continuous polyester filaments: a permeable, high-elongation fabric that lets water through and **retains the soil particles**, without clogging.

Its work is quiet but decisive — and it is the cheapest component of the geosynthetic package.

- **Separates** the granular layer from the subgrade and stops the rise of fines
- **Filters** water from drains and wall backs without carrying soil with it
- **Conveys** water in its own plane
- **Protects** geomembranes from stone puncture

Property	Range
Process	Needle-punched nonwoven
Polymer	Polypropylene (PP) or polyester (PET)
Weights	100 to 600 g/m², to suit the project
Durability	UV stabilised · pH 2–13 · 50+ years

APPLICATIONS

Layer separation in roads and platforms · Filter for drains and wall backs · Geomembrane protection in reservoirs and landfills · Drain wrapping · Under geocells and concrete mattresses

> **The rule of thumb:** every drain needs a filter and every geomembrane needs a cushion. The nonwoven is both. Ece selects it by **permittivity and apparent opening size** to suit the soil of the project.



Laying the nonwoven geotextile on site, before the granular layer · photo: Strata

THE RANGE, IN BRIEF

Series	What for	Mass	It is chosen by
Standard	Separation, filtration, drainage and erosion control	105 to 542 g/m²	AASHTO M288 survivability class
High strength	Geomembrane cushion and environmental works	135 to 542 g/m²	CBR puncture and thickness
Resurfacing	Fabric under the asphalt course	129 and 143 g/m²	Asphalt retention and melting point

70% UV strength retention at 500 h (ASTM D4355) and elongation ≥50% across the line. The grade-by-grade detail is on sheet F·4.

06 STRATADRAIN™ — DRAINAGE GEOCOMPOSITES

The drain that rolls out like a blanket. StrataDrain™ combines an HDPE drainage geonet — **biplanar** (SD series) or **triplanar** (TD and HF) — with nonwoven geotextiles laminated on one or both faces: water enters filtered through the textile, runs along the channels of the core and is collected at the foot of the system — **no gravel, no over-excavation**.

- Up to **1.75 l/m·s** in-plane flow (HF, σ=20 kPa)
- It replaces thick layers of drainage gravel
- Durable in aggressive soils (**pH 2–10**)
- Rolls of **3.8 m** wide: fewer overlaps, more output

> **In road design it counts twice:** in AASHTO 93 the drainage coefficient **m** of a well-drained base reaches **1.40**, against **0.40** than one that stays saturated more than 25% of the time.

Grade	Core	Thickness
SD 40 · 45 · 50	Biplanar	4.8 – 6.2 mm
TD 50	Triplanar	by grade
HF 55	High-flow triplanar	21.5 kN/m

APPLICATIONS

Wall backs · Landfills and waste sites · Contaminated sites · Roads, railways and airports · Tunnels and underground works · Mining · Earthworks · Drainage trenches · Reinforced slopes



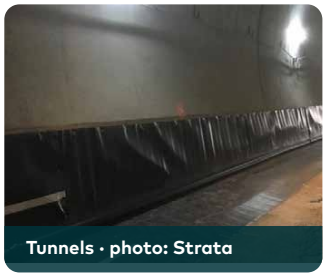
Longitudinal trench · photo: Strata



Behind walls · photo: Strata



Landfills · photo: Strata



Tunnels · photo: Strata

07 MECHANICALLY STABILISED EARTH WALLS

Two systems, one and the same logic: the mass is reinforced with **StrataGrid™ uniaxial geogrids** and the face gives it shape, finish and containment. Ece builds them together with **Geo Soluções** — Strata's regional partner — so the geogrid working inside the wall is the same one we specify in the rest of the catalogue, with its stability check and its creep reduction factors. Both are **vertical solutions**: for gentle slopes and erosion control, the answer is StrataWeb® or the erosion control mattings.

StrataSlope®

Facing of galvanised steel mesh bent in an "L", stabilised with tie rods and filled with clean stone: a face that is **self-draining** and natural in appearance. Its great advantage is economic — **it uses the soil already on site** as reinforced fill, doing away with borrow pits and haulage, and it takes compaction with heavy plant up to 1 m from the face. Modules of 40 and 50 cm, assembled on site. Design to **ABNT NBR 16920-1**.

