



Enkagrid®

SOIL REINFORCEMENT

Soil reinforcement on a roll

COLBOND
GEOSYNTHETICS

Enkagrid

The Family

To help engineers around the world respond to demanding construction and maintenance challenges, Colbond Geosynthetics has developed a family of certified high-performance engineered soil reinforcement products - the Enkagrid range of welded geogrids.

The geogrid comprises distinctive precision-manufactured high-tensile extruded polymer bars bonded in a regular lattice that delivers high-integrity and cost-effective performance. In many major projects around the world Enkagrid has been employed to build demanding geotechnical structures, with contractors benefiting from the product's ease of handling, competitive price and excellent long-term performance.

The expanded Enkagrid family is the result of more than a decade of research, with a continual design and development program backed by extensive independent testing and certification. Colbond Geosynthetics offers exceptional product support, ranging from unique design software to application-specific advice from the company's experienced engineers.

Colbond

Colbond is a globally active producer of high quality products for civil engineering applications including drainage, erosion control, landfill applications, soil reinforcement and soil improvement. The wide range of geosynthetics includes Enkamat®, Enkadrain®, Enkagrid®, and Colbondrain®.

The company is also a leading producer of high performance polyester nonwovens for the flooring, automotive and construction industries.

Colbond is headquartered in Arnhem, the Netherlands and has production facilities in the Netherlands, Germany and the United States. Regional sales offices are located all over the world.

Applications



airport runways

bridge abutments

structural foundations

car parks

construction haul roads (unpaved)

embankments

mining areas

paved roads

permanent unpaved roads

piled embankments

Enkagrid

Offering ease of design, handling and installation with long-term performance and minimum risk, Enkagrid geogrids save time and money throughout a project's lifetime, making unusable sites and soils practical and extending the working life of structures.

PRO

Enkagrid PRO is a uniaxial geogrid of extruded polyester bars available in a number of different strengths.

The product offers a **PRO**fessional solution with unparalleled strength, performance and reliability for the reinforcement of slopes, walls and embankments. The double-weft structure of highly oriented laser-welded polyester bars provides powerful and dependable reinforcement in demanding applications. Purpose-developed design software backed up by our free design service ensures that Enkagrid PRO meets any challenge.

MAX

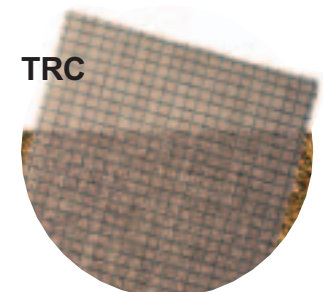
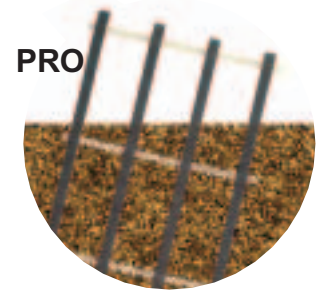
Enkagrid MAX is a biaxial geogrid of extruded polypropylene bars, available in a number of different strengths in both axes.

The product delivers **MAX**imum cost-effective performance for sub-base stabilization beneath construction roads and parking areas. The unique double-weft laser-bonded structure gives rigid junctions with consistent stress-strain performance throughout the matrix. For high-speed installation with consistent long-term high performance due to high passive bearing resistance and optimum soil interaction, Enkagrid MAX is the solution for permanent and temporary roadway projects.

TRC

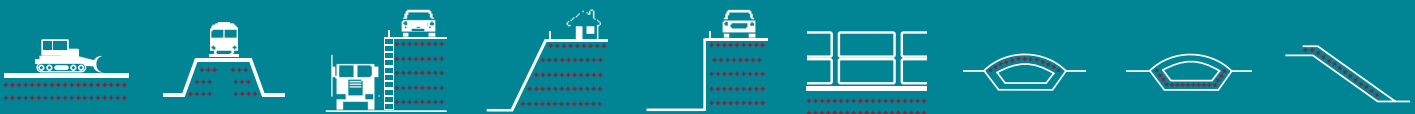
Enkagrid TRC is a proven multifunctional geogrid composite with the same strength in both axes.

The product delivers reinforcement, separation and filtration in one easy to install product for paved roads, parking areas and platforms. It reduces the required sub-base thickness and increases road life, due to a unique combination of high-modulus low-elongation Twaron® aramid fibers embedded in a Colback® nonwoven polyester. The nonwoven prevents mixing of fill and subsoil for a long-term consistent, high-performance solution.



The Enkagrid family delivers:

- Reinforcement for all soil structures
- A perfect combination of geometry and polymers to create the optimum soil-grid interaction for all types of soil
- Excellent mechanical long-term durability based on high quality
- Ease of handling and installation
- Proven design programs, a free design service and technical backup, for a reliable effective design
- A wide choice of products to suit your needs



basal reinforced platforms

railways

segmental retaining walls

steep slopes

walls

container terminals

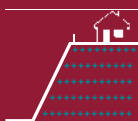
landfill capping

landfill foundation

topsoil stabilization

Enkagrid PRO

Applications



Enkagrid PRO is a uniaxial polyester geogrid, available in a number of different strengths, ensuring a precisely engineered solution for each specific application. Enkagrid PRO's uniaxial design with color-identified polyester bars ensures correct installation as a powerful reinforcement in slopes, vegetated and segmental block walls, abutments, embankments, platforms and in the foundations of buildings and structures.

Enkagrid PRO offers:

- High-performance soil reinforcement
- Excellent durability and long-term performance
- Ideal interaction with all soil types due to its innovative structure
- Fast and easy installation with 5 m wide rolls

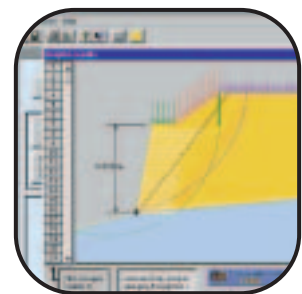
For **reinforced slopes**, Enkagrid PRO's geometry and ideal soil-grid interaction creates an anchoring effect and allows designers to increase the slope angle, saving space at the foot of the slope.

The same benefits deliver greater design freedom and options for **retaining walls and segmental block walls**.

When used as **base reinforcement** Enkagrid PRO increases the bearing capacity of an embankment or platform on marshy soils. It delivers extra stiffness to prevent differential settlement during consolidation and prevents sliding by increasing the external stability.

As a high-performance **foundation of buildings and structures**, Enkagrid PRO prevents differential settlement by forming a stiff raft, cutting the need for complex and costly piling operations.

www.enkaslope.com

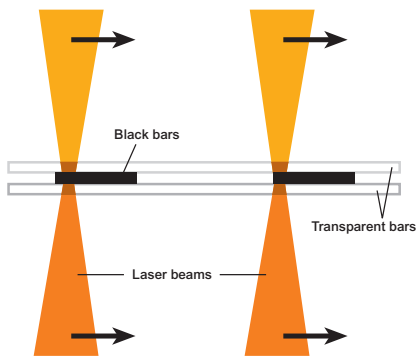


Building on years of research, Colbond Geosynthetics' engineers have developed a number of user-friendly and proven design programs. The program available for designing the reinforcement in slopes, walls and abutments is **EnkaSlope** - a software tool based on established design methods and existing programs. Copies of this design software can be obtained on request free of charge.

Enkagrid MAX

Enkagrid MAX is a cost-effective biaxial polypropylene geogrid that delivers the high performance expected of Colbond Geosynthetics' products. Enkagrid MAX is ideal for subbase stabilization, typically on paved and unpaved roads. Delivered to site in 5 m wide rolls, Enkagrid MAX is easy to handle and install correctly, and suits permanent and temporary works.

Its unique high-precision laser-bonded structure of chemically inert extruded polypropylene bars delivers high resistance to UV degradation, elevated passive bearing resistance and optimum interaction with all soil types.

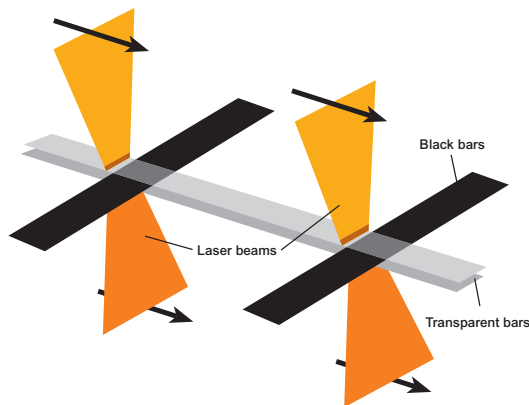


For consistency and reliability, Enkagrid MAX is the logical choice to deliver MAXimum performance at the right price on construction challenges in soft soils around the world.