STONE FACE · SELF-DRAINING

Lock+Load®

A modular cantilever wall: each unit — a face panel of **41 kg** plus a counterfort of **18 kg**, in concrete of **42 MPa**— it is laid **by hand, with no crane**, and is held by the compacted fill itself. It takes intensive compaction against the face without going out of line, accepts any inclination, curve or corner, and with soil reinforcement forms structures of **more than 18 m** in height.

TEXTURED CONCRETE FACE

THE COMPLETE SYSTEM

Every Ece wall is delivered with its engineering: **StrataGrid geogrid** sized by calculation, **StrataTex™ nonwoven geotextile** filter, **StrataDrain drainage geocomposite** behind the wall and the surface finish the project calls for. **Strata's complete line:** StrataWeb® geocells · StrataGrid™ SGU and SGB polyester geogrids · StrataBase® rigid geogrids · StrataTex™ nonwoven geotextiles · StrataDrain™ drainage geocomposites.

Alternative systems, on request: StrataBlock® (segmental concrete blocks with soil cover) and StrataWeb® faced walls (geocell filled with lean concrete or topsoil) — sized when the project justifies it.



StrataSlope® wall — exposed stone face, self-draining

From design to site: Ece sizes the wall with the manufacturer, supplies the complete system and builds it with its own crews — a single party responsible from the engineering to handover.

08 ROAD AND PAVEMENT REINFORCEMENT

It is not an optional improvement: it is standardised. Reinforcement of the granular layer of flexible pavements with geosynthetics is approved by **AASHTO R 50** — *Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures*— and it is built into the design **AASHTO 93**, the method that governs road design in Paraguay.

The standard defines three design parameters, obtained by testing for each product:

- **TBR** — *Traffic Benefit Ratio*: how many times more traffic the reinforced section carries for the same rutting
- **BCR** — *Base Course Reduction*: how much base thickness is saved for the same design life
- **LCR** — *Layer Coefficient Ratio*: how much the structural coefficient of the layer improves

In the AASHTO 93 equation the benefit goes straight into the structural number: **SN = $a_1 \cdot D_1 + a_2 \cdot D_2/(1-BCR) \cdot m_2 + \ldots$** — either you gain service life, or you save thickness. Never both at once.
And the m_2 coefficient is the drainage one: a well-drained base with **StrataDrain™** can be worth up to **1.40**, against **0.40** than one that stays saturated more than 25% of the time.

Design objective	Mechanism	Function
Stabilise the granular layer	Lateral restraint of the aggregate	Stiffening
Prevent the layers from mixing	It stops the pumping of fines and the penetration of the aggregate	Separation and filtration
Stabilise soft subgrades	Vertical confinement and membrane effect	Reinforcement
Mitigate expansive clays	It keeps the granular layer intact	Stiffening
Get the water out of the pavement package	It intercepts the flow and lowers the water table clear of the carriageway	Drainage and filtration

WHERE IT APPLIES

Flexible pavements (base and sub-base) · **Rigid pavements** — the reinforcement does not go in the slab but in the sub-base, evening out the support and stopping pumping · **Unpaved roads**, gravel and cobbled roads · **Railways** (ballast and sub-ballast) · **Platforms** and loading yards. The drainage of the package is solved with geocomposites **StrataDrain™** in a longitudinal trench.

Field evidence (FHWA/MT-14-002, 17 instrumented sections): the **woven geotextile** achieved the best performance of the 14 products tested, with **TBR from 4.1 to 14.8** according to the rutting allowed and **A BCR of 26.9%** — almost **11 times** the traffic of the control section.

09 THE DESIGN IS INCLUDED

A reinforcement geosynthetic is not bought by the square metre: it is calculated. Strata states it on every one of its technical data sheets —*every project incorporating its products must be designed by a competent engineer*—. That calculation is included in Ece's supply, with the backing of the manufacturer's engineering department.

HOW A REINFORCED WALL OR SLOPE IS VERIFIED

The analysis is done by **limit equilibrium**, assuming a plane failure surface to Rankine and no hydrostatic pressures — the drainage is solved separately, and that is why StrataDrain™ comes into the same project. Three levels are worked through:

- **Internal stability.** It sets the vertical spacing between reinforcement layers, the length of each layer and the overlap. The layer height should not exceed 50 cm to avoid bulging of the face.
- **External stability.** It checks the reinforced block against overturning, sliding and foundation failure; if it does not close, the internal design is corrected.
- **Global stability.** It analyses circular and plane failure surfaces that cut through the reinforced mass itself. The safety factor must be **≥ 1.5**.

For **roads and pavements** the route is AASHTO 93: the geogrid enters as an improvement of the structural number or of the layer coefficient, and translates into less granular thickness (BCR) or more service life (TBR).

> **The reduction factors are specific to each product.** A calculation done with the values of one geosynthetic and installed with another is no longer valid: substitution by an "equivalent product" without recalculating is the most frequent cause of poor performance.

FROM NOMINAL STRENGTH TO DESIGN STRENGTH

$$T_{perm} = T_{ult} \div (FR_{ID} \times FR_{FL} \times FR_{DQB})$$

T_{ult}	Ultimate strength by the wide-strip method (ASTM D6637 / D4595)
FR_{ID}	Damage during installation
FR_{FL}	Creep or *creep* in the long run
FR_{DQB}	Chemical and biological degradation

On top of that design strength comes the pull-out check (*pullout*), with a factor of 1.5 in granular soils and 2.0 in cohesive soils.

USUAL REDUCTION FACTORS · GEOGRIDS

Application	Damage of installation	Creep (creep)	Degrad. chem./biol.
Paved roads	1.2–1.5	1.5–2.5	1.1–1.7
Unpaved roads	1.1–1.6	1.5–2.5	1.0–1.6
Embankments	1.1–1.4	2.0–3.0	1.1–1.5
Slopes	1.1–1.4	2.0–3.0	1.1–1.5
Walls	1.1–1.4	2.0–3.0	1.1–1.5
Bearing capacity	1.2–1.5	2.0–3.0	1.1–1.6

Reference ranges after Koerner (2012). The design value comes from testing the specific product and from the required service life.

WHAT ECE DELIVERS WITH THE MATERIAL

Design calculations and stability check · Reinforcement layout drawings (level, length and spacing of every layer) · Take-off by product and grade · Technical specification for the tender · Installation guide and crew training · Support and technical supervision on site

10 STRATA IN PARAGUAY, WITH ECE

+24 PROJECTS DELIVERED BY ECE	**100%** INSTALLATION WITH OUR OWN CREWS	**Asunción** LOCAL STOCK AND TECHNICAL SUPPORT	**+100** YEARS OF STRATAGRID STRUCTURAL LIFE

Why with Ece: we do not just deliver the roll — we size the solution with our own engineers and the manufacturer's, install it with our own crews and back it with the experience of more than 24 infrastructure projects in the country.

Ask for the technical verification of your project: we survey the topography and loads and send back the sized solution with its quotation, at no charge.

> **One party responsible:** from sizing to delivery, with stock and technical support in Asunción.



StrataWeb® laid out along the road, before filling

Ece®
EMPRESA DE CONTROL DE EROSIÓN

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Ece projects with Strata geosynthetics

Approaches to the city of Alberdi	**57,000 m²** of integrated slope protection, finished with revegetation reinforced with turf reinforcement mats
Paraguayan Navy — Remanso Bridge base, Mariano R. Alonso	**23,000 m²** of integrated slope protection finished with revegetation
Forestry roads, Concepción	Geocell reinforcement **100 mm StrataWeb®**
Route PY12	Supply of **60,000 m²** of biaxial geogrids for reinforcing at-grade transitions at sub-base level



StrataWeb® — the honeycomb that reinforces the soil: each cell is filled with whatever material suits