Enkagrid MAX is:

- Suitable for sub-base stabilization with MAXimum performance at the right price
- Designed for maximum bearing capacity and shear resistance
- Delivered in 5 m wide rolls for easy handling on site and fast installation



The engineered structure of Enkagrid geogrids applies cutting-edge manufacturing concepts such as the patented computer-controlled laser welding process. Using laser technology the quality of the junction bonds is precisely controlled during the production process. This creates consistently rigid joints throughout the geogrid without affecting the polymer orientation or stress-strain performance of the extruded bars.

Applications



Enkagrid TRC

Applications



Enkagrid TRC is a high-modulus multifunctional geogrid composite. It strengthens weak or poor subgrade soils, and is also suitable for reinforcing the aggregate base course in paved or unpaved roadways, parking areas, small embankments, building foundations and platforms. The innovative multifunctional geogrid composite is formed with Twaron® aramid fibers embedded in a Colback® polyester nonwoven to reinforce the structure and separate differing soil types.

Enkagrid TRC offers:

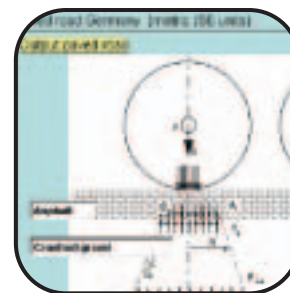
- Reinforcement, separation and filtration in one product
- One-step easy installation
- High modulus, low strain - mean value 3.5%
- Proven results on construction sites around the world

The Twaron® component, typically five times stronger than steel, has a unique blend of mechanical properties with high modulus and low elongation (approximately 1.5% under working loads and 3.5% at break) so that high tensile forces are mobilized with minimal deformation of the subbase. As a result, cracks propagate more slowly into the road surface, leading to extended service life.

The Colback® nonwoven performs separation and filtration functions, preventing both pumping of fines from the subsoil into the roadbase and mixing of fill and subsoil.

Designs using Enkagrid TRC offer cost savings in construction and maintenance due to reductions in roadbase thickness, improved roadbase drainage, lower deformation and a longer service life.

www.enkaroad.com



Over the past years, Enkagrid TRC 30 has been proven the most suitable product to suit the engineers' needs for reinforcement, separation and filtration functions in one go. With excellent long-term properties, Enkagrid TRC acts as the backbone of your structure by ensuring lifetime performance and stability.

Based on existing design methods, established theories and extensive field trials Colbond Geosynthetics has developed design software for reinforced roads. Named **EnkaRoad**, the program is suitable for both Enkagrid MAX and Enkagrid TRC and covers reinforced unpaved and paved roads. Available on CD-ROM, EnkaRoad allows design engineers to select specific soil parameters, surface layers and traffic intensities.

Enkagrid

Case Studies



Segmental Retaining Wall

For the access road to the Football World Cup stadium at Junju, Korea, a bridge abutment has been constructed with Enkagrid PRO. Colbond's Korean distributor made the design for a 14 m high segmental retaining wall of concrete segmental blocks. Enkagrid PRO has proven to be the best product with excellent characteristics suiting the demands of this impressive project.



Construction Haul Road

In Auckland, New Zealand, a major upgrade to a large waste water treatment plant necessitated the construction of a haul road over ground containing peat and organic silt with a CBR as low as 1 % during the rainy season. Colbond's New Zealand agents worked with the contractor to deliver a design which could support 30 t dump trucks. Enkagrid TRC was chosen to reinforce the structure and maintain separation between soil and aggregate, proving easy and fast to install.



Paved Road

Paved streets in a residential area of Las Vegas, originally laid directly on soft subgrade, were cracking and rutting badly. The city's engineers decided to relay the road with reinforcement to extent its load-bearing capacity and working life, but wished to minimise construction time to avoid inconveniencing residents. 45,000 sqm of Enkagrid MAX were laid with a separation geotextile providing a durable and strong sub-base for the new road surface in minimum time.



Steep Slope

In the French Pyrenees, the authorities planned to widen a tourist access road without cutting into the mountain landscape. Colbond's engineers worked with the contractors to design a built-up steep slope of more than 6 m height. Layers of Enkagrid PRO were placed with compacted gravel to form the reinforced slope with backing layers of hydro-seeded Enkamat to promote vegetative cover. In less than one growing season, the new steep slope was completely covered with alpine vegetation.



All Enkagrid PRO geogrids are BBA certified up to a pH of 12.5.



All Enkagrid geogrids are rigorously tested in Colbond's own laboratories. If required, certification to relevant national and international standards is obtained from independent organisations such as tBU (Germany), L.I.R.I.G.M. (France) and TRI (USA).



The Quality Management of Colbond Geosynthetics, at Arnhem (development and sales) and Osnabrück (production), has been approved by Lloyd's Register Quality Assurance Limited to the NEN-EN-ISO 9001:2000 quality management system standard (Certificate No. 935136). All Enkagrid types are CE-certified by a notified body (no. 0799-CPD). From raw material through manufacture, shipping, on-site storage, installation and service, Enkagrid products benefit from Colbond Geosynthetics' years of experience and extensive resources.

Enkagrid

The Properties

Enkagrid PRO: uniaxial geogrid

	Tensile strength (kN/m)	Strain at break (%)	Load at 2 % (kN/m)	Load at 5 % (kN/m)	Polymer
PRO 40	48	6	18	36	PET
PRO 60	70	6.5	23	46	PET
PRO 90	100	6.5	34	67	PET
PRO 120	140	6.5	41	81	PET
PRO 180	200	7	61	100	PET

Enkagrid MAX: biaxial geogrid

	Tensile strength (kN/m)	Strain at break (%)	Strain at break (%)	Load at 2 % (kN/m)	Load at 2 % (kN/m)	Load at 5 % (kN/m)	Load at 5 % (kN/m)	Polymer
		Longitudinal	Transverse	Longitudinal	Transverse	Longitudinal	Transverse	
MAX 20	24	10	10	9	11	17	19	PP
MAX 30	36	10	10	14	12.5	26.5	25	PP
MAX 40	48	10	10	18	17	35	33	PP

Enkagrid TRC: multifunctional geogrid composite (biaxial)

	Tensile strength (kN/m)	Strain at break (%)	Load at 2 % (kN/m)	Load at 3 % (kN/m)	Permeability (mm/s)	Pore size O ₉₀ (mm)	Polymers
TRC 30	35	3.5	22.5	32.5	190	0.18	aramid+PET

All values are mean values.

Enkagrid

Around the World



The Netherlands

Colbond Geosynthetics
Postbus 9600
6800 TC Arnhem
The Netherlands

Phone: +31 26 366 4600
Fax: +31 26 366 5812
Email: geosynthetics@colbond.com
Web: www.colbond-geosynthetics.com

Germany

Colbond Geosynthetics GmbH
Postfach
63784 Obensburg
Germany

Phone: +49 6022 812 020
Fax: +49 6022 812 800
Email: geosynthetics@colbond.com
Web: www.colbond-geosynthetics.de

France

Colbond Geosynthetics Sarl
"le Pressense"
268, Avenue de Président Wilson
93218 Saint-Denis la Plaine Cedex
France

Phone: +33 1 49 46 24 30
Fax: +33 1 49 46 24 35
Email: france.colbond@colbond.com
Web: www.colbond.fr

Singapore

Colbond Geosynthetics
510 Thomson Road # 17-00
Singapore 298135
Singapore

Phone: +65 6 258 1333
Fax: +65 6 259 8607
Email: geosynthetics@colbond.com
Web: www.colbond-geosynthetics.com

North America

Colbond Geosynthetics
Sand Hill Road / PO Box 1057
Enka, North Carolina 28728
USA

Phone: +1 828 665 5050
Fax: +1 828 665 5009
Email: info@colbond-usa.com
Web: www.colbond-usa.com

The information in this brochure reflects our best knowledge at publication. We have a policy of continuous development, so products and information may be subject to change. We do not accept liability arising from the application of these products or the information in this brochure.

Copyright © 2002 by Colbond bv. All rights reserved. No part of this publication may be transmitted, transcribed, reproduced, stored in any retrieval system or translated into any language or computer language in any form or by any means, mechanical, electronic, magnetic, optical, chemical, manual or otherwise without the prior written consent of Colbond bv, Westervoortsedijk 73, PO Box 9600, 6800 TC Arnhem, The Netherlands.

Enkamat, Enkadrain, Enkagrid, Colbondrain and Colback are registered trademarks of Colbond bv. Twaron is a registered trademark of Teijin Twaron bv